Vector Analysis of Education,Health,and Agriculture in Australia

Ema Sulisnaningrum
STIE Jaya Negara Tamansiswa Malang, Indonesia

Abstract : This study examines the direction of the relationship between human capital and agriculture where education and health are indicators of human capital development in this study. For indicators of agricultural development, we focus on agriculture performance and employment in agriculture. This study uses vector analysis to see the direction of the relationship between education investment, health investment, employment in agriculture and agriculture performance. The data used is secondary data with an annual period from 2000 to 2019. We found that the forecasting graphs of agricultural performance, health investment, and education investment appear to have an increasing trend but begin to tilt and tend to curve like a decline in growth. This shows that the stability of the performance of agriculture, education and health in Australia has entered a steady state. The decline in employment in agriculture indicates the use of technology is increasingly efficient so that the need for human resources is decreasing. However, the continued decline in employment in the services sector and the downward trend in the graph indicate a risk of labor shortages in the agricultural sector in Australia.

Keywords: Human Capital, Agriculture, Employment in Agriculture, Vector Analysis

JEL Classification : C01,E24,J24, J43

1 INTRODUCTION

Processed foods and other agricultural products, such as leather, wool, and cotton, constitute what is called "agriculture." In terms of economic growth, employment and exports, agriculture is an important part of the Australian economy. An important agricultural sector in which the Australian Trade Commission participates is food and beverage. Australia is dominated by livestock, mining, and manufacturing. Rich in industrial sheep, cattle, wheat, and yeast. It is the largest mineral resource country in the world. The agricultural population is rich in resources, such as iron, aluminum, nickel, and uranium (O'Keeffe,2019 ; Sheng et al., 2021). Australian agriculture has clear characteristics: First, livestock has a clear advantage over agriculture. The second is the main feature of large-scale farming, and the number of farms operating simultaneously is increasing.

Australian agriculture adopts highly specialized and socialized production methods. Farmers use their own labor and participate in business activities. Large farms that need to hire labor usually also employ their own relatives. In addition to its abundant agricultural production resources, Australian agriculture has achieved high levels of technological achievement and is also an important reason. Australia is a typical country with more land and fewer people, and the agricultural labor force is declining year on year. To ensure sustainable agricultural development, a large number of agricultural machines must be used to replace agricultural labor. Replacing capital for labor is a major direction of Australian agricultural technology. Australia's agricultural and livestock production and operations are relatively extensive, but due to a high degree of mechanization and reasonable management methods, the efficiency of agricultural and livestock production is relatively high. The trend of agricultural mechanization is to increase work efficiency, not increase the number of agricultural machines (Baležentis et al.,2021).

Australia still demonstrates tremendous comprehensive strength in environmental health. In indicators such as air quality, water resources, sanitation management, and heavy metal residues. The discovery of cervical cancer vaccines, cochlear implants, pacemakers, and the extraction and production of penicillin are major achievements in Australian medical science. Australia has the world's most comprehensive medical management system and medical and health infrastructure Medical security is combined with private health insurance to provide comprehensive medical and health services to all Australians. All medical supplies marketed in Australia must comply with the "Australian Medical Supplies Act", register and apply to the Australian Medical Supplies Authority, and only after obtaining a permit can the supplies be legally marketed. In addition, some countries will include health care products in the food category, but in Australia, the government classifies health care products like pharmaceuticals, and regardless of the type of health care product, they must comply with the highest production standards of the Australian government. A good health system in Australia can maintain and develop the health of the population so that the population can continue to be

productive (Esparraga, 2014).

All of Australia's good achievements in agriculture and health are the result of good education in Australia. Education encourages the development of technology in various fields including health and agriculture. This study examines the direction of the relationship between human capital and agriculture where education and health are indicators of human capital development in this study. For indicators of agricultural development, we focus on agriculture performance and employment in agriculture.

2 LITERATURE REVIEW

The concept of "human capital" has long circulated scientifically. Many scientists have paid attention to the study of the role of human capital. There are two main reasons for the interest in this concept. First, it is a general pattern of development of modern science in general, which is manifested in the concentration of scientists on the study of human problems. Second, it is an acknowledgment of the fact that the activation of human creativity, the development of a highly-skilled workforce is the most effective way to achieve economic growth. Human capital is recognized as the most valuable resource, far more important than natural resources or the accumulation of wealth. It is human capital, not material means of production, which is the determining factor of competitiveness, economic growth, and efficiency (Widarni & Mora,2021 ; Mora,A.G.O., Afriani,I.H. (2021).

