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Agricultural Restructuring in Vietnamese Mekong Delta: Economic Analysis of Rotational Sesame Production on Rice Field among Small-scale Farmers.

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***Abstract*—** *The study examined the economic analysis of sesame production compliant withagricultural restructuring plan in rural areas of Vietnamese Mekong Delta. Conditional non-probability sampling technique was employed to select 90 respondents who have produced sesame rotationally on rice field in summer-autumn crop season. Primary data were analyzed using both descriptive and inferential statistics including percentage, frequency and farm budget model. Gross Margin analysis was used to estimate cost, returns sesame production in the study area. The study revealed that the average cost, revenue, gross margins of production per hectare was 17.60, 37.38 and 20.56 million VND, respectively.Moreover,the average rate of returnsalsoindicated that with every 1,000 VND invested to sesame production, a farmer made a profit of 1,390 VND. As a result, it can be concluded that sesame farming is profitable in the context of agricultural restructuring strategy from rice to other crops in Mekong Delta region. It is recommended that smallholders should take initiative in participation in sesame cooperatives and 'big field' model to be more beneficial to inputs price, harvested machine and formal credit in the beginning of each season.*

***Keywords*— economic analysis, sesame, smallholders, profitable, gross margins, 'big field' model.**

I. BACKGROUND

Sesame is one of the plants that has oil and has high levels of oil in the grain of which products are both used in food and other purposes such as industry, handicraft industry, pharmaceuticals, and biofuel production (RichardBell, 2008).Rotational and intercropping sesame cultivation have the positive effect of limiting pests and diseases, increasing productivity and improving the quality of land. In Thailand, sesame crop is mainly rotated with rice crop. Recommendations in Thailand suggest that rotation cultivation destruction of post-harvest residues are always necessary in order to prevent some important diseases to rice and sesame. (Pornparn and Sorasak, 2001).

The study by Ibrahim et al. (2014) also reported that sesame is one of the major industrial crops produced in northern Kordofan, Sudan and mainly for sesame oil production. Random sampling technique was used to survey 205 farmers. Results showed that the technical efficiency of crop production ranged from 11% to 100% with an average error of 84% for sesame. Average technical performance indicates that there are opportunities to increase by 16% the total output of sesame by introducing certain inputs by adopting existing technologies by farm households have a good technique.

When evaluating the profitability of sesame cultivars in Nigeria, Abu et al. (2012) used Cobb-Douglas analysis to determine the technical efficiency, distribution and economic efficiency of sesame-seed farmers in the state of Nasarawa. They used a targeted sampling technique to collect data from 194 sesame households. Technical analysis shows that production scale and pesticides are not significantly correlated to technical efficiency, while seed, labor and fertilizer are statistically significant for efficiency.

In recent years, sesame cultivation area in Vietnamese Mekong Delta has been increasing rapidly because of the agricultural restructuring plan in some localities. In An Giang, Can Tho, Dong Thap and Long An provinces, there are about 7,000 ha of sesame, occupying 17% of national area, of which Dong Thap and An Giang are the two provinces with the highest average productivity of 1.2- 1.4 tons/ha (MARD, 2017).

In Vietnam, many researchers consider that the competitiveness of the national vegetable oil industry is still

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weak because the raw material for production is mainly sesame oil, peanut oil and rice bran, the remaining 90% of raw materials have to be imported from abroad. Vegetable oil extraction outside the jungle also includes other crops, including soybean and groundnut, both of which are suffering from a lack of raw materials. Due to this shortage, Vietnam has to import 1.0 - 1.3 million tons of soybean annually (7 times the domestic production of soybean) to process vegetable oil and animal feed. (Vietrade, 2012).

Sesame cultivation on rice field in Mekong Delta is still spontaneous with smallfarms, farmers mainly use their own experience in using fertilizers and pesticides and the low application of mechanizationintopeoducing stagesis still a big matter of concern.For the above reasons, economic analysis of sesame planting model in Mekong Delta is necessary to promote new directions for this crop variety and potential economic development of the whole region in the future.

II. METHODS

Research area

Can Tho, Dong Thap and Long An provinces were chosen as the study area in Vietnamese Mekong Deltasince data from MARD, DARD and related research results have indicated that by 2016 these are the three largest areas of sesame production and have relatively potential growth when comparing to farming models in other provinces.

Sampling techniques

Conditional non-probability sampling methodwas used to collect primary data since sesame households located scatteredly in rural regions and their production usuallyfluctuate each year due to the risk related to market price.

