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Measuring and Decomposing Productivity of Co-operatives in Aceh, Indonesia

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Abstract

This study empirically assesses the co-operatives' productivity across 23 districts/cities in Aceh province, Indonesia, over 2014-2018 using the Malmquist Total Factor of Productivity Index (MTFPI) based on Data Envelopment Analysis (DEA). Unlike previous studies that focused only on selected sectors and industries, this study examines the co-operative productivity of all industries and sectors within one province. Overall, this study recorded a low productivity level of co-operatives. Only co-operatives in Subulussalam City consistently experienced a fully productive using both Constant Return to Scale (CRS) and Variable Return to Scale (VRS) estimations. Meanwhile, based on the VRS estimation, the study found that the co-operatives in Aceh Besar and Aceh Utara's districts had experienced the full total productivity. Overall, the co-operatives' productivity level has slightly declined, contributed mainly by a decline in technical efficiency. However, the co-operatives' efficiency level has increased, mainly due to their scale efficiency improvement. The findings suggested the importance of implementing sound co-operative governance principles and enhancing technical efficiency by adopting e-marketing and the internet of things in their business activities.

Keywords:
total factor productivity, co-operatives, DEA, Malmquist index

How to Cite:

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INTRODUCTION

Co-operatives are pertinent to global social, cultural, and economic development, including Indonesia. Article 33 of the 1945 Constitution of Indonesia has positioned co-operative as a pillar and backbone of the national economy. Since its first establishment in 1896 in Purwokerto, Central Java (Nasution, 1990), co-operative has been able to increase its members' welfare and free them from moneylenders. In the last few decades, co-operatives have been showing tremendous progress. In 2016, they had offered 574,451 job opportunities and contributed about 2% to Indonesia's economy (Azhari et al., 2017). At the end of 2019, 22.46 million Indonesians registered as members of the 204,734 co-operatives nationwide (Ministry of Co-operatives and SMEs, 2019).

The promising progress of co-operatives and their contribution to the national economy is not isolated from the government support through the issuance of legal basis to oversee the Co-operative, such as the 1945 Constitution and the 1992 Co-operative Act, No. 25. However, of the total number of co-operatives, 39.90% of them have been inactive nationwide. Lacking capital, unskilled staff, mismanagement, and low level of productivity have contributed to their inactivity (Majid et al., 2020). Many co-operatives in Indonesia are also facing a similar problem, including in Aceh province.

The co-operatives in Indonesia have promoted the national economy, but their contribution is still beyond expectation due to a larger number of inactive and unproductive co-operatives. Their contribution to promoting the development of Indonesia's economy has been smaller compared to the contribution of co-operatives to the economies of Sweden (13%), Switzerland (16.4%), Finland (21%), New Zealand (22%), and Kenya (45%) (Hasan et al., 2018). The failure of co-operatives in Indonesia to play its crucial role as the national economy's backbone is also mainly caused by their lower productivity (Hasan et al., 2018).

Many previous studies have explored the productivity of co-operative worldwide. For example, in the developed countries, Ludena (2010) has explored the co-operatives' productivity in America, Pasiouras (2013) and Akinsoyinu (2015) in European countries. On the other hand, studies for developing economies have been investigated by Dong & Featherstone (2004) in China and Khan et al. (2010) in Pakistan. Most of these studies documented a low-level productivity of the co-operatives.

Previous studies investigating the co-operatives' productivity have commonly used two approaches, namely parametric and non-parametric. In this case, Stochastic Frontier Approach (SFA) and Data Envelopment Analysis (DEA) are the most frequently used parametric and non-parametric approaches, respectively (Berger and Humphrey, 1997). Of these approaches, the DEA is the most commonly adopted approach measuring cooperatives' productivity globally due to its prediction superiorities and accuracy.

Using the DEA method, Fandel (2003) measured the efficiency of 1,147 co-operatives in the agricultural sector in Slovakia and documented that the farms with the size group of below 100 ha and above 1.000 ha had shown a higher technical efficiency, while those with the size of 500 to 1.000 ha had recorded higher scale efficiency.

