PROSPECT AND SUSTAINABILITY OF SORGHUM PRODUCTION IN RAJI VILLAGE DEMAK REGENCY CENTRAL JAVA INDONESIA

Wiwin Widiastuti [1], Alfina Handayani [2], Sujarwanto Dwiatmiko[3]

[123]*Regional Planning, Research & Development Board, Central Java Province, Jl Pemuda 127-133 Semarang, Central Java, Indonesia*

Abstract

Resource Scarcity & Rural Development (2)

Sorghum is an important source for food, feed and energy (bio ethanol). In the semiarid tropics, it is consume for a large segment of the human population. However, in Indonesia, sorghum has so far been regarded as a minor crop and its research and development remain insignificant. The study examined prospect and sustainability of sorghum production, through 1) identify the social-economic characteristics of farmer, 2) analyze economy feasibility and, 3) identify conditions and problems of sorghum production. Primary data were used for this study. They were obtained through interview schedule. A total of 62 households engaged in sorghum production were investigated. Data collated were analyzed using suitable statistical tools such as descriptive statistics and budgetary analysis. Result showed that social and economic condition in the development of sorghum have good future because most farmers in the productive stage, although the average education level was low but farming experience was quite good. From the economic side, sorghum was quite viable. The condition of the average farmer's land is limited (<1 ha) and most of farmers were rental status and a lot of the number of dependents, there are some factors that made farmers very selective in choosing a commodity to be cultivated. Decreasing of sorghum production in Demak due to competition with other food commodities that more profitable, more over the existing government policies not support the development of sorghum.

Keywords

Keywords: economy analysis; production; sorghum

1. Introduction

Sorghum (Sorghum bicolor L moench) is is the world's fifth most important cereal, in terms of both production and areas planted in many semi-arid developed countries in Asia, Africa and America (FAO, 2005, Nedumaran et al. 2013). Sorghum can be planted in dry climate area and requires less inputs compare with other food crops. It is primarily grown in areas experiencing low rainfall. Most of these areas are unsuitable for the production of other grains unless irrigation is available (FAO and ICRISAT, 1996).

Sorghum can be utilized as food, feed and fuel (bio ethanol) source. Grain sorghum as food has better protein content (11% per gram) than that of maize or rice (Department of Health, 1992). Some sorghum varieties are rich in antioxidants and all sorghum varieties are gluten free, an alternative for wheat allergy sufferers (Annon 2, 2010). Its biomass can be used

as animal feed, and the sugar content on the stem can be processed to produce bio ethanol (Biba, 2011).

Unfortunately, in Indonesia, the lack of commercial market has limited farmer interest in improving the management of this crop. Sorghum utilization is still limited because the post-harvest processing is difficult. Tannin content is quite high, reaching 0,40−3,60% (Rooney and Sullines 1977).

Demak Regency is the one of sorghum areas in Central Java (Agriculture Agency of Central Java, 2015). As one of the sorghum-producing areas, the use of sorghum as an alternative food, feed or energy in Demak is very limited. Sorghum growing areas in the District of Demak reach the area 70 ha (Statistic Bureau of Demak, 2014). Although well-adapted to Demak climate and soils, grain sorghum is a minor crop in the area. Since in Indonesia has conducted relatively little agronomic research on this crop and development remain insignificant. In fact, in recent years there is a trend of planting sorghum area tends to decrease. At this time, sorghum is cultivated only in one village that is Raji Village.

To examine prospect and sustainability of sorghum production in Demak Regency, we have three approaches: 1) identify the social-economic characteristics of farmer, 2) analyze economy feasibility and, 3) identify conditions and problems of sorghum production.

2. Material and Method

2.1. Study Area

Demak as one of Regency in Central Java locate on Coordinate between 60 43’26’’ to 70 09’43’’South Latitude and between 110027’58’’ to 1100 48’4’’ East Longitude. Administratively wide of Demak Regency are 89,743 ha, consist of 14 Districts, 243 urban villages and 6 villages. As agrarian area which most of settle of living by agriculture, most of Demak Regency region consist of wet land wide 51.558 ha (57,45 percent), and rest are dry land. The total population in Demak Regency was counted 1.106.328 people consist of 548.310 male (49.55 percent) and 558.133 female (50.45 percent). Research location was selected purposively in Raji Village Demak Regency that is the only area that still cultivate sorghum. The study was conducted over three (3) months from March to June 2015.

