Technical and economic productivity of seaweed farming labor in South Konawe Regency, Indonesia

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Abstract. This research aimed to estimate seaweed farming labor's technical and economic productivity in the South Konawe Regency. The study was carried out in the South Konawe Regency in 2020. There were 221 samples involved in the study, chosen using the Simple Random Sampling technique. Both primary and secondary data were utilized as the sources of research data. Meanwhile, the data collection was carried out using direct interviews and literature studies. In this case, the research variables studied were production, working hours, working days, and number of labor. The data obtained were further analyzed through the labor productivity analysis consisting of labor technical productivity and labor economy productivity. The findings revealed that the average technical productivity of seaweed farming labor in South Konawe Regency was 151 kg/working day, while its average economic productivity was IDR 30,712/working day.
Key Words: farmer, labor, production, seaweed, South Konawe Regency.

Introduction. Seaweed is one of the leading commodities in the South Konawe Regency, which has the potential to increase the regional economy. The production value of seaweed in the South Konawe Regency was IDR 192 billion in 2019 and grew to IDR 214.3 billion in 2020 but experienced a decrease during the Covid 19 pandemic in 2021 to IDR 167.7 billion (BPS Kabupaten Konawe Selatan 2021). Furthermore, according to Nuryadi et al (2017), Limi et al (2018), Muthalib et al (2019), Kepel et al (2020), Nababan et al (2020), Nuryadi et al (2020), and Rosmawaty et al (2020), seaweed can still be found and feasible for cultivation even during the dry season and environmental conditions that do not support the growth of seaweed, thus seaweed cultivation still exists in South Konawe Regency.

Farmers are currently carrying out seaweed cultivation only to maintain a sustainable seaweed production system through an environmental approach and only hope for a natural increase in productivity to support seaweed production to overcome production targets, maintain price stability, and increase seaweed stocks as raw material by ignoring sustainable economic and social dimensions (Delaney et al 2016; Bak et al 2020; Nuryadi et al 2020; Pereira et al 2020; Purnomo et al 2020; Sutinah et al 2020; Pereira et al 2021).

Based on the social indicators, 51% of the current investment capital for seaweed farming came from the farmers' money that uses both male and female labor, assisted by the son or daughter during production. In this case, the labor employed and expects an even distribution of income because both male and female labors have the same role in the cultivation to increase the seaweed production and quality. On the other hand, labor is the primary source of production costs in seaweed cultivation that must be minimized by the farmers when the demand for agricultural labor is still high (De La Torre-Castro et al 2017; Fitriana 2017; Cuaton 2019; Shafitri et al 2019; Pereira et al 2020; Pereira et al 2021; Rimmer et al 2021).

According to Zulham et al (2018), since the demand for seaweed is still very high, seaweed farmers need to expand their cultivation area so that seaweed cultivation

activities also require additional labor starting from land preparation, planting, to harvesting. Therefore, it is not effective and efficient if done by the farmers themselves as owners without labor in supporting the management of seaweed farming so that farmers expect an increase in labor productivity to increase the production (Utami et al 2015; Ariwijaya 2018; Cuaton 2019; Shafitri et al 2019). On the other hand, the management of seaweed farming in South Konawe Regency is not optimal in increasing the production due to the distribution of labor that is not optimal. According to Ariwijaya (2018), the low seaweed production is due to the limited production factors owned by farmers, one of which is optimizing the distribution of labor.

According to Asri et al (2021), labor greatly contributes to seaweed farming. Labor productivity on seaweed farming in South Konawe Regency is an illustration of the effectiveness of the distribution of labor with the amount of seaweed production as well as an illustration of the suitability of wages earned by the labor with the amount of work given to the seaweed production. Therefore, the purpose of this study was to find out how the technical and economic productivity of seaweed farming labors in South Konawe Regency.