However, there are pressing issues of research on the concept of "human capital", its economic place, its features in the agro-industrial complex, and its impact on the transformation process in terms of institutional approaches. The agricultural sector for the country of Australia has always been one of the priority areas of economic development of the country of Australia, Not only the survival and self-sufficiency of the state and people depend on it, but also the various directions of human activity. Agriculture is never separated from agri-industry or agri-business (Widarni & Drean,2021 ; Everingham et al., 2015).

The main task of agriculture is to provide food and industrial raw materials for the population. Agriculture is closely linked to many other sectors of the economy. These are the machinery manufacturing industry, which produces agricultural machinery and equipment, the chemical industry, which produces mineral fertilizers, pesticides, and plant protection products, and the light and food industry, which processes raw materials. Production and non-production infrastructure are essential for efficient agricultural operations. Infrastructure companies provide procurement, transportation, storage, and sale of agricultural products, as well as training for the industry. The agro-industrial complex includes the production of agricultural products, their processing, and logistics. Thus, agro-industry can include plant breeding activities (creation of new plants and improvement of existing plants), mechanical engineering (design and manufacture of machinery and equipment), production of mineral fertilizers, discovery and application of efficient harvesting methods, processing, storage, transportation, sales, and others. To succeed in the agro-industrial market, businesses need to continuously improve their technology, means, and methods of production, as well as properly protect (and protect) their work from competitors (Drean & Bawono,2021 ; Oliveira & De-Carli,2021).

3 RESEARCH OBJECTIVE AND METHODOLOGY

This study uses vector analysis to see the direction of the relationship between education investment, health investment, employment in agriculture and agriculture performance. The data used is secondary data with an annual period from 2000 to 2019.

4 RESULTS AND DISCUSSION

The table below presents a summary of descriptive statistics of several variables used in this study during the period 2000 to 2019.

Table 1. Descriptive statistics of agricultural performance in USD value in January 2021, education (investment in education in USD value in January 2021), and employment in agriculture (total working population).

	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE	HEALTH
Mean	2.51E+10	5.17E+10	3.71E+05	8.86E+10

Median	2.49E+10	5.62E+10	3.66E+05	9.18E+10
Maximum	3.59E+10	8.24E+10	4.67E+05	1.38E+11
Minimum	1.30E+10	1.85E+10	3.20E+05	2.91E+10
Std. Dev.	8.19E+09	2.23E+10	4.23E+04	4.03E+10

Based on Table 1 above, it appears that from the period 2000 to 2019, the average agricultural performance in Australia is very high at around 25.1 billion USD which can be seen from the mean value in Table 1. with a high level of volatility at 8.19 billion USD. With an average number of workers 371 thousand people with an average educational investment value of 51.7 billion USD, and Health investment 88.6 billion USD. To see a more detailed and careful relationship of influence, vector analysis is carried out, namely Vector Autoregressive. Before estimating using Vector Autoregressive, there are several conditions that must be met from several observed variables, namely Stationarity Test, and Optimum Lag Test.

Cointegration test to see if there is a long-term relationship between variables and a causality test to see a reciprocal relationship between variables. Estimation using the VAR model requires all variables to be stationary at the level, if the variable is not stationary at the level, the estimation is carried out using the VECM model on the condition that all variables formed are cointegrated with each other where the results are shown in Table 2 below:

Table 2. stationarity test

Method			Statistic	Prob.**
ADF - Fisher Chi-square			8.37E+01	0.00E+00
ADF - Choi Z-stat			-7.96E+00	0.00E+00
Series	Prob.	Lag	Max Lag	Obs
D(AGRICULTURE_PERFORMANCE,2)	0.00E+00	0.00E+00	3.00E+00	1.70E+01
D(EDUCATION,2)	0.00E+00	0.00E+00	3.00E+00	1.70E+01
D(EMPLOYMENT_IN_AGRICULTURE,2)	0.00E+00	0.00E+00	3.00E+00	1.70E+01
D(HEALTH,2)	1.00E-03	0.00E+00	3.00E+00	1.70E+01

From the results of stationarity testing with Augmented Dickey-Fuller, it can be seen that at the 2nd level the difference is stationary and vector estimation uses Vector Autoregressive. It can be seen that the probability is less than 0.05 in each tested variable. After doing the stationarity test, a cointegration test was conducted to see the long-term integration between variables. If there is cointegration between variables, the estimation is made using the Panel Vector Error Correction Model (VECM) method, but if there is no cointegration, the estimation is made using the Vector Autoregressive method. Cointegration test results are shown in Table 3.