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Examining the productivity of the horticultural co-operatives in Andalusia, Galdeano-Gomez et al. (2006) found a considerable increase in the co-operatives' productivity during 1995-2004.

In other studies, using the DEA approach, Ariyaratne et al. (2006) found an increase in the productivity of co-operatives in the United States was primarily caused by the changes in their technical and pure efficiencies change over the period from 1990 to 1998. Ludena (2010) also documented a similar finding, where an improved productivity level of the agricultural co-operatives in Latin America during the 1961-2007 period was due to efficiency and technical improvement. However, co-operatives recorded slight declines in their productivity during 2004-2008 (Candemir et al., 2011). Focusing on European countries, using the DEA approach, Doumpos and Zopounidis (2012) documented that Austria and Italy's co-operatives are recorded as the best and worst efficient co-operatives during the 2005-2010 period, respectively. The co-operatives in European countries are also found to be efficient and stable over the 2008–2013 period (Akinsoyinu, 2015).

Previous studies have also investigated the productivity of co-operatives in Asian countries using DEA approaches. For example, Dong and Featherstone (2006) found that the rural co-operatives in China over the period 1991-1995 recorded almost similar level of productivity across the provinces as they utilized almost similar technology and co-operatives' scales. In Sri Lanka, Jayamaha and Mula (2010) found a low productivity level of savings and credit co-operatives during the 2003-2005 period. Meanwhile, in India, the co-operatives experienced a declining trend in their productivity during the 1992-1997 period (Singh et al., 2010).

In Indonesia's context, there have also been several studies that measured and analyzed the productivity of the co-operatives in specific economic sectors and cities. For instances, Sulikah (2010) measured efficiency of the co-operatives in Klaten, Yogyakarta, Wirnoto (2011) in Pekalongan, Central Java, and Syamni and (Majid, 2016) in Lhokseumawe, Aceh. These studies recorded that the co-operatives in these selected Indonesian provinces had a lower level of productivity. Since these studies focused their analysis on the co-operatives in the specific sectors and districts, they failed to offer ample empirical evidence province-wide.

Besides, previous studies have not provided detailed sources of productivity of the co-operatives; thus, they failed to offer a holistic recommendation to enhance their performances and contribution to the national economy. Therefore, this present study intends to fill the existing studies' gaps by assessing the productivity of co-operatives across 23 districts/cities in Aceh provinces, Indonesia using the Malmquist Total Factor of Productivity Index (MTFPI) based on the Data Envelopment Analysis (DEA). The TFPI comprises efficiency change (EFch) and technical efficiency change (TEch). EFch is further decomposed into two sub-components [i.e., pure technical efficiency change (TEch) and scale efficiency change (SEch)].

This study's results are expected to offer references for the co-operatives and regulators in designing policies to promote their productivity and contribution to the provincial economy.

Besides, this study was conducted in Aceh Province, one Indonesian Province that received a significant number of transfer funds from the central government. Thus, the contribution of the fund to the performance of co-operatives in Aceh Province is anticipated.

The remaining parts of the research are structured in the following manner. Section 2 highlights the data and empirical model of TFPI-DEA, followed by the presentation and discussion of the findings and their implications in Section 3. Finally, Section 4 concludes the study.

METHODS

Previous studies have adopted three major approaches to measuring productivity and efficiency: traditional, parametric, and non-parametric approaches (Majid and Maulana, 2012). Of these approaches, a non-parametric, namely Data Envelopment Analysis (DEA), has been the most widely utilized to measure productivity in various scientific disciplines and operational activities due to its superiorities. Apart from its ability to discover the sources of inefficiency (Omar et al., 2006; Majid and Maulana, 2012; Ismail et al., 2013), DEA is also able to take into account a wide range of inputs or outputs, technology, capacity, competition, and demographics to measure efficiency. Thus, this study measures the generalized output-oriented Malmquist Total Factor of Productivity Index (MTFPI) using the DEA program (Coelli, 1996).

