An Analysis of Household Foods Demand in Rural Burundi

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Abstract. This study was aimed to investigate the roles of income and other socioeconomic variables such as household size, land size, head of household education level, raising the animals, source of income on food demand in rural Burundi. The needs for foods among the households in rural Burundi were examined using a recent survey done by the authors. An almost ideal demand system (AIDS) was laboring to evaluate the price and expenditure elasticities and the influence of socioeconomic variables on food demand products. An econometric model was then involved in analyzing the factors of food demand. The assessed expenditure elasticities for the food groups settled from 0.64 for oils to 1.36 for meats. The outcomes showed that there is a raised expenses elasticity for meats, fish, cereals and grains. The appraisal showed that the revenue and other socioeconomic variables exerted significant effects on food demand, and important expenditure elasticity for food group items will increase remarkably with rising income.

Keywords: almost ideal demand system (AIDS), food demand, non-parametric estimation, instrumental variables, Burundi.

1 Introduction

Food and diet demands are two features of the same question, in which food demand is related to the economics and food qualities demand is associated with the food demand. Malnourishment is not only caused by inadequate food intake but also caused by other variables such as flooding, drought, no schooling that involves a good diet. For example, meats or fruits and vegetables may be consumed in insufficient quantities by lower disposable income either because they are given low preference due to the availability from the local market or because of the ignorance. Food policies need more information on the interaction between household socioeconomic characteristics, food prices, and the choices of foods [1]. All the factors influencing food demand, in turn, will affect the health state.

Imbalanced food or insufficient food intake can cause many chronic diseases, such as different forms of malnutrition, kwashiorkor in children, and vitamin deficiency. There are no several studies that have analyzed the food consumption pattern in Burundi using single-equation models, such as the per capita consumption of animal in quantity estimated by the OLS (Ordinary Least Square) regression [2], or the food consumption structure in rural Burundi by the linear expenditure system and almost ideal demand system(AIDS) [3]. However, no study has been mentioned so far in estimating household food demand in Burundi.

The first part of the study is to find out how socioeconomic characteristics, prices, and expenditure influence food demands by using a recent survey done by the authors. A constructed econometric model was applied to detect influencing aspects of main food consumption and food expenditure shares. The second part investigated the linearity in household behaviors by applying the AIDS model for the condition of a food demand system with food group properties. The model where the expenditure shares are spent on food items by consumers was introduced by Deaton and Muellbauer in 1980 [4].

2 Theoretical Model and Estimation

The paper uses the Almost Ideal Demand System (AIDS) to evaluate demand and expenditure elasticities. AIDS is a complete system capable of revising several characteristics of food demand and its multiple mechanisms. It is designated for assessment because it automatically gratifies the combination control, and with modest parameter instructions, adding up, homogeneity and symmetry can be executed [5]. Deaton and Muellbauer [6] used Price Independent Generalized Logarithmic (PIGLOG) preferences to derive Almost Ideal Demand System (AIDS). In relationships of budget shares and prices, this is given by:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} lnp_j + \beta_i ln\left(\frac{m}{P}\right) \tag{1}$$

where w_i is the budget-share of the ith commodity, α_i is the constant coefficient in the i^{th} share equation, γ_{ij} is the slope coefficient associated with the j^{th} good in the i^{th} share equation, p_j is the price of the j^{th} good, m characterizes the total expenditure on the system of goods given by:

$$m = \sum_{i=1}^{n} p_i q_i \tag{2}$$

in which q_i is the quantity demanded of the i^{th} good. And p is the price index defined by

$$lnp = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2}\sum_{i}^{n}\sum_{j}^{n} \gamma_{ij}\, lnp_i lnp_j \text{ in nonlinear AIDS model} \tag{3}$$

$$\text{and } \gamma_{ij} = \frac{1}{2}(\gamma_{ij} + \gamma_{ji})$$

According to economic theory, diverse strictures of the demand equations must embrace the resulting limitations:

Adding up: $\sum_{i=1}^{n} \alpha_i = 1$,

Homogeneity: $\sum_j \gamma_{ij} = 0$ and $\sum_i \gamma_{ij} = 0$, $\sum_i \beta_i = 0$

