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## Two Essays on International Beef and Poultry Consumer Demand

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I am submitting herewith a thesis written by Bhishma Raj Dahal entitled "Two Essays on International Beef and Poultry Consumer Demand." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural and Resource Economics.

Karen L. DeLong, Major Professor

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(Original signatures are on file with official student records.)

**Two Essays on International Beef and Poultry Consumer Demand**

**A Thesis Presented for the  
Master of Science  
Degree  
The University of Tennessee, Knoxville**

**Bhishma Raj Dahal  
May 2023**

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## ABSTRACT

This study examines meat preferences in China and Rwanda. In China, we analyzed the factors associated with frequent beef purchasing decisions. Using a survey of 560 consumers in Beijing, Shanghai, and Guangzhou, we found that nearly 50% of respondents purchased beef at least 2-3 times a week. Those who purchased specific cuts of beef from wet markets and supermarkets and considered the country of origin and growth hormone-free products important were likely to buy beef more often. The frequency of consumption was also higher for younger respondents with higher wages and those who prioritized price and premium quality. Our findings provide insights for domestic and foreign beef producers on the characteristics of Chinese beef consumers.

In Rwanda, we examined the willingness of restaurants to purchase Rwandan broiler chicken compared to local bird chicken, with the aim of increasing the consumption of meat-based protein in the country and to provide revenue to farmers. We conducted face-to-face interviews with 100 restaurants in Kigali and found that female respondents were more likely to purchase Rwandan broilers. Those who considered the availability and reliability of the supplier important were more likely to purchase broiler chickens, while those who were willing to take risks and considered the healthiness and consistency of the product important were less likely to purchase Rwandan broilers. The relative price of the broiler chicken compared to the local bird was not a significant determinant of whether the restaurant would purchase the broiler. Our study provides insights into the factors influencing restaurant preferences for broiler chickens.

Key words: Broiler, Brisket, Flank, Ordered probit, Rwanda, Survey, and steak

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## **CHAPTER 1: INTRODUCTION**

This thesis focuses on analyzing Chinese and Rwandan consumers' meat purchasing preferences. Specifically, I will examine Chinese consumer preferences for beef and Rwandan restaurant preferences for broiler chicken. Chapter 2 of this thesis will utilize data from a survey in China and Chapter 3 will utilize data from a survey in Rwanda. The Chinese survey, conducted in the three major cities of Beijing, Shanghai, and Guangzhou, focuses on examining the demographics and attitudes of Chinese consumers who more frequently purchase beef products. Results of this study will be informational for domestic and foreign beef producers who supply beef to China. The Rwanda study of Chapter 3 focuses on restaurant willingness to purchase Rwanda broiler chickens compared to indigenous chickens. Results of this study will be informative to the emerging Rwandan broiler chicken industry which has the goal of increasing protein intake in a country whose population still suffers from many diseases which are a result of protein deficiencies.

## **CHAPTER 2: FACTORS AFFECTING CHINESE CONSUMERS' BEEF PURCHASE FREQUENCY**

(Dahal, B.R., DeLong, K.L, Grebitus, C., Muhammad, A and Gao, S. (2022). Factors Affecting Chinese Consumers' Beef Purchase Frequency. *Agribusiness: an international Journal* (**Under review**))

### **Introduction**

China has undergone an economic transformation with an average annual growth rate of approximately 9 percent from 1978 through 2020 (World Bank, 2022). This rapid economic growth has allowed more Chinese to enter the middle class, and beef has become more common in Chinese diets. Moreover, with incidences of African Swine Fever, pork consumers in China likely began consuming beef as an alternate source of animal protein (Euromeat, 2020). Accordingly, China has become an important emerging market for beef. Chinese beef consumption reached 9.9 million metric tons (MTs) in 2021, a 27% increase from 2018 (USDA, 2022b). Annual per capita consumption of beef in China has increased from 0.639 kilograms in 1990 to 4.143 kilograms in 2021 (OECD, 2021). Despite this large increase in consumption, the domestic production of beef has remained constant for the past 4 years at around 6.8 million MTs (USDA, 2022b) with beef consumption outpacing domestic beef production (USDA, 2022b). Therefore, China's beef imports increased from 1.4 million metric tons in 2018 to 3 million metric tons in 2021 (USDA, 2022b). The beef market in China includes imports from Brazil, Argentina, Uruguay, New Zealand, Australia, and the United States. Brazil alone accounts for 38% of total Chinese beef imports, followed by Argentina (18%), Uruguay (15%), New Zealand (9%), Australia (7%), and the United States (7%) (USDA, 2022a).

Provided the increase in China's beef consumption and imports, research using choice experiments have examined Chinese consumers' preferences and willingness to pay (WTP) for beef, particularly focusing on food traceability and country of origin labeling (Lin et al., 2020; Ortega et al., 2016). Although studies have discussed and evaluated consumer preferences and WTP for beef, only Lui et al. (2006) examined the factors affecting how frequently Chinese consumers' purchase beef. Since Chinese beef demand has increased considerably since the mid-2000s, and it is likely that consumer preferences have changed accordingly, there is clear need for more recent estimates on purchasing behavior.

Research suggests consumers' purchasing frequencies are an important consideration in determining consumption habits (Buason & Agnarsson, 2020; Robin, 1993). Using French scanner data on fish purchases, Buason and Agnarsson (2020) estimated a demand system based on purchase frequencies. They found that purchase frequencies could provide enough information to identify various consumer segments in the seafood market. Similarly, Buason et al. (2021), also using French seafood scanner data, found that habits in purchase frequencies are important for habit formation; however, habits in average purchase quantities are less important for habit formation. Thus, examining consumer purchase frequencies are beneficial to understanding purchasing habits and for identifying consumer segments of demand (Buason & Agnarsson, 2020; Buason et al., 2021).

Provided Chinese consumers have been consuming significantly more beef in recent years, and no recent research was identified analyzing Chinese consumer purchase frequencies of beef, this study evaluates the factors associated with how often Chinese consumers purchase beef. Through a consumer survey conducted in three major Chinese cities, the aim of this study

is to evaluate the factors influencing how frequently Chinese consumers purchase beef, especially focusing on beef cuts, beef attributes, consumer attitudes, store type, and other socio-demographic characteristics. This information is important for those who export beef to China, as well as domestic beef producers, as they consider strategies for increasing sales and customer retention rates. For marketing purposes, it is critical to understand socio-demographics and attitudes of consumers who more frequently consume beef to be able to promote beef to these consumers. Given the emerging importance of the Chinese beef market, a better understanding of the factors affecting Chinese consumers' beef purchase frequency is needed.

### **Literature review**

Mao et al. (2016) provided a review of sheep and beef production. They observed that the food consumption patterns in China are currently in a state of change, moving from diets that primarily consist of vegetables to diets that include animal protein. Moreover, Mao et al. (2016) found that consumers are gradually shifting away from at-home food consumption, to away-from-home food consumption. Urban beef consumers, in particular, are notable for exhibiting this trend.

Zhang et al. (2018) conducted a consumer survey in Guangzhou to estimate the factors affecting household meat purchases, including pork, chicken, beef, and mutton. Using the modified version of the AIDS model, Zhang et al. (2018) estimated expenditure and uncompensated and compensated own price elasticities. Their findings revealed that consumers with higher incomes tended to purchase more meat than those with lower incomes.

Zhu et al. (2021) analyzed data collected from household surveys conducted by the National Bureau of Statistics of China to examine the relationship between household income

and domestic beef consumption, with a particular emphasis on urban areas. Zhu et al. (2021) estimated the income elasticities of beef demand across various income levels, and found that the income elasticity of beef consumption at home is higher for high-income households. They also projected that beef consumption could potentially rise by up to 40% within a decade and by 70% within 15 years.

Several studies have evaluated consumer willingness to pay (WTP) for beef products in China using choice experiments, including studies by Ortega et al. (2016) and Lin et al. (2020). Lin et al. (2020) conducted an online survey to evaluate consumer preferences for beef products labeled with country of origin and blockchain traceability. The study found that Chinese consumers were willing to pay more for beef flank with a blockchain traceability label and beef flank from Australia. In another study, Ortega et al. (2016) used a discrete choice experiment to assess consumer WTP for imported beef in Beijing. The results indicated that Chinese consumers highly valued enhanced food safety information in beef products, and were willing to pay more for beef from Australia compared to beef from the US or domestic sources.

Similar to our study, Lui et al. (2006) conducted a consumer survey in 2005 in China to examine their beef consumption frequency, purchasing behavior, and perceptions of beef products. They found that the primary barriers to beef consumption were its relatively high price and consumers' lack of familiarity with its cooking methods. They also found that wet markets and supermarkets were the main primary channels for beef sales. To evaluate the factors influencing Chinese consumers' decisions to purchase beef, they utilized a probit regression model. The dependent variable was the binary choice of whether or not to purchase beef. They found that urban consumers and those with higher incomes were more likely to purchase beef.

Lui et al. (2006) also evaluated Chinese consumers' beef consumption frequency using an ordered probit model. They found that the family size and age were negatively associated with beef consumption frequency, whereas income and education were positively associated. Given the significant increase in Chinese beef consumption over the past two decades, we updated and expanded upon the study conducted by Lui et al. (2006) by including several additional independent variables in our analysis different from Lui et al. (2006) and directly asking consumers about their beef purchasing frequency.

## **Methodology**

### ***Data and survey***

To evaluate the factors affecting Chinese consumer beef purchase frequency, we surveyed 560 consumers in three major Chinese cities (Shanghai, Beijing, and Guangzhou) during the summer of 2021. These cities were chosen due to their economic significance in China (Song, 2022). The survey questionnaire was developed using Qualtrics software, and the data were collected through this platform. To be eligible for participation in the survey, respondents were required to be beef consumers, residents of Shanghai, Beijing, or Guangzhou, and 18 years of age or older. To elicit beef purchase frequency, the survey asked, “how often do you purchase beef or beef products?” respondents could respond with the following: “2-3 times a week, weekly, every other week, monthly, and less than once a month. the survey asked participants about their socio-demographic background, which types of beef cuts they typically consume, where they usually purchase beef, their attitudes towards beef, the importance they place on different attributes of beef, and their location.



