INTERNATIONAL FOOD
POLICY RESEARCH INSTITUTE
sustainable solutions for ending hunger and poverty
Supported by the CGIAR

IFPRI Discussion Paper 01072

March 2011

Farm Households' Preference for Cash-Based Compensation versus Livelihood-Enhancing Programs

A Choice Experiment to Inform Avian Flu Compensation Policy in Nigeria

Adewale Oparinde

Ekin Birol

Markets, Trade and Institutions Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI) was established in 1975. IFPRI is one of 15 agricultural research centers that receive principal funding from governments, private foundations, and international and regional organizations, most of which are members of the Consultative Group on International Agricultural Research (CGIAR).

PARTNERS AND CONTRIBUTORS

IFPRI gratefully acknowledges the generous unrestricted funding from Australia, Canada, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, the Netherlands, Norway, the Philippines, South Africa, Sweden, Switzerland, the United Kingdom, the United States, and the World Bank.

AUTHORS

Adewale Oparinde, University of Cambridge

Ekin Birol, International Food Policy Research Institute
Impact and Policy Coordinator, Harvest Plus

Notices

[1] Effective January 2007, the Discussion Paper series within each division and the Director General's Office of IFPRI were merged into one IFPRI–wide Discussion Paper series. The new series begins with number 00689, reflecting the prior publication of 688 discussion papers within the dispersed series. The earlier series are available on IFPRI's website at http://www.ifpri.org/publications/results/taxonomy%3A468.

[2] IFPRI Discussion Papers contain preliminary material and research results. They have been peer reviewed, but have not been subject to a formal external review via IFPRI's Publications Review Committee. They are circulated in order to stimulate discussion and critical comment; any opinions expressed are those of the author(s) and do not necessarily reflect the policies or opinions of IFPRI.

Contents

Abstract	v
Acknowledgments	vi
1. Introduction	1
2. The Choice Experiment Method	3
3. Survey Design and Administration	5
4. Results	10
5. Conclusions and Policy Implications	17
References	18

List of Tables

3.1—Descriptive statistics of the sampled households, pooled and by village 6

3.2—Compensation plan attributes and attribute levels used in the choice experiment 8

4.1—Conditional logit model for compensation plan attributes 10

4.2—Random parameter logit model (RPLM) and RPLM with interactions 11

4.3—Mean (std. dev.) of the average and eight selected household profiles 14

4.4—Marginal WTP/WTA for compensation plan attributes (95% C.I.) in NGN/household for RPLM with interactions 14

4.5—Proportion of WTP/WTA differences for compensation plan attributes falling below zero 15

4.6—Compensating surplus (95% C.I) for each scenario and household profile (in NGN per rooster per household) 16

List of Figures

3.1—Example of a choice set 9

4.1—Compensating surplus for the status-quo compensation plan (0) and four improved scenarios 16

ABSTRACT

In this paper we attempt to bridge the resilience school of thought and incentive compatibility in livestock disease control policies through a pilot choice experiment study conducted on 104 farm households in the Nasarawa state of Nigeria. The aim of this study was to shed light on farm households' valuation of various compensation plan attributes and trade-offs among these attributes. In the experiment presented here, *compensation plan* was defined broadly to include not just the traditional attributes, such as the number of days it takes to receive the payment, the compensation rate, and the method of payment, but also more diverse interventions, such as training in biosecurity measures and access to bank loans, which are expected to have longer-term impacts on households' livelihood outcomes. We analyzed the data using various discrete choice models, the best-fitting of which was the random parameter (or mixed) logit model with interactions, which enabled us to capture both unobserved and observed heterogeneity in farm households' preferences for the compensation plan attributes. The results reveal that overall, study households preferred compensation plans that made payment in fewer days, provided facilitated credit access, and offered biosecurity training. Households with better-educated heads and those with lower income levels valued compensation plans that provided credit access and biosecurity training the most. These findings are expected to inform the design of efficient, effective, equitable, and targeted compensation policies, which could not only reduce the livestock disease risk but also improve the resilience of poor farm households' livelihoods against future poultry-related or other idiosyncratic shocks.

Keywords: choice experiment method, conditional logit model, random parameter logit model, livestock disease, avian flu, compensation scheme

ACKNOWLEDGMENTS

We are grateful to Ian Hodge and Devesh Roy for their valuable comments and suggestions. We also thank the survey respondents from Angwan Mayo and Hayin Gada villages for their valuable time and patience. This research was funded by the Markets, Trade, and Institutions Division of the International Food Policy Research Institute, Cambridge Commonwealth Trust, and Smuts Memorial Fund. Any errors and omissions are the authors' own.

1. INTRODUCTION

The important role of compensation policy for the efficient and effective control of zoonotic diseases, such as avian flu, is well recognized. Several studies have used theoretical or empirical approaches, or both, to derive the optimal level of compensation for zoonotic diseases under different scenarios (see, for example, Gramig, Horan, and Wolf 2005; Beach, Poulous, and Pattanayak 2006). It has been demonstrated that if the compensation rate is set too low, farmers have little incentive to report outbreaks, whereas if it is set too high, moral hazard ensues with disincentive to invest in control measures. The rate of compensation is therefore a very important policy tool for influencing farmer behavior (Beach, Poulous, and Pattanayak 2006).

Compensation policy has the dual role of protecting farmers' livelihoods while providing them with incentives for reporting outbreaks and for investing in control measures to reduce disease risk. In developing countries, compensation policy functions as a safety net, especially for resource-poor farm households (Amanfu 2006). In addition to cash-based compensation, there are other potential interventions that may reduce poor farm households' vulnerability to disease outbreaks as well as to other livelihood shocks. The occurrence and spread of zoonotic disease outbreaks could be minimized through providing, for example, information, technical assistance and training in biosecurity measures, and financial support (Beach, Poulous, and Pattanayak 2006). Such interventions could enable farm households to adopt private prevention and control measures at socially optimal levels (Beach, Poulous, and Pattanayak 2006). Moreover, given that the great majority of livestock in developing countries is managed by resource-poor, small-scale, or household-level producers (Livestock in Development 1999), an integrated approach that combines building of livelihood resilience with the design of compensation policy is warranted. According to the resilience school of thought (Resilience Alliance 2007), households' resilience to several covariant socioecological or idiosyncratic livelihood shocks, such as zoonotic diseases, could be enhanced through diversification of livelihood strategies assisted by, for example, training in alternative income-generating activities and increased access to credit (Holling 1973; Ellis 1998, 2000; Adger 2000; Folke et al. 2002a, 2002b; Gunderson and Holling 2002; Eriksen, Brown, and Kelly 2005; Marschke and Berkes 2006).

Several experts have highlighted lack of knowledge about the optimal rate of compensation and the scope of compensation policy in developing countries, pointing out the need to consult with farmers about what types and levels of compensation they find acceptable (Amanfu 2006; Delgado 2006). There is a need to estimate farmers' demand for livelihood-enhancing interventions vis-à-vis cash-based compensation and to study the potential trade-offs farmers may make between cash-based compensation and interventions that may yield longer-term outcomes (such as training or credit). Moreover, an understanding of the heterogeneity in farmers' preferences for these public interventions, each with different scope and cost, could help inform the design of efficient, effective, and targeted compensation and livelihood enhancement plans.

In this paper we present the results of a pilot stated-preference choice experiment study that aimed at estimating farmers' valuation of various compensation policy attributes and their trade-offs among these attributes. We define *compensation policy* in wide terms to include not just the traditional attributes such as the level of payment and the number of days it takes to receive it, but also more diverse interventions including training in biosecurity measures and access to bank loans for livelihood diversification. The study presented in this paper was conducted in Nigeria, where avian flu is considered to be endemic and two different compensation plans have been in place since 2006 (Obi, Oparinde, and Maina 2008).

The first outbreak in Nigeria occurred in January 2006 and the most recent one occurred in July 2008. During this period numerous outbreaks were recorded in 25 States and the Federal Capital Territory, of the 36 states in Nigeria. The outbreaks occurred in all poultry production systems, including the household level, backyard/village extensive ones. According to the records of the World Bank funded Avian Influenza Control Program, from February 2007 to January 2008 NGN623,077,880

(US$4,215,683) has been paid in the form of compensation to farmers whose birds were culled, however no information is available on the costs of culling, diagnostic testing of samples, cleaning and disinfection and other administrative costs. Similarly, changes in the numbers of commercial, semi-commercial and backyard production systems before and after the outbreaks remain un-quantified by the government authorities (Obi, Oparinde, and Maina 2008).

