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Does Organic Agriculture Lead to Better Health among Organic and Conventional Farmers in Thailand? An Investigation of Health Expenditure among Organic and Conventional Farmers in Thailand

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Abstract

Poverty and health are inextricably linked as the poor are always the first to suffer from degraded soil, water, and environment. For poor farmers in developing countries, inappropriate use of pesticides is known to be a serious problem. To investigate if adoption of organic agriculture leads to better health or lower expenditure on healthcare, a survey was conducted on organic and conventional rice-farming households in North and Northeast Thailand in 2006. The results show that health expenditure of conventional farmers is 56% higher than organic farmers. The burden of health expenditures is also disproportionately borne by the poor with the two poorest quintiles spending approximately 3% of discretionary expenditure on healthcare, compared with only 1.85% for the two richest quintiles. Catastrophic health expenditure is also significantly higher for conventional farmers than organic farmers. Among households with health expenditure exceeding 40% of discretionary expenditure, the percentage is 1.3% for conventional households compared to 0.25% for organic households. Although health outcomes are influenced by factors other than pesticide exposure, the results suggest that organic farmers may be in better health. Results also show that organic farmers have more to spend on other household necessities rather than having to spend more discretionary income on healthcare, implying better welfare. The results suggest that organic agriculture as a development strategy might lead to improved health, one of the foundations to sustainable poverty reduction.

JEL Classification: I18, I3, Q12

Contents

I.   INTRODUCTION

Health is one of the most important components of an effective poverty reduction strategy. Better health can increase productivity and household income, while poor health is likely to reduce output (Croppenstedt and Muller 2000; Antle and Pingali 1995). The conventional approach to addressing health problems among the poor has been to extend medical and health services. However, this approach can be a large burden on public expenditure and the outreach to poor in rural areas is often limited.

Among the rural poor, the majority of whom earn their living through agriculture, one of the main causes of health problems is exposure to agrochemicals, in particular pesticides. The World Health Organization (WHO) estimates that at least three to four million people in the developing world are severely poisoned each year from exposure to agrochemicals, a number that would likely be far higher if it included the many rural poor who do not seek treatment in hospitals. Recent attempts to quantify the health costs of pesticide use in Europe have estimated annual costs of 125 million euros in Germany and 190 million euros in the United Kingdom (IFAD 2005). In developing countries where safety standards are lower, the costs are likely to be considerably higher.

Surveys consistently show that one of the main reasons why organic producers choose to shift to organic methods of production is their concern about the health problems associated with the use of chemical inputs (International Fund for Agricultural Development [IFAD] 2003, 2005). When used in excess without proper care, pesticides and other agrochemicals can negatively affect the health of farmers, their families, and their communities. Incidences of serious illnesses such as cancer due to long-term exposure to pesticides are well-documented, with evidence linking pesticide use to increased risks of birth malfunction, birth defects, and other reproductive problems (Kerdsuk 2004; Ransom 2002).

Organic agriculture can eliminate the health risks associated with pesticides and minimize the public health costs of conventional chemical farming. Although there has been little quantitative research on the health effects of shifting to organic agriculture, there is abundant anecdotal evidence. Farmers in India reported that symptoms of pesticide poisoning disappeared after they adopted organic farming (IFAD 2005), while an IFAD (2003) study in six Latin American countries found that organic farmers generally perceived themselves to be in better health after converting to organic agriculture.

Beyond reduced risk of exposure to agrochemicals, organic agriculture has indirect impacts on health through increased income and improved food security and dietary quality (Setboonsarng 2006). Rising incomes allow households to spend more on food and preventative healthcare, reducing the incidence of illness and lowering the long-term opportunity costs of poor health. Again, however, this conclusion is based on anecdotal evidence, as little quantitative data is available on the effects of organic production on health.

To fill this gap, this study attempts to empirically examine whether the adoption of organic farming practices leads to better health. As a proxy for health status, we compare the health expenditure patterns of organic and conventional rice-farming households in North and Northeast Thailand. Using data from a 2006 household survey covering 626 households in eight provinces, we calculate catastrophic health expenditures as out-of-pocket (OOP) medical expenditures exceeding a specified percentage of the household budget.

The structure of the paper is as follows: we first briefly provide background on OOP medical expenditures and our methodology for identifying the incidence of catastrophic health expenditure. We then define household expenditure and calculate the budget shares of OOP payments before presenting our findings on the incidence of catastrophic health expenditure for organic and conventional households. We next examine the differences in expenditure

patterns of households with and without catastrophic health expenditure. A concluding section summarizes our main findings.

II.   CATASTROPHIC OUT-OF-POCKET MEDICAL EXPENDITURES

OOP payments are the primary means of financing healthcare in the many low-income Asian countries that lack prepayment mechanisms such as health insurance or tax (Van Doorslaer et al. 2007). The welfare of households without health insurance may be severely reduced by OOP medical expenditures should a household member fall ill. While some households may be able to finance healthcare through savings or on credit, households lacking savings or access to credit must cover medical expenses from the household budget. If the OOP expenses are large in proportion to the household budget, they may be considered catastrophic. Having a sick household member can thus lead some households into immediate poverty and force financially constrained households to choose between cutting household consumption and going without treatment.

