SORGHUM AS AN ALTERNATIVE FOOD SOLUTION, ANIMAL FEED, AND RENEWABLE ENERGY SOURCE IN NORTH SUMATRA

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Abstract

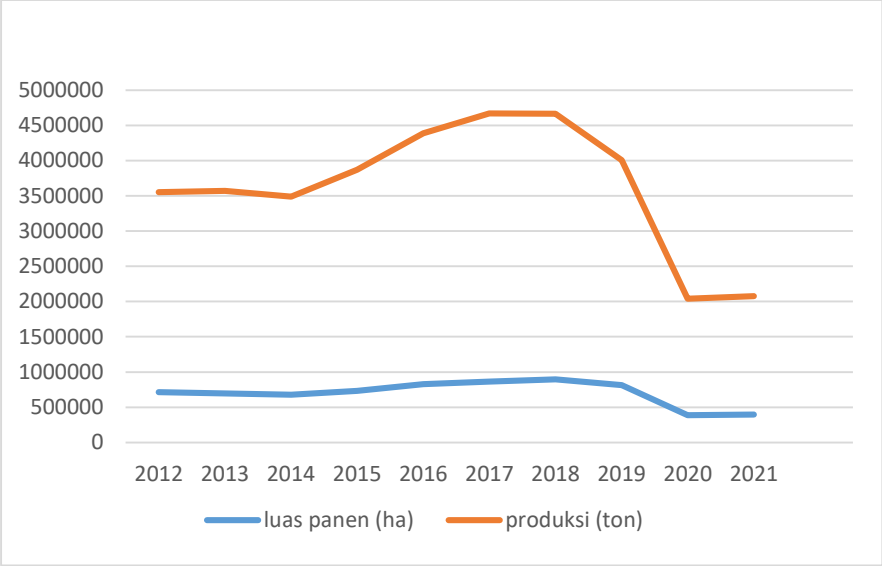
Indonesia is the country with the 3rd most population in Asia. The increasing population requires Indonesia to be able to meet its food needs without having to depend on other countries. Indonesia's consumption of animal protein is also still relatively low. How could it not be, many cattle breeders only use it as a source of labor for cultivating the land so they develop it only with what they have and eating from the existing wild grass. Population growth will of course also increase the use of energy sources which is getting higher and higher every year. The aim of this research is to find the right solution. The results of this research state that cultivating sorghum plants can be an alternative food solution, sorghum can be a substitute for rice, popcorn, flour and other derivatives. Sorghum can also be used as animal feed with its sweet taste which will be liked by cattle, goats or chickens, thus improving the quality of beef cattle, goats and broiler chickens. Sorghum can also be a renewable energy solution. Sorghum can be processed into a renewable alternative energy source to replace fuel in Indonesia, especially North Sumatra.

Keywords: Sorghum, Alternative Food Solution, Animal Feed, Renewable Energy Resource

1. Introduction

Indonesia is the country with the 3rd most population in Asia and the 1st most populous country in Southeast Asia, namely 278.11 million people. This means that Indonesia contributes around 5.85% of the total population of Asia. Indonesia's population is predicted to increase by 2.9 million per year. This figure is a higher figure than the increase in population in the world. The increase in population must be accompanied by an increase in food supply. However, seeing the amount of food production and land area continuing to decline which causes food imports is certainly an illustration of a problem that must be resolved and a solution is needed. An increase in food imports indicates weak food in an area.

According to data from the North Sumatra Central Statistics Agency (BPS) in 2020 figures, North Sumatra's rice production during the 2008-2019 period experienced an increase per year on average. In the last five years, paddy fields and paddy fields have increased. However, according to the 2022 BPS report, food crop production in North Sumatra shows a decline. The development of harvest area and food crop production in North Sumatra has tended to decline recently. This phenomenon will have an impact on food scarcity.



