# Ntb's Potential as a Sorghum Producer for Alternative Food and Export Commodities

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**Abstract.** The area of sorghum planted in NTB Province is currently around 650 ha, with details of Bima Regency covering 250 ha, Bima City covering 250 ha, Sumbawa Regency covering 150 ha and West Sumbawa Regency 10 Ha (Kementan RI, 2021). Participation of farmers in sorghum farming, farmers tend to cultivate without tillage and intensive care. The level of technology adoption tends to be low, and Government support for sorghum cultivation is also standard. The Regional Government focuses on rice and corn cultivation through the Central Government program. In the end, a low public perception of sorghum cultivation was formed. The cultivation of Sorghum in NTB aims to improve farmers' welfare by cultivating alternative food crops with high economic value, becoming one of the alternative food crops and also a leading export commodity. The method used in this study is a literature study of several scientific articles, national and international journals and other sources, which were analyzed descriptively. Based on the results of this literature review, the development of Sorghum in NTB with a relatively wide dry land condition can potentially make NTB one of the producers of sorghum with export quality. This condition is supported by the Astra Prosperous Village Program, which has exported several processed sorghum products to various countries. Several countries, such as Timor Leste and Malaysia with a total export value of hundreds of millions of rupiah. The limited use of land for sorghum development is an obstacle and a challenge for sorghum productivity in NTB.

**Keywords:** sorghum; alternative food; export commodity.

## INTRODUCTION

The need for food, especially rice, as the world's leading food ingredient, even in Indonesia, is increasing every year in line with the rapid increase in population. In 2025, Indonesia's population is predicted to reach approximately 300 million people, which will require vast amounts of food. In 2014 alone, the Indonesian government targeted rice production of 75.7 million tons of dry-milled unhulled rice [1].

At this time, the increase in national rice production is highly dependent on lowland rice. In contrast, the area of rice fields tends to continue to shrink due to the conversion of land use for non-agricultural businesses. This condition can make it difficult for Indonesia to meet its food needs, especially rice, independently if it only relies on production in lowland rice fields. As an anticipatory step, there must be an alternative that must be done to overcome future problems, one of which is by increasing the productivity of carbohydrate-producing plants other than rice as the main non-rice food source and utilizing existing land and maximizing other lands.

Indonesia has enormous potential to produce plants that produce carbohydrates or sugar from plants that can be used as a primary food source. The diversity of plant species that have the potential as the main food source thrives and is widespread in Indonesia, namely in the form of grain crops(rice, corn, sorghum and wheat), root crops (cassava, sweet potato, potato and arrowroot), as well as other crops (sugar cane, sweet sorghum, coconut, and sugar palm).

Sorghum (*Sorghum bicolor L.*) is a dry land food crop with great potential if developed in Indonesia, especially on dry land. Sorghum can be used as a food source for producing carbohydrates instead of rice, animal feed and bioenergy (bioethanol), as well as being able to adapt to marginal

land conditions and requiring relatively more minor water (more resistant to drought than other food crops). Sorghum can grow well on marginal lands because of its tolerance to high temperatures and drought. Sorghum is also considered one of the most successful local food crops grown in dry climates [2].

Currently, sorghum is a cereal commodity that Indonesian people have not widely consumed, even though the nutritional value of sorghum is not inferior to rice. Sorghum contains 8-12% protein equivalent to wheat or higher than 6-10% rice, and 2-6% fat content, higher than 0.5-1.5% rice [3]. Sorghum seeds also contain three types of carbohydrates, namely, starch, dissolved sugars, and fibre. The dissolved sugar content in sorghum consists of sucrose, glucose, fructose and maltose. Sorghum contains insoluble or crude dietary fibre, 6.5–7.9% and 1.1–1.23%, respectively.

To several studies in the field, sorghum can be a potential food commodity that can be developed to support food diversification programs in Indonesia. The obstacles in the area that occur during the development of sorghum farming at the farmer level are the exploitation that is still not optimal. It is necessary to manage a comprehensive (holistic) sorghum production system concerning the area and the value of comparative and competitive advantages of sorghum compared to other food crops [4, 5]. Optimizing the development of large-scale sorghum production will lead to land use competition with other commodities. It can be directed at marginal and non-productive lands, widely spread in Indonesia's central and eastern regions. Sorghum can be developed as a staple food supplementation of rice and a component of the feed supply [6].

Production of food crops in West Nusa Tenggara in 2021 for main food crops: paddy 1,432,460 tons, corn and soybeans at 1,085,009 tons. Meanwhile, the first sorghum harvest in 2021 is still relatively low at 70 tons from the 14 ha harvested area belonging to the Bima City Honest Farmers Group. This data shows the opportunity for developing sorghum as a source of food, fuel and fodder in NTB. The potential of dry land owned by the vast province of NTB reached 1.84 million hectares [7].

