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CHANGES IN THE STRUCTURE OF LABOR AND THE REALIZATION OF LEWIS TURNING POINT IN INDONESIA

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Abstract

As a region with a relatively high and sustainable economic growth, Indonesia is transfor-ming into an industrial and service country. This has prompted a shift in the concentration of economic activity and manpower, from the agricultural sector to the non-agricultural sector, both industry and services. In contrast to a number of previous studies which focused more on analyzing patterns of structural change and their impact on poverty and sectoral inequality, this research places more emphasis on discussing the achievement of Lewis turning point conditions, which is one of the important theses within the framework of structural transfor-mation analysis, as formulated by Lewis (1954). As a result, it is known that Indonesia has not yet reached the Lewis Turning Point stage as a result of the process of structural change. Indonesia almost reached the Lewis turning point in the 1990s, which is considered the peak of industrialization and the take-off period, with an average agricultural surplus ratio of <5%. However, the Asian financial crisis caused the Indonesian economy to contract by up to -13.7%, which had an impact on the ability of the non-agricultural sector, especially industry, to absorb surplus agricultural labor. This condition caused the surplus of agricultural labor to increase again in the post-Asian financial crisis period. The intensification of the use of technology in the Indonesian agricultural sector has had different impacts on capital and labor. In this case, the impact of technology leads to intensive use of capital in the Indonesian agricultural sector, or what is known as input intensive. Meanwhile, the opposite condition occurs for the workforce, where technological developments lead to the use of less labor or input saving.

INTRODUCTION

During its more than 75 years of existence, Indonesia has transformed from a relatively poor country in the 1960s to a developing country with an upper middle income. This economic development was marked by a change in the economic structure in Indonesia, from originally being based on agriculture to becoming an industrial and service country. This condition can be seen from the output contribution of the agricultural sector which continued to decline from 26.9% in 1980 to 13.3% in 2020. Meanwhile, at the same time, the output contribution of the non-agricultural sector (including industry and services) increased from 73.1% to 86.7% (BPS , 2020). Pingali (1997) notes that the process of economic transformation in Indonesia is rapid. As happened in developed countries, the process of economic transforma-tion in Indonesia is also characterized by a decreasing role/contribution of the agricultural sector, and an increasing role of the industrial and service sectors in the economy (Todaro, 2011; Bathla, D'Souza and Joshi, 2019).

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The impact of this economic development has driven sectoral labor shifts from agriculture to non-agriculture. The share of agricultural labor decreased from 64% in 1980 to 30% in 2020. Meanwhile, the share of labor in the non-agricultural sector increased from 36% to 70%. Wiggins' study (2016) shows that labor shifts from the agricultural to non-agricultural sectors increase economic productivity. Another study conducted by McCaig and Pavcnik (2018) explains that this labor movement underpins the development of the industrial and service sectors.

A number of studies have found that the process of economic transformation that is taking place in Indonesia has resulted in a reduction in the absolute poverty rate. However, at the same time, the level of income inequality between communities has also increased (Teguh, Yuan, and Sofiyandi, 2017). Dastidar (2012), in his study observing patterns of structural change in 78 countries during the period 1980 – 2005, found that there were differences in patterns of structural transformation between developed and developing countries. In developed countries, the pattern of structural transformation starts from the agricultural sector, moves to the industrial sector, and finally to the service sector. Meanwhile in developing countries, including Indonesia, the transformation starts from the agricultural sector, the service sector, and finally to the industrial sector. According to Dastidar (2012), the pattern of structural transformation experienced by developing countries has led to increased income inequality. This is because in developing countries, including Indonesia, income distribution in the service sector is very unequal, especially when compared to income from agriculture. Yusuf et al (2021) who discusses the relationship between structural transformation and inequality in Indonesia, also finds that the process of tiarization, namely the transition from agriculture to the service sector, in the period after the Asian financial crisis increased inequality.

In contrast to a number of previous studies which focused more on analyzing patterns of structural change and their impact on poverty and sectoral inequality, this study emphasizes more on the discussion of the achievement of turning point conditions, which is one of the important theses within the framework of structural transformation analysis, as formulated by Lewis (1954). This thesis explains that there is a surplus of labor in the agricultural sector which causes the marginal productivity of the agricultural sector to be very small (close to zero), which Lewis (1954) calls disguised unemployment. Disguised unemployment refers to situations where a person appears to be working, but in fact their productivity contribution to output is very small, or even non-existent. Disguised unemployment often occurs in the agricultural sector in developing countries. In the traditional agricultural sector, families who own fields generally employ all members of the family, including those who are not really needed to obtain optimal agricultural output. Therefore, even though it looks like working, the actual production efficiency does not increase because the additional worker relatively does not contribute.

