

Rice production in the Mekong River Delta: Differentiation of rice production efficiency among farms and causal factors

TRAN Tien Khai, PHAM Van Bien, Philippe Lebailly

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Summary

The objective of the paper is to study the differentiation of rice production efficiency in Mekong River Delta, Vietnam and causal factors. Dataset analyzed is drawn from a study conducted in the period 1994-2000 at farm level and focuses in adaptive strategies of rice farms to maintain the competitiveness. Main data have been collected through a semi-permanent survey on around 150 rice farms of different ecosystems representative for Mekong region.

The study found that the differentiation of rice farms in terms of production efficiency occurred because of the disparities in technical levels and production factors holding. The interactions of different factors as socio-economic conditions, policies, techniques and the production management of farm household must be taken into account.

The results also imply that the selection of suitable production zones, the application of simplified input-saving techniques, the improvement of extension service as well as knowledge transfer to farmers would be the appropriate measures to improve farm income and competitiveness of Vietnamese rice.

1. Introduction

Since the decade 1990, competitiveness of some main agricultural sectors of Vietnam has initially recognised when the national economy in transition has strongly depended on export. Of which, it is necessary to understand the nature of competitiveness of Vietnamese rice and the dynamic changes of rice production, particularly at farm level, the core of agricultural sector. The understanding would help to know how to maintain the strength of Vietnamese rice in international rice market and to improve farm income.

The purpose of this paper is to analyse an aspect of rice production that is differentiation of rice production efficiency among rice farms. The aim is to search reasons explaining why and how difference of competitiveness among farms. The approach direction, therefore, is not the central tendency but inclines to the observation of individual farms.

2. Study methodology

The analysis is based on the panel dataset drawn from the study conducted by Institute of Agricultural Sciences for Southern Vietnam and the Department of Economics and Rural Development, Gembloux Agricultural University of Belgium in the period 1995-2000. The used dataset for the analysis covered 84 rice farms in 6 different villages¹ in Mekong Delta, in which, the interviews on rice production costs and returns were conducted at each continuous rice crop.

* Institute of Agricultural Sciences of South Vietnam; ** Gembloux Agricultural University of Belgium

¹ Flood plain of Mekong River, irrigated rice: Thanh Quoi and Duong Xuan Hoi villages

Ancient alluvial terrace of Mekong Delta, rainfed rice : Duc Lap Ha and Hoa Khanh Tay villages

High coastal plain of Mekong River, rainfed rice: Thuan My and Vinh My A villages

The rice farms were proportionally drawn from the populations classified into three main socio-economic classes: rich, medium and poor.

The interrogated rice farms were classified into different groups according to quintiles of revenues from rice production (the remained value after subtracting all production costs from product value, except opportunity cost of family labour). This economic indicator is considered representative for the efficiency of rice production because it expresses the real returns to farmers after devoting their resources (land, capital and family labour/management) to rice production and fits with farmer's priority: maximising real returns. Therefore, getting more revenues on a land unit indicates better use of farms resources, or production efficiency. The comparison between the highest and the lowest revenue quintiles would be useful to explore how different the integrated use of production factors and farm management are. In such an approach, the changes in integrated uses of resources of the representative farms will be taken into account. The study expects to find reasonable answers for the issues as how farmers are able to maintain low costs of production and why some farms lose while the others win in competition.

In this analysis, the cultivated condition is assumed homogeneous in the same village. In addition, the selection procedure has to ensure that the representative farms have the same performance during the observation time. Assuming that rice farms are not able to adjust their production factors as well as cultivation techniques in the short run, the selection of the farmers having the same performance in the study period is probably appropriate for the analyses. Therefore, selected farms of two quintiles in each village must have high frequency of occurrence during observed crops, which varied from 4 to 18 continuous crops depending on different villages. T-test is applied to evaluate difference between to farms groups.

The paper will discuss key parameters affecting to rice production efficiency. The factors mentioned will be socio-economic situation of rice farms, land productivity, cost management, technical application and skills in use of some main inputs, mode of utilisation of manual labour and mechanised equipment as well as influences of price factor.

