QUANTITATIVE MODEL OF ELEMENTS AFFECTING PEASANTS INCOME: A CASE STUDY OF KAMPONG CHAM, CAMBODIA

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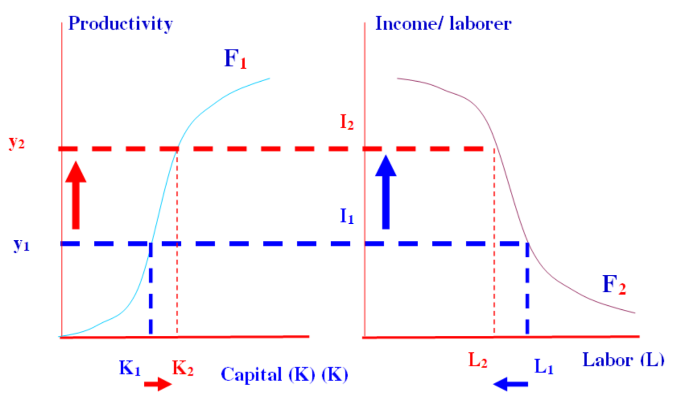
Until recently, there have been many researches by both Vietnamese nationals and foreigners on solutions to peasants' income, but a scientific basis for these solutions is still lacking, especially a quantitative model of elements of peasants' income. Identifying a quantitative model based on agronomical theories and hard facts is still a challenge to researchers and policy- makers in many countries. To deal with this challenge, we have conducted a research on income of rice-growing peasants in Kampong Cham, Cambodia, with a view to collecting facts and data for the model. This paper concentrates on two main issues: a framework of quantitative model and results applied to rice-growing peasants in Cambodia.

1. Theoretical framework

a. Theoretical model:

Mankiw (2003) argues that difference in income between nations comes from differences in productivity [1].

Figure 1: Productivity and income of a agricultural laborer



According to Park S.S (1992) [2], on the way to development, agricultural growth comes from improvement in the productivity in agricultural production, and this growth enhances peasants' income. Figure 1 shows increased capital makes the productivity get higher, and reduces the labor force in the agricultural sector. Park proves that increases in the income depend on labor productivity.

Thus, the productivity is a condition for changes in the income. What affect the productivity will have impacts on the income.

Lewis (1955) [3] maintains that idle labor does exist in the agricultural sector, therefore, the productivity in this sector is low. Moving part of idle labor from the agricultural to manufacturing sector helps improve the agricultural productivity.

Park (1992) [2] shows that the agricultural development experienced three stages: primitive, developing and developed. Decisive factors for these stages are size of labor force, application of biotechnology and mechanization respectively.

Oshima (1995) [3] notes that in the developing stage, increase in the agricultural output depends on diversification of production, application of biotechnology, and large-scale production (farm) aiming at increasing the output.

According to Randy Barker (2002) [4], the labor productivity in the agriculture depends on land yield (value of output per hectare) and size of farming land (land area per laborer).

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After a survey in the Mekong Delta, Đinh Phi Hổ (2008) [3] discovers that the land productivity depends on: application of biotechnology, size of investment, labor force, and peasants' knowledge of agricultural production.

The authors (Đinh Phi Hổ, Vann Dy, 2008) [5] have conducted a survey of peasant families in three districts typical of low-, middle-, and high-income ones in the province of Kampong Cham, Cambodia with 150 randomly-selected samples. Results show that a linear correlation exists between productivity of agricultural labor (or income per laborer) and theoretical variables as follows:

Table 1: Correlation between labor productivity and theoretical variables

Dependent variable: Productivity of agricultural labor (Income / laborer)	Regression coefficient (B_i)
Independent variable:	
Farming area (ha)	0.12
Expense on machine (riel1,000/ ha)	0.08
Loan capital (riel1,000)	0.01
Agricultural knowledge (point)	0.40
Labor cost (riel1,000/ ha)	-0.17
Biological cost (riel1,000/ ha)	0.08

The Table 1 shows that the income has a linear correlation with the following variables: farming area, mechanization (expense of mechanic service), agricultural knowledge, labor, and biological cost (expenses on seeds, fertilizer, chemicals, etc.)

b. Quantitative model

Based on theoretical model of agronomy and results gathered from Kampong Cham, the quantitative model of factors affecting the income of rice-growing peasants is assumed as follows:

Y = F (DT, MC, CA, AK, LC, BC)

Dependent variable:

Y: Income (Total sales of rice per laborer in the family: riel1,000 per year)

Independent variables:

DT: Farming area per family (ha)

MC: Mechanization cost (riel1,000/ ha/year)

CA: Loan capital from formal sources (CA = 1, or with loan; CA = 0, or without loan)

KL: Agricultural knowledge (point)

LC: Labor cost (riel1,000/ ha)

BC: Biological cost (riel1,000/ ha)

Model of the income of rice-growing peasant (DPH1-2010) assumes that a linear relation between dependent variable and independent ones exists according to the following form:

$$LnY = B_o + B_1LnDT + B_2LnMC + B_3CA + B_4LnKL + B_5LnLC + B_6LnBC$$

It's expected that the independent variables have positive linear relations with dependent one (except for the variable 'labor cost').

Parameters are estimated using the OLS method and SPSS in the following steps:

(1) Doing the linear regression with all selected variables in the model to produce initial results.

(2) Assessing the goodness of fit of the model (through the adjusted R^2 and analysis of variance ANOVA), and taking the step 3 if the model is fit.

(3) Testing violations of necessary assumptions in the linear regression:

- Multicollinearity (through VIF and Pearson correlation matrix): if the multicollinearity exists, variables are tested and removed in order to get rid of the multicollinearity.

- Changing variance (by Spearman rank correlation test): If the changing variance exists in a variable, it is removed from the model and regression is done again. Then the step 2 is conducted again until all variables are free from changing variance.

2. Results of application of the model in Kampong Cham

To apply the model to reality, the authors select 180 samples in three districts typical of low-, middle-, and high-income ones in Kampong Cham. This province is some 124km from Phnom Penh on the National Route 7. It borders Tây Ninh (Vietnam) to the east, provinces of Kampong-Chhnang and Kampong-Thom to the west, province of Kratie to the north and province of Prey Veng to the South. It is the main supplier of rice in Cambodia.

Samples are selected randomly and interviews with rice-growing peasants are conducted directly, and 150 samples have full information as required by the model.

a. Results of multiple regression analysis

(1) Initial model:

Table 2: Regression results of the initial model

Dependent variable: LnY

	Unstandardized coefficient		Standardized coefficient	*t*	Sig.
	B	Standard error	β		
(Constant)	1.971	0.821		2.402	0.018
LnDT	0.894	0.078	0.737	11.417	0.000
LnMC	0.276	0.061	0.289	4.544	0.000
LnLC	-0.100	0.082	-0.087	-1.222	0.225
LnAK	0.476	0.196	0.149	2.422	0.017
LnBC	0.339	0.107	0.231	3.172	0.002
CA	0.016	0.155	0.006	0.100	0.920

Table 2 shows that four variables (farming area, mechanization, knowledge and biotechnology) ensure statistical significance at a level of 95% (Significance < 0.05). Labor and loan from formal institutions don't have statistical significance (Significance > 0.05).

Adjusted model is free from variables with no statistical significance.

$LnY = B + B_1LnDT + B_2LnMC + B_3LnAK + B_4LnBC$

Results show that the analysis of variance Anova (with reliability of 99%) of the linear regression model is sufficient to consider the model appropriate to the data. Independent variables explain 69.7% of changes in the dependent variable. Of these variables, farming area, mechanization, agricultural knowledge and biotechnology have forward and statistically significant effects on the income.

Table 5: Pearson correlation coefficient matrix

	LnY	LnDT	LnMC	LnAK	LnBC
LnY	10.000	0.6930	0.2358	0.3888	0.3439
LnDT	0.6930	10.000	0.1565	0.3728	0.0816
LnMC	0.2358	0.1565	10.000	0.2147	0.3926
LnAK	0.3888	0.3728	0.2147	10.000	0.1280
LnBC	0.3439	0.0816	0.3926	0.1280	10.000

Table 5 shows that the independent variables have correlation coefficients smaller than 0.6. This result, along with VIF < 10 (shown in the Table 3) allows us to affirm that the regression model is free from autocorrelation.

With the Durbin-Watson value of 1.44 (greater than 1 and smaller than 3), the initial model has no autocorrelation.