Following the studies by Omar et al. (2007), Saad et al. (2006), Majid and Maulana (2010), and Majid et al. (2017), this study measures MTFPI using the following equations:

$$M_o\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = (a)x(b) \qquad (1)$$

where: $a = \dfrac{D_o^t(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)}$; and $b = \left[\left(\dfrac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})}\right)\left(\dfrac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)}\right)\right]^{1/2}$

where M_o is the MTFPI; D_o is the distance function, x and y are the input and output for t and $t+1$ periods, respectively; a is the technical change, and b is the efficiency change.

The MTFPI comprises two components, namely: efficiency change (EFch) and technical efficiency change (TEch). EFch is further decomposed into two sub-components, namely: pure technical efficiency changes (PEch) and scale efficiency change (SEch). The decomposition of MTFPI into its components and sub-components represented by the following equations:

$$M_o\left(x^t, y^t, x^{t+1}, y^{t+1}\right) = (a)x(b)$$
$$= (a)x(cxd) \qquad (2)$$

where: $a = \left[\left(\dfrac{D_o^{t+1}(x^t, y^t)}{D_o^t(x^t, y^t)}\right)\left(\dfrac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^{t+1}, y^{t+1})}\right)\right]^{1/2}$; $c = \left(\dfrac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^{t+1}, y^{t+1})}\right)$; and

$$d = \left(\frac{D_{oc}^{t+1}(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_{oc}^{t+1}(x^{t+1}, y^{t+1})} \frac{D_{oc}^t(x^t, y^t)}{D_o^t(x^t, y^t)} \frac{D_o^t(x^{t+1}, y^{t+1})}{D_{oc}^t(x^{t+1}, y^{t+1})}\right)^{1/2}$$

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a is the technical change (TEch), *b* is the efficiency change, *c* is the pure efficiency change (PEch), and *d* is the scale efficiency change (SEch).

Finally, the study summarizes the findings of productivity sources of the co-operatives across 23 districts/cities using Constant Return to Scale (CRS) and Variable Return to Scale (VRS). Unlike CRS, the VRS assumes the ratio between additional input and output is dissimilar. This implies that the auxiliary inputs by x times do not necessarily increase the output by x times. It can be smaller or larger than x times (Banker et al., 1984).

This study uses three inputs and one output to measure the sources of productivity of the co-operatives across 23 districts/cities in Aceh, Indonesia, over the period from 2014-2018. Of 4,410 units of active co-operatives province-wide, 345 of them were selected as the sample of the study using a stratified random sampling technique. These co-operatives comprise three co-operatives in every five economic sectors (i.e., trade, fishery, agriculture, plantation, creative economy, and services) across 23 districts/cities. Since the study covers five years; thus, in totality, the data investigated in this study comprises 1,725 observations. In this study, the inputs consist of own capital, external capital, and managerial board, while the output is the co-operative surplus. The inputs and output are selected based on the Indonesian Co-operative Act, No. 25 (1992), which states that the co-operative is operated using its own and external capital, supported by its managerial committee to produce a co-operative surplus. The data are gathered from the annual reports of the selected co-operatives in five economic sectors across 23 districts/cities in Aceh Province. The description of the input-output specification and their definitions are reported in Table 1.

Table 1. Inputs-Output Definitions and their Measurements

Variable	Definition	Remark
Own capital	The number of co-operative-owned capital comprises principal savings, mandatory savings, reserves, and grants.	Input
External capital	The capital from external sources in the form of loans from members, other co-operatives, banks, financial institutions, and issuances of bonds and securities.	Input
Managerial boards	A person who is given trust by co-operatives can manage the organization through the Annual Member Meetings.	Input
Co-operative surplus	Total revenue minus total cost within a fiscal year period.	Output

RESULT AND DISCUSSIONS

This study measures and analyzes the sources of productivity of co-operatives across 23 districts/cities in Aceh, Indonesia, over the 2014-2018 period. Table 2 illustrated the Return to Constant Return to Scale (CSR) and Variable Return to Scale (VRS) - productivity level of co-operatives in 23 districts/cities in Aceh, Indonesia. The value of 1.000 signified that the co-operative is productive (on the frontier line), while the value of smaller than 1.000 indicated non-productive (below the frontier line).

