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Market Performance and Price Analysis of Sesame in Myanmar

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Abstract This study examines market performances and price behavior of sesame seeds in Myanmar. Data were obtained by interviewing representatives of the intermediaries of the sesame marketing channels in the townships of Mandalay, Monywa, Pakokku and Yangon during November to December 2008. Price spread, gross margin and share in the export price were calculated for each intermediary. Monthly wholesale prices from September 2002 to October 2008 of white and black sesame seeds and export price in selected markets were used for cointegration analysis. Engle and Granger's cointegration method, error correction model and Granger causality test were applied for price analysis. Mandalay farmers got the highest gross margin for black and white sesame. Farmers received the highest gross margin for white sesame exported to China. Exporters received the highest gross margin for black sesame to Japan. Wholesalers received the highest share of the export price. Mandalay market was integrated with Monywa and Pakokku markets. All domestic markets were integrated with the export market because exporters used the domestic wholesale price to set the export price. Deviation from domestic long-run equilibrium of black sesame price could be corrected by decreasing price in Mandalay and increasing it in Pakokku market. Speed of adjustment for export price to correct the deviation from long-run equilibrium was faster than that of all domestic prices. Long-run equilibrium of both colored sesame prices could be obtained by increasing export price and decreasing domestic wholesale prices.

Keywords: sesame seed, marketing margin, cointegration, error correction model

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การวิเคราะห์ราคาและบทบาทของตลาดเมล็ดงาในประเทศพม่า

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สมพร อิศวิลานนท์ สถาบันคลังสมองของชาติ

บทคัดย่อ การศึกษาวิเคราะห์ถึงบทบาทของตลาดและพฤติกรรมราคาของตลาดงาในประเทศพม่า โดยใช้ข้อมูลจากการสัมภาษณ์ตัวแทนผู้เกี่ยวข้องในตลาดเมืองมันดาเลย์ มงยัว ปากกกู และย่างกุ้ง ระหว่างเดือนพฤศจิกายนถึงธันวาคม พ.ศ.2551 เพื่อศึกษาส่วนแบ่งราคาและกำไรเบื้องต้นของคนกลางทั้งหมด โดยใช้การวิเคราะห์ cointegration และอาศัยข้อมูลรายเดือนของราคาขายส่งและราคาส่งออกงาดำและงาขาวของเดือนกันยายน พ.ศ.2545 ถึงตุลาคม 2551 ตามวิธีการของ Engle and Granger, error correction model และ Granger causality test จากการศึกษาพบว่า เกษตรกรที่มันดาเลย์ได้รับส่วนแบ่งกำไรสูงสุดทั้งสินค้างาดำและงาขาว เกษตรกรได้รับส่วนแบ่งกำไรสูงสุดจากการส่งออกงาขาวไปประเทศจีน ส่วนผู้ส่งออกได้รับส่วนแบ่งสูงสุดจากการส่งออกงาดำไปประเทศญี่ปุ่น พ่อค้าขายส่งได้รับส่วนแบ่งราคาสูงสุดจากราคาส่งออก ตลาดมันดาเลย์มีความเชื่อมโยงกันกับตลาดมงยัวและตลาดปากกกู ตลาดภายในประเทศทั้งหมดมีความเชื่อมโยงกับตลาดส่งออก เพราะผู้ส่งออกใช้ราคาขายส่งภายในประเทศในการกำหนดราคาส่งออก การแก้ไขการเบี่ยงเบนจากดุลยภาพระยะยาวของราคางาดำภายในประเทศ สามารถทำได้โดยลดราคางาดำในตลาดมันดาเลย์ และเพิ่มราคางาดำในตลาดปากกกู การปรับตัวเข้าสู่ดุลยภาพระยะยาวของราคาส่งออกมีความรวดเร็วกว่าการปรับตัวของราคาในประเทศ การเพิ่มขึ้นของราคาส่งออกและการลดลงของราคาขายส่งภายในประเทศสามารถทำให้เกิดดุลยภาพระยะยาวของราคางาขาวและงาดำ

คำสำคัญ: เมล็ดงา ส่วนเหลื่อมการตลาด ความเชื่อมโยงของตลาด

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Introduction

The role of sesame (Sesamum indicum) is as important as rice in Myanmar's culture and traditions. Sesame cultivation for domestic self-sufficiency of edible oil and as a high quality commodity for export had commanded major attention. Sesame occupied 44 percent (3.73 million acre) of all oilseed crops area and supplied 30 percent of domestic edible oil in 2006/07 (Favre and Kyaw Myint, 2009). Myanmar sesame has a comparative advantage in the oil crop sector of export market. Myanmar is currently a deficit producer of edible oil importing several tons of palm oil from Malaysia. The volume of imported palm oil was 0.3 million tons in 2006/07 and the government has been spending US$ 50-70 million per year. The total domestic production of the various edible oils was around 0.3 million tons in 2006/07 which could meet only half of the domestic demand (Favre and Kyaw Myint, 2009). The government has been promoting the expansion in cultivated area and production of oil crops including sesame.

However, the trend in producer price of sesame seed has been flat over the last 15 years (FAO, 1991-2007). Myanmar sesame has great potential for export to China and Japan but current export policy on sesame seed is variable and prevents the liberalization of the market. Generally, when domestic price rises, export is banned for some extended period whatever the export demand is and then opens again. The slow increase in producer's price and household income had dampened the willingness and weakened the ability of farmers to adopt improved seed varieties and technologies from support institutions such as the Department of Agricultural Research of the Myanmar Agriculture Service. This has been a direct cause for a stagnant domestic production over the last few decades (FAO, 2004). Another limitation was that local currency was overvalued by the official exchange rate in Myanmar. As well, there are several exchange rates such as money changer rate, custom rate, and hotel rate. These parallel foreign exchange markets and rates had not only caused distortion in market and price but also negatively affected export and import of agricultural product and farm input. Price incentive and market efficiency are important factors to increase sesame production.

This study attempts to understand market performance under current policies by classification of marketing channel and estimation of marketing cost and marketing margin. It estimates how the domestic price of sesame seed reflects on the export price and itself. There is no previous academic research on market and price of sesame seed in Myanmar. However, Myanmar's

rice market performance was estimated by Hinn Yu Lwin (2005) and market integration and price causality of Myanmar rice was investigated by Theingi Myint (2007). The finding of this study would provide the knowledge of how the sesame market was operating and price information of the sesame industry to all participants in the marketing channels as well as to researchers and policy makers. The results could suggest what additional support the government could provide to farmers to increase sesame production, and policy measures for the sesame marketing sector. In next section, the conceptual framework applied to this paper is presented followed by methods, data, result and discussion and conclusion and recommendations.

Conceptual Framework

The overall long-run performance of sesame market and price behavior was affected not only by the efficiency of marketing system but also by macroeconomic policies that tended to distort the market. A marketing channel is an organized network of agencies and institutions which performs all the activities required to link producers with users to accomplish the marketing task (Bennett, 1988). Marketing cost and margin are required to understand the behavior of all players in agricultural market. Farmers need to pay attention not only to production cost but also to be aware of marketing cost and demand condition. Wholesalers, retailers and processors must be fully aware of their costs so they can be sure that they would be better off from trading in different marketing channels (Andrew, 1993) and policy makers should have a full understanding of marketing cost and margin and monitor the efficiency of agricultural marketing regularly for improvement. Figure 1 is the conceptual framework for market and price analysis of sesame in Myanmar.