Ideally, longitudinal data is necessary to allow one to track the changes in non-medical spending following an illness and estimate the reduction in household welfare caused by a catastrophic medical expenditure. In this case, however, only cross-section data is available, and some approximation must be made. Following Van Doorslaer et al. (2007) and Wagstaff et al. (2007), this paper defines catastrophic health expenditure as OOP payments exceeding a particular budget threshold. Spending a large share of the household budget on medical expenses can reduce welfare in the short term, if financed by sacrificing current consumption, or in the long term, if financed by savings, credit or the sale of assets. Although the short- term disruption of living standards is typically more severe, large OOP expenditures can also threaten the long-term stability of a household if it becomes indebted and cannot absorb further economic shocks (Van Doorslaer et al. 2007).

The two key variables for calculating catastrophic expenditure are total household OOP medical expenditure and household expenditure, which is used a measure of household resources. Unlike other measures of household resources, such as income, the use of household expenditure reflects the assumption that the impact of OOP expenditure is greater on households without savings (Wagstaff et al. 2007).

III.   HOUSEHOLD EXPENDITURE AMONG FARMING HOUSEHOLDS
IN NORTH AND NORTHEAST THAILAND

The farm survey was conducted from April–July 2006 in eight provinces to compare the socioeconomic characteristics of small-scale organic and conventional rice farmers. In Northern Thailand, the survey covered four provinces, namely Chiangmai, Payao, Chiangrai, and Uthaithani. In Northeast Thailand, it covered four provinces, namely Ubon Ratchathani, Amnartcharoen, Surin, and Yasothon. A total of 626 farms were surveyed, including 309 organic farms and 317 conventional farms. All the organic farms were certified organic and had not used chemicals for at least three years. They were producing mainly for export market.

Overall, the survey sample is representative of poor rural households in the rice-based, rain-fed ecosystem of Southeast Asia. Table 1 shows the household and farm characteristics of the sampled farms. On average, organic and conventional farmers are very similar in terms of age, education, and income, although organic households owned significantly more land than conventional households.

Table 1: Farm and Household Profile

	Organic		Conventional		*p*-value
	(mean)		(mean)		
Age of Household Head	51.9		52.0		0.9128
Educational Attainment of Household Head	(N)	(%)	(N)	(%)	
None	1	0.3	3	1	
Able to Read and Write (self-study, did not undergo formal schooling)	3	1.0	2	0.6	
Primary	262	84.8	258	81.4	
Secondary	41	13.3	45	14.2	
Vocational	1	0.3	4	1.3	
University or Higher			2	0.6	
Total Land Area (in rai)	26.0		22.1		0.0014***
Owned Land Area (in rai)	24.2		19.5		0.0001***
Rented Land Area (in rai)	1.9		2.5		0.2826
Total Income (in baht)	130,657		141,126		0.3289
Income from Crops (in baht)	50,475		58,760		0.0810*
Income from Livestock (in baht)	14,696		14,973		0.9284
Other On-farm Income (in baht)	10,092		12,104		0.5363
On-farm Income from Non-agricultural Activities (in baht)	7,864		9,253		0.7712
Off-farm Income (in baht)	4,004		8,551		0.0170**
Off-farm Income from Non-Agricultural Activities (in baht)	43,525		37,484		0.2840

Note: *significant at 10% **significant at 5% ***significant at 1%

Source: Authors' own calculations

Total household expenditure (Table 2) includes all expenditures net on- and off-farm expenses, including food, clothing, toiletries, utilities, transportation, health, education, and entertainment. The average total household expenditure for all surveyed households was 66,985 baht (US$1,723) [1] . On average, there was no significant difference in total expenditure by organic and conventional farmers, except in the poorest quintile, where organic farmers spent slightly less than conventional farmers. Total household expenditure increased by approximately 15,000 baht per quintile until the eightieth percentile. The largest increase was from the second richest quintile to the richest quintile, in which total expenditure more than doubled. The top quintile represented the larger farms and farms with high non-farm incomes.

Table 2: Total Household Expenditure per Quintile, 2006

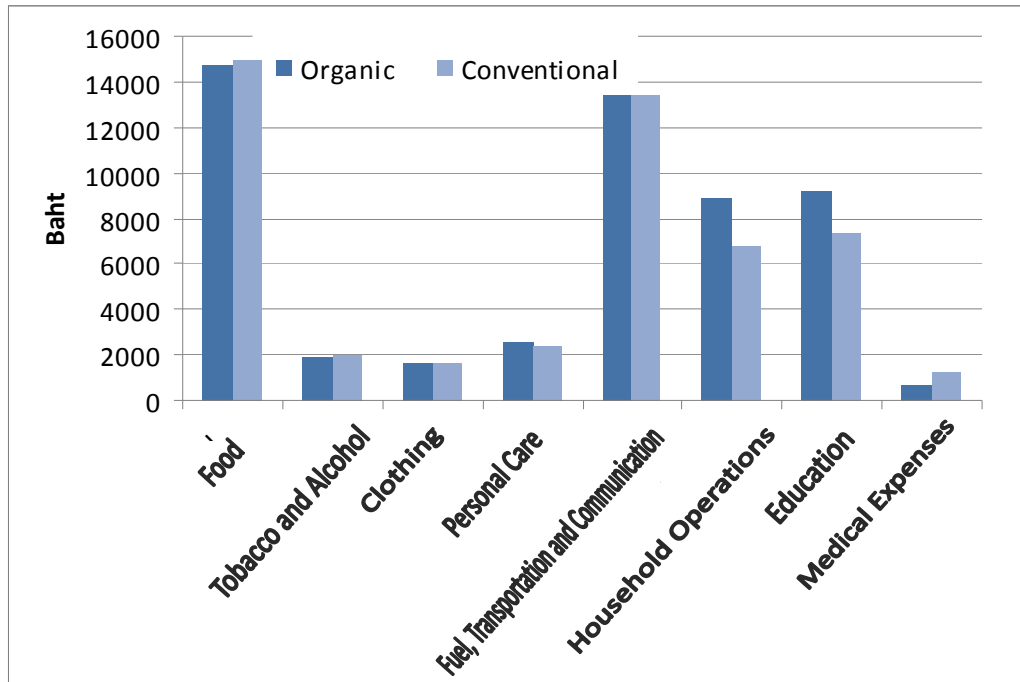| Total Household Expenditure	Total	Organic	Conventional	*p*-value
	66,985	**67,885**	**66,107**	**0.5925**
Poorest 20%	17,966	16,746	19,040	0.0215**
Second Poorest	33,014	33,641	32,335	0.9861
Middle	45,746	45,406	46,139	0.1836
Second Richest	65,245	65,236	65,255	0.4950
Richest 20%	173,303	175,123	171,455	0.5470

