



# Food Price, Local Market and Nutrient Intake of Farmer Households of Different Income Categories in Rural China

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**Abstract.** Food price and market development are important factors affecting farmers' rights to food. Through The quantile regression, this paper investigated and compared the effects of food price on nutrient intake of farmers of different income categories in rural China. The paper also looked into the impact of local market size and the distance to market on nutrient intake of residents of local communities. Result: The impact of different food prices on nutrient intake of rural residents varied and the price of cereals has a positive impact on nutrient intake of low-income groups. The distance to market has in most cases negative impact on nutrient intake of farmers; nevertheless, a larger market is conducive to nutrient intake of farmers. Under the conditions of ever-increasing food prices, attention on one hand should be given to the impact of higher prices on the welfare of farmers and on the other hand to the establishment of sound rural food market.

**Keywords:** Food Price · Nutrients Intake · Market Conditions · Quantile Regression

## 1 Introduction

Food prices in China have been fluctuating at a high level in recent years due to the impact of market conditions both at home and abroad. The prevailing traditional perception about farmers' food consumption is "self-sufficiency". As such, farmers are hardly affected by food price fluctuation. However, the status quo is being changed along with increasing commodification of grains. Over 50% of rural residents even though engaged in farm production purchase substantial quantities of basic foodstuff (Holmes et al. 2008 [4]). In 2009, the commodification rate of grain was over 70% for farmer households with over 10 mu of landholding, of which, the grain commodification rate of farmer households with over 30 mu of land reached 90.3%. Meanwhile, a national survey carried out by the Chinese Academy of Social Sciences also found out that many farmer households in some important grain producing provinces started to reduce or maintain no grain stock, and most of them chose to sell the entire production. Monetary expenditure on food has gradually become the prevailing approach to food consumption of rural residents. Thus, it is increasingly necessary to pay attention to the impact of food price change

particularly the increase of grain prices on the wellbeing of farmers and low-income farmers in particular [1, 2].

Availability and accessibility of food are the two most fundamental aspects of food security (Haifeng Xiao i.e., 2008 [3]). Food price is an important but not the single factor that affects the right of the low-income groups to food. Besides price factor, the development of the market also affects the right of the low-income group. Long distance to market and less-developed market would increase the cost of accessing adequate and diversified foods. Normally, being closer to the market means higher possibilities of accessing food (Jing Zhu 2003 [11]); the larger the market is, there are more possibilities of accessing diverse types of foods. Therefore, even under the condition of adequate supply of grains, whether grain and other foodstuff supply could be accessed through the market is also an important factor that affects food security [6, 7]. Food supply market in rural China currently continues to follow the traditional “country fair” model, and market conditions vary substantially by location. In some remote areas, convenient access to food is still a problem. No matter from the scale of food supply or from the perspective of food security, food supply in rural areas still faces many problems, which has an important impact on food security and rural resident’s life safety [5].

Against the above backdrops, this paper started from nutrient intake, through empirical analysis based on CHNS data, to explore the impact of food prices and local market conditions on the welfare of rural residents [8]. Meanwhile, the paper held the view that income level to some extent could indicate farmers’ dependence on the market and their capacity to cope with market risks. Nutrient intake of farmer households of different income categories under the conditions of market development is subject to different impacts of food price fluctuation and market development. Therefore, this paper attempted to identify more accurately the disparities, which would bear important significance for the formulation of more targeted price intervention policies and the improvement of rural food supply market, and this is exactly what the paper wants to achieve [9, 10].

The rest of the paper is structured as: the next section is dedicated to a synthesis of relevant literature; Sect. 3 portrays the data source and description; and the distribution characteristics of nutrient intake of households of different income categories is analyzed in Sect. 4; Sect. 5 provides findings of empirical analysis and related discussions and the last section presents conclusions and issues that warrant further studies.

## 2 Methodologies

### 2.1 Data and Estimating Model

This study is primarily based on the 2006 data of the China Health and Nutrition Survey (CHNS). CHNS data sampling covers 9 provinces respectively representing eastern, western and central China. CHNS adopts multiple-stage cluster random sample methods. About 4400 households with 15,000 individuals are sampled every year. The survey included family income, individual features of family members, food consumption and prices of local markets.