A cointegration technique can be used for the analysis of price transmission which focuses on market integration between prices in different markets. Spatial price determination models suggest that if two markets were linked by trade in a free market regime, the excess demand or supply shocks in one market would have an equal impact on price in both markets. The implementation of import tariffs and export taxes allows international price changes to be fully transmitted to domestic markets in relative terms. However, if import tariff or export tax level is high, changes in international price will be only partly transmitted to the domestic market (Rapsomanikis *et al.,* 2003). The domestic sesame marketing system is affected by current policies on oil seed sector to go along with price signal from the international sesame market. The transportation facilities within the country from one market to another and informal export to other markets may separate domestic markets.

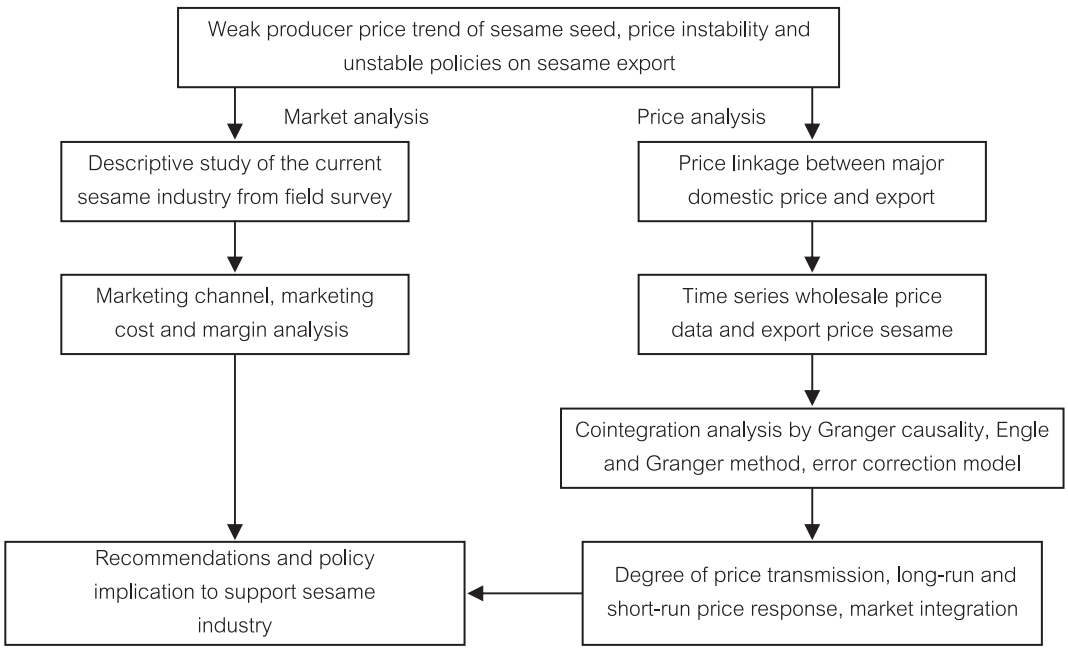

Figure 1 Conceptual framework of market and price analysis of sesame in Myanmar
Source: Modified from Rapsomanikis, Hallan, and Conforti (2003); Andrew (1993)

The four major domestic sesame seed markets are studied to understand market performances and links between domestic and export markets. The limitation of this study is the lack of processing costs of sesame seed into oil. Price analysis of the other colored sesame seeds is not carried out in this paper.

Methods

The demographic, socio-economic and agricultural characteristics of farmers, wholesalers, millers and traders and effectiveness of farming systems, farming practices and marketing activities are summarized by descriptive data. Marketing margins at different levels of marketing chain are compared by price spread, gross margins and farmer's share of export price. Price spread is a measure of marketing margin in monetary terms. It represents payments including profits for all marketing functions performed in assembling, processing and the conduct of other activities after the product has left the farm. The price difference between farm and retail levels is called farm-retail price spread. Changes in farm-retail price spread reflected changes in marketing costs, profits or both (Kohls and Uhl, 2002). The price spread is the costs and profits of the marketing

system that moves the farm product from farm to its final form (Hahn, 2004). In our study, the producer-to-export price spread for sesame seed is calculated. Gross margin is the difference between the price a farm pays for products (cost of goods sold including all marketing costs) and the price it charges its customers; it is also called gross profit and expressed as percentage of the firm's selling price (Kohls and Uhl, 2002). Marketing margin should be understood as gross margin because precise marketing costs that account for cash and non-cash items are difficult to determine in many agricultural marketing chains. Gross margin includes all marketing costs (Mandoza, 1995). Gross margin and price spread are related so that an increase in gross margin is likely to cause an increase in price spread. Price spread would be lower if farm price increased and/or retail (export) price decreased (Hahn, 2004). Price spread measures the cost of providing a mix of marketing services but does not measure the effect of adding new products and improving the well-being of farmers (Tomek and Robinson, 1990).

A farmer's share in the market basket approach is the ratio of farm value of a market basket of domestically produced food items to their retail values (Kohls and Uhl, 2002). In this study farmer's share and wholesaler's share of the export price are calculated. Gross margins for producers, wholesalers and exporters are calculated as percentage of selling prices. Calculation of the price spread, gross margin, farmer's and wholesaler's share of the export price for the sesame seeds in Mandalay, Monywa and Pakokku markets are presented in Equation 1 to 4. Buying price of farmers is sum of production and marketing costs; it is assumed as cost to farmers. Transportation, labor and packaging cost, commission, and export license fee are the marketing cost.

$$\text{Price spread} = \text{Export price} - \text{Price received by farmer} \tag{1}$$

$$\text{Gross margin (percent)} = \left(\frac{\text{Selling price} - \text{Buying price}}{\text{Selling price}}\right) \times 100 \tag{2}$$

$$\text{Farmer's share to export price} = \left(\frac{\text{Price received by farmer}}{\text{Export price}}\right) \times 100 \tag{3}$$

$$\text{Wholesaler's share to export price} = \left(\frac{\text{Price received by wholesaler}}{\text{Export price}}\right) \times 100 \tag{4}$$

Among several methods for price transmission and market integration, cointegration and error correction model (ECM) are very useful in integration analysis. Cointegration can be tested for the presence of nonspurious long-run equilibrium relationship between the variables under study in multivariate setting with and without a time trend. Error correction mechanism enables an estimation of the speed of adjustment back to the long-run condition among the variables. There are two cointegration methods: Engle and Granger's method and Johansen's (Johansen, 1988) and Johansen and Juselius (1990) method. Engle and Granger's method is a two-step procedure to test cointegration and generally used for two variables because this method cannot identify the number of cointegration vectors. Normally, Johansen's method is not necessary for the bivariate model. If there are more than two variables in the model, Johansen's procedure is used instead of the two-step procedure. Johansen's test can estimate not only the number of cointegration but also the short-run dynamic of the system.

This study contains two variables in each model so that Engle and Granger's method is used for cointegration test. Before the cointegration analysis, Granger causality test is applied to estimate the direction of causality ie. which variables should be the dependent variables. Cointegration test is then performed. After the test, ECM and long-run Granger causality test are applied to identify short-run effect and long-run causality.

