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Egg Market Integration and Financial Feasibility Laying Hens Farmer in Central Java, Indonesia

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Abstract

The research aims to determine the degree of chicken egg market integration, determine the price asymmetric and determine the financial feasibility of chicken egg business in Central Java, Indonesia. Secondary data from January 2017- December 2019 was used for research. Survey research was conducted on 100 (one hundred) laying hens farmers. The research study was conducted in Semarang city, Kendal regency and Semarang regency. Johansen test, Pearson correlation and Granger Causality test were used in this study. Financial feasibility analyses such as investment, payback period (PP), net present value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI), and Benefit-cost (B/C) ratio are used in this study. The result showed there was a positive correlation between the Price in Kendal Regency and Semarang City. Increasing prices in Semarang City caused the increasing Price in Kendal regency vice versa. There was a marketing integration between Semarang city and Kendal regency, and Granger Causality showed Price in Semarang city influenced the Price in Kendal regency and Semarang regency. The price of chicken eggs in Semarang city, Kendal regency, and Semarang city were symmetric. Based on the calculation of PP, NPV, IRR, ROI and B/C ratio, laying hens business in Central Java is feasible to run.

Keywords: market integration; financial feasibility; chicken egg

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INTRODUCTION

Chicken eggs are an animal food source of protein and are easily accessible in terms of availability and affordability. The ease of access is due to the rapid development of the poultry industry which tends to spread close to consumers. Chicken egg production in Central Java is ranked 2nd in Indonesia which is dominated by the city of Kendal by 40%. The demand for eggs from the community always increases, as well as production which has increased by more than 10% every year. The laying hen business needs to look closely at the problems that exist in the field so as not to get the wrong strategy.

Prices that are always changing still occur and have become a habit that often occurs in Indonesia. The condition of egg prices occurred again in mid-2018 and it is suspected that the condition of the price increase occurred at a time when chicken egg production was increasing. A detailed search needs to be done from production to habits in the field. For example, on fixed costs in production, big days in society to climate / weather.

The problem of changing chicken eggs can be known if several factors can be related to details. Production and consumer areas have a strong attachment. Integration in this case can have a symmetrical value if the difference is only in transportation costs or commonly called the Law of One Price (LOP). When the business area is traced, it will be related to workers' wages, land prices and rental prices obtained from capital. However, this is not easy because of the restrictions such as the habits that are often done by producers in an area. For this reason, knowing more about these two things can increase the choice of strategies for producers and the quality of life of consumers.

The purpose of this study is to determine the degree of integration of the purebred chicken egg market, determine the asymmetrical price of purebred chicken eggs, and find out the feasibility of laying hen business in Central Java. The most important thing from this study is to see the relationship that occurs in several factors in one area so that it can determine the level of feasibility in the laying hen business. This research hopes to be able to facilitate producers to be able to find out more clearly how the market can be achieved so that they can maintain their business properly.

RESEARCH METHODS

The study was conducted in Central Java Province, Indonesia. The study was conducted in Semarang city, Kendal regency, and Semarang regency. Monthly data from January 2017-December 2019. Secondary data were used in this study covering the periods January 2017-December 2019. Data was collected from the Animal and Animal Health Office, Central Java, Central Bureau of Statistics of Central Java, and the Directorate General of Livestock, Ministry of Agriculture in Indonesia. The producer area would choose Kendal regency and Semarang regency, and Semarang city was chosen as consumer area. Survey research was conducted 100 (one hundred) laying hens farmer was interviewed in the study. Chicken farmer characteristic, and finacial feasibility such as Total investment, payback period (PP), Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI) and Benefit/Cost Ratio (B/C ratio) were observed.

DATA ANALYSIS

Descriptive statistics include mean, standard deviation, coefficient of variation, and price correlation coefficients were computed. To determine the correlation between one market to another market used the Pearson Correlation analysis [19]. Price transmission to choosing causal between central market price extends to another, and the speed at which the price changes occur at a given market is also reflected at other market levels [11]. The the Augmented Dickey Fuller (ADF) t-statistic was applied to test the hypothesis of a unit root in series, was illustrated as follows:

$$\Delta P_t = \alpha P_{t-1} + \sum_{j=1} b_j \Delta P_{t-j} + \theta + \beta t + \varepsilon_t \quad \text{.....(Eryigit \& Karaman, 2011)}$$

