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RESEARCH ARTICLE

Financial Effects of HPAI H5N1 Cases on Backyard Poultry in the Kızılırmak Delta [1]

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Summary

This study was carried out to investigate the risk factors relating Highly Pathogen Avian Influenza H5N1 and to evaluate consumer demand and related economic losses for poultry raised in the Kızılırmak Delta. Data were obtained from 361 householders in the Kızılırmak Delta and surrounding rural areas of the delta where a Highly Pathogen Avian Influenza outbreak occurred in 2008. The total cost of the disease outbreak in the area was estimated as 501.768 TL for the 3.116 enterprises. Based on market prices for 2011, the compensation cost for the disease was estimated at 276 TL per enterprise. The time of the Highly Pathogen Avian Influenza outbreaks had happenned, correlation between the consumption of eggs and poultry families were significant at 0.05 level. In conclusion, the present study contributed to the determination of production losses due to the disease Highly Pathogen Avian Influenza, disease-related control and protection measures, estimated payments and direct economic effects.

Keywords: *HPAI, Poultry, Production loss, Risk Assessment, Kızılırmak Delta*

HPAI H5N1 Vakalarının Kızılırmak Deltasındaki Köy Tavukçuluğuna Finansal Etkileri

Özet

Bu çalışma Highly Pathogen Avian Influenza H5N1 bağlı olarak Kızılırmak Deltasının risk faktörlerinin değerlendirilmesi, kümes hayvanlarında meydana gelen ekonomik kayıpların ve tüketici talebinin incelenmesi amacıyla yapılmıştır. Çalışma verileri 2008 yılında Highly Pathogen Avian Influenza vakası görülen Kızılırmak Delta'sı civarındaki 361 haneye ilişkin verilerdir. Hastalığın alandaki toplam maliyeti 2011 yılı piyasa fiyatlarıyla 3.116 hane için 501.768 TL olarak tahmin edilmiştir. Her bir kanatlı işletmesi için hastalığın tanzim maliyeti ise 276 TL olarak hesaplanmıştır. Highly Pathogen Avian Influenza'nın görülmesi durumunda ailelerin birey sayısı ve yumurta ve kanatlı eti tüketimi arasındaki korelasyon 0.05 düzeyinde önemli bulunmuştur. Bu çalışma neticesinde, Highly Pathogen Avian Influenza'ya bağlı üretim kayıpları tahmin edilmiş ve koruma kontrol ve hastalık tanzim maliyetlerinin belirlenmesi konularında karar merkezlerine gereken destek sağlanmıştır.

Anahtar sözcükler: *HPAI, Kanatlı, Üretim kaybı, Risk değerlendirme, Kızılırmak Deltası*

INTRODUCTION

Influenza viruses in poultry and mammals such as humans, pigs, horses, cats and dogs have caused major economic losses through trade disruption but also involve animal welfare issues [1-3]. The highly pathogenic avian influenza (HPAI) A, H5N1virus infects birds and humans. It's contagious among birds, and can be fatal, especially in domestic poultry.

The first cases of the HPAI were reported in a pandemic in 1959 [4]. Since 2012, HPAI has been continuing a threat, in date of December 2012 was reported in 12 country by the World Organization for Animal Health (OIE) [5]. According to OIE, as HPAI H5N1 viruses evolve, other mammals may be infected with the virus. A total of 257 human cases of Avian Influenza were reported between 2008 and 2012 by WHO [6]. Moreover, 43% of those cases resulted in death. Several studies have reported that wild waterfowl are susceptible [2,7-9]. As the vast majority of these bird species are migratory, areas along their the migration routes are

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at risk from the HPAI H5N1 virus.

The Kızılırmak Delta, located in the central Black Sea Region of northern Turkey, is one of the most important resting and breeding areas for migratory birds. This Natural Protected Area (RAMSAR) listed wetland covers an area of 56.000 ha and contains critical habitat for globally endangered bird species [10,11]. Therefore, the delta area presents a risk in terms of Avian Influenza during every migration period. According to OIE reports, 23% of cases of the disease in the period 2005-2006 in Turkey were detected in Samsun Province, as were 2 of the 6 disease cases in 2008 [12].