2.2. Farmer Interviews

Respondents are farmers who grow sorghum on their own/rented land. Information on farmers’ perspectives was obtained through semi-structured and open-ended interviews. Total number of farmer households in this area were 620 families, 10 % for sampling are 62 farmer households. Sampling was done purposively with consideration that the conditions and farming activities were carried out by farmers in the study area were relatively equal or homogeneous (Nazir, 1988).

Data collection techniques were implemented by survey method which is collect information directly from respondent through interviews using structured questions in the questionnaire. Secondary data collected from various sources/ literature, research reference, Central Bureau of Statistics, Department of Agriculture and other relevant agencies.

2.3. Data Analysis

The descriptive statistics employed includes frequencies and percentages ratios processing by SPSS 20. This was used to analyze the social-economic characteristics of the farmer as well as the constraints associated with sorghum production.

Gross margin analysis is by definition the different between the gross farm income and total variable cost (Suratiyah, 2008). Normally, gross margin analysis is used to test the effects of changes that do not alter the fixed cost of production, especially the cost of land and other durable factors. It is used to determine the potential profitability and effect on farmer's farm income. It has the advantage of being simple as well as useful in the analysis of the profitability of small farms that have small fixed costs (Sams, 2009).

The gross margin analysis was estimated from costs and returns in sorghum production. Gross Margin model is expressed as follows:

GM = TR – TVC

Where:

TR = Total revenue or total value of output from the sorghum enterprise (Rp/ha). It is the product of average output per hectare multiplied by the market price. The price used was open market price of the year 2014.

TVC = Total variable cost or the costs that are specific in producing (sorghum) output (Rp/ha). TVC varies according to output and are incurred on variable inputs. This includes cost of inputs like seeds, fertilizer, and harvesting, processing, labor cost (hired/family).

Table 1. Social Economic Characteristic at Demak Regency

Variable	Description	Frequences	Percentage
Age of Respondent	31-40	16	25,8
	41-50	15	24,2
	51-60	19	30,6
	>60	12	19,4
	Total	62	100,0
Education Status	No formal education	18	29,0
	Elementary education	35	56,5
	Secondary Education	4	6,5
	Senior High School	4	6,5
	College/University	1	1,6
	Total	62	100,0
Years of farming experience	< 10	21	33,9
	11-20	12	19,4
	21-30	13	21,0
	31-40	10	16,1
	>40	6	9,7
	Total	62	100,0
Income Level	<10 jt	29	46,8
	11-20	16	25,8
	21-30	11	17,7

Variable	Description	Frequencies	Percentage
	Total	62	100,0
	31-40	6	9,7
	Total	62	100,0
	None	2	3,2
	1-2	15	24,2
Number of Dependent	3-4	36	58,1
	5-6	7	11,3
	>6	2	3,2
	Total	62	100,0
	<0.5 ha	24	38,7
	0.6 -1 ha	25	40,3
Land Area	1.1- 2 ha	9	14,5
	2.1-3 ha	3	4,8
	> 3 ha	1	1,6
	Total	62	100,0
	Own land	25	40,32
	Lease	30	48.38
Land Status	Own Land and Lease	7	11.29
	Total	62	100,0

Source: Primary Data

Efficiency ratio

$$BCR = \frac{\text{Discounted gross benefit}}{\text{Discounted total cost}}$$ (Gittinger, 1986)

If the value of the B / C ratio > 1 the business is eligible to run, meanwhile if the value of the B / C ratio < 1, the project is not viable (Presumptuous , 1990).

3. Results

3.1. Social economic characteristics

Farmer resources have a crucial role in the sustainability of farming. Farmers who are productive, educated and supported by the good technology adoption will be success to manage their farm. In this research, data presented are primary data that derived from survey in 62 farmer household. The results of the social economic characteristics are presented in Table 1.

The average age of farmers are in the productive age between 30-60 years. The highest is in the range of 51-60 years i.e. 30.6 % and the lowest is non productive age > 60, there are 19.4 %.

In line with the age of the farmer, the longer the experience of farming the less percentage of respondents. The highest distribution of respondents <10 years (33%), and the average experience of farming in the range of 11-40 years.

Farmer incomes were divided into four criteria, namely <10 Million per year, 11-20 million per year, 21-30 million per year, 31-40 million and > 40 million per year. Most farmers have an income <10 million per year, or less than 1 million per month was 46, 8%. The second largest percentage in the 11-20 million per year is about 25.8%. Such revenues are net agricultural products received by farmers in one year taking into account other costs such as land lease.