$$\Delta P_t = \alpha P_{t-1} + \sum_{j=1} b_j \Delta P_{t-j} + \theta + \varepsilon_t \quad \text{.....(Franken } et\ al.\text{, 2005)}$$

$$\Delta P_t = \alpha P_{t-1} + \sum_{j=1} b_j \Delta P_{t-j} + \varepsilon_t$$

The stationary of the time series data was tested using the Augmented Dickey-Fuller Test (ADF), in the Augmented Dickey-Fuller test equation by the lagged values of the difference terms. For example, if ε_t is AR (p), the test equations become

$$\Delta y_t = \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \text{.....} + \delta_{t-p} + \varepsilon_t \text{ .....(Gan } et\ al.\text{, 2019)}$$

$$\Delta y_t = \beta_1 + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \text{.....} + \delta_{t-p} + \varepsilon_t \quad \text{.....(Ganneval, 2016)}$$

$$\Delta y_t = \beta_1 + \beta_2 t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \text{.....} + \delta_{t-p} + \varepsilon_t \text{ .....(Gelli } et\ al.\text{, 2017)}$$

The null and alternative hypotheses were still the same. The Dickey-Fuller (DF) test is just the special case of the ADF test. The ADF Test is carried out in the same way as the DF test (Sofyan *et al.*, 2019).

The econometric analysis of the chicken egg price transmission identifies which marketing levels (or location) played an important role in determining chicken egg prices. These concerns established the direction of a causal relationship in chicken egg prices in the vertical (or spatial) marketing system. The causal direction between different price levels and between spatial markets was tested empirically using pairwise Granger causality tests by estimating the following equations (Sofyan *et al.*, 2019)

Between wholesale and retail prices of chicken egg:

Model 1: $W_t = \theta_1 + \sum_1^n a_{1i} W_{t-i} + \sum_{i=1}^n \beta_{1i} R_{t-i} + \varepsilon_{1t}$ .....(Hamulczuk *et al.*, 2019)

Model 2: $R_t = \theta_2 + \sum_1^n a_{2i} W_{t-i} + \sum_{i=1}^n \beta_{2i} R_{t-i} + \varepsilon_{2t}$ .....(Krisdiana *et al.*, 2021)

Where F_t is the monthly farm price at time t & W_t is the monthly wholesale price at time t & R_t is the monthly retail price at time t, θ is the intercept, $a_i s$ are the coefficients on the lagged values of farm and wholesale prices, $\beta_i s$ are the coefficients on the lagged values of wholesale and retail prices, i is the lag length used for retail prices, and ε_t is the error or disturbance term at time t.

In the same way, the equations that were used to test the causality relationships between spatial markets, for example, between regions X and Y, are as follows:

Model 1: $X_t = \theta_1 + \sum_i^n a_{1i} X_{t-i} + \sum_1^n \beta_{1i} Y_{t-i} + \varepsilon_{1t}$ .....(Longworth *et al.*, 2019)

Model 2: $Y_t = \theta_2 + \sum_i^n a_{2i} X_{t-i} + \sum_1^n \beta_{2i} Y_{t-i} + \varepsilon_{2t}$ .....(Mafimisebi, 2012)

Where X_t and Y_t are the monthly wholesale prices of the chicken egg at regions X and Y at time t, the other variables are defined in the same way as previously described. A statistically significant F-statistic to be obtained in both directions of causation would suggest a feedback relationship between markets, which means that shocks are coming from the reference or base market influence pricing in the other markets (Sofyan *et al.*, 2019).

The Law of One Price (LOP)

To tested LOP the he Engle-Granger Test is a Dickey-Fuller Test applied (Sofyan *et al.*, 2019) to the residuals (e_t) of the cointegrating equation but with some modifications. The test equation was:

$\Delta e_t = \gamma e_{t-1} + v_t$ .....(Mahmoud *et al.*, 2005)

where v_t is a white noise. The null and alternative hypotheses are:

$H_0 = \gamma = 0$

$H_a = \gamma < 0$

The LOP was computed to determine if the price in one market was symmetric or not with another market.

Pearson correlation

Pearson correlation is used to determine the relationship between prices in market x and prices in market Y. A strong correlation indicates that markets x and Y are integrated with each other.

$$rxy = \frac{n.\Sigma XY - \Sigma X.\Sigma Y}{\sqrt{\{n.(\Sigma X^2) - (\Sigma X)^2\}\{n.(\Sigma Y^2) - (\Sigma Y)^2\}}}$$ .....(Marks, 2010)

Granger causality test

The Granger causality test is used to find out which markets affect other markets (Yazdani *et al.*, 2013).