Material and Method. The current study was carried out in the South Konawe Regency in 2020. There were 221 persons involved as the research samples who were selected through simple random sampling technique. Both primary and secondary data were utilized as the sources of research data. In this case, the data were collected using direct interviews and literature studies. Meanwhile, the research variables studied were the production, labor pay, and labor outpouring. Furthermore, the data collected were analyzed using the labor productivity analysis which consists of technical productivity and economic productivity (Tatipikalawan 2012), as explained below:

- Technical Productivity of Labor: is the ratio between the amount of seaweed harvested and the amount of labor time spent in one production process. This ratio is mathematically formulated as follows:

$$\text{Technical Productivity} = \frac{\text{Total Harvest (Kg)}}{\text{Outpouring of Labor (Working Day)}}$$

- Economic Productivity of Labor: is the ratio between labor wages in seaweed farming and the amount of labor time spent in one production process. This ratio is mathematically formulated as follows:

$$\text{Economical Productivity} = \frac{\text{Wages (IDR)}}{\text{Outpouring of Labor (Working Day)}}$$

Results and Discussion

Respondent identity. In this case, the respondent's identity was described in terms of the age, education level, number of family dependents, and experience in seaweed farming in the South Konawe Regency. The discussion regarding the identity of the respondents is explained based on the following sections.

Age. According to BPS Kabupaten Konawe Selatan (2021), age is categorized into three, those are the age of 0-14 years which are categorized as the unproductive age, the age of 15-64 years old which are categorized as the productive age, and the age of above 64 years old which are categorized as the hopeless age. Table 1 demonstrates that farmers of productive age dominate the seaweed farming in South Konawe Regency, accounting for 210 persons or 95.02% of the total responses. This implies that farmers backed up the most seaweed farmers in the South Konawe Regency with strong physical abilities who quickly adapted to changes in the seaweed farming industry. Furthermore, according to Nuryadi et al (2019), the development of seaweed agribusiness in the South Konawe Regency was constrained by the age of the farmers who were already aging. The farmers' mindset and physical abilities also began to decline. This follows the opinion of Tuwo (2011), which explains that age is one of the variables that significantly determines a

person's mindset and physical abilities in a business. In addition, Soeharjo & Patong (1972) stated that that quality of human resources can be seen from the productive age.

Level of education. According to Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional (2003), formal education is a structured and tiered educational path consisting of primary education, secondary education, and higher education. Primary education is in the form of Elementary School (basic education) or its equivalent and Junior High School (middle education). Meanwhile, the secondary education is in the form of Senior High School (higher education) or its equivalent. Furthermore, Higher Education is the education level that follows the secondary education and includes the education of diploma, undergraduate, master, post-graduate supported by university. Table 1 demonstrates that farmers with primary education dominated the seaweed farming in South Konawe Regency, accounting for 163 persons or 73.75% of the total responses. Following the study results, previous research (Aslan et al 2015) also found that seaweed farmers commonly had an elementary school education level. The educational condition of seaweed farmers can be interpreted that there were still many seaweed farmers in South Konawe Regency who had not taken formal education up to the level of secondary education (Higher Education) or at the level of higher education (Aslan et al 2015). In this case, the most common sources of knowledge on seaweed cultivation came from the family members (family traditions), other farmers and related group activities, extension workers, and government-sponsored training courses. According to Nuryadi et al (2019), due to the poor level of farmer education in the South Konawe Regency, training or technical counseling on seaweed farming management needs to be provided in order to alter the mentality and boost the understanding of seaweed farmers. This would further stimulate the improvement of farmer families' economies.

The number of family dependents. The dependents of the family referred to in this study are the family members who live in the same house and fulfill their daily needs in one management unit. According to Elmanora et al (2012), a small household consists of less than or equal to 4 people, a medium household consists of 5 to 6 people, and a large household consists of more than or equal to 7 people. Table 1 demonstrates that tiny families with fewer than or equal to four family dependents account for 204 persons or 92.30% of the total seaweed farming respondents in the South Konawe Regency. This follows the results of the previous study (Limi et al 2018) where the number of dependents of seaweed farmer households was four people. This means that seaweed farmers must have the ability and skills to generate added value to increase the family income.

Farming experience. According to Soeharjo & Patong (1972), farming experience is categorized into three groups based on the following criteria, namely less experienced (< 5 years), quite experienced (5-10 years), and experienced (> 10 years). According to the study results, Table 1 shows that quite experienced farmers dominated the seaweed farming in Konawe Selatan Regency by 137 people or 61.99% of the total respondents. Previous research (Aslan et al 2015) further reported that seaweed farmers generally had an average seaweed farming experience of 5.9 years. This means that, in general, seaweed farmers in South Konawe Regency knew seaweed farming management based on their previous experience. However, learning and training activities that support the understanding of farmers to hone the mindset and knowledge of farmers in organizing seaweed farming activities in the South Konawe Regency are still necessary.

Table 1

Identity of seaweed farming respondents in South Konawe Regency

No.	Respondent identity	Number (people)	Percentage (%)
1	Age (years)		
	Productive (15-64)	210	95.02
	Not productive (> 64)	11	4.98
2	Level of education		
	Elementary School (basic education)	163	73.75
	Junior High School (middle education)	57	25.79
	Senior High School (higher education)	1	0.45
3	Family dependents (persons)		
	Small household (< 4)	204	92.30
	Medium household (5-6)	15	6.80
	Large household (> 7)	2	0.90
4	Farming experience (years)		
	Less experienced (< 5)	59	26.69
	Quite experienced (5-10)	137	61.99
	Experienced (> 10)	25	11.31

Source: Primary data processed, 2020.

Production and use of labor inputs. According to Valderrama et al (2015), Campbell et al (2019), Geo et al (2020), and Rimmer et al (2021), seaweed cultivation is suitable for small-scale seaweed farming because, economically, it is still profitable and considered to have low risk. In addition, the need for labor in seaweed farming is relatively low so that at the same time it allows seaweed farmers to have other livelihoods. However, traditional seaweed cultivation that is managed and located near a sheltered coast requires a lot of labor (Bak et al 2020). The use of labor input in seaweed farming activities in the South Konawe Regency had an essential role in increasing production. This is following the opinion of Tuwo (2011) that through a proportional labor input, it is expected that the production process will be more optimal and increased. The considerable quantity of work utilized in each kind of activity in the seaweed farming production process includes tying seeds, cleaning the ropes, and harvesting, reflects labor usage in seaweed farming in the South Konawe Regency. According to Utami et al (2015), the distribution of labor is the time spent by the labor on a specific business activity. The following parts discuss the quantity of output and labor inputs in seaweed farming in South Konawe Regency.

Production. Production is an activity to change inputs into outputs. These production activities include any work that creates or adds value and use to a product or service (Sugiarto et al 2007). Furthermore, according to Yusriadin (2019) the production process, especially in seaweed farming, is an activity to manage inputs for seaweed farming which aims to produce output, indicated by a large amount of dried seaweed made. A large amount of dry seaweed production obtained by farmers in one growing season results from the management of various farming inputs ranging from ropes, nets, tarpaulins, buoys, boats, seeds, fuel, labor, and farm construction land (Limi et al 2018). An overview of the amount of seaweed production in the South Konawe Regency can be seen in Table 2 and Figure 1.

Table 2

Seaweed production in South Konawe Regency

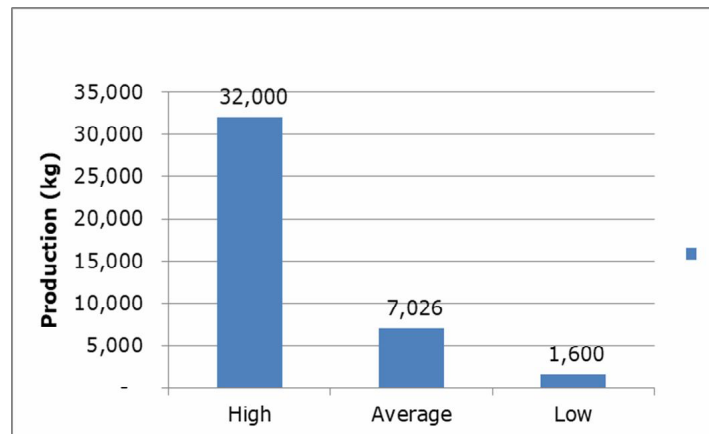| No.	Description	Production (kg)
1	Tall	32,000
2	Average	7,026
3	Low	1,600

Source: Primary data processed, 2020.