Based on the data found that the majority of farmers (58%) had a number of family dependents 3-4 people, 24, 2% have dependents 1-2 people and families with dependents 5-6 are 11.3%. Generally , the farmer respondents between the ages of 30-50 years have 3-4 dependent, while the respondents who over 50 years old have the number of dependents smaller, because their children already have their own income. The number of dependent in productive ages give an advantage for farmers as a source of labor.

Land area becomes a crucial factor in agricultural production, the smaller land area, the smaller income. Overall, the size of paddy fields in Raji Village approximately 276 hectares consisting of 127 ha of tecnical irrigation, 76 ha 1/2 technical irrigation and 73 ha of rain fed land. Sorghum is usually cultivated in rain fed areas. Based on the survey results, the average area of land ownership were less than 1 ha (79%) and the rest were between 1-3 ha. Most area were the rental status which reached 48.38%.

3.2. Economic viability

Revenue is the result of the cooperation of production factors of land, labor, capital, and management. Literally income can be defined as the remainder of the reduction in value of revenues generated by the costs incurred. To measure the success of farming can be done by analyzing farm income, by doing this analysis can be seen farming picture at this time so it can do the evaluation for the planning of farming activities in the future.

To determine whether the sorghum farming a profitable analyzed BCR (Benefit Cost Ratio). B / C ratio is a measure that indicates the ratio between the value of Net Income (Benefit = B) and Total Cost (Cost = C). Within the limits of the amount of the B / C to know whether an attempt favorable or favorable (Gittinger,1986).

An attempt if the value of the net B / C ratio> 1, then the business is eligible to run, while the value of the net B / C ratio <1, then the project is not viable (Prawirokusumo, 1990).

Based on the results of the calculation of the value of BCR are:

$$\frac{14{,}726{,}600.00}{4.225.000} = 3.48$$

Value BCR> 1 means the farming of sorghum feasible taking into account the fixed ratio was still well worth the effort.

Seed is that independently cultivated by sorghum farmers in the village of Raji, in a hectare of land needed seeds ranged between 5-6 kg. The average of farmers stored seeds for the next planting needs. Seed saving is placed in sealed plastic bottles and still have the growing power in good conditions even without any treatment.

Table 2. Sorghum Economy Analysis per Hectare in Raji Village Demak

	Description	Volume	Unit	Price/ Unit(Rp)	Total (Rp)
Production		4.020	kg	3.663	14.726.600
Production Cost					4.225.000
1	Seed	15	kg	10.000	150.000
2	Fertilizer				
	a. UREA	3	kw	90.000	270.000
	b. TSP	3	kw	110.000	330.000
	c. Ponska	3	kw	115.000	345.000
3	Pesticide	2	bottle	90.000	180.000
4	Labor Cost				
	Tillage	8	DPW	50.000	400.000
	Cultivation	10	DPW	50.000	500.000
	Fertilization	3	DPW	50.000	150.000
	Maintenance	3	DPW	50.000	150.000
	Harvest	15	DPW	50.000	750.000
	Post harvest	20	DPW	50.000	1.000.000
5	**Revenue**		DPW		**10.501.600**

Source: Primary data

3.3. Conditions and problems of sorghum development

Based on analysis of the feasibility of farming, sorghum is feasible to grow by farmers in the Raji Village Demak. However, there is a decreasing tendency in acreage of sorghum in Demak during the past 10 years (2005 -2014). In 2005, production reached 1,619 tons and in 2014 only 404 tons or decreased 75%, which means a lot of sorghum farmers switch to cultivate other profitable commodities.

Viewed from the side of the application of technology, most farmer have good agricultural practiced, sorghum productivity on average over the last 10 years 48 kw / ha, the average lowest productivity in 2011 is 35.69 kw / ha and the highest in 2012 amounted to

62.97 kw / ha. High yielding varieties of sorghum were released during the period 1970-2012 have a productivity of between 2.6 to 6 tons (Subagio and Aqil, 2013).

According to the House (1985), Sorghum has higher yield potency compared with rice and wheat. When soil moisture is not a limiting factor, the results of sorghum can reach 11 t / ha with an average of 7-9 t / ha. In areas with minimal irrigation, the average results of sorghum 3-4 t / ha.