Financial Feasibility

Financial feasibility is calculated to find out how much investment is invested, then the investment criteria of the investment are PP, IRR, NPV, ROI, and B/C ratio (Zhao *et al.*, 2021).

RESULTS AND DISCUSSION

Degree of Chicken Egg Market Integration

The chicken egg price in Central Java province fluctuated during 2017-2019 after deflated with the consumer price index (CPI). The average chicken egg retail price reached its peak at IDR. 25,000/kg in the Semarang city, and the lowest Price was IDR. 19,000 /kg). The Semarang city is an importing region since it does not produce many layer chickens. The Price in Semarang regency the highest Price was IDR 23,000/kg, and the lowest price was 17,500. The highest price of chicken egg in Kendal regency was IDR 22,000, and the lowest Price was IDR 17,000. The price fluctuations of chicken eggs are presented in table 1. The price of chicken eggs which is quite high in value is due to fluctuations in demand and supply in the province of Central Java. When the demand for eggs is high, such as during religious holidays, it will trigger an increase in egg prices.

Table 1. Chicken egg retail price and price volatility.

Market	Minimum	Maximum	Average Price	STD. Error oF Mean	CV%
	IDR kg $^{-1}$				
Semarang city	19,000	25,000	22,500	1114.1	40
Semarang regency	17,500	23,000	21,500	1230.2	41
Kendal Regency	17,000	22,500	22,000	1455.5	43

Sumber: Primary Data Processed

As shown in Table 1. Coefficient Variation (CV) was 40% in Semarang city, 41% in Semarang regency, and 43% in Kendal regency & this condition showed in producer area the price more fluctuated compared with consumer area. This result is in agreement with existing research (Longworth *et al.*, 2019). Further, they stated milk price in producer area more fluctuated than milk price in the consumer area. The high CV shows that the mechanism of supply and demand for chicken eggs in Central Java is very high, this causes the price of chicken eggs to rise and fall rapidly.

As shown in Table 2, there was a strong correlation between price in producer and consumer areas. Increasing price in consumer area tends to increased price in producer area. A strong correlation between beef cattle producers and Central Java consumers [19]. Increasing price in consumer area would follow the increasing price in producer area no longer than two months. The results in agreement with Longworth et al (2019) which stated there was a strong correlation between price in producer area and consumer area in Dutch. Increasing number of egg demand would increase the egg price in producer area.

Table 2. Pearson correlation of chicken egg price at retail level.

Market	Semarang city	Kendal	Semarang Regency
Semarang City	1.00		
Kendal	0.88	1.00	
Semarang	0.90	0.92	1.00