There have been a few studies that investigated the economic impacts of these outbreaks. A study conducted in 16 of the 36 states, right after the initial outbreaks revealed that the official confirmation of avian flu caused panic, resulting in the total boycotting of poultry and poultry products (UNDP, 2006). Within two weeks, egg and chicken sales declined by 80 percent, due to demand shock, and up to four months after, prices had not recovered up to 50 percent of pre-avian flu levels. The study found that although the highest bird mortality rates occurred in commercial farms, village and backyard poultry farmers were also severely affected by the avian flu outbreaks, since they lack necessary assets for recovery and often did not qualify for compensation (especially village extensive poultry producing households). Affected backyard producers suffered up to a 100 percent poultry income loss, while non-affected producers also witnessed poultry income losses as high as 68.2 percent (UNDP 2006; Obi, Oparinde, and Maina 2008).

In addition to this study, there have been a few state level studies that investigated the economic impacts of HPAI on poultry producers. A study conducted in Kwara state found that avian flu resulted in a 57 percent drop in the chicken prices in this state (Obayelu 2007). The household level demand shock was as high as 80 percent, and supply shock resulted in 75 percent of poultry farmers to stop ordering of new supplies of birds and to opt out of poultry farming altogether. According to Obayelu (2007) household level small-scale commercial producers and backyard poultry farmers suffered the most income losses as a result of HPAI. A more recent study conducted by UNICEF and AED in Kano and Lagos states found that HPAI shocks resulted in substantial losses in employment in the poultry sector, as well as sharp decreases in poultry prices. In Kano, the price of chicken in the markets dropped by as much as 90 percent, while in Lagos the price fell by 81 percent (UNICEF/AED, 2008).

A more recent study by Birol et al (2010) used nationally representative data and quasi-experimental impact evaluation methods to estimate the livelihood impacts of avian flu outbreaks. This study found that the average number of birds kept by a Nigerian household (around five birds) is too small for avian flu outbreaks to result in a significant impact on household income or wealth. However those households who kept larger, i.e., above average size, flocks could lose up to 42 percent of their livestock income (which translates to 7.4 percent of their total annual household income) if they lost up to 75 percent of their flocks due to avian flu outbreaks.

For the study presented in this paper, we interviewed 104 farmers in the northern state of Nasarawa, where avian flu outbreaks have occurred in the small-scale, household-level poultry sector. We analyzed the data using a conditional logit model (CLM) as well as a mixed logit or random parameter logit model (RPLM) and RPLM with interactions, in order to investigate unobserved and observed heterogeneity in farmers' preferences for various compensation plan attributes. The results of our analysis reveal that overall, farmers chose compensation plans that made the payment sooner, provided facilitated credit access, and offered biosecurity training. Farm households with better-educated heads and those with lower income levels valued compensation plans that provided credit access and biosecurity training more than other households did. These findings are expected to inform the design of efficient, effective, and targeted compensation policies that could not only reduce the avian disease risk but also improve the resilience of poor farmers' livelihoods against future poultry-related or other idiosyncratic shocks.

The rest of the paper unfolds as follows. The next section describes the choice experiment method and the econometric models applied. Section 3 explains the choice experiment design and survey administration, and presents the descriptive statistics. The results of the econometric analyses are reported in Section 4, and Section 5 concludes.

2. THE CHOICE EXPERIMENT METHOD

The choice experiment method has its theoretical grounding in Lancaster's model of consumer choice (Lancaster 1966) and its econometric basis in random utility theory (RUT) (Luce 1959; McFadden 1974). Lancaster proposed that consumers derive satisfaction not from goods themselves but from the attributes they provide. To illustrate the basic model behind the choice experiment presented here, consider a farmer's choice of a compensation plan. Assume that utility depends on choices made from a choice set *C,* which includes all possible alternative compensation plans. The farmer has a utility function of the form

$$U_{ij} = V(Z_{ij}) + e(Z_{ij})\,. \tag{1}$$

For any farmer *i*, a given level of utility will be associated with any compensation plan alternative *j*. Utility derived from any of the compensation plan alternatives depends on the attributes of the compensation plan (expressed in vector *Z*), such as the amount of compensation per bird, the number of days it takes to receive the payment, and whether or not the plan includes non-monetary benefits such as biosecurity training or access to a loan.

RUT is the basis for integrating behavior with economic valuation in the choice experiment method. According to RUT, the utility of a choice is composed of a deterministic component (*V*) and an error component (*e*), which is independent of the deterministic part and follows a predetermined distribution. The error component implies that predictions cannot be made with certainty. Choices made between alternatives will be a function of the probability that the utility associated with a particular compensation plan option *j* is higher than the utility associated with other alternatives. Assuming that the relationship between utility and attributes is linear in the parameters and variables function, and that the error terms are identically and independently distributed with a Weibull distribution, the probability that any particular compensation plan alternative *j* will be chosen can be expressed in terms of a logistic distribution. Equation (1) can be estimated with a conditional logit model (CLM) (McFadden 1974; Greene 1997; Maddala 1999).

The assumptions about the distribution of error terms that are implicit in the use of the CLM impose a particular condition known as the independence of irrelevant alternatives (IIA) property. IIA states that the relative probabilities of two options being chosen are unaffected by introduction or removal of other alternatives. If the IIA property is violated, then CLM results will be biased. A second limitation of CLM is that it assumes homogeneous preferences across respondents. Preferences, however, especially those of farmers, are generally heterogeneous and depend on various household- and farm-level factors. Accounting for this heterogeneity enhances the accuracy and reliability of estimates of benefits, marginal welfare, and total welfare (Greene 1997). Furthermore, accounting for heterogeneity makes it possible to recommend policies that take equity concerns into account. An understanding of who will be affected by a policy change and of the aggregate economic value associated with such a change is necessary for the design of equitable policies (Boxall and Adamowicz 2002).

Compared to the CLM, the random parameter logit model (RPLM) does not require the IIA assumption and can also account for unobserved, unconditional heterogeneity in preferences across farmers. The random utility function in the RPLM is given by

$$U_{ij} = V(Z_j(\beta + \eta_i)) + e(Z_j) \tag{2}$$

Similarly to the CLM, utility has a deterministic component (*V*) and an error component stochastic term (*e*). Indirect utility is assumed to be a function of the choice attributes (Z_j), with the utility parameter vector β, which may vary across farmers by a random component η_i due to preference heterogeneity. The probability of choosing *j* in each of the choice sets can be derived by specifying the distribution of the error terms e and η (Train 1998). By accounting for unobserved heterogeneity, the random parameter logit model (RPLM) takes the form

$$P_{ij} = \frac{\exp(V(Z_j(\beta + \eta_i)))}{\sum_{h=1}^{C} \exp(V(Z_h(\beta + \eta_i)))}. \qquad (3)$$

Since this model is not restricted by the IIA assumption, the stochastic part of utility may be correlated among alternatives and across the sequence of choices via the common influence of η_i. Treating preference parameters as random variables requires estimation by simulated maximum likelihood. Procedurally, the maximum likelihood algorithm searches for a solution by simulating k draws from distributions with given means and standard deviations. Probabilities are calculated by integrating the joint simulated distribution.

Even if unobserved heterogeneity can be accounted for in the RPLM, however, this model fails to explain the *sources* of heterogeneity (Boxall and Adamowicz 2002). One solution to detecting the sources of heterogeneity while accounting for unobserved heterogeneity could be to include interactions of farmer-specific household and farm characteristics with choice-specific attributes in the utility function. The RPLM with interactions can detect preference variation in terms of the heterogeneity of tastes (unconditional or random heterogeneity) and the heterogeneity of individual characteristics (conditional heterogeneity), thereby improving the fit of the model (Revelt and Train 1998). When the interaction terms are included, the indirect utility function that is estimated becomes

$$V_{ij} = \beta_1 Z_1 + \beta_2 Z_2 + \ldots + \beta_n Z_n + \delta_1 S_1 + \delta_2 S_2 + \ldots + \delta_l S_m, \qquad (4)$$

where n is the number of compensation plan attributes considered and the vector of utility parameters β_1 to β_n is attached to the vector of attributes (Z). In this specification, m is the number of farmer-specific household and farm characteristics that explain the choice of compensation plan, and the vector of coefficients δ_1 to δ_l corresponds to the vector of interaction terms (S) that influence utility. Since farmer-specific household and farm characteristics are constant across choice occasions for any given farmer, they enter as interaction terms only with the compensation plan attributes. Interaction terms help to capture heterogeneity across farm households, minimizing the error component η_i.