Table 3. Sorghum production at Demak Regency during 10 years (2005-2014)

Year	Harvest Area (Ha)	Production (Ton)	Average (Kw/Ha)
2005	390	1,619	41.51
2006	351	1,456	41.48
2007	172	933	54.24
2008	238	1,244	52.27
2009	185	903	48.81
2010	285	1,202	42.18
2011	72	257	35.69
2012	37	233	62.97
2013	70	399	57.00
2014	81	404	49.88

Source: Agriculture Agency of Central Java (2015) referred from the Agriculture Office of Demak District and Statistic Bureau of Demak

The problem is an obstacle in the development of sorghum in Demak is the fluctuating price. During the last five years (2010 - 2014), the average price of sorghum in the lowest level around Rp. 2000, - and the highest Rp 3.500, -. This condition also caused traders collectors in this area is limited, so the price is controlled by the trader. Meanwhile, if the price in this year goes down then the next year the sorghum is going down anyway, and if the price of sorghum high then next year will increase anyway.

Increasing and decreasing of the sorghum areas may be are affected by the seasons. In this area, planting season is divided to 3 times, in planting season I and 2, most farmer grow paddy and planting 3 palawija (such as soybean, corn, sorghum). Environmental constraints the main reason for choosing sorghum or other commodity for all households. The number of varieties a household plants also varies with changing growing conditions, especially rainfall. When the time of planting is still a lot of rain, the farmers will move to other commodities such as green beans or soybeans, meanwhile if it is comes in poor rainfall, the potential of sorghum land increased.

Currently, the use of sorghum is very limited because even though in the past local people consume sorghum as food but now people switch to practice food that is easy to access and easy to process, such as instant foods rice or noodles. As an alternative food, sorghum require post-harvest process that more difficult than other commodities and no processing equipment available in there, so most farmers sold sorghum yield as raw material only. Although the Raji village is the center of sorghum but no sorghum processing company in their area.

However, our study confirms others that show farmers prefer long-cycle varieties for their superior taste and yield, and grow them when rain and resources permit. It seems

important, therefore to improve both long- and short-cycle FVs, and to help farmers to improve their ability to make choices that optimize production, such as increasing availability of plows and weather forecasts. In other words, crop improvement programs need to specificaly target farmer's growing environments, and to use local germplasm as the basis for this (Ceccarelli and Grando, 2002)

Efforts to improve the welfare of farmers is also one of the obstacles in the development of sorghum, especially in Demak. The Agricultural Agency of Demak Regency during the last 5 years has been no policy to support the development of sorghum. During this time, stimulant assistance for the development of sorghum coming from Province Government funding. While the policy in Demak Regency Government is to support increased self-sufficiency in rice, corn and soybeans from 2015-2017. This condition is explanatory in the development of sorghum in Demak Regency that is constrained by policies that do not provide positive support for the management of on-farm and of the farm.

4. Discussion

Age is a very important factor in the farming system. Ideally, farmers in productive age will have more influence on farming activities because it requires physical strength. These results showed that farmer age spread evenly, but the average of farmers were more than 30 years old, none farmers below 30 years old. This condition means decreasing number of younger generations in sorghum cultivation. The fact showed that 40 % of the population in the village of Raji work as migrant workers.

For most farmers in the village of Raji, sorghum farming has been a culture. With the ease of information flow, farmers began smarter to pick more profitable agricultural commodities. According to Rahmat (2001), the experience is one way the ownership of the knowledge that a person experiences within an unspecified time. Psychologically entire human thinking, personality and temperament is determined sensory experience. Thoughts and feelings are not the cause of action but by the causes of the past.

Family dependent is one of the main reasons for farmers to run their farm, with a large number of dependents, the farmers tend to do better. According Sihol Situngkir et. al., (2007), the large number of dependents is a factor that influences the willingness to do the job. Because if respondents have more dependents, the time allowed respondents to work more effective.

Data showed that 56,6 % of respondents only have primary school and 29% no formal education. Weir and Knight (2004), found that educated farmers are early innovators, providing an example that may be copied by less-educated farmers; and educated farmers are better able to copy those who innovate first, enhancing diffusion of the new technology more widely within the site. However, According to Zhu et. al. (2012), improving education can help local areas retain their surplus farmer, who can then work in local non agricultural jobs or migrate permanently. In the fact, 40 % of the population in the village of Raji work as migrant workers.

Farming experience is one of the factors that affect an farm productivity . The more experienced farmers to manage their agricultural resources the more capable of handling the risks and opportunities in farming. According to Rukka et al. (2006) , the more experience of farmers in farming influence on the way to respond to an innovation. The longer the farming experience, the level of response to a technology will be higher.

5. Conclusion

Social and economic condition in the development of sorghum have good future because most farmers in the productive stage, although the average education level was low but farming experience was quite good. Sorghum farmers acquired their knowledge in sorghum cultivation from generation to generation and has become a culture of local communities.

