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Determining strategies for water, energy, and food-related sectors in local economic development

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ABSTRACT

Water, energy, and food (WEF) related sectors are important to support people's life in a region. Resource evaluation is one of the stages in resource management to ensure that the existence of those sectors is provided sustainably. The assessment of the agglomeration level and growth of each sector in economic development can give better insights for local stakeholders either government bodies or private firms to improve sustainable management of these sectors. The objectives of this paper are to portray the agglomeration level and recent growth of WEF related sectors in local regions in Indonesia, and to determine possible sustainable development strategies. The location quotient (LQ) and competitive position (CP) analysis methods are employed in this regard. By analysing Gross Regional Domestic Product (GRDP) between 2000 and 2015, basic and non-basic sectors have been determined. Results show that the general characteristics of WEF related sectors in this region can be distinguished clearly based on its main economic development focus. Results show recent growth in WEF sectors locally, from which possible strategies for future sustainable development are formulated that could be considered in the evaluation and planning process. This approach can be expected to assist local government and stakeholders in undertaking preliminary evaluation, in particular the availability of WEF resources, ensuring that development meets local and national sustainable development targets.

1. Introduction

Equitable access to, and proper management of water, energy, and food (WEF) sectors play an important role in determining the efficacy of poverty alleviation, welfare improvement of people in a region, and sustainable development (FAO, 2014) and is essential for human life. Availability, accessibility, and quality of water, energy, and food are the primary components of these resources that should be addressed in an integrated manner. Inward-looking and resistance to sharing information and resources among departments concerning water, energy, and food sectors leads to ineffective achievement of national and local sustainability targets. Based on global projections for the next decades, Hoff (2011) concludes there will be a prominent increase of water, energy, and food demand due to population growth, economic activities, changes in diets, culture, technology, and climate. Global population increased by two billion during the period 1990–2015. At present, one in nine people has insufficient food, while one third is malnourished (UNDP, 2016). There are around 750 million people with lack of improved drinking water access, while global industrial water demand is predicted to escalate by 400% during 2000–2050 (UNWWAP, 2015). Additionally, energy demand will almost double, while the demand for water and food are foreseen to escalate by more than 50% by 2050 (IRENA, 2015).

The concept of sustainable development is relevant with respect to water, energy, and food issues. Not only should these sectors be secured (availability, accessibility, quality), but this should be achieved in a sustainable way. In 1987, the Bruntland Commission Report provided a definition of sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (United Nation, 1987). In this context, (Endo et al., 2015) explain that interlinkages between water, energy and food are very complicated and have become crucial for the global community in the future to handle this issue in a sustainable way. Additionally, Hoff (2011) underlines that resources availability is not the one and only factor of security. Accessibility and quality are crucial to be covered in achieving resource security. Focusing only to certain aspect and resource, without considering others will potentially cause conflict and unbalanced competition among sectors (i.e. the current 'nexus' approach). The long-term stability of resources is one of the final goals of sustainable development. It only can be achieved by integrating and acknowledging social, environmental,

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and economic aspects in decision-making process (Emas, 2015). Those three aspects have to be evaluated and planned correctly to ensure the achievement of the development goals in each region.

In this context, the evaluation of a WEF-sector's agglomeration or concentration and its trends in a region are significantly important to give better understanding and insights for local government and stakeholders in setting the goals and allocating budget for development activities. By assessing recent trends and potential future directions, the sustainable development of these resources can be better guided, especially in the context of national and local sustainability targets. Sector agglomeration defines how concentrated a sector is within a region. It is important for those sectors which greatly affect people's lives such WEF-related sectors. One of the perspectives that can be used to do this kind evaluation from an economic point of view is economic base analysis (EBA). EBA is crucial for governments to understand better those sectors that contribute disproportionally to the economic growth of a region. This theory has prolonged practice regarding planning and geography with the main assumption that all economic activities in a region can be classified into basic and non-basic industries or activities (Isserman, 1977; Wang and Hofe, 2007). Furthermore, Wang and Hofe (2007) proposed one of the assumptions related to basic and non-basic sectors, where basic sectors yield more goods or services than the local needs, so the surplus can be exported to other regions. On the contrary, the non-basic sector is assumed under the level of self-sufficiency and therefore unmet demand needs to be imported.