Symmetry: $\gamma_{ij} = \gamma_{ji}$, $i \neq j$

Equation (1) can be taken as a Marshallian or uncompensated demand function in budget shares (expenditure elasticities). The Hicksian price elasticities of good i concerning good j can be derived from the Marshallian price elasticities via the Slutsky equation in elasticities. The countenance for the Marshallian price elasticity converts to:

$$\varepsilon_{ij}{}^{\mathrm{M}} = -\delta_{ij} + \frac{1}{w_i}\left[\gamma_{ij} - \beta_i\left(\alpha_i + \sum_i \gamma_{ij} ln\, p_i\right)\right]$$

$$\varepsilon_{ij}{}^{\mathrm{M}} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_j}{w_i} \tag{4}$$

while the expenditure elasticity for good i is:

$$\eta_i = 1 + \frac{\beta_i}{w_i} \tag{5}$$

The Hicksian (compensated) price elasticity for good i for good j is given as:

$$\varepsilon_{ij}{}^{H} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} + w_j \tag{6}$$

where δ_{ij} is the Kronecker delta, defined as: $\delta_{ij} = 1\; if\;\; i = j\; (own\; price), and\; 0\; for\; cross - price$.[7]

In order to determine the functional form, it was necessary to examine the expenditure share equations. Non-parametric regression was useful in estimating the type of function. Epanechnikov kernel function was applied to calculate the weighted local polynomial estimate, and local mean smoothing was used with a rule-of-thumb bandwidth. In the study, Y is the food groups share, and X is the logarithm of per capita household foods expenditure.

The goal was to estimate m(x0) = E[Y|X=x0], weighted by Epanechnikov kernel function K(r) = 0.75(1-r2). Using r = ln(x), we constructed a 50-point equally spaced grid over this interval, [r0, r1]. In each point X, a weighted linear regression of food group share on the logarithm of household food expenditure per capita was calculated over this interval.[8]

3 Data Description

The data used for analyzing in this paper derives from an investigation named "Food Security and Food demand analysis in the rural area of Burundi." The survey was led in July-August by the authors. The study has collected more information at the household level, such as demographic characteristics, food consumption, income and expenditure, farming production, etc. The survey selected the northeastern region of Burundi, where MUYINGA and RUTANA have been chosen as the sample and were among the most affected provinces of the country [9].

Two communities in each province were selected as samples, one is a developed community, and another is relatively less developed. Two zones or sectors were selected in each sample community, and two villages were chosen in each zone. Ten households were selected in each village, and the survey interviewed 210 families as valid samples. Based on the database obtained from a study on rural households, the essential characteristics of rural households, housing conditions, income, consumption expenditure, consumption of major foods, and others were collected. We focused not only on household consumption quantity, prices, and total expenditure statistics on several items but also on social and economic demographic factors.

The commodity groups were classified based on the similarity of food items using nutritional and economic criteria [1]. Six combined commodity groups were selected for the analysis in this study: cereals (including wheat, sorghum, rice, and maize), grains (including beans, peas, and groundnuts), tubers including Irish and sweet potato, cush, yam, banana, and cassava), vegetables (including cabbage, amaranth, carrot, beans leaves, cassava leaves, and fruits), oil and fat (denoting oil), and finally the group covering all animal product such as meats, fishes, milk and eggs (denoting meat). Thus, the total quantity of constraints in the model was reduced, and the features of food groups were displayed. Each food group price was weighted averagely on exact items described by the interviewer, and the prices of the foods self-produced by the households were estimated based on the prices the producers reported.

The information on various demographic characteristics of the households was also used in this analysis, including family size (number of family members), rate of purchased food, coefficient of family burden, income source, age of household age, women's schooling, children under five years, expenditures share of the six food groups.

3.1 Characteristics of the Households Definition of Some Terms

Coefficient of family burden: the rate of the labor to the non-labor in number
Rate of purchased food: the percentage of the expenditure on food from the market to the expenditure on all food.