As illustrated in Table 2, the study found that only the co-operatives from the city of Subulussalam have been operated consistently productive during the study period, indicated

by both CRS and VRS values of 1.000. The ability of co-operative management in the Subulussalam City to maintain minimal inputs to produce optimal outputs supported by sufficient capital provided by the relevant government authorities has contributed to the steady level of the co-operative productivity in the district. On the other hand, the co-operatives from Pidie District were found to be the least productive both from the perspectives of CRS and VRS. On average, co-operatives in this district have operated by only about 20% productivity level. This could be done, inter alia, by implementing good co-operative governance, supported by the professional human resources and adequate funds. Overall, the rest of the 22 districts/cities co-operatives have recorded a low productivity level (66.4%). These findings indicate a huge room for the co-operatives to improve their productivity level by 33.6%. In so doing, the co-operatives need to maintain and improve their management continuously by implementing good co-operative governance, supported by well-trained human resources and sufficient adequacy co-operative capital.

Table 2. CRS and VRS – Productivity Level of Co-operatives in Aceh, Indonesia

No.	District/City	2014		2015		2016		2017		2018	
		CRS	VRS	CRS	VRS	CRS	VRS	CRS	VRS	CRS	VRS
1.	Banda Aceh	0.302	1.000	0.273	0.998	0.145	0.435	1.000	1.000	0.293	0.517
2.	Aceh Besar	0.209	1.000	0.210	1.000	0.331	1.000	0.292	1.000	1.000	1.000
3.	Pidie	0.042	0.142	0.043	0.146	0.318	0.355	0.211	0.239	0.155	0.165
4.	Pidie Jaya	0.687	0.814	0.943	1.000	0.333	0.378	0.954	1.000	0.324	0.337
5.	Bireuen	0.712	1.000	0.488	0.961	0.787	1.000	1.000	1.000	0.413	0.482
6.	Lhokseumawe	0.301	0.351	0.206	0.251	0.288	0.291	0.687	0.705	0.454	1.000
7.	Aceh Utara	0.431	1.000	0.303	1.000	0.425	1.000	0.409	1.000	0.460	1.000
8.	Aceh Timur	0.234	0.246	0.292	0.486	0.329	0.411	0.644	1.000	0.534	0.784
9.	Langsa	0.071	0.093	0.155	0.261	0.140	0.430	0.915	1.000	0.690	0.705
10.	Aceh Tamiang	0.206	0.565	0.138	0.469	0.653	0.844	0.148	0.495	0.260	0.565
11.	Aceh Tenggara	0.236	0.236	0.183	0.185	0.341	0.387	0.281	0.281	0.211	0.241
12.	Gayo Lues	0.222	0.289	0.337	0.363	0.322	1.000	0.404	0.440	0.697	1.000
13.	Aceh Tengah	0.267	1.000	0.348	0.496	0.189	0.199	0.179	0.188	0.330	0.528
14.	Bener Meriah	0.941	1.000	0.764	1.000	1.000	1.000	0.662	0.992	0.571	1.000
15.	Aceh Singkil	0.429	0.946	0.608	1.000	1.000	1.000	0.601	1.000	1.000	1.000
16.	Sabang	0.299	0.403	0.155	0.157	0.188	0.207	0.669	0.677	0.133	0.133
17.	Aceh Barat	0.295	0.426	0.310	0.439	0.588	0.584	0.330	0.422	0.323	0.370
18.	Nagan Raya	0.704	1.000	1.000	1.000	1.000	1.000	0.735	0.879	1.000	1.000
19.	Abdya	0.487	1.000	0.329	0.885	0.291	0.671	0.298	0.653	1.000	1.000
20.	Aceh Selatan	1.000	1.000	0.392	0.460	0.465	0.438	0.541	0.757	0.231	0.245
21.	Subulussalam	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
22.	Simeulue	0.223	1.000	0.309	1.000	0.275	0.448	0.188	0.369	0.137	0.199
23.	Aceh Jaya	0.225	0.670	0.105	0.402	0.350	0.496	0.136	0.337	0.985	1.000
	Mean	**0.414**	**0.703**	**0.387**	**0.650**	**0.468**	**0.634**	**0.534**	**0.715**	**0.530**	**0.664**