3. Results

The preliminary graphical screening revealed that there was a consistent positive relation between paddy yield and farm revenue of family labour. High revenue is likely associated with high yielding production. Therefore, obtaining high paddy yield appears as a very important measure leading to high farm income in Mekong Delta. In addition, the consistent inverse relation between revenue of family labour and unit cost of paddy confirms the association between high revenue and low unit cost. Hence, maintaining low unit cost would be another important measure that ensures high real farm income. Meanwhile, unclear relation between revenue and total costs means high investment in cash to rice production is not useless if it generates high paddy yield. From the above relations, farmers obtaining the highest levels of revenue were probably the ones who had high paddy yields in combination with low production costs. Therefore, generally speaking, maintaining a reasonable investment in combination with high paddy yields could be the key factor bringing high revenue to rice farms. To those cases, low unit cost is ensured.

The observation of distributions of revenue, farm size, paddy yield and unit cost permits to draw some important issues related to socio-economic situation of farms as follows: (1) revenue of family labour per land unit is positively associated with relatively farm size; (2) the majority of farms having high revenue per land unit belong to the rich and the medium farms; (3) poor farms could obtain the same level of paddy yield as the rich and the medium and (4) the poor were able to obtain high efficiency as the rich or the medium ones.

Table 1 - DISTRIBUTION OF SELECTED SAMPLES BY GROUP OF EFFICIENCY

Villages	Thanh Quoi	Duong Xuan Hoi	D.L.Ha H.K.Tay	Vinh My A	Thuan My	Total
Observations per crop (farm)	15	15	24	15	15	84
High efficient farms (farm)	3	3	5	3	3	17
Percentage (%)	20.0	20.0	20.8	20.0	20.0	20.2
Low efficient farms (farm)	3	3	5	3	3	17
Percentage (%)	20.0	20.0	20.8	20.0	20.0	20.2
Observed crops (crop)	10	18	6	4	6	

Source: calculated from survey data of the project CFR-MK-VN and author

The result of the farm selection for efficiency analyses is presented in the table 1 below. The farms of the highest revenue quintiles are named as ‘High efficient farms’ or ‘High’ or ‘Best’. Similarly, the terms ‘Low efficient farms’ or ‘Low’ or ‘Worst’ imply farms belonging to the lowest revenue quintiles.

How was production efficiency of farms different? Although natural and cultivation conditions are relatively homogenous at village level, the disparity in farm revenues of rice production among farms was remarkable. The high efficient farms often obtained much higher income on the same rice area in comparison to the low efficient farms. The gap in efficiency between two groups was widened in the ancient alluvial terrace and high coastal plain sowing traditional rice (9.6 and 4.3 times, respectively). The differences frequently occurred during observed rice crops and all statistically significant at high confidence level.

Other economic indicators as the total product value, the gross margin and the ratio between total product value and variable costs show the same issue (table 3). With the same land area, the high efficient farms often generated much more values of total product value and gross margin. On average, the total product values of the best were higher than that of the worst by 28% to 86% depending upon villages. Capital utilisation of the best group was also much more lucrative than the worst. For modern rice, an investment of one \$US into rice production of the worst created only 1.22 to 2.20 \$US. Meanwhile a similar investment of the best generated 2.34 to 3.46 \$US. In relative values, profit ratio of the high efficient farms was from 1.6 to 2.2 times higher than that of the low efficient.

Table 2 - REVENUES OF FAMILY LABOUR FROM RICE PRODUCTION OF HIGH AND LOW EFFICIENT FARMS (\$US/ha/crop, 1994-1999 averages)

Villages	Thanh Quoi	Duong Xuan Hoi	Duc Lap Ha Hoa Khanh Tay	Vinh My A	Thuan My
High efficient farms	559.6	375.1	315.1	490.5	572.3
Low efficient farms	329.3	179.1	32.8	191.3	131.4
Difference between High and Low (%)	169.9	209.4	962.0	256.4	435.6
Frequency of right occurrence	+9/10	+18/18	+5/5	+4/4	+6/6
Means difference	***	***	*	***	***