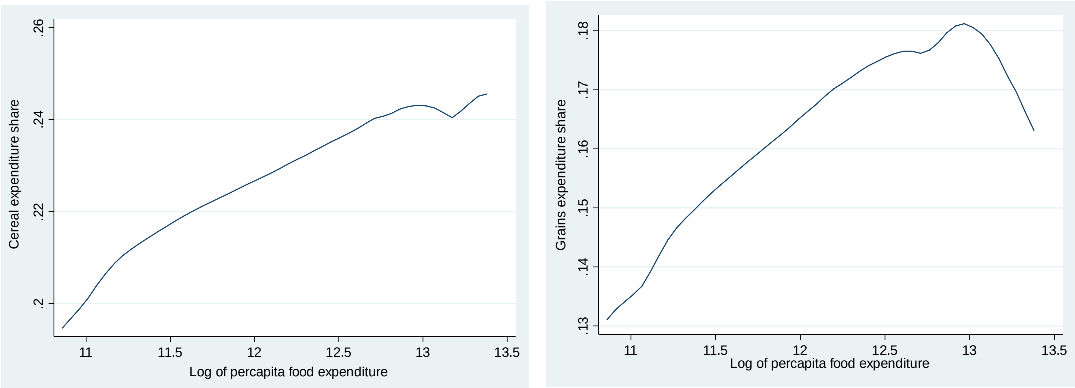
Food expenditure share: the percentage of the total expenditure on food to the expenditure on all items, including food and non-food.

Own-price elasticity is the ratio change in an item quantity divided by a ratio change in its price.

Per capita annual food consumption: the yearly food consumption per person for the six food items.

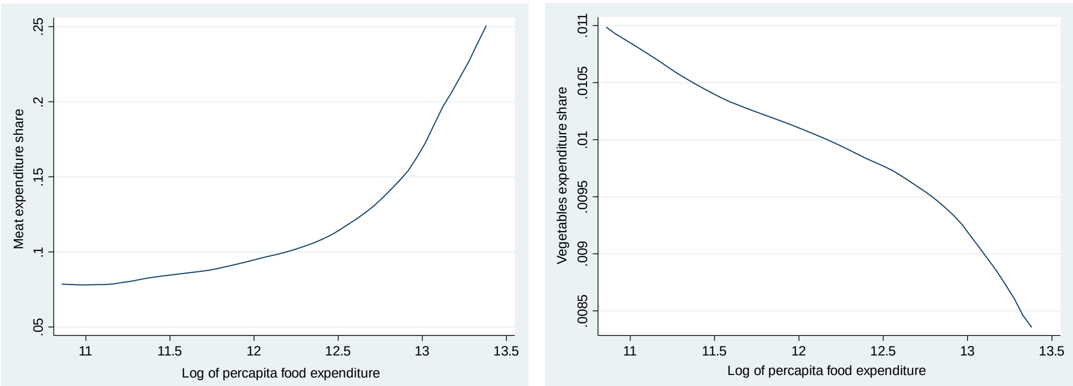
3.2 Food Demand

Fig. 1-6 represent the non-parametric guesstimates of our six food groups. Some forms of the curves indicated linear approximate in expenditure shares, while other shapes of the curves do not display linearities in expenditure shares. These are the case of cereals, grains, and meat with the same linear approximate, which means that the form of the Almost Ideal Demand System may meet user behavior. In contrast, the food groups of tubers, vegetables, and oil share the same linear approximate.



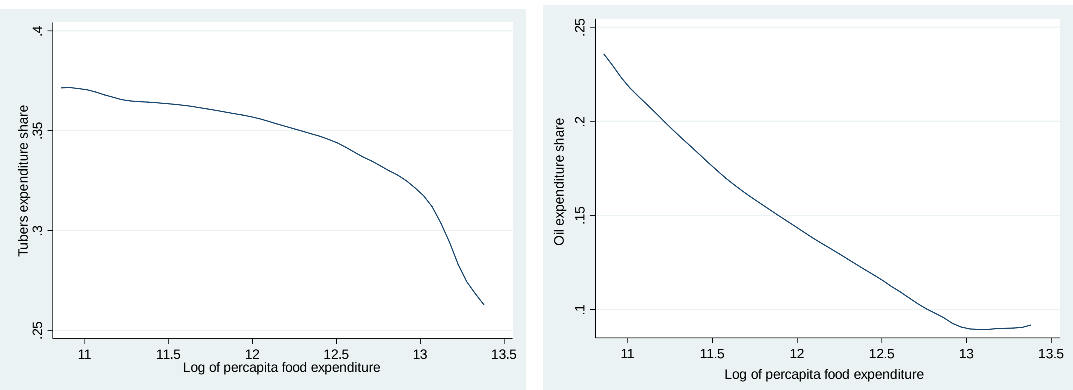
(1) (2)

