Tropentag 2009
University of Hamburg, October 6-8, 2009
Conference on International Research on Food Security, Natural Resource Management and Rural Development

Farm Household Adjustment to Price Shocks in Thailand

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Abstract

The 2008 price crisis in the world markets for fuel, chemical fertiliser and agricultural commodities, including rice, came as a shock to producers and consumers. While rice producers in principle will gain from high international prices of rice these price effects were not completely translated to equivalent increases in farm gate prices. However, the 2008 food price crisis may have raised the expectations of rice farmers even in low productivity areas of Northeastern Thailand and prompted them to intensify production in spite of price hikes for chemical fertiliser and fuel. The data collected in three provinces in Thailand (Buriram, Ubon Ratchathani, Nakon Panom) under the DFG research project "Impact of Shocks on the Vulnerability to Poverty: Consequences for Development of Emerging Southeast Asian Economies" provides a good basis to study adjustments of rural farm households to these recent price changes. On the basis of a mathematical programming model using the concept of typical farm households, the effects of adjustments decision on household income-generating activity to changes in relative prices was simulated. Results show that adjustments are strongly influenced by the household's resource endowment and their objective function. Households with a high share of non-residential household members and those who put emphasis on household food security are unlikely to show a strong supply response. Under a profit maximisation regime, however, an expansion of rice production is more likely to take place. Incorporating risk into the model allows the analysis of the effects of price changes on expected poverty by comparing cumulative distribution functions of household income with existing provincial poverty lines.

Keywords: Farm households, household adjustment, price shocks, typical farms

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1. Introduction

The food crisis in 2008 marked the historical peak in world market prices for agricultural input and output especially fuel, fertilizer and rice. These fluctuations were unexpected shocks to both consumers and producers. Although the international price effects do not entirely arrive at farm gate, continuous price hikes are anticipated and prompts for production intensification among rice producers even in low productivity areas. Depending on relative changes in prices of input and output, the decision on agricultural production and other income-generating activities is determined. Hence, variation in prices is particularly important for small-scale farm households in developing countries whose income and consumption mainly rely on agriculture.

2. Objectives and data

Our study aims to analyze the adjustments of rural farm households to recent price changes and the implication on income. For this purpose, we use the base data pool collected in 3 provinces in Northeastern Thailand under the DFG research project "Impact of Shocks on the Vulnerability to Poverty: Consequences for Development of Emerging Southeast Asian Economies"[1]. As a case study, 64 farm households in Ubon Ratchathani province are selected with additional in-depth household survey conducted in May 2008 and January 2009 to cover the period of price changes. These households represent typical farms which are an empirically prevailing reference for an existing farm or group of farms in a specific region with typical characteristics such as demographic, income level and income-generating portfolios.

3. Typical farm household in Northeastern Thailand

A typical farm in Northeastern Thailand consists of 5 persons with monthly per capita income of approximately 737THB[2] which is below provincial poverty line of 35US$ indicating some degree of vulnerability to poverty. The agricultural member ratio of 83% signifies the importance of agriculture as a major source of income relative to simultaneous off-farm and non-farm employment and support from remittances and public transfers. With average land for rice and field crops of almost 10 Rai or 1.6 hectare, 3 food crops and 1 cash crop are predominantly cultivated (Table 1). Rice is produced generally once a year and while jasmine rice is usually produced for sale due to price premium, glutinous rice is more preferred by the Northeastern households for subsistence consumption. Vegetable, on the other hand, is mainly grown in the backyard for subsistence consumption in multiple cycles throughout the year. Lastly, cassava is cultivated once a year for industrial processing. Apart from field crops, households undertake livestock farming such as buffalo and cattle for sale as well as chicken for consumption.

Table 1: Agricultural production of a typical farm

Annual production	Jasmine rice	Glutinous rice	Vegetable	Cassava
Yield (KG/Rai)	221	224	795	1,097
Sale	80%	14%	15%	100%
Consume	20%	86%	85%	-
Output price (THB/KG)	13.19	11.28	20	3.2
Gross margin[a] (THB/Rai)	982	908	13,527	1,289

[a] Gross margin includes non-cash income from home consumption.

[1] DFGFOR756 is a Deutsche Forschungsgemeinschaft (DFG)-financed collaborative research unit of the Universities of Gießen, Goettingen, Hannover (all in Germany), Kasetsart University (Bangkok, Thailand), and the Centre of Agricultural Policy (Hanoi, Vietnam). For further information see: http://www.ifgb.uni-hannover.de/vulnerability.html or http://www.dfg.de

[2] Equivalent to approximately 22USD with an exchange rate of 33 THB = 1USD as per 8th October 2009.