### ***Conceptual Framework and Hypothesized Results***

According to neoclassical consumer theory, people select their food products based on the utility they derive from them. This utility is influenced by factors such as product characteristics, geographical location, and socioeconomic factors. Therefore, we hypothesized that a consumer's beef purchase frequency is affected by these factors. For consumer  $i$ , with beef purchase frequency  $j$ , we hypothesize that beef purchase frequency (*Beef\_Frequency*) is a function of the following factors:

$$(1) \text{ Beef\_Frequency}_{ij} \\ = f(\text{BeefCut}_i, \text{StoreType}_i, \text{BeefAttribute}_i, \text{Demographics}_i, \text{Attitudes}_i, \text{City}_i)$$

Where *BeefCut* are variable indicating the type of beef consumers purchase (Table 1, all figures and tables are included in an appendix at the end of the document), *StoreType* are variables indicating the point of sale where consumer purchase beef, and *BeefAttributes* are characteristics consumer consider important when purchasing beef. *Demographics* and *Attitudes* are variables associated with consumer demographics and the general attitudes of the respondents (Table 2.). *City* is an indicator variable indicating whether the respondent was from Beijing, Shanghai, or Guangzhou.

Beef cuts: Scozzafava et al. (2016) conducted an online choice experiment to evaluate consumer preferences for beef cuts. They found that beef cuts are the most important criterion when purchasing beef. It follows that consumer beef purchase frequency might be affected by the type of beef cuts they consume. Therefore, we constructed binary variables indicating whether the consumer purchased steak, shank, flank, rib, tenderloin, or brisket (Table 1).

Store type: We hypothesized that respondents who purchase beef from wet markets and supermarkets were more likely to buy beef more frequently since Lui et al. (2006) found these were the main outlets where beef was sold. We also included online purchases as an option since Chinese beef is sold routinely online. In the survey, we asked participants where they purchase beef with the options of wet market, supermarket and online on a Likert scale with never purchasing at this location=1 to always purchasing at this location=5 (Table 1).

Beef attributes: We expect that beef attributes, such as, price, growth hormone-free production, premium quality, traceability, and country of origin, might affect consumers' beef purchase frequency. Therefore, the survey asked respondents to "*indicate how important each of the following attributes is to you when you purchase beef*" with 1=not important to 5=very important. Table 1 lists the attributes consumers were asked to rate. Also included in this category was whether consumers believe food safety in general affects their beef consumption patterns with 1=no effect to 5=major affect (see Table 1) and whether Covid-19 affected their beef purchasing decisions with 1=not at all to 7=very much so (Table 1).

While evaluating consumer preferences for beef in Spain, Mesías et al. (2005) found that price is an important factor that consumers consider when purchasing beef. Further, previous literature has found that Chinese beef consumption is higher among those with higher incomes (e.g., Lui et al., 2006; Zhu et al., 2021; Zhang et al., 2018), hence, we hypothesized that as consumers consider price a more important attribute when purchasing beef, they will purchase beef less frequently.

Previous research has found that consumers value growth-hormone free production (Lusk et al., 2003; Lusk & Fox, 2002). Therefore, we expect that respondents who consider hormones

an important factor for beef purchases might be less likely to purchase beef since they worry beef is produced with growth-hormones. While evaluating meat (beef and pork) quality and consumer behavior in Europe, Grebitus et al. (2011) and Mannion et al. (2000) found that food consumption depends on the perceived product quality. Moreover, to examine consumer habits concerning beef consumption Ellies-Oury et al. (2019) conducted a consumer survey in France and found that consumers desire high-quality beef. Therefore, we hypothesized that when consumers consider premium quality to be more important when purchasing beef they will purchase beef more or less frequently depending on their perception of beef quality (e.g., if consumers consider beef to be of lower (higher) quality, then this factor would have a negative (positive) effect on beef purchase frequency).

China has traceability requirements (Feng et al., 2013; Lin et al., 2020) and Chinese consumers' prefer food traceability systems (Jin et al., 2017) and traceability labeling (Ortega et al., 2016). Thus, if Chinese consumers consider beef to have strong traceability standards, then we expect this factor to be positively correlated with beef purchase frequency. Conversely, if consumers believe traceability is lacking for beef, then as consumers value traceability more, they may be less likely to purchase beef frequently.

Many studies have shown that country of origin labeling is a significant attribute when purchasing beef, with most studies showing consumers prefer beef from their domestic country. However, Ortega et al. (2016) conducted a discrete choice experiment in Beijing and found that consumers from Beijing were willing to pay more for Australian beef than US and domestic beef. Therefore, the importance of country-of-origin information can affect beef consumption frequency in both directions. Food safety concerns are increasing among beef consumers due to

frequent and lethal food safety incidents in China (Ortega et al., 2016). Therefore, food safety concerns may also affect beef purchase frequency in both directions.

Rossolov et al. (2022) conducted a study to evaluate changes in shopping frequency during COVID-19 and found that the outbreak of the COVID-19 pandemic affected food purchase frequency. Thus, we expect consumers who state that COVID-19 affects their beef purchase decisions to purchase beef less frequently.

Demographics and attitudes: The role of generalized trust has increasingly been used in many consumer studies (e.g., Ding et al., 2012; Dumortier et al., 2017; Grebitus et al., 2015). Risk preference have also been used to explain consumer consumption behavior (Angulo & Gil, 2007; Mitchell, 1998). Since beef is a relatively new product in China, we expect those who have higher measures of trust and those who are more risk taking to consume beef more frequently. We hypothesized that general trust and risk-taking attitudes of consumers will affect beef purchase frequency (Table 2).

We expect the demographic characteristics age, education, income, gender, and wages to affect beef purchase frequency (Table 2). Sánchez et al. (2012) conducted a panel tasting in the US and Spain to explore sensory and market evaluations of beef according to socioeconomic factors. They found age, education, income, and gender affect beef consumption. While evaluating the impact of sociodemographic factors on beef consumption, Guenther et al. (2005) found a strong impact of income; Yen et al. (2008) demonstrated the influence of age, and Tepper et al. (1997) found an effect regarding age, and education on beef consumption. Similarly, families in China with more male members aged between 16 to 45, those with a better education, those who are younger, and those with higher incomes were willing to purchase beef

more frequently (Lui et al., 2006). Thus, we hypothesize that males, those who are younger, those with more education, and those who have higher wages purchase beef more frequently. City: We hypothesized that consumers from various Chinese cities (Beijing, Shanghai, and Guangzhou) differ regarding beef purchase frequency. Therefore, we constructed binary variables indicating whether the consumer was from Beijing, Shanghai, or Guangzhou (Table 2).

### ***Econometric Model***

Due to fewer observations in some categories of purchase frequency, namely less than once a month (7 observations), monthly (19 observations), and every other week (47 observations), these categories were merged into a single category labeled "less than weekly." As a result, there were a total of 73 observations out of 560 in the newly created category of "less than weekly." An ordered probit model was utilized to estimate the factors associated with how often Chinese consumers purchase beef. The ordered probit model is an appropriate statistical analysis whenever survey responses are ordinal (Daykin & Moffatt, 2002). The model is an extension of the binary probit model and can be used when the dependent variable is a ranked discrete dependent variable, such as food purchase frequencies.

The ordered probit model is an advancement over a linear regression model. The linear regression assumes that the difference between ordinal outcomes, less than weekly (coded as 1), weekly (coded as 2), and 2-3 times a week (coded as 3) is the same. The linear regression would treat the difference between 1 and 2 the same as 0 and 1. However, the assumption behind the difference between the ordinal outcome is not the same because the categories only reflect ordinality (Daykin & Moffatt, 2002; Fielding, 1999; Greene, 2000). Additionally, the interpretation of the linear regression coefficients (number of units by which the dependent

variable change due to one unit change in the independent variable) is inappropriate if the dependent variable is ordinal (Daykin & Moffatt, 2002). Therefore, we utilized the ordered probit model to evaluate beef purchase frequency in China. The ordered probit model assumes that the utility of each factor falls within a specific interval, and the estimation assumes that all the respondents perceive nearly the same utility difference between the categories. This is a probability model therefore the probability outcome is calculated on a linear function of the explanatory variables and a set of threshold parameters (Kumar, et. al. 2008). The ordered probit model is explained by:

$$(2) y^* = \beta'x + \varepsilon$$

where  $y^*$  is unobserved,  $x$  is measurable factor, and  $\varepsilon$  is certain unobservable factors. We observed that

$$(3) Y = \begin{cases} 0 & \text{if } y^* \leq \mu_{-0} \\ 1 & \text{if } \mu_{-0} < y^* \leq \mu_{-1} \dots \dots \dots \\ i & \text{if } y^* \geq \mu_{-j} \end{cases}$$

The  $\mu$ 's are unknown parameters to be estimated with coefficient  $\beta'$ . In this study, the frequency of beef purchase has three possible choices represented categorically as: less than weekly, weekly, and 2-3 times a week. We assume that  $\varepsilon$  is normally distributed and we have the following probabilities.

$$Pr(y = 0) = \Phi(-\beta'x) \text{ is the probability of the first frequency category}$$

$$(4) \quad Pr(y = 1) = \Phi(\mu_{-1} - \beta'x) - \Phi(-\beta'x) \text{ is the probability of the second frequency category}$$

$$\dots \dots \dots Pr(y = i) = 1 - \Phi(\mu_{i-1} - \beta'x) \text{ is the probability of the last frequency category}$$

For all the probabilities,

$$0 < \mu_1 < \mu_2 \dots \dots \dots < \mu_{i-1}$$

The probability of cell  $i$  is  $Prob(y^*) = \Phi(\mu_i - \beta'x) - \Phi(\mu_{i-1} - \beta'x)$ , where  $\Phi(\cdot)$  is the standard normal cumulative distribution function. Therefore, based on the sample  $(y_j, x_j)$  where  $j= 1, 2, \dots, j$ . Then, the log-likelihood function is.

$$\begin{aligned} (5) \log L &= \sum_i \sum_j \ln [pr(y)^*] \\ &= \sum_i \sum_j \ln [\Phi(\mu_i - \beta'x) - \Phi(\mu_{i-1} - \beta'x)] \\ &= \Phi(\mu_{i-1} - \beta'x \end{aligned}$$

With the iterative process the log likelihood is maximized along with the cut points  $\mu_1, \mu_2 \dots \dots \mu_{i-1}$  to obtain maximum likelihood estimation (MLEs) of both the parameters.