Note: * significant at 10% **significant at 5%; *** significant at 1%

Source: Authors' own calculations

1April 2006 exchange rate (38.88 THB=US$1)

Although their total household expenditures were similar, Figure 1 and Appendix Table 1 show that the organic and conventional farmers' spending varied by expenditure category. On average, conventional households had higher medical expenditure than organic households, yet spent significantly less on education and household operations. Overall, the two groups had similar levels of expenditure on food; tobacco and alcohol; personal care; clothing; and fuel, transportation, and communications.

Figure 1: Household Expenditure Comparison, Selected Categories

Source: Authors' own calculations

A potential problem arises, however, if the incidence of catastrophic expenditure is based on OOP payments as a share of *total* household expenditure. As the majority of resources in poor households are devoted to subsistence expenses and few resources are available for healthcare, the budget share of OOP payments in poor households may appear to be low (Wagstaff et al. 2007). The actual magnitude of the effect of OOP payments on the welfare of poor households may be better measured as a share of discretionary expenditure—total household expenditure net spending on basic necessities. Following the approach of a number of authors, non-food expenditure is used as an approximation for discretionary expenditure (Van Doorslaer et al. 2007; Wagstaff et al. 2007).

Table 3: Food Expenditure per Quintile, 2006

Food Expenditure (Share of Household Expenditure)	Total	Organic	Conventional	*p*-value
	14,859 (30%)	**14,752 (30%)**	**14,958 (30%)**	**0.4126**
Poorest 20%	6,274 (36%)	5,914 (38%)	6,592 (35%)	0.0894*
Second Poorest	11,033 (33%)	11,489 (34%)	10,540 (33%)	0.8798
Middle	15,088 (33%)	14,980 (33%)	15,158 (33%)	0.4409
Second Richest	18,552 (28%)	17,143 (27%)	19,938 (30%)	0.0681*
Richest 20%	23,418 (17%)	23,827 (18%)	23,003 (17%)	0.6009

Note: *significant at 10% **significant at 5% ***significant at 1%

Source: Authors' own calculations

The average household spent 14,859 baht (30% of total expenditure), or approximately 1,200 baht per month, on food (Table 3). Although organic households in the poorest, middle, and second richest quintiles spent slightly less on food than conventional households, the overall difference in the food expenditure of the two groups was limited. Annual food expenditure increased by approximately 4,000 baht per quintile. However, consistent with Engel's law, the poor spent a significantly higher proportion of their household expenditure on food. On average, the poorest quintile devoted 36% of household expenditure to food, compared with only 17% by the richest quintile.

Given this severe budget constraint of poor households, discretionary expenditure may better distinguish between rich and poor households and provide a more accurate measure of the impact of health spending on the poor households than household expenditure (Table 4). Among all surveyed households, discretionary expenditure averaged 52,129 baht, with no significant difference between the organic and conventional groups. While the trend per quintile is similar to total household expenditure, the difference between the poorest and richest quintiles is significantly more pronounced, as discretionary spending by the rich was nearly 15 times that of the poor.

Table 4: Discretionary Expenditure per Quintile, 2006

Discretionary Expenditure	Total	Organic	Conventional	*p*-value
	52,129	**53,133**	**51,150**	**0.6067**
Poorest 20%	11,691	10,832	12,448	0.0364**
Second Poorest	21,980	22,152	21,794	0.6608
Middle	30,658	30,427	30,981	0.3344
Second Richest	46,694	48,093	45,317	0.9221
Richest 20%	149,886	151,296	148,452	0.5368

Note: *significant at 10% **significant at 5% ***significant at 1%

Source: Authors' own calculations

IV.   BUDGET SHARES OF OUT-OF-POCKET MEDICAL EXPENDITURE

OOP payment for healthcare is defined as expenditure for drugs and medicine, medical and dental care, hospital room charges, and contraceptives. In Thailand, since universal coverage reform in 2001, there has been a flat charge of 30 baht per visit for most medical services, and no charge for vaccinations, immunizations, and family planning. Under this health program, the medical expenditure reported in the survey is based on number of visits and may underestimate the actual expenditures associated with severity of illness.

Table 5: Out-of-Pocket Medical Expenditure per Quintile, 2006

Medical Expenditure	Total	Organic	Conventional	*p*-value
	999	**712**	**1,277**	**0.0676***
Poorest 20%	359	293	406	0.2608
Second Poorest	685	564	781	0.2837
Middle	616	483	759	0.8783
Second Richest	820	860	767	0.4167
Richest 20%	2,516	1,245	3,892	0.0661*

Note: *significant at 10%, **significant at 5%, ***significant at 1%

Source: Authors' own calculations

Table 5 presents the average household medical expenditure. Although survey data on medical expenditure is potentially subject to bias due to the infrequency in which many healthcare payments are made, the one year recall period of this survey should reduce such bias. It appears from Table 5 that OOP medical expenditure is significantly higher for conventional farmers than for organic farmers. On average, conventional households spent 1,277 baht on healthcare payments, compared with 712 baht spent by organic households. Except the second richest quintile, all conventional agriculture households had significantly higher OOP medical expenditure, although the difference is statistically significant only in the richest quintile, in which conventional agriculture households spent 3,892 baht/year compared to 1,245 baht/year for organic agriculture households.