Source: calculated from survey data of the project CFR-MK-VN and author

Table 3 – DIFFERENCES OF HIGH AND LOW EFFICIENT FARMS ON SOME ECONOMIC PARAMETERS ON LAND UNIT (% , 1994-1999 averages)

Villages	Thanh Quoi	Duong Xuan Hoi	D.L.Ha H.KTay	Vinh My A	Thuan My
Product value	128.0***	122.5***	146.8*	148.42***	186.6*
Frequency of right occurrence	+9/10	+16/18	+5/5	+4/4	+6/6
Gross margin	165.8***	192.7***	480.7*	223.2***	316.2***
Frequency of right occurrence	+9/10	+18/18	+5/5	+4/4	+6/6
Product value / variable costs	157.0***	159.5***	192.3***	172.5***	220.6*
Frequency of right occurrence	+10/10	+18/18	+6/6	+4/4	+6/6

Source: calculated from survey data of the project CFR-MK-VN and author

Influence of the socio-economic situation of farms to the efficiency of rice production

One of the factors considered having a connection with efficiency is the socio-economic situation of rice farms. The studied results show that although poor farms have tried to improve paddy yield, they often got lower land productivity than the rich. In addition, their overuse of inputs and costs has been common in all agro-ecological zones. In consequence, the poor farms appeared to be less efficient than the richer farms.

Nevertheless, there is evidence that the poor farms were able to obtain high efficiency. Although many of them belong to the lowest quintiles (59% of in-group observation), at least 29% of poor farms belonged to the highest quintiles. On the contrary, some rich farms fell into the lowest quintiles. 18% of farms belonging to the low efficient group were the rich ones. In other words, efficiency is not only come from the richness but also from other factors. It means the poor can become efficient producers thanks to their efforts.

That factor is likely to influence the efficiency of rice production through the effect of “economy of scale”. The results revealed that advantage of large-scale farms appeared to be common in irrigated zones, where cultivation conditions are relatively controlled and land potential can be developed to a high degree. However, it is not clear enough in the unfavourable conditions.

Table 4 - FARM SIZES OF HIGH AND LOW EFFICIENT FARMS (ha/farm, 1994-1999 averages)

Villages	Thanh Quoi	Duong Xuan Hoi	D.L.Ha H.KTay	Vinh My A	Thuan My
High efficient farms	2.01	0.82	1.05	1.34	0.67
Low efficient farms	0.74	0.67	0.47	2.31	0.58
Difference between High and Low (%)	270.7	122.4	221.1	58.1	115.5
Frequency of right occurrence	+10/10	+17/18	+6/6	-4/4	+4/6
P-value for means difference	0.0000	0.0000	0.0277	0.0661	0.3292

Source: calculated from survey data of the project CFR-MK-VN and author

Effect of farm management on efficiency of rice production

The disparity between the two quintiles was very clear when results of farm management analysed. From the dataset, it is likely that the best farms obtained high paddy yield, low production costs and as the result, low paddy unit cost (table 5).

The consistent relation between high yielding and high efficiency is confirmed by the remarkable difference between two farm groups. The best farms generated much higher paddy output in a land unit in comparison to the worst farms. On average, paddy yield they obtained was from 1.16 to 1.75 times higher than that of the worst. In absolute values, the yield differences ranged from 829 kg to 1 721 kg/ha/crop. Cost management is also a factor influencing to efficiency of rice production. Cost spending between two extremes were remarkable. Generally, the high efficient farms frequently spend fewer costs than the low efficient. In absolute values, the differences

varied from 17 \$US to 96 \$US/ha/crop, respectively. Those saved amounts contributed importantly to farm income, especially for the small-scale producers.