Testing the unit root and order of integration. The first step of cointegration is to test whether the time series data are stationary in order to avoid the problem of spurious regression. Augmented Dickey Fuller (ADF) test is used for unit root test. ADF test with and without trend is performed by including up to 11 lagged terms of the differenced terms in regression. Optimum lag length of ADF equation was determined based on Schwartz Information Criterion (SIC). The null hypothesis of nonstationary was tested with τ-statistic and compared with the critical value calculated by MacKinnon (1990). The null hypothesis is that β is zero and alternative hypothesis is that $\beta<0$. If the null hypothesis is rejected, the tested variable is stationary. Equation for ADF test is shown in Equation 5.

$$\Delta P_t = \alpha + \beta P_{t-1} + \gamma t + \sum_{k=1}^{n} \delta \Delta P_{t-k} + \varepsilon_t \qquad (5)$$

where, ΔP_t is the first difference of prices, (P_t-P_{t-1}), k is the number of lagged differences, P_t is price at time t, α is vector of constant, γ is trend coefficient, α, β, γ and δ are parameters to be estimated. ε_t is white noise error term meaning that $\varepsilon_t \sim$iid $N(0,\sigma^2)$.

Causality test. After testing for unit root, Granger causality test is applied to specify the dependent variable for the long-run equation. If a variable or a group of variables *x* is found to be helpful for prediction another variable or group of variables *y* then *x* is said to granger cause *y* otherwise it is said to fail to granger cause *y* (Granger, 1980). If variable are nonstationary and I(1), Granger causality test can be made only in first differences and F test can be used. The optimum lag lengths of Vector Autoregressive (VAR) analysis are decided by common selection of criteria by Maximum Likelihood Ratio (LR), Hannan-Quinn (HQ), Akaike Information Criteria (AIC), SIC and Final Prediction Error (FPE) criterion. However, the selected lag lengths are determined by SIC and AIC. Lagrange Multiplier (LM) test is used to serialize the correlation of error term. A bivariate VAR to test the Granger causality is as follows:

$$\Delta P_{1t} = \alpha_1 + \sum_{i=1}^{k} \alpha_{11}(i)\Delta P_{1t-i} + \sum_{i=1}^{k} \alpha_{12}(i)\Delta P_{2t-i} + \varepsilon_{1t} \quad (6)$$

$$\Delta P_{2t} = \alpha_2 + \sum_{i=1}^{k} \alpha_{21}(i)\Delta P_{1t-i} + \sum_{i=1}^{k} \alpha_{22}(i)\Delta P_{2t-i} + \varepsilon_{2t} \quad (7)$$

If we could not reject the null hypothesis of $\alpha_{12}(i) = 0$, P_{2t} was not granger caused P_{1t} and if $\alpha_{22}(i) = 0$, P_{1t} was not Granger caused P_{2t}.

Engle-Granger's cointegration test. After determining dependent variables, long-run equilibrium relationships of the prices between different markets are estimated by using OLS (Equation 8).

$$P_{1t} = \beta_0 + \beta_1 P_{2t} + e_t \quad (8)$$

where P_{1t} is price of market 1 at time t, P_{2t} is price of market 2 at time t, β_0 is constant term and β_1 is cointegration parameter. In order to determine whether variables are actually cointegrated, the residual $\hat{e}_t$ series from Equation 8 are estimated by ADF. The ADF test with the Equation 9 is applied to perform on the residual $\hat{e}_t$ to determine the order of integration with autoregression with null hypothesis of unit root ($\rho = 1$). Since, $\hat{e}_t$ sequence is the estimated residual from Equation 8 there is no need to include constant term and trend. If the null hypothesis is rejected, the residual series is stationary (I(0)) and both variables are cointegrated (Enders, 2004: 336).

$$\hat{e}_t = \rho\hat{e} + \varepsilon_t \quad (9)$$

where ε_t is a white noise error term. If the residuals did not appear to be white noise, augmented form of the test, Equation 10, would be used instead of Equation 9.

$$\Delta\hat{e}_t = \alpha + \beta\hat{e}_{t-1} + \sum_{i=1}^{n}\delta\Delta\hat{e}_{t-i} + \varepsilon_t \quad (10)$$

If the residual was nonstationary, β=0, the variables would not be cointegrated. If the residual was stationary, β<0, the variables would be cointegrated.

Error Correction Model. The principle behind ECM is that there often exists a long-run equilibrium relationship between two or more economic variables. In the short run, however, there may be disequilibrium. With the error correction mechanism, a proportion of the disequilibrium in one period is corrected in the next period. For instance, the change in price in one period may depend on the excess demand in the previous period. The Granger representation theorem shows that any cointegrating relationship can be expressed as an equilibrium correction model. Engle and Granger propose the estimation of ECM for two variables as follows:

$$\Delta P_{1t} = \alpha_1 + \alpha_{p1}(P_{t-1} - \beta_0 - \beta_1 P_{2t-1}) + \sum_{i=1}^{k}\alpha_{11}(i)\Delta P_{1t-i} + \sum_{i=1}^{k}\alpha_{12}(i)\Delta P_{2t-i} + \varepsilon_{1t} \quad (11)$$

$$\Delta P_{2t} = \alpha_2 + \alpha_{p2}(P_{t-1} - \beta_0 - \beta_1 P_{2t-1}) + \sum_{i=1}^{k}\alpha_{21}(i)\Delta P_{1t-i} + \sum_{i=1}^{k}\alpha_{22}(i)\Delta P_{2t-i} + \varepsilon_{2t} \quad (12)$$

where P_{1t} and P_{2t} are the prices in market 1 and 2 at time t, β_1 is parameter of cointegration vector, ε_{1t} and ε_{2t} is a white-noise error term, α_{p1} and α_{p2} are the speed of adjustment, α_1 and α_2 are constant, $\alpha_{11}(i)$ and $\alpha_{21}(i)$ are the coefficients of ΔP_{1t-i} and $\alpha_{12}(i)$ and $\alpha_{22}(i)$ are the coefficients of ΔP_{2t-i}.

Long-run Granger causality test. Since cointegration cannot make the inferences about the direction of causation among the variables, a causality test is then applied. Granger (1988) discussed that if two price series were cointegrated, the standard Granger causality test might be no longer appropriate. Because if two price series were cointegrated, Granger causality test without error correcting term may give mis-specified results. To rectify this problem, if the I(1) variables were not cointegrated, the standard Granger causality test with first difference variables could be applied with F test. However, if the variables were I(1) and cointegrated, Granger causality test with the error correction framework is used to estimate long-run causality. Chi-square (χ^2) (Wald) statistics is used for joint significance of the other lagged endogenous price series in each equation of the model. Rejection of the null is taken as evidence of Granger causality. The estimated ECM for causality test is as in equation 11 and 12. If α_{12} was zero, P_{2t} would not Granger cause P_{1t} and if was zero, P_{1t} would not Granger cause P_2 in the long run.