The budget shares of OOP payments are shown in Table 6. For all households, OOP payments accounted for 1.62% of total household expenditure and 2.31% of discretionary expenditure. The mean budget share of OOP payments was higher for conventional households than for organic households, both as a share of total household expenditure and as a share of discretionary expenditure. For all quintiles except the second richest, organic households spent a smaller proportion of their household budget on healthcare than their conventional counterparts.

Table 6: Budget Shares of Out-of-Pocket Payments

	Total	Organic	Conventional
Payments as a Percentage of Household Expenditure			
Mean	1.62%	1.27%	1.96%
Median	0.20%	0.20%	0.98%
Concentration Index	-0.0551	-0.0720	-0.0279
Quintile Means			
Poorest 20%	1.87%	1.48%	2.17%
Second Poorest	2.00%	1.63%	2.29%
Middle	1.37%	1.07%	1.71%
Second Richest	1.27%	1.33%	1.20%
Richest 20%	1.57%	0.94%	2.25%
Payments as a Percentage of Discretionary Expenditure			
Mean	2.31%	1.81%	2.80%
Median	0.27%	0.27%	0.27%
Concentration Index	-0.0966	-0.1048	-0.0746
Quintile Means			
Poorest 20%	2.75%	2.26%	3.12%
Second Poorest	3.08%	2.40%	3.62%
Middle	2.03%	1.58%	2.52%
Second Richest	1.84%	1.84%	1.83%
Richest 20%	1.85%	1.15%	2.61%

Source: Authors' calculations.

The burden of OOP payments is also disproportionately borne by the poor, as the poorest households spent a larger fraction of their resources on healthcare than the richest. The gradient is steepest as a proportion of discretionary spending, as the two poorest quintiles spent approximately 3% of discretionary expenditure on healthcare, compared with only 1.85% for the two richest quintiles. In addition to the quintile means of budget share, the negative concentration indices confirm that the poor are spending more on healthcare than the rich, especially in relation to discretionary expenditure.

These results are consistent with the findings of Whitehead, Dahgren, and Evans (2001) that poor households in low-income countries spend more on OOP payments than the rich. Yet they are inconsistent with the findings of Van Doorslaer et al. (2007) that the rich spend more on healthcare in most countries in Southeast Asia. A possible explanation offered by Van Doorslaer et al. for the disparate results is that findings that poor households spend more on healthcare are typically based on small samples in rural areas. However, when national datasets are used, the results reflect the health expenditure of the whole country, including OOP payments by the wealthier urban population.

V.   INCIDENCE OF CATASTROPHIC EXPENDITURE

As defined above, medical expenditure can be considered catastrophic if OOP payments account for an excessively high share of household resources. The basic idea is that spending a large proportion of the household budget on healthcare payments deprives the household of spending on other goods and services and can push some households into poverty. This premise will be examined in the following sections, first by approximating the incidence and depth of catastrophic expenditure and then estimating the decreases in consumption of other goods and services.

Previous literature highlights the limitations of estimating the catastrophic effect of illness by using the share of high OOP health payments (Xu et al. 2003) . First, this method identifies only those households that actually acquire treatment and does not take into account households that have illness but cannot afford treatment. It is likely that these households actually incur a higher opportunity cost from poor health. Second, this method does not distinguish between types of medical expenditure. This is potentially problematic as expenditure by wealthy households on elective medical care would not under normal circumstances be considered catastrophic. However, we can assume that in low-income countries, most medical care is essential (Van Doorslaer et al. 2007).

Finally, there is no a priori standard for choosing the expenditure threshold. A common choice in the literature has been 10% of household expenditure, assumed to be the threshold at which the majority of households are forced to forgo other basic needs. Yet while 10% of household expenditure on OOP healthcare payments is catastrophic, 10% of discretionary expenditure is likely not catastrophic (Van Doorslaer et al. 2007; Wagstaff et al. 2007). Therefore, following other authors, we consider various thresholds of both household and discretionary expenditure.

Appendix Table 1 shows the catastrophic payment headcounts for organic and conventional households. The catastrophic payment headcount is defined as the percentage of households from the sample exceeding a particular threshold z. Let T_i be the OOP payments of household i, x_i be household expenditure, and E_i an indicator equal to 1 if $T_i / x_i > z$ and zero otherwise. The percentage of households incurring catastrophic expenditure is:

$$H = \frac{1}{N} \sum\nolimits_{i=1}^{N} E_i ,$$

where the sample size is denoted by N.