Table 5 - COMPARISON OF RICE PRODUCTION EFFICIENCY BETWEEN HIGH AND LOW EFFICIENT FARMS (% , 1994-1999 averages)

Villages	Thanh Quoi	Duong Xuan Hoi	D.L.Ha H.KTay	Vinh My A	Thuan My
Paddy yield	116.1***	123.3***	137.1*	137.4*	175.8***
Frequency of right occurrence	+9/10	+17/18	+6/6	+4/4	+6/6
Total costs	80.7***	87.9***	69.4*	93.8 ns	62.2*
Frequency of right occurrence	-10/10	-18/18	-6/6	-3/4	-5/5
Paddy unit cost	67.8***	73.2***	52.9*	67.3***	31.6***
Frequency of right occurrence	-10/10	-18/18	-6/6	-4/4	-5/5

Source: calculated from survey data of the project CFR-MK-VN and author

Obviously, there is a difference in use of capital resource of rice farms. For those who obtained high level of efficiency, their in-cash investment appears to be much efficient because they could reduce expenditures to a land unit while maintaining higher paddy yield. On the contrary, the low efficient farms had to spend more money but they get a low production result. As the aggregate results, high efficient farms obtained a much cheaper unit cost of paddy, which leads to significantly higher farm real revenues.

The detailed analyses of technical application and skills showed many differences between two quintiles. The parameters observed were seed rate and costs, expenditures on chemical fertilisers and application techniques, pesticides use, labour use and mechanisation. The investigation on the use of material inputs in terms of quantity and value, input costs affirmed the role of technical development to enhance overall production efficiency.

Advantage of getting favourite output price for the high efficient farms

There is likelihood that the high efficient farms in some villages had also stronger price negotiation power on paddy price in comparison to the small farms due to bulk sale. Getting higher prices in that way probably contributes to the difference in selling prices of the high efficient farms.

Thanks to obtaining higher paddy price, the high efficient farms received favourable relative prices of fertilisers to paddy. Although the fertilisers prices in absolute value did not differ, relative prices were lower. For urea kind, they paid at the levels varying from 87.3 to 98.4% in comparison to the low efficient farms. The differences of less than 8% were statistically significant, as in Thanh Quoi and Vinh My A villages. Data also implied the continuity of price advantage of the best farms in most of villages during the study period (table 6).

Table 6 - SELLING PRICE AT FARM GATE OF PADDY OF HIGH AND LOW EFFICIENT FARMS (% , 1994-1999 averages)

Villages	Thanh Quoi	Duong X.Hoi	D.L.Ha H.Ktay	Vinh My A	Thuan My
Selling price	109.2***	99.0 ns	108.5 ns	111.8 ***	104.2 ns
Frequency of right occurrence	+9/10	-11/18	+5/5	+4/4	+5/6
Relative price of urea to paddy	91.8 *	98.4 ns	92.8 ns	87.3 *	95.6 ns
Frequency of right occurrence	-7/10	-9/18	-4/5	-4/4	-3/5

Source: calculated from survey data of the project CFR-MK-VN and author

4. Discussion

There was the wide difference in efficiency of rice production among the study farmers in the period 1994-1999. Such disparity frequently and systematically occurred. It is expressed through

the indicators of farm income as the gross margin and the revenue of family labour. In addition, the best farms often obtained much better efficiency in the use of capital for rice production.

The majority of farms obtaining high revenue from rice production belong to the rich and the medium farms. It revealed that the socio-economic situation of farms likely affected the efficiency of rice production. However, being rich is only a necessary condition but not sufficient to gain high profits in rice production in the study context. In other words, efficiency is not only formed based on the richness but also other factors. It means the poor can become the efficient producers thanks to their efforts, especially knowledge and skills of cultivation.

Simultaneously, high efficiency is likely associated with relative big farms while the small farms often have low efficiency. Nevertheless, the advantage of large-scale farms requires a good control of cultivation conditions. Therefore, the large-scale farms in irrigated zones have better opportunity to obtain high efficiency than ones in rainfed conditions. In the later case, big farm size is not associated with high efficiency due to difficulties in improvement of the natural environment for cultivation.

Farms obtaining the highest levels of revenue were probably the ones that had high paddy yields in combination with low production costs. Therefore, maintaining a reasonable investment in combination with high paddy yields could be the key factor bringing high revenue to rice farms. To those cases, low unit cost is ensured.