Table.1: Proportion of Sesame Farmers Selected from Communes

Province	District	Commune	No. of households
Cần Thơ	Ô Môn	Thới Long	30
Đồng Tháp	Cao Lãnh	Tịnh Thới	30
Long An	Vĩnh Hưng	Khánh Hưng	30
Total			**90**

Source: Field Survey, 2016

Due to the limitation of time and research budget, sample size was 90 units (sesame growers). The structure of sample observations is illustrated that 30 farmers located in O Mon District (Can Tho), 30 farmers from Cao Lanh District (Soc Trang) and the last 30 ones from Vinh Hung District (Long An).

Primary data were collected by interviewing personally 90 farmers in the three districts using structured questionnaire to record information on household resources and sesame production in 2016 crop year.

Method of data analysis

Descriptive statistics like means, percentages, standard deviation and frequencies were used in analyzing socioeconomic characteristics of respondents.

Gross Margin (GM) analysis (Olukosi and Erhabor, 1988) was used to determine the mean gross margin per hectare, the mean total revenue per hectare, the mean total variable cost per hectare, the highest cost incurred by the respondents as well as the mean output obtained by the respondents.

The GM analysis of sesame production in Mekong Delta was expressed as:

$$GM = TR - TVC \quad ------ (1)$$

Where

GM = Gross margins per hectare

TR = Total revenue per hectare

TVC=Total variable cost per hectare

The estimation of GM served as a profit index of sesame producers in the study area. The higher the GM the more likely a sesame farm was considered to be profitable and the smaller the GM, the lesser the profit possibility.

III. EMPIRICAL RESULTS

Socio-economic characteristics of sesame growers

Table 2 showed that majority (93.3%) of the respondents were male and be within the age group Older than 50 years old (52.2%). The productive group of sesame in Vietnamese Mekong Delta, young farmers who are always active and ready to adopt new technique, occupied just a proportion of 12%. This can be considered as a disadvantage of sesame production since older farmers are more likely to apply traditional seasonal crops calendar and not willing to change to another new ways of using fertilizers and pesticides.

Table.2: Socioeconomics characteristics of sesame farming households

Item	No. of respondents	Percentage (%)
Gender		
Male	84	93.3
Female	6	6.7
Age		

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From 21 to 30	7	7.8
From 31 to 40	11	12.2
From 41 to 50	25	27.8
Older than 50	47	52.2
Education		
Uneducated	2	2.2
Primary school	36	40.0
Secondary school	38	42.2
High school	11	12.2
Undergraduate	3	3.3
Family size		
From 1 to 3	4	4.4
From 3 to 5	38	42.2
More than 5	48	53.3
Total farm size (ha)		
From 0.1 to 1	44	48.9
From 1 to 1.5	8	8.9
More than 1.5	38	42.2
Input contract		
Yes	6	6.7
No	84	93.3
Output contract		
Yes	0	0
No	90	100

Source: Field Survey, 2016

Figures on educational level indicated that 42.2% of sesame growers have secondary education. This was followed by the primary and high school groups with 40% and 12.2% respectively. There was only 3.3% of undergraduate respondents.

Most of farmers (53.3%) belonged to households with more than 5 members, followed by those with the family size of 3 to 5 persons constituting 42.2%. It can also be seen that 48.9% of sesame growers own from 0.1 to hhhhhhhhhn6y51 hectare land size for production. This result indicated that the largest proportions of total farm holdings in the study area are small scale holdings.

Input contracts obtained by 6.7% of respondents here were small contracts for purchasing fertilizers, pesticides between farmers and local agencies. Most of local farmers have to buy inputs on credit and give partial payment. About contract of consumption, 100% of sesame households have no guarantee for selling their products. After harvesting, farmers retains a small portion for food and seeds, and the rest for sale. For that reason, unexpectedly output price alwaysdependson middle-men or local traders and becomes a great concern of farmers.

Table.3: Distribution of respondents by sesame output per hectare

Yield (kg/ha)	No. of respondents	Percentage
From 100 – 300	4	4.4
From 301 – 600	8	8.9
From 601 – 900	22	24.4
From 901 – 1200	17	18.9
From 1201 – 1500	19	21.1
More than 1500	20	22.2
Total	90	100
Mean	1100.92	
SD	514.594	

Source: Field Survey, 2016

Table 3 showed that majority of the farmers (24.4%) obtained sesame yield of 601-900kg per hectare and followed by those respondents (22.2%) who obtained sesame output of more than 1500 kg per hectare. Those respondents who obtained sesame yield of 1200 – 1500 kg per hectare accounted for 21.1% of the total sample. Only 3.3% of the respondents have sesame yield of less than 300 kg per hectare. The mean sesame stands at 1100.92 kg per hectare.