This condition results in the movement of labor from the agricultural sector to the non-agricultural sector will not have an impact on decreasing output and increasing agricultural labor wages. Conversely labor migration to the non-agricultural sector can increase productivity and overall output in the economy. Therefore, the strategic goal of economic

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development is to divert the workforce from the labor-intensive agricultural sector to a more productive industrial sector. However, along with changes in the economic structure, the movement of labor will experience a slowdown because the surplus labor in the agricultural sector has been lost, which makes the marginal productivity of workers in the agricultural sector no longer equal to zero. This condition is what Lewis calls the Lewis Turning Point (LTP) and forms the basis of his theory to explain economic development.

ASEAN countries, as one of the other regions with high and sustainable economic growth rates, are also the focus of studies on structural changes and turning points. Yamada (2016), who examined the condition of achieving a turning point in Vietnam, concluded that, although labor shifts had occurred, Vietnam had not yet reached a turning point. This conclusion is based on three indicators, namely (i) a comparison of the real wage rate and the marginal productivity of labor in the agricultural sector, (ii) changes in the real wage rate in the agricultural sector and (iii) changes in the real wage gap between unskilled labor and skilled labor.

Cheng, et.al (2014) conducted research on achieving turning points in Cambodia. This is because there have been various reports reporting labor shortages in the garment and construction sectors, as well as in a number of areas in Cambodia. Related to this, Cheng, et.al (2014) found that Cambodia had reached the LTP stage in a limited way in a number of regions in 2011. However, nationally, Cambodia had not yet reached a turning point.

Bowonthumrongchai (2019), who conducted a study of structural change and turning point conditions, found that the agricultural sector is the main source of economic growth in Thailand. Bowonthumrongchai (2019) adopted Minami's (1968) five criteria to determine the turning point conditions, namely (1) comparison of the real wage rate and the marginal productivity of workers in the agricultural sector, (2) correlation of the real wage rate and the marginal productivity of labor in the agricultural sector, (3) movements in the real wage rate of the agricultural sector, (4) differences in the real wage rates of the agricultural and non-agricultural sectors, (5) the elasticity of the supply of agricultural labor to the non-agricultural sector. From the results of his analysis, Bowonthumrongchai (2019) found that Thailand had experienced a labor shortage since the early 1990s, and reached a turning point in the early 2000s. Even so, Bowonthumrongchai (2019) suspects that the turning points that occur are more local and temporary (local equilibrium of turning points), rather than global and permanent as in Japan and other developed countries. Furthermore, Bowonthumrongchai (2019) found that the achievement of this LTP or turning point had a positive impact on income distribution, as measured by the value of the Gini coefficient. This is because, increasing wages will cause income inequality to decrease, and this finding supports the inverse-U hypothesis (Kuznets, 1955).

The problem is that even though the above studies can describe the condition of achieving turning points in several ASEAN countries, the findings still have a number of limitations, namely first, the approach is still partial and does not yet cover a number of other ASEAN countries which also show trends of intense structural change, such as Indonesia. In fact, Indonesia is a country with a relatively stable growth rate in the non-agricultural sector, followed by a significant decline in the share of output and employment in the agricultural

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sector since the 1980s. LTP analysis is important to pay attention to because when the surplus of labor in the agricultural sector has been exhausted, this will encourage an increase in the wage rate. For any country that reaches the LTP condition, including Indonesia, the performance of the industrial sector has the potential to slow down because cheap labor is no longer available, causing industrial sector labor wages to rise more quickly, followed by a decline in industrial and investment profits.