Table 3. Cointegration test results

Hypothesized		Trace	5.00E-02	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	6.93E-01	4.78E+01	4.79E+01	5.10E-02
At most 1	5.60E-01	2.65E+01	2.98E+01	1.14E-01
At most 2	3.96E-01	1.18E+01	1.55E+01	1.69E-01
At most 3	1.39E-01	2.69E+00	3.84E+00	1.01E-01

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

From the cointegration result, the critical value is higher than the Trace Statistics value and the Max-Eigen Statistics value which shows that there is no cointegration relationship in the variable equation so that the next method that can be used to determine the long-term and short-term relationship is the Vector Autoregressive method.

Optimum lag test is used to determine the time period of the influence of a variable on other variables which will give optimal results. This is because changes in the movement of a variable are not directly responded to by changes in other variables, but there is still a certain grace period. Therefore it is important to know the lag length. The optimum lag test can be seen in Table 4.

Table 4. Optimum lag test

Lag	LogL	LR	FPE	AIC	SC	HQ
0.00	-1.48E+03	NA	5.92E+66	1.65E+02	1.65E+02	1.65E+02
1.00	-1.45E+03	49.39154*	8.33e+65*	163.0789*	164.0682*	163.2153*
2.00	-1.44E+03	7.06E+00	3.14E+66	1.64E+02	1.66E+02	1.64E+02

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

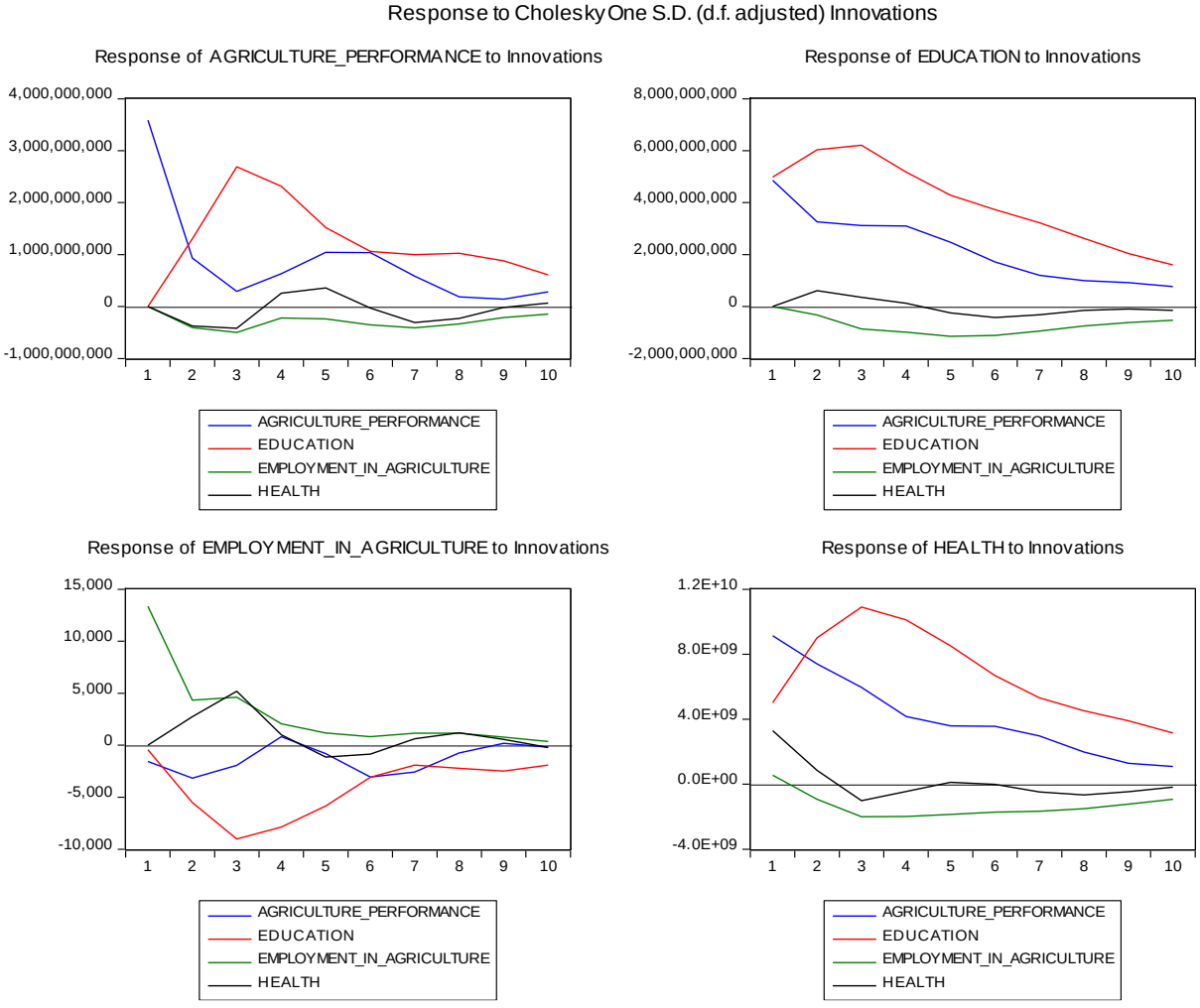
From the results of the Optimum lag test, it can be seen that the optimum lag is found in lag 1. The results of the Vector Autoregressive are shown in Table 5.