The number of poultry, including commercial enterprises, in Samsun province was 2.952.982 in 2008 [13]. The number of villages in the province is 966 so the average number of poultry per village was 3.057. The estimated production losses due to the disease are difficult to estimate, as there are difficulties in determining the direct costs from the disease due to data collection problems. Nevertheless, data collection is vital for these kinds of cost analyses and the development of models for control programs.

Hence, the aim of this study was to investigate the risk factors related to HPAI H5N1 and also to evaluate consumer demand and related economic losses for poultry raised in the Kızılırmak Delta.

MATERIAL and METHODS

Data were obtained from survey questionnaires conducted face to face with householders in the Kızılırmak Delta and surrounding rural areas of the delta where a HPAI outbreak occurred in 2008.

Research Area

An outbreaks had happened the Yörükler town in Samsun, The case started January 26 2008, and it was evaluated reverse transcription - polymerase chain reaction (RT-PCR) and found as positive. The disease came to an end on 25 February 2008 [12]. This town is one of the nearest settlements to the Kızılırmak Delta and is also the nearest town to Samsun. In the present study, a total of 23 settlements, including Yörükler town, and 22 associated villages and districts, were investigated. The settlements in the area are indicated by the coordinates shown in *Fig. 1*. A total of 3.116 households, from the official records of the local administrators, was included in the study.

Sample Size

Determination of effective sample size was used this formulation.

$n = N.t^2.p.q/d^2.(N-1) + t^2.p.q$

N: the number of individual target group

n: the number of individual sampled

p: examined the frequency of the incident (the probability of occurrence)

q: nothing on examined the frequency of the incident (nothing of the probability of occurrence)

t: A certain level of significance, according to the statement of the theoretical value of t ($\alpha = 0.05$)

d: accepted that ± incidence according to the frequency of sampling error

This non-homogeneous structure with the formula of 95% confidence interval for the universe, with a sampling error of ± 0.05% of the required sample size n = 343,

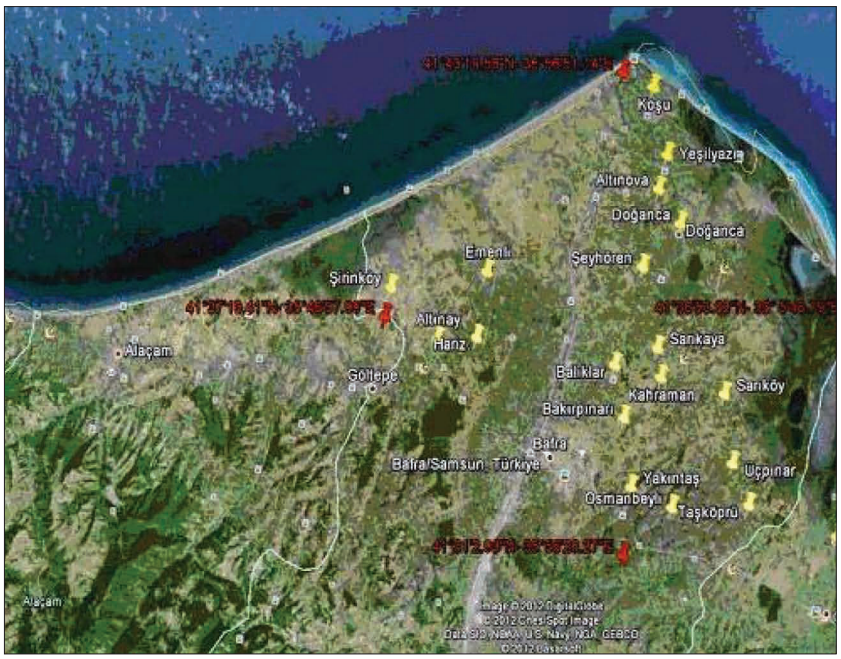

Fig 1. Location of the Kızılırmak Delta and settlements

Şekil 1. Kızılırmak Deltası ve yerleşim alanları

respectively. In this context, 361 households selected randomly administered questionnaires.