Figure 1-2. Non-parametric Engel curves for cereals (1), and grains (2)



(3) (4)

Figure 3-4. Non-parametric Engel curves for meat (3), and vegetables (4)



(5) (6)

Figure 5-6. Non-parametric Engel curves for tubers (5), and oil (6)

4 Results and Characteristics of the Households

The AIDS model is projected using nonlinear seemingly unrelated regression (NLSUR) the technique, with theoretic limits of adding-up, homogeneity, and symmetry executed during assessment.

Table 1 is the summary of data and descriptions of the variables used in the analysis. To assess the impacts of these variables on food expenditure share and consumption of the six food items, demographic variables, including two dummy variables, were divided into two groups. The non-dummy variables were divided into two groups based on the average level. The average household size consisted of close six persons. The average for per capita household expenditure was 178889 BIF per person year-round. Households spent approximately 91.7% of their entire expenses on food items.

Notes.

1. Bif=Burundian franc
2. Burundian franc=US$0.00054 in 2019

Table1. Statistics of food expenditure shares and per capita annual food consumptions means

				Mean food expenditure share						Per capita annual food consumption kg					
Variables	Group	Observations	Rate	Cereals	Grains	Tubers	Meat	Vegtb	Oils	Cereals	Grains	Tubers	Meat	Vegtb	Oils
Household size	<=6	119	57%	0.125	0.091	0.209	0.055	0.006	0.079	20.27	18.1	75.2	2.41	3.48	4.63
	>6	91	43%	0.096	0.069	0.144	0.044	0.004	0.074	12.03	10.32	40.1	0.88	2.21	3.07
Rate of purchased food	<=0.45	112	53%	0.116	0.081	0.203	0.05	0.006	0.077	17.97	15.76	68.39	1.96	3.18	4.08
	>0.45	98	47%	0.106	0.08	0.149	0.049	0.004	0.077	14.33	12.68	46.94	1.32	2.51	3.63
Burden coefficient	<=0 .75	102	49%	0.112	0.08	0.184	0.053	0.006	0.083	15.45	14.05	60.75	1.36	3.11	4.08
	> 0.75	108	51%	0.11	0.08	0.168	0.046	0.004	0.07	16.84	14.58	54.58	1.93	2.58	3.62
Provinces	RUTANA	105	50%	0.112	0.061	0.189	0.054	0.005	0.077	16.26	11.44	57.46	1.95	2.99	3.76
	MUYINGA	105	50%	0.11	0.099	0.164	0.045	0.005	0.077	16.04	16.99	57.87	1.34	2.71	3.94
Land	<1.5 Ha	116	55%	0.115	0.082	0.197	0.058	0.006	0.093	14.41	13.48	59.13	1.76	2.87	4.23
	>=1.5 Ha	94	45%	0.107	0.078	0.156	0.041	0.004	0.061	17.9	14.95	56.21	1.53	2.82	3.47
Income source	1=Agr	141	67%	0.149	0.11	0.251	0.059	0.007	0.109	18.97	17.65	72.66	1.09	3.49	4.86
	0=Others	69	33%	0.073	0.05	0.102	0.039	0.003	0.045	13.34	10.79	42.67	2.2	2.21	2.85
Raise animals	<=2	74	51%	0.141	0.108	0.238	0.06	0.007	0.106	18.57	17.32	73.05	1.1	3.64	4.89
	>2	71	49%	0.081	0.053	0.114	0.038	0.003	0.047	13.73	11.11	42.28	2.19	2.05	2.81
Education(year)	<=3	159	76%	0.16	0.118	0.277	0.073	0.008	0.12	21.27	19.87	85.66	1.63	3.96	5.67
	>3	51	24%	0.062	0.042	0.076	0.026	0.002	0.033	11.03	8.56	29.68	1.66	1.73	2.03

There were differences in mean food expenditure share and annual per capita food consumption between the two groups. According to the household size, the household groups with more than six members had less per capita food consumption than the household groups with less or equal to six persons. The rate of purchased food was averagely 0.45; Compared to the group with the lower rate of purchased food, the group with more than 0.45 as the rate of purchased food to the local market consumed fewer food groups. The mean burden coefficient was 0.75. The households with a smaller burden coefficient consumed fewer foods, especially cereals, grains, and meats, but more tubers, vegetables, and oil.