Data

The survey was conducted in major sesame growing areas such as Mandalay Township in Mandalay Division, Monywa Township in Sagaing Division, Pakokku Township in Magway Divison and Yangon Township in Yangon Division during November to December 2008. The selection of study sites is based on the size of sesame growing areas, number of growers, accessibility for communication and majority of sesame markets in central Myanmar. Mandalay is located in the middle Myanmar and 695 kilometers north of Yangon. Monywa is located within Sagaing division and 136 kilometers north of Mandalay. Pakkoku is a town in Magway Division and located 350 kilometers southwest of Mandalay. The interviews were carried out on 106 farmers from three selected villages, namely Kula village (Mandalay Township), Kyawe Ye village (Monywa Township) and Miethwekan village (Pakokku Township) and 19 millers and 16 wholesalers from Mandalay, Monywa and Pakokku markets. Five exporters from Mandalay and 3 exporters from Yangon were also interviewed.

Yangon is not a sesame growing area. Most exporters from Yangon directly purchase sesame seed from major markets in central Myanmar. Different structured questionnaires were prepared for each of the actors along the sesame crop chain: farmers, wholesalers, millers and exporters. The representative exporters from Yangon markets were interviewed for sesame seeds export to Japan. The traders, wholesalers and millers were interviewed at the Crop Exchange Centre (CEXC) in each township, or at their mills and places of business. In order to identify the long-run price performances, monthly wholesale prices of sesame seeds in Mandalay, Monywa and Pakokku markets and the FOB export prices from September 2002 to November 2008 were used. The required secondary data were obtained from Central Statistical Organization (CSO) and the Department of Agricultural Planning (DAP).

Results and Discussion

This section presents the marketing channels of sesame seed, marketing performances of all participants along the chain, the results of calculation of marketing costs and margins, and discussion of the results.

Marketing Performances

The intermediaries such as primary collectors, commission agents, brokers, wholesalers, traders, oil millers participated in marketing of oil seeds and the processing and distribution of edible oils in the country. Based on the interviews, the current marketing performances of all participants for sesame market were estimated. Small farmers did not sell all of their sesame seeds as they were mainly processed for household consumption of edible oil. Farmers did not wait more than two months because of the poor storage facilities and they fear that new products might enter the market. The majority of farmers sold their products to the town wholesalers. The farmers were responsible for the costs of transportation and labor, and sometimes pay a commission of one percent to the wholesalers who acted as commissioners and primary collectors. The time of vending sesame seeds by the farmers depended on the prices; prices vary depending on the season and market demand. Major constraints of farmers were high production cost, limited access to credit and poor quality of sesame seed for cultivation, poor storage facilities, poor roads, and poor quality of oil seeds.

In addition, the price of sesame seed in the central dry zone was largely influenced by export demand especially from China. The commissioners received one percent of the total sale value. Wholesalers purchased sesame seed directly from farmers or from CEXC. In addition, if they performed as traders they stored the seed for some periods with expectation of higher prices. Some wholesalers had good storage facilities and waited for prices to increase. Therefore, profits depended on the fluctuation of sesame seed prices. Some of the sesame seeds were processed for traditional snacks by wholesalers and local processors. The millers generally also operated as wholesalers.

Millers in Mandalay Township purchased raw sesame seed from farmers and millers in Monywa, and Pakokku townships purchased sesame seed from the township CEXC. Millers used the cheapest sesame for processing. Most oil millers in Myanmar had no choice but to buy poor quality seeds for processing as the price for good quality seed was too high (Kyaw, 2008). Millers were using the expeller system and the ratio of sesame seed, oil and oil cake was 1:0.46:0.50. About 4 percent was waste from processing. To meet the demand of low income consumers, some millers mixed sesame oil with palm oil or sunflower oil and sold the product at a price lower than pure sesame oil. Some millers were also processing the customer's sesame seed by taking only processing charge. Major constraints of millers were unreliable supply of electricity and inefficient processing infrastructure. There was 4-10 percent of oil due to the use of traditional oil press. As

a by-product of the processing, the millers sold the sesame oil cake directly to poultry, livestock and fish farmers and industries or to wholesalers and retailers.

The CEXC determined the daily price of sesame seed based on price set by CEXC. The wholesalers and traders bargained over the price according to demand and quality. All farmers and intermediaries used cash down system in sesame marketing. Exporters have to obtain an export permit from the Ministry of Commerce; it takes two to three weeks to get a permit, which expires after three months. Some of the small scale exporters in Mandalay purchased export permit from other large scale exporters who had already applied for a permit. The price of a permit at the time of survey was 25,500 Kyats/ton (about 22 $/ton) including export tax.

Marketing Channels

Marketing channels of sesame in the study areas are shown in Figures 2, 3 and 4. There were two channels for sesame seeds, exporting to countries like China, Japan and India and processing traditional snack and food. In the study village in Mandalay, all farmers cultivated white sesame. About 83.10 percent of total sesame production was traded as seed and 16.90 percent was processed for edible oil. Farmers in Monywa Township cultivated white, black and other colored sesame. As to the market channels in Monywa, large amounts of sesame seeds including some low quality black sesame seeds were sold for processing because the producers and wholesalers in Monywa were more interested in delivering sesame oil than sesame seed to other deficit regions in upper Myanmar. All white sesame, 52.42 percent of black and 38 percent of other colored sesame seeds were exported and 47.58 percent of black and 62 percent of other colored sesame seeds were processed. In Myanmar, black sesame oil is famous for its various purposes such as medical use and edible oil. All white and black sesame seeds in Pakokku were exported and all other colored sesame seeds were processed for edible oil. In Pakokku Township, farmers cultivated a large area of black sesame and a small area of white and other colored sesame seeds since good quality black sesame seeds in this area is preferred by the Japanese market. Oil cakes were sold either directly to poultry and livestock raisers or through wholesalers. Gross margins as in percentage of selling prices of producers, wholesalers and exporters were put together in their respective boxes. The marketing margins in the first bracket represent the marketing margins of sesame seeds exported to China and the second bracket represents the marketing margins of sesame seeds exported to Japan.