Based on the VRS-productivity level, only the co-operatives from Aceh Besar and Aceh Utara were found to experience consistently productive during the 2014-2018 period, as indicated by the VRS value of 1.000. The presences of well-managed co-

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operatives owned by large-scale companies in those two districts, such as PT. Pupuk Iskandar Muda, PT. Kertas Kraft Aceh, PT. Arun NGL in Aceh Utara district and PT. Semen Andalas Indonesia in Aceh Besar could partially be contributed to the steady productivity growth of the co-operatives in the said districts. Meanwhile, the rest of the co-operatives in 21 districts/cities have recorded productivity by about 65%. Compared to the CRS-productivity level, the co-operatives' VRS-productivity level was higher as the estimation has a flexibility assumption decreasing the increasing return to scale. Overall, the lowest CRS-productivity level (38.7%) was recorded in 2015, while the highest value (53.4%) was documented in 2017. On the other hand, in view of the VRS estimation, the lowest productivity level (63.4%) was recorded in 2016, while the highest value (71.5%) was documented in 2017. The co-operatives showed a volatile level of productivity and failed to maintain and continuously improve their productivity level. Their small scale, lacking capital, and mismanagement are the main contributors to the low productivity level of the co-operatives in Aceh, Indonesia.

Table 3. Malmquist Total Factor of Productivity Index of Co-Operatives

No.	District/City	2014-2018				
		EFch	TEch	PEch	SEch	MTFPIch
1.	Banda Aceh	0.993	1.083	0.848	1.171	1.075
2.	Aceh Besar	1.479	0.669	1.000	1.479	0.990
3.	Pidie	1.389	0.935	1.039	1.337	1.299
4.	Pidie Jaya	0.829	0.870	0.802	1.033	0.721
5.	Bireuen	0.873	0.983	0.833	1.047	0.858
6.	Lhokseumawe	1.108	1.042	1.299	0.853	1.154
7.	Aceh Utara	1.016	1.044	1.000	1.016	1.061
8.	Aceh Timur	1.230	0.827	1.336	0.920	1.017
9.	Langsa	1.765	0.772	1.660	1.064	1.362
10.	Aceh Tamiang	1.059	0.815	1.000	1.059	0.863
11.	Aceh Tenggara	0.973	1.021	1.005	0.968	0.993
12.	Gayo Lues	1.331	0.813	1.364	0.975	1.081
13.	Aceh Tengah	1.054	0.952	0.853	1.236	1.004
14.	Bener Meriah	0.883	1.058	1.000	0.883	0.933
15.	Aceh Singkil	1.236	0.874	1.014	1.219	1.080
16.	Sabang	0.816	1.214	0.758	1.076	0.990
17.	Aceh Barat	1.023	0.930	0.965	1.060	0.951
18.	Nagan Raya	1.092	0.950	1.000	1.092	1.037
19.	Abdya	1.197	0.629	1.000	1.197	0.753
20.	Aceh Selatan	0.693	0.982	0.703	0.986	0.681
21.	Subulussalam	1.000	0.921	1.000	1.000	0.921
22.	Simeulue	0.885	0.986	0.668	1.324	0.872
23.	Aceh Jaya	1.446	0.738	1.105	1.308	1.068
	Mean	**1.077**	**0.907**	**0.988**	**1.090**	**0.977**