Table 5. The results of the Vector Autoregressive estimation

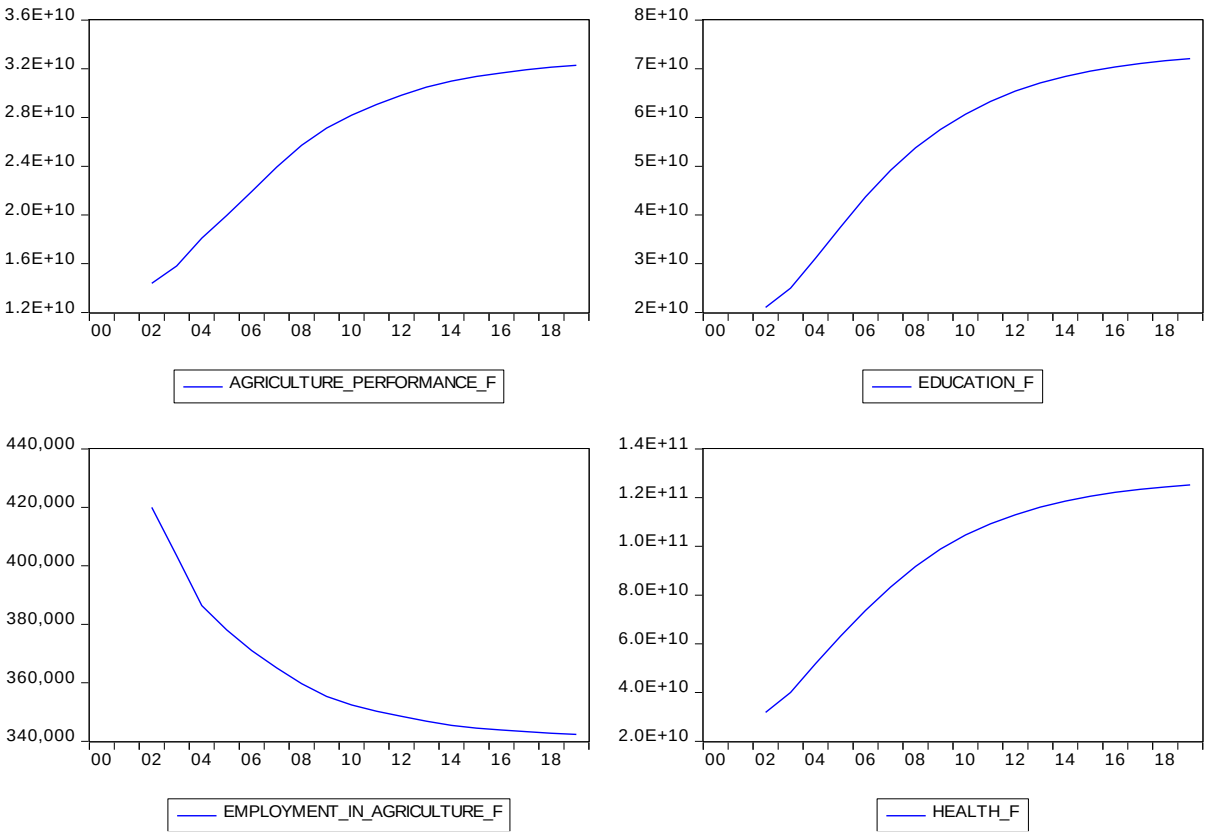
	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE	HEALTH
AGRICULTURE_PERFORMANCE(-1)	3.26E-02*	-9.60E-01	-2.82E-07*	-7.13E-01
	-6.15E-01	-1.19E+00	-2.30E-06	-1.88E+00
	[0.05296]	[-0.80383]	[-0.12192]	[-0.37940]
AGRICULTURE_PERFORMANCE(-2)	-2.39E-01*	1.69E-01*	-1.03E-06*	6.92E-01
	-6.00E-01	-1.17E+00	-2.30E-06	-1.83E+00
	[-0.39748]	[0.14531]	[-0.45905]	[0.37726]
EDUCATION(-1)	3.74E-01*	1.02E+00*	-1.92E-06*	1.54E+00
	-4.32E-01	-8.38E-01	-1.60E-06	-1.32E+00
	[0.86719]	[1.21850]	[-1.18511]	[1.17028]
EDUCATION(-2)	3.97E-01*	9.95E-02*	-2.03E-06*	6.28E-01
	-4.64E-01	-9.01E-01	-1.70E-06	-1.42E+00
	[0.85451]	[0.11041]	[-1.16586]	[0.44279]
EMPLOYMENT_IN_AGRICULTURE(-1)	-2.56E+04	-3.24E+04	2.89E-01*	-7.99E+04
	-6.55E+04	-1.27E+05	-2.46E-01	-2.00E+05
	[-0.38996]	[-0.25453]	[1.17464]	[-0.39893]
EMPLOYMENT_IN_AGRICULTURE(-2)	-2.07E+04	-3.63E+04	1.95E-01*	-6.19E+04