Figure 2: Catastrophic Payment Headcount as % of Total Household Expenditure
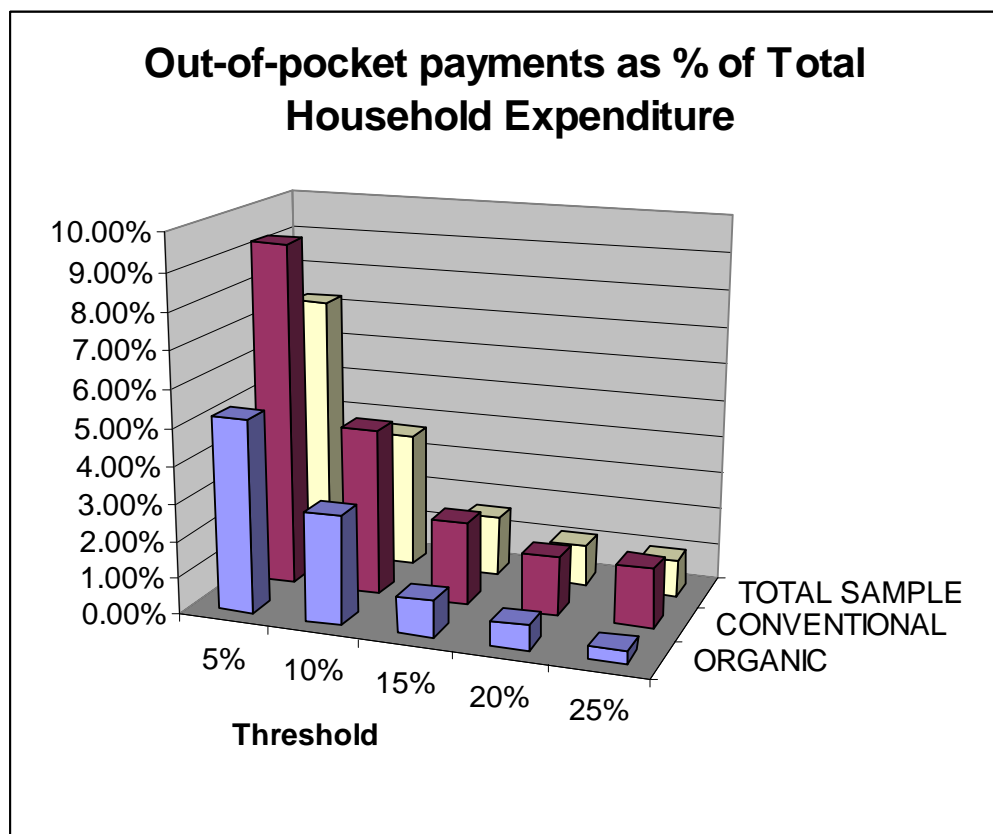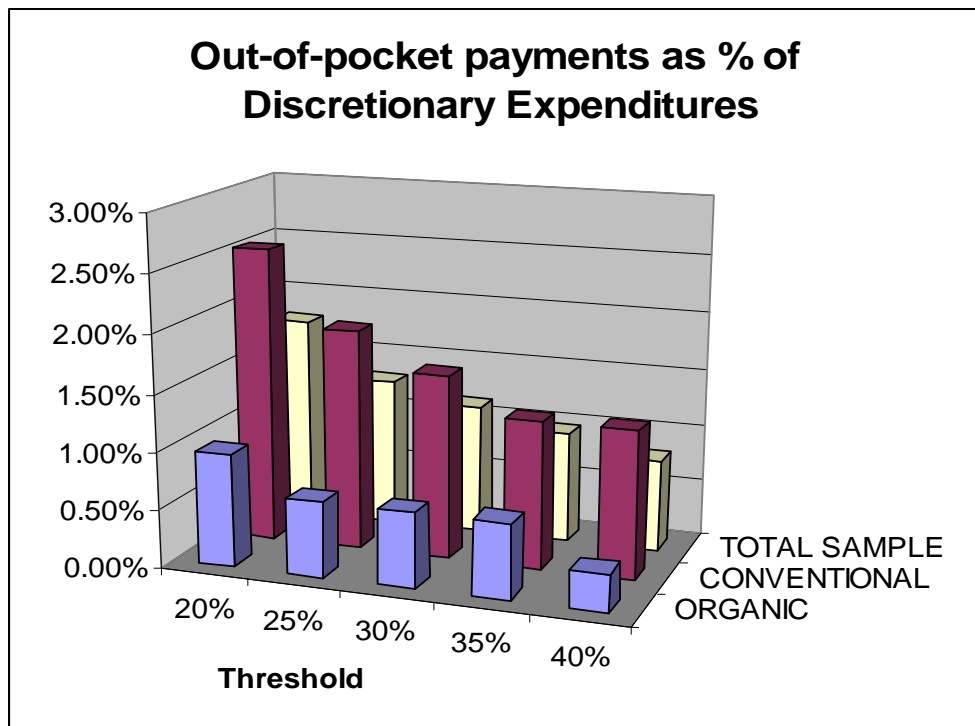

Source: Authors' calculations.

As the threshold rises incrementally from 5% to 25% of total household expenditure, the percentage of households with catastrophic expenditure decreases (Figure 2). The largest decline is seen between the 5% and 10% thresholds. At the crucial 10% threshold, nearly 4% of all households had medical expenditure in excess of 10% of their total household budget. A further 1% of households had OOP payments greater than 25% of total household expenditure. However, organic households had a lower incidence of catastrophic payments than conventional households, regardless of threshold. At 10% of household expenditure, 4.5% of conventional households incurred catastrophic payments, compared with only 2.9% of organic households.

Figure 3 presents catastrophic expenditure as a share of discretionary (non-food) expenses. Nearly 2% of the surveyed households had medical payments in excess of 20% of their discretionary budget. At the staggering 40% threshold, almost 1% of households had catastrophic expenditure. Once again, however, significantly fewer organic households incurred catastrophic payments than did conventional households. Less than 1% of organic households devoted 20% of discretionary spending to health payments, compared with 2.6% of conventional households. Spending on healthcare exceeded 40% of discretionary expenditure in 1.3% of conventional households. Such excessively high expenditure on healthcare is likely to have a significant impact on the household budget, forcing the household to forgo other consumption and severely reducing its living standard.