The data confirm the difference in the use of capital resource of rice farms. Capital use efficiency comes from the combination of cost reduction and maintaining high paddy yields. The study results imply once the appropriate technical measures are applied, improvement in capital use efficiency of rice production is possible.

The frequent misuse of inputs of the lowest revenue farms implies that they often applied inadequate cultivation techniques. That is obvious in the use of rice seed, fertilisers and pesticides. In comparison to the lowest revenue farms, the best farms likely practised better application methods. Thanks to the application of appropriate seed rates in combination with good water management, they were able to reduce seed quantity and costs. In addition, their appropriate use of pesticides, especially herbicides contributes to the reduction of relevant expenses. Moreover, although they applied less fertiliser rates in a land unit, they obtained much higher paddy yield and higher fertiliser use efficiency. It is due to the more balanced nutrient application and appropriate timing. In addition, thanks to the adequate use of herbicides, they were able to save remarkable labour quantities for rice replanting and hand weeding.

High efficiency in the use of family labour is another characteristic of the best farms. Although labour intensity was common for the lowest revenue farms, it appeared to be ineffective when they had to use external machined services at the same level as the highest revenue farms.

The difference in technique application between the highest and lowest revenue farms implied the existence of disparity in technical knowledge among farms. It also proved that the process of knowledge intensification has been forming and gradually replacing for input intensification for rice production in Mekong Delta in recent years.

Another advantage of the highest revenue farms was to get favourite prices of inputs and output. Thanks to the bulk sale and high demand of external services, they had a stronger price negotiation power. The reduction of input quantity per land unit and favourite prices of materials, services and product were noted. Price advantage made the disparity of costs and revenues between two farm groups more widened.

As the aggregate results, the best farms obtained much cheaper unit cost of paddy, which leads to significantly higher farm real revenues. The combination of better practise of cultivation

techniques and advantages due to economy of scale resulted in stronger competitiveness for a small group of rice producers who were usually large-scaled and rich farms.

The study implies the complexity of differentiation of rice farmers in terms of production efficiency in Mekong Delta. The process of differentiation is affected by numerous factors that might interact each other. The analyses permit to outline the differentiation process. The possible causal factors affecting the process might be divided into four factors' groups: (1) natural, socio-economic and policy environment of rice production; (2) farm resources; (3) technical level of rice farmers that varies by natural conditions of rice cultivation and (4) farm accessibility to markets.

The natural, socio-economic and policy environment of rice production and its impacts on the differentiation in Mekong Delta in the decade 1990 might be summarised by the following features:

- *Diversity in natural conditions and then, in rice cropping patterns*: the factor leads to difference in efficiency of rice production in different agro-ecological zones and seasonal crops;
- *Land fragmentation and majority of small farms*: that feature might reflect the influences of the economy of scale on rice production in Mekong Delta. In the context of the dominance of small farms and the legal land ceiling, increase in farm size is synonymous with increase in production efficiency, measured per land unit. However, optimum scale of rice production is still not studied yet.
- *Intensification of rice production*: under the pressure of a dense population and the dependence on the agriculture of national economy, rice intensification has become the priority in rice research and development. The intensification probably contributes to differentiation of rice farmers due to requirement of capital and material-input intensity that small farmers might not fully satisfy because of poor resources.
- *Increase in market orientation* changes rice production from subsistence to commercialisation. Consequently, market-oriented policies put rice farmers in competition. It forces farmers to change cultivation techniques in order to increase rice yield and improve rice grain quality. *Integration into international rice market* makes the pressures on reduction of production costs and improvement of rice quality higher.