Variable names and definitions to be used in the model are shown in Table 1.

***Likelihood ratio test and diagnostics***

Provided we have observations from three cities, we could estimate three separate models for each city or pool the data into one regression. To decide whether three separate regressions (for Beijing, Shanghai, and Guangzhou), or one pooled regression, should be estimated, a LR (likelihood ratio) test was performed. In this context, our null hypothesis is that Beijing, Shanghai, and Guangzhou consumers' beef purchase frequencies were not different. Failure to reject the null hypothesis indicates that the data from all three models can be pooled into one model because purchase frequency across three cities are not different. Rejection of our null

hypothesis indicates that purchase frequencies across the three cities is different, and the data should not be pooled.

For the LR test, we estimated a separate regression for each of the three cities, and a pooled regression that combined the data from all three cities. The LR test statistics= $-2*[\text{LR}(\text{pooled model})-\text{LR}(\text{restricted model})]$ , where the LR restricted model= $\text{LR}(\text{Beijing})+\text{LR}(\text{Shanghai})+\text{LR}(\text{Guangzhou})$ . The  $\chi^2$  test statistic has  $K_b+K_s+K_g-K_p$  degrees of freedom where  $K_b$ ,  $K_s$ ,  $K_g$ , and  $K_p$  are the parameters for the Beijing, Shanghai, and Guangzhou models, and the pooled model.

In addition to the LR test, we also conducted tests to examine the presence of multicollinearity. It is suggested that if the condition indices of the variables in a regression analysis are lower than 30, then there is no issue of collinearity present (Belsley, 1991).

## **Results and discussion**

### ***Descriptive Statistics***

A total of 560 responses were obtained, and 528 completed all the questions. Of these 528 responses, 193 were from Beijing, 217 from Shanghai, and 118 from Guangzhou (Table 3). Among the 560 responses, most consumers (49.64%) purchase beef 2-3 times a week, 37.32% of consumers purchase beef weekly, and very few (13.04%) purchase beef less than weekly (Figure 1). Among the three cities, most of the Beijing consumers (54.98%) purchased beef 2-3 times a week and 46.52% and 46.22% of the respondents from Shanghai and Guangzhou purchased beef 2-3 times a week. However, there is not much difference in beef purchase frequency across the three cities (Figure 1).



Table 3 shows the descriptive statistics of consumer demographics and attitudes. Approximately 46% of the respondents were male. Among the cities, approximately 44%, 50%, and 44% were male for Beijing, Shanghai, and Guangzhou, respectively. Similarly, the percent of the respondents who have completed a bachelor's or higher were 83%, 76%, and 74% for Beijing, Shanghai, and Guangzhou, respectively. The approximate age of the respondents was 37 years. The average approximate household income before tax (ranked from 1 to 13) was 10.05, where 10 represents the household income between ¥ 19,000 - ¥ 20,999 and 11 represents the household income between ¥ 21,000 - ¥ 22,999. There was no difference in the approximate household income before tax except for Beijing and Guangzhou. The approximate household income was 10.073, 10.290, and 9.593 for Beijing, Shanghai, and Guangzhou, respectively, on a scale from 1 to 13 and scale 9 represents the household income between ¥ 17,000 - ¥ 18,999. Respondents' willingness to take a risk (ranked from 1 to 10) was 6.40, 6.58, and 6.22 for Beijing, Shanghai, and Guangzhou, respectively. The percentage of respondents who said most people can be trusted were approximately 31%, 45%, and 37% for Beijing, Shanghai, and Guangzhou, respectively.

Table 4 shows the descriptive statistics of type of beef products consumed. 93.2% of the respondents from China purchase steak, and there was no significant difference between the three cities (see Table 4). Among the respondents who answered all questions, 83.9% of the respondents purchased slice beef. There was no significant difference in purchasing sliced beef among the three cities except for Beijing and Shanghai ( $P < 0.05$ ). Similarly, 83.7% of the respondents purchased a flank and there was a significant difference between Beijing and Shanghai for the purchase of flank ( $P < 0.05$ ). The percent of respondents who purchased flank

was 78.2%, 88.0%, and 84.7% for Beijing, Shanghai, and Guangzhou, respectively (see Table 4). There was no significant difference in purchase shank among the three cities except for Shanghai and Guangzhou ( $P<0.05$ ). The percentage of respondents who purchase shanks was 62.2%, 69.6%, and 57.6% for Beijing, Shanghai, and Guangzhou, respectively. The results showed no significant difference among the three cities for respondents who purchased rib, brisket, and tenderloin. The percentage of respondents who purchased ribs was 61.1%, 61.3%, and 52.5% for Beijing, Shanghai, and Guangzhou, respectively (Table 4). The percentage of respondents who purchased brisket was 59.1%, 58.1%, and 56.8% for Beijing, Shanghai, and Guangzhou, respectively. Similarly, the percentage of respondents who purchased tenderloin was 69.9%, 73.3%, and 70.3% for Beijing, Shanghai, and Guangzhou, respectively.

Table 5 presents the different locations at which respondents purchase beef. The results show that consumers from all three cities mainly purchased beef from a supermarket compared to the wet market and online market. Beijing consumers purchased significantly more beef from supermarkets than consumers from Shanghai and Guangzhou ( $P<0.05$ ). Similarly, Beijing consumers bought significantly more beef online than consumers from Guangzhou.

Table 6 shows Beijing, Shanghai, and Guangzhou consumers' average responses regarding beef attribute preferences. All participants considered food safety to affect their beef purchase patterns significantly more than price, country of origin, growth hormone-free, quality, and traceability ( $P<0.05$ ). Beijing and Guangzhou consumers considered food safety to have a significantly higher influence on beef purchases compared to Shanghai consumers ( $P<0.05$ ). Beijing consumers considered country of origin labeling to have a significantly higher impact on their beef purchase patterns than Guangzhou consumers ( $P<0.05$ ). Similarly, Beijing consumers

considered premium quality and COVID-19 to have a significantly higher impact on their beef purchase patterns than Shanghai and Guangzhou consumers ( $P < 0.05$ ).

### ***Empirical Results***

The results of the multicollinearity diagnostics showed that the value of the Condition Indices for all the variables included in the model is not greater than 30. Therefore, our model is free from serious multicollinearity. The LR test results indicated that beef purchase frequencies across the three cities is not different; hence, our data should be pooled. To conduct the LR test, the individual regression for each city were conducted and appear in Table A of Appendix A. Since the LR null hypothesis failed to be rejected (since the calculated  $\chi^2$  statistic of 106.99 is smaller than the  $\chi^2$  statistics=222.07), we will discuss the results from the pooled model (Table 7). Table 7 presents the ordered probit model results, as well as the marginal effects for each purchase frequency level. The measure of the effect of the variables on Chinese beef purchase frequency is given by the marginal effects. In the case of continuous variables, the marginal effect is the change in the predicted probability of different frequencies of beef purchase that results from a unit change in the independent variables when other factors are kept constant. However, in the case of dummy variables, the marginal effects are calculated based on differences between the two predicted probabilities, without and with variables (Greene, 2000). The estimated marginal effects of all the purchase frequency levels sum to zero. The estimated ordered probit regression had a pseudo  $R^2$  of 0.2131, and the Wald chi-square statistic with degrees of freedom was significant ( $P < 0.001$ ).

Beef cuts: Results in Table 7 indicate that respondents who purchase steak, flank, shank, and brisket were more likely to purchase beef more frequently. Steak, shank, and brisket were

significant at 5% level of significance, and flank was significant at 1% level of significance. The marginal effects of those variables become positive with increasing frequency of beef purchases. Therefore, respondents who bought steak, flank, shank, and brisket had a higher probability of purchasing beef 2-3 times a week. For example, if a person purchased steak, they were 16.5% more likely to purchase beef 2-3 times a week. Ultimately, beef purchase frequencies differ significantly depending on the types of beef products consumed. This is consistent with previous research that found beef cuts are a key driver of purchasing behavior (Ardeshiri et al., 2019; Scozzafava et al., 2016).

**Store type:** Respondents who purchased beef from the wet market and supermarket were more likely to buy beef more frequently ( $P<0.01$ ) (Table 7). The estimated marginal effects of wet markets and supermarkets become positive with the increasing frequency of beef purchases. Respondents who purchase beef from wet markets and supermarkets had a higher probability of purchasing beef 2-3 times a week. For example, consumers who purchase beef at supermarkets were nearly 7% more likely to purchase beef 2-3 times per week. These results are consistent given that wet markets are the traditional market where most Chinese purchase food (Zhang & Pan, 2013), and research has found wet markets and supermarkets are where consumers buy most beef (Lui et al., 2006). Interestingly, we found no evidence of the online market affecting purchase frequency.