3. SURVEY DESIGN AND ADMINISTRATION

Data Collection and Sample

In this pilot choice experiment study, time and budget constraints allowed for only a small sample size. A multi-stage sampling procedure was undertaken. In the first stage, of the 35 local government areas (LGAs) in which avian flu outbreaks had been confirmed, Kokona LGA, in the northern state of Nasarawa, was chosen as the study site. In 2006, Kokona recorded the first confirmed highly pathogenic avian influenza (HPAI) outbreak in small-scale household-level poultry in Nigeria (Obi, Oparinde, and Maina 2008).

Based on review of the secondary data and consultations with local government officials in Kokona, a list of villages was compiled. This list included village characteristics, such as income status, major livelihood activities undertaken by the households (for example, crop farming, livestock production, and off-farm employment), infrastructure level and quality (including distance to the main road and distance to market centers), and avian flu status (whether or not there had been recorded outbreaks, and whether or not culling and consequent compensation took place).

In the second stage of the multi-stage sampling procedure, two villages were chosen from the village list based on their characteristics. These villages were Hayin Gada and Angwan Mayo, which were similar in terms of several characteristics such as income, livelihood activity portfolio, and distance to markets and main road (as reported in Table 3.1) but differed in terms of avian flu outbreak status. Hayin Gada had experienced an HPAI outbreak, with consequent culling and compensation interventions, in 2006. Angwan Mayo, on the other hand, had not experienced any avian flu outbreaks, though livelihood outcomes of poultry farmers in this village, as in other villages in the Kokona LGA, were expected to be affected by the avian flu threat. These two villages, with different avian flu status, were chosen in order to investigate whether ex post preferences of poultry producers in Hayin Gada differ from ex ante ones of those in Angwan Mayo.

In the third stage of the multi-stage sampling procedure, household lists were compiled for both of the villages. One-third of all households in both villages were randomly selected to be interviewed with the choice experiment and household survey instruments. A total of 104 households were interviewed face to face during the dry season (February and March) of 2009, when farmers were less busy with crop farming activities and could devote the time to participate in these structured survey instruments. Descriptive statistics of the households interviewed are reported in Table 3.1.

According to the descriptive statistics reported in Table 3.1, key household and household head characteristics, livelihood diversification, and infrastructure access for the two villages were not statistically significantly different. Therefore it can be concluded that the two villages, which were similar in terms of these characteristics but different in terms of avian flu status, were selected successfully for the purposes of this study.

One interesting finding is that in Hayin Gada village the percentage of households that kept poultry fell significantly from 96 percent before the 2006 outbreak to 75 percent when the survey data were collected in February 2009. In Angwan Mayo too, the percentage of households that kept poultry was lower in 2009 than it was in 2006, though the difference is not statistically significant. Even though this reduction in the percentage of households that kept poultry in Hayin Gada may not be directly attributable to the avian flu outbreak (since this study was not a randomized control trial, and the before and after data are self-reported and hence likely to be inaccurate due to various recall or strategic biases), this finding may be indicative of the impact of the avian flu outbreak regarding the households' choice of a livelihood activity.

Table 3.1—Descriptive statistics of the sampled households, pooled and by village

Household Characteristic	All households, N = 104	Hayin Gada households, N = 30	Angwan Mayo households, N = 74
	Mean (std. dev.)		
Household head age	45.29 (15.20)	49.36 (14.80)	43.89 (15.19)
Household head education	8.85 (5.41)	9.46 (5.15)	8.65 (5.52)
Household size	6.44 (3.19)	6.80 (3.23)	6.32 (3.18)
Total household income (in NGN)/month	32074 (42477)	34761 (29400)	31153 (46253)
Land area owned (in ha)	9.19 (20.22)	12.52 (29.30)	7.91 (15.49)
Number of cattle kept/year	1.39 (7.91)	0 (0)	1.92 (9.26)
Number of pigs kept/year	1.59 (2.91)	1.29 (2.68)	1.71 (3.00)
Number of goats kept/year	2.55 (4.09)	2.89 (4.50)	2.41 (3.95)
Number of sheep kept/year	0.63 (3.83)	0 (0)	0.88 (4.49)
Number of poultry kept/year***	34.74 (59.85)	89.27 (101.99)	18.30 (22.79)
Income from poultry sales/month	310.43 (1242.45)	619.27 (1755.46)	195.71 (979.57)
Income from poultry sales as a share of total monthly income (%)	1.08 (4.10)	1.48 (3.50)	0.93 (4.31)
Number of birds lost to culling in 2006	7.89 (18.60)	27.30 (26.07)	NA
Distance to market (minutes)	428.55 (392.89)	478.12 (363.10)	411.34 (403.71)
Distance to major road (minutes)	10.10 (12.60)	7.28 (4.43)	11.07 (14.27)
	Percentage		
Household head gender is male = 1, 0 otherwise	89.00	88.00	89.00
Household has access to market = 1, 0 otherwise	95.00	92.00	96.00
Household is member of poultry association = 1, 0 otherwise	19.00	20.00	19.00
Household kept poultry at the time of the interview = 1, 0 otherwise***	89.00	75.00	95.00
Household kept poultry before 2006 outbreak = 1, 0 otherwise	98.00	96.00	99.00
Household lost birds to culling = 1, 0 otherwise	19.00	68.00	NA
Of those whose birds were culled, household was compensated = 1, 0 otherwise	71.43	71.43	NA
Household aware of culling as avian flu control strategy = 1, 0 otherwise	98.00	99.00	97.00
Household aware of compensation plan for birds culled = 1, 0 otherwise	92.00	93.00	92.00

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.

Notes: NGN, Nigerian naira, US$1 = NGN 151.5 (exchange rate on October 28, 2010); ***significantly different across the two villages according to the pairwise t-test and Pearson chi-square test, respectively; NA, not applicable since there were not any HPAI outbreaks in Angwan Mayo village.

Finally, it is also worth noting that the average flock size kept by the Hayin Gada households was significantly larger than that in Angwan Mayo. However, neither the monthly income from poultry sales nor the share of monthly income obtained from poultry sales was significantly different across the two villages. Therefore we cannot argue that the role of poultry in income was different across the two villages, although poultry may have provided a larger share of other livelihood outcomes (for example, food and nutrition security) for Hayin Gada households than it did for Angwan Mayo households.

Design of Choice Sets

As mentioned in the introduction, in the choice experiment study presented here we endeavored to define a broad compensation policy, which included not only short-term benefits such as monetary compensation for the birds culled but also other public interventions that may have longer-term impacts on households' livelihood outcomes. These impacts would be expected to materialize through diversification of households' livelihood portfolios so as to improve their resilience to future shocks, whether caused by avian flu, other poultry diseases, or other idiosyncratic shocks.

In each of the selected villages, three focus group discussions (FGDs) were conducted to identify the relevant attributes and their levels to be used in the choice experiment. In order to avoid several problems that may potentially arise in FGD settings (such as domineering personalities, gender differences, and some participants' unwillingness to contradict older individuals or those with higher standing in the community) each focus group was kept small (seven participants) and men, women, and younger participants were grouped separately. (Please see Oparinde 2011 for a detailed explanation of the focus group methodology and findings).

In Hayin Gada village, where avian flu outbreaks and consequent culling and compensation programs took place in 2006, the focus group participants were asked their experiences and opinions about the compensation plan of 2006, and what aspects of the plan they would like to see changed. In Angwan Mayo village, on the other hand, focus group participants were asked about what kind of compensation plan they would prefer if their birds were to be culled in the future.

FGD participants in Hayin Gada stated that the compensation rates they were offered in 2006 were too low compared to the local market prices of poultry at the time. Many of the participants in this village stated that it took them up to five months to receive payments after their birds were culled. In both villages the FGD participants said they would like to receive the compensation payment as soon as possible. Moreover, none of the FGD participants in either village were aware of the new compensation plan that was introduced in 2007.

When asked about the means through which the payments were to be made, participants in four of the six focus groups said they would prefer to be paid privately, either in the bank or in their own homes, whereas two groups preferred the current public disbursement of payments.

Finally, focus group members were also asked if there were other services or benefits they would expect from the authorities in addition to or instead of monetary compensation. Several FGD participants stated that they would like to be trained in better poultry management practices so as to minimize their losses to future disease outbreaks and also to improve the general health and productivity of their flocks.

Some FGD participants also stated that instead of cash payment they would prefer to have access to credit at a low interest rate so that once their flocks were disposed of they would have the option to diversify into alternative livelihood activities, including non-farm businesses such as small-scale manufacturing using local farm produce and petty trading of manufactured items. There is an existing small and medium enterprise (SME) program in Nigeria, the Agricultural Credit Guarantee Scheme, under which the federal government has empowered the Nigerian Agricultural, Co-operative and Rural Development Bank Ltd. (NACRDB) to offer loans to small-scale farmers. As a result, the participants were familiar with NACRDB, though few said they had access to credit, which requires sufficient collateral.