The area of sorghum planted in NTB Province is currently around 650 ha, with details of Bima Regency covering 250 ha, Bima City covering 250 ha, Sumbawa Regency covering 150 ha and West Sumbawa Regency 10 Ha. Participation of farmers in sorghum farming, farmers tend to cultivate without tillage and intensive care. The level of technology adoption tends to be low, and Government support for sorghum cultivation is also standard. The local government currently focuses on developing rice and corn cultivation per the central government's program. Thus, a low public perception of sorghum cultivation is formed [8].

The existing agronomic conditions in NTB for the development of sorghum can support food substitution to increase the production of sorghum as a leading commodity and excellent export and alternative food in a promising future. The purpose of this paper is to conduct a study on the strategy of developing sorghum plants in West Nusa Tenggara through a literature study.

## METHODS

The material used in preparing this article is data from relevant agencies, including the Department of Agriculture and Plantation of the Province of West Nusa Tenggara, the Central Bureau of Statistics and other relevant agencies, especially the development of sorghum production. Several publications are also used in this paper, in the form of books and scientific articles published in international and national journals and other information related to the sorghum plant. Data from various sources is then analyzed descriptively.

## RESULTS AND DISCUSSION

Sorghum plants have the same growth pattern as maize, but the time interval between growth stages and the number of leaves that develop can differ. So the time it takes to reach each stage of development depends on the variety and the environment in which it grows. The environmental factors include soil moisture and fertility, pests and diseases, abiotic stresses, plant populations, and weed competition. Sorghum plant growth can be grouped into three stages: vegetative, reproductive, seed formation and physiological maturity.

Sorghum is one type of staple food with a nutritional content that is not inferior to rice, so sorghum plants have great potential to be cultivated and developed commercially because they have wide adaptability [9]. Sorghum has high produc-

tivity, is resistant to plant pests and diseases and is more resistant to marginal conditions such as drought, salinity, and acid soil [10].

Sorghum plants can grow well on various soil types [11]. Soil texture is closely related to the availability of groundwater for plants. The author [12] stated that dry land in North Lombok Regency has soil made of pumice as the parent material. The physical properties of pumice parent soil related to the soil environment that supports plant growth include high soil porosity, low water-holding capacity, high water-passing rate, and low aggregate stability [12].

*Sorghum (Sorghum bicolor L.) for food diversification*. Indonesia needs to develop various potential plants to support national food security through a food diversification program, including in the West Nusa Tenggara region. In Indonesia, one carbohydrate-producing plant, apart from rice and corn, has the potential to become an alternative material in food diversification with great potential, which is Sorghum (*Sorghum bicolor L.*). Sorghum is suitable for food diversification because its seeds contain relatively high carbohydrates as the primary food source and have protein, calcium, minerals and vitamins that are not inferior to rice and corn (Table 1).

Table 1 – Comparison of nutrients in various foodstuffs (per 100 grams of edible parts) [13]

| Commodity | Calories (cal) | Carbohydrates (gr) | Protein (g) | Fat (g) | Calcium (mg) | Phosphorus (mg) | Iron (mg) | Vitamin B1 (mg) |
|---|---|---|---|---|---|---|---|---|
| Sorghum | 332 | 73 | 11 | 3.3 | 28 | 287 | 5.4 | 0.38 |
| Rice | 360 | 78.9 | 6.8 | 0.7 | 6 | 140 | 1.8 | 0.41 |
| Corn | 361 | 72.4 | 8.7 | 4.5 | 9 | 380 | 4.6 | 0.38 |
| Wheat | 365 | 77.3 | 8.9 | 1.3 | 16 | 106 | 1.2 | 0.41 |

In developing countries, sorghum is cultivated mainly as food and alcoholic beverages or for traditional ceremonies. An alcoholic beverage made from sorghum seeds can be beer derived from fermented seeds after germination. In developed countries, sorghum stems or seeds are used as animal feed. When given as animal feed, this sorghum plant's stems can accelerate the livestock's fattening - especially sweet sorghum. The stems are used as an ingredient for sugar and have a higher sugar content than sugar cane. Sorghum is cultivated in Southern Europe, North America, Central America and South Asia. The Sorghum bicolour L. moench species is the most widely grown among the *Sorghum bicolor L*. Moench species. The morphology of the sorghum plant includes roots, stems, leaves, shoots, flowers, and seeds. In addition to food, sorghum can also be used as fodder for poultry (seeds) and ruminants (stems and leaves) [14].