Calculating value of poultry by species, Turkish Statistical Data were accepted [14].

The equation, Production Loss (Turkish Lira = TL) = A x B x C, where A is the number of households, B is the number of poultry per household, and C is the chicken price, was used to calculate poultry production losses.

Scope of Study Area and Sampling

Determining the sample size in the study area and to ensure the participation of breeders willing to work; primarily the front of the village headmen were interviewed. Three hundred and sixty one households selected by random sampling method specified in the study area were surveyed. Field work was completed in 22 days. Seventeen questions were asked in the survey. Some of them are the total number of individuals in the family, as the total number of birds and species, number of eggs and chickens purchased for consumption on families, on the fate of the assets of avian influenza in poultry were asked to hand in a time of. It is also investigated the risk area of the disease, according to an emergency national action plan [15].

In the collection of survey data, it was important to ensure that the questions were simple and clear due to the low level of education of people involved in the present study. In addition, some restrictions and limitations were assumed in the data, i) all poultry meat consumed was considered fresh whole chicken, ii) consumed eggs were considered chicken eggs and iii) every family unit was considered as a commercial farm. Accordingly, the questionnaire in the survey determined family consumption habits, farm structure and responses to the presence of the disease.

The data set obtained from the surveys was analysed with the SPSS. Evaluating of the data descriptive statistical methods (number, percentage, mean, standard deviation, maximum and minimum) were used. Kolmogorov-Smirnov test was applied to the normal distribution of the study variables. Normally distribution were not detected ($P<0.05$). Spearman's Correlation test was used for the analysis of the nonparametric methods. The findings of the 95% confidence interval was evaluated at the level of significance of 5%.

RESULTS

Cases of HPAI reported by OIE were examined in the present study. A total of 23 locations *(Fig. 1)* were investigated. According to records officially obtained from local authorities, there were 3.116 households in the study area and 361 of them were sampled. The average number of households per village was 135 and average family size was 5. The present study in the Kızılırmak Delta area were evaluated in terms of risk. For this purpose, it is used interviews with local mayors, field observations and data from the literature *(Table 1)*.

Descriptive statistics of backyard poultry enterprises were studied *(Table 2)*.

The most common species of poultry is chicken and less common type of poultry is other in backyard poultry enterprises *(Table 2)*.

The average number of poultry per household enter-

Table 1. *Risk assessment of the Kızılırmak Delta*
Tablo 1. *Kızılırmak Deltası'nın risk değerlendirilmesi*

Risk Criteria	**Risk Assessment**
Migration routes	Yes [10,11]
Natural Parks and Lakes	Yes [10,11]
Wildlife and Hunting	Possible [10,11]
Stagnant water contaminated with bird droppings and streams	Yes (field observation)
Village poultry animals	Yes (field observation)
Movements of infected birds	Possible (field observation)
Live birds market	No (field observation)
Human movements of infected areas	Possible (field observation)
Infected live poultry or poultry products imports legally or illegally	No [15]
To be significant risk criteria are not included in the emergency action plan	Risk assessment
The transportation of feed, pharmaceuticals, food additives, tools and equipment and materials	Yes (field observation)
Animal movements	Yes (field observation)
Tourism	Yes (field observation)
Poultry products processing unit., outlets and consumption unit of product markets	Yes (field observation)

prise was 23, comprising 89.0% chickens, 2.4% goose, 7.8% ducks, 0.5% turkeys and 0.3% other poultry breeds *(Table 3)*.