Based on these FGDs, five attributes were selected to be used in the definition of the broader compensation plan:

Compensation Payment Rate. This is the compensation payment per local rooster (male chicken). This bird was chosen because many farm households in the selected villages are expected to have one (as opposed to commercial chickens or other species such as turkey, duck, or goose) and it is considered to be more valuable than a female chicken. Consequently, it was thought that with the local rooster as the "flagship" bird the respondents would take the choice experiment exercise, which is hypothetical in nature, more seriously. The levels for compensation payment per local rooster were determined through the market prices reported in the FGDs as well as the compensation rates reported in the federal government's manual on compensation (FMARD 2006). This attribute had five levels: Nigerian naira (NGN) 750, NGN 600, NGN 400, NGN 340, and the status-quo level of NGN 250.

Days it Takes to Receive the Payment. This attribute refers to the number of days it takes to receive the compensation payment after birds are culled. Based on the FGDs regarding what could constitute an appropriate time frame within which to receive the payment, this attribute was defined in five levels: 14, 35, 56, and 105 days, in addition to the status-quo level of 140 days (five months) reported in the FGDs in Hayin Gada.

Method of Payment. Based on the mode of compensation payment discussed in the FGDs, there were two possible alternative levels to this attribute: The compensation money could be paid either in private, at the home of the recipient, or in public, in the presence of the entire village and relevant government representatives, which was the status-quo level.

Biosecurity Training. This attribute refers to training on better poultry management practices (such as medication, housing, and disinfection) to improve biosecurity levels and thereby minimize future losses to avian flu or other poultry disease outbreaks as well as to improve the health and productivity of flocks. This attribute had two levels: training offered versus not offered, where the latter was the status-quo level.

Facilitated Bank Loan. This attribute refers to farm households whose flocks are culled having access to facilitated collateral-free bank loans of up to NGN 20,000 at a two percent annual interest rate for five years. This loan would be provided by NACRDB. The information used to define the loan offer was obtained from Central Bank of Nigeria (2005), Olaitan (2006), Oladeebo and Oladeebo (2008), and consultations with NACRDB officials at the Akwanga and Lafia branches. This attribute had two levels: facilitated bank loan offered versus not offered, where the latter was the status-quo level.

The attributes and the levels used in this choice experiment are summarized in Table 3.2.

Table 3.2—Compensation plan attributes and attribute levels used in the choice experiment

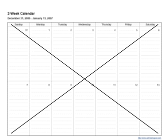
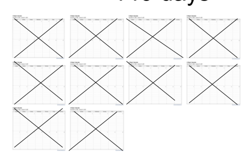
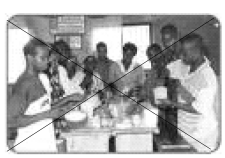
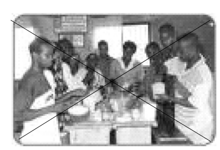
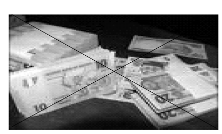
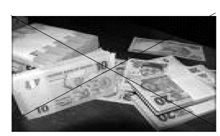
Attribute	Definition	Levels
Compensation payment rate	Monetary compensation paid per rooster culled is …	NGN 750, NGN 600, NGN 400, NGN 340 or *NGN 250**,[a]
Days it takes to receive payment	Number of days it takes to receive the compensation payment is …	14, 35, 56, 105 or *140* days
Method of payment	Compensation payment given to the affected household is made …	In private vs. *in public*
Biosecurity training	Free training on how to improve biosecurity in small-scale household-level poultry production is …	Offered vs. *not offered*
Facilitated bank loan	Collateral-free loan of NGN 20,000 at 2% interest rate for 5 years is …	Offered vs. *not offered*

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.
Notes: *Levels in italics indicate the status-quo levels of each attribute; [a]NGN, Nigerian naira.

Experimental design techniques (Louviere et al. 2000) were used to obtain an orthogonal design, which consisted of only the main effects and resulted in 32 pairwise comparisons of compensation plan alternatives. These were randomly blocked to four different versions, each with eight choice sets. Each set contained two new compensation plan alternatives (A or B) and a status-quo or baseline alternative, whose inclusion in the choice set is instrumental to achieving welfare measures that are consistent with demand theory (Bateman et al. 2003). The attributes chosen for the status-quo alternative were those of the 2006 compensation plan, since according to the FGD findings presented above, this was the only plan the farm households were aware of. Figure 3.1 provides an example of a choice set presented to the respondents.

Figure 3.1—Example of a choice set

Assuming there is a bird flu outbreak in your village and the government culls your birds, which of the following compensation plans will you accept?

Compensation Plan Benefits	**Compensation Plan A**	**Compensation Plan B**	**Status-Quo Compensation Plan**
Compensation payment per rooster	NGN 750 	NGN 400 	NGN 250 
Days it takes to receive payment	14 days 	35 days 	140 days 
Method of payment	Public 	Private 	Public 
Biosecurity training	No 	Yes 	No 
Facilitated bank loan	Yes 	No 	No 

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.

4. RESULTS

Data Coding

The data were coded according to the levels of the attributes. Attributes with two levels (method of payment, biosecurity training, and facilitated back loan) entered the utility function as effects-coded binary variables (method of payment coded as 1 for "private," -1 for "public"; training and loan coded as 1 for "offered," -1 for "not offered") (see Table 3.2) (Louviere et al. 2000). Data for the attributes with four levels were entered in cardinal-linear form. The attributes for the status-quo option (the status-quo compensation plan) were coded with the values that focus group participants reported for the 2006 compensation plan.

Conditional Logit Model

The choice experiment was designed with the assumption that the observable utility function would follow a strictly additive form. The model was specified so that the probability of choosing a particular compensation plan was a function of the five attributes. Using the 832 choices elicited from the 104 respondents, we estimated the conditional logit model (CLM), the results of which are reported in Table 4.1.

Table 4.1—Conditional logit model for compensation plan attributes

Attribute	Coeff. (Std. Err.)
Compensation payment rate	0.00233***(0.0003)
Days it takes to receive payment	-0.0091***(0.0013)
Method of payment	0.2428***(0.4943)
Biosecurity training	0.4576***(0.0538)
Facilitated bank loan	0.4607*** (0.0545)
ρ^2	0.00688
Log-likelihood	-603.39
Sample size	832

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.

Note: ***1% significance with two-tailed tests.

The overall fit of the model, as measured by McFadden's ρ^2, is low. The ρ^2 value in conditional logit models is similar to the R^2 in conventional analysis except that significance occurs at lower levels. According to Hensher, Rose, and Greene (2005), values of ρ^2 between 0.2 and 0.4 are considered to be extremely good fits. Even though the fit of the CLM is poor, all the coefficients are statistically significant and intuitively correct. All the attributes were significant factors in determining the farmers' preference of a compensation plan, and *ceteris paribus*, farmers were more likely to choose plans that offered higher compensation rates, payments made in fewer days, payments made in private, biosecurity training, and facilitated bank loans.

Among the attributes with two levels, the coefficient on the facilitated bank loan attribute is the highest, followed very closely by that of biosecurity training, whereas the method of payment attribute is only half as important in the choice of a compensation plan compared with the two former attributes. Finally, the sign of the compensation payment attribute is positive and significant, as expected according to the economic theory.

To test whether the CLM is the appropriate model specification, a Hausman and McFadden (1984) test was carried out. The IIA property was significantly violated when any one of the three choice alternatives was dropped from the choice sets, indicating that the model does not fully conform to the underlying IIA property. Therefore the model needs to be augmented either by employing the random parameter logit model (also referred to as mixed logit) or by including socioeconomic characteristics as interaction terms, or both (Revelt and Train 1998).

Random Parameter Logit Model

The random parameter logit model (RPLM) (Train 1998) was estimated. The results of the RPLM estimations are reported in Table 4.2.