Figure 1: The Impact of Technology on Input Use

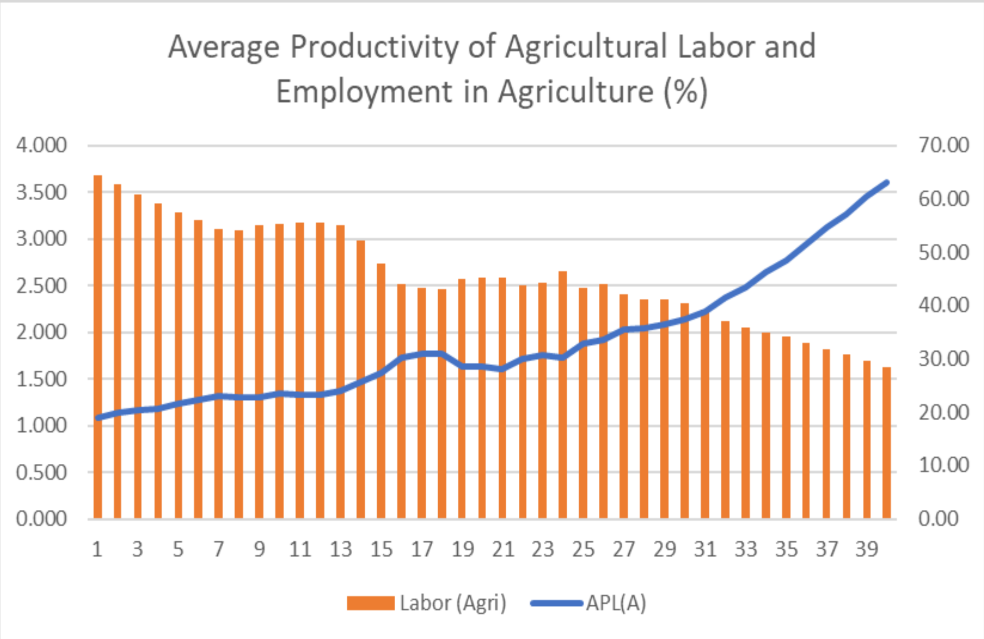

Figure 1 above shows the trend of the average productivity of labor (APL) in the agricultural sector in Indonesia during the period 1980 – 2020. The APL value of the Indonesian agricultural sector increased from USD 1,090 in 1980 to USD 3,474 in 2020. This indicates, referring to Lewis' analysis framework (1954), that surplus agricultural labor has begun to be absorbed by the non-agricultural sector, both industry and services. This increase in APL value is an indication that the surplus of agricultural labor in Indonesia is beginning to be absorbed and is heading towards the Lewis Turning Point (LTP).

Second, the studies that have been conducted have not analyzed the impact of the use of technology in the agricultural sector on the use of inputs, both capital and labour. In fact, the trend of using agricultural technology in Indonesia is getting more intense. This has the potential to affect the role and absorption of labor in the agricultural sector. In the long run, this condition could have an impact on the achievement of turning points in Indonesia. Therefore, it is important to assess the impact of technology on input use to assess its tendency towards input intensive or input saving, especially in labor.

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CONCEPTUAL FRAMEWORK

For an analysis of the achievement of Lewis's turning point by considering the role of technology in the use of agricultural sector inputs, this study adapts the theoretical framework developed by Bairagi and Kamal (2019), and Mariyono (2009) as follows:

$$Y_A = f(L_A, K_A, H_A) = \alpha_0 L_A^{\alpha_L} K_A^{\alpha_K} H_A^{\alpha_H} \quad (1)$$

$$Y_{NA} = g(L_{NA}, K_{NA},) = \alpha_0 L_{NA}^{\beta_L} K_{NA}^{\beta_K} \quad (2)$$

Subscripts A and NA refer to agriculture (agriculture) and non-agriculture (non-agriculture); Y is output; L, K, and H are production inputs, including labor, capital, and land. α and β are the input coefficients to be estimated. The linear log form of equations (1) and (2) can be written as follows:

$$\ln Y_A = \ln\alpha_0 + \alpha_L \ln L_A + \alpha_K \ln K_A + \alpha_H \ln H_A + e_A \quad (3)$$

$$\ln Y_{NA} = \ln\beta_0 + \beta_L \ln L_{NA} + \beta_K \ln K_{NA} + e_{NA} \quad (4)$$

The equation for the marginal productivity of agricultural and non-agricultural labor is obtained by deriving equations (1) and (2) for labor as follows:

$$MPL_A = \frac{dY_A}{dL_A} = \alpha_L \frac{\alpha_0 L_A^{\alpha_L} K_A^{\alpha_K} H_A^{\alpha_H}}{L_A} = \alpha_L \frac{Y_A}{L_A} = \alpha_L APL_A \quad (5)$$

$$MPL_{NA} = \frac{dY_{NA}}{dL_{NA}} = \beta_L \frac{\beta_0 L_{NA}^{\beta_L} K_{NA}^{\beta_K}}{L_{NA}} = \beta_L \frac{Y_{NA}}{L_{NA}} = \beta_L APL_{NA} \quad (6)$$

APL is the average productivity of labor; α_L and β_L are estimation parameters from equations (3) and (4). Identification of the turning point (LTP) and the optimal allocation of labor in the agricultural sector, referring to the theory of Lewis (1954) and Fei and Ranis (1961), occurs when the wage rate $W_A = MPL_A$. By modifying equations (5) and (6), the following equations are obtained:

$$MPL_A = W_A \quad (7)$$

$$W_A = \alpha_L \frac{Y_A}{L_A} \quad (8)$$

$$L_A = \alpha_L \frac{Y_A}{W_A} \quad (9)$$

Equations (7), (8) and (9) are used to identify turning point conditions (LTP) and the optimal amount of labor in the agricultural sector (equilibrium employment).

Analysis of the impact of technology on the use of inputs in the agricultural sector in this study adapts the theoretical framework developed by Mariyono (2010). Mariyono (2010) explains that there are two types of production changes as a result of technological changes, as illustrated by the following figure.