According to the location, the agricultural households were divided into two provinces Rutana and Muyinga. Their consumptions are almost the same, except for fewer grains to the households of the Rutana area.

According to the land size possession, the arable land size was divided into two groups; the households with an average of arable land size less than 1.5 hectares (<3.707 acres), and the households with the arable land size greater or equal to 1.5 hectares (>=3.707 acres). Thus, 116 households have an arable land size less than 1.5 ha, and represented 55%, while 94 households have an arable land size greater than or equal to 1.5 Ha, and represented 45%.

For the income source, the households were divided into two groups; income from agricultural and income from other types of jobs. The households with agricultural income consumed more cereal, grains, tubers, vegetables, and oil, while households with other sources of income consumed more meat than households with agricultural income.

A simple assessment shows that households that raised more than two animals (goat, chicken, cow, pork, and rabbit) consumed 1 kg per capita more than households with less than two animals raised (2.19 kg versus 1.1 kg). Concerning the education level of the household's head, the analysis found that 159 households consequently 76%, their heads of household have less or equal to three years of education, and only 51 households, then 24% of household heads have more than three years of education.

For the household size and the education years, we observe a significant difference within the group at per capita, annual food consumption level due to their observations.

Table2. Expenditure elasticities and expenditure shares

Food category	Expenditure elasticity	Expenditure share	Marginal expenditure share%
Cereals	1.25169	22%	28%
Grains	1.13329	16%	18%
Tubers	0.84038	35%	30%
Meats	1.36313	10%	14%
Vegetables	0.83107	1%	1%
Oil	0.64031	15%	10%
Total		100%	100%

Our expenditure elasticity computations accord with economic perception. The estimates of the expenditure elasticities for tubers, vegetables, and oil are inelastic 0.84, 0.83, 0.64, respectively, indicating that tubers, vegetables, and oils have become the necessities foods for household consumers within their expenditure shares. The expenditure elasticities for cereals, grains, and meats 1.25, 1.13, and 1.36, respectively, are considered luxuries foods within their expenditure allocations. The observed expenditure elasticities are shown in Figure 7.

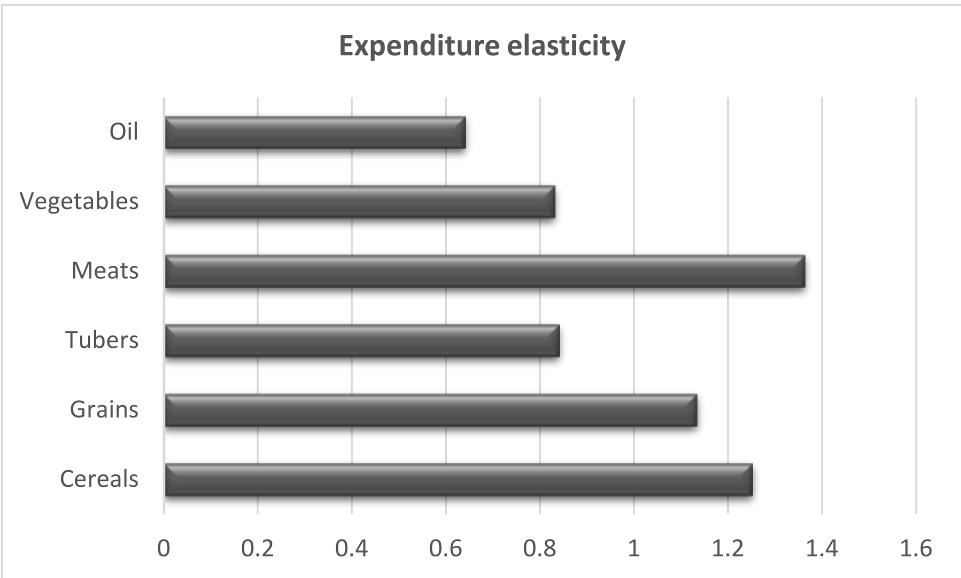


Figure 7. Expenditure elasticities of the six food groups

In directive to estimate the marginal expenditure shares, the appraised expenditure elasticities were multiplied by the expenditure shares. The outcomes propose that vegetables (1%) consumption will continue to be stable. For any growth in the future of food expenditures, the main share of that growth will be assigned to cereals consumption (28%), pursued by meats (14%) and grains (18%). At the same time, tubers and oils will decrease by 5% for each one. These consequences farther assert the significance of food nourishments and the economy.