Figure 1. Seaweed production in South Konawe Regency.

Table 2 shows that the highest seaweed production in South Konawe Regency was 32,000 kg. This was due to the large number of stretch ropes used by farmers, namely 1,000 ropes, compared to the lowest production of 1,600 kg, which only used 50 ropes. In comparison, the seaweed farmers' average production in South Konawe Regency was 7,026, with a moderate rope used as much as 220. So it can be concluded that one of the factors that affected the seaweed farming production was the large number of ropes used by farmers and the size of the construction area of seaweed farming. This means that the use of the number of ropes affected the increase or decrease of the amount of production in seaweed farming in South Konawe Regency. This is supported by Budiyanto et al (2019), who claimed that the amount of ropes had a beneficial and considerable impact on seaweed farming output. Thus, it can be concluded that in order to increase the productivity of seaweed farming, farmers must increase the number of ropes per unit area with the number of seeds per ropes according to the standard. In this case, it is stated that one unit of seaweed cultivation with a long line system measuring 10 x 10 m^2 = 1000 m^2 requires 240 kg of seeds or 1 ha area needs 2400 kg of seeds (WWF-Indonesia 2014).

Labor wages. Labor is one of the production factors that has an essential role in the production process, thus it needs to be considered from the availability of labor as well, instead of only the quality and type of labor (Soekartawi 2003). One of the factors that influence the use of labor input is wages. Wages are remuneration in the form of money received by labors. It is explained by Salim et al (2019) that the level of wages influences the use of labor. There are three main activities in seaweed farming in the South Konawe Regency that use labor as a supporting factor in the production process with a wage system, including activities of tying seeds, cleaning ropes, and harvesting. In this case, the role of non-family workers with comprehensive basic skills is very important in this activity to reduce losses (Aslan et al 2015; Delaney et al 2016; Fitriana 2017). An overview of the wages of seaweed farming labor in the South Konawe Regency can be seen in Table 3 and Figure 2.

Table 3

Labor wages by type of activities in seaweed farming in South Konawe Regency

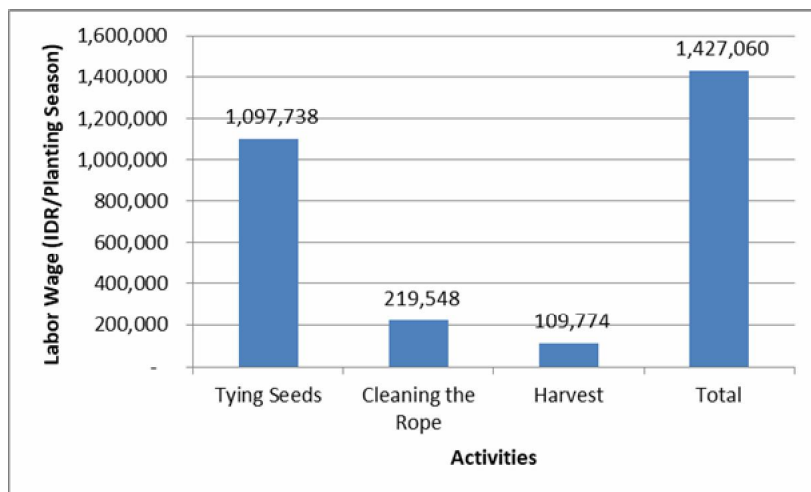| No.	Activity	Labor wages (IDR/planting season)
1	Tying the seeds	1,097,738
2	Cleaning the rope	219,548
3	Harvesting	109,774
	Total	1,427,060

Source: Primary data processed, 2020.

Figure 2. Labor wages by type of activities in seaweed farming in South Konawe Regency.