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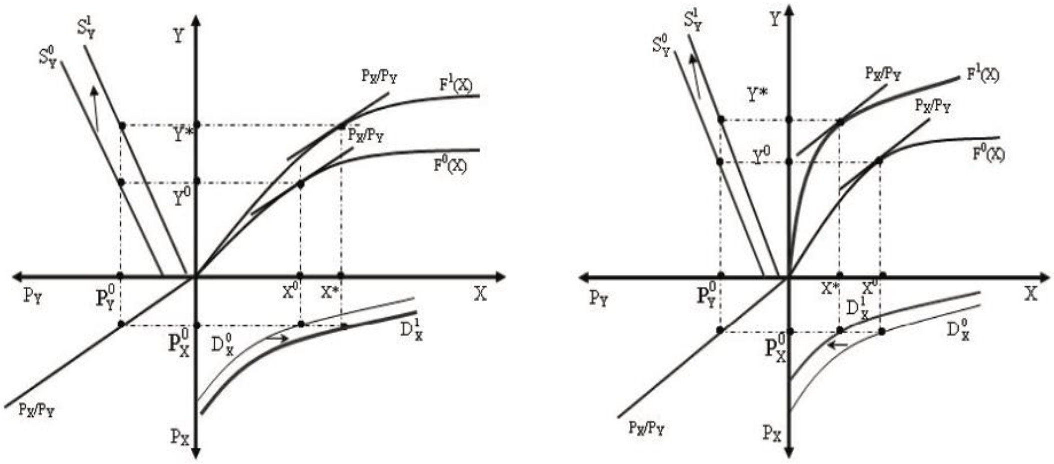
Figure 2: Impact of Technology on Input Use



Source: Mariyono (2010)

For example, there is a technological change that shifts the production frontier upward from Y= F^0(X) ke Y= F^1(X). Assuming constant prices, P_Y^0 dan P_X^0, producers will allocate input X*, where slope F^1(X) is the ratio P_X^0 / P_Y^0 and the production level of new output is Y*. In figures A and B, the supply of output increases from S_Y^0 ke S_Y^1, and the demand for input changes from D_X^0 and D_X^1 in opposite directions in the two figures.

In figure A, it can be seen that changes in technology lead to an increase in the use of inputs because with new technology the same level of MP_L is achieved with higher use of inputs. However, Figure B shows different results, where with the application of new technology, the same level of MP_L is achieved with lower input usage. In both cases, changes in input use are due to profit maximization.

Associated with the ever-increasing adoption of agricultural technology, model A is used to analyze the economic impact of technological advances. This is because using model A, it is assumed that there is a demand for agricultural inputs. However, new technology is expected to increase efficiency, and therefore the same amount of output can be achieved by using lower inputs. Consequently, new technologies that drive input demand down are more likely to occur if model B is used.

Model A, mathematically can be expressed in terms of the Cobb-Douglas production function assuming a single output and input as follows:

$$Y = AL^{\alpha}e^{\psi T} \quad (10)$$

Y is output, A is total factor productivity, L is input variable, and T is change in technology. The addition of T in the time series econometric model is to measure changes in technology over time (Millan and Aldaz, 1998). The model implies that technological changes only affect total factor productivity A. The value of the marginal product L resulting from the production function is:

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$$MP_L = \alpha A L^{\alpha-1} e^{\psi T} \quad (11)$$

Because ψ is expected to be positive, technological developments will have an impact on increasing demand for L and supply for Y. Model B, on the other hand, can be expressed mathematically as follows:

$$Y = A L^{\alpha+\beta T} e^{\psi T} \quad (12)$$

This model is called simplified translog technology because the interaction between inputs is eliminated (Ahmad and Bravo-Ureta, 1996). In this case, technological changes not only affect total productivity A, but also the production elasticity of input L. The marginal product L is:

$$MP_L = (\alpha + \beta T) A L^{\alpha+\beta T-1} e^{\psi T} \quad (13)$$

In the conditions above, ψ is still expected to be positive. But now increasing T will give rise to two possible outcomes. First, if β is positive, then an increase in T will result in a higher marginal product at the same level of input use, so that as a result there is an increase in the use of inputs to maximize profits. This phenomenon is called input-intensive technological change. Second, if β is negative, then the marginal product at the same level of input use is lower when there is an increase in T. This phenomenon is called input saving technological change.

The difference between Model A and Model B comes from limiting the value of β = 0. If restrictions were imposed on Model B, the two models would be identical. However, imposing restrictions is not always acceptable. Need to test whether these restrictions are applied correctly or not (Wooldridge, 2003). If the test results reject the restriction, the estimates will be biased, which misleads the policy implications.

Thus, the optimal allocation of labor in the agricultural sector with the impact of technology can be calculated by modifying equations (7), (8), and (9) as follows:

$$MPL_A = W_A \quad (14)$$

$$W_A = (\alpha + \beta T) \frac{A L^{\alpha+\beta T} e^{\psi T}}{L_A} = \frac{Y_A}{L_A} \quad (15)$$

$$L_A = (\alpha + \beta T) \frac{Y_A}{W_A} \quad (16)$$

Equations (14), (15) and (16) are used to identify turning point conditions (LTP) and the optimal amount of labor in the agricultural sector (equilibrium employment) which takes into account the impact of technology on the use of agricultural inputs, especially labor.