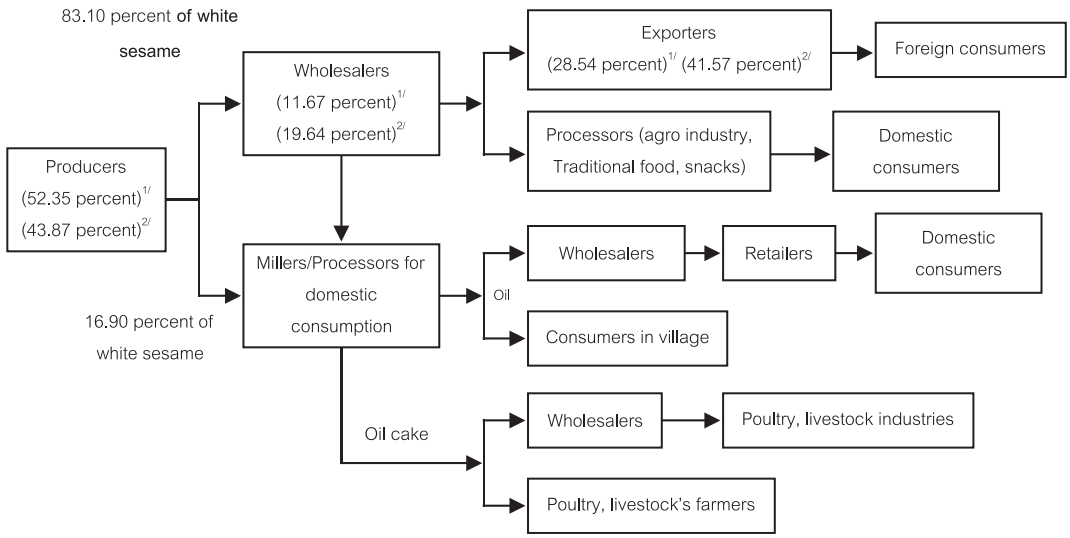

Figure 2 Marketing channel in Mandalay

Note: 1/ Gross margin percent for the white sesame exported to China

2/ Gross margin percent for the black sesame exported to Japan

Source: Personal interview in 2008

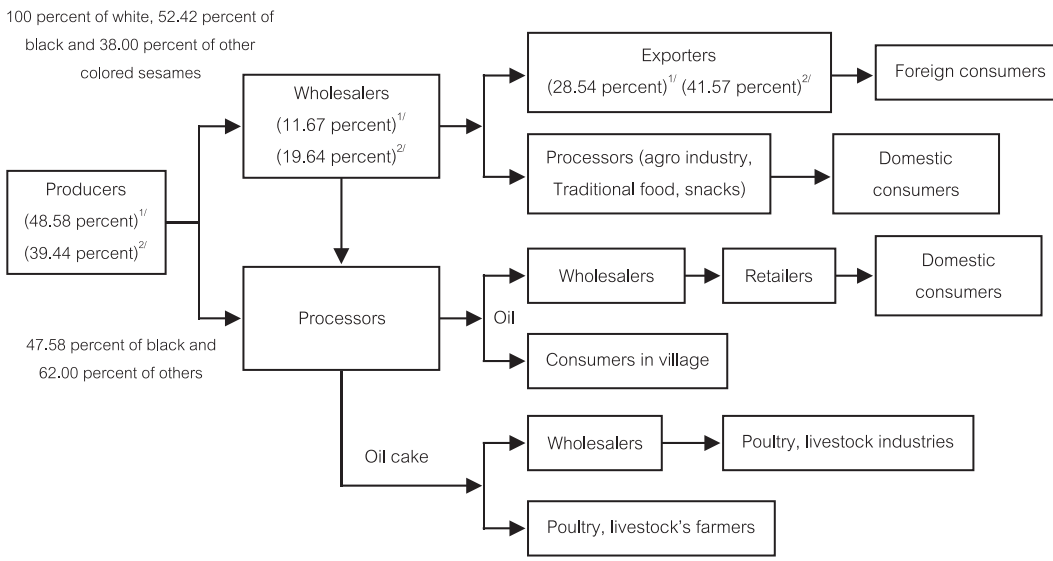

Figure 3 Marketing channel in Monywa

Note: 1/ Gross margin percent for the white sesame exported to China

2/ Gross margin percent for the black sesame exported to Japan

Source: Personal interview in 2008

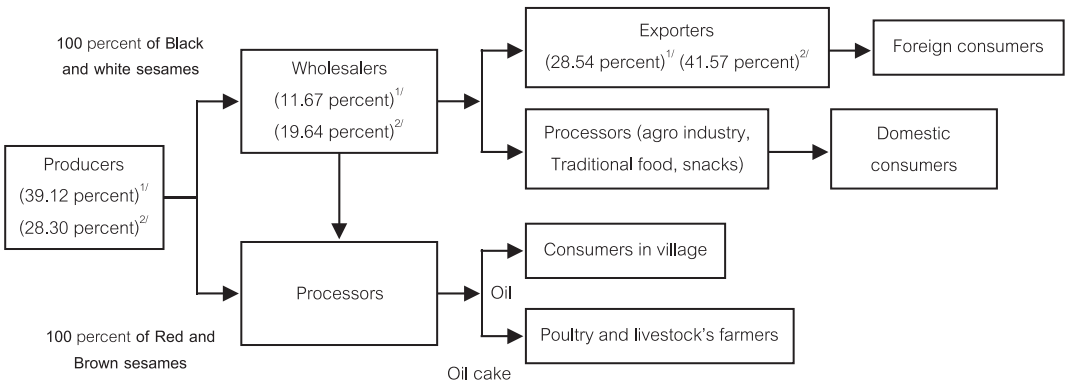

Figure 4 Marketing Channel in Pakokku

Note: 1/ Gross margin percent for the white sesame exported to China

2/ Gross margin percent for the black sesame exported to Japan

Source: Personal contact in 2008

The producers directly sold sesame seed to the wholesalers who in turn sold to other wholesalers, millers and exporters for the export market, Japan and China. There were no primary collectors operating between the producers and wholesalers, because the selected villages were near each township and the farmers kept in touch with wholesalers. Another channel was that the producers directly sold to the millers who in turn sold sesame oil and oilcake to the local wholesalers, retailers and to poultry and livestock industries. Some small millers directly sold sesame oil to consumers and oilcake to poultry and livestock farmers. In Kyawe Ye village most of the small farmers processed the sesame seed for home consumption and sold the surplus oil directly to the villagers. Most of the wholesalers from Mandalay, Monywa and Pakokku townships acted as commissioners depending on the condition of the market.

Marketing Costs and Margins

The marketing margins of the white sesame were calculated between the farmers and exporters for the China market since the white sesame was mostly exported to China (Table 1). The calculation of the marketing margins for the black sesame was carried out between farmers and exporters for Japanese market (Table 2). In Yangon, good quality black sesame was exported to Japan whereas in Mandalay white sesame was purchased by the traders to export to China via Muse. The price received by farmers was taken from the average current price at the time of survey

(1,082.07 kyats/kg for white sesame and 918.74 kyats/kg for black sesame). The export price to China was based on FOB Ruilli (9.30 Yuan/kg) and that to Japan on FOB Myanmar (1,700 $/ton) at the time of survey. The market exchange rates of 184.33 kyats/Yuan and 1,150 kyats/$ were used for currency conversion. Wholesalers were assumed to buy sesame seed from commissioners and re-sell it without storage. The amount of commission was considered as cost of the wholesalers. The commissioners from all the domestic markets received one percent of the total sale value.

Table 1 Marketing margins of white sesame exported to China, 2008

Items	Mandalay	Monywa	Pakokku
Farmers			
Average yield (kg/ha)	799.68	514.17	373.38
Sale price of farmers (kyats/kg)	1,082.07	1,082.07	1,082.07
Production cost (including marketing costs) (kyats/kg)	515.65	556.43	658.78
Marketing cost (kyats/kg)	14.90	9.19	18.43
Gross margin (kyats/kg)	566.42	525.64	423.29
Gross margin (percent)	52.35	48.58	39.12
Price spread (kyats/kg)	632.20	632.20	632.20
Share to export price (percent)	63.12	63.12	63.12
Wholesalers			
Sale price (kyat/kg)	1,225.00	1,225.00	1,225.00
Marketing cost (kyats/kg)	26.82	16.94	24.06
Gross margin (kyats/kg)	142.93	142.93	142.93
Gross margin (percent)	11.67	11.67	11.67
Share to export price (percent)	71.46	71.46	71.46
Exporters			
Export price (Kyat/kg)	1,714.27	1,714.27	1,714.27
Marketing cost (kyats/kg)	76.52	76.52	76.52
Gross margin (kyats/kg)	489.27	489.27	489.27
Gross margin (percent)	28.54	28.54	28.54

Note: Export price is FOB Shwe Li (Ruili). Export price was 9.30 Yuan/kg (7/12/2008). Exchange rate was 184.33 kyats/Yuan (7/12/2008)