Source: Primary Data Processed

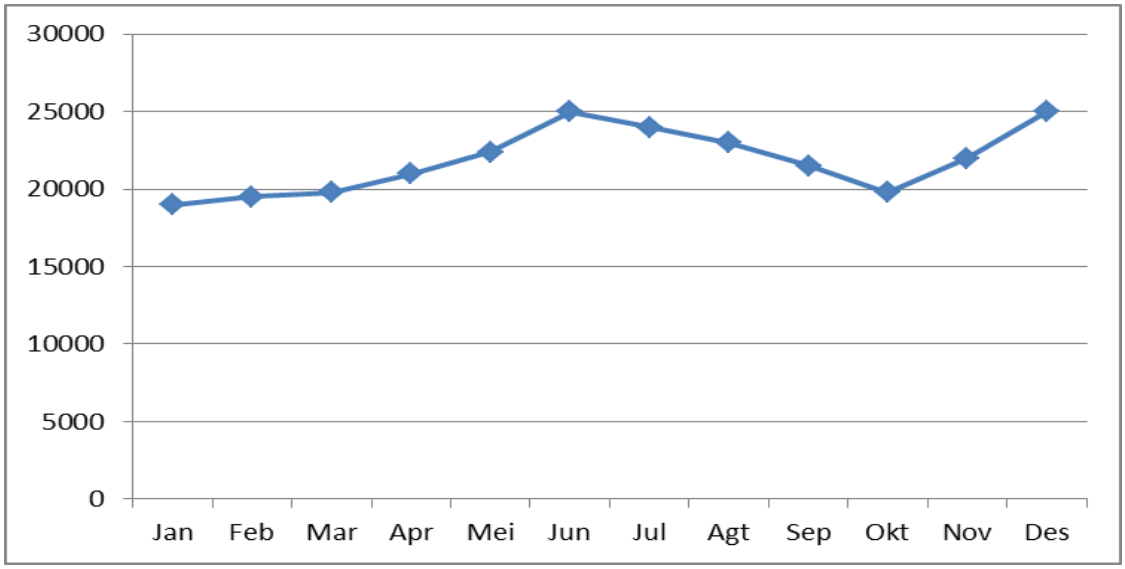

Figure 1. Chicken egg price 2019

As shown in figure 3. The chicken egg price in Semarang city fluctuated. The highest price of its was in June and December, and the lowest price was in October. The price was high during the Idul Fitri Moslem festival and Christmas Festival. The increasing price of chicken egg triggers the more supply to consumer area.

Table 3. Degree of market integration.

Price Series	Level	First Difference
	With Drift and Trends	
Semarang city	-2.896	-3.88**
Kendal regency	-3.820	-3.68**
Semarang regency	-2.948	-3.70**

*** Significant at 1% probability level
** Significant at 5% probability level
Source: Primary Data Processed

To test the degree of market integration using ADF test. Testing ADF test findings that all of the chicken egg market were stationary (Table 3). All of the market observed was stationary. As shown in Table 4. Kendal regency and Semarang city was integrated. The differences price just only in transaction cost. Semarang city and Semarang regency was also integrated, and Semarang regency and Kendal regency was integrated also. Increasing price in one market would follow the increasing price in other market. This result in agreement with existing research (Longworth *et al.*, 2019). They found increasing milk price in one market would also follow increasing price in another market.

Table 4. Results of bi-variate cointegration test at the chicken egg at retail level.

HO: RANK=P	Eigenvalue	Trace Test	Max Test
1. Kendal and Semarang city			
P=0	0.890	25.08***	25.08***
P≤1	0.036	1.765	1.765

2. Semarang regency and Semarang city			
P=0	0.867	20.55***	20.55***
P≤1	0.039	1.665	1.665
3. Semarang regency and Kendal			
P=0	0.516	8.926***	8.926***
P≤1	0.032	1.265	1.265

*** Significant at 1% probability level

Source: Primary Data Processed

As shown in Table 4. There was a cointegration between chicken egg prices in Semarang city, Kendal regency, and Semarang regency. Price of chicken egg in Kendal and Semarang city was integrated, price of chicken egg in Semarang regency and Semarang city was integrated and price of chicken egg in Semarang regency and Kendal regency was integrated.

ASYMMETRIC PRICE

As shown in Table 5, the cointegrating vector of producer area and consumer area were cointegrated. The price of chicken egg in Semarang city was the price of chicken egg in Kendal plus transaction cost. The price of chicken egg in Semarang city was the chicken price in Semarang regency plus transactional cost, and the price of chicken egg in Semarang regency was the price of chicken egg in Kendal plus transactional cost. They were increasing the transactional cost such as transportation cost, wholesale profit. Etc would tend to increase the price of chicken eggs in the consumer area.

Table 5. Normalizing cointegrating vectors of the system of cointegrated price series at the retail level.

Cointegrating Vector	Lop Imposition
1	Semarang city= Kendal +c1
2	Semarang city = Semarang regency +c2
3	Semarang regency = Kendal +c3

Source: Primary Data Processed

As shown in Table 6, Semarang city caused the price of chicken egg in Kendal and Semarang regency. The high demand for chicken eggs in Semarang city as a consumer area would attract more product supply from the producer area.

Table 6. Result of Granger-Causality test for chicken egg price series at the retail level, Central Java.

Relation	Type
Semarang city= Kendal +c1	Unidirectional
Semarang city = Semarang regency +c2	Unidirectional
Semarang regency = Kendal +c3	Unidirectional

Source: Primary Data Processed

Table 7. Asymmetric test results at the chicken egg price at the retail level, Central Java.