METHODOLOGY

This research uses secondary data from various institutions, including the World Bank, Food Agricultural Organization (FAO), and UNCTAD. The data collected is a time series for the period 1980 – 2020. To identify the achievement of Lewis Turning Point (LTP) conditions in Indonesia, data with the following details is needed:

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Table 1: Data and Sources

Sector	Variable	Notation	Definition	Data Sources
Agriculture	Output	Y_A	*Real agricultural GDP* (in million US$)	UNCTAD$_{stat}$
	Labour	L_A	Employment in Agriculture (in 000)	World Bank
	Capital	K_A	*Real agricultural capital stock* (in million US$)	FAOSTAT
	Land	H_A	Agriculture Land (in 000 Ha)	FAOSTAT
Non-Agriculture	Output	Y_{NA}	*Real non-agricultural GDP* (in million US$)	UNCTAD$_{stat}$
	Labour	L_{NA}	Employment ini Non-Agriculture (in 000)	World Bank
	Capital	K_{NA}	*Real non-agricultural capital stock (GFCF - K_A)* (in million US$)	World Bank

To analyze the impact of technological developments on the use of inputs as well as the achievement of Lewis's turning point in the agricultural sector, this study adopts the approach of Mariyono (2010) which combines both the primal approach and the simplified translog of the Cobb-Douglas production function. The analysis is carried out using a production per hectare approach, so that each variable in the agricultural production function, namely output, labor (labor) and capital, is calculated per hectare. This is done based on a number of considerations, namely (1) the focus of the analysis is on technological developments on the use of labor and capital inputs in the agricultural sector, whether the trend is input intensive or input saving; (2) technically, analysis using the per hectare approach can reduce the potential for exact multicollinearity time series to occur in the case of aggregate data. This approach is based on the assumption that the production function has a constant return to scale pattern. By dividing the right and left sides by land, a production function with constant land is obtained, so it can be lost in the model. The empirical model for the analysis of technological developments on the use of inputs is as follows:

$$Ln\,\frac{Y_{A_t}}{H_{A_t}} = \alpha_0 + \beta_1 Ln\,\frac{L_{A_t}}{H_{A_t}} + \beta_2 Ln\,\frac{K_{A_t}}{H_{A_t}} + \psi_1 T + \varepsilon_t \qquad (17)$$

Equation (17) can then be modified to see the impact of technological progress on the use of agricultural inputs, becoming equation (18) as follows:

$$Ln\,\frac{Y_{A_t}}{H_{A_t}} = \alpha_0 + \beta_1 Ln\,\frac{L_{A_t}}{H_{A_t}} + \beta_2 Ln\,\frac{K_{A_t}}{H_{A_t}} + \alpha_1 TLn\,\frac{L_{A_t}}{H_{A_t}} + \alpha_2 TLn\,\frac{K_{A_t}}{H_{A_t}} + \psi_1 T + \varepsilon_t \qquad (18)$$

RESULT AND DISCUSSION

The estimation results show that 1% additional labor in the non-agricultural sector can increase output in the non-agricultural sector by around 0.89%. Meanwhile, an additional 1% of capital can increase the output of the non-agricultural sector by around 0.37%. Relatively, the elasticity of non-agricultural labor to output is relatively greater than of the agricultural sector. This is partly due to the low level of education and the aging of the workforce in the agricultural sector (Supriyati, 2010). Labor and capital inputs are able to explain variations in agricultural output up to 99.1%. This means that the role of labor and capital is very decisive for the production of

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non-agricultural output in Indonesia. Formally, the estimation results meet the cointegration requirements with a negative and significant error correction term sign at the 5% level, thus avoiding the potential for spurious regression.

Table 2: Estimating Results of the Non-Agricultural Sector Production Function

Variabel:	Koefesien	Std Error	P > |t|	Robust Std Error	P > |t|
L_{NA}	0.891	0.104	0.000	0.074	0.000
K_{NA}	0.367	0.063	0.000	0.047	0.000
Cons	-1.151	0.427	0.001	0.349	0.000
Obs	41			41	
R^2	0.991			0.991	
CRS	33.81 (0.000)				
Structural Residual (ut) Diagnostic:					
ADF (5% critical value -2.986)	-3.383 (0.006)				
Error Correction Term (u_{t-1})	-0.246 (0.019)				

The production function of the non-agricultural sector shows an increasing return to scale (IRS) pattern. In other words, additional input will produce additional output in larger quantities. The non-agricultural sector production process has an IRS pattern due to several factors, namely first, related to economies of scale and efficiency. By increasing the scale of production, the non-agricultural sector can adopt more sophisticated and efficient technolo-gies and production methods. Factors such as the use of machinery and automation, labor specialization and the availability of better infrastructure can provide greater economic benefits.