Source: Personal contact in 2008

Table 2 Marketing margins of black sesame exported to Japan, 2008

Items	Mandalay	Monywa	Pakokku
Farmers			
Average yield (kg/ha)	799.68	514.17	373.38
Sale price of famers (kyats/kg)	918.74	918.74	918.74
Production cost (including marketing cost) (kyats/kg)	515.65	556.43	658.78
Marketing cost (kyats/kg)	14.90	9.19	18.43
Gross margin (kyats/kg)	403.09	362.31	259.96
Gross margin (percent)	43.87	39.44	28.30
Price spread	1,037.84	1,037.84	1,037.84
Share to export price (percent)	46.96	46.96	46.96
Wholesalers			
Sale price of wholesalers (kyat/kg)	1,143.32	1,143.32	1,143.32
Marketing cost (kyats/kg)	39.18	41.18	34.18
Gross margin (kyat/kg)	224.58	224.58	224.58
Gross margin (percent)	19.64	19.64	19.64
Share to export price (percent)	58.43	58.43	58.43
Exporters			
Export price (Kyat/kg)	1,956.58	1,956.58	1,956.58
Marketing cost (kyats/kg)	58.93	58.93	58.93
Gross margin (kyats/kg)	813.26	813.26	813.26
Gross margin (percent)	41.57	41.57	41.57

Note: One basket was 24.49 kg. Export price was 1,700 $/ton (FOB Myanmar). Exchange rate was 1,150 kyats/$ (January 2008)

Source: Personal contact in 2008

For the white sesame seeds to China, farmers received gross margins of 566.46, 525.64 and 423.39 kyats/kg in Mandalay, Monywa and Pakokku townships, respectively, meaning that farmers obtained 52.35, 48.58 and 39.12 percent of the selling price. The price spread between farm and export was 632.20. The price spread consisted of the wholesaler's gross margin (142.93 kyats/kg) and the exporter's gross margin (489.27kyats/kg). The highest gross margin for the farmer was found in Mandalay because of high yield per unit area (799.68 kg/ha) during the survey period. Marketing costs of farmers were 14.90, 9.19 and 18.43 kyats/kg in Mandalay, Monywa and Pakokku, respectively. Farmer's share of export price was 63.12 percent meaning that farmers

received 63.12 percent of the export price for the white sesame seed exported to China. The wholesalers obtained a relatively low gross margin, 11.67 percent of the sale price because wholesale prices used in this calculation was the price set by CEXC and wholesalers were assumed to re-sell sesame seed without storage. However, wholesaler's share of export price was 71.46 percent in all townships which was higher than farmer's share of the export price. Exporters incurred large marketing costs (76.52 kyats/kg) because of transportation, packaging, loading/unloading costs and license fee (including export tax). Exporter's gross margin was 489.27 kyats and it was about 28.54 percent of the sale price (export price).

For the marketing margins of the black sesame to Japan, Mandalay farmers obtained the highest gross margin, about 43.87 percent. Pakokku farmers received the lowest gross margin (28.30 percent) because of low yields. Farm-export price spread was 1,037.84 kyats/kg and it was composed of wholesalers' and exporters' gross margins. Farmer's share of the export price was 46.96 percent which was lower than farmer's share of the export price for white sesame (63.12 percent). The highest marketing cost (41.18 kyats/kg) was incurred by Monywa wholesalers because of high transportation cost of black sesame to Yangon. Wholesaler's gross margin was 19.64 percent and wholesaler's share of the export price was 58.43 percent in all townships because wholesale prices used in this study was set by CEXC in each township. Exporter's gross margin was 813.26 kyats/kg and it was 41.57 percent of their sale value.

In sum, farmers received the highest gross margin for the white sesame exported to China. For the black sesame exported to Japan, Mandalay farmers received higher gross margin than the farmers and exporters in Monywa and Pakokku. The reason is that Mandalay is the central wholesale market and farmers have easy access to wholesale market. In addition, the yield of Mandalay farms was higher than the yield of those in other townships. With respect to farmer's share, farmers got higher share of the export price for white sesame (63.12 percent) than for black sesame (46.96 percent) although the export price of white sesame was lower. The reason is that the price collected for white sesame was higher than that of black sesame in the domestic market. The gross margin of exporters of black sesame sold to Japan (41.57 percent) was larger than that of white sesame exported to China (28.54 percent) because of the high export price to Japan.

The economic crisis in 2007 caused a drop in the demand from China. Discussions with the exporters revealed that because of the low demand from China, more volume of sesame seeds

entered the domestic market and the price fell especially at harvest time. Generally, if farmers sold their products to the wholesalers, they were responsible for all costs including transportation cost, labor charges, and even the commission for selling their products. When the wholesalers acted as traders, they incurred some marketing costs for the transportation, storage, loading, repackaging and purification. Some wholesalers have good storage facilities, which allow them to wait for higher prices. Therefore, wholesalers and traders were able to make higher profits from the export of sesame seeds. But farmers could not do the same and could not benefit from the high price during the off-season and the export price.

Unit Root Tests

The ADF test statistics presented in Table 3 corresponds to the regression with drift plus lag and drift plus trend plus lag that had minimized the SIC. The values of τ statistic for the unit root tests of residuals from long-run relation of all tested price pairs of white and black sesame seeds were less (more negative) than Mackinnon critical value at 1 and 5 percent significant level. Therefore, all domestic price series of sesame seed and FOB prices were non stationary and insignificant of order one I(1).

Table 3 Results from the unit root test of sesame seed prices from November 2002 to October 2008

No.	ADF test	Level		First differences		Order of integration
		Drift	Drift & trend	Drift	Drift & trend	
1.	PW_a	-0.0642	-1.6140	-6.8775***	-6.9129***	I(1)
2.	PW_b	-0.7599	-2.4819	-5.8205***	-5.8139***	I(1)
3.	PBL_a	-0.0183	-1.5237	-7.7055***	-7.7891***	I(1)
4.	PBL_c	-0.7097	-2.3008	-10.2929***	-10.2899***	I(1)
5.	FOB	-0.3296	-2.6474	-12.3115***	-12.7243***	I(1)

Note: 1) Optimum lag length was selected by Schwartz Information Criterion (SIC) (max 11 lag)

2) Critical values with draft -3.5(1%), -2.9 (5%), -2.58(10%), and with trend and drift -4.06(1%), - 3.46(5 %), -3.16 (10 %)

3) ***, ** and * indicated market integration in 1%, 5% and 10% significant level, respectively.

Granger Causality Tests

The results of Granger causality tests are presented in Table 4 indicating which price caused others. Optimum leg length of VAR is determined by AIC. According to the results of

causality tests, PWb caused PWa and PWa was used as dependent variable for domestic white sesame price series. With respect to black sesame prices, PBLa caused PBLc and PBLc was used as dependent variable. All domestic prices caused FOB, and this FOB was used as dependent variable.