In the event of the occurrence of the disease HPAI, poultry production by small sized farming enterprises is eliminated. For that reason, farmers who normally meet their poultry needs out of their own resources are forced to purchase their needs. In considering HPAI outbreaks, the annual consumption of poultry by farmers is relevant to the determination of economic losses. Therefore, in the present study, demand for poultry products by farmers during the period of the HPAI outbreak was determined. Accordingly, the demand for eggs by households ranged from 210.9 to 1621.8 and average number of poultry carcasses purchased per household was 12.29 (*Table 4* and *Table 5*).

Table 2. *Descriptive statistics of the number of households with poultry*
Tablo 2. *Kanatlı yetiştiriciliği yapan hanelere ilişkin tanımlayıcı istatistikler*

Type of Poultry	N	Minimum	Maximum	Mean	Std. Deviation
Chicken	339	1	120	21.72	15.193
Turkey	16	1	6	2.75	1.571
Duck	112	2	20	5.74	3.541
Goose	23	2	100	8.87	20.017
Other	5	2	9	5.40	3.362
Total	341	1	135	24.52	17.135

Non-parametric tests Spearman's correlation test was used to study data to investigate the relationship between the demand for eggs with the number of individual households. The correlation coefficient "r" was -0.026. There is a weak negative relationship between the number of family size and purchase of eggs. It was used to study data to investigate the relationship between the demand for chicken with the number of individual households. The correlation coefficient "r" was -0.048. Relationship is still negative but stronger the demand of eggs.

Family's consumption of eggs's and chicken meat's the correlation coefficient is -0.110 and, 131, respectively. Correlations are significant at 0.05. It's explained that people react to they eat eggs less but eat chicken meat more when the outbreak had happened.

Payment of compensation was carried out after legislated process of culling was completed in the affected area. However, during the outbreak of the disease, 38% of poultry farmers reported that they hadn't received their compensation due to the lack of information about the process, and 42% of farmers reported that they continued breeding poultry. Furthermore, 20% of the farmers reported that they had slaughtered their poultry and consumed them during this period. After factoring in the information above, the total cost of the disease outbreak in the area was calculated at 501.768 TL for the 3.116 enterprises. Based on market prices for 2011, the compensation cost for the disease was estimated at 276 TL per enterprise *(Table 6)*.

Table 3. *The number of species of poultry, poultry prices and the financial value of backyard poultry*
Tablo 3. *Türler itibariyle kanatlı sayıları, kanatlı fiyatları ve köy tavukçuluğunun finansal değeri*

Type	The Number of Examined Poultry	The Percentage of Examined Poultry (%)	Unit Price (TL)	The Total Price of the Examined Poultry (TL)	Total Poultry Number	Total Price (TL)*
Chicken	7363	89.0	12	88.356	63554	762.648
Turkey	44	0.5	34	1.496	380	12.920
Duck	643	7.8	12	7.716	5550	66.600
Goose	204	2.4	34	6.936	1761	59.874
Other	27	0.3	15	405	233	3.495
Total	8281	100		104.909	71478	905.537

** Financial value of 3116 household backyard poultry (TL)*

Table 4. *The number of purchased eggs for 361 housholds*
Tablo 4. *361 hanenin satın aldığı yumurta sayıları*

Number of Purchased Eggs	Household Number	Lower Limit of the Annual Number of Purchased Eggs (Calculation-Number)	Upper Limit of the Annual Number of Purchased Eggs (Calculation-Number)
None	199	-	-
1-10	70	3.640	36.400
11-20	42	24.024	480.480
21-30	43	46.956	67.080
31 and above *	7	1.519	1.519
Total	361	76.139	585.479

Table 5. *The number of purchased chickens for 361 housholds*
Tablo 5. *361 hanenin satın aldığı kanatlı sayısı*

The Monthly Number of Purchased Chicken	Household Number	The Annual Number of Puchased Chicken
None	130	-
1 pieces	132	1584
2 pieces	59	1416
3 piece and above	40	1440
Total	361	4440

very important in the control and in the preparation of management protocols. However, the lack of quantitative data for village-type poultry production makes it difficult to determine appropriate measures. That is one reason why the present study was undertaken.