Table 3 shows that the total wage for labor in three seaweed farming activities in South Konawe Regency, namely tying seeds, cleaning ropes, and harvesting was IDR 1,427,060/planting season. The wages of these workers are lower compared to Kendari city minimum wage (UMK) in 2021, which was IDR2,768,592/month, as well as the provincial minimum wage (UMP) of the Southeast Sulawesi Provincial government that has been set based on (Surat Edaran Gubernur Sulawesi Tenggara Nomor 561/5209 Tahun 2020 Tentang Penetapan Nilai Upah Minimum Tahun 2021 Pada Masa Pandemi Covid-19, 2020) which was IDR 2,552,014/month. However, the labor wages in seaweed farming in the South Konawe Regency were higher than the results of research conducted previously by Lagaronda (2016). Lagaronda (2016) obtained that the labor wages in seaweed farming with a rope of 100 meters were IDR 1,155,714,68/per planting season.

Based on the study results, it was shown that among the three activities that used labor, tying seeds is an activity in seaweed farming in South Konawe Regency with the highest labor wage of IDR 1,097,738/planting season. This is because the wages of labor for tying seeds were IDR 5,000/rope, which were higher than the wages of workers for cleaning ropes of IDR 1,000/rope and harvesting of IDR 500/rope.

Labor distribution. The distribution of labor in seaweed farming is the time labor spent in a seaweed farming activity. The amount of work in the study was measured using working day units. There are three main activities in seaweed farming in South Konawe Regency, namely tying seeds, cleaning ropes, and harvesting. All of these activities employed non-family workers (Aslan et al 2015). An overview of the labor distribution of seaweed farming in the South Konawe Regency can be seen in Table 4 and Figure 3.

Table 4

The distribution of Seaweed Farming Labor in South Konawe Regency

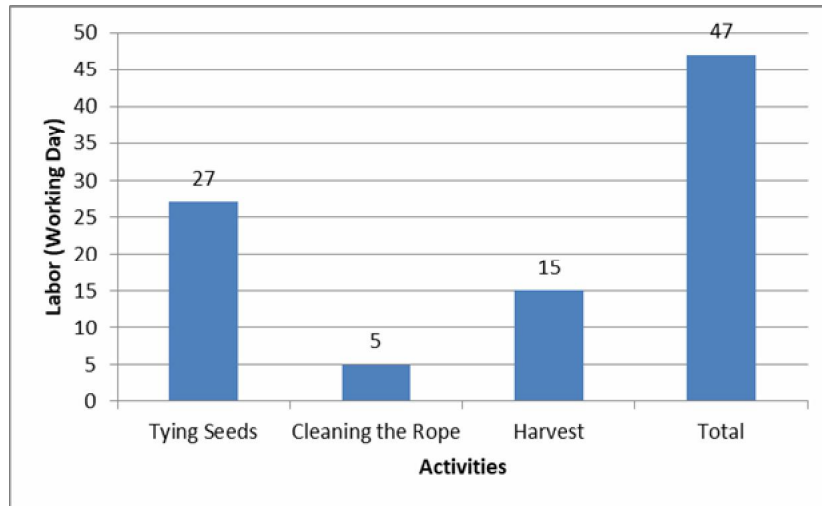| No.	Activity	Outpouring of labor (working day)
1	Tying seeds	27
2	Cleaning the rope	5
3	Harvesting	15
	Total	47

Source: Primary data processed, 2020.

Figure 3. The distribution of labor for seaweed farming in South Konawe Regency.

Table 4 shows that the average labor distribution for seaweed farming in Konawe Selatan Regency was 47 working days. This distribution of labor was relatively higher compared to the previous research results of Ariwijaya (2018), which explained that the labor distribution for seaweed farming activities in Liang District was 18 working days. In this case, the optimal use of labor can increase production. In addition, according to Aslan et al (2015), the use of non-family workers in seaweed farming in Southeast Sulawesi ranged from 3 to 15 workers. This supports the opinion of Mubyarto (1995), that every reduction in labor means a decrease in output. Therefore, based on these conditions, the influence of work on seaweed farming production is huge (Asri et al 2021).

