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Adaptation of Dry Season with the Cultivation of Feed Maize in Playen Gunungkidul D.I. Yogykarta

Arif Anshori[1] and Tri Endar Suswatiningsih[2]

[1]Asssessment Institute for Agricultural Technology of Yogyakarta Indonesia
[2]Faculty of Agriculture INSTIPER Yogyakarta Indonesia
*Corresponding author : arifanshori@yahoo.com

Abstract.

Adaptation to the dry season are carried out by some farmers in Gunungkidul Regency by planting feed maize. This research aimed to study the cultivation of feed maize during the dry season. The study was conducted at Playen Gunungkidul D.I. Yogyakarta using the farmer interview and field survey methods. The results showed that farmers growing feed maize with irrigation from deep well pumps. Irrigation were performed on average 7 days, as needed. Farmers are plants maize with an average spacing of 20 x 40 cm and 2-3 seeds per hole. The average of urea fertilizer were 20 kg/1,000 m^2 and NPK too. The fresh weight of feed biomass was 7.512 ton/1,000 m^2. B/C 2.35, farmers profit Rp. 2,384,000/1,000 m^2. The fresh weight of root biomass was 0.788 ton/1.000 m^2. Feed biomass was transported out from the land. Root biomass was returned to the soil. In addition, carbon dioxide absorption occurs in feed maize, consists of feed biomass of 3.673 ton/1,000 m^2 and root biomass of 0.623 ton/1,000 m^2.

Keywords: water deficit, biomass, carbon, profit

1. Introduction

Agricultural land in Gunungkidul Regency depends on rainfall. Only 2,189 ha (2.9%) irrigated, from the total 75,304 ha of agricultural land (BPS Kabupaten Gunungkidul, 2018). Rainfall determines in the management of agricultural land (Suryanti, et al., 2010). However, with limited water, farmers still survive (Twigg, 2004). Farmers plant twice a year, in the first and second rainy season and without plant in the dry season (Anshori, et al., 2012), as a form of adaptation. The third planting during the dry season is prone to failure due to lack of water.

Water determines the success of land use. On rainfed, rain water determines for crop cultivation (Rengganis, 2016), requires additional irrigation. Development and revitalization of water harvest infrastructure in the form as reservoirs, ditches, long storage and pump irrigation to irrigate agricultural land, has the potential to increase cropping index (Kartiwa, et al., 2017), so that the welfare of farmers is realized (Kementerian Pertanian Republik Indonesia, 2015) .

Ground water has been used for agricultural, through pump irrigation. Groundwater has the potential to be developed, although it is not easy (Rengganis, 2016). Utilization of ground water for irrigation is determined by the debit and crop water requirement (Zulkarnaen, et al., 2017). The development of groundwater irrigation must consider local conditions (Lasmana and Millo, 2018). The use of ground water has increased the cropping index (Zuhaedar and Suriadi, 2012). Development and management of irrigation systems is carried out participatory, integrated, environmentally friendly, transparent, accountable and fair (Pemerintah Republik Indonesia, 2006).

Groundwater for irrigation, as an alternative adaptation to rainfed land (Mulyadi, et al., 2015; Mulyadi, et al., 2016), potential for crop cultivation during the dry season. The benefits are increased production, farmer income, biomass production and carbon sequestration. Biomass are organic product of plants (Erenstein, et al., 2011). Carbon sequestration is the absorption of carbon dioxide (CO_2) by plants in the process of photosynthesis, then stored as plant biomass (leaves, twigs, stems, roots) (Bongen, 2003). Carbon dioxide sequestration protects the environment (Gonzalez, et al., 2013; Hese, et al., 2005; Lal, 2001; Lal, 2004a; Lal, 2004b; Navas, et al., 1995; Yoshioka, et al., 2002).