Our findings are in harmony with previous studies conducted by Sulikah (2010), Wirnoto (2011), and Syamni and Majid (2016). They found low levels of productivity

of the co-operatives in specific regions of Indonesia. However, our findings of different productivity level of co-operatives across 23 districts/cities in Aceh contradicted the finding by Dong & Featherstone (2006). They found a relatively similar productivity level of the rural credit co-operatives across 29 provinces/regions in mainland China during the 1991-1995 period. Thus, it is enormously essential for the government through the Office of Co-operatives and SMEs of Aceh province in particular, and the Ministry of Co-operatives and SMEs of the Republic of Indonesia in general, to formulate suitable policies to advance all co-operatives to have a relative similar productivity level that, consequently, contribute to the just regional economy. The co-operatives that were non-productive should benchmark the highest productive co-operatives to improve their productivity level.

Furthermore, Table 3 reported the findings of Malmquist Total Factor Productivity Index change (MTFPIch) the co-operatives in 23 districts/cities in Aceh, Indonesia over the 2014-2018 period and its components of Technical Efficiency Change (TEch) and Efficiency Change (EFch). The findings from EFch are further decomposed into tow sub-component, namely: Pure Efficiency Change (PEch) and Scale Efficiency (SEch). The MTFPIch of less than 1.000 shows a decline in the productivity level, the indices of 1.000 indicate no productivity level changes. In contrast, the index value of greater than 1.000 implies a rise in the co-operatives' productivity level.

As reported in Table 3, the mean of the MTFPIch of the co-operatives across the districts/cities in Aceh over the 2014-2018 period was 0.977, indicating that the overall productivity of the co-operatives has experienced a declining trend by -2.3%. The co-operatives in the Aceh Selatan District recorded the highest productivity reduction by -31.9%, while the co-operatives in the Langsa City documented the highest productivity improvement by 36.2%. To further identify each MTFPI components' contribution to the changes in the entire co-operatives' productivity, the efficiency change (EFch) and technical change (TEch) are now reported. In terms of EFch, the co-operatives from Aceh Selatan District were recorded to experience the worst productivity decline (-30.7%). In comparison, the co-operatives in Langsa City recorded the highest productivity improvement (76.5%). Across the districts/cities, the co-operatives showed an improvement in their productivity by 7.7%. These results indicate that the EFch has positively contributed to the MTFPIch of the co-operatives' industry in Aceh. The co-operative management ability to utilize and properly mix inputs to produce the highest output has contributed to a slight improvement of the co-operatives' productivity level during the study period.

Table 3 further reported the findings of the two sub-components of EFch, namely pure efficiency change (PEch) or scale efficiency change (SEch). The study found that PEch contributed negatively to the EFch of the co-operatives by –1.2%, while the SEch contributed 9.0% to the improvement of the EFch. These findings indicate that co-operatives' management has failed to combine the inputs to produce an optimal co-operative surplus properly. On the other hand, the co-operatives have experienced economies of scale as the SEch showed a positive value. Specifically, the study documented that the Simeuleu District co-operatives recorded the largest decline in their PEch by -33.2%. Our findings provide some evidences of different level of productivity of co-

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operatives across demographical areas in Aceh Province. Co-operatives located in the urban and sub-urban areas were documented to have higher level of productivity growth as compared to the co-operatives located in the rural areas in the provinces. These findings showed the importance for relevant government authorities of focusing their co-operatives' empowerment programs on the co-operatives in the rural areas.

In comparison, the co-operatives in Langsa City documented the largest increase in their PEch by 66.0%. Finally, SEch, as the last sub-component of EFch (i.e., SEch), is found to positively contribute to the changes in the EFch with an average of 9.0%. Co-operatives from the district of Bener Meriah recorded the largest decline in their SEch (-11.7%), while the co-operatives from the Aceh Besar documented the most remarkable improvement in their SEch (47.9%). Finally, Table 3 also reported the technical efficiency changes (TEch) as the second and the last component of MTFPI changes. As observed from Table 4, on average, the co-operatives have recorded technical progress by -9.3% over the period 2014-2018. This finding shows that technological progress was found to be the main contribution to the reduction in MTFPIch of the co-operatives province-wide. The low utilization of advanced technology, such as e-marketing, e-planning, e-budgeting, and the internet of things, has contributed to the decline in the co-operatives' technical regress.

