Increasing Sorghum Production on Marginal Land in the Framework of Food Procurement Post-Covid-19 Pandemic

Muhammad Hazmi [1*], Iskandar Umarie[1], Hidayah Murtiyaningsih [1], Laras Sekar Arum [1*]

[1]*Program Studi Agroteknologi, Fakultas Pertanian, Universitas Muhammadiyah Jember*
[*]*Corresponding author. Email: mhazmi.hazmi@gmail.com*

ABSTRACT
The Covid-19 outbreak has been going on for more than a year in Indonesia, causing many people to die and lowering the economic level of the community. People's income and food availability decreased. The procurement of staple foods has always relied on the production of rice and corn. Sorghum is a cereal crop that has the potential to increase the availability of staple foods and can produce well on marginal land, so as not to reduce the area of rice and corn planted. Chemically, sorghum seeds are very likely to be able to substitute or complement the use of materials derived from rice, corn, and wheat. Sorghum is also potential to be used as industrial raw material. Sorghum stalks can produce sap as raw material for bioethanol. Sorghum leaves can be used as fodder for ruminants. Sorghum seeds can be used as a staple food for humans, poultry feed, can be used as flour, bread, snacks. In many countries, except in Africa, India, and America, Sorghum is less attractive to farmers than rice, corn, and wheat. The superiority of Sorghum needs to be socialized more intensively to the community so that farmers are interested in planting it and people like to consume it. The development of sorghum cultivation will reduce dependence on rice, corn, and wheat as well as make sorghum an important economic commodity.

Keywords: *Increase, production, Sorghum, marginal land.*

1. INTRODUCTION

The Covid-19 outbreak began to spread in Indonesia since the beginning of 2020, causing 3,331,206 people to be exposed and 90,552 people died [1]. The Covid-19 pandemic, in addition to causing human casualties, also has a negative impact on all life activities, such as education, offices, transportation, tourism, trade, and the economy. In the first semester of the pandemic, the Director General of Taxes at the Ministry of Finance warned that this epidemic will have three major impacts on the Indonesian economy, namely: 1) A deep decline in household purchasing power and consumption, which has so far supported 60% of economic transactions. 2) Generating prolonged uncertainty so that investment will also weaken and have implications for the cessation of business. 3) The whole world experienced a weakening economy, causing commodity prices to fall and Indonesia's exports to several countries also stalled [2]. This situation triggers a food crisis which is usually overcome by imports of food. To reduce imports of food sources of carbohydrates, it is necessary to immediately empower the potential for local food production to complement rice and corn production.

Anticipating the possibility of a severe food crisis, the government and the community will try to secure the availability of the main food ingredients, namely carbohydrates. The COVID-19 pandemic affected the availability of family food, reduced family income, and caused 92.6% of respondent families to choose to focus on fulfilling carbohydrate needs from other types of needs [3]. The main sources of carbohydrates in Indonesia are rice, corn and wheat. Procurement of rice and corn in Indonesia is difficult to fulfill together from within the country, because both are planted intensively alternately on the same land, meanwhile wheat is almost completely imported. Before the food crisis gets worse, it is necessary to increase the production of alternative sources of carbohydrates that

can complement and even substitute some of the functions of rice, corn, and wheat.

Sorghum (*Sorghum bicolor* (L.) Moench) is a cereal crop that can be relied upon to complement the uses of rice, corn, and wheat. Sorghum is known to have been cultivated in Indonesia since 1970 with the planting area covering the islands of Java, South Sulawesi, Southeast Sulawesi, West Nusa Tenggara (NTB) and East Nusa Tenggara (NTT) until now [4]. Sorghum production in Indonesia is still very limited when compared to rice and corn. On the other hand, sorghum has the potential to substitute various functions for rice, corn, and wheat. The low production of sorghum in Indonesia is caused by the limited planting area in a few areas and low consumer demand, so that it is less attractive to farmers to plant sorghum. This paper briefly describes the need to increase the production of sorghum in Indonesia, because its nutritional content is equivalent to that of rice, corn, and wheat, agronomically easy to cultivate, economically very profitable, and socially well-known by the public.

2. THE DILEMMA OF AVAILABILITY OF CEREALS PRODUCTS IN INDONESIA

The dominant cereal crops grown in Indonesia are rice and corn. Most of the rice and corn crops and even other seasonal crops are planted intensively alternately on the same land. As a result, during the rice harvest season, there will be a shortage of corn supply, and vice versa. Rice and corn, especially on the island of Java, are difficult to plant in the same season, because the area of land managed by farmers is small.