The measurement of nutrition level of rural residents in the paper is realized through the calorie and protein intake of reference man per day of a household. CHNS databank

provided the number of man-days of all persons having meals in the household during the survey period with their age, gender and physical activity level recorded. On the basis of calculating food consumption of three days of a household and in line with the food code and food nutrient composition provided in “China Food Composition 2004”, this paper converted consumption into nutrient intake. In order to enhance comparability of nutrition level of households with different features and in line with different age, gender and physical activity levels, the paper converted them to number of reference man-days to calculate nutrient intake of each reference man-day of the household. While in the process of studying and in order to reduce interference of abnormal values, this paper eliminated samples that were beyond 5 in standard deviation.

Compared with other existing literature, the price adopted in this paper is the objective price of local communities, which would better represent local market price. CHNS community survey involves prices of 39 types of food of 9 categories, including grains, edible oils, sugar and major seasoning products, vegetables, fruits, meats and poultry, fresh milk and dairy products, fish and Tofu; furthermore, the survey includes retail prices of large stores and prices of free markets. Since consumption of rural area is mostly concentrated in free market, this paper chose free market price as the proxy of rural market price. Nutrient intake of rural residents is mainly sourced from cereal, vegetables, eggs and meat. This paper in the process of analysis excluded rare food types with relative low consumption in rural areas such as dairy products and fruits. Among the categories of food, CHNS provided the prices of several types of food popular in communities, and this paper calculated the weighted value of different prices of foods of the same category and induced a unified price to represent the price of a category of food. Let's use vegetables as an example, there are over 200 types of vegetables consumed among rural households, but the community data only provided the prices of cabbage and cole, it is necessary to calculate the weighted price of cabbage and cole in order to get a typical price of the vegetable category. Through food code, this paper first of all located the consumption of cabbage and cole in the community to get the sum and consumption proportion of the two vegetables as the weight of the summed two prices. The prices of other categories of food are also calculated through this approach.

In terms of studying market conditions, this paper chose two proxy variables, i.e., the location of free market— “the distance from the community to the closest free market” to denote the achievability of purchasing food by rural residents; and the scale of free market, which is measured by the “number of stands of traders in the closest free market”, because larger number of stands of traders means higher possibilities of more types of foods.

Besides the above major variables, this paper also controlled other important factors that might affect family nutrient intake, such as family per capita income, number of family members, and the structure of the family such as the proportion of children under 16 years old and the proportion of elderly over 60 in a family. Furthermore, this paper has in particular investigated the age, gender and education of the family member responsible for purchasing food. The reason that this paper did not study the individual characteristics of the householder as it did in the previous literature is that the key that affects family food expenditure and nutrient intake lies with the person who buys food and who cooks, which sometimes is not done by the householder. Therefore, it is more meaningful to

investigate the characteristics of the food purchaser of the family. This paper controlled the self-sufficiency rate of families. The paper compared the market value of household consumption of various farm production of the household with the total income of farm production of the household. The result is used to denote the proxy variable of household self-sufficiency rate. In addition, due to differences among regions in food consumption habits, this paper also assigned virtual variables of regions to control regional factors.

### 2.2 Estimating Model

In line with the above analysis, this paper first constructs a model of the factors that affect nutrients intake of households, as follows:

$$N_{il} = \alpha_0 + \alpha_1 \text{income}_i + \alpha_2 \text{PRICE}_{ki} + \alpha_3 \text{Market}_i + \alpha_4 \text{Family}_i + \alpha_5 D_i \tag{1}$$

In the equation,  $N_{il}$  is the intake of nutrient  $l$  of household number  $i$ ;  $\text{income}$  is the per capita mean income of the household;  $\text{PRICE}_{ik}$  denotes the price of food  $K$  of sample number  $i$ ;  $\text{Market}_i$  is the market condition, including the number of kilometres to the free market and the scale of the free market;  $\text{Family}_i$  is the household controlled variable, including family size and structure, and the age, gender, education and knowledge command of the food purchaser of the household;  $D_i$  is the regional control variable. As illustrated before, nutrient intake is abnormal distribution, therefore, the paper adopted quantile regression model rather than OLS model for analysis.