Table 4.2—Random parameter logit model (RPLM) and RPLM with interactions

	RPLM		**RPLM with interactions**	
Attribute and Interaction	Coeff. (s.e.)	Coeff. Std. (s.e.)	Coeff. (s.e.)	Coeff. Std. (s.e.)
Compensation payment rate	0.00373*** (0.0006)	-	0.00342*** (0.0006)	-
Days it takes to receive payment	-0.0141*** (0.004)	0.0002 (0.004)	-0.0142*** (0.004)	0.00003 (0.0004)
Method of payment	0.0233 (0.186)	0.836*** (0.299)	-0.182 (0.212)	0.83613*** (0.3)
Biosecurity training	0.55** (0.257)	1.0296*** (0.297)	0.667*** (0.332)	1.025*** (0.309)
Facilitated bank loan	0.386** (0.196)	0.123 (0.415)	0.206 (0.233)	0.0752 (0.342)
Education x loan	-	-	0.198* (0.152)	-
Education x training	-	-	0.0376** (0.189)	-
Number of birds culled x compensation	-	-	0.00004* (0.00002)	-
Number of birds culled x training	-	-	0.0067* (0.005)	-
Income from poultry x loan	-	-	0.0342* (0.024)	-
Total household income x training	-	-	-0.00002*** (0.000006)	-
Total household income x method of payment	-	-	0.000008** (0.000004)	-
ρ^2	0.365		0.383	
Log-likelihood	-580.03		-564.12	
Sample size	832		832	

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.
Notes: ***1% significance, **5% significance, *10% significance level with two-tailed tests.

Compared with the CLM, the RPLM has a higher level of parametric fit, exhibiting higher ρ^2 and log-likelihood. With its ρ^2 value of 0.365, the RPLM has an extremely good fit. The improvements in the model specification with the use of the RPLM can be tested for significance with a Swait-Louviere log-likelihood ratio test. The calculated statistic is -2[-603.39-(-580.03)] = 46.72, which is larger than 14.86, the critical value of χ^2 distribution at 4 degrees of freedom (the difference between the number of parameters in the two models) at the 0.5 percent significance level. This result indicates that the improvement in model fit is significant. Therefore the RPLM is a better fit than CLM for the estimation of the data.

The RPLM results revealed that the method of payment attribute supported a significant and large standard deviation. Almost half (49 percent) of the households preferred payment in public and the other half preferred payment in private. The high level of heterogeneity in households' preference for this attribute, as evident in the significant and large attribute standard deviation, resulted in the insignificance of the overall coefficient mean.

The biosecurity training attribute also supported a significant and large standard deviation, with almost two-thirds (67 percent) of the households preferring that the compensation plan offers biosecurity training. The other three attributes had insignificant standard deviations, revealing that all households preferred higher compensation rates, wanted to receive their payment in fewer days, and wanted the compensation plan to offer a facilitated bank loan.

Random Parameter Logit Model with Interactions

In order to identify the possible *sources* of heterogeneity, interactions of household-specific socioeconomic and HPAI-related characteristics with choice-specific attributes were included in the utility function. We tested various interactions of the five compensation plan attributes with the household-level characteristics reported in Table 3.1. The model that included interactions of choice-specific attributes with the years of education of the household head, number of poultry culled in 2006, income from poultry sales, and total household income was found to fit the data best. Variance inflationary factor calculations and the correlation matrix revealed the correlation and multicollinearity among these household-level variables to be insignificant. The utility function was extended to include these interactions, and the final model was estimated. The results are reported in the last two columns of Table 4.2.

Compared with the basic RPLM, the RPLM with interactions has a higher level of parametric fit: ρ^2 increases and log-likelihood decreases. The Swait-Louviere log-likelihood ratio test is -2[-580.03-(-564.12)] = 31.8, which is larger than 20.28, the critical value of χ^2 distribution at 7 degrees of freedom at the 0.5 percent significance level. Therefore the RPLM with interactions is a better fit for the data than the RPLM. Similar to the results of the RPLM, the results of RPLM with interactions revealed that the standard deviations for the method of payment and biosecurity training attributes were significant and large, indicating significant unobserved heterogeneity for these attributes, which could not be explained entirely by the inclusion of the interaction terms.

The significant interactions revealed that households with more-educated heads preferred compensation plans that offered a facilitated loan and biosecurity training. Households that had a higher number of birds culled during the 2006 outbreaks preferred plans that would pay higher compensation rates and offer biosecurity training. Finally, households with higher total household incomes were less likely to choose plans that would provide biosecurity training and more likely to choose plans that would make the payment in private, in the recipient's home.

Estimation of Willingness to Pay

The choice experiment method is consistent with utility maximization and demand theory (Bateman et al. 2003). Welfare measures can be calculated from the parameter estimates by using the following formula:

$$CS = \frac{\ln \sum_i \exp(V_{i1}) - \ln \sum_i \exp(V_{i0})}{\alpha}, \qquad (5)$$

where *CS* is the compensating surplus welfare measure, α is the marginal utility of income (represented by the coefficient of the monetary attribute in the choice experiment, which is compensation rate in this case) and V_{i0} and V_{i1} represent indirect utility functions before and after the change under consideration (that is, after the improvement in the status-quo compensation plan of 2006).

For the linear utility index, the marginal value of a change in a single compensation plan attribute can be estimated as a ratio of coefficients. The ratio represents the marginal rate of substitution between the monetary attribute and the compensation plan attribute in question, or the marginal welfare measure (willingness to pay [WTP] or willingness to accept [WTA]) for a change in any one of the attributes. For the binary compensation plan attributes, which are effects-coded, equation (5) reduces to a part-worth (or marginal implicit price) formula (see Hu et al. 2004):

$$WTP = -2\left(\frac{\beta_{attribute}}{\beta_{monetary\ variable}}\right). \tag{6}$$

The demand functions conditional on the respondent characteristics reported in Table 4.2 can be used to calculate the value assigned by the respondent to compensation plan attributes by modifying equation (6):

$$W = -2\left(\frac{\hat{\beta}_{attribute} + \delta_{atribute} \times S_1 ... + \delta_{attribute} \times S_4}{\hat{\beta}_{monetaryattribute} + \delta_{monetaryatribute} \times S_1 + ... + \delta_{monetaryattribute} \times S_4}\right), \tag{7}$$

where variables S_{1-4} are the four respondent-specific characteristics under consideration. Respondents' valuation (WTP or WTA) for compensation plan attributes were calculated for the best-fitting RPLM with interactions for the average household and for eight selected household profiles. These eight household profiles were generated to describe the variation in WTP/WTA within the sample, based on the farm- and household-level characteristics that were found to affect the households' preferences for different compensation plan attributes.

The first two profiles were generated according to the household heads' education level, the third and fourth based on the number of birds culled, the fifth and sixth according to the households' income from poultry, and the last two based on total household income. For each set of households, the sample mean for the variable was chosen to profile those who had above-mean versus mean and below-mean values for each of the variables used for profiling.

Table 4.3 reports the characteristics of the average household and the eight selected household profiles. Table 4.4 reports the marginal WTP/WTA results for these households and Table 4.5 presents the results of the Poe, Severance-Lossin, and Welsh (1994) simple convolutions process, which tests whether there are significant differences between the WTP/WTA values of the average household and those of the eight selected household profiles.

WTP/WTA estimates derived from the best-fitting RPLM with interactions resulted in insignificant values for the method of payment attribute for each of the profiles. For the attribute of how long it takes to receive the payment, an average household was willing to accept NGN 3.8 (NGN 2.6 to NGN 5) more compensation per rooster for each day of delay in receiving the payment. This value is similar across the household profiles, with the exception of household profile 3 (households with above-sample-average number of birds culled in 2006), who were willing to accept statistically significantly lower compensation for each extra day they had to wait for their monetary compensation. This may be explained by the fact that these households were already used to waiting for long periods and therefore their discount rates were lower compared to those who had not experienced long waits to receive a payment.

For the training and loan attributes, farm households exhibited negative WTA values, implying that they would be willing to pay, or willing to forgo the monetary compensation, if they were to be able to have access to these benefits. The average household in our sample was willing to pay NGN 140 (NGN 73 to NGN 207) or willing to forgo this level of compensation (per rooster) in order to receive training from the veterinary department on better poultry management practices and improvement of biosecurity levels so as to be able to minimize disease risk and improve productivity of poultry production.

Compared to the average household profile, household profiles 1, 4, 6, and 8 were willing to pay significantly higher amounts for the training attribute, whereas profile 5 was willing to pay less for this attribute. This can be explained by the fact that households that derive a greater share of their income from poultry have larger flocks and rely on poultry for their income more than the average household;

therefore, they are already informed about biosecurity measures and efficient poultry management practices and they are more likely to lose a greater proportion of their income if their birds are culled.