**Beef attributes:** Respondents who considered price and premium quality as important factors for purchasing beef were less likely to buy beef frequently ( $P<0.01$ ) and had a lower probability of purchasing beef 2-3 times a week ( $P<0.01$ ) (Table 7). It was expected price would have a negative relationship with beef purchase frequency provided Chinese individuals with lower

incomes have been found to consume beef less frequently (e.g., Lui et al., 2006; Zhu et al., 2021; Zhang et al., 2018). Given that premium quality had a negative relationship with beef purchase frequency, we suspect that Chinese consumers do not consider beef a high-quality product since Grebitus et al. (2011) and Mannion et al. (2000) found that consumption frequencies depend on the perceived quality of the product.

Respondents who considered country of origin ( $P < 0.01$ ) and growth hormone-free production ( $P < 0.05$ ) important factors when purchasing beef were more likely to buy beef more frequently. The estimated marginal effects of country of origin and growth hormone-free became positive with increasing frequency of beef purchase with respondents who considered country of origin and growth hormone-free production important having a higher probability of buying beef 2-3 times a week. Provided consumers who value country of origin and growth hormone-free production purchase beef more frequently, it is valuable for beef producers to consider consumer preferences related to these attributes to attract consumers. This is consistent with previous research that has found consumers are willing to pay premiums for these types of attributes (Lusk et al., 2003; Lusk & Fox, 2002; Ortega et al., 2016; Lin et al., 2020).

Demographics and attitudes: The results indicate that trust and age were negatively related to beef purchase frequency ( $P < 0.01$ ) (Table 7). The estimated marginal effects become negative with increasing frequency of beef purchases. Thus, respondents who believe most people can be trusted and older respondents had a lower probability of purchasing beef 2-3 times a week. A similar negative relation between meat consumption and age was observed among Chinese consumers by Lui et al. (2006). The result that more trusting individuals were less likely to

purchase beef is opposite to our expectations but could be explained by more trusting individuals simply being a personality of those who consume beef less frequently.

Being male ( $P<.10$ ) and income ( $P<0.01$ ) were positively related to beef purchase frequency. Men and respondents with higher income had a higher probability of purchasing beef 2-3 times a week. For example, as a person had an increase in income, they were 3.1% more likely to purchase beef 2-3 times per week ( $P<0.01$ ). This is consistent with expectations provided previous research also found that men (Lui et al., 2006) and those with higher income (Lui et al., 2006; Zhu et al., 2021; Zhang et al., 2018) were more likely to purchase beef more frequently.

City: In contrast to our expectations, the location of the respondent did not have a significant effect on purchase frequency (Table 7).

## **CHAPTER 3: WILLINGNESS TO PURCHASE RWANDAN BROILER CHICKEN RELATIVE TO INDIGENOUS BREEDS: EVIDENCE FROM KIGALI RESTAURANTS**

### **Introduction**

Rwanda is a small landlocked low-income country with hilly terrain in east-central Africa. It is the second most densely populated country in Africa. The African nation has experienced remarkable economic growth with significant improvement in living standards and poverty reduction. However, poverty and food insecurity among rural households continue to be a concern (Gill et al., 2020; Weatherspoon et al., 2019). The nation ranks 165 out of 191 countries on the Human Development Index (UNDP, 2023). Almost sixteen percent of the urban population and 43.1% of the rural population are living in extreme poverty (World Bank, 2020). According to the Global Hunger Index (GHI), Rwanda ranks 102 out of 121 countries with a serious hunger index (GHI, 2022). Agriculture is the backbone of the nation's economy, agriculture alone accounts for 30% of the Gross Domestic Product (GDP) (MINAGRI, 2023). Almost two third (69%) of the total household in Rwanda is dependent on agriculture. The agricultural system in Rwanda is subsistence with small-scale farming on limited land and the majority of farming concentrated in rural areas (NISR, 2021). The government of Rwanda (GoR) and donor agencies are trying to address poverty and food insecurity among rural households via agricultural development (Alinda & Abbott, 2012; Diao et al., 2010). Farm production in Rwanda is facing significant challenges due to small farm sizes that are not enough to sustain households, as well as soil fertility that is declining, which is affecting crop production (Alinda & Abbott, 2012). Given the limited land, high population, and scarce resources, it is imperative to determine the most efficient farm commodity for production (Gill et al., 2021). Broiler

chickens require less land for production and have a high feed conversion ratio compared to other livestock except for fish (Shapiro et al., 2017). Broilers are heavier (Dyubele et al., 2010), have faster growth (Wattanachant et al., 2004), and are generally cheaper (Dalle Zotte et al., 2020) than indigenous/local chickens. From a nutritional point of view, both are comparable to some extent (Dalle Zotte et al., 2020). Rural family poultry production can contribute to poverty alleviation and food security in Africa (Gueye, 2000; Sonaiya, 2007). An increase in Rwandan broiler production particularly among rural households could increase food security by generating income and increasing access to a nutritious diet in Rwanda (Gill et al., 2020).

To address the issue associated with rural poverty and food insecurity, it is crucial to figure out the stable source of income particularly among rural households. One potential solution is to encourage small-scale farmers in rural areas to produce broiler chickens, which they can sell to generate income while also providing a source of animal-based protein and other essential nutrients (Gill et al., 2020). However, to ensure the long-term viability of such small farms, it is important to have a clear understanding of the demand for broiler chickens in Rwanda. In this context, it is imperative to evaluate the preferences of Rwandan restaurants for Rwandan broiler chickens versus local birds. This study aims to survey Rwandan restaurants to determine their willingness to purchase Rwandan broiler chicken and identify the factors that influence their choice between the two. Therefore, we conducted face-to-face and interviews with Rwandan restaurants to determine (1) whether they would purchase Rwandan broiler chicken instead of local birds and (2) determine which characteristics of the restaurants are associated with their choice of Rwandan broiler chickens over local birds.



## **Background Information**

The GoR's national livestock master plan (LMP) formulated a strategy for increasing the production, consumption, and export of poultry to the Democratic Republic of Congo (Shapiro et al., 2017). The production and the import of chicken meat have increased in recent years but per capita, availability was very low (1.5kg) in 2020 (Muhammad et al., 2022). Additionally, overall meat availability was 8 kg per person in 2020 which is considerably lower than the recommended minimum of 50 kg per person (FAO, 2019). Investing in family chicken and broiler production have the highest potential for reducing the meat availability gap (Shapiro et al., 2017). Therefore, various efforts have been made to develop the Rwanda broiler sector, particularly in the production and supply sector (Muhammad et al., 2022). Moreover, research and development efforts throughout Sub-Saharan Africa mainly focused on broiler production efficiency (Cisse et al., 2017), profitability (Ike & Ugwumba, 2011), and characteristics of the broiler production system (Mahoro et al., 2017; Mbuza et al., 2016, 2017a), and smallholder broiler sales (Muhammad et al., 2022). But less focus on understanding the factors affecting buyer behavior that affects farm-level profitability (Muhammad et al., 2022).

## **Literature Review**

Birhanu et al. (2022) conducted a baseline survey, cluster-randomized study, and market survey to evaluate the feasibility of Tropically Adapted Improved Breeds (TAIBs) of chicken in sub-Saharan Africa. Birhanu et al. (2022) reported that the majority of the smallholder farmers preferred TAIBs to indigenous chicken. They also found that TAIBs' chicken-based production system improved the status of producers' consumption and income generation.

The purchase of a Rwanda broiler can be considered similar to the adoption of recent/innovative technology. Bizimana et al. (2002) conducted a survey to study factors influencing the adoption of recommended technology by Rwandan coffee farmers. They found that the education, gender, and wealth of the primary operator of the farm were the important factors influencing the adoption of recommended farm practices. Moreover, Ingabire et al. (2018) studied factors affecting the adoption of Artificial Insemination (AI) technology by small dairy farmers in Rwanda and they found that age, gender, education status, income, and extension services positively contributed adoption of AI technology.

Gathering the data from various stakeholders Vernooij et al. (2018) conducted a study on regionalization in poultry development in Eastern Africa. Vernooij et al. (2018) found that there is steady growth of chicken consumption across East African countries mainly due to the rapid urbanization, growing of middle class, increase in disposable income, advancements in farming techniques, and rise of quick service restaurants.

Dyubele et al. (2010) conducted a study in South Africa to evaluate the consumer sensory characteristics of broiler and indigenous chicken meat. They found that consumers gave a higher score for most attributes of meat from broilers. The consumers also gave higher sensory scores except flavor and off flavor from meat from broilers as opposed to indigenous chickens.

There are several studies on willingness to pay for local food (Adalja et al., 2015; Brown, 2003; Gracia et al., 2012; McKay et al., 2019), but very limited studies were focused on estimating willingness to pay against the local product. Similar to our study, McKay et al. (2019) conducted a telephone survey in Tennessee, USA to evaluate the restaurant willingness to pay (WTP) for the beef. In contrast to our study McKay et al. (2019) focused on WTP for

local/indigenous breeds. They found that the restaurant's willingness to pay for the local beef is positively associated with the location of the restaurant in cities and sustainability. Moreover, profitability on a choice to offer local products, the seating capacity of the restaurant, and price were negatively associated with the restaurant's willingness to purchase local food (McKay et al., 2019).

## **Methodology**

A study was conducted in Kigali, the largest and capital city of Rwanda. We selected the city because it is an important cultural, economic, and transportation hub of Rwanda. A questionnaire was formulated using the HarvestYourData platform. After finalizing the questionnaire, we collected the data using face-to-face interview method from 100 restaurants in Kigali. Simple random sampling was used to select the 100 restaurants in Kigali. It took approximately 20 minutes to complete the survey, and the data collection was done in the Qualtrics panel. To qualify for the survey the respondent must be 18 years or older. Before starting the survey, we enlightened the respondents regarding the risk and benefits of participating in this study. We offered four price levels 2000, 2750, 3500, and RWF 4250 per kg for Rwanda broiler chicken to respondents. Each price level was offered to 25 respondents, and we recorded the choice of the restaurant to broiler chicken versus local chicken.