In order to investigate the factors that affect nutrients intake of households of different income categories at different quantiles, this paper constructed the following quantile regression model:

$$\text{Quant}_\theta(N_{il}|X_i) = \beta^\theta X_i \tag{2}$$

In the equation,  $X_i$  denotes various factors mentioned in Eq. (1);  $\beta^\theta$  is the co-efficient vector;  $\text{Quant}_\theta(\text{nutrient intake level}_i|X_i)$  denotes the corresponding conditional quantile at quantile point  $\theta$  ( $0 < \theta < 1$ ) when  $X$  is given. The co-efficient vector  $\beta^\theta$  corresponding to  $\theta$  is realized through minimizing LAD, i.e.:

$$\beta^\theta = \text{argmin} \left\{ \sum \theta |N_{il} - X_i \beta| + \sum (1 - \theta) |N_{il} - X_i \beta| \right\} \tag{3}$$

This paper implemented quantile regression for calorie and protein respectively, which is the typical nutrient intake, and the results are presented in Table 3. In order to analyse more directly how did the impact of food price and local market on nutrient intake of farmer households of different income categories change at different quantiles, this paper has drawn relevant figures to reflect the co-efficient of the estimated quantile regression model along with the change of the  $p$  value.

### 3 Empirical Results

Impact of food price and local market on calorie intake of farmer households.

- ① Food price: regression results indicated that calorie intake of households of different income categories was subject to the impact of the prices of different foods. Cereal is the important source of household calorie intake. As for low-income households are concerned, the price of cereal has significant positive effect on their calorie intake; furthermore, it also presents positive impact at different quantiles. It is likely that most low-income households are engaged primarily in farm production and their cereal consumption is normally based on their own production. Therefore, the benefits of income increase resulting from hikes of cereal price are greater than the consumption effect of low-income households; increasing income would enhance the augment of calorie intake. The price of cereal does not have significant impact on middle and high-income households. As for calorie intake of households of different income categories is concerned, the price of eggs has significant negative correlation. For low-income households, the coefficient of impact is greater than that of middle and high-income households. For middle-income households, the price of meats presents significant correlation with calorie intake, and it is even greater for low-income households. Even though eggs and meats are not the main sources of calorie intake of households but important sources of nutrition for rural residents, the increase of their prices will necessarily affect the food consumption structure of all households; it is particularly true for the low-income households. Along with income increase, such impact gradually weakens. In addition, the paper also found out that calorie intake of middle-income households was susceptible to negative impact of prices of more types of foods. As illustrated earlier, the self-sufficiency rate of vegetables and cereals for low-income households is greater, but the dependence of middle-income households on market is higher than low-income households. The income of middle-income group do not raise to the level high enough to offset the negative impact caused by price. Therefore, it is not difficult to understand that calorie intake of middle-income households is subject to the impact of price of more types of foods.

The smaller graphics in Fig. 1 denote the impacts of prices of cereal, egg, vegetable and meat on low, middle and high-income households at different quantiles. The graphics are produced with the co-efficient point estimates from quantile regression and when 95% of confidence interval is within  $p \in (0, 1)$ . We can see that as for low-income households are concerned, the difference of impact of cereal price and meat price at different quantiles is not obvious, and it is almost within 95% of the confidence interval. However, the impact of egg price would gradually decrease along with the increase of intake quantile. For middle-income households, except cereal prices that do not have significant impact, the impact of meat price at different quantiles is also similar; but the impact of egg and vegetable would gradually weaken along with the increase of quantiles of calorie intake. For high-income households, even though the price of egg has significant impact on their calorie intake. But Fig. 2 also indicates that the impact behind 0.7 quantile is basically beyond confidence interval, that means when calorie intake reaches certain high level, they are no longer subject to significant impact of egg price. Nevertheless, the impact of

vegetable price would gradually weaken along with the increase of the quantiles of calorie intake.