Figure 3: Catastrophic Payment Headcount as % of Discretionary Expenditure

Source: Authors' calculations.

These findings show that organic households spend significantly less on healthcare than conventional households, both in absolute terms and as a share of household resources. As the household survey does not include data on the health status of household members, it is impossible to conclude with certainty the reason for the lower medical expenditure of organic farmers. However, it is likely that the organic farmers are healthier as they are not exposed to toxic agrochemicals and have better access to homegrown organic products which are known to have higher levels of vitamins and minerals (Brandt 2007).

Among poor farmers in developing countries, illness resulting from the inappropriate use of pesticides is a serious problem. Therefore, it is also important to determine whether poorer organic and conventional households are disproportionately incurring catastrophic health payments. The concentration curves in Figure 4 show the concentration indices for catastrophic headcounts at various thresholds of income. Figure 4 also shows Lorenz curves representing household expenditure by organic and conventional households.

Figure 4: Concentration and Lorenz Curves for Organic and Conventional Households
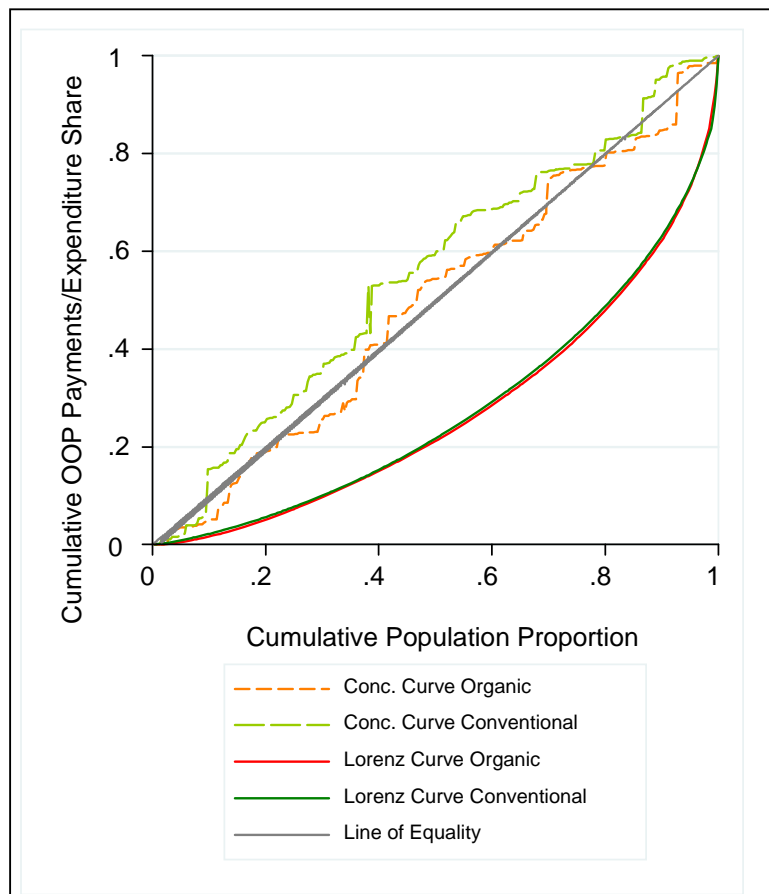
Source: Authors' own calculations.

The concentration curves suggest that catastrophic payments are higher among the poorest farming households, particularly those practicing conventional chemical agriculture. The curve representing organic households, on the other hand, lies below the conventional curve, indicating that catastrophic medical expenditure is borne more equally among organic households. The Lorenz curves show that organic and conventional households have nearly identical patterns of expenditure. This finding reinforces the earlier findings that despite almost equal household expenditure, under the same expenditure category, conventional farmers are spending significantly more on healthcare.

Although health expenditure is influenced by many factors, the findings from these different analyses consistently suggest that organic farmers are in better health. However, these findings are also a concern as they imply that the 30 baht scheme may not be effective at shielding the poor from catastrophic medical expenditures.

VI.   MEDICAL EXPENDITURE AND ITS INFLUENCE ON HOUSEHOLD EXPENDITURE COMPOSITION

After examining the budget shares of OOP medical expenditure and the incidence of catastrophic expenditure among organic and conventional households, we now turn to the impact of catastrophic expenditure on household consumption. The final section looks at the differences in consumption between households with and without catastrophic expenditure and the trade-off between medical spending and other household expenditures. We also estimate the impact of catastrophic payments on different categories of expenditure while controlling for demographic characteristics.

Expenditures were separated into eight categories, including expenses that occur frequently (such as food, tobacco and alcohol, personal care, and fuel) and irregular expenditures (such as education, clothing, and home improvements). The definitions of each expenditure category are listed in Table 7. The independent variable (catastrophic expenditure) is defined here as OOP medical expenditure in excess of 10% of total household expenditure.