## ***Conceptual Framework***

A consumer will purchase one product over another when utility gained from that product is greater than other product. In this scenario, random utility framework is often used to model the decision regarding willingness to purchase (McFadden, 1994). However, McKay et al.

(2019) extended the random utility model to the restaurant's purchasing decision, considering that restaurant maximizes profit instead of utility. Let a restaurant  $r$  choose Rwanda broiler (RB) over indigenous/local bird (LB) if the expected profit from purchasing RB ( $E(\Pi_{rRB})$ ) is greater than its expected profit from indigenous/local bird ( $E(\Pi_{rLB})$ ).

$$\text{i.e., } E(\Pi_{rRB}) > E(\Pi_{rLB})$$

Estimating the probability (Pr) that a restaurant will choose Rwanda broiler (RB) relates with the probability that the expected profit from serving Rwanda broiler will exceed the expected profit from serving a indigenous/local bird. Thus,

$$Pr[Y_{rRB} = 1] = Pr [E(\Pi_{rRB}) > E(\Pi_{rLB})] = Pr(x'_r\beta + \varepsilon_r) = F(x'_r\beta)$$

Where  $x'_r\beta$  are the observable elements of the difference between expected profits and  $\varepsilon$  is the difference between random term. F is the cumulative distribution function. In our study,  $x$  is a vector of explanatory variables consisting of restaurant characteristics, price of Rwanda broiler, and attitudes and preference of the respondents. The latent model depicting the choice of Rwanda broiler is

$$Y_{rRB}^* = x'_r\beta + \varepsilon_r$$

$$\text{Where, } Y_{rRB}^* = \begin{cases} 1 & \text{if } Y_{rRB}^* > 0, \\ 0 & \text{otherwise} \end{cases}$$

Because the decision to serve Rwanda broiler is observed not the actual expected profit.

### ***Econometric framework***

The respondent's choice of Rwanda broiler (yes or no) is a binary dependent variable that takes the value of zero or one (whether a respondent would choose or not). Dependent variables with a binary variable can be analyzed by using OLS regression, and the probit/logit model. In

the context of a binary response variable, the OLS model considers a linear probability model, and this model can also be used to explain conditional probabilities. However, the residuals from the linear probability do not satisfy the homoskedasticity and normality of error assumptions (Long, 1997). Therefore, we selected Probit model for estimating restaurant willingness to purchase Rwanda broiler.

$$(3) p\left(y = \frac{1}{x}\right) = G(x\beta) = \Phi(x\beta) = \int_{-\infty}^{\infty} \varphi(x) dx$$

Where,  $G(x\beta)$  is a standard normal cumulative distribution. We use maximum likelihood estimators (MLE) to estimate coefficients for probit model. To obtain MLE, we need the density of  $y_i(y=0,1)$  given  $x_i$

$$(4) f(y_i / x_i\beta) = [G(x_i\beta)]^y [1 - G(x_i\beta)]^{1-y}$$

We take the log to find the log-likelihood

$$(5) l_i(\beta) = y_i \log[G(x_i\beta)] + (1 - y_i) \log[1 - G(x_i\beta)]$$

$$(6) L(\beta) = \sum_{i=1}^n l_i(\beta)$$

Then we find the  $\beta$  that maximizes the log-likelihood.

*Willingness to pay (WTP)*

Results from the probit regression model were used to estimate restaurant average WTP for Rwanda broiler with the formula:

$$(8) \widehat{WTP}_{RB} = \frac{-\hat{\beta}_o + Z' \hat{\beta}_{-p}}{\hat{\beta}_p}$$

Where  $\hat{\beta}_o$  is the estimated intercept of the probit regression model,  $Z$  is the vector of explanatory variables except price,  $\hat{\beta}_{-p}$  is the vector of estimated parameters except the price

coefficient, and  $\hat{\beta}_p$  is the estimated parameter for the price of the Rwanda broiler (RB). A similar method for estimating WTP was used by Dobbs et al. (2016) and McKay et al. (2019).

#### *Diagnostics test*

We also conducted condition index tests to examine the presence of multicollinearity. It is suggested that if the condition indices of the variables in a regression analysis are lower than 30, then there is no issue of collinearity present (Belsley, 1991).

#### *Hypotheses for explanatory variables*

Consistent with demand theory, we hypothesized that as the price of Rwanda broiler decreases, restaurants will be more likely to purchase the broiler chicken (Table 9). McKay et al. (2019) conducted a telephone survey in Tennessee, USA to evaluate the restaurant's willingness to pay (WTP) for local beef. McKay et al. (2019) hypothesized that price affects the restaurant WTP for local beef and they found that price was negatively associated with the restaurant's willingness to purchase local beef. We hypothesized that the restaurant characteristics like seating capacity and the number of years the respondents have in the restaurant business affect restaurant willingness to purchase (Table 9.). While evaluating the restaurant's willingness to purchase local beef in Tennessee, USA, McKay et al. (2019) found that the restaurant's willingness to purchase is negatively associated with the seating capacity of the restaurant. Moreover, McKay et al. (2019) hypothesized that the restaurant characteristics like seating capacity and the number of years of business affect restaurant willingness to purchase. Consistent with the WTP study of McKay et al. (2019), we hypothesized that the quality of Rwanda broilers, sustainability, and profitability in offering broilers at restaurants affect purchase decisions (Table 9.). McKay et al. (2019) found that profitability in offering and

sustainability significantly affected the restaurants' WTP to sirloin steak. Availability of Rwanda broiler, reliability of the suppliers, consistency of the product, and healthy chicken might influence the restaurant's owner to offer Rwanda broiler at their restaurant. Therefore, we hypothesized that those variables affect purchase decisions (Table 9.)

Similar to the WTP study of Dobbs et al. (2016) and McKay et al. (2019), we hypothesized that the socio-demographics of the restaurant owner/decision maker affect the willingness to purchase Rwanda broilers (Table 9). McKay et al. (2019) hypothesized that the age of the manager or the owner is most likely to affect the purchase decisions. While estimating the consumer willingness to pay for Tennessee beef Dobbs et al. (2016) hypothesized that age and gender affect purchase decisions. Restaurants from Rwanda might have different preferences for different forms of Rwanda broiler. Therefore, we hypothesized that variables like chicken and cut chickens might affect willingness to purchase (Table 9.).

## **Results and Discussion**

A total of 100 respondents participated in the survey, but 83 of them answered all the questions. Figure 2 shows the choice of broiler at different price points among the 100 restaurants in Rwanda. At the lower price (RWF 2000/kg), 68 percent of the respondents preferred Rwanda broiler. The preference for Rwanda broiler decreased with an increase in price up to RWF 2750/kg, beyond that price level, the choice of Rwanda broiler increased. At the higher price, RWF 4250/kg, eighty percent of the restaurant owner chose Rwanda broiler chicken (Figure 2). This unusual behavior of restaurant owner in purchasing Rwanda broiler chicken might be due to the trust issues. Most respondents choosing to purchase the Rwandan broiler chicken at higher price can be partly attributed to the fact that the current price of the

local bird is close to the higher offered price (RWF 4250 per kg). The respondent might have perceived the cheap broiler chicken (very less than current price of local bird) as inferior quality and expensive as superior quality. We conducted a t-test to compare the selection of Rwanda broiler chicken among four different price levels, and the results showed that there was no significant difference in the responses across the four price levels.

Table 10 presents the descriptive statistics of the variables used in a probit regression model. Among the respondents who answered all the questions, approximately 73 percent chose Rwanda broiler over local chicken. The average age of the respondent was approximately 36 years. Almost forty percent of the respondent were female. With a mean score of 7.88, the respondents had a high risk-taking ability. The seating capacity of the sampled restaurants was approximately 125 people. In addition, the average years during which the restaurants were in business was 6 years. The average proposed price of the Rwanda broiler was 3147 RWF/kg. With a mean score higher than 4, the respondents considered availability, healthy, high quality, sustainability, and reliability were very important factors to offer Rwanda broiler chicken at a restaurant (Table 10). The mean score value for consistency was 3.9, which depicted that consistency was an important factor that influence to offer of Rwanda broilers at a restaurant. Approximately ninety-three percent of the respondent believed that offering a broiler would make a restaurant more profitable. Very few (21.7) percent of the respondent preferred live broiler chicken and approximately half of the respondents preferred cut chicken (Table 10).

### ***Factors affecting willingness to offer Rwanda broiler chicken***

According to the results of the multicollinearity diagnostics, all variables included in the model have condition indices that are less than or equal to 30. This indicates that there is no



significant multicollinearity issue in the model. Table 11 presents the probit regression model estimate and marginal effects for factors affecting willingness to offer Rwanda broiler chicken. The estimated ordered probit regression had a pseudo  $R^2$  of 0.5682, and the LR chi2 of 54.54 was significant ( $P < 0.001$ ). We checked for multicollinearity and found no serious multicollinearity. Among fifteen variables included in the model, gender, availability, and reliability were positively related to choosing broiler chicken. Gender and reliability were significant at a 5% level of significance, while availability was significant at a 10% level of significance. Female respondents had a 0.202 higher probability of choosing Rwanda broiler chicken. A plausible explanation for this statement could be partly attributed that females were efficient in the production of poultry in Sub-Saharan Africa (Aboki et al., 2013). Moreover, more female was involved in poultry production in Sub-Saharan Africa (Aboki et al., 2013). Thus, they might know about the benefits of broiler chicken which increases the chance of offering broiler chicken at a restaurant. A unit increase in the availability of broilers, increased the probability of the adoption of the chicken by 0.103. Bhargave et al. (2016) and Steinhart et al. (2013) reported that when a product is available then consumers generally purchase it if they found some good thing in it. The availability of Rwanda broilers might have induced restaurant owners to buy the chicken. A similar result was found by Van Loo et al. (2010). Moreover, there is still a problem with the easy availability of the Rwanda broiler chicken due to poor commercialization of the poultry sector (Gill et al., 2021; Mahoro et al., 2017; Mbuza et al., 2017a). A unit increase in reliability of Rwanda broiler increased the probability to choose the broiler by 0.217. Reliability impacts the perceived superiority of the product (Erdem & Swait, 1998; Saleem et al., 2015).

The respondents might have perceived the Rwanda broiler as a superior product which could influence them to choose it.

However, willingness to take a risk, years in business, healthy, consistency, and live broiler had a negative relation with the choice of Rwanda broiler. Willingness to take a risk, years in business, and healthy were significant at a 10% level of significance while live broiler was significant at a 1% level of significance. Interestingly, a unit increase in willingness to take a risk, decreased the probability of preference for broiler chicken by 0.603. Stefani et al. (2008) found that the role of risk perception and purchase of chicken is ambiguous because risk perception further depends on knowledge of hazards and trust in food chains. In contrast to our expectations, years of restaurant business had a negative relation with the preference for Rwanda broiler. A unit increase in years in business, decreased the probability of choice of broiler chicken by 0.0116. The negative relation might be due to a lack of information regarding the profitability of offering broiler chicken. Moreover, the restaurant owner might have perceived that the consumer does not prefer broiler chicken. One unit increase in variable healthy decreased the probability of adopting broiler chicken by 0.603. This might be due to indigenous chicken healthier than Rwanda broiler chicken (Alam et al., 2020; Sokoya et al., 2019). The incidences of avian influenza in Sub-Saharan Africa (Kalonda et al., 2020; Świętoń et al., 2020), chemical, and microbiological risks associated with broiler chicken (Yeung & Morris, 2001) could have demotivated restaurants owner to offer Rwanda broiler. One unit increase in consistency decreased the probability of choosing broiler chicken by 0.603. This depicted that the respondents doubted full regarding the consistency of the Rwanda broiler Chicken. This might be due to little information about broiler chicken as Rwanda broiler doesn't have a long

history of commercial production and consumption (Gill et al., 2021; Mbuza et al., 2017b; TRAIDE, 2019). The respondent who preferred to receive live broilers had a 0.777 lower probability of choosing Rwanda broilers. This depicted that the respondents preferred chicken in other forms.

### ***Willingness to Pay***

The mean willingness to pay (WTP) for Rwanda broiler chicken is RWF 6196.03 per kg, which is RWF 4196.03 per kg higher than the lowest price offered (RWF 2000 per kg) to the respondents, and RWF 1946.03 per kg higher than the highest price offered (RWF 4250 per kg). The mean WTP for Rwanda broiler chicken is also higher by RWF 1196.03 per kg when compared to the current price of indigenous broiler chicken. This difference could be attributed to the preference for Rwanda broilers over indigenous chicken. Moreover, Dyubele et al. (2010) reported that consumers in Africa gave higher sensory scores to the broiler chicken compared to the indigenous chicken.

## CHAPTER 4: CONCLUSIONS

While many studies have discussed consumer preferences for beef, only a few studies have evaluated the factors influencing how often individuals purchase beef. As the Chinese beef market is essential to both domestic producers and foreign exporters (such as Australia, New Zealand, and the United States), it is crucial to comprehend the determinants of beef purchase frequency in China. In this study, we analyzed the factors affecting beef purchase frequency in three major cities of China (Beijing, Shanghai, and Guangzhou). Results revealed that approximately half of the respondents purchased beef 2-3 times a week, while the other half bought it either once a week or less.

Results from the ordered probit regression suggest that frequency of purchase is higher for respondents who purchase steak, flank, shank, and brisket. The study found that consumers who purchase beef from wet markets and supermarkets tend to buy beef more frequently. Furthermore, younger shoppers with higher incomes tend to have a higher beef purchase frequency. Respondents who prioritize attributes such as country of origin and growth hormone-free production are more likely to purchase beef more often. However, those who consider price and premium quality as important factors when shopping for beef tends to have a lower purchase frequency.

Results depict that beef processors and other stakeholders could focus on selling premium quality beef at a reasonable price to improve the perception of beef as an affordable product and quality product. Beef marketing strategies could also be tailored to target younger shoppers with higher incomes and export specific beef cuts to wet markets and supermarkets with certain attributes. However, since the study only surveyed three major cities in China, future research

could expand to include rural areas to determine beef purchasing patterns. Additionally, future studies could explore consumer preferences and willingness to pay for hormone-free beef, beef with different quality standards, and country of origin labeling at varying price levels.

Previous studies were focused on evaluating the characteristics of a broiler production system, production efficiencies, smallholder broiler sales, and profitability in Sub-Saharan Africa, but no study was conducted to understand the buyers' behaviors. Given the serious stunting in Rwanda, buyers purchasing behaviors imperative to increase protein-based meat consumption. Additionally, the government of Rwanda and other donor agencies are seriously involved in reducing the stunting statistics via increasing broiler meat consumption. Generally, restaurants and markets are the main actors that link producers and consumers. Therefore, to strengthen the production system and increase consumption of Rwanda broiler, factors affecting the broiler purchase decision among restaurants and market owners are pivotal.

In this context, we conducted a study to evaluate the willingness to offer Rwanda broilers over local chicken. Using the questionnaire administered through the Qualtrics panel, we adopted the face-to-face interview method to collect the data from March-April 2022. We used a probit regression model to evaluate the factors affecting the preference for Rwanda broiler chicken. We found that female respondents, availability of the broiler, and reliability had a higher probability of offering Rwanda broilers at a restaurant. However, willingness to take risks, healthy, consistency of product, and live broiler negatively influenced the choice of broiler. These findings can be meaningfully explained to derive some insights into policy formulations. The policy perspectives include education and outreach programs on the profitability of selling broiler chicken at a restaurant and the health benefits of broiler chicken consumption. The

education program could target restaurants with female owners for offering Rwanda broilers at their restaurant as initial adopters. They could further act as the source of information dissemination to other restaurants.

Our study suggests, that strengthening accessibility to Rwanda broiler chicken through a concrete value chain approach could increase the chance of offering broiler chicken at a restaurant. Moreover, the concerned agencies must focus on producing healthy and consistent broilers maintaining biosecurity measures and adopting recommended technology for broiler production. The stakeholders of the poultry industry should focus on selling processed broilers instead of the live bird. Our study demands further study on consumer preference for different parts of Rwanda broiler chicken. Additionally, further study on technology adoption of recommended practices among smallholder farmers could be insights for producing a healthy, consistent, and reliable product.

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## APPENDICES

### Tables

**Table 1. Variable definitions**

Variable Names	Variable Definitions
Dependent variable	
Beef frequency	How often respondent purchase beef or beef products, 1= less than weekly, 2=weekly, and 3=2-3 times a week
Independent variables	
Beef Cuts	
Purchase steak	1 if purchases steak, otherwise 0
Purchase sliced	1 if purchases sliced beef, otherwise 0
Purchase flank	1 if purchases flank, otherwise 0
Purchase shank	1 if purchases shank, otherwise 0
Purchase rib	1 if purchases rib, otherwise 0
Purchase brisket	1 if purchases brisket, otherwise 0
Purchase tenderloin	1 if purchases tenderloin, otherwise 0
Store type	
Wet market	Consumer purchases beef at wet market <sup>a</sup>
Supermarket	Consumer purchases beef at supermarket <sup>a</sup>
Online market	Consumer purchases beef online <sup>a</sup>
Beef Attributes	
Price	Importance of price when purchasing beef <sup>b</sup>
Hormone free	Importance of growth hormone free production when purchasing beef <sup>b</sup>
Premium quality	Importance of premium quality when purchasing beef <sup>b</sup>
Traceability	Importance of traceability when purchasing beef <sup>b</sup>
Country of origin	Importance of country of origin when purchasing beef <sup>b</sup>
Food safety	Effect of food safety on beef consumption pattern <sup>c</sup>
Covid	Has covid affected the purchase decision <sup>d</sup>

Note: <sup>a</sup>scale from 1 to 5 where 1= never and 5=always; <sup>b</sup>scale from 1 to 5 where 1=not important and 5=very important; <sup>c</sup>scale from 1 to 5 where 1=no effect 5=major effect; <sup>d</sup>scale from 1 to 7 where 1=not at all and 7=very much

**Table 2. Variable definitions**

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Attitudes	
Risk	How do you see yourself? Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? <sup>a</sup>
Trust	1 if the respondent says most people can be trusted, otherwise 0
Demographics	
Gender	1 if respondent is male, otherwise 0
Education	1 if the respondents education level is bachelors degree or higher, otherwise 0
Age	Age of respondent in years
Wage	Approximate monthly household income before tax <sup>a</sup>
City	
Beijing	1 if the respondent is from Beijing, otherwise 0
Shanghai	1 if the respondent is from Shanghai, otherwise 0
Guangzhou	1 if the respondent is from Guangzhou, otherwise 0

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<sup>a</sup> where 1= not at all willing and 10= very willing, <sup>b</sup>There are 13 categories of the approximate monthly household income before tax (Under ¥ 3,00, ¥ 3,000 - ¥ 4,999, ¥ 5,000 - ¥ 6,999, ..., ¥ 25,000 and over)

**Table 3. Descriptive statistics of consumer demographics and attitudes.**

Variable	Overall (n=529)		Beijing (n=193)		Shanghai (n=218)		Guangzhou (n=118)	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Willingness to take risk	6.43	2.09	6.40	2.28	6.58	1.98	6.22	1.94
Trust	30.81%	0.46	30.56%	0.46	27.52% <sup>bc</sup>	0.45	37.30% <sup>bc</sup>	0.49
Male	46.50%	0.50	43.52%	0.5	50.45%	0.5	44.06%	0.5
Education	78.07%	0.41	82.90% <sup>ab</sup>	0.38	76.14% <sup>ab</sup>	0.43	73.72% <sup>ac</sup>	0.44
Age	37.24	11.63	35.74 <sup>ab</sup>	9.73	39.04 <sup>abc</sup>	12.15	36.37 <sup>bc</sup>	13.06
Wage	10.05	2.79	10.07 <sup>ac</sup>	2.57	10.29	2.7	9.59 <sup>ac</sup>	3.24

<sup>a,b,c</sup> In each city, if two rows contain the same letter, they are significantly different at less than the 5% level. For example, there is no difference in trust except Shanghai and Guangzhou at less than 5% level of significance. Notes: Variable definitions appear in Table 2.