Maize is developed during the dry season, producing biomass for animal feed. The problem of animal feed is not continuous availability, low quality and limited during the dry season (Syamsu and Abdullah, 2009). Biomass maize as a source of animal feed are stems, leaves and cob/kelobot. Composition of biomass maize consists of 39.47% cellulose, 27-32% hemicellulose, 3-5% lignin, 12-16% ash and 1-3% extractive (Riyanti, 2009). This research aimed to study the cultivation of feed maize during the dry season by irrigation from deep well pumps.

2. Methods

The study was conducted at Playen Gunungkidul D.I. Yogyakarta Indonesia, in the dry season, July-October 2019. The cropping patterns applied by farmers as in Table 1. Without plants during the dry season. But, feed maize, groundnuts and vegetables are planted with additional irrigation from deep well pumps. The research period were day without rain.

Table 1. Cropping pattern without and with irrigation at Playen Gunungkidul

	Rainy Season I	Rainy season II	Dry Season
Without Irrigation	Paddy, Maize, Soybean, Groundnut	Mayze, Soybean, Groundnut	-
With Irrigation (Deep Well Pump)	Paddy, Maize, Soybean, Groundnut	Paddy, Maize, Soybean, Groundnut, Vegetables	Feed Maize, Groundnut, Vegetables

Interviews were conducted with 5 key farmers. Interview has to find out the factors that play a role in the adaptation to the dry season by planting feed maize, cultivation techniques and social-economic data. The survey was conducted to obtain the data of feed maize productivity. Wet biomass productivity data were obtained from 2 x 2 meter tiles. Dry biomass were obtained based on percentage of water content. (Eviati and Sulaeman, 2009), total organic carbon is calculated based on the percentage of organic carbon biomass. The percentage of organic carbon is measured based on ash content (Eviati and Sulaeman, 2009), the absorption of carbon dioxide (CO_2) is calculated based on the equivalence of CO_2 and $C_6H_{12}O_6$ in photosynthetic reactions (Baharuddin, et al., 2014 ; Daud, et al., 2014 ; Gardner, et al., 1991). The data were analyzed descriptively (Creswell, 2010).

3. Results

Gunungkidul Regency lacks animal feed during the dry season. Feed maize cultivation are sufficient to feed livestock and increase farmers' incomes. During the dry season, animal feed is limited, demand for animal feed is high, so the price of animal feed is expensive.

Feed maize is a maize that biomass harvested for animal feed. Feed maize is harvested around 60 days after planting, when the highest accumulation of stem and leaf biomass.

According to Paat (2011) there is the highest accumulation point of biomass as a result of photosynthesis in maize.

The deep well pump at Logandeng Playen Village in Gunungkidul is sufficient for agricultural water when low rainfall or in the dry season. Water debit are 15 litre/second. Deep well pump is an adaptation of farmers to lack of water. The use of deep well pumps for feed corn is accepted by farmers, because affordable operational costs, potential to continue. Illustration of deep well pump can be seen in Figure 1.

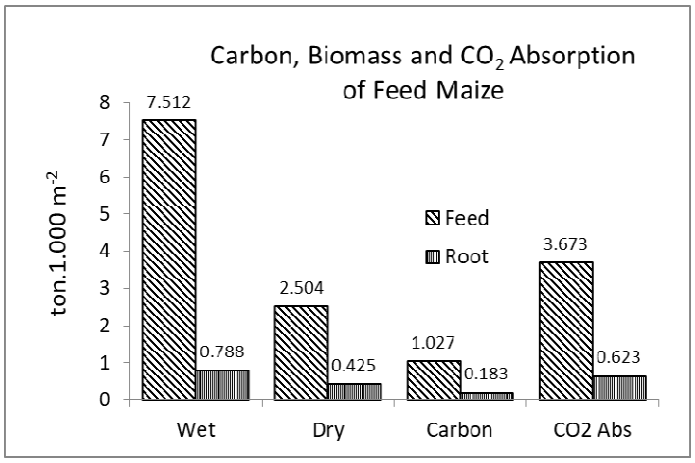
Feed maