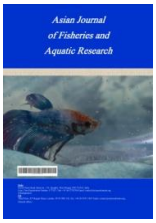

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Analysis of Competitiveness in the Field of Brackish Water Aquaculture in Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted from August 2020 to July 2021. Competitiveness can be interpreted as the ability of a region to make it excel in producing a commodity more than any other region. The competitiveness, especially in the field of brackish water aquaculture can be known through several indicators, i.e. human resources, infrastructure, production and science and technology. This study aims as an effort to realizing fisheries development in Indonesia by knowing the competitiveness profile of brackish water aquaculture in Indonesia through qualitative descriptive analysis method. The research procedure was conducted in several stages, the first of which was the collection of secondary data at the Ministry of Marine Affairs and Fisheries. The second stage is to analyze the primary data in the form of expert opinions or competent people in their fields. Then the last stage is to analyze the data that has been obtained during the research. Based on the results of the study, it was concluded that the competitiveness profile of brackish water aquaculture in Indonesia was outperformed by south Sulawesi province with a final value of 17.03, while the region with the lowest competitiveness value was Riau Islands Province with a final value of 0.05.

Keywords: Brackish water aquaculture; fishery competitiveness; brackish water shrimp aquaculture; brackish water fish aquaculture; brackish water seaweed aquaculture.

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1. INTRODUCTION

Geographically, Indonesia stretches from 60^0 North Latitude to 110^0 South Latitude and 92^0 to 142^0 East Longitude, consisting of large and small islands which are approximately 17.504 islands. Three-quarters of its territory is sea (5.9 million km^2), with a coastline of 95.161 km, the second longest after Canada [1]. The potential area of brackish water cultivation in Indonesia is 2.9 million hectares with a new land utilization rate of 532 thousand hectares or about 18 percent and still very able to be develop [2]. Brackish water aquaculture has the potential to absorb labor and give rise to new shoots because the technology is easy to apply with a fairly fast harvest time span so this activitiy is very prospective and promises a large profit. In addition, commodities cultivated through encroachment activities have high economic value and can play a large foreign exchange contributor to the country.

The Ministry of Marine Affairs and Fisheries (KKP) has set the direction of policy and strategy of marine and fishery development through the industrialization of fisheries. This policy aims to increase productivity and added value of products and increase competitiveness based on knowledge and technology. There are seven things to be achieved in fishery industrialization such as increased added value, increased competitiveness, modernization of upstream and downstream production systems, strengthening of fishery industry players, commodity-based, regional and management systems, sustainable and social transformation [3].

Competitiveness is one of the parameters in the concept of fishery development [4]. In another sense competitiveness is the ability of a commodity to enter the market and survive in that market, if a commodity can compete then this will directly affect the income level of farmers. The level of competitiveness in Indonesia is certainly formed by the competitiveness capabilities of its provinces, where each province has the characteristics of human resources, facilities and infrastructure, production and production value, as well as different sciences and technologies. The measurement of competitiveness level of these four indicators is further supported by appropriate strategies that can support the improvement of competitiveness in Indonesia.

Research on competitiveness conducted by Dhelia, shows that one of the centers of aquaculture in Indonesia is in West Java, but in terms of competitiveness, milkfish commodities are still inferior to Central Java and Sulawesi. This is because West Java has several determining factors that are far below ideal conditions such as human resources, capital resources, infrastructure and other facilities, supporting industries, and related industries [5]. Several strategies can be taken to overcome this problem, spesifically by building effective communication between the main groups of fisheries actors and the government, increasing support for facilities and infrastructure in fostering, increasing human resource capabilities according to technological developments, and increasing supervision and evaluation [6].

Another research on competitiveness conducted by Mufa'ah and Hayati revealed that there are 6 provinces in Indonesia that contribute the highest exports of fishery products, East Java at 352,839 tons or an increase of 3.24 percent, DKI Jakarta at 274,762 tons or an increase of 4.29 percent, Maluku by 187,143 tons or an increase of 28.24 percent, South Sulawesi by 91,125 tons or an increase of 1.19 percent, North Sumatra by 77.975 tons or an increase of 10.33 percent, and West Papua by 42.844 or an increase of 15.84 percent [7].

Based on this description, this study aims to determine the level of competitiveness of brackish water aquaculture in each province as an effort to implement fisheries development in Indonesia.

2. MATERIALS AND METHODS

The research was conducted from August 2020 – July 2021 in Bandung, West Java, Indonesia. The method of data retrieval used in this research is the method of literature study. The data obtained in the form of primary data and secondary data are realized in the form of numbers and analyzed using qualitative descriptive methods. Primary data in the form of expert opinion gives weight to the indicators and comparison of variables while secondary data is in the form of data on the main indicators of competitiveness of brackish water fish farming fisheries. The study used time-running data from 2003 to 2017.

2.1 Competitiveness Analysis

Data analysis conducted by using qualitative descriptive analysis. Qualitative descriptive

analysis in this study is used to obtain a profile picture and development of competitiveness in the field of brackish water cultivation in Indonesia. Analysis of the competitiveness profile of brackish water cultivation in each province of Indonesia through several stages: 1.) Determining the main indicators and variables including human resources, facilities and infrastructure, production and production value, application of technology and knowledge for the fishery results of brackish water cultivation. 2.) The stage of conducting research is to take data on brackish water cultivation in Indonesia during 2003 to 2017. 3.) Identify the priority weight or level of relative importance between the indicators, variables and sub-variables. 4.) Take a primer in the form of expert opinion that gives weight to the main indicators and variables. 5.) Calculate the weight of the results of the expert and question of each indicators, variable and sub-variable. 6.) Processing data that has been obtained during the study, using secondary data, namely statistical data of brackish water cultivation in Indonesia in 2017 to determine the competitiveness profile of each province. 7.) Calculates the scores and values of the main indicators, variables, and sub-variables of the secondary data and calculates the values based on the weight and score obtained:

$$\text{Scores} = \frac{Data\ per\ Province}{Total\ Data\ Indonesia}\ x\ 100\%$$

Value= Weight x Score

8.) Shorten the competitiveness of brackish water cultivation between all provinces in Indonesia based on weighted value. 9.) Determine the competitiveness criteria of brackish water cultivation of each province in Indonesia using quartile with excel application. Quartile criteria are divided into four namely, Q1 is a very high competitive region, Q2 is a highly competitive region, Q3 is a fairly competitive region, Q4 is a low competitive region. The following productivity formula is calculated for the main indicators of fishery competitiveness [4]. As for productivity, it is calculated from statistical data of Indonesian brackish water cultivation with the following formula:

a. Production Productivity per Land Area

$$Ppt = \frac{Pik}{Tik} \quad (1)$$

Information:

Ppt : Production productivity per land area (ton/$m^{2)}$

P : Total Production (tons).
T : Total land area (m^2)
i : Province i (i = 1, ... , 33)
k : Time period

b. Production productivity per Labor

$$Ppn = \frac{Pik}{Nik} \quad (2)$$

Information:

Ppn : Production productivity per labor (tonnes/person)
P : Total Production (tons).
N : Total number of workers (people)
i : Province i (i = 1, ... , 33)
k : Time period

c. Productivity of Production Value per Land Area

$$Pnpt = \frac{NPik}{Tik} \quad (3)$$

Information:

Pnpt : Productivity of production value per land area (rupiah/m^2)
NP : Production Value (Rupiah).
T : Total land area (m^2)
I : Province i (i = 1, 33)
k : Time period

d. Productivity of Production Value per Labor

$$Pnpn = \frac{NPik}{Nik} \quad (4)$$

Information:

Pnpn : Productivity of production value per labor (rupiah/person)
NP : Production Value (Rupiah).
N : Total number of workers (persons)
i : Province i (i = 1, ... , 33)
k : Time period

3. RESULTS

3.1 Fishery Competitiveness Profile of Brackish Water Cultivation in Indonesia

The level of competitiveness is one of the parameters in the concept of sustainable economy. The higher the competitiveness level of a region, the higher the level of community welfare. Indicators measured in the

measurement of competitiveness level in this study are indicators of human resources, facilities and infrastructure, production, and science and technology. The four indicators are considered to be positively corlerated in determining the competitiveness of brackish water cultivation in Indonesia. The classification of competitive positions in this study was adapted from [8] those states that the order of competitive positions consists of 4 (four) highest to lowest classifications i.e. highly competitive (*Sustained Competitive Advantage*), high competitiveness (*Temporary Competitive Advantage*), sufficient competitiveness (*Competitive Parity*), and low competitiveness (*Competitive Disadvantage*).

South Sulawesi is the highest competitive province in Indonesia based on the results of calculations in this study (Fig. 1). This can happen because South Sulawesi is one of the production centers of brackish water cultivation and has the largest pond in Indonesia, even still has the potential to expand its farmland. There are three groups of commodities cultivated in south Sulawesi ponds, namely fish, crustacea and seaweed. However, there has been a shift in production dominance from fish and crustacea to seaweed on the east coast of South Sulawesi, as a result of geographical conditions especially soil quality that is not suitable for fish cultivation and crustacea.

Ponds on the east coast of South Sulawesi are dominated by acid sulfate soils, which makes fish and crustacean cultivation activities fail. Acid sulphate soils are characterized by low soil pH, high content of toxic elements and low macronutrients. As a result, the production of natural food which is very important for fish and crustaceans is also very low which results in slow growth of organisms. In addition, the quality of acid sulphate soil like that can also reduce the quality of pond water which not only causes slow growth of aquatic organisms but can even be deadly. This usually occurs after a long dry season and then it rains which causes the pyrite oxidation products to dissolve in the bund soil and enter the pond [9]. Meanwhile, the development of seaweed cultivation is relatively fast, as a result of its easy and inexpensive cultivation technology. Seaweed is an aquatic plant that is relatively resistant to extreme land conditions, so that South Sulawesi can maintain the competitiveness of its aquaculture through seaweed as its main commodity.

Fig. 1. Overall map of Indonesia's brackish water aquaculture competitiveness (2017)

The results showed the province with the lowest competitiveness of brackish water cultivation is Riau Islands, this phenomenon occurs because basically Riau Islands have a larger ocean area (96%) compared to the land area of only (4%) therefore, this province has more potential to have a high level of competitiveness in the field of fishing and aquaculture than brackish water cultivation. Increasing level of competitiveness of brackish water cultivation in Riau Islands can be caused because the activity of opening mangrove forests to be the location of ponds has begun to be done [10]. While the drastic decrease in the level of competitiveness is due to the use of more land used as a settlement compared to the expansion of brackish water fish farming areas, for example the rate of population growth in Bintan Island, the largest island in Riau Islands reaches an average of 4.5% annually, the number of residents who increase quite sharply increases the need for land to meet the needs of life. In addition, coastal land in this region is also widely utilized other sectors besides fisheries, such as bauxite mining, charcoal manufacturing industry, plantations to tourism so that the competitiveness of brackish water cultivation in Riau Islands is classified as the lowest in Indonesia.

3.2 Competitiveness Profile Based on Human Resource Indicators

The province with the highest competitiveness category of brackish water cultivation in Indonesia in the human resources indicator is South Sulawesi with a score (19.48), has a total of RTP as many as 48,862 and the number of farmers as many as 147,403 people. This can happen because of the establishment of good cooperation between farmers because in this region there are four types of partnership patterns, especially in the activities of windu shrimp cultivation namely: business patterns of farmers with groups of farmers, patterns of cooperation of feed companies with farmers, patterns of partnerships plasma core, and business patterns without activities [11].

Contrast to the position of competitiveness of West Sumatra province in the indicator of human resources is the lowest score (0.02) because as previously mentioned, the coastal area of West Sumatra is more used for tourism zones, port zones, mangrove forest zones, as for cultivation activities but the main priority is the cultivation of floating net caramba. So it can be concluded if the human resources for brackish water cultivation in West Sumatra is very low because the community is widely divided for other sectors because it does not make brackish water cultivation activities as a top priority.

3.2.1 Competitiveness profile based on facilities and infrastructure Indicators

Ranked one level of competitiveness of brackish water cultivation in Indonesia based on indicators of facilities and infrastructure occupied by South Sulawesi. The successful cultivation of windu shrimp in ponds in the early 1990s was the cause of the increase in pond area in South Sulawesi Province. The conversion of rice fields into ponds is widely done with consideration of the occurrence of income as a brackish water cultivation [12]. Another cause that encourages the opening of ponds in this province is the suitability of land that supports for the process of cultivation activities. In contrast to the province of West Sumatra with the lowest competitive position in the category of indicators of facilities and infrastructure, this is triggered because the coastal area of West Sumatra is more used for other sectors than the fishery sector, especially brackish water cultivation. Another factor that can be a trigger is the current existence of ponds increasingly threatened by sea abrasion, mangrove land is shrinking due to the insistence of settlements.

In contrast to the province of West Sumatra with the lowest competitive position in the category of facilities and infrastructure indicators (Fig. 3), this is triggered because the coastal areas of West Sumatra are more used for sectors other than brackish water aquaculture. Another factor that can be a trigger is that currently the existence of ponds is increasingly threatened by sea abrasion, mangrove land is increasingly shrinking due to pressure from population settlements so that the competitiveness in pond cultivation activities in this province is the lowest in Indonesia.

3.2.2 Competitiveness profile based on production indicators and production value

Production resulting from brackish water cultivation activities in South Sulawesi Province in 2017 reached 1,258,649 tons, with a production value of 6,033,843,927,000 rupiah, the number one largest in Indonesia. The quality of seaweed from the North east coast of South Sulawesi province is one of the best in

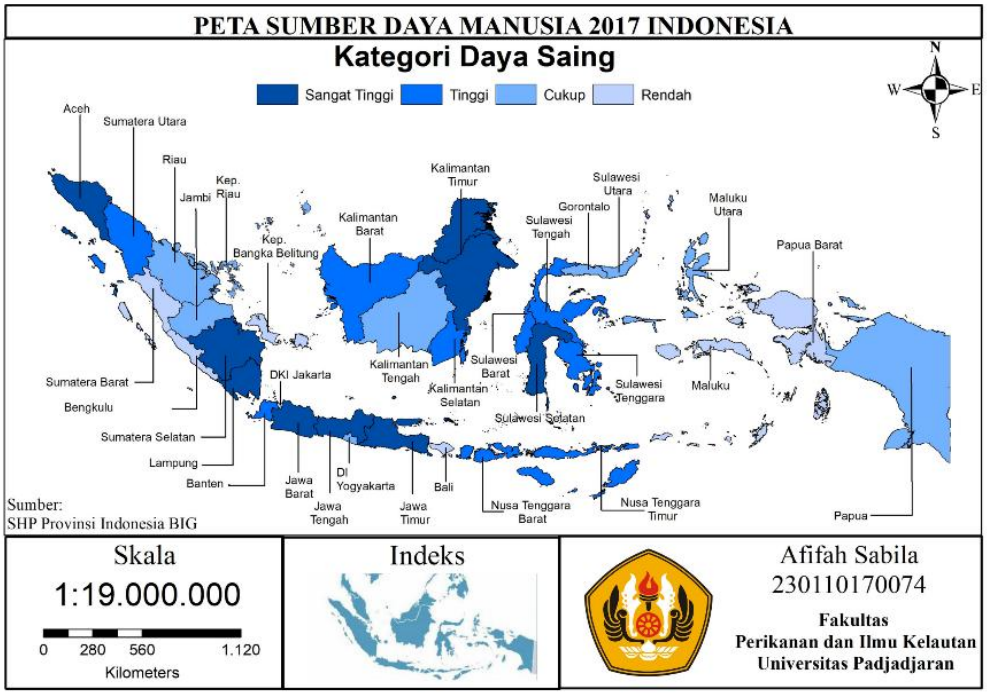

Fig. 2. Map of the Competitiveness Profile of Brackish Water Aquaculture Based on Human Resources Indicators (2017)

Fig. 3. Map of the Competitiveness Profile of Brackish Water Aquacultur Based On Facilities and Infrastructure Indicators (2017)

Indonesia. In addition, South Sulawesi is one of the provinces that became the center of seaweed development in Indonesia. Efforts to determine the production centers of seaweed cultivation in ponds have also been conducted in the province to strengthen the contribution of South Sulawesi as a seaweed producer and the largest export contributor in Indonesia. The risk factors that affect the production of aquaculture are divided into two, namely controlled risk factors (production inputs) and uncontrolled risk factors (season, disease, and quality of human resources) [13].

Provinces with lowest production competitiveness position in Indonesia is Riau Islands (Fig. 4), this is due to pond activities by opening mangrove forests have not been done much, in cultivation activities in general people more often use cages. The potential of fishing catch in Riau Islands Province is greater than that of aquaculture fisheries seen from the difference in the tendency of catch fishery production with aquaculture fisheries. Fishing increased from 23,432.00 tons (in 2006) to 25,758.60 tons (in 2008). While aquaculture fisheries experienced a very drastic decrease, namely from 18,955.91 tons to 456.00 tons.

3.2.3 Competitiveness profile based on science and technology indicators

Bengkulu Province occupies the highest competitive position in science and technology indicators (Fig. 5). High productivity can be caused by the amount of production obtained by the area of land as a medium that is not too wide, in addition to the leading commodities cultivated in Bengkulu is shrimp vannamei with a type of intensive cultivation activities. The high selling value of commodities can also be a factor in the high productivity score of Bengkulu in brackish water fish farming activities [14]. The province with the lowest competitiveness position in the category of science and technology is Riau Islands, as explained in previous indicators that the province prioritizes fishing activities over brackish water fish farming activities. It can also be caused by low life success and growth and production instability as a result of declining environmental quality, disease outbreaks, mismanagement of aquatic environments and the application of aquaculture technology.

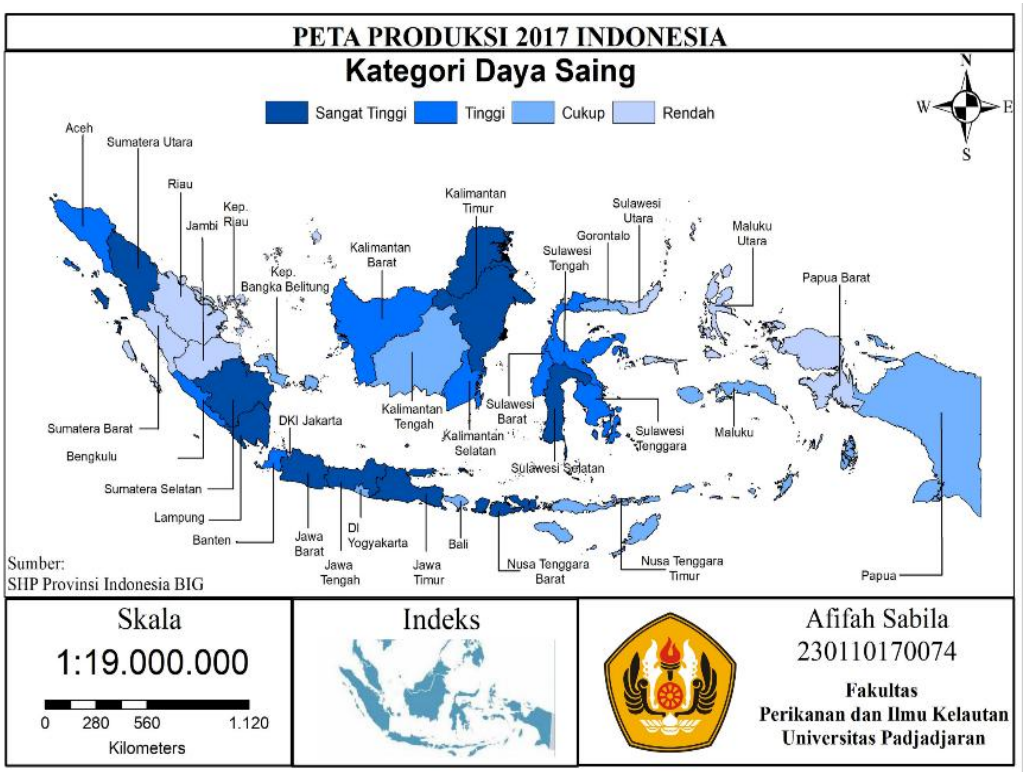

Fig. 4. Map of the Competitiveness Profile of Brackish Water Aquaculture Based On Production and Production Value Indicators (2017)

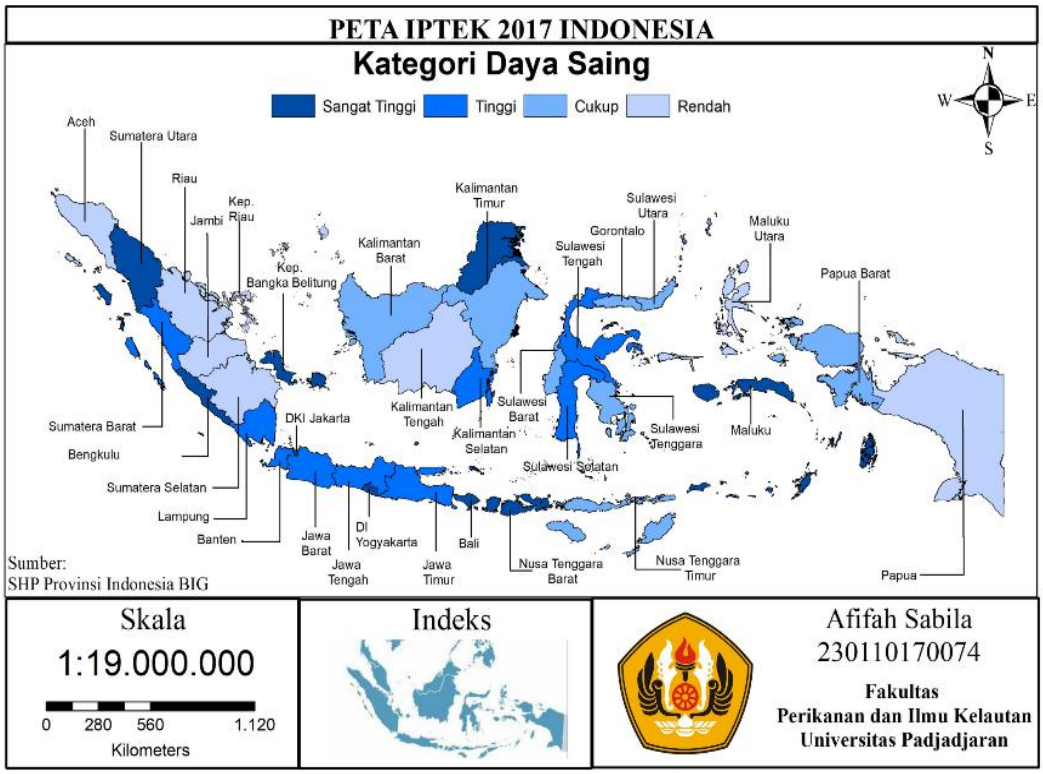

Fig. 5. Map of the Competitiveness Profile of Brackish Water Aquaculture Based on Science and Technology Indicators (2017)

3.3 Policy Strategies

Some strategies that can be done to improve the competitiveness development of the brackish water cultivation sector include:

1. Developing human resources in this case are brackish water farmers by increasing their knowledge of sustainable cultivation activities by means of counseling, building special training centers for aquaculture activities in high-potential areas and improving their education by building accredited schools.
2. Establish strict and clear rules regarding the suitability of brackish water cultivation land by adjusting the characteristics of each province region with the requirements needed to be able to conduct cultivation activities.
3. Provide assistance to brackish water farmers such as capital assistance, superior seeds, feed, fertilizers, and pesticides. This will improve production efficiency technically by minimizing the use of inputs so that it will produce maximum output.
4. Pay attention to the *cost benefit ratio* of farmers by facilitating all aspects needed during brackish water cultivation activities, such as equalization of prices for the production needs of western and eastern regions of Indonesia.
5. Make the planting season strategy as an aspect of production success.
6. Determination of the price of the results of fish cultivation of brackish water is rational so that the income of the farmers can be guaranteed.
7. Institutional strengthening through farmer groups. With the strengthening of this development, it is expected that the farmers have a wider connection so as to facilitate in terms of capital.

4. CONCLUSION

South Sulawesi province occupies the category of competitiveness of brackish water aquaculture are very high with a final value of 17.03. The province outperforms three categories of indicators at once, namely human resources, facilities and infrastructure and production, but its

productivity position is still below other provinces. Riau Islands ranked bottom (33th) on two main indicators of production and productivity. Other indicators are only slightly better which can only reach the 27th rank in the human resources indicator and the 32nd rank in the facilities and infrastructure indicators.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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