Estimating poultry numbers in the affected area is important for implementing control measures for the disease and providing compensation. Based on the number of commercial and village poultry farms and the number of affected villages, the average number of poultry per village was 3.057 and mean number of households for the 23 villages was 135. Therefore, according of the results of the present study, the reported number of poultry in the study area may be lower than determined in the previous studies. Underestimating of poultry number in those case can lead to the failure of intervention programs.

Table 6.*The financial value of the estimated production losses*
Tablo 6. *Üretim kayıplarının tahmini finansal değeri*

Effects	N	Production Loss (TL) for 341 Households	N (Calculation)	Production Loss (TL) for 3116 Households
I have culled my poultry	131	36.156	1197	330.372
I have slaughtered my poultry and eaten	68	18.768	621	171.396
I continued to produce poultry	142		1297	
Total	341	54.924	3116	501.7680

DISCUSSION

The Kızılırmak Delta area is protected by RAMSAR site status [10,11]. The delta is also important for the livelihood of persons who live there. Poultry and other livestock such as dairy animals are two of the main sources of agricultural income for households. Farmers in the area use low technology in poultry production due to small scale of their enterprises. Rushton [16] reported that poultry production in rural areas was carried out on the principle of low input-low output and noted that these systems are extremely inefficient in terms of investment and disease control; poultry management and breeding requires huge investments for modern production systems that maximise productivity and minimise disease risk. Furthermore, low technology poultry farms constitute a risk to modern enterprises [16].

The average poultry size were found 23 in this study. By comparison, flock size in backyard poultry enterprises in France ranged from 15 to 20 [17] and in Africa ranged from 10 to 20 [3,18].

HPAI is a disease that requires the implementation of varying degrees of biosecurity measures across all components of the poultry sector and those measures are interpreted in economic terms [19]. In that context, poultryhousing and care were poor in the study area. Overall, housing and biosecurity for HPAI management should be considered together. Therefore, as far as compensation for HPAI is concerned, its investment in the redesign of poultry housing for improved biosecurity in the outbreak area could be considered more economic. Knowledge of the financial costs of animal diseases is

In the present study, the total cost of the disease outbreak in the area was calculated at TL 501.768 for the 3.116 enterprises. Based on market prices for 2011, the compensation cost for the disease was estimated at TL 276 per enterprise.

The study investigated the output of eggs and chicken meat consumption trends. Correlations are significant at 0.05. Negative correlation coefficient of egg consumption in households due to the disease. Positive correlation coefficient of chicken meat consumption in households due to the disease. Increasing consumption of eggs in the absence of disease, and the disease is called reduced. Depending on the cutting poultry in this period so much, poultry meat consumption seems to be increased.

Considering of the criteria of animal welfare for poultry, concept of poultry production in rural farming type is gradually spread in European Union [20]. However, Turkey has an adventage in this context, as 35% of the total population of Turkey lives in rural areas, village enterprises play a very important role in poultry production. Therefore, in the management of epidemic diseases, particularly avian influenza, the re-establishment of poultry farming and Broiler sector after disease outbreaks is of great importance [21].

Turkey's poultry sector affected the HPAI outbreaks in

the period of 2005-2006. Several studies have reported on economic consequens of the disease and disease control applications [22-24]. In these studies, the emphasis is on the importance of the sector and reveals that the chicken farming is necessiate in the countryside. On the other hand, the lack of information in terms of human health should be solved [25].

The present study contributed to the determination of production losses due to the disease HPAI, disease-related control and protection measures, estimated payments and direct economic effects. If the need arises for vaccination, correctly estimating the number of affected poultry is essential for the determination of the vaccine costs. Furthermore, knowledge of the disease process and its management is vital in the poultry sector in the context of food security.

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