**Table 4. Descriptive statistics of types of beef.**

Variable	Overall (n=529)		Beijing (n=193)		Shanghai (n=218)		Guangzhou (n=118)	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Beef purchase frequency	2.36	0.70	2.42 <sup>ab</sup>	0.70	2.30 <sup>ab</sup>	0.72	2.36	0.66
Purchase steak	93.19%	0.25	93.26%	0.25	93.11%	0.25	93.22%	0.25
Purchase sliced	83.93%	0.37	87.56 <sup>ab</sup>	0.33	79.35% <sup>abc</sup>	0.41	86.44% <sup>bc</sup>	0.34
Purchase flank	83.74%	0.37	78.23 <sup>ab</sup>	0.41	88.07% <sup>ab</sup>	0.33	84.74%	0.36
Purchase shank	64.08%	0.48	62.17%	0.49	69.26% <sup>bc</sup>	0.46	57.62% <sup>bc</sup>	0.50
Purchase rib	59.36%	0.49	61.13%	0.49	61.46%	0.49	52.54%	0.50
Purchase brisket	58.22%	0.49	59.06%	0.49	58.26%	0.50	56.77%	0.50
Purchase tenderloin	71.45%	0.45	69.94%	0.46	73.39%	0.44	70.33%	0.46

<sup>a,b,c</sup> In each city, if two rows contain the same letter, they are significantly different at less than the 5% level. For example, there is no difference in beef purchase frequency except Beijing and Shanghai at less than 5% level of significance. Notes: Variable definitions appear in Table 1.

**Table 5. Descriptive statistics of the location of beef purchase.**

Variable	Overall (n=529)		Beijing (n=193)		Shanghai (n=218)		Guangzhou (n=118)	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Wet market	3.48	1.27	3.54	1.14	3.58	1.36	3.58	1.32
Supermarket	4.22	0.98	4.51 <sup>abc</sup>	0.77	4.10 <sup>ab</sup>	1.04	3.98 <sup>ac</sup>	1.07
Online market	3.11	1.25	3.18 <sup>ac</sup>	1.26	3.18	1.30	2.88 <sup>ac</sup>	1.13

<sup>a,b,c</sup> In each city, if two rows contain the same letter, they are significantly different at less than the 5% level. For example, there is no difference in online market except Beijing and Guangzhou at less than 5% level of significance. Notes: Variable definitions appear in Table 1.



**Table 6. Descriptive statistics of importance of beef attributes.**

Variable	Overall (n=529)		Beijing (n=193)		Shanghai (n=218)		Guangzhou (n=118)	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Price	3.81	1.00	3.84	1.00	3.76	1.07	3.83	0.87
Country of origin	3.89	0.95	4.00 <sup>ac</sup>	0.99	3.88	0.95	3.72 <sup>ac</sup>	0.87
Growth hormone free	4.15	0.90	4.20	0.92	4.092	0.91	4.15	0.86
Premium quality	4.18	0.86	4.24	0.88	4.11	0.89	4.20	0.74
Traceability	3.97	0.94	4.03	1.00	3.96	0.94	3.88	0.84
Food safety	4.30	0.75	4.38 <sup>ab</sup>	0.74	4.20 <sup>abc</sup>	0.78	4.37 <sup>bc</sup>	0.71
Covid	5.20	1.59	5.48 <sup>abc</sup>	1.57	5.13 <sup>ab</sup>	1.57	4.88 <sup>ac</sup>	1.62

<sup>a,b,c</sup> In each city, if two rows contain the same letter, they are significantly different at less than the 5% level. For example, there is no difference in country of origin except Beijing and Guangzhou at less than 5% level of significance. Notes: Variable definitions appear in Table 1.

**Table 7. Marginal Effects for Ordered Probit Model**

(N=529)	Model	Less than weekly		Weekly		2-3 times a week		
Variables	coef.	SEM	dy/dx	SEM	dy/dx	SEM	dy/dx	SEM
Purchase steak	0.548**	0.239	-0.084**	0.037	-0.080**	0.036	0.165**	0.071
Purchase sliced	-0.196	0.158	0.030	0.024	0.029	0.023	-0.059	0.047
Purchase flank	0.288*	0.159	-0.044*	0.025	-0.042*	0.023	0.087*	0.048
Purchase shank	0.303**	0.135	-0.047**	0.021	-0.044**	0.020	0.091**	0.040
Purchase rib	0.015	0.132	-0.002	0.020	-0.002	0.019	0.004	0.040
Purchase brisket	0.305**	0.130	-0.047**	0.020	-0.045**	0.019	0.092**	0.039
Purchase tenderloin	0.188	0.140	-0.029	0.022	-0.028	0.021	0.057	0.042
Wet market	0.173***	0.046	-0.027***	0.007	-0.025***	0.007	0.052***	0.014
supermarket	0.229***	0.062	-0.035***	0.010	-0.034***	0.009	0.069***	0.018
Online market	-0.032	0.049	0.005	0.008	0.005	0.007	-0.010	0.015
Price	-0.159***	0.058	0.025***	0.009	0.023***	0.009	-0.048***	0.017
Country of Origin	0.250***	0.062	-0.039***	0.010	-0.037***	0.009	0.075***	0.018
Hormone	0.163**	0.070	-0.025**	0.011	-0.024**	0.010	0.049**	0.021
Premium quality	-0.197**	0.077	0.030**	0.012	0.029**	0.011	-0.059***	0.023
Traceability	-0.063	0.065	0.010	0.010	0.009	0.009	-0.019	0.019
Food safety	0.063	0.080	-0.010	0.012	-0.009	0.012	0.019	0.024
Trust	-0.378***	0.124	0.058***	0.019	0.055***	0.018	-0.113***	0.037
Willingness to take risk	0.024	0.030	-0.004	0.005	-0.004	0.004	0.007	0.009
Covid	0.032	0.037	-0.005	0.006	-0.005	0.005	0.010	0.011
Male	0.195*	0.113	-0.030*	0.017	-0.029*	0.017	0.058*	0.034
Education	0.080	0.159	-0.012	0.025	-0.012	0.023	0.024	0.048
Age	-0.03***	0.006	0.005***	0.001	0.004***	0.001	-0.009***	0.002
Wage	0.103***	0.024	-0.016***	0.004	-0.015***	0.004	0.031***	0.007
Shanghai	-0.136	0.129	0.022	0.021	0.019	0.019	-0.041	0.039
Guangzhou	0.118	0.149	-0.017	0.021	-0.019	0.023	0.035	0.045
cut1	1.580**	0.625						
cut2	3.132***	0.635						
Pseudo R <sup>2</sup>	0.2131							
Log likelihood	-410.043							
LR chi2(25)	222.07							
Prob > chi2	0.000							

Note: \*\*\*, \*\*, and \* reflect 1%, 5%, and 10% level of significance. SEM=Standard Error Mean

## Appendix A

**Table 8. Ordered Probit Model for beef purchase frequency in three major Chinese cities**

Variables	Beijing (n=193)		Shanghai (n=218)		Guangzhou (n=118)	
	Coefficients	SEM	Coefficients	SEM	Coefficients	SEM
Purchase steak	-0.356	0.458	1.655***	0.470	0.211	0.588
Purchase Sliced	0.390	0.322	-0.155	0.249	-0.483	0.420
Purchase flank	0.055	0.264	0.046	0.309	0.177	0.386
Purchase Shank	-0.381	0.273	1.026***	0.237	0.301	0.297
Purchase Rib	-0.089	0.269	0.365*	0.212	-0.528*	0.301
Purchase brisket	0.683***	0.245	0.201	0.231	0.352	0.317
Purchase Tenderloin	0.332	0.257	-0.307	0.25	0.654*	0.341
Wet market	0.180*	0.096	0.300***	0.082	0.329***	0.107
supermarket	0.575***	0.138	0.320***	0.102	-0.002	0.129
Online market	-0.063	0.088	-0.206**	0.085	0.116	0.132
Price	-0.098	0.111	-0.275***	0.096	-0.300*	0.156
Country of Origin	0.552***	0.114	-0.089	0.107	0.545***	0.169
Hormone	0.346**	0.139	0.291**	0.12	-0.316*	0.164
Premium quality	-0.428***	0.148	0.115	0.125	-0.220	0.206
Traceability	-0.250**	0.116	-0.036	0.111	0.233	0.156
Food safety	-0.167	0.160	0.191	0.129	0.041	0.193
Trust	-0.835***	0.244	-0.167	0.213	-0.078	0.269
Willingness to take risk	0.007	0.053	0.094*	0.054	-0.135*	0.077
Covid	0.156**	0.070	0.031	0.067	-0.078	0.083
Male	0.225	0.209	0.358*	0.201	0.212	0.263
Education	0.232	0.304	-0.630*	0.333	0.486	0.314
Age	-0.0362***	0.012	-0.047***	0.010	-0.022*	0.012
Wage	0.174***	0.049	0.153***	0.044	0.106*	0.059
cut1	2.672**	1.271	3.536***	1.07	-0.623	1.442
cut2	4.425***	1.296	5.290***	1.096	1.296	1.454
LR chi2(23)	130.14		139.94		53.17	
Prob > chi2	0.00		0.00		0.0003	
Log likelihood	-119.523		-151.413		-85.611035	
Pseudo R2	0.3525		0.3161		0.2369	