Other cereal crops in Indonesia that are grown on a limited basis are sorghum and wheat. Sorghum has actually become a people's crop, especially in marginal dry land, such as in a small part of West Java, Central Java, and East Java as well as in East Nusa Tenggara and West Nusa Tenggara. Consumer demand for sorghum seeds in Indonesia is still very limited compared to rice and corn, so farmers are not interested in growing sorghum as the main crop. This causes sorghum production in Indonesia to stagnate compared to rice and corn.

Another cereal crop that is much needed by the Indonesian people is flour with a variety of downstream products, namely wheat. Wheat is a staple food for the people of Europe, America, Australia, parts of Africa. In general, wheat is widely grown in subtropical regions with four seasons, although there is also wheat grown in hot climates such as Africa and India. Wheat is planted once a year, as in Europe it is mostly planted in early spring and harvested in summer. Wheat cultivation in Indonesia is still very limited and managed by certain companies for the benefit of industrial raw materials.

Wheat as an ingredient in wheat flour is an international trade commodity. In Indonesia, wheat flour consumption is very high, both on an industrial and household scale. Many types of processed foods in Indonesia are based on wheat flour. This causes the consumption of wheat flour to be very high, on the other hand Indonesian farmers do not cultivate wheat. As a result, the procurement of wheat for the community is very dependent on imports [5 - 9] from abroad, especially from Australia. The data shows that Indonesia is not yet independent in the procurement of cereal products and is highly dependent on imports (Table 1).

Table 1 Imports of Cereals (Wheat, Rice, Corn) Indonesia in 2017-2021 (before and during the Covid-19 Pandemic).

Year / month		Cereal type (Net weight Kg)		
		Wheat	**Rice**	**Corn**
2017	May	1.144.182.600	23.286.390	57.352.164
	Cumulative	4.420.356.228	94.692.495	185.846.873
2018	May	866.805.808	346.978.953	65.025.175
	Cumulative	3.864.088.229	896.035.773	228.414.105
2019	May	1.013.737.508	41.716.908	67.251.666
	Cumulative	4.942.433.515	166.658.989	479.389.566
2020	May	628.070.316	37.030.094	81.147.490
	Cumulative	4.970.580.772	105.914.237	316.382.937
2021	May	661.733.915	53.258.295	35.646.962
	Cumulative	4.130.822.700	136.650.259	307.793.327

Sources: [5 - 9]

Table 1 shows that from 2017 to 2021, Indonesia imported wheat, rice and corn. Indonesia imports wheat is understandable, because Indonesia's wheat production is very small compared to its consumption. Facts show that Indonesia also imports rice and corn to meet the needs of consumers, both industrial and household, even though the cultivation of rice and corn is very intensive by most farmers. This situation is caused by various weaknesses in the development of cereal crops in Indonesia, such as: alternately planted on the same land, the area of land per farmer is narrow on average less than 1 hectare, harvesting one type will lack the other, planting intensity is very high and intensive, especially on the island of Java which resulted in a decrease in the organic matter content of the topsoil, has not been able to meet the consumption of wheat flour (wheat) except imports, has not maximized the potential of sorghum as an alternative substitute for other cereal products. Therefore, it is necessary to immediately improve the cultivation of cereals to reduce dependence on imports of wheat, rice, and corn. The most likely alternative is to optimize the function of sorghum as a substitute for wheat, rice, and corn.

3. POTENTIAL SORGUM

Sorghum is a cereal crop that has a lot of potential that is very valuable with a variety of product contributions it produces [10]. Parts of the sorghum plant, such as seeds, seed stalks, leaves, stems and roots, can be used as industrial raw materials. Seed stalks (panicles) can be used as material for making brooms or handicrafts. Sorghum seeds can be cooked as rice, porridge, and can be processed into flour which has the potential to substitute wheat flour (wheat) as an ingredient for making bread. Sorghum leaves are useful as animal feed for mammals and can also be used as organic fertilizer. Sap from sorghum stalks can be processed into syrup, sugar, bioethanol and others. Sorghum stalk dregs can be used as a mixture of planting media. The great potential of sorghum, especially its seeds, is supported by its chemical content [11] which is not much different from the chemical content of other cereal crops such as rice, corn, and wheat (Table 2).