Source: Statistic Central Data (Processed Data by Researcher, 2023)

Figure 1.
Harvest Area and Rice Production in North Sumatra

Based on the description of the harvested area and the amount of rice production in North Sumatra, it shows that the land for rice crops tends to decrease. There was an increase in production and an increase in harvested area until 2018 but there was a decline until 2021. This decreasing phenomenon indicates a decline in the amount of food from North Sumatra, resulting in imports of Indonesian food from abroad. If imports continue, this shows that Indonesia is unable to overcome local food problems. How can a country be called developed if its food depends on foreign sources? There is a need for alternative solutions to fulfill local food supplies.

At the end of 2022, President Joko Widodo also emphasized that there would be a world economic recession, including Indonesia, and a food crisis in Indonesia would continue. Therefore, we need a solution to maintain local food sources. It is important to diversify food as an effort to encourage people to create variations in the types of food that can be consumed.

Khairani (2014) states that land conversion is widespread, development politics have no clear direction and are not integrated so that existing development is pragmatic, lack of government policy in promoting sustainable food crops for Indonesia, relatively low harvest periods, climate conditions, lack of public attention in paying attention to food consumed health in consuming food sources is also a food problem in North Sumatra. Responding to the Minister of Agriculture, Syahrul Yasin Limpo in 2022, who stated that there was a need to accelerate national food security with local feed, one of which was the development of sorghum as an alternative food source.

Apart from the food crisis, animal feed is also no less important. The reason is that until now the existing phenomenon is that cattle are often kept as a source of labor for cultivating land, savings for certain festive events, and not for beef cattle, and many actors or owners of cattle/livestock only develop livestock as is. This condition causes the livestock results obtained to be not optimal. Until now, most livestock farmers still depend on seasonal forages and the use of waste or by-products from agricultural crops. So there are still few human resources oriented towards producing livestock according to market demand. According to Puteri (2015), this problem requires exploratory efforts to obtain animal feed plants that have high productivity and are able to survive the land and climate conditions in Indonesia.

Population growth will of course also increase the use of energy sources which is getting higher and higher every year. So far we still rely on fossil energy sources which will one day run out and are non-renewable. Apart from taking a very long time, this energy also has a negative impact on the environment. There is a need for renewable

energy solutions that can be an alternative to replacing our previous energy sources so that we can strengthen the sustainability of our country without having to depend on other countries.

Based on this phenomenon, it is necessary to develop a solution as a local food ingredient that can be cultivated on dry land and has the potential to substitute the role of rice as a staple food or substitute the role of wheat/wheat flour as a raw material for processed food products. The research also looks at the potential of sorghum as a source of animal feed and the potential of sorghum as a renewable energy solution that can be developed in North Sumatra given the existing climate and soil conditions.

2. Literature Review

Moench (Andriani and Isnaini, 2013) Sorghum is a cereal plant that originates from East Africa and is widely cultivated in Southern Europe, North America, Central America and South Asia. The sorghum genus consists of 20 or 32 species, but the most widely cultivated is the Sorghum Bicolor (L) species.

Fitriyani, et al., (2019), Food is the most basic need for human life. According to Government Regulation of the Republic of Indonesia Number 17 of 2015 Food is everything from natural springs to agriculture, livestock, forests, fisheries, animal husbandry, water and goods, if handled, which are designated as food or drink for human use, including food additives, food raw materials, etc. ingredients used in the planning, preparation and production of food or drinks. Prabowo (2014) Food has important values because if there is an increase in food prices it will have an impact on reducing protein and calorie consumption.

Nugroho & Mutisari (2015) Food security is a condition where food is met for the community down to the individual level. Asmara (2012) Food security is assessed by the availability of sufficient food, in terms of quantity and quality, safe, diverse, evenly distributed, nutritious and affordable. Food security is a situation where the population can meet its food needs.

Lubis (1992) Feed is anything that can be eaten by livestock, can be digested in whole or in part and does not harm the health of livestock. Khairul (2009) Food functions to fulfill basic life needs, reproduction, maintenance, growth, metabolism and others.

3. Analysis Methods

The analytical method in this research is a qualitative method by comparing research results and collecting literature from previous research. Through secondary data collection techniques. Emphasizes organizing, coordinating, and synthesizing large amounts of data as well as developing theory from narrative data – words to describe complexity.

4. Results and Discussion

Indonesia has biodiversity and a diversity of food sources but has not been able to get rid of rice as a food source. Several food sources that have been widely developed in Indonesia include rice, corn, potatoes, cassava, sago and most recently sorghum. Minister of Agriculture Syahrul Yasin Limpo (2022) stated that there is a need to accelerate national food security with local feed, one of which is the development of sorghum as an alternative food source. Sorghum is a commodity that is a solution to the problem phenomena described above. Sorghum (Sorghum Bicolor L. Moench) is an alternative food substitute plant that is rich in benefits. Apart from having considerable potential to be a suitable food and climate solution in Indonesia, sorghum is also good for health so it can be a public health solution. Basically, sorghum is a type of wheat plant that can live in tropical and subtropical areas. Sorghum is a potential cereal crop that needs to be developed to support food security and agribusiness programs considering its broad adaptability and low water requirements.

A shift in food consumption that substitutes the role of rice as a source of calories actually occurs in various food products made from wheat/wheat flour which is an imported food ingredient, such as noodles and bread. In certain groups of people, the consumption of noodles and bread made from wheat flour has even replaced the role of rice as a food ingredient for breakfast and changes in consumption patterns tend to increase in line with

rising incomes and the growth of urban areas. The consequence is that Indonesia's wheat imports increased rapidly from around 1.72 million tons or ranked 17th in the world in 1990 to 4.66 million tons or ranked 6th in the world in 2009 (FAO, 2011).

Indonesia can reduce this dependence by processing sorghum which can actually grow in Indonesia. The nutritional content of sorghum flour is no less than other flours which are also widely consumed by Indonesian people, such as rice, corn and wheat flour. Indonesia has an increasing dependence on wheat flour. Sorghum flour has the advantage of higher levels of crude fiber, fat, ash and starch compared to wheat flour.

Purnomohadi (2006) Almost all parts of the sorghum plant can be used. Sorghum stems can be used to make bioethanol from sorghum stem sap, sorghum seeds can be used as food and feed, and sorghum leaves can be used as animal feed. (Hermawan, 2013). White sorghum seeds are suitable for use in various types of processed foods. Sutrisna (2012) Sorghum seeds can be processed directly into sorghum rice or processed into semi-finished ingredients. One use of sorghum seeds is to process them into sorghum flour which has the advantage of high swelling power and is easily soluble in water so that sorghum can be made into various dry (cookies, biscuits, etc.) and wet (bread, noodles, etc.) foods. This sorghum flour has the advantage of high swelling power and is easily soluble in water so that sorghum can be made into various dry foods.

Irawan (2013) Food commodities that are widely consumed in Indonesia are rice, corn, cassava and soybeans. Compared to the four food commodities, sorghum has a relatively high calorie content, namely 332 cal/100 g and is higher than the calorie content of cassava and soybeans. The carbohydrate content of sorghum is also quite high, namely 73 g/100 g and higher than the carbohydrate content of cassava. corn and soybeans. Likewise, the protein content in sorghum (11 g/100 g) is higher than rice, cassava and corn, although lower than soybeans (30.2 g/100 g).

An important asset owned by farmers is the agricultural land where they farm. The choices made by farmers are rational choices with various considerations. It is not uncommon for farmers to change the types of crops grown, such as rice and corn, to become plantation crops. The problem is that if left untreated and without extra supervision, it is possible that this will cause disruption to resilience food. Food security is closely related to national resilience, economic stability, especially food production, agricultural land and population.

5.1 Sorghum Development Potential In North Sumatra

Agricultural land is generally divided into wetland and dry land. Where rice fields are mainly used for rice crops and as a result of being converted to non-agricultural use, the area of rice fields continue to decrease, thereby reducing rice production capacity. In these conditions, in the context of food diversification, the development of food crops other than rice should not be developed in paddy fields to avoid competition with rice plants but should be developed in dry land. The following description reveals several characteristics of dry land in North Sumatra Province and the extent to which the potential for sorghum plants can be developed on this type of land.