Furthermore, the study found that the co-operatives in the district of Abdya gained the highest technical regress (-37.1%). The lack of technological facilities to support co-operative business entity is believed to be the main contributor to the finding. Most co-operatives in the district still adopted traditional management system and managed by the part-time workers. In comparison, the co-operatives in Sabang City recorded the highest technical progress (21.4%). Sabang is a well-known tourism city in the province; their co-operatives have been growing technically faster due to their services provided to domestic and foreign tourists (Goodwin, 2002). Our study's empirical results are contradictory to the findings of the previous studies by Syamni and Majid (2016). They found the TEch was the main contributor to productivity as opposed to the EFch. The findings of different level of co-operatives' MTFPI across the districts/cities are in line with the previous studies (Akinsoyinu, 2015; Asawaruangpipop & Suwunnamek, 2014; Pasiouras, 2013; and Khan et al., 2010. These previous studies found that the co-operatives' productivity level was different from one to another.

The low productivity level of the co-operatives across 23 districts/cities in Aceh is not surprising. Due to their small scale, the co-operatives tend to be more vulnerable to economic turbulences. Besides, traditional business culture and low managerial and entrepreneurial skills have been detrimental for the co-operatives to become productive business entity (Ropke, 2000). Thus, continuous efforts should be taken to promote co-operative productivity further. The compensation scheme for the co-operatives' managers should be implemented to a performance-based reward and attractive promotion packages (Othman et al., 2014). Improving the administrative and entrepreneurial skills of the co-operatives personnel through ongoing certified training should be recurrently provided. The co-operatives should be encouraged to adopt relevant and updated technology into their day-by-day business activities. The government need to review its policy to promote

co-operatives in all districts/cities. The co-operative act's enforcement to warrant co-operative conformity to the existing co-operative principles and rules should be executed to enhance co-operative productivity, ensure their sustainability, and amplify their chance of success. Finally, the private economic sector should be encouraged to support co-operative business activities.

CONCLUSIONS

This study empirically measured the total factor productivity level of the co-operatives across 23 districts/cities in Aceh, Indonesia, using Data Envelopment Analysis (DEA) with Malmquist Index over the 2014-2018 period. The study recorded the low productivity level of co-operatives. Only co-operatives in Subulussalam City consistently experienced fully productive based on both CRS and VRS estimations. Meanwhile, based on the VRS estimation, the co-operatives in Aceh Besar and Aceh Utara were found to experience fully productive over the study period. Overall, the co-operatives' productivity level has slightly declined, contributed mainly by a decline in technical efficiency. However, the efficiency level of co-operatives has shown a slight increase, contributed mainly by the rise in their scale efficiency.

The findings suggest that pure and technical efficiencies need to be continuously improved to promote the co-operatives' productivity level further. The co-operatives should implement sound governance principles and adopt e-marketing and the internet of things in their business activities. The remunerative scheme for the co-operatives' managers should be more attractive based on performance-based reward and punishment systems. The government needs to review its policy to promote co-operatives in all districts/cities, focusing more on rural areas. The government should warrant all co-operatives to conform to the existing principles, rules, and regulations to ensure their sustainability through continuous product improvement programs. The private economic sector should be given financial incentives to support cooperative business activities, such as tax reduction. Finally, the co-operatives ought to regularly conduct training for their staff to improve their professional managerial skills.

Future studies might explore the performance of the various sectors of co-operatives in Indonesia to offer a better portrait of their performance nationwide. Ultimately, combining both parametric and non-parametric approaches to measure their productivity levels could enrich existing empirical findings, thus offering references for designing policy to realize the co-operatives as the pillar of Indonesia's as mandated by Article 33 of the 1945 Indonesia's Constitution.

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