Farm resources compose the internal factors affecting rice production in both economic and technical aspects with different levels from low to high. In the study context, increase in farm resources and increase in production efficiency seem to be synonymous. They imply farm ability to respond to production environment, especially market orientation and intensification of rice production. Those internal factors can be divided into some sub-factors as follows:

- *Richness of farms*: that term implies the socio-economic situation, the level of holding production factors, the ability to access to formal credit as well as the price negotiation power of rice farmers. The practical observations showed that increase in richness of rice farms probably facilitates capital use and investment for rice production.
- *Farm size*: in the context of land fragmentation and dominance of small farms in Mekong Delta, farm size has a close relation to production efficiency due to the positive economy of scale (cost economies). In the study, farm size also reflects the richness of rice farms.
- *Control level for conditions of cultivation*: implies ability to satisfy requirements of rice intensification. The most important condition for rice intensification in the Mekong Delta is water supply and management. Therefore, increase in water control level probably enhances efficiency in the use of material inputs and consequently, improves the overall production

efficiency. It is clearly expressed through the difference in production efficiency between irrigated and rainfed rice zones.

The technical level of rice farmers varies by the natural conditions of rice cultivation as well as by farmers, individually. Generally, the technical level develops from land augmentation to labour substitution and then knowledge intensity phases. In Mekong region, while the first phase is still dominant in the rainfed zones, labour substitution and knowledge intensity take place strongly in the irrigated zones. Therefore, the development direction of technical level is from rainfed to irrigated conditions. However, due to the introduction and the transfer of new cultivation techniques, progressive farms can reach the third phase, even in the rainfed rice zones. The development of the technical levels from low to high is synonymous with the increase in production efficiency. The most differences in technical levels among individual farms are expressed through the use of labour and machine, material inputs as fertilisers, pesticides and the improvement of rice quality and the application of input-saving techniques. Relying on the improvement of cultivation knowledge, even farms with poor resources can obtain high production efficiency.

Another factor directly or indirectly influencing to production efficiency is probably the farm accessibility to several markets, especially input, output and capital markets. Such factor is likely to have a close relation to the richness of rice farms. Its direct influence is that the inputs prices rice farms pay are not the same between poor and rich farms due to the differences in capital availability and accessibility to formal credit. The disadvantage over capital resource of poor farmers becomes heavier when they apply capital-intensive techniques.

At the present, it seems that farm resources play a decisive role in the differentiation process of production efficiency, in which, farm richness may be the key factor. However, the improvement of the technical level for small farmers is likely a reasonable and promising solution to strengthen their production efficiency. Relying on the appropriate and simplified advanced techniques, the small farmers can overcome the limits of physical resources.

5. Policy implication

At the micro level, the analyses show a possibility that the improvement of farm technical level can help farmers to overcome resource-caused constraints and obtain high production efficiency. Therefore, the right way might be strengthening agricultural extension activity. The technical transfer should be specialised for different farm groups because of the inequality in farm skills, information accesses and production resource. The simplified technical packages of input-saving techniques should be introduced in priority. Moreover, the cultivation techniques for other agricultural activities should be introduced when the diversification of agricultural activity becomes essential for increasing farm revenues. The transfer of knowledge related to the integrated use of farm resources, especially exploiting natural advantages for alternative production is a necessity. Besides, the extension service should also introduce the knowledge and the skills of farm management to farmers. In particular, simple accounting technique for farmers is probably necessary. It can help farms to monitor their expenditures and income and support a better decision-making process.

Improvement of the accessibility to formal credit for small farms is also an appropriate measure to reduce financial pressure on small farms. Credit support for other farm activities than rice production will permit farmers to seek the opportunities of income diversification. To enhance a better allocation of farm resources, the establishment of different co-operation types among farms would be suitable as a measure that helps to make use of cost economies.

References

- Lebailly P., Dogot.T., Pham.V.B., Tran.T.K. (2000). La filière rizicole au Sud Viêt-nam. Un modèle méthodologique. Les presses agronomiques de Gembloux – Belgique. 142 p.
- Project CFR-MK-VN (1997). *Compétitivité de la filière rizicole dans la région du Mékong. Rapport scientifique de synthèse '94-'96*. FUSAGX; UMH; ISA; UC; UEH. 118p.
- TRAN Tien Khai. (2003). *Methodology for analysis of rice production costs evolution: application to Mekong region (Vietnam)*. Doctorate thesis. Gembloux, Belgium, Faculté universitaires des Sciences agronomiques.