Note: \*\*\*, \*\*, and \* reflect 1%, 5%, and 10% level of significance. SEM=standard error of mean

**Table 9. Name of variables and their definition**

Variable	Variable definition
Choice of Rwanda broiler	1 if the respondent chose Rwanda broiler 0 otherwise
Independent variables	
Age	Age of respondent in years
Female	1 if the respondent is female 0 otherwise
Willingness to take risk	Risk taking ability of the respondent (ranked from 1 to 10 where 1=not willing and 10=very willing)
Seating capacity	Seating capacity of a restaurant
Years in business	Number of years the respondent is in restaurant business
Price	Price of the Rwanda broiler chicken (2,000 RWF/kg, 2750 RWF/kg, 3500 RWF/kg, and 4250RWF/kg)
Availability	Availability is a factor that influence to offer Rwanda broiler chicken at restaurant <sup>a</sup>
Healthy	Healthy is a factor that influence to offer Rwanda broiler chicken at restaurant <sup>a</sup>
High quality	High quality is a factor that influence to offer Rwanda broiler chicken at restaurant <sup>a</sup>
Sustainable	Sustainable is a factor that influence to offer Rwanda broiler chicken at restaurant <sup>a</sup>
Reliability	Reliability of supplier is a factor that influence to offer Rwanda broiler chicken at restaurant <sup>a</sup>
Consistency	Consistency is a factor that influence to offer Rwanda broiler chicken at restaurant <sup>a</sup>
Profitable	1 if the respondent believes that offering Rwandan broiler chicken products would make restaurant more profitable 0 otherwise
Live broiler	1 if the respondent prefers to receive the Rwanda broiler chicken live 0 otherwise
Cut chicken	1 if the respondent thinks that consumer prefer Rwanda broiler chicken as cut chicken 0 otherwise

Note: a denotes the scaling ranked from 1 to 5 where 1= not at all and 5= extremely

**Table 10. Descriptive statistics of variables used in Probit regression model**

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Variable	Number of observations=83	
	Mean	Std. dev.
Choice of Rwanda broiler	0.7349	0.4440
Age	36.1205	8.5303
Female	0.3976	0.4924
Willingness to take risk	7.8795	2.0146
Seating capacity	125.0361	140.1923
Years in business	6.0000	4.7344
Price	3147.5900	879.1592
Availability	4.2651	1.0942
Healthy	4.2289	1.0160
High quality	4.6747	0.5866
Sustainable	4.2530	1.1353
Reliability	4.4578	0.8454
Consistency	3.9518	1.2087
Profitable	0.9277	0.2605
Live broiler	0.2169	0.4146
Cut chicken	0.4819	0.5027

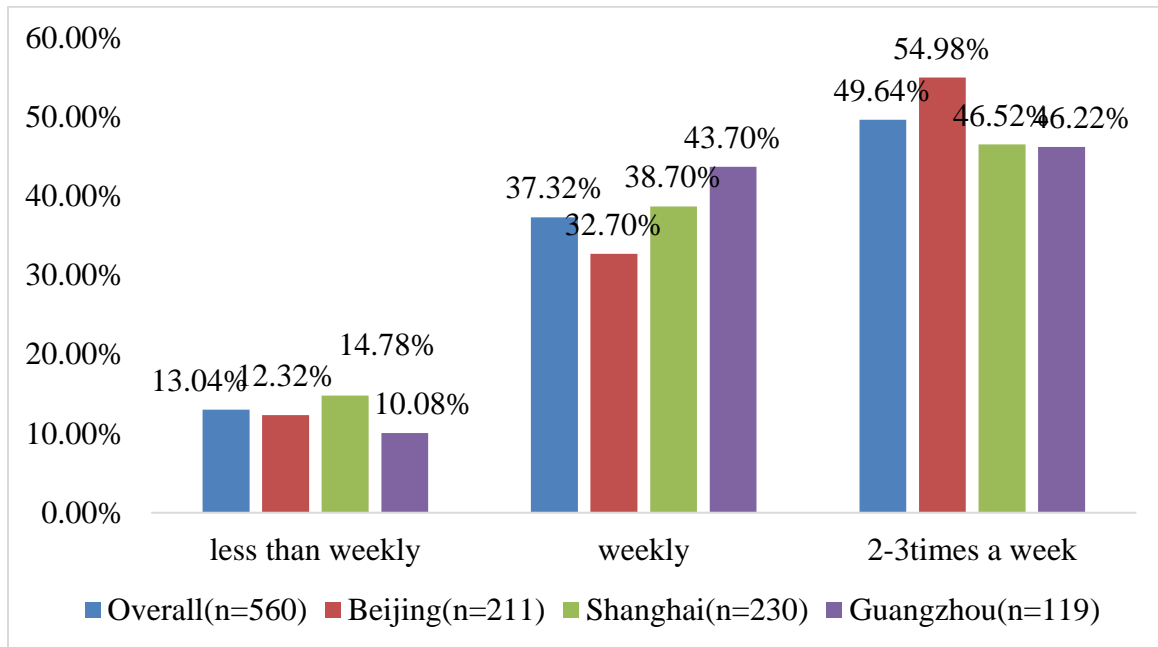
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**Table 11. Probit model estimates for factors affecting willingness to offer Rwanda broiler chicken<sup>a</sup>**

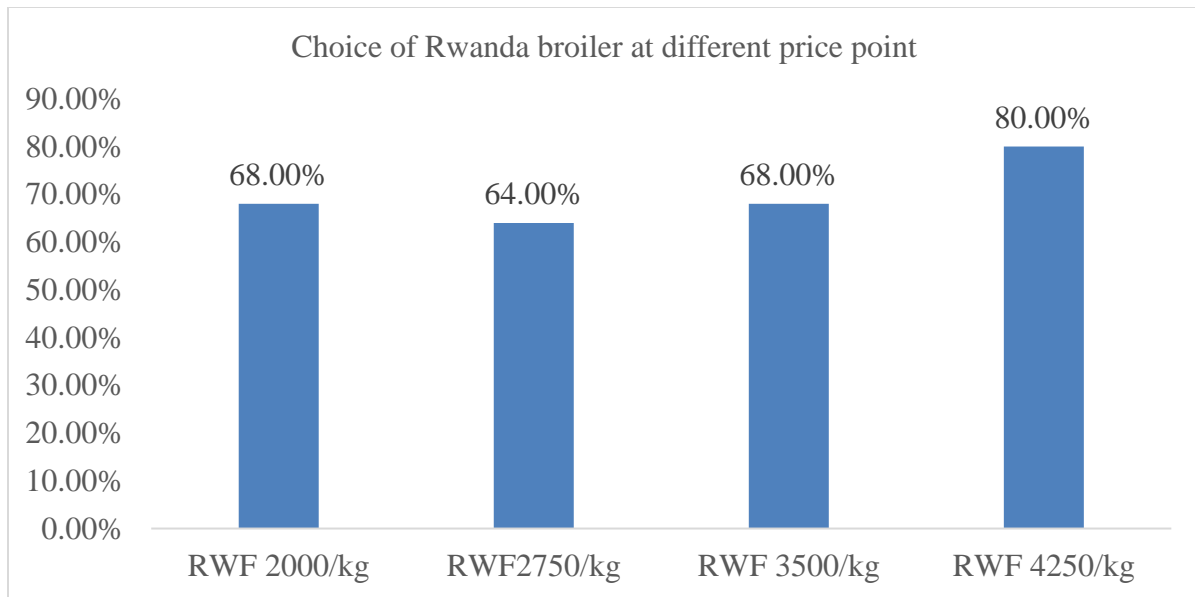
Variables	Coefficients	SEM	Marginal effects	SEM
Age	0.0362	0.0337	0.00492	0.00454
Female	1.487**	0.685	0.202**	0.0857
Willingness to take risk	-0.444*	0.235	-0.0603**	0.0302
Seating capacity	-0.00433	0.00317	-0.000588	0.000419
Years in business	-0.0852*	0.0507	-0.0116*	0.0066
Price	-0.000341	0.000346	-0.0000464	0.0000465
Availability	0.755*	0.435	0.103*	0.0565
Healthy	-0.730*	0.413	-0.0993*	0.0529
High quality	0.694	0.715	0.0944	0.0964
Sustainable	0.416	0.478	0.0566	0.0633
Reliability	1.598**	0.716	0.217**	0.0901
Consistency	-0.899*	0.46	-0.122**	0.0583
Profitable	4.466	4.313	0.607	0.575
Live broiler	-2.039***	0.648	-0.277***	0.0735
Cut chicken	-0.155	0.575	-0.0211	0.0782
cons	-7.583	5.513		
Number of observations	83	83		

<sup>a</sup> \*, \*\*, \*\*\* indicate level of significance at 10%, 5%, and 1% level of significance SEM=standard error of mean

## Figures



**Figure 1. Beef purchase frequency in China**



**Figure 2. Choice of Rwanda broiler at different price point (no significant different for choice of broiler across four price levels)**



## VITA

Bhishma Raj Dahal, born on October 3, 1996, in Sindhuli, Nepal, was raised on a small remote farm in the highlands of Nepal. This upbringing inspired him to pursue higher education in Agricultural Science, which led him to enroll in Agriculture and Forestry University in Nepal, where he completed his bachelor's degree in Agricultural Sciences in 2020. In 2021, he moved to the United States to continue his studies at the Department of Agricultural and Resource Economics at the University of Tennessee. He is pursuing a Master of Science degree in Agricultural and Resource Economics with a minor in Statistics and is expected to graduate in May 2023. Bhishma's research interests are centered around consumer economics, international development, trade, and applied econometrics.