Table.4: Mechanization application in each step of sesame production

	Level 1 0%	Level 2 < 25%	Level 3 < 50%	Level 4 < 75%	Level 5 > = 75%	Total
Step 1. Ploughing	21	5	15	18	21	*80*
Step 2. Planting	64	1	6	5	2	*78*
Step 3. Fertilizing	80	0	1	0	1	*82*
Step 4. Spraying pesticide	14	7	23	20	24	*88*

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Step 5. Pumping	2	12	20	18	35	*87*
Step 6. Harvesting	78	0	1	2	6	*87*
Step 7. Transporting	24	16	20	6	2	*68*
Step 8. Shell seperation	27	0	14	18	25	*84*
Step 9. Storage	69	4	0	0	0	*73*

Source: Field Survey, 2016

Mechanization was mainly used in soil preparation, spraying pesticides, irrigation and shellseparation steps. Level 5 (more than 75% of application) was highly used in the two stagespumping (35 respondents) and shell separation (25 respondents), followed by spraying pesticides (24 respondents) and ploughing (21 respondents) steps. In these production stages, mechanical machinery is used primarily by re-using machinery from rice production because of their same function withmany types of crops. At the same time, planting, fertilizing, harvesting, storage (drying and stocking) stages were done with an average of 0% mechanization.Especially,farmers have to harvest sesame by hands because there are no specialized harvested machine to use for this important stage in Mekong region. This is the reason why farmers will have to use more hired labor costs for the production of sesame in hand-work steps.

Table.4: Cost and return analysis of sesame production in Vietnamese Mekong Delta

	Mean (thousand VND/ha)	Std. Dev.
Total Revenue (TR)	37386.60	18600.478
Seed cost	514.21	284.408
Fertilizer cost	4989.79	2473.417
Pesticides cost	4630.72	4035.756
Family labour cost	7278.51	6760.751
Hired labour cost	5382.78	3642.505
Mechines cost	649.46	909.290
Hired machines cost	1438.99	1545.778
Total Variable Costs (TVC)	17606.04	7532.430
Gross Margins (GM)	20558.08	14681.324
Average Rate of Returns	1.39	

Source: Field Survey, 2016

In the crop season of 2016, seasame production achieved a total revenue of 37.38 million VND. However, the result would be better if there was no price pressure from the middle-man and natural plant disease affected productivity.

The average profit of sesame farmers was 20.56 million VND/ha, lower than that one of 34.26 million VND/ha in Tan's research (2016) on sesame in Dong Thap province. With an average profit of more than 20 million VND per hectare in a 2.5-month crop, this was a relatively high result compared to the same period of summer-autumn rice crop. A typical example of Dao (2015) study in 2012, Cao Lanh district, Dong Thap province, summer-autumn rice crop yield was 5.8 tons/ha, with11 million VND/ha of profit and another study by Cuong (2013) also indicated that the profit of summer-autumn rice crop in O Mon District, Can Tho City is 11.63 million VND/ha. Therefore, the profit of sesame plants is 2 times higher than that of rice in the same summer-autumn crop.

In general, based on the results of the analysis of the financial performance indicators, we can conclude that with every 1,000 VND invested into production, it is about 1,390VND of profit to be made. It can be seen that sesame cultivation on rice field in Mekong Delta provinces has a positive performance, although it is not too high.In next years, ifsmall-scale area will possibly be concentrated into bigger farms,sesame production will totallybring such a potential economicdevelopment for the whole region in the context of restructuring the mainly-wet rice agriculture into other positively more profitable crops.

IV. CONCLUSIONS AND RECOMMENDATIONS

This study analyzed the economic indicators of smallholder sesame growers in the three provinces Can Tho, Long An and Dong Thap in Vietnamese Mekong region. Rotational sesame production on the rice field has become one of the most popular models chosen by farmers in recent years. Through the Gross Margins item, the model has proven that sesame plants are more economically efficient than rice production in the same crop season.The results of this study would help providing significant reference sourcefor farmers who possibly want to change their main product and local policy makers who give decisions about

which crops to produce in regions in the context of severve climate change.

In the year 2016, the production of sesame in the Mekong Delta achieved high yield and returns but the financial efficiency was not much positive for famers to totally change from rice to sesame in a long-term period. Cost items in the production process were occupied such a big proportion, especially fertilizer, pesticide and labor costs. For that reason, farmers must use fertilizer properly under the guidance of agricultural officers, avoiding the use of old practices that could affect negatively to their products. The Department of Agriculture and Rural Development should organize more frequent training courses to help people improve knowledge, farming skills and technology related to sesame production.

The formation of cooperatives for sesame is very necessary to help making production process stable, reducing input price, stabilizingoutput price of sesame by using contracts to help farmers avoid the market risks. In addition, the government should mobilize farmers to convert the sesame in accordance with the master plan into "big fields", thereby reducing the area of summer-autumn rice season. At the same time, to invest in irrigation system to ensure sufficient supply of water for sesame in the dry season, promote mechanization in production, planning raw material areas and associate with enterprises to buy products for farmers.

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