Table 4 Results from the Granger causality test for wholesale price of white sesame seed

No.	Direction	Lag	Standard Granger causality test	
			F statistic	Probability
1.	$PW_b \longrightarrow PW_a$	1	8.3588***	0.0051
	$PW_a \longrightarrow PW_b$		0.0036	0.9525
2.	$PW_a \longrightarrow FOB$	1	2.6318**	0.0123
	$FOB \longrightarrow PW_a$		1.0859	0.4036
3.	$PW_b \longrightarrow FOB$	1	3.5811***	0.0033
	$FOB \longrightarrow PW_b$		1.3200	0.2601
4.	$PBL_c \longrightarrow PBL_a$	8	1.4451	0.2026
	$PBL_a \longrightarrow PBL_c$		9.5284***	8.9E-08
5.	$PBL_a \longrightarrow FOB$	1	4.4408***	0.0003
	$FOB \longrightarrow PBL_a$		0.9401	0.5076
6.	$PBL_c \longrightarrow FOB$	4	2.6820**	0.0399
	$FOB \longrightarrow PBL_c$		1.0412	0.3936

Note: ***, ** and * indicated the rejection of null hypothesis of non Granger causality at 1%, 5% and 10% significant level.

Engle and Granger Cointegration Test

After identifying dependent variables, long-run regressions for the sesame seed prices were estimated; the equations were presented in Table 5. Each equation illustrates the responses of each dependent price to independent price series. For instance, if domestic price of white sesame seed in Monywa increased by one unit, the domestic price of white sesame seed in Mandalay would increase 1.06 units (see Equation 13).

After estimating the long-run regressions, the residual from each equation were tested according to Equation 9 and 10 to identify whether these prices were cointegrated. The results of Engle and Granger cointegration tests are shown in Table 6. All domestic white (PWa and PWb) and black (PBLa and PBLc) sesame seed markets were found to be cointegrated. Mandalay market was central market and Mandalay CEXC was the first market to operate daily price and first price maker of oil crops in Myanmar. Other CEXCs in Yangon, Monywa, Pakokku, Magway, Myingyan and Taunggyi townships referred to the price information and demand in Mandalay.

Table 5 Long-run equations for the price of sesame seed

Long-run equations for white sesame seed		Long-run equations for black sesame seed	
PW_a = -173.4356+1.0669(PW_b)	(13)	PBL_c = 504.3759 + 0.9749 (PBL_a)	(16)
(487.9697) (0.0239)***		(597.6041)* (0.0298)***	
FOB = 5606.9766 + 1.0425(PW_a)	(14)	FOB = 5797.1030 + 1.1206 (PBL_a)	(17)
(439.8145) (0.02030)***		(1132.9270)*** (0.0564)***	
FOB = 5253.4545 + 1.12173 (PW_b)	(15)	FOB = 6380.2651 + 1.0841 (PBL_c)	(18)
(1346.2278)*** (0.0661)***		(1276.6880) *** (0.0633)***	

Notes: ***, ** and * indicated the rejection of null hypothesis at 1%, 5% and 10% significant level.

Table 6 Results of Engle and Granger cointegration test for wholesale prices of white and black sesame seeds

No.	Pairs of Price Series	Coefficient of Residual	Standard Error	ADF τ statistics	R^2
1.	PW_b vs. PW_a	-0.3109	0.0856	-3.6308**	0.1547
	PW_a vs. PW_b	-0.3104	0.0861	-3.6053**	0.1528
2.	PW_a vs. FOB	-0.3547	0.0945	-3.7541**	0.2202
	FOB vs. PW_a	-0.4054	0.1105	-3.6708**	0.2350
3.	PW_b vs. FOB	-0.4957	0.1052	-4.71299***	0.2653
	FOB vs. PW_b	-0.6019	0.1248	-4.8222***	0.2849
4.	PBL_c vs. PBL_a	-0.3194	0.1699	-4.9175***	0.4831
	PBL_a vs. PBL_c	-0.7642	0.1648	-4.6384***	0.4584
5.	PBL_a vs. FOB	-0.3194	0.0879	-3.6340**	0.2462
	FOB vs. PBL_a	-0.3507	0.0942	-3.7239**	0.2586
6.	PBL_c vs. FOB	-0.5549	0.1329	-4.1755***	0.2722
	FOB vs. PBL_c	-0.6604	0.1593	-4.14559***	0.2761

Notes: 1) First variables are dependent variables in cointegrating regression.

2) Critical values of two variables in cointegration equations were -4.0655 (1%), -3.4295 (5%) and -3.1055 (10%) (Ender, 2004: 441)

3) ***, ** and * indicated the rejection of null hypothesis at 1%, 5% and 10% significant level.

Wholesalers and traders made their transactions based on the price set by CEXC in each township and negotiated a new price with buyers depending on quality and demand. All domestic markets and export markets (PW_a and FOB, PW_b and FOB, PBL_c and FOB, PBL_a and FOB) were also cointegrated. If the demand from China increased, the domestic price of white sesame would increase. Moreover, market demand and price information at the border with China were easily transmitted to Mandalay and other domestic markets by mobile phone and by truck drivers plying the Mandalay-Chinese border route. The exporters used the wholesale price as a cost of sesame

seed to set Myanmar export prices because the export price used in this study was the average FOB Myanmar of black and white sesame seed agreed by exporters and importers. These prices may be affected by export policies and change in domestic supply and export demand. Separate data for the export price of white and black sesame seeds were not available. The results of Granger causality test in Table 8 confirmed that all domestic wholesale prices caused the export price to change. Therefore the domestic markets of white and black sesame seeds were strongly integrated with the export market.

Error Correction Model

The results of ECM for wholesale prices of white and black sesame seeds are in Table 7. The Table (Row 5), shows that the response of FOB is larger than the change in domestic wholesale prices. For the white sesame prices (Equation 14), if the price in Mandalay market changed by one unit (kyat), FOB would change by 1.04 units (kyat). But FOB might not respond fully by this amount within one month so that how much these markets responded in one month was estimated by ECM. Error correction term represented the correction of deviation from long-run equilibrium price in a single period and verified how fast the deviations in the long-run equilibrium were corrected. All coefficient values of speed of adjustment were less than one and showed appropriate signs.

Table 7 Results of Error Correction Model for the wholesale price of white and black sesame seeds

No	Price series	Lag	Dependent variables	Speed of adjustment (α)	Std. error	T-statistic	Probability
1.	PW_a vs. PW_b	1	ΔPW_a	-0.1122	0.1243	-0.9032	0.3680
			ΔPW_b	0.1983*	0.1107	1.7936	0.0751
2.	FOB vs. PW_a	1	ΔFOB	-0.2754***	0.0731	-3.7664	0.0002
			ΔPW_a	0.0241	0.0445	0.5413	0.5892
3.	FOB vs. PW_b	1	ΔFOB	-0.3105***	0.0730	-4.2555	0.0000
			ΔPW_b	0.0773*	0.0382	2.0247	0.0449
4.	PBL_c vs. PBL_a	8	ΔPBL_c	-0.4578***	0.1639	-2.7929	0.0063
			ΔPBL_a	0.2973*	0.1714	1.7353	0.0860
5.	FOB vs. PBL_a	1	ΔFOB	-0.2560***	0.0851	-3.0088	0.0031
			ΔPBL_a	0.0289	0.0433	0.6685	0.5050
6.	FOB vs. PBL_c	4	ΔFOB	-0.4653***	0.0917	-5.0742	0.0000
			ΔPBL_c	0.1777**	0.0841	2.1117	0.0368

Note: 1) ***,** and * denotes rejection of the null hypothesis at the 1%, 5% and 10% significant level

2) In price series Column 2, the first variables are dependent variables in cointegration equations.