Regarding production technology, all crops are rather labour-intensive and share similar input (Table 2). Both jasmine and glutinous rice follow the same production pattern and input use intensity except the use of hired labour during intensive harvesting period for jasmine rice. However, the production is subject to resource constraints (Table 3). To ensure food security, households preserve some amount of yield for subsistence consumption and sell the surplus for cash income. Moreover, except for jasmine and glutinous rice, land is subject to substitution limitation between crops due to fertility and topographical characteristics suitable for specific crop types. Family labour can be distinguished on the one hand between mixed and hard labour regarding physical intensity requirement for on-farm activity, and family labour for off-farm employment on the other hand. All types of family labour as well as hired labour are also subject to some hours per month maximum capacity.

Table 2: Production technology and input intensity of major crops

Input use per Rai	THB/unit	Jasmine	Glutinous	Vegetable	Cassava
Machine (day)	200	0.76	0.67	0.4	0.22
Machine/Labour (day)	280	-	0.14	-	-
Manure (kg)	-	46.34	96.82	75	-
Fertilizer organic (kg)	8.785	23	29.54	8	150
Fertilizer chemical (kg)	26.16	14.96	14.08	-	21.19
Pesticide (kg)	151.33	4.8	5	10	-
Herbicide (kg)	250	-	-	0.2	1.02
Fuel (liter)	39.86	1.16	1.48	2	1.31
Family Labour – Mixed (hour)	-	165.61	180.78	172	164.93
Family Labour – Hard (hour)	-	70.44	103.40	170.67	1.62
Hired Labour (hour)	13.54	26.7	-	-	-

Table 3: Resource constraints

Resource constraints	Unit	Jasmine	Glutinous	Vegetable	Cassava
Consumption requirement	KG	42.56	191.64	675	-
Land	Rai	7.66		1.625	3.42
Family Labour – Mixed	Hour/month	870			
Family Labour – Hard	Hour/month	420			
Family Labour – Off-farm	Hour/month	130			
Hired Labour	Hour/month	210			

4. Farm household model

Target Minimization Of the Total Absolute Deviations (Target MOTAD) model was applied to simulate the adjustments of farm households. In this model, households are assumed to maximize expected cash and non-cash income from all activities (Eq.1) with the attempt to minimize negative deviation (Z_t^-) from the target minimum income requirement (Y_0) (Eq.2). In addition to resource constraints (Eq.3) and non-negativity condition (Eq.4), household take into account the probability (p_t) of expected shortfall from the target income (λ) which represents the risk perception of all possible states of the world, i.e. anticipated price fluctuations.

Objective function: $$\max \quad E = \sum_j \overline{c}_j X_j \qquad \text{--- (Eq.1)}$$

Subject to:

$$Y_0 - \sum_j \bar{c}_{jt} X_j - Z_t^- \le 0, \forall t \quad \text{--- (Eq.2)}$$

$$\sum_j a_{ij} X_j \le b_i \quad ,\forall i \quad \text{--- (Eq.3)}$$

$$X_j, Z_t^- \ge 0 \quad ,\forall j,t \quad \text{--- (Eq.4)}$$

$$\sum_t p_t Z_t^- = \lambda \quad \text{--- (Eq.5)}$$

where a_{ij} is technical coefficients, b_i is resource constraints and $\bar{c}_j$ is expected objective function coefficients for activity X_j.

Survey data gives an overview of farmgate price development between 2007 and 2008 (Table 4). On average, jasmine and glutinous rice prices increased by 20% but at the same time input prices increased substantially with 50% in chemical fertilizer, 40% in fuel and organic fertilizer, 30% in hired labour and 10% in machine rent.

Table 4: Price development of output and input 2007-2008

Price (THB)	Unit	2007	2008
Jasmine - farmgate	kg	9.43	11.56
Glutinous - farmgate	kg	7.5	8.87
Fertilizer - chemical	kg	16.66	25.07
Fertilizer - organic	kg	4.96	6.86
Fuel	liter	25.74	35.85
Machine rent	day	93.727	103.39
Hired labour	day	148	194.91

Taken the average of the price development, four price fluctuation expectations are assumed to reflect gradual increase and decrease of prices (Table 5). With the minimum target income of 17,700THB, the expected shortfall increases in 2,000 THB scale up to 10,000THB. Holding other prices constant, the base household model (Scenario 0) was further simulated with price variations in 3 scenarios. Scenario 1 imposed 20% increase in input prices while holding rice farmgate prices constant whereas the opposite is modified for Scenario 2 and Scenario 3 controlled for 20% increase in input prices together with 30% increase in rice farmgate prices.

Table 5: Price fluctuation expectation

Price variation	Input						Output	
	Machine	Machine/ Labour	Fertilizer Organic	Fertilizer Chemical	Fuel	Hired Labour	Jasmine Sale	Glutinous Sale
Average	**10%**	**10%**	**40%**	**50%**	**40%**	**30%**	**20%**	**20%**
Price 1	5%	5%	20%	25%	20%	15%	10%	10%
Price 2	10%	10%	40%	50%	40%	30%	20%	20%
Price 3	-5%	-5%	-20%	-25%	-20%	-15%	-10%	-10%
Price 4	-10%	-10%	-40%	-50%	-40%	-30%	-20%	-20%

5. Results of adjustment scenarios

The simulation results show that the increase in input price does not lead to a change in income while the increase in rice farmgate prices alone raises income by 6%. However, the gain is offset by a simultaneous increase in input prices resulting in income increase by only 5% (Figure 1).