Second, a larger scale of production allows the non-agricultural sector to invest in physical and technological capital, which in turn can increase output. Investments in modern equipment, computerization, and research and development are becoming more effective on large production scales. Third, IRS production patterns in the non-agricultural sector are also related to network effects and dependence. Several non-agricultural sectors, such as the information and technology industry, telecommunications, and financial services benefit from network and dependency effects. In this case, the more existing users in the system, the higher the added value for new users. Therefore, the greater the number of customers in this sector, the greater the scale of production and the level of profit generated. Fourth, specialization and diversification. In this case, as production scale increases, it is easier for the non-agricultural sector to adopt specialization in production and product diversification. Specialization can help improve efficiency and quality, while diversification can help reduce risk and increase competitiveness.

Overall, the non-farm sector tends to operate on an IRS production pattern due to opportunities for increased efficiency, adoption of advanced technologies, benefits derived from network effects and dependability, and greater diversification and specialization. However, keep in mind that this production pattern also depends on market conditions, industry competition, and government regulations which can affect the growth potential of the non-agricultural sector on a larger scale (Sen, 2019).

The test results show that the time trend coefficient is $\psi_1 \neq 0$. This means that there is technological progress in the Indonesian agricultural sector. However, from the results of further tests it is known that the impact of technology is not Hicks-Neutral, where the impact of technology tends to result in intensive input to capital. This can be seen from the positive and significant value of capital elasticity and tends to increase with the time index. Thus, this becomes an incentive for the agricultural sector to further increase the intensity of capital use.

Table 3: Estimated Results of the Production Function of the Agricultural Sector

Variable:	Coeff	Std Error	P > |t|	Robust Std Error	P > |t|
L_A/H_A	0.274	0.131	0.043	0.124	0.003
K_A/H_A	0.442	0.065	0.000	0.062	0.000
(L_A/H_A)*Time	-0.002	0.001	0.008	0.004	0.002
(K_A/H_A)*Time	0.006	0.004	0.041	0.004	0.035
Time	0.008	0.004	0.041	0.003	0.032
Cons	0.071	0.024	0.005	0.028	0.002
Obs	41			41	
R^2	0.983			0.983	
Structural Residual (ut) Diagnostic:					
ADF (10% critical value -2.613)	-2.619 (0.09)				
Error Correction Term (u_{t-1})	-0.247 (0.007)				

The opposite condition occurs in the workforce, where technological developments have an impact on less use (input saving). Although labor has a significant positive elasticity, its value tends to decrease with the time index. This situation is relevant to the condition of Indonesian agriculture, where the number of agricultural workers is experiencing an oversupply. Therefore, increasing the supply of agricultural labor actually reduces its productivity, which results in a decrease in labor elasticity. This finding further strengthens the evidence of disguised unemployment or a surplus of labor in the agricultural sector.

The rapid industrial growth is the main factor driving the absorption of surplus labor in the agricultural sector. LA's surplus ratio during the period 1980–1995 tended to be low. In other words, Indonesia at that time was heading for a turning point. However, the positive trend of economic transformation experienced a setback when the 1998 Asian crisis occurred. The crisis caused the Indonesian economy to experience a contraction. The BPS report said that in 1998 the Indonesian economy grew negatively, namely -13.7 percent. Whereas in previous years, Indonesia's economic growth was always positive with an average of 6-7 percent/year. In 1998, most of the economic sectors recorded negative growth, except for the agricultural, livestock, fishery and forestry sectors which were able to grow 0.81%, (Susilo & Handoko, 2002). The impact of the collapse of various economic sectors at that time was a decrease in employment opportunities in the industrial sector by up to 58%.

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Table 4: Comparison of Elasticity Values, APL, MPL, and WA

Year	Elasticity L_A	APL_A (US$)	MPL_A (US$)	W_A (US$)	MPL_A/W_A (%)
1980	0.274	1.090	299	303	98.5
1985	0.265	1.282	340	343	99.1
1990	0.256	1.333	341	354	85.5
1995	0.247	1.789	442	471	93.9
2000	0.238	1.664	396	522	75.9
2005	0.229	1.912	438	616	71.1
2010	0.220	2.249	495	753	65.7
2015	0.211	2.983	629	933	67.5
2020	0.202	3.474	702	1.122	62.5