Table3. The estimated uncompensated (Marshallian) own price and cross-price elasticities

		Price					
		Cereals	Grains	Tubers	Meats	Vegetables	Oils
Demand	Cereals	**-0.8876**	-0.18131	0.026273	-0.11053	-0.02109	0.039014
	Grains	-0.14984	**-0.14991**	-0.32566	-0.09055	0.053665	0.132079
	Tubers	-0.10363	-0.81993	**-0.53154**	-0.17854	0.069248	0.040696
	Meats	-0.03824	-0.03316	0.001733	**-0.90161**	0.026332	0.02071
	vegetables	-0.00523	0.000324	0.001895	-0.00271	**-0.84076**	-0.00587
	Oils	-0.06715	0.050707	-0.01307	-0.07918	-0.11846	**-0.86693**

Tables 3-4 recap the uncompensated (Marshallian) and compensated (Hicksian) price elasticities. All own-price elasticities have the expected negative signs. The uncompensated own-price elasticity for meats is -0.9, cereals -0.89, oils -0.87, vegetables -0.84, tubers -0.53, and grains -0.15. These valued outcomes show that the demand for these foods is inelastic.

Besides 30 cross-price elasticities, 18 are negative, signifying that food groups are accompaniments while 12 are positive, implying that food items are alternatives. Finally, all the cross-price elasticities are inelastic. The compensated (Hicksian) own-price elasticities are generally lower but comparable to the uncompensated own-price elasticities.

Table 4. The estimated compensated (Hicksian) own price and cross-price elasticities

		Price					
		Cereals	Grains	Tubers	Meats	Vegetables	Oils
Demand	Cereals	**-0.60895**	-0.15164	-0.00926	-0.02969	-0.0587	-0.04106
	Grains	0.113202	**-0.1285**	-0.3513	-0.03223	0.026531	0.074305
	Tubers	0.207913	-0.77283	**-0.58794**	-0.05024	0.009556	-0.0864
	Meats	0.209368	-0.01993	-0.01412	**-0.86555**	0.009556	-0.01501
	vegetables	0.219938	0.001677	0.000275	0.000977	**-0.84248**	-0.00952
	Oils	0.194216	0.071229	-0.03765	-0.02327	-0.14447	**-0.92231**

5 Conclusion

This study contributed to the considerate of the problems and conceivable policy formulation by examining the dealings among the household socioeconomic features, foods, and food prices in rural provinces of Burundi. Using the AIDS model to analyze the household food demand, we found that there was a solid relationship between socioeconomic variables and household food demand. In certain, the household size, rate of purchased, land size, income source, raising animals, education level of household chief played an important role in inducing the consumption of foods with the six food groups. The own-price elasticity of most food groups was more than 0.5 and close to one, representing a high response to the changes in food prices expected only for grains. The degrees of the appraised expenditure elasticities were generally significant than those of the own-price elasticities, suggesting that revenue policies may be more active in influencing consumption designs than price strategies. Generally, the results of the food demand analysis reveal that the smaller land size, the higher population density, and lower-income have negative impacts to the food demand system.

The findings also demonstrated that meat and cereal consumption would decline with increasing meat and cereal prices, while the demand for tubers, oils will rise with decreases in their prices. It consequently, seems rational to deduct that a low-priced food, price policy might recover food demand. Generally, the outcomes of the food demand analysis expose that income development may lead to considerable progress in food diversities.

Acknowledgements. This study was supported by National Key R&D Program of China (Number: 2017YFE0104600) and CAAS Science and Technology Innovation project (number; CAAS-ASTIP-2020), instituted by the Key Laboratory of Digital Agricultural Early-Warning Technology, Ministry of Agriculture, Beijing, China.

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