Labor productivity. Labor productivity in seaweed farming illustrates the effectiveness of the distribution of labor on the amount of output obtained and the suitability of wages earned by labor in seaweed farming on the distribution of labor during the production process. According to Tatipikalawan (2012), it was explained that labor productivity consisted of technical productivity, namely the comparison between harvest and the amount of labor time spent in a period in working day units, and economic productivity, namely the comparison between wages earned with the distribution of working time in operating day units. An overview of the labor productivity of seaweed farming in the South Konawe Regency can be seen in Table 5 and Figure 4.
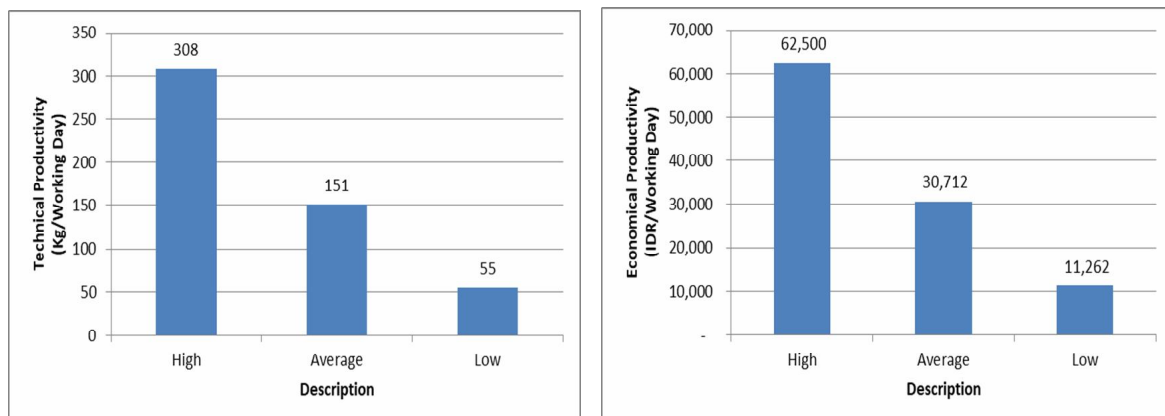

Figure 4. Technical (left) and economic (right) productivity of seaweed farming labor in Indonesia South Konawe Regency.

Table 5
Labor productivity of seaweed farming in South Konawe Regency

No.	Description	Technical productivity (kg/working day)	Economic productivity (IDR/working day)
1	High	308	62,500
2	Average	151	30,712
3	Low	55	11,262

Source: Primary data processed, 2020.

Table 5 shows that the technical productivity of seaweed farming labor in Konawe Selatan Regency was on the average of 151 kg/working day. This indicates that the use of labor in seaweed farming activities for 1 working day produced 151 kg. This shows that the distribution of labor in seaweed farming affected the production because the basic skills possessed by farmers can reduce errors in the cultivation and post-harvest processes that can cause losses. This condition was in line with the previous study results of Fitriana (2017) and Ariwijaya (2018), that both labor and comprehensive farmer skills had vast effect on seaweed production in order to reduce production post-harvest losses. In comparison, the economic productivity of seaweed farming labor in South Konawe Regency was IDR 30,712/working day. This indicated that the use of labor in seaweed farming for 1 working day required a labor wage of IDR 30,712. This labor wage was lower than the average wage of processing seaweed into carrageenan flour which was IDR 36,000/working day (Ngamel 2012).

Conclusions. Based on the study results, it can be concluded that the technical productivity of seaweed farming labor in South Konawe Regency is on the average of 151 kg/working day. In contrast, the economic productivity of seaweed farming in the South Konawe Regency is on the average of IDR 30,712/working day. Therefore, it is necessary to have good labor-management so that it can increase the labor productivity, both technical productivity of labor and economic productivity of work, especially in seaweed farming in South Konawe Regency.

Conflict of interest. The authors declare that there is no conflict of interest.

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