	-6.38E+04	-1.24E+05	-2.40E-01	-1.95E+05
	[-0.32476]	[-0.29302]	[0.81242]	[-0.31756]
HEALTH(-1)	-1.14E-01*	1.85E-01*	8.34E-07*	2.56E-01
	-3.56E-01	-6.91E-01	-1.30E-06	-1.09E+00
	[-0.32054]	[0.26795]	[0.62370]	[0.23553]
HEALTH(-2)	-1.42E-01*	-2.12E-01*	1.44E-06*	-6.76E-01*
	-2.96E-01	-5.75E-01	-1.10E-06	-9.05E-01
	[-0.47926]	[-0.36849]	[1.29728]	[-0.74624]
C	3.14E+10	4.40E+10	2.19E+05	7.09E+10
	-2.40E+10	-4.70E+10	-9.11E+04	-7.40E+10
	[1.29464]	[0.93285]	[2.40109]	[0.95604]
R-squared	8.79E-01	9.39E-01	8.83E-01	9.54E-01

Adj. R-squared	7.72E-01	8.85E-01	7.78E-01	9.13E-01
Sum sq. resids	1.16E+20	4.36E+20	1.63E+09	1.08E+21
S.E. equation	3.59E+09	6.96E+09	1.35E+04	1.10E+10
F-statistic	8.18E+00	1.73E+01	8.47E+00	2.32E+01
Log likelihood	-4.15E+02	-4.27E+02	-1.90E+02	-4.35E+02
Akaike AIC	4.71E+01	4.85E+01	2.22E+01	4.94E+01
Schwarz SC	4.76E+01	4.89E+01	2.26E+01	4.98E+01
Mean dependent	2.64E+10	5.53E+10	3.60E+05	9.51E+10
S.D. dependent	7.50E+09	2.05E+10	2.86E+04	3.71E+10