Table 4.3—Mean (std. dev.) of the average and eight selected household profiles

Profile	HH head education in years	No. of birds culled	Share of poultry income in total income	Total household income (in NGN)
Average household (HH)	8.85 (5.38)	8.26 (18.76)	1.26 (4.23)	24,762 (20,616)
Profile 1: HH head education above average (N = 61)	13.13 (2.06)	8.28 (20.22)	1.04 (3.95)	23,402 (19,503)
Profile 2: HH head education below average (N = 43)	3.58 (3.02)	8.23 (16.48)	1.54 (4.55)	26,413 (21,787)
Profile 3: HH with no. of birds culled above average (N = 21)	8.83 (3.97)	40.52 (20.87)	1.72 (3.77)	36,932 (27,613)
Profile 4: HH with no. birds culled below average (N = 83)	8.86 (5.66)	0.1 (0.9)	1.15 (4.32)	22,039 (17,588)
Profile 5: HH poultry income above average (N = 17)	7.27 (5.94)	18 (30.49)	11.09 (7.12)	31,833 (16,219)
Profile 6: HH poultry income below average (N = 87)	9.06 (5.28)	6.36 (14.74)	0.01 (0.11)	23,813 (20.959)
Profile 7: HH income above average (N = 47)	8.39 (5.66)	11.92 (22.67)	2 (5.1)	44,826 (19,614)
Profile 8: HH income below average (N = 57)	9.2 (5.14)	5.25 (14.09)	0.72 (3.37)	12,089 (5,968)

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.
Note: NGN, Nigerian naira.

Table 4.4—Marginal WTP/WTA for compensation plan attributes (95% C.I.) in NGN/household for RPLM with interactions

	Days it takes to receive payment	Biosecurity training	Facilitated bank loan
Average household	3.79 (2.62 to 4.96)	-140.1 (-207.05 to -73.15)	-113.15 (-167.75 to -58.55)
Profile 1	3.78 (2.61 to 4.95)	-189.8(-264.4 to -115.2)	-133.6 (-192.45 to -74.75)
Profile 2	3.79 (2.82 to 4.76)	NS	-87.95 (-144.55 to -31.35)
Profile 3	2.8 (1.47 to 4.13)	NS	-87(-129 to -45)
Profile 4	4.15 (3.05 to 5.25)	-168.9 (-245.05 to -92.75)	-123 (-184.15 to -61.85)
Profile 5	3.4 (2.2 to 4.6)	-79.9 (-138.25 to -21.55)	-176.1(-255.6 to -96.6)
Profile 6	3.86 (2.74 to 4.98)	-150.1(-219.2 to -81)	-105 (-160.4 to -49.6)
Profile 7	3.64 (2.42 to 4.86)	NS	-113 (-165.9 to -60.1)
Profile 8	3.91 (2.69 to 5.13)	-215.05 (-292.5 to -137.6)	-118.85(-175.8 to -61.9)

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.
Note: NGN, Nigerian naira; WTP, willingness to pay; WTA, willingness to accept; C.I., confidence interval; RPLM, random parameter logit model; NS, not significant.

Table 4.5—Proportion of WTP/WTA differences for compensation plan attributes falling below zero

	Days it takes to receive payment	Biosecurity training	Facilitated bank loan
Average vs. Profile 1	0.8109	0.9764**	0.7631
Average vs. Profile 2	0.8107	NS	0.7635
Average vs. Profile 3	0.9009*	NS	0.7726
Average vs. Profile 4	0.7764	0.9492**	0.6754
Average vs. Profile 5	0.8449	0.9994***	0.7322
Average vs. Profile 6	0.8033	0.9937***	0.6844
Average vs. Profile 7	0.8244	NS	0.0183
Average vs. Profile 8	0.7988	0.9994***	0.8632

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.
Notes: ***1% significance, **5% significance, *10% significance level with two-tailed tests; WTP, willingness to pay; WTA, willingness to acceptl; NS, not significant.

Households with more-educated heads (profile 1) and those who had lower income levels (profile 6) valued training highly. This may be explained by the former's ability to assess the marginal impact such an intervention could have on their poultry productivity and income, and the latter's willingness to try better poultry management practices to improve their livelihood outcomes, such as income. Households who had fewer birds culled in 2006 (profile 4) and those who derived smaller proportions of their incomes from poultry (profile 6) also valued the training attribute highly, perhaps owing to the former's willingness to minimize avian flu disease risk and the latter's willingness to increase the share of income from poultry. For the facilitated loan attribute, an average household was willing to accept less compensation (or willing to pay) as much as NGN 113 (NGN 59 to NGN 168) per rooster. Across household profiles the marginal value of this attribute did not vary significantly. However, those who were more educated and had an above-average number of birds culled in 2006 valued this attribute more, revealing these households' willingness to have access to loans for restocking their flocks, diversifying into other livelihood strategies, or both.

The marginal WTP/WTA values reported in Table 4.4 do not provide estimates of compensating surplus (CS) for alternative compensation plans. In order to estimate the farmers' CS for different compensation plans, four improved plans were created, in addition to the status-quo (2006) plan:

Status-quo compensation plan (0). In this plan, it takes 140 days to receive the payment, which is made publically; no facilitated loan or biosecurity training is offered.

Improved compensation plan 1. In this plan, it takes 14 days to receive the payment, which is made publically. This is equivalent to the improved compensation plan of 2007. However, no facilitated loan or biosecurity training is offered.

Improved compensation plan 2. In this plan, it takes 14 days to receive the payment, which is made publically; a facilitated loan is offered but biosecurity training is not offered.

Improved compensation plan 3. In this plan, it takes 14 days to receive the payment, which is made publically; biosecurity training is offered but a facilitated loan is not offered.

Improved compensation plan 4. In this plan, it takes 14 days to receive the payment, which is made privately; both a facilitated loan and biosecurity training are offered.

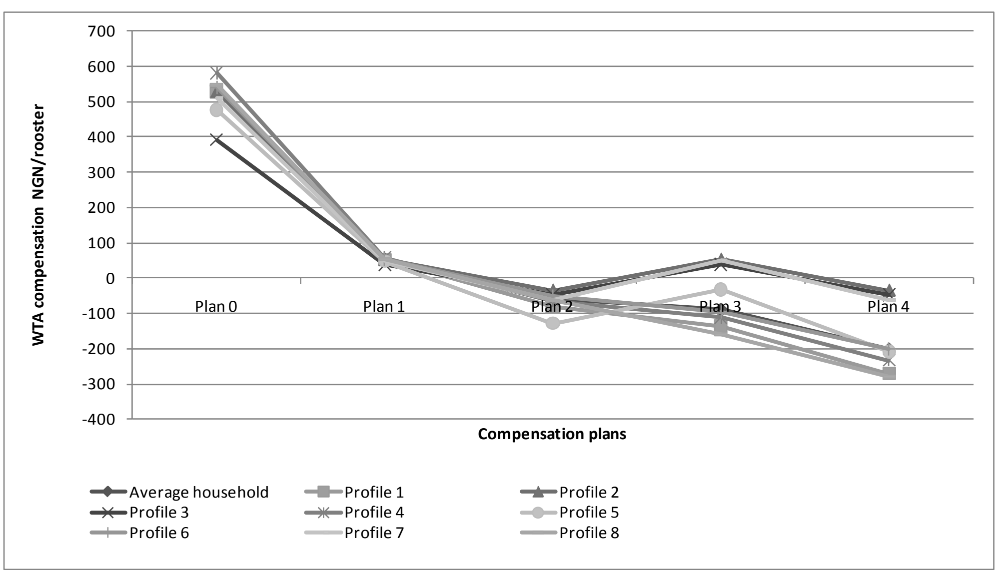
The CS values for the five compensation plans are presented in Table 4.6 for each household profile; the mean CS values are depicted in Figure 4.1. For all household types, there was a steep decline in CS values when the status-quo plan (2006) was improved to plan 1 (the 2007 plan), revealing that lower compensation payment rates would be acceptable if the compensation payment were made sooner. The average household profile's WTA compensation (as well as those of profiles 1, 4, and 6) decreased and became negative (that is, turned into WTP) with improvements in scenarios. Especially household profiles 1 (households who had heads with above-mean education) and 8 (households with incomes below mean) highly valued the fourth plan, which offers both training and a loan.