Table 5: Estimated Labor Surplus in Indonesia Agricultural Sector

Year	Actual Employment L_A (in 000)	Equilibrium L_A (in 000)	Surplus L_A (in 000)	Rasio Surplus L_A (%)
	(1)	(2)	(3) = (1) – (2)	(4) = (3)/(1)
1980	35.126	34.583	543	1.5
1985	35.473	35.141	333	0.9
1990	40.559	34.661	5.899	14.5
1995	35.233	33.070	2.157	6.1
2000	40.677	30.875	9.802	24.1
2005	41.310	29.378	11.932	28.9
2010	42.160	27.710	14.451	34.3
2015	38.943	26.272	12.665	32.5
2020	38.336	24.597	14.739	37.5

Since the mid-1990s, agricultural mechanization using capital such as tools, machines and other supporting technologies in the agricultural sector has intensified. Tables 3 and 4 show that technological developments that lead to input saving labor have resulted in an increase in the agricultural labor surplus. This is because the more intensive use of technology in the agricultural sector can reduce the number of workers. A study conducted by the Center for Standard Testing of Agricultural Instruments (PSEKP-BPP Mektan) in 2015 found a decrease in the uptake of modern rice farming workers in South Sulawesi and Java by more than 50 percent. Research by Hermanto et al. (2016) showed that the use of agricultural machinery reduces labor from outside the family. Saliem, et.al (2015) also found a similar thing, where the use of agricultural machinery in an area provides several benefits, including reducing the number of workers. In aggregate, the negative relationship between mechanization and the number of workers per hectare of agricultural land can be seen in Figure 15 below:

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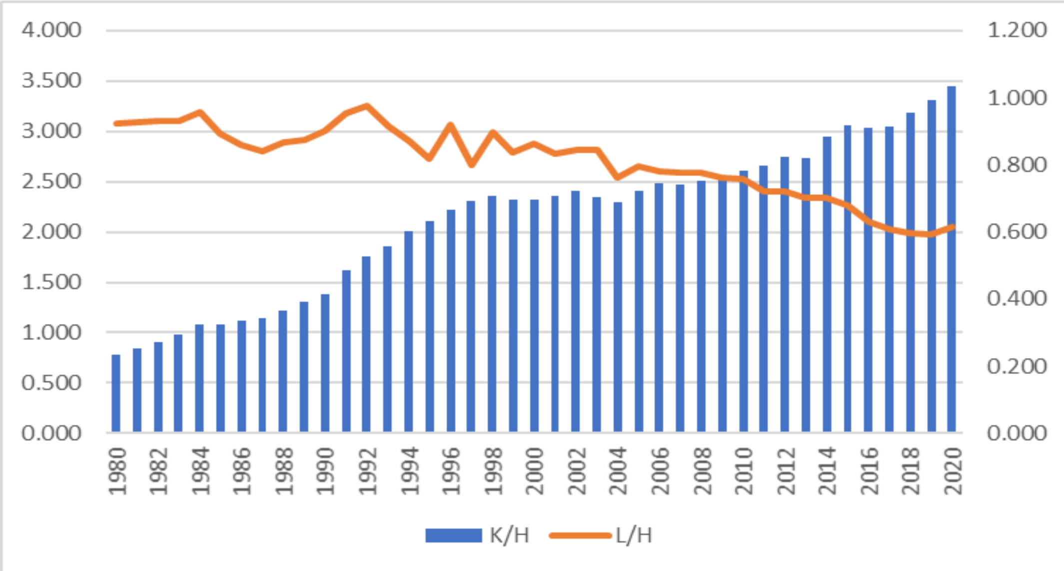