Based on the results of the estimated output, it can be indicated the direction of the relationship, and the significance of each variable and each period. Negatively related variables are marked (-). Significant relationships are marked with a sign (*). The value of the coefficient of determination (Adj. R-Square) shows the degree of truth of the estimate of 0.772. This means 77% accuracy of the calculation rate of the vector error correction model. Impulse Response Function (IRF) describes the response of an endogenous variable to shock that occurs in other variables in a dynamic VAR system. IRF can be used to see the effect of fluctuations or shocks from one variable on the value of another variable either now or in the future. The results of the Impulse Response Function (IRF) of the Infrastructure variable against other variables are shown by the following Impulse Response graph:



Based on the response and impulse graphs, it can be seen that each variable responds to each other since the first time period with a lag of 2. This shows that in Australia the three variables influence each other. To see the direction of influence can be seen in the following forecasting chart:



Based on the forecasting graph, it can be seen that the growth of agriculture performance is in line with education and health investment in Australia. The graphs of agriculture performance, health investment, and education investment appear to have an increasing trend but are starting to slope and tend to curve like a decline in growth. This indicates that the stability of agriculture performance, education, and health in Australia has entered a period of establishment. The decline in employment in agriculture shows the use of technology that is increasingly efficient so that the need for human resources is decreasing. However, the continuous decline in employment in the service sector and the trend of the graph showing a downward trend indicate the risk of labor shortages in the agricultural sector in Australia.

5 CONCLUSION

The graphs of agricultural performance, health investment, and education investment appear to have an increasing trend but begin to tilt and tend to curve like a decline in growth. This shows that the stability of the performance of agriculture, education and health in Australia has entered a steady state. The decline in employment in agriculture indicates the use of technology is increasingly efficient so that the need for human resources is decreasing. However, the continued decline in employment in the services sector and the downward trend in the graph indicate a risk of labor shortages in the agricultural sector in Australia.

REFERENCES

Baležentis,T., Li,T., Chen,X. (2021). Has agricultural labor restructuring improved agricultural labor productivity in China? A decomposition approach. Socio-Economic Planning Sciences,76(8).90-97. doi : 10.1016/j.seps.2020.100967

Drean,B., Bawono,S. (2021). Learning with Fun, Agricultural Economics and Agri-Business. Singapore : Triple Nine Communication Press

Esparraga, F. (2014). Overview of the Australian Commonwealth Administrative Law System: Preliminary Issues for Consideration. Beijing Law Review, 5, 62-79. doi: 10.4236/blr.2014.51006.

Everingham, Y. , Inman-Bamber, G. , Sexton, J., Stokes, C. (2015). A Dual Ensemble Agroclimate Modelling Procedure to Assess Climate Change Impacts on Sugarcane Production in Australia. Agricultural Sciences, 6, 870-888. doi: 10.4236/as.2015.68084.

Mora,A.G.O., Afriani,I.H. (2021). Increasing the Resilience of Students in Educational and Economic Inequalities from a Psychological and Human Capital Point of View. Tamansiswa Management Journal International,1(1),41-44.

O'Keeffe,P.(2019).Making Markets in Australian Agriculture Shifting Knowledge, Identities, Values, and the Emergence of Corporate Power. Singapore : Springer Nature Singapore

Oliveira, E. , De-Carli, R. (2021). Studies in Agro-Industrial Complexes: Analysis of Literature Indexed on the Web of Science 1945-2020. Open Journal of Business and Management, 9, 1121-1132. doi: 10.4236/ojbm.2021.93060.

Sheng,Y., Zhao,S., Yang,S. (2021). Weather shocks, adaptation and agricultural TFP: A cross-region comparison of Australian Broadacre farms. Energy Economics,101(9),51-57. doi : 10.1016/j.eneco.2021.105417

Widarni,E.L., Drean,B.(2021). Vector Analysis Study in 22 Country in 5 Continent About Human Capital And Agriculture. Malang : Janega Press

Widarni, E.L., Mora,A.G.O. (2021). How to Understand and Develop Humans: Based on Psychology and Management Perspectives for Better Human Resources and Organizational Performance. Munich : Book Rix