Table 4.6—Compensating surplus (95% C.I) for each scenario and household profile (in NGN per rooster per household)

	Status-quo plan (0)	Compensation plan 1	Compensation plan 2	Compensation plan 3	Compensation plan 4
Average household	530.6 (366.8 to 694.4)	53.06 (36.68 to 69.44)	-60.09 (-131.07 to 10.89)	-87.04 (-170.37 to -3.71)	-200.19 (-338.12 to -62.26)
Profile 1	529.2 (365.4 to 693)	52.92 (36.54 to 69.3)	-80.68 (-155.91 to -5.45)	-136.88 (-227.86 to -45.9)	-270.48 (-420.31 to -120.65)
Profile 2	530.6 (394.8 to 666.4)	53.06 (39.48 to 66.64)	-34.89 (-105.07 to 35.29)	53.06 (39.48 to 66.64)	-34.89 (-105.07 to 35.29)
Profile 3	392 (205.8 to 578.2)	39.2 (20.58 to 57.82)	-47.8 (-108.42 to 12.82)	39.2 (20.58 to 57.82)	-47.8 (-108.42 to 12.82)
Profile 4	581 (427 to 735)	58.1 (42.7 to 73.5)	-64.9 (-141.45 to 11.65)	-110.8 (-202.35 to -19.25)	-233.8 (-386.5 to -81.1)
Profile 5	476 (308 to 644)	47.6 (30.8 to 64.4)	-128.5 (-224.8 to -32.2)	-32.3 (-107.45 to 42.85)	-208.4 (-363.05 to -53.75)
Profile 6	540.4 (383.6 to 697.2)	54.04 (38.36 to 69.72)	-50.96 (-122.04 to 20.12)	-96.06 (-180.84 to 11.28)	-201.06 (-341.24 to -60.88)
Profile 7	509.6 (338.8 to 680.4)	50.96 (33.88 to 68.04)	-62.04 (-132.02 to 7.94)	50.96 (33.88 to 68.04)	-62.04 (-132.02 to 7.94)
Profile 8	547.4 (376.6 to 718.2)	54.74 (37.66 to 71.82)	-64.11 (-121.06 to -7.16)	-160.31 (-237.76 to -82.86)	-279.16 (-413.56 to -144.76)

Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.
Note: C.I., confidence interval; NGN, Nigerian naira.

Figure 4.1—Compensating surplus for the status-quo compensation plan (0) and four improved scenarios



Source: Nasarawa Avian Flu Compensation Choice Experiment Survey, 2009.
Note: NGN, Nigerian naira.

5. CONCLUSIONS AND POLICY IMPLICATIONS

Among the limited livelihood diversification strategies that poor households in developing countries tend to have, livestock constitutes an important livelihood strategy. At the same time, a great majority of the livestock in developing countries is owned or managed by these resource-poor, small-scale, household-level producers (Livestock in Development 1999). This paper is based on the premise that in order to be able to control livestock diseases in developing countries efficiently, effectively, and equitably, an integrated approach that combines building of livelihood resilience with the design of compensation policy is required.

To this end, in this paper we present the results of a choice experiment study designed to shed light on poor farm households' preferences for various compensation plan attributes and these households' trade-offs among these attributes following a livestock disease outbreak. We collected data from 104 farm households located in the Nasarawa state of Nigeria and used avian flu as the livestock disease of focus. We defined *compensation plan* broadly, to include not just the traditional attributes (such as the number of days it takes to receive the payment, the compensation rate, and the method of payment) but also more diverse interventions, such as training for poultry farmers in biosecurity measures and facilitating access to bank loans. These latter attributes are hypothesized to have longer-term impacts on the farm households' livelihood strategies and hence outcomes, by helping them diversify into livelihood activities other than poultry, improve the productivity of their poultry, or both. Therefore these interventions are expected to enhance households' resilience against future shocks (be they poultry disease outbreaks or other idiosyncratic shocks), thus bridging livelihood resilience-building and the design of incentive-compatible disease control policies.

The choice experiment data were analyzed by using various discrete choice models, the best-fitting of which was the random parameter (or mixed) logit model with interactions. This model enabled the capturing of both unobserved and observed heterogeneity in farm households' preferences for the compensation plan attributes. The results of our analysis revealed that overall, farm households chose compensation plans that would make the payment sooner, provide facilitated credit access, and offer biosecurity training. Households with better-educated heads and those with lower income levels had the highest utility or demand for compensation plans that would provide credit access and biosecurity training.

Even though these findings are from a small pilot study, they may be indicative of the preferences of resource-poor Nigerian farm households who have been affected by avian flu outbreaks or threats. According to our findings, the provision of biosecurity training to household-level, small-scale poultry producers may be an appropriate policy that encourages private preventive investments that could result in socially optimal biosecurity levels. Further, the identification of different household profiles' preferences could assist in the development of targeted interventions, which could not only reduce the avian flu disease risk but also improve the resilience of poor farm households' livelihoods against future poultry-related or other idiosyncratic shocks. The findings presented here are therefore expected to inform the design of efficient, effective, equitable, and targeted compensation and livelihood diversification policies.

REFERENCES

Adger, W. N. 2000. "Social and Ecological Resilience: Are They Related?" *Progress in Geography* 24:347–364.

Amanfu, W. 2006. "Livelihoods, Economic Impact and Compensation Policies in Avian Influenza." Paper presented at the United Nations Regional Meeting on the Avian Influenza Situation in Africa, Libreville, Gabon, March 20-22.

Bateman, I. J., R. T. Carson, B. Day, W. M. Hanemann, N. Hanley, T. Hett, M. Jones-Lee,et al. 2003. *Guidelines for the Use of Stated Preference Techniques for the Valuation of Preferences for Non-Market Goods.* Cheltenham, UK: Edward Elgar.

Beach, R. H., C. Poulous, and S. K. Pattanayak. 2006. "Prevention and Control of Avian Influenza: A View from the Farm Household." Paper presented at the CAES-FLP-CATPRN joint workshop "Crises in Agricultural and Resource Sectors Workshop: Analysis of Policy Responses," Calgary, Alberta, Canada, October 15–17.

Birol, E., D. Asare-Marfo, G. Ayele, A. Mensa-Bonsu, L. Ndirangu, B. Okpukpara, D. Roy, and Y. Yakhshilikov. 2010. *Investigating the Role of Poultry in Livelihoods and the Impact of Avian Flu on Livelihoods Outcomes in Africa: Evidence from Ethiopia, Ghana, Kenya, and Nigeria*. IFPRI Discussion Paper 01011. Washington, DC: International Food Policy Research Institute.

Boxall, P. C., and W. L. Adamowicz. 2002. "Understanding Heterogeneous Preferences in Random Utility Models: A Latent Class Approach." *Environmental and Resource Economics* 23:421–446.

Central Bank of Nigeria (CBN). 2005. *Microfinance Policy, Regulatory and Supervisory Framework for Nigeria.* Abuja, Nigeria: Central Bank of Nigeria.

Delgado, C. 2006. *Avian Influenza Compensation in Developing Countries: Issues and Knowledge Gaps.* Washington, DC: The World Bank.

Ellis, F. 1998. "Household Strategies and Rural Livelihood Diversification." *Journal of Development Studies* 35 (1): 1–38.

________. 2000. "The Determinants of Rural Livelihood Diversification in Developing Countries." *Journal of Agricultural Economics* 51 (2): 289–302.

Eriksen, S., K. Brown, and P. Kelly. 2005. "The Dynamics of Vulnerability: Locating Coping Strategies in Kenya and Tanzania." *The Geographical Journal* 171 (4): 287–305.

FMARD (Federal Ministry of Agriculture and Rural Development). 2006. Nigerian Avian Influenza Emergency Control Compensation Fund Management Manual, *The Project Implementation Manual,* Federal Republic of Nigeria.

Folke, C., S. Carpenter, T. Elmqvist, L. Gunderson, C. S. Holling, and B. Walker. 2002a. "Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations." *Ambio* 3 (5): 437–440.

Folke, C., S. Carpenter, T. Elmqvist, L. Gunderson, C. S. Holling, B. Walker, J. Bengtsson, F. Berkes, et al. 2002b. *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations.* Series on Science for Sustainable Development 3. Paris: International Council for Science.

Gramig, B., R. Horan, and C. Wolf. 2005. "A Model of Incentive Compatibility under Moral Hazard in Livestock Disease Outbreak Response." Paper presented at the American Agricultural Economics Association annual meeting, Providence, RI:US, July 24–27.

Greene, W. H. 1997. *Econometric Analysis*, 4th ed. Upper Saddle River, NJ, US: Prentice-Hall.

Gunderson L. H., and C. S. Holling, eds. 2002. *Panarchy: Understanding Transformations in Human and Natural Systems.* Washington, DC: Island Press.

Hausman, J. A., and D. McFadden. 1984. "Specification Tests for the Multinomial Logit Model." *Econometrica* 52:1219–1240.

Hensher, D. A., J. M. Rose, and W. H. Greene. 2005. *Applied Choice Analysis: A Primer.* Cambridge, UK: Cambridge University Press.