Figure 3: Comparison of the Share of Labor and Total Agricultural Capital/Ha

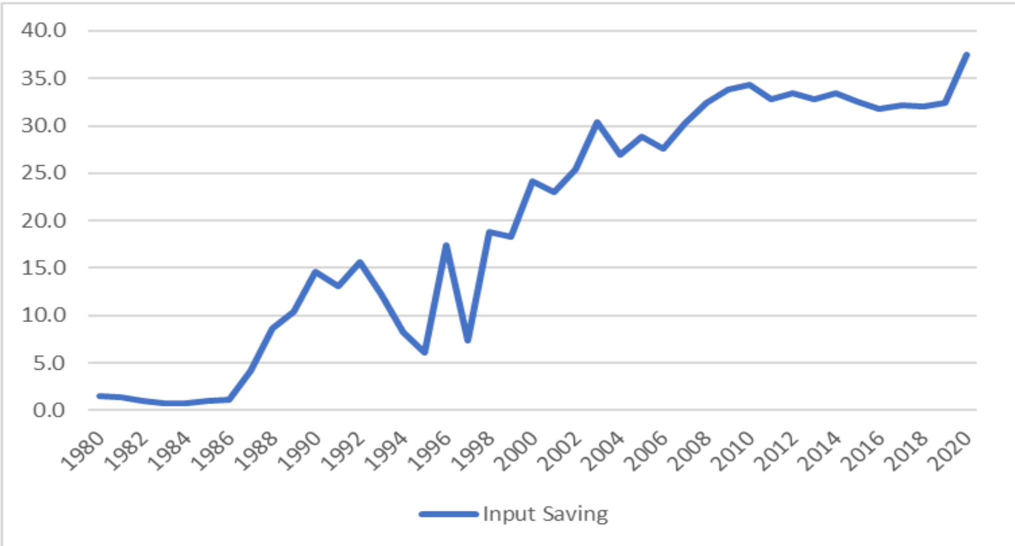

Figure 4: Agricultural Labor Surplus in Indonesia

Various studies show that the economic incentives obtained by farmers by using technology or mechanization are quite large. The study of Prayuginingsih et al., (2021) found that the use of mechanization technology in the form of a combine harvester can reduce yield losses, resulting in a higher productivity level compared to non-user farmers. This is in accordance with the results of the study of Paulus, Indra and Fauzi (2018) who found that the combine harvester has an effectiveness of up to 128.57%. The benefits of mechanization in reducing yield losses were also found by Hasbullah and Dewi (2012) which showed that the use of a power thresher was able to reduce threshing rates to only around 0.5%–1.21%. The findings of Prayuginingsih

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et al., (2021) show that the income of farmers using mechanization reaches IDR 9.018.592/ha, higher than non-user farmers (IDR 6.819.592/ha). The reasons are: (1) the productivity of farmers using mechanization is higher, (2) the selling price of mechanized commodities is more expensive because the quality is better. The combination of higher productivity and selling price results in higher income for farmers. This finding is in accordance with Gosh (2010) and Aldilla (2016) which state that mechanization can increase production and farming profits.

In addition, by applying mechanization, farming can avoid the potential decline in the productivity of an aging agricultural workforce. Based on data from the 2003–2013 Agricultural Census, the agricultural workforce is dominated by older workers aged more than 40 years, the number of young workers is not large and tends to decline compared to the previous 10 years. The results of Susilowati (2014) analysis of the 2013 Agricultural Census data show that the portion of farmers aged over 40−54 years is the largest, namely 41%. The second largest proportion is the group aged over 55 years who can be classified as old farmers, which is 27%, while the group of the younger generation aged less than 35 years is only 11%. The 2003 Agricultural Census also showed that most of the farmers were in the age group of 25–44 years at 44.7%, followed by the age group of 45−60 at 23.2%, the proportion of workers in the older age group (>60 years) was around 13.8%, and the lowest was the young group (<24 years) only 9.2%. The data shows that for two decades, in absolute and relative terms, the number of young farmers has decreased sharply, while those belonging to the old age have increased.

The various reasons for the decline in the interest of young workers in the agricultural sector are primarily the image of the agricultural sector which is less prestigious and less able to provide adequate compensation. This stems from the relatively narrow average tenure of farming land. Another reason is that the perspective and way of life of the young workforce has changed. For young people in the village, the agricultural sector is losing its appeal. The crisis of young farmers in the agricultural sector and the dominance of older farmers has consequences for the development of the agricultural sector, especially on agricultural productivity.

IMPLICATION

Indonesia has not yet reached the Lewis Turning Point stage as a result of the process of structural change. Indonesia almost reached the Lewis turning point in the 1990s, which is considered the peak of industrialization and the take-off period, with an average agricultural surplus ratio of <5%. However, the Asian financial crisis which caused the Indonesian economy to contract by up to -13.7%, which was followed by the emergence of premature deindustrialization problems and the reallocation of resources to natural-based sectors, such as mining, in the post-Asian crisis period had an impact on the decline in the ability of the non-agricultural sector, especially industry, in absorbing surplus labor from the agricultural sector. This condition caused the surplus of agricultural labor to increase again in the post-Asian financial crisis period.

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The intensification of the use of technology in the Indonesian agricultural sector has had different impacts on capital and labor. In this case, the impact of technology leads to intensive use of capital in the Indonesian agricultural sector, or what is known as input intensive. Meanwhile, the opposite condition occurs for the workforce, where technological developments lead to the use of less labor or input saving. The results of the study show that the Indonesian agricultural sector still has a surplus of labor which keeps the level of worker productivity relatively low. Therefore, this surplus of agricultural labor needs to be absorbed in order to encourage the economy to develop more quickly. Efforts that must be made are encouraging the development of the non-agricultural sector, especially the manufacturing industry based on agricultural resources, through industrial area policies. This industrial area can overcome three main problems which are issues in the effort to develop an agricultural resource-based manufacturing industry, namely (i) availability of ready-to-build land complete with supporting facilities and infrastructure, (ii) legal certainty of business location so that it avoids all forms of disturbance and obtains amenities for the business world (iii) overcomes spatial problems and environmental impacts resulting from industrial activities.

Limitation And Future Research

This study only discusses the achievement of Lewis's turning point in Indonesia. The next study can compare the achievement of turning Point Lewis in a number of ASEAN countries, taking into account the impact of technology on the use of agricultural inputs.

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