One common method in economic base analysis is Location Quotient (LQ). This technique has been employed in many sectors such as the mapping crime (Brantingham and Brantingham, 1998), trade sector (Chiang, 2009), industrial concentration (Billings and Johnson, 2012), and carbon emission (Trappey et al., 2013), marine sector (Morrissey, 2014), economic development (Alhowaish et al., 2015), and road project development (Berawi et al., 2017) among others. In addition, there are many studies employing the competitive position method to analyse various sectors (for instance Horta and Camanho, 2014; Dang and Yeo, 2017). However, although extensive research has been carried out on sector's agglomeration analysis, no single study exists which focuses on water, energy, and food-related sectors in more detail and in the perspective of local economic and sustainable development. In this respect, this study is novel, and could yield new insight for policy makers, especially when developing sustainability targets, and when evaluating progress towards existing targets.

This study analyses the agglomeration of WEF related sectors and other sectors in three characteristic local regions in Indonesia and WEF related sub-sectors in an agriculture–manufacture based region. This research also determines strategies for WEF related sectors based on agglomeration and competitiveness. This work analyses gross regional domestic product (GRDP) in the year 2011–2015 and 2000–2015 using the combination of LQ techniques and competitive position charts (Zhao et al., 2016).

The paper is organized into five sections. The first section is an introduction, and then continued by the second section that will elaborate briefly about the study area comprises Karawang Regency and two others local regions in West Java Province, Indonesia as comparison. Section 3 focuses on methodologies employed in this study. The computational result, analysis, and discussion of the research will be reported in Section 4, and afterwards concluding remarks of all the stages, findings, and recommendation are given in Section 5.

2. Methods

2.1. Data

The data used in this study were taken from Statistics of West Java report, Statistics of Karawang Regency, Statistics of Cianjur Regency, Statistics of Bekasi City, and other related data sources. The main datasets used in LQ computation are as follows:

a. GRDP of West Java Province at 2000 Constant Market Prices by Industrial origin, the year 2000–2015;
b. GRDP of Karawang Regency at 2000 Constant Market Prices by Industrial origin, the year 2000–2015
c. GRDP of West Java Province at 2010 Constant Market Prices by Industrial origin, the year 2011–2015;
d. GRDP of Karawang Regency at 2010 Constant Market Prices by Industrial origin, the year 2011–2015;
e. GRDP of Cianjur Regency at 2010 Constant Market Prices by Industrial origin, the year 2011–2015; and
f. GRDP of Bekasi City at 2010 Constant Market Prices by Industrial origin, the year 2011–2015.

In this study, the data used were the statistical data series of 16 years of GRDP (2000–2015) that has been verified and analysed by the statistical agencies. Gross Domestic Product (GDP) or Gross Domestic Regional Product (GRDP) at the provincial/regency level are arranged based on a production and expenditure approach. Production-based GRDP by industrial origin denotes a basic measure of value-added emerging from various kind of economic activities and production in a region. GRDP therefore implicitly accounts for the basic factors of production in its metric, but does not report on the effects of these factors explicitly. It has changed since 2010 in the number of categories from 9 main sectors to 17 main sectors, comprises 39 sub-sectors, and 5 sub sub-sectors.

In this paper, the water-related sector is based on the definition from statistics agencies which consists of domestic and industrial water supply, sewerage, waste management, & remediation products and services. Agricultural water or irrigation purposes for instance is not specifically included in this statistical value. In addition, the term 'water supply' was used in the period of 2000–2010 and classified as 'sub-sector'. Meanwhile, in the period of 2011–2015, the 'water supply, sewerage, and waste' term categorized as 'sector'. Both terms have similar definition and coverage. Therefore, to avoid confusion, the term 'water supply' is used in this study to represent the water sub-sector. The energy-related sector covers electricity, manufacture of gas, and production of ice. Furthermore, the food-related sector is defined as agriculture, livestock, hunting, & agriculture services (with sub-sectors; food crops, horticultural crops, plantation crops, livestock, agriculture services & hunting), forestry and logging, and fishing. All the definitions and coverage may slightly differ between authorities or government institutions, however there basic levels of coverage remain similar and are considered comparable for this study.

2.2. Location quotient (LQ)

There are four basic techniques in economic base analysis that can be used, especially if the availability of data becomes an obstacle in using more complex economic analysis. These are: survey methods, assumption methods, location quotient (LQ) method, and minimum requirement method (Wang and Hofe, 2007). According to (Leigh, 1970), the best measure to determine basic and non-basic sector is the use of primary surveys. Nevertheless, this can be very difficult and costly, in particular for a large region with diverse economic activities (Leigh, 1970; Brodsky and Sarfaty, 1977). LQ is the methodology adopted for this study. Miller et al. (1991) defined LQ as 'a basic analytical tool to yield a coefficient or simple expression of how well represented a particular industry is in a given study region'. LQ has been widely applied in economic geography and regional economics since the 1940s due to the data unavailability (at that time) of interregional trade flow (Wang and Hofe, 2007). It can be applied to compare the role of industrial sectors in a region with the same variable in the higher regional