*Improving Dryland Productivity*. Indonesia has vast agricultural land and arid land. However, not all land is classified as fertile and suitable for food crop cultivation. Most of the land is classified as marginal. The most dominant marginal land is land that is often hit by drought (drought-prone areas) in the long term, acid soil (acid soil), and land with high salt content (saline soil). Many efforts have been made to increase the productivity of marginal lands by finding suitable crops, such as sorghum, which is highly resistant to extreme conditions such as drought.

Indonesian farmers have long known sorghum, especially in Java, NTB and NTT, but its cultivation and development are still shallow and limited. Sorghum has a vast and prospective potential to be developed in line with efforts to increase marginal land productivity because sorghum has wide adaptability and requires relatively little water for its growth. So, sorghum is very resistant to conditions on land with relatively low rainfall, such as on dry land. This is due to the domestication of this plant from Africa, which has an arid or semi-arid climate [15, 16]. Table 2 shows the planted area, production and productivity of sorghum in several development centres in Indonesia [4].

Wide adaptability, low water requirements and drought resistance are the main advantages of sorghum so that it can be developed in Indonesia. According to [6] potential dry land for sorghum is 108.8 million hectares. Sorghum is the most suitable crop of choice to increase the productivity of marginal dry land, vacant land or other non-productive land.

Table 2 – Average planted area, production and productivity of sorghum in several centres of sorghum development in Indonesia (various years) [4]

| Location | Broad (ha) | Production (tons) | Productivity (ton/ha) |
|---|---|---|---|
| Central Java (1973/1983) | 15.309 | 17.350 | 1.13 |
| East Java (1984/1988) | 5.963 | 10.522 | 1.76 |
| DI Yogyakarta (1974/1980) | 1.813 | 670 | 0.37 |
| West Nusa Tenggara (1993/94) | 30 | 54 | 1.80 |
| East Nusa Tenggara (1993/94) | 36 | 39 | 1.50 |

*The Potential of Sorghum in NTB and Its Development Strategy*. With the vast potential of dry land owned by the Province of NTB reaching 1.84 million hectares [7], the opportunity for developing sorghum as a source of food, fuel and fodder in NTB is vast and promising. Because sorghum has a high economic value, by planting sorghum, land productivity will increase and also support efforts to develop sustainable agriculture and increase food production as well as a leading export commodity from NTB farmers.

In 2020, sorghum cultivation in NTB, especially on Sumbawa Island, uses an area of 650 ha. The sorghum variety developed is the Bioguma type, with an area of 500 ha for the Ministry of Agriculture program and 150 ha for self-help. The land area is spread over 250 ha each in Bima City, 250 ha in Bima Regency and 150 ha in Sumbawa.

The Astra Welfare Village Program (DSA) Sorghum Lombok, which PT initiated. Astra International Tbk. Has started a program to encourage the growth of micro, small and medium enterprises (MSMEs), which are trying to recover from the impact of the 2018 earthquake and the COVID-19 pandemic. This program was initially started five years ago with two assisted villages. Currently, the number of assisted villages has increased to 22 villages involving more than a thousand farmers spread across North Lombok, East Lombok, Central Lombok and South Lombok by implementing the farmer corporation concept. The development of DSA Sorghum also contributes to the absorption of labour and the improvement of the welfare of the surrounding community, especially homemakers who are involved in processing various foods and beverages [17].

The condition of internal and external factors in the development of sorghum, according to [18] and can also be applied in NTB are as follows:

1) Internal factors that are the strength of sorghum include (a) sorghum farming experience; (b) sorghum adaptive to the environment; (c) no pests during sorghum cultivation; (d) continuity production; (e) sorghum cultivation has a small failure risk, and (f) easy cultivation.

2) Internal factors that are weaknesses of sorghum include (a) sorghum is a less commercial commodity, (b) has high tannin content, (c) storage is not durable due to pest attacks, (d) poor farm management; (e) sorghum cultivation is not a priority for farmers.

3) External factors that are opportunities for sorghum include (a) increasing non-oil and gas exports, (b) availability of seed procurement assistance from the government, (c) development into processed products, (d) sorghum as an alternative to biofuel products, (e) suitable natural conditions for sorghum cultivation.

4) External factors that pose a threat to sorghum include (a) low selling price of sorghum, (b) unfavourable market share, (c) difficulty for people to switch to consuming sorghum as a staple food, (d) dissemination of information and cultivation development sorghum at the farmer level is not yet intensive, (e) there is competition with other agricultural products.

According to [18], alternative strategies for developing sorghum crop strategies that can also be carried out in NTB according to the results of the SWOT analysis are

1) SO strategy, which includes (a) expansion of the sorghum planting area by utilizing dry land and guidance from the government, (b) fostering regarding processing sorghum seeds into processed products, and (c) conducting business meetings with investors for large-scale processing of sorghum.