The fact currently faced is that the national food consumption pattern still relies on or depends on one type of staple crop, namely rice. Based on these facts, the objectives of diversifying food consumption based on the concept of sustainable development are:

1) Reducing Dependence on Rice Imports

Rice imports are carried out because of dependence on food demand for food such as rice. Through consumption diversification food is expected to make choices about food ingredients become increasingly diverse, so as to reduce dependence on imports rice.

2) Achieving Appropriate Food Consumption Patterns

Food security focuses on the aspect of resource allocation to efficient, flexible, and stable direction of use by utilizing available local potential.

3) Realizing Hope Food Patterns

Diversification of food consumption aims to provide nutrition or adequate nutrition for household consumption patterns, so that it will able to fulfill healthy and nutritious consumption patterns in society.

4) Affordable Nutrition for All Income Levels

The national food consumption pattern which has so far depended heavily on this type of rice causes the price of rice to increase more quickly.

As a result, the price of rice has become increasingly difficult for all household income groups to afford. Through diversification of food consumption, it is hoped that we will be able to allocate income to choose types of food commodities that are relatively more affordable.

Sorghum has a relatively high photosynthesis rate compared to other cereal plants. The high rate of photosynthesis causes the height of sorghum stalks to reach 5 meters. Apart from its stems being rich in sugar which can then be processed into jiggery (a type of brown sugar) sorghum can also produce bioethanol. Sorghum stem extract in the form of sap can be fermented and distilled to make ethanol. Sorghum plants can grow well at temperatures ranging from 23°C - 30°C with relative humidity of 20 – 40 percent (Sudaryono, 1996). Sorghum can grow at heights above 500 meters but plant growth will be hampered. Sorghum plants can also grow in very diverse soil conditions. Sorghum can grow well on sandy soil, almost all types of soil, on less fertile soil and can grow at a soil pH ranging from 5.0 - 7.5. Sorghum plants are also more tolerant of saline soil and waterlogging than other cereal crops. This condition certainly matches the temperature conditions in North Sumatra.

Potential for Sorghum Development in Dry Lands Sorghum is a cereal crop that can be developed in tropical and sub-tropical areas such as China, India and the USA. On the African continent, sorghum is widely developed in the countries of Sudan and Nigeria which have relatively dry climates. In the Southeast Asia region, this plant has been developed in Thailand, the Philippines and Indonesia, although in a limited area. In Indonesia, sorghum plants have been developed traditionally in several areas of West Java, Sulawesi and Kalimantan. And this plant has the potential to be a food solution for North Sumatra as well as improving the economy through product diversification from processed sorghum.

5.2 Potential of Sorghum As Animal Feed

Until now, cattle are still often used by people to plow land or as a side business by relying on makeshift crops as a source of animal feed. Until now, Indonesia still has a beef crisis. This main problem should be able to make people more serious about raising livestock and more innovative in running livestock businesses so that Indonesia can get out of the meat crisis by being able to produce livestock meat independently.

According to the Animal Husbandry and Animal Health Service, livestock breeders or cattle breeders must provide feed that meets the requirements for cattle growth. Feed that meets the requirements and quality is feed that contains protein, carbohydrates, fat, vitamins, minerals and water. This feed can be provided in the form of forage and concentrate. The quality of the feed provided greatly influences the level of success of the livestock business. Even if the cattle used come from superior breeds and have good genetic characteristics, if they are not balanced with appropriate and high-quality feed, the advantages they possess will not provide significant added value.

Harmini (2021) Sorghum plants have the potential to be developed as a source of forage for ruminant livestock. Sorghum is able to grow and produce nutrients well on sub-optimal land, especially dry land. Hybrid sorghum was developed as forage for livestock. The dry matter content of sorghum is higher than corn even though the nutritional content is lower. In addition, the metabolizable energy value, KcBO and crude protein content in sorghum cultivated hydroponically (Sorghum Green Fodder/SGF) is higher than field grass. The nutrient content of sorghum is also quite high. Water deficit and heat stress will increase kernel density which results in increased protein content, digestibility and micronutrient composition. Sorghum is a cereal that can grow almost anywhere, is rich in nutrients, fiber and bioactive components that are not yet widely utilized by humans and is often used as animal feed.