Even though sorghum was quite viable considering the sorghum price no less than Rp 3.500, - / kg. The condition of the average farmer's land is limited (<1 ha) and most of farmers were rental status and a lot of the number of dependents, there are some factors that made farmers very selective in choosing a commodity to be cultivated.

Decreasing of sorghum production in Demak due to competition with other food commodities that more profitable, more over the local government policies not support the development of sorghum.

Acknowledgement

We would like to thank the Research and Development Board Central Java Province for funding this work.

References

Annon 2, (2010). Sorghum cultivation and uses. (http://www.grains.org index. Retrieved October, 2010.

BPS (2014) Demak Dalam Angka 2014. (Central Bureau of Statistics, Demak Regency in Number, 2014).

*Biba, A.201. Prospek Pengembangan Sorgum untuk Ketahanan Pangan dan Energi. Iptek Tanaman Pangan Vol. 6 No. 2 - 2011. (*Biba, A. 2011. Prospect of Sorghum Development for Food Security and Energy. Science and Technology of Crops, Vol. 6 No. 2 - 2011.).

Departemen Kesehatan (1992). Daftar Komposisi Bahan Makanan. Penerbit Bhratara-Jakarta. 57p (Department of Health, List of Food Composition, 1992, Bharata Publiser, Jakarta)

FAO and ICRISAT(1996). The world sorghum and millet economies Facts, trends and outlook. Italy, India: FAO and ICRISAT

Gittinger, J.P. (1986) Analisa Ekonomi Proyek-Proyek Pertanian. Edisi Kedua. Universitas Indonesia. Jakarta. (Gittinger, J. P.; 1986, Economic analysis of agricultural projects; second edition Indonesia University Jakarta).

Human, S.(2014) Riset & Pengembangan Sorgum Dan Gandum Untuk Ketahanan Pangan. Pusat Aplikasi Teknologi Isotop dan Radiasi, Badan Tenaga Nuklir Nasional (BATAN).

House, L. R. (1985) A Guide to Sorghum Breeding. International Crops Research Institute for Semi-Arid Tropics. Andhra Pradesh, India.

Nasir, M. (1988) Metode Penelitian. Ghalia Indonesia. Jakarta. (Nasir, M. (1988) Research Method, Galia Indonesia. Jakarta.

Nedumeran, S., P. Abinaya, M.C.S. Bantilan.(2013) Sorghum and millets futures in asia under changing socio-economic and climate scenarios. Series Paper Number 2. Inter national Crops Research Institute for the Semi- Arid T ropics.

Rooney, L.W. and R.D. Sulline (1977). The structure of sorghum and its relation to processing and nutritional value. Cereal Quality Laboratory, Texas University, USA. p. 91-109.

Samm, B.M. (2009): Gross Margin Analysis and Linear Programming; Tools in understanding how farmers in the guinea savannah region of Nigeria rejected the most profitable type of sorghum recommended by scientists. Proceedings; Pre-Conference of the Western Agricultural Economics Association 2009 Meeting. June 24, pp. 1-20

Subagio, H. dan M. Aqil, (2013). Pengembangan Produksi Sorgum Di Indonesia. Seminar Nasional Inovasi Teknologi Pertanian. Balai Penelitian Tanaman Serealia (Sorghum production development in Indonesia. 2013 National Seminar on Agricultural Technology Innovation. Cereal Crops Research Institute).

Suratiyah, K., 2008. Ilmu Usahatani. Cetakan ke-2. Penebar Swadaya. Bogor. (Suratiyah, K., 2008. Farming Science. Second Edition. Penebar Swadaya. Bogor).

Weir, S., & Knight, J. (2004). Externality Effects of Education: Dynamics of the Adoption and Diffusion of an Innovation in Rural Ethiopia. Economic Development and Cultural Change, 53(1), 93-113. doi:1. Retrieved from http://www.jstor.org/ stable/10.1086/423254 doi:

Zhu, H., He, L., & Yuan, T. (2012). COULD EDUCATION RETAIN FARMERS IN THE LOCAL AREA? *Hitotsubashi Journal of Economics, 53*(1), 39-47. Retrieved from http://www.jstor.org/ stable/43296277

Manyeverea, A. P. Muchaonyerwa, M. C. Lakera, P.N.S. Mnkeni. Farmers' perspectives with regard to crop production: an analysis of Nkonkobe Municipality, South Africa. Journal of Agriculture and Rural Development in the Tropics and Subtropics. Vol. 115 No. 1 (2014) 41–53