Id	Market Pair	Lag	Chi-Statistics
1	Semarang city and Kendal regency	1	0.710 ns
2	Semarang city and Semarang regency	1	0.442 ns
3	Semarang regency and Kendal regency	2	0.083 ns

ns: Not significant at 5% probability level
Source: Primary Data Processed

The Price in Semarang city, Kendal regency, and Semarang regency were symmetric. The Increase in Price in Semarang city would follow by increasing Kendal regency in less than one month, so we can conclude that LOP happened between two markets. The price of chicken egg in Semarang city was symmetric with the price of chicken egg in Semarang regency. So LOP happened between two markets. The price of chicken egg in Semarang regency was symmetric with the price of chicken egg in Kendal regency. So LOP happened between two markets. The distance between producer and consumer areas was near. When the price of chicken egg in Semarang city increased, the price easily transmitted to Semarang regency and Kendal regency.

Table 8. Laying hens farmer characteristic.

No	Items	Number
1	Experiences	14
2	Number of laying hens)heads)	4,300
3	Average chicken egg production (kg/day)	233
4	Age (year)	45
5	Education Backgorund	
	Elementary school (%)	16
	Junior high school (%)	10
	Senior high school (%)	72
	Diploma/undergradaute	2
6	Number of respondents	100

Source: Primary Data Processed

As shown in table 8. The average ownership of laying hens is 4300 heads with a daily production of 233 kg. Laying hens have an average age of 45 years with 14 years of experience. Laying chicken breeders in Central Java have on average had quite a long time in managing laying hens, this causes the laying hens business to be sustainable. Most of the breeders are graduates of senior high school so they are able to receive knowledge and absorb knowledge and changes from outside.

BUSINESS FEASIBILITY

As shown in table 9, to raise 4300 laying hens requires an investment of 478,000,000. Based on the calculation of the income and expenditure assumptions issued by the farmer, the PP value for 1 year and 11 months will be obtained, the NPV is IDR 820,000,000, the IRR is 62%, the ROI is 58% and the B/C ratio is 2.48. Based on these calculations, laying hens business in Central Java Indonesia is feasible to implement.

Tabel 9. Financial feasiblity of smallscale laying hens business

No.	Feasibility items	Value	Description
1	Investment (IDR)	478,000,000	
3	*Payback Period (PP)*	1 year 11 Months	Feasible
4	NPV (IDR)	820,000,000	Feasible
6	IRR (%)	62%	Feasible
2	ROI	58%	Feasible
5	B/C Ratio	2.48	Feasible

Source: Primary Data Processed

CONCLUSION

The market among producer area and consumer area in Central Java were integrated. The correlation between price in producer area and consumer area were highly integrated. Increasing the price in the consumer area would follow by increasing the price in the producer area. The Price in Semarang city influenced the Price in Kendal regency and Semarang regency. The Price in Semarang city, Kendal regency, and Semarang regency were symmetric. The government in Central Java should manage the Price in Semarang city to stabilize the price of chicken eggs in Central Java. The laying hens business in Central Java, Indonesia, is feasible.

RECOMMENDATION

According to the results of study, the Central Java Government should be have proper regulation to save the chicken farming. Price of egg always fluctuated because many oligopoly firms influence the egg price. Regulation of the government would create egg price stability.

REFERENCES

Baquedano, F.G. & W.M. Liefert. (2014). Market Integration and Price Transmission in Consumer Markets of Developing Countries. *Food Pol*, 44, 103–11

Craig, L.A. & M. T. Holt. (2017). The Impact of Mechanical Refrigeration on Market Integration: The U.S. Egg Market, 1890–1911. *Explorations in Eco. Hist*, 66, 85–105.

Eakin, H., S. Sweeney., A.M. Lernerc., K. Appendini., H. Perales., D. G. Steigerwald. & C. F. Dewes., F. Davenporth. & J. C. Bausch. (2018). Agricultural Change and Resillience & Agricultural Policy, Climate Trends and Market Integration in The Mexican Maize System. *Anthropocene*, 23, 43–52.

Eryigit, K.Y. & S. Karaman. (2011). Testing for spatial market integration and law of one Price in Turkish wheat markets. *Qual Quant*, 45, 1519–1530.

Franken, J.R.V., J.L. Parcell., M. Sykuta. & C.L. Fulcher. (2005). Market Integration: Case Studies of Structural Change. *Agricultural and Res. Eco. Rev*, 34, 163-172.

Gan, J., I. Stupak. & C. T. (2019). Smith. Integrating Policy, Market, and Technology for Sustainability Governance of Agriculturebased Biofuel and Bioeconomic Development in The US. *Energy, Sustain. Soc*, 9, 43

Ganneval, S. (2016). Spatial Price Transmission on Agricultural Commodity Markets Under Different Volatility Regimes. *Economic Mod*, 52, 173–185

Gelli, A., E. Becquey., R. Ganaba., D. Headey., M. Hidrobo. & L. Huybregts. (2017). Improving Diets and Nutrition Through An Integrated Poultry Value Chain and

Nutrition Intervention (SELEVER) in Burkina Faso: Study Protocol for A Randomized Trial. *Trials*, 18, 412.