Sorghum has the advantage of having antioxidant compounds, high Fe mineral content, dietary fiber, essential amino acids and oligosaccharides.

Hajar (2019) conducted research on sorghum seeds that are good for use as feed and planting distances for sorghum commodities. And the result is that fresh biomass production and dry matter production in the 12S49001 variety is higher compared to the 12FS9006 variety and the 13FB7001 variety. A planting distance of 25x25cm is better than a planting distance of 25x40cm. The best nutrients are found in the 12S49001 variety compared to other varieties.

Hidayat (2021) The results of biological tests on the substitution of corn by sorghum in broiler chicken rations show that sorghum is a feed ingredient capable of substituting corn up to 100%. The potential for developing sorghum in Indonesia for feed ingredients is very large, because sorghum is able to grow on marginal and dry land, so it can maximize marginal land in areas in Indonesia.

5.3 Potential of Sorghum As A Source Of Bioenergy (Renewable Energy)

According to Suranto, a sorghum plant breeding researcher on the sidelines of a training event on radiation mutation techniques for bioenergy plants held by Batan and the International Atomic Energy Agency (IAEA) in Jakarta, "In general, countries in Asia are experiencing an energy crisis, and fossil energy sources are increasingly being eroded. and finished. "Why don't we develop renewable energy that comes from plants." According to Suranto, one of the potential bioenergy crops to be developed is sorghum. This plant is resistant to growing on marginal or dry land where food plants cannot grow there.

He also explained that sorghum is a stubborn plant, and can be planted in dry areas where rainfall is very low. So that instead of empty land (planting sorghum) it can produce products and have many benefits where the seeds contain high levels of carbohydrates, fats and protein so they can be used as food. Meanwhile, the stems and leaves can be used as cattle feed. Meanwhile, sweet sorghum whose stems contain quite a lot of liquid sugar can be used to make liquid sugar, syrup, or be processed into bioethanol. "*Sweet sorghum* It can be squeezed and made into ethanol which can be used as fuel for stoves, lighting lamps, etc.

Sihono (2021) Application of nuclear science and technology in agriculture, especially breeding gamma radiation induced mutations, new genotypes of sorghum have been obtained which have good properties including good nutritional quality, ideal as food and large, long and sweet stems suitable as raw material bioethanol (energy) and forage leaves can be used as ruminant feed.

Fathurrahman (2022) In Indonesia, ethanol is used as a raw material for cosmetics and pharmaceuticals, industry, and can also be used as a substitute for gasoline. Bioethanol is made from sap derived from green pressing in the form of sorghum stalks which is then fermented over a period of 3 (three) days and 7 (seven) days with 5% starter with the average yields obtained being 9.996% and 8.556% respectively.

Indriatama (2023) The P-341 mutant line is a characteristic forage sorghum because it produces high plant biomass and low lignin characteristics. The G-5 mutant strain contains high stem sugar content and low fiber content so it has the potential to be developed as a bioethanol producing sorghum and can be projected as an alternative energy source due to its high stem sugar content.

6. Conclusion

Based on the results and discussion, the sorghum commodity is very suitable to be planted and used as an alternative food for Indonesia, especially North Sumatra, looking at the climate and soil elements. Sorghum has the potential as an alternative food, has the potential as animal feed from livestock cultivation (broiler livestock), including cows, goats and chickens, and sorghum can be processed into a renewable alternative energy source to replace fuel in Indonesia, especially North Sumatra.

7. References

Abdurachman, A., Mulyani, A., Irawan. 2013. Sumber Daya Lahan untuk Kedelai di Indonesia. Balai Penelitian dan Pengembangan Sumber Daya Lahan Pertanian: Bogor.