- ② Market conditions: regression results demonstrated that whether it was low-income or high-income households, the size of market had positive impact on their calorie intake, indicating that along with the expansion of market size, the diverseness of foods consumed by farmer households increases and sources of calorie intake also increase along with it. The distance to the market has no significant impact on low-income households, but it has significant negative impact on households of the other two income categories. The reason behind this might be that since low-income households have greater self-sufficiency rate, their dependence on market is less. However, the dependence of middle and high-income households on the market is greater; therefore, the location of market imposes more limitations to their increase of food consumption. The impact of market conditions on calorie intake of households of the three income categories is presented.

#### Impact of food price and local market on protein intake of farmer households.

- ① Food price: animal protein in the form of meats and eggs is one of the major sources of protein of rural households; to some extent, it represents the quality of nutrient intake of rural households. The regression results as shown in Table 3 indicated that protein intake of households of different income categories was primarily subject to the impact of these two types of food, while the strength of impact and direction were the exact same. For low-income households, the price of egg is an important factor that affects protein intake; furthermore, it is significantly negative under 1%. However, for middle-income households, the prices of four types of foods have significant negative impact on protein intake, indicating that the quality of food consumption of middle-income households depends heavily on the market. Therefore, it is more susceptible to the impact of multiple foods. As for the high-income households are concerned, their protein intake is not significantly affected by food prices. Figure 3 presents the impact of prices of different foods on protein intake of households of the three income categories at different quantiles.
- ② Market condition: one can see from Table 3 that the impact of distance to the market on protein intake basically complies with the expectation of this paper, i.e., the greater distance to the free market, the lower the protein intake. As for low-income households are concerned, market size is an important aspect of securing diversified protein intake sources. The larger the market size is, the more the protein intake is. In terms of middle and high-income households, the impact of market conditions on the intake of protein is not significant. The impact of market conditions on calorie intake of the households of the three income categories at different quantiles is given (Table 1).

**Table 1.** Factors that affect nutrient intake of households of different income

	Calorie			Protein		
	Low	Middle	High	Low	Middle	High
Per capita mean income	0.061***	0.122***	0.084**	0.065**	0.078***	0.056
Age	0.00135**	-0.0000	0.00133	0.00174**	3.72e-10	0.000491
Householder gender	-0.030	0.0000	0.0019	-0.0273	0.0061	0.0140
Education	0.00606*	-0.00000255	0.00289	0.00785*	-2.20e-09	0.00454
Family size	-0.190***	-0.131***	-0.0692***	-0.127***	-0.0590***	-0.0436**
Proportion under 16	0.168***	-0.0161	0.339***	-0.110.	-0.452***	-0.0505
Proportion of elderly over 60	0.192***	0.0457**	0.280***	-0.0146	-0.222***	0.0737
Self-sufficiency rate	0.174***	0.00485	0.247	0.119	-0.297***	0.0253
Cereal price	0.948***	-0.000469	0.130	0.165	-0.192***	0.127
Egg price	-0.304***	-0.134***	-0.113*	-0.172***	-0.0900***	-0.0341
Vegetable price	0.0143	-0.046***	-0.13***	-0.0074	-0.049***	0.0113
Meat price	-0.118*	-0.0950***	-0.0840	0.0296	-0.179***	-0.00234
Distance to market	0.013	-0.0204***	-0.0674***	0.013	-0.05***	-0.009
Market size	0.078***	0.021***	-0.006	0.046***	-0.001	0.014

## 4 Conclusions

On the basis of other studies, this paper through quantile regression investigated the impact of food price and market condition on calorie and protein intake of farmer households. One important contribution of this paper includes: (i) it uses local objective price as an external variable, which prevented errors brought about by using unit value; (ii) market size and distance to the market are used to study the impact of market condition faced by farmer households on their accessibility to foods. Results indicated that different food prices have different impacts on nutrient intake of rural residents, and the prices of cereals have positive impact on nutrient intake of low-income group, indicating that there exist certain income effects. Low and middle-income households in rural areas are more susceptible to the impact of food prices. Distance to market has negative impact in most cases on nutrient intake of farmer households. In terms of market size, the bigger the market is, the more conducive it is to nutrient intake of farmer households. Thus, it can be seen that in the context of accelerated market-driven process, more attention is needed to the impact of market condition change on the right of farmer households to food, which is also an important condition to ensure nutrient intake of farmer household and increase their wellbeing.

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