Table 2 Nutrient composition of sorghum and other cereals

Cereal type	Protein (g)	Fat (g)	Crude fibre (g)	Carbohydrate (g)	Energy (kcal)	Calcium (mg)	Iron (mg)
Sorghum	**10.4**	**3.1**	**2.0**	**70.7**	**329**	**25**	**5.4**
Rice (Brown)	7.9	2.7	1.0	76.0	363	33	1.8
Wheat	11.6	2.0	2.0	71.0	348	30	3.5
Maize	9.2	4.6	2.8	73.0	358	26	2.7
Per Millet	11.8	4.8	2.3	67.0	363	42	11.0
Finger Millet	7.7	1.5	3.6	72.6	336	35	3.9

Source: [11]

Table 2 shows that the nutritional content of sorghum seeds contains higher protein than rice and corn and lower than wheat. The fat content is higher than rice and wheat and lower than corn. The crude fiber content is higher than rice, the same as wheat and lower than corn. The content of carbohydrates, energy, and calcium is lower than rice, wheat and corn. Sorghum has a higher iron content than rice, wheat, and corn. In general, it can be said that the nutritional content of sorghum is more or less equivalent to that of rice, wheat, and corn, so it has the potential to complement and even substitute for the function of rice, wheat and corn as a source of carbohydrates.

In Europe and Japan, the consumption of sorghum flour-based foods is increasing, mainly due to the increasing number of people experiencing celiac disease [12]. An increasing number of people are experiencing celiac disease, an autoimmune disease whose symptoms appear as a result of consuming wheat flour-based foods that contain gluten. Sorghum flour that does not contain gluten [11] is very prospective to be developed in a healthy diet.

Sorghum has good agronomic potential, so its cultivation management is easier when compared to rice, wheat, and corn. The minimal agronomic potential of sorghum includes:

1) Reliable to support national food diversification made from local food.

2) All parts of the plant have economic value.

3) Can substitute wheat flour and its processed products.

4) Sorghum is mature and can be harvested at the age of 80-110 days.

5) Sources of carbohydrates, foodstuffs, animal feed, and export commodities.

6) Sorghum is usually grown through seeds or stem cuttings.

7) Resistant to drought and inundation when compared to other secondary crops.

8) Optimum temperature 23-30 degrees C.

9) Relative humidity 20-40% and rainfall 375-425 mm.

10) Can grow on almost all soil types and pH 5.0-5.5.

11) Can grow well on marginal land, does not disturb land for rice and corn

12) The productivity of sorghum in Indonesia is around 4-6 tons/ha, there are even varieties that reach 10 tons/ha.

Sorghum also has economic potential because it can increase farmers' household income. In Gunungkidul Regency, which is famous for its dry, barren lands, sorghum contributes 2% of the total family income [12]. The contribution of sorghum was obtained from planting sorghum as a filler for the vacant land in the second dry season. Sorghum yields have not been processed to obtain higher added value products. Sorghum seeds are sold for bird feed, while the stems and leaves are partly used for animal feed and partly sold. This simple cultivation of sorghum generates farm income of IDR 2,754,794 per hectare and income of IDR 1,973,144 per hectare (Table 3).

Table 3 Revenue, costs and income of sorghum farming on marginal land in Gunungkidul Regency.

Component analysis	Per Farm (Rp.)	Per Hectare (Rp)
Total Revenue (a)		
Sorghum Seeds	236.800	1.480.000
Sorghum Stem	203.967	1.274.794
Total Cost (b)		
Seeds	6.450	40.313
Urea Fertilizer	16.500	103.125
TSP Fertilizer	4.767	29.794
Manure	16.480	103.000
Ponska Fertilizer	3.467	21.669
Others	4.567	28.544
Workers Outside the Family	72.833	455.206
Sorghum Farming Income (a-b)	**315.703**	**1.973.144**

Source: [13]

Table 3 shows the results of the analysis of the income of sorghum farming in Gunungkidul Regency. Even though it was carried out in a very simple way in the second dry season, it was able to contribute to the income of farming families. Of course, it is not easy to find types of plants that can be produced in extreme dry land such as in Gunungkidul Regency.

4. MARGINAL LAND POTENTIAL

Rice and maize farming in Indonesia is carried out on fertile land with good irrigation channels, meanwhile wheat is cultivated by a small number of companies to produce raw materials for their factory products. However, Indonesia still imports rice and corn, let alone wheat. The cereal crop that is most likely to be developed to reduce dependence on imports, especially wheat, is sorghum, because it has the same nutritional content and can grow well on marginal land, so it does not interfere with the intensity of rice and corn planting.

Marginal land is also called sub-optimal land (LSO) [14] is land that has low quality soil for plant growth and development, because there are several limiting factors. The limiting factors consist of land slope, parent material dominance, poor in nutrients and organic matter, low moisture content, pH that is too low or too high and drought. There may also be accumulation of metallic elements that are toxic to

plants. Marginal land area in Indonesia reaches 157,246,565 hectares and 91,904,643 hectares (58.4%) [15] can be used for food crop agriculture, especially sorghum.