Adlin U. Lubis. (1992). Kelapa Sawit (Elaeis guineensis Jacq.) di Indonesia. Pusat Penelitian Perkebunan Marihat Bandar Kuala, Pematang Siantar Sumatera Utara. 434 halaman.

Andriani A., dan M. Isnaini, 2013. Morfologi dan Fase Pertumbuhan Sorgum. Balai Penelitian Tanaman Serealia.

Badan Pusat Statistik (BPS) : Provinsi Sumatera Utara Dalam Angka 2020

Badan Pusat Statistik (BPS) : Provinsi Sumatera Utara Dalam Angka 2021

Badan Pusat Statistik (BPS) : Provinsi Sumatera Utara Dalam Angka 2022

C. Hidayat. 2021. Penggunaan Sorgum sebagai Bahan Pakan Sumber Energi Pengganti Jagung dalam Ransum Ayam Pedaging. Jurnal Petenakan Indonesia (JPI) : Vol. 23 (3): 262-275.

Elvira Sari Dewi. 2017. Potensi Pengembangan Sorgum Sebagai Pangan Alternatif, Pakan Ternak Dan Bioenergi Di Aceh. Jurnal agroteknologi

Fitriyani, Adyatma, S. & Kumalawati, R., 2019. Analisis Tingkat Ketahanan Pangan Kabupaten Banjar rovinsi Kalimantan Selatan. JPG (Jurnal Pendidikan Geografi), 5(3), pp. 20-27.

Fathurrahmaniah. 2022. Potensi Sorgum (Sorghum Bicolor l. Moench) sebagai Bahan Baku Pembuatan Bioetanol. Jurnal PIPA: Pendidikan Ilmu Pengetahuan Alam: Vol. 03 No. 02. November 2022

Hajar dkk. 2019. Produksi dan Kandungan Nutrien Beberapa Varietas Sorgum Hybrid dengan Jarak Tanam Berbeda sebagai Sumber PakanJurnal Ilmu Nutrisi dan Teknologi Pakan (JN : Vol.17 No.1: 1-5, April 2019

Harmini (2021). **P**emanfaatan tanaman sorgum sebagai pakan ternak ruminansia di lahan kering. Livestock and Animal Research

Hermawan, R. 2013. Usaha Budidaya Sorgum Si Jago Lahan Kekeringan. Pustaka Baru Press. Yogyakarta.166 hal

Khairani, Rafida. 2014. Analaisis Konversi lahan Pangan menjadi lahan perkebunan Sawit Sumatera Utara. UNIMED : Digilib

Prabowo, D. W. (2014). Pengelompokan Komoditi Bahan Pangan Pokok Dengan Metode Analytical Hierarchy Process. Buletin Ilmiah Litbang Perdagangan, 8(2), 163–182.

Purnomohadi, M. 2006. Potensi penggunaan varietas sorgum manis (Sorghum biclor L. Moench) sebagai tanaman pakan. Jurnal Penelitian Hayati, 4 (12): 41-44.

Sihono, Wijaya M. Indriatama, Soeranto Human dan Marina YM. 2021. Perbaikan Komoditas Sorgum sebagai Pangan dan Bioenergi melalui Pemuliaan Mutasi Radiasi. Agrista: Jurnal Ilmiah Mahasiswa Agribisnis UNS

Sutrisna, N. 2012. Sorgum untuk Penganekaragaman Pangan. Sinar Tani. Balitbang Pertanian Jakarta. 11-12.

Nugroho, C. P. & Mutisari, R., 2015. Analisis Indikator Ketahanan Pangan Kota Probolinggo: Pendekatan Spasial. Jurnal Agrise, XV(3), pp. 166-181

Wijaya Murti Indriatama dkk. 2023. Ciri Agronomi dan Serat Delapan Varian Sorgum sebagai Pakan (Evaluation of Agronomic Characteristics and Fiber of Eight Sorghum Variants as Forage). Jurnal Ilmu Pertanian Indonesia (JIPI), Juli 2023 Vol. 28 (3) 344-351