2) WO strategy, which includes (a) periodic counselling and guidance on good sorghum cultivation and (b) providing training and post-harvest technology assistance.

3) ST strategy, which includes (a) cooperation with the food processing industry, and (b) the role of the government in determining selling prices and promoting sorghum.

4) WT strategy is to increase interaction between researchers, extension workers,

*Sorghum as an Alternative Food and Export Commodity*. As food, sorghum seeds can be made into flour which can then be used as raw material to manufacture various types of pastries, cakes and noodles [19]. In the manufacture of different food products, sorghum flour can substitute 15-50% of flour without reducing the taste, texture, and aroma. One of the advantages of sorghum flour is that it has a higher nutritional value than rice, corn, and cassava flour. The starch content of sorghum seeds is also relatively high, around 83%. The fat and protein contents are 3.60% and 12.3%, respectively [4].

Another advantage of sorghum flour is its very high swelling power, and is easily soluble in water. Both of these properties are required in the manufacture of flour-based food products. Using sorghum in flour is more profitable because it is more practical and easier to process into various snack products. Processing of Sorghum into flour has been carried out, although on a small scale, among others, by PT Bogasari. One of the food industries in Jakarta has also used sorghum flour for crackers which are crispier than those made from wheat flour [2].

There are many benefits of sorghum. The seeds are processed into flour to replace rice flour or wheat flour as food, sorghum seeds can replace corn which is widely used as a raw material in the animal feed industry, and sugar and bioethanol are made from juice squeezed from sweet sorghum stalks. The leaves of sorghum can be used as forage for animal feed.

In addition, the sorghum pulp (bagasse) that has been extracted can be used for its fibre as raw material for pulp in the paper industry. In this case, the development of sorghum plants supports government programs in food security (food self-sufficiency program) and energy (energy independent village program). Besides that, it also supports the development of other industries, namely cattle fattening (meat self-sufficiency) and the pulp (paper) industry.

Sorghum can adapt to areas with a tropical-dry climate (semi-arid) to wet environments. Cultivating plants is easy with relatively low costs, and can be planted through monoculture or intercropping. Plant productivity is very high and can be ratified or harvested more than once in one planting with results that are not much different, depending on the maintenance of the plant. In addition, sorghum plants are more resistant to pests and diseases, so the risk of failure is relatively small. The sorghum plant functions as an industrial raw material with many uses and is a world export commodity [20].

## CONCLUSIONS

Sorghum as alternative food in Indonesia has the potential to be developed, including in NTB, in the context of diversifying local food and reducing dependence on wheat consumption as an imported food ingredient. The potential for sorghum development is supported by the characteristics of sorghum which can grow well on dry land, and the availability of dry land in NTB is quite broad. The result of sorghum still faces various problems, especially related to aspects of cultivation technology, processing and industry, market creation and price guarantees, and institutional elements for the sustainability of sorghum development. The statistical data on sorghum, which is widely accessible for development, is relatively limited, showing the lack of attention to the development of this commodity in NTB, agronomically and economically.

The strategies and policies needed for developing sorghum in the cultivation aspect are intensive and wide-scale development, and the provision of production facilities (exceptionally superior seeds) appropriately, especially in potential areas for sorghum development. It is necessary to map the location of sorghum production centres covering growing environmental conditions, especially fertility, soil type, and rainfall.

For the aspect of processing technology and industry, it is necessary to increase the variety of processed products from sorghum seeds through the application of product processing technology that can improve taste and appearance, as well as packaging technology to increase the selling value of the product. For the economic aspect, it is necessary to expand the market by increasing the use of sorghum not only as a raw material for traditional food products but also as a raw material for the food industry, as a raw material for other industrial products, and as an ingredient for animal feed and bioethanol.

From the institutional aspect, it is necessary to build networking and community development consisting of elements of farmers as production implementers, the government as policyholders,

research institutions as the development of sorghum plants/products and industry as business actors to accelerate and maintain the sustainability of the sorghum development program.

The recommendations that can be given are that the government should carry out a program to expand the sorghum planting area, one of which is by utilizing dry land, conducting business group discussion forums with investors or the sorghum processing industry, and promoting sorghum as a secondary food, not only as an alternative food.

Agricultural instructors conduct regular training on reasonable sorghum cultivation procedures, provide training and post-harvest technology assistance, and process sorghum into processed products to increase the selling value of sorghum. In addition, other researchers should be able to analyze the potential of sorghum or the nutritional content of sorghum compared to other commodities by cultivating each item in the same land condition.

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