Table 7: Expenditure Patterns for Households with and without Catastrophic Expenditure

Expenditure Category	Description	Households with and without Catastrophic Expenditure (CE)					
		Total		With CE		Without CE	
		Mean	Percent	Mean	Percent	Mean	Percent
Food	Rice, bread, vegetables, fruits, meats, etc.	14,876.14	29%	10552.96	28%	15071.33	29%
Tobacco and alcohol	Cigarettes, cigars, beer, wine	1,991.48	4%	977.04	3%	2037.28	4%
Clothing	Clothes, footwear	1,646.24	3%	881.48	2%	1680.77	3%
Personal Care	Toiletries, beauty products	2,476.00	5%	1888.52	5%	2502.52	5%
Fuel, Transportation, and Communication	Fuel, light, water, transport, communication	13,404.37	26%	8102.89	21%	13644.14	26%
Household Operations	Rental, repairs, furniture	7,845.19	15%	3046.67	8%	8061.85	15%
Education	Tuition, school supplies, books	8,273.04	16%	2040.00	5%	8554.94	16%
Medical Expenses	Hospital, medical charges, drugs	999.50	2%	10685.19	28%	562.19	1%

Source: Authors' own calculations

The descriptive analyses indicate that the average surveyed household spent 2% of total household expenditure on healthcare (Table 7). For households incurring catastrophic payments, however, medical spending was the largest category of expenditure, accounting for 28% of household expenditure, compared to only 1% for households without catastrophic payments. Although expenditure shares of food, tobacco and alcohol, clothing, and personal care were roughly similar for households with and without catastrophic expenditure, spending on education, household operations, and transportation and communications was significantly reduced among households incurring catastrophic payments.

Following Wang, Zhang, and Hsiao (2006), a multiple fractional logit regression model was used to analyze the relationship between catastrophic health expenditure and expenditure patterns after controlling for demographic characteristics. Table 8 shows the regression analysis results for each expenditure category. After controlling for age, education of the household head, and organic farming practice, the share of expenditure across all categories is lower for households with catastrophic expenditures. The result is statistically significant for food, clothing, fuel, and education. The relationship between catastrophic payments and decreased expenditure is particularly pronounced for education, pointing to the fact that the welfare of children is most adversely affected when poor households face catastrophic

health expenditure. Interestingly, the analysis shows that expenditure on tobacco and alcohol, which is presumably consumed by male household members, does not decline when households have catastrophic expenditure.

**Table 8: Results of Regression Analysis of Catastrophic Expenditure
and Share of Expenditure Categories**

Expenditure Category	Households with Catastrophic Expenditure	Standard Error
Food	-0.000030*	0.0000301
Tobacco and alcohol	-0.00023	0.00015
Clothing	-0.000607**	0.0002498
Personal Care	-0.000135	0.0001356
Fuel, Transportation, and Communication	-0.0000576*	0.0000316
Household Operations	-0.000007	0.0000147
Education	-0.000086**	0.0000494
Medical Expenses	0.0003749*	0.0000694

Notes: 1. **p<0.05, *p<0.10

2. Regression controlled for age, educational attainment, and farming type.

Source: Authors' own calculations

These findings reveal that catastrophic expenditure on healthcare has a significant effect on households' consumption and can have a negative impact on both the short- and long-term well-being of a household. Households incurring catastrophic payments were forced to cut back expenditure on essential goods and services, such as clothing; fuel, transportation, and communication; and food, thus investing less in their current production system. Perhaps of greater concern, the incidence of catastrophic expenditure forced households to sharply reduce their investment in education, threatening long-term productivity and well-being. This suggests that often poor households must sacrifice long-term benefits for immediate medical treatment.

VII.   CONCLUSION AND RECOMMENDATIONS

Breaking the vicious cycle of ill health and poverty is essential to economic development. Poor health can reduce productivity by reducing labor capacity, limiting productive investments, and depriving children of educational opportunities. The typical public policy response has been to make healthcare services available to the poor, an approach which is costly and generally not successful in reaching the most vulnerable groups. Organic agriculture, on the other hand, achieves health outcomes by promoting preventive health by improving the availability and nutritional quality of homegrown produce, improving the environment and sanitation conditions, and reducing exposure to toxic agrochemicals.

Despite abundant anecdotal evidence that organic agriculture leads to better health outcomes among farmers, there has so far been limited empirical evidence. Using household catastrophic medical expenditure as a proxy for health status, this study attempted to empirically examine whether the adoption of organic agriculture leads to lower medical expenditure, a proxy for improved health. The results of the empirical analysis support the assertion that organic households are in better health than conventional farming households.

The findings of the study revealed that organic households had lower OOP medical expenditure than conventional households, both in absolute terms and as a share of the household expenditure. The results show that organic households had lower incidences of

catastrophic medical expenditure, as significantly more conventional farmers incurred healthcare payments in excess of a large fraction of the total household expenditure. In some cases, OOP healthcare payments absorbed more than one-quarter of total household expenditure and 40% of non-food expenditure in conventional households.

The findings also revealed that the impacts of catastrophic medical expenditure are greater in low-income households than higher-income households. The concentration curves and indices show that catastrophic healthcare payments are borne disproportionately by the poor, especially among conventional farmers. The highest medical expenditures are incurred by the poorest quintiles of conventional farming households. This result is not surprising as it is generally accepted that inappropriate pesticide use is most prevalent among the poorest farmers, who are often illiterate and do not receive training on the proper use of pesticides. This finding suggests that promoting organic agriculture among the poor, who are at high risk of pesticide abuse, would result in more significant health gains than promoting organic agriculture among higher-income farmers.

Households incurring catastrophic payments were forced to cut back expenditure on essential goods and services, such as clothing, fuel, transportation, communication, and food, thus investing less in their current production system. Poor households can only cover the high level medical expenditure by diverting resources from household consumption, accumulating debt, selling assets, or using savings, if they have any. Although we cannot draw a causal relationship between medical expenditure and consumption due to the limitations of cross-sectional data, our findings suggest that household consumption decreased with the incidence of catastrophic medical expenditure. Spending on all major categories of household consumption was lower among households with catastrophic expenditure than those without. Of great concern, education expenditure appears to be among the first expenditures sacrificed when a household member falls ill and requires medical care. These findings reveal that catastrophic expenditure on healthcare has a significant effect on household consumption and can have a negative impact on both the short- and long-term well-being of a household.