Hamulczuk, M., O. Makarchuk. & E. Sica. (2019). Searching for Market Integration :Evidence from Ukrainian and European Union Rape Seed Markets. *Land Use Pol*, 87, 104078.

Krisdiana, R., Prasetiaswati, N., Sutrisno, I., Rozi, F., Harsono, A. & Mejaya, M.J. (2021). Financial Feasibility and Competitiveness Levels of Soybean Varieties in Rice-Based Cropping System of Indonesia. *Sustainability*, 13, 8334.

Longworth, N., R.A. Jongeneel. & H.W. (2019). Saatkamp. A Vertically Linked Dynamic Partial Equilibrium Model to Analyze Market Shocks Caused by HPAI Control in The Dutch Egg Production Chain. *Wageningen J. Li. Sci*, 88, 112–128.

Mafimisebi, T.E. (2012). Spatial Equilibrium, Market Integration and Price Exogeneity in Dry Fish Marketing in Nigeria: A Vector Auto-Regressive (VAR) Approach. *J. Econ. Finance Adm. Sci*, 17, 31-37.

Mahmoud, C.S., I. Hossain. & G. Shively. (2005). Vegetable Market Integration In Bangladesh. *The Bangladesh Development Studies*, 31, 3-4.

Marks, D. (2010). Unity or Diversity? On The Integration And Efficiency of Rice Markets in Indonesia 1920-2016. *Exploration Eco. Hist*, 47, 310-324

Ravallion, M. (1986). Testing Market Integration. *American J. Agri. Eco*, 68, 1.

Sekhar, C.S.C. (2012). Agricultural Market Integration in India: An Analysis of Select Commodities. *Food Pol*, 37, 309-322

Setiadi, A., Sunarso., F. A. Lantican. & N. L. de Castro. (2012). Spatial Integration of Beef Markets at The Retail Level in Central Java, Indonesia. *Philipp J. Vet. Anim. Sci*, 38, 97-106.

Setianti, C T. Ekowati. & A. Setiadi. (2017). Market Integration of Fresh Milk in Dairy Business Area of Pamijahan District and Cisarua District, Bogor Regency – Indonesia. *J. Indo. Trop. Anim. Agric*, 42, 42-47

Sofyan A, E Suprijatna, S I Santoso, and A Setiadi. (2019). Business Sustainability Model of Smallholder Layer Farms in Kendal Regency, Central Java, Indonesia. *J. Indo. Trop. Anim. Agri*, 44(4): 408-414

Sun, Q., X. Gao., S. Wen., Z. Chen. & X. Hao. (2018). The Transmission of Fluctuation Among Price Indices Based on Granger Causality Network. *Physica A*, 506, 36–49.

Swanson, J.C., Y. Lee., P. B. Thompson., R. Bawden & J. A. Mench. (2011). Integration: Valuing stakeholder input in setting priorities for socially sustainable egg production. *Poultry Sci*, 90, 2110–2121.

Tinta, A.A. (2017). The Effect of A Positive Policy Integration on Agriculture and Climate Change Adaptation in ECOWAS. *Agric & Food Secur*, 6, 54.

Walker, S. (2018). Cultural Barriers to Market Integration: Evidence from 19th Century Austria. *Journal of Comparative Economics*, 46, 1122–1145.

Waroux, Y.P. & J.Chiche. (2013). Market Integration, Livelihood Transitions and Environmental Change in Areas of Low Agricultural Productivity: A Case Study from Morocco. *Hum. Ecol*, 41, 535–545

Yazdani, S., H. Rafiee., S.S. Hosseini. & A. Chizari. (2013). Spatial Integration of The Caspian Sea Bony Fish Market: An Application of The Seasonal Cointegration Approach to Monthly Data. *Ocean and Coast. Manag*, 84, 174-179.

Zhao, X., K. V. Calvin., M. A. Wise. & G. Iyer. (2021). The Role of Global Agricultural Market Integration in Multiregional Economic Modeling: Using Hindcast Experiments to Validate An Armington Model. *Economic Analysis and Pol*, 72, 1–17.