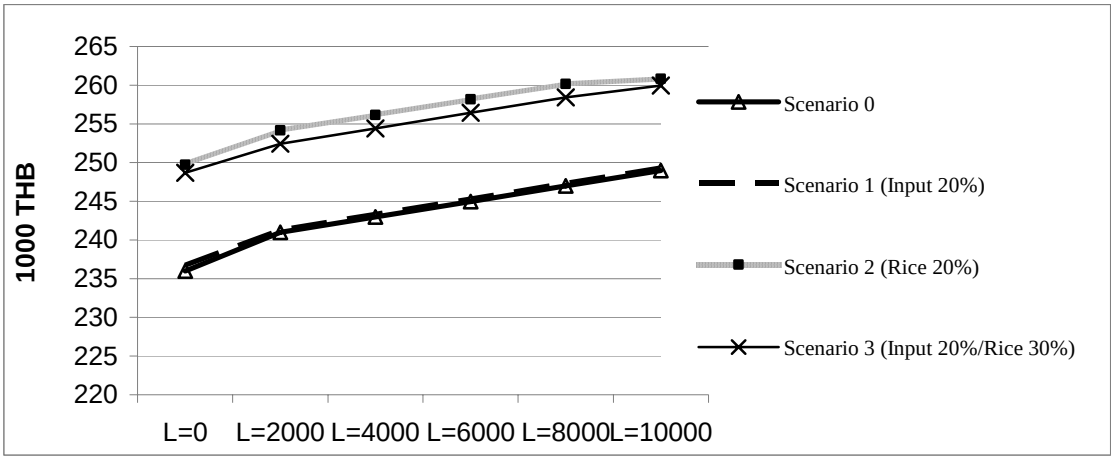

Figure 1: Income change to price scenarios

For all price scenarios and price fluctuation expectations, all crop areas, yield and proportion of sale to consumption remain unchanged at the maximum resource constraint and the minimum consumption requirement. Land allocation for each crop reaches the maximum availability with jasmine rice occupies the majority of land (6.78 Rai) and glutinous rice is only cultivated as much as to secure home consumption (0.88 Rai). However, while all other input requirements remain unchanged due to rigid technical coefficients, the adjustment capacity is observed for labour as hired labour can be substituted by idle household labour who would otherwise rather enjoy leisure time than working on farm (Figure 2).

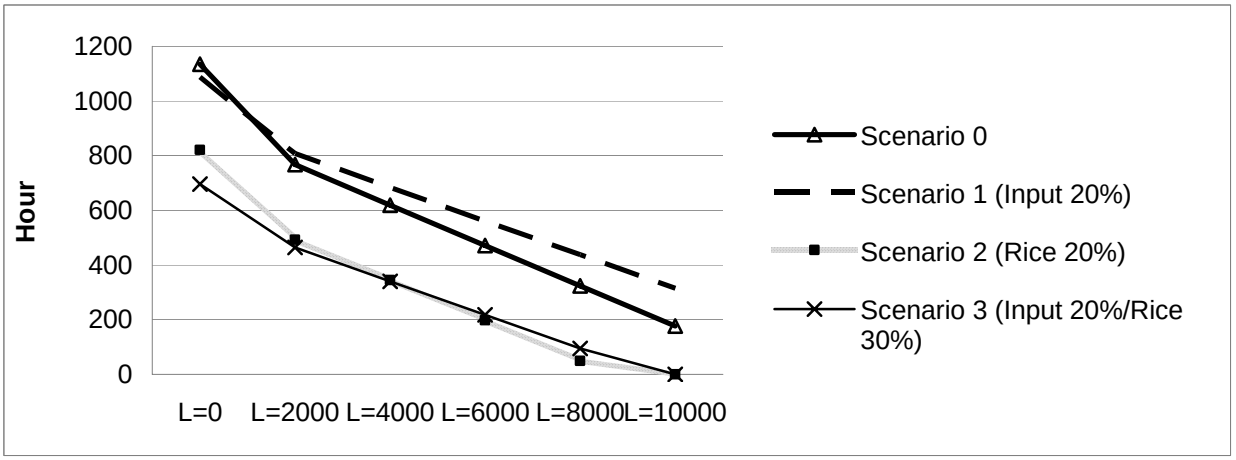

Figure 2: Hired labour adjustment to price scenarios

6. Summary

The preliminary simulation model shows that adjustments are strongly influenced by the household's resource endowment and their objective function. Price increase in output offers opportunity for farm households to achieve higher income but simultaneous increase in input prices may offset the gain. That is mainly because land and other rigid constraints including household food security requirement impose a limit on production intensification. However, households try to maximize income by adjusting the flexible input factor and substitute hired labour with idle household labour. Nonetheless, more adjustment capacity is likely when some constraints are relaxed, e.g. land substitutability, consumption requirement and production technology.