Our findings indirectly show that organic households experience less illness than conventional households. Although health outcomes are influenced by a variety of factors, it is likely that organic households are healthier due to a combination of reduced exposure to pesticides, improved food security, better nutrition, and better sanitation conditions in general. By reducing spending on healthcare, the adoption of organic agriculture enables poor households to invest in other areas, such as education, leading to long-term poverty reduction.

Health is so critical to development that three out of the eight United Nations Millennium Development Goals are health related. These findings suggest that promoting organic agriculture is an effective poverty reduction strategy leading to the achievement of the health-related Millennium Development Goals while saving public expenditure on healthcare for the poor. Organic agriculture also uniquely offers a comprehensive health improvement strategy which goes well beyond spending on healthcare to improve related areas such as food security, water, sanitation, and the environment.

Future research should further investigate the links between various health factors, such as nutritional intake, exposure (or lack of exposure) to pesticides, and sanitation conditions, and health outcomes in organic and conventional households through time-series data or a long-term household study. Beyond the health impacts on producers, the impacts on consumers should be further investigated. Since the trade of organic products is growing rapidly in international markets, future research should also investigate how international trade of organic products can have implications beyond national health programs as a global public good.

APPENDIX

Table A1: Household Expenditure, Selected Categories (in baht)

	Organic	Conventional	*p*-value
Food	14,752	14,958	0.8250
Tobacco and Alcohol	1,930	2,052	0.6292
Clothing	1,662	1,625	0.7913
Personal Care	2,561	2,390	0.4202
Fuel, Transport, & Communications	13,395	13,423	0.9805
Household Operations	8,903	6,817	0.5347
Education	9,217	7,349	0.1905
Medical Expenses	712	1,277	0.1309

Note: *significant at 10%; **significant at 5%; ***significant at 1%

Source: Authors' own calculations

Table A2: Percentage of Households Incurring Catastrophic
Out-of-Pocket Medical Expenditure

	Payments as a Percentage of Total Household Expenditure				
	5%	**10%**	**15%**	**20%**	**25%**
TOTAL SAMPLE					
Headcount	7.23%	3.70%	1.61%	1.13%	0.96%
Standard Error	0.02114	0.010296	0.006105	0.006254	0.004845
Overshoot	0.006507	0.003871	0.002757	0.002081	0.001588
Standard Error	0.002021	0.001517	0.001248	0.000951	0.0007
Mean Positive Overshoot*	8.99%	10.47%	17.15%	18.49%	16.46%
ORGANIC					
Headcount	5.19%	2.92%	0.97%	0.65%	0.32%
Standard Error	0.016397	0.0085	0.006177	0.005915	0.002958
Overshoot	0.003901	0.001687	0.000775	0.000384	0.000199
Standard Error	0.001256	0.000881	0.000635	0.00035	0.000182
Mean Positive Overshoot	7.51%	5.77%	7.95%	5.92%	6.14%
CONVENTIONAL					
Headcount	9.27%	4.47%	2.24%	1.60%	1.60%
Standard Error	0.028089	0.013218	0.006609	0.006893	0.006893
Overshoot	0.009093	0.006033	0.004716	0.003757	0.002959
Standard Error	0.002911	0.002195	0.00189	0.001566	0.001225
Mean Positive Overshoot	9.81%	13.49%	21.09%	23.52%	18.52%

Note: *Mean positive overshoot (MPO) is a measurement of the intensity of catastrophic payments. MPO reflects the payment in excess of the threshold averaged over all households exceeding the threshold (Van Doorslaer et al. 2007). The mean budget share of households exceeding a particular threshold is therefore equal to the threshold plus the MPO. For example, the mean budget share of conventional households exceeding the 25% threshold is 25% + 18.52% = 43.52%.

Source: Authors' own calculations

**Table A2 (continued): Percentage of Households Incurring Catastrophic
Out-of-Pocket Medical Expenditure**

	Payments as a Percentage of Household Non-food Consumption				
	20%	**25%**	**30%**	**35%**	**40%**
TOTAL SAMPLE					
Headcount	1.77%	1.29%	1.13%	0.97%	0.81%
Standard Error	0.006241	0.005612	0.006263	0.004853	0.003476
Overshoot	0.003464	0.002727	0.002109	0.001575	0.001142
Standard Error	0.001646	0.00138	0.001091	0.000804	0.000607
Mean Positive Overshoot	19.56%	21.17%	18.71%	16.30%	14.19%
ORGANIC					
Headcount	0.98%	0.65%	0.65%	0.65%	0.33%
Standard Error	0.008894	0.00593	0.00593	0.00593	0.002965
Overshoot	0.001348	0.000984	0.000659	0.000333	0.000108
Standard Error	0.001227	0.000896	0.000599	0.000303	9.87E-05
Mean Positive Overshoot	13.79%	15.11%	10.11%	5.11%	3.33%
CONVENTIONAL					
Headcount	2.56%	1.92%	1.60%	1.28%	1.28%
Standard Error	0.007014	0.005928	0.006893	0.004358	0.004358
Overshoot	0.005551	0.004445	0.003539	0.002799	0.00216
Standard Error	0.002138	0.001903	0.001601	0.001311	0.001112
Mean Positive Overshoot	21.72%	23.19%	22.15%	21.90%	16.90%

Source: Authors' own calculations

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