Holling, C. S. 1973. "Resilience and Stability of Ecological Systems." *Annual Review of Ecology and Systematics* 4:1–23.

Hu, W., A. Hunnemeyer, M. Veeman, W. L. Adamowicz, and L. Srivastava. 2004. Trading off health, environmental and genetic modification attributes in food. *European Review of Agricultural Economics* 31:389–408.

Lancaster, K. 1966. "A New Approach to Consumer Theory." *Journal of Political Economy* 74:217–231.

Livestock in Development. 1999. *Livestock in Poverty-Focused Development.* Crewkerne, U.K.

Louviere, J. J., D. Hensher, J. Swait, and W. Adamowicz. 2000. *Stated Choice Methods: Analysis and Applications*. Cambridge, U.K.: Cambridge University Press.

Luce, D. 1959. *Individual Choice Behavior.* New York: Wiley.

Maddala, G. S. 1999. *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge, UK: Cambridge University Press.

Marschke, J. M., and F. Berkes. 2006. "Exploring Strategies That Build Livelihood Resilience: A Case from Cambodia." *Ecology and Society* 11 (1): 42.

McFadden, D. 1974. "Conditional Logit Analysis of Qualitative Choice Behavior." In *Frontiers in Econometrics,* edited by P. Zarembka. New York: Academic Press.

Obayelu, A.E., 2007. "Socio-Economic Analysis of the Impacts of avian influenza epidemic on Households Poultry Consumption and Poultry Industry in Nigeria: Empirical Investigation of Kwara State." *Livestock Research for Rural Development*, 19 (1).

Obi, T. U., A. Oparinde, and G. A. Maina. 2008. *Pro-Poor HPAI Risk Reduction Strategies in Nigeria.* Africa/Indonesia Team Working Paper 5. London: DFID Collaborative Research. www.hpai-research.net.

Oladeebo, J. O., and O. E. Oladeebo. 2008. "Determinants of Loan Repayment among Smallholder Farmers in Ogbomoso Agricultural Zone of Oyo State, Nigeria." *Journal of Social Science* 17 (1): 59–62.

Olaitan, M. A. 2006. "Finance for Small and Medium Enterprises: Nigeria's Agricultural Credit Guarantee Scheme Fund." *Journal of International Farm Management* 3 (2): 1–9.

Oparinde, A. O. 2011. "Impact of Asset and Income Shocks on Rural Livelihoods and Food Security in Less Developed Countries: The Case of Highly Pathogenic Avian Influenza (HPAI) Outbreak and its Control Policies in Nigeria." PhD Dissertation, Department of Land Economy, University of Cambridge, U.K.

Poe, G. L., E. K. Severance-Lossin, and M. P. Welsh. 1994. "Measuring the Difference (X–Y) of Simulated Distributions: A Convolutions Approach." *American Journal of Agricultural Economics* 76:904–915.

Resilience Alliance, 2007. *Assessing Resilience in Socio-Ecological Systems: A Scientists Workbook'*, Resilience Alliance, Version 1.1. www.resalliance.org.

Revelt, D., and K. Train. 1998. "Mixed Logit with Repeated Choices: Households' Choice of Appliance Efficiency Level." *Review of Economics and Statistics* 53:647–657.

Train, K. E. 1998. "Recreation Demand Models with Taste Differences over People." *Land Economics* 74:230–239.

UNDP (United Nations Development Programme). 2006. *Socio-Economic Impact of Avian Influenza in Nigeria*. New York: UNDP.

UNICEF/AED (Academy for Educational Development). 2008. *Participatory Action Research on Avian Flu Communications: Findings from Nigeria*. New York: UNICEF; Washington, DC: AED

RECENT IFPRI DISCUSSION PAPERS

For earlier discussion papers, please go to http://www.ifpri.org/publications/results/taxonomy%3A468.
All discussion papers can be downloaded free of charge.

1071. *Petroleum subsidies in Yemen: Leveraging reform for development*. Clemens Breisinger, Wilfried Engelke, and Olivier Ecker, 2011

1070. *Joint estimation of farmers' stated willingness to pay for agricultural services*. John Ulimwengu and Prabuddha Sanyal, 2011.

1069. *Using a spatial growth model to provide evidence of agricultural spillovers between countries in the NEPAD CAADP framework*. John Ulimwengu and Prabuddha Sanyal, 2011.

1068. *Social services, human capital, and technical efficiency of smallholders in Burkina Faso*. Fleur Wouterse, 2011.

1067. *Decentralization of public-sector agricultural extension in India: The case of the District-level Agricultural Technology Management Agency (ATMA).* Claire J. Glendenning and Suresh C. Babu, 2011.

1066. *Institutional and capacity challenges in agricultural policy process: The case of Democratic Republic of Congo*. Catherine Ragasa, Suresh C. Babu, and John Ulimwengu, 2011.

1065. *Cartels and rent sharing at the farmer-trader interface: An example from Ghana's tomato sector*. Elizabeth J.Z. Robinson and Guyslain Ngeleza, 2011.

1064. *Agricultural, food, and water nanotechnologies for the poor: Opportunities, Constraints, and role of the Consultative Group on International Agricultural Research*. Guillaume Gruère, Clare Narrod, and Linda Abbott, 2011.

1063. *Decentralization and rural service delivery in Uganda.* Bernard Bashaasha, Margaret Najjingo Mangheni, and Ephraim Nkonya, 2011.

1062. *Dynamic informative advertising of new experience goods*. Alexander E. Saak, 2011.

1061. *The role of elected and appointed village leaders in the allocation of public resources: Evidence from a low-income region in China*. Ren Mu and Xiaobo Zhang, 2011.

1060. *Trade and investment in Latin America and Asia: Lessons from the past and potential perspectives from further integration*. Valdete Berisha-Krasniqi, Antoine Bouët, Carmen Estrades, and David Laborde, 2011.

1059. *Transmission of world food price changes to markets in Sub-Saharan Africa*. Nicholas Minot , 2011.

1058. *Fertilizer market situation: market structure, consumption and trade patterns, and pricing behavior*. Manuel A. Hernandez and Maximo Torero, 2011.

1057. *The wealth and gender distribution of rural services in Ethiopia: A public expenditure benefit incidence analysis*. Tewodaj Mogues, Carly Petracco, and Josee Randriamamonjy, 2011.

1056. *The gender implications of large-scale land deals.* Julia Behrman, Ruth Meinzen-Dick, and Agnes Quisumbing, 2011.

1055. *Impact of global change on large river basins: Example of the Yellow River basin*. Nicola Cenacchi, Zongxue Xu, Wang Yu, Claudia Ringler, and Tingju Zhu, 2011.

1054. *Strategic grain reserves in Ethiopia: Institutional design and operational performance.* Shahidur Rashid and Solomon Lemma, 2011.

1053. *Foreign aid to agriculture: Review of facts and analysis.* Nurul Islam, 2011.

1052. *Impacts of global change on the Nile Basin: Options for hydropolitical reform in Egypt and Ethiopia*. Anja Kristina Martens, 2011.

1051. *Estimating the role of spatial varietal diversity on crop productivity within an abatement framework: The case of banana in Uganda.* Norman Kwikiriza, Enid Katungi, and Daniela Horna, 2011.

1050. *Strengthening innovation capacity of Nigerian agricultural research organizations*. Catherine Ragasa, Suresh Babu, Aliyu Sabi Abdullahi, and Baba Yusuf Abubakar, 2010.

1049. *Asset dynamics in northern Nigeria.* Andrew Dillon and Esteban J. Quiñones, 2010.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

www.ifpri.org

IFPRI HEADQUARTERS

2033 K Street, NW
Washington, DC 20006-1002 USA
Tel.: +1-202-862-5600
Fax: +1-202-467-4439
Email: ifpri@cgiar.org

IFPRI ADDIS ABABA

P. O. Box 5689
Addis Ababa, Ethiopia
Tel.: + 251 (0) 11-617-2500
Fax: + 251 (0) 11-646-2927
Email: ifpri-addisababa@cgiar.org

IFPRI NEW DELHI

CG Block, NASC Complex, PUSA
New Delhi 110-012 India
Tel.: 91 11 2584-6565
Fax: 91 11 2584-8008 / 2584-6572
Email: ifpri-newdelhi@cgiar.org

IFPRI ACCRA

CSIR Campus
Airport Residential Area, Accra
PMB CT 112 Cantonments,
Accra, Ghana
Tel.: +233 (0) 21 780-716
Fax: +233 (0) 21 784-752