Cultivation of sorghum on marginal land will be easier than other crops. Sorghum can grow well on dry land in Gunungkidul Regency [12]. Optimizing the function of marginal land is very important to increase the extensification of sorghum production. The increase in sorghum production will increase the reserves of local carbohydrate sources and is expected to reduce imports of wheat.

5. CONCLUSION

The COVID-19 outbreak is not yet certain when it will end, but the damaging effects have already occurred. It can be expected that it will greatly affect the food security of the community. Purchasing power declines, food prices may rise, foodstuffs may become scarce or insufficiently available. This makes it difficult to get basic food ingredients. On the other hand, dependence on imported carbohydrate sources is very high, especially wheat. Therefore, as early as possible there must be an effort to increase the availability of food ingredients as a good source of carbohydrates to overcome the impact of the Covid-19 outbreak while reducing imports of wheat.

Extensification of sorghum cultivation on marginal land is the best alternative to increase the availability of carbohydrate sources. Sorghum plants can produce well on marginal land, so as not to reduce the planting area of rice and corn. Indonesia still has around 60 million hectares of uncultivated marginal land. Increasing sorghum production on marginal land is the most likely solution to reduce the government's annual wheat imports.

ACKNOWLEDGMENTS

The author would like to thank the University of Muhammadiyah Jember which has facilitated this publication and all parties who have helped the smooth writing of this article.

REFERENCES

[1] Satgas Penanganan Covid-19, 2021. Kematian Covid-19 Indonesia Masih di Puncak Dunia. CNN Indonesia. Jumat, 30/07/2021 05:55 WIB. https://www.cnnindonesia.com/internasional/20210730015209-106-674075/kematian-covid-19-indonesia-masih-di-puncak-dunia

[2] Utomo S., 2020. Tiga Dampak Besar Pandemi Covid-19 bagi Ekonomi RI. Repuplika, 15 Juli 2020. https://republika.co.id/berita/qdgt5p383/tiga-dampak-besar-pandemi-covid19-bagi-ekonomi-ri

[3] Aisyah I. S., 2020. Ketahanan Pangan Keluarga di Masa Pandemi Covid 19. Jurnal Kesehatan Komunitas Indonesia, 16 (2): 179-189.

[4] Kementan, 2019. 2020 Kita Dorong Sorgum Jadi Pangan Alternatif. Kementerian Pertanian Republik Indonesia. https://www.pertanian.go.id/home/?show=news&act=view&id=3978#

[5] BPS, 2017. Buletin STATISTIK PERDAGANGAN LUAR NEGERI, IMPOR. Badan Pusat Statistik.

[6] BPS, 2018. Buletin STATISTIK PERDAGANGAN LUAR NEGERI, IMPOR. Badan Pusat Statistik.

[7] BPS, 2019. Buletin STATISTIK PERDAGANGAN LUAR NEGERI, IMPOR. Badan Pusat Statistik.

[8] BPS, 2020. Buletin STATISTIK PERDAGANGAN LUAR NEGERI, IMPOR. Badan Pusat Statistik.

[9] BPS, 2021. Buletin STATISTIK PERDAGANGAN LUAR NEGERI, IMPOR. Badan Pusat Statistik.

[10] Ananda G. K. S., H. Myrans, S. L. Norton, R. Gleadow, A. Furtado, and R. J. Henry, 2020. Wild Sorghum as a Promising Resource for Crop Improvement. Frontiers in Plant Science 11: 1-13

[11] Muui C.W., 2014. Identification and characterization of Sorghum (Sorghum bicolor (L.) Moench) landraces and improvement of on-farm seed production in Esatern Kenya. Ph.D. Thesis. Kenyatta University. Kenya.

[12] Nyoni N., Dube M., Bhebhe S., Sibanda B, Maphosa M., and Bombom A., 2020. Understanding biodiversity in sorghums to support the development of high value bio-based products in sub-Saharan Africa. Journal of Cereals and Oilseeds 11 (2): 37-43. DOI: 10.5897 / JCO2020.0217

[13] Gupito R.W., Irham, dan L. R. Waluyati, 2014.

Analisis Faktor-Faktor yang Mempengaruhi Pendapatan Usahatani Sorgum di Kabupaten Gunungkidul. Agro Ekonomi 24 (1): 66-75.

[14] Suharta N., 2010. Karakteristik dan Permasalahan Tanah Marginal dari Batuan Sedimen Masam di Kalimantan. Jurnal Litbang Pertanian 29 (4): 139-146.

[15] Sahabatpetani, 2018. Lahan Marginal Menyimpan Potensi Menunjang Ketahanan Pangan. http://sahabatpetani.com/2018/04/13/lahan-marginal-menyimpan-potensi-menunjang-ketahanan-pangan/