In relation to the domestic white sesame prices and the export prices (ΔPW_a vs. ΔFOB and ΔPW_b vs. ΔFOB), the coefficient of speed of adjustment of ΔPW_a was not statistically different from zero indicating that ΔPW_a was unresponsive to its correcting error with respect to FOB while ΔPW_b showed significant response at 5 percent level and the rate of adjustment was very slow (about 7.73 percent per month). In both cases, ΔFOB provided negative and significant coefficients for speed of adjustment ie. -0.27 and -0.31. Monthly adjustment of FOB would be about 27 percent of the deviation of FOB_{t-1} from its cointegrating value with respect to PW_{at-1} and 31 percent of the deviation of FOB_{t-1} from its cointegrating value with respect to $PW_{bt-1.}$

As to black sesame prices in Mandalay and Pakokku markets, the coefficients of speed of adjustment for ΔPBL_c (-0.45) had a negative sign and significantly responded to long-run equilibrium at 1 percent level. The response of PBLc could correct 45 percent of the previous period's deviation from long-run equilibrium within one month. With respect to ΔFOB vs. ΔPBL_a and ΔFOB vs. ΔPBL_c, the coefficients of speed of adjustment for ΔFOB (-0.25 and -0.46) had negative signs and significantly different from zero at 1 percent level. This suggests that only export price was likely to increase to correct the last period deviation from long-run equilibrium with the speed of adjustment of 25 percent within one month. However, increase in FOB and decrease in PBL_c would attain their long-run equilibrium since both parameters of speed of adjustment were statistically significant. FOB would correct 46 percent of last period's deviation from the long-run equilibrium within one month. In sum, Mandalay central market was unaffected by all long-run price sequences. The export prices showed strong responses to all long-run price sequences with all domestic markets, and the adjustment rates were fast.

Granger Causality with Long-run Relation

Since all price series were found to be cointegrated, causality test with the ECM framework was applied to test the long-run causality (Table 8). There is a strong connection between cointegration and causality in this procedure, and Granger causality relationship must exist at least once in a cointegrated system. Black sesame prices in Mandalay and Pakokku granger caused each other. However, white sesame prices in Mandalay did not cause changes in Monywa. Farmers in Monywa Township cultivated not only white but also red and brown sesame since there is a large number of oil mills whose combined capacity is much larger than current production. One reason is that there was a separate informal and formal export of sesame seeds from Monywa to India

through Tamu. If sesame demand from informal and formal exporters to India and from other deficit regions of upper Myanmar increased, price in Monywa would rise and sometimes higher than the price in Mandalay. In this case the price in Mandalay would be affected since the two markets were integrated. All domestic prices caused the export price and export price did not cause any domestic wholesale prices of white and black sesame.

Reviewing the previous results for these variables indicates a long-run relationship by Engle and Granger cointegration tests. ECM estimate also showed at least one of the coefficients of speed of adjustment from both tests were significantly different from zero, which proved the existence of a long-run relationship amongr those variables. Again, if the variables are cointegrated, there should be causality at least in one direction (Enders, 2004). For these reasons, the results of Granger causality tests were consistent with the results of cointegration tests and ECM results. The results were reasonable for a country like Myanmar where the exporters used the wholesale prices as a cost of sesame seed to set the export price. In this study, the FOB price represented the average export price of black and white sesame seeds of Myanmar, which was agreed by exporters and buyers. In some events, the export price might be affected by export policies, cost of transportation, shortage or surplus of domestic supply.

Table 8 Results of Granger causality tests for the wholesale prices of white and black sesame seeds

No.	Granger causality with ECM			
	Direction	χ^2	d.f.	Probability
1.	$PW_b \longrightarrow PW_a$	5.3649**	1	0.0205
	$PW_a \longrightarrow PW_b$	0.4713	1	0.4924
2.	$PW_a \longrightarrow FOB$	1.4481**	1	0.0288
	$FOB \longrightarrow PW_a$	1.9897	1	0.1584
3.	$PW_b \longrightarrow FOB$	5.4343**	1	0.0197
	$FOB \longrightarrow PW_b$	1.7367	1	0.1876
4.	$PBL_a \longrightarrow PBL_c$	22.2660***	8	0.0044
	$PBL_c \longrightarrow PBL_a$	13.3789*	8	0.0995
5.	$PBL_a \longrightarrow FOB$	5.1021***	1	0.0001
	$FOB \longrightarrow PBL_a$	1.5875	1	0.3905
6.	$PBL_c \longrightarrow FOB$	21.6809***	4	0.0002
	$FOB \longrightarrow PBL_c$	7.2531	4	0.1231

Note: ***, ** and * indicate rejection of null hypothesis of non Granger causality at 1%, 5% and 10% significant level.

Conclusion and Recommendations

Marketing performances of all intermediaries along the marketing channels were well organized. Marketing channels of the same color of sesame seed were mostly similar in all selected townships except for some low quality black sesame seeds that were processed in Monywa where a large number of oil mills have been established. In the domestic market chain, Mandalay farmers got the highest gross margins for both white and black sesame. Farmers received the highest gross margins for white sesame to China. All exporters and Mandalay farmers received the highest gross margins for black sesame to Japan. Wholesalers received the highest share of the export price in both channels; their margins depended on storage time and price. Major domestic markets for black and white sesame seeds were integrated to each other and also integrated with export markets over the long run. In the short run however all markets deviated from the long-run equilibrium. Mandalay central market did not show any response to the long-run equilibrium but the adjustment of white sesame prices in Monywa and black sesame prices in Pakokku markets could attain a long-run equilibrium. The responses of export price to changes in domestic prices for black and white sesame seeds were relatively large and speeds of adjustment to correct the deviation from long-run equilibrium were fast. This suggests that sesame seed prices were not fully transmitted in the short run but would be fully transmitted in the long run among different domestic markets and between export and domestic markets.

In order to increase yields and gross margins, farmers should be provided high quality seeds and have access to a formal and reliable fertilizer supply system. Farmer's share could be increased by increasing the domestic price collected and decreasing the marketing costs. To achieve sufficiency in domestic supply and to increase export volume, the government should review the policy on liberalization of sesame seed exports driven by quality of the product. This would benefit farmers, wholesalers and exporters. Because of an unstable policy on the export of sesame, a high export tax, inefficient infrastructure, and the low volume of domestic supply the export price did not cause the domestic price; there was a large gap as well between the domestic and export prices. This might separate the markets in the short term. Support institutions such as Myanmar Agriculture Service (MAS), Department of Agricultural Research (DAR) and Myanmar Agricultural Development Bank (MADB) should also be strengthened for the provision of technical advice to boost farm productivity, improved post harvest technology, good quality seed and conduct

further market research to develop the sesame trade at least in Asia. Government should support the traders in finding new markets by attending international trade fairs, which are important activities to spot and develop new market opportunity.

Further study should focus on the market integration and price transmission of sesame between all major domestic markets and export markets in the Association of South East Asian Nations (ASEAN) countries. Probably India, China and regional economic integration will continue to play increasingly important role in the sesame world market. The market analysis of farmers and wholesalers should be made for the regions that are not near the major markets. The detailed marketing costs and margins of the millers should also be analyzed; this would help identify measures to promote the efficiency of processing of sesame oil.

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