Table 3: Regression results

	Unstandardized coefficient		Standardized coefficient	*t*	Sig.	Collinearity statistics	
	B	Std. error	β			Tolerance	VIF
(Constant)	2.444	0.733		3.334	0.001		
LnDT	0.852	0.071	0.702	12.008	0.000	0.843	1.186
LnMC	0.257	0.058	0.269	4.412	0.000	0.774	1.292
LnAK	0.477	0.194	0.150	2.459	0.016	0.779	1.284
LnBC	0.406	0.089	0.276	4.569	0.000	0.788	1.269

Table 3 shows that significance of all independent variables is smaller than 0.05, therefore the variables, ie. area, mechanization, agricultural knowledge, and application of biotechnology, have statistically significant relations with the income.

(2) Tests:

Table 4: Analysis of variance (ANOVA)

	Sum of squares	Degree of freedom	Mean square	F	Sig.	Adjusted R^2	Durbin Watson
Regression	696.894	40.000	174.223	609.893	0.0000	0.691	1.44
Residual	294.232	103.000	0.2857				
Total	991.126	107.000					

Table 6: Spearman test

		ABSRES
ABSRES	Correlation coefficient	1
Logarithm DT	Correlation coefficient	0.12223
	Significance (two-tail)	0.09507
Logarithm AK	Correlation coefficient	0.0151
	Significance (two-tail)	0.580572
Logarithm BC	Correlation coefficient	0.21442
	Significance (two-tail)	0.106328
Logarithm MC	Correlation coefficient	0.2138
	Significance (two-tail)	0.059217

Testing the changing variance using the Spearman test shows that the independent variables after two-tailed test (area, agricultural knowledge, biotechnology and mechanization) have significance greater than 0.05. This means that there is no change in variance of error.

We conclude that the adjusted model has statistical significance with all tests conducted.

Thus, the model DPH1-2010:

LnY = 2.444 + 0.852LnDT + 0.477LnAK + 0.406LnBC + 0.257LnMC

is the final model selected for our research.

3. Conclusions

The variables (farming area, agricultural knowledge, application of biotechnology and mechanization) explain 69.1% of changes in the income.

The farming area is the variable that produces a forward effect on the peasants' income and a statistical significance. Namely, when other variables in the model do not change and the area increases by 1%, the income increases by 0.84%.

The application of biotechnology also has a forward effect on the income: if the biological cost increases by 1%, the income rises by 0.40%.

The same effect is produced by the mechanization: it makes the income rise by 0.25% when it increases by 1%.

The agricultural knowledge produces a forward and statistically significant effect on the peasants' income: when other variables in the model do not change and the point given to peasant's knowledge increases by 1%, the income increases by 0.47%.

Standardized regression coefficients reflecting the effects of each factor on the income arranged in order of importance are as follows: area (0.7), biotechnology (0.276), mechanization (0.269) and peasant's knowledge (0.15).

To increase the income of rice-growing peasants, agricultural policies must aim at: (1) developing the agricultural production into a larger scale; (2) accelerating the application of the biotechnology (new strains, fertilizers and crop-protecting chemicals); (3) Enhancing the mechanization; and (4) Helping the peasants enhance their agricultural knowledge■

References

1. N. Gregory Mankiw (2003). Nguyên lý kinh tế học. Tập 1 (Vietnamese version of *Principles of Economics*, Vol. 1). Thống Kê Publishing House. Hà Nội.

2. Park S.S, 1992. Tăng trưởng và phát triển (Vietnamese version of *Growth and Development*). CIEM. Hà Nội.

3. Đinh Phi Hổ (2008). *Kinh tế học nông nghiệp bền vững* (Sustainable agronomy). Phương Đông Publishing House. HCMC.

4. Đinh Phi Hổ (2003). *Kinh tế nông nghiệp: Lý thuyết và thực tiễn* (Agricultural economy: Theory and practice). Thống Kê Publishing House. HCMC.

5. Chiv Vann Dy (2009). "Các yếu tố ảnh hưởng đến thu nhập của nông dân sản xuất lúa ở Kongpongcham, Campuchia" (Factors affecting the income of rice-growing peasants in Kampong Cham, Cambodia). Unpublished doctoral thesis. UEH. Mentor: Ass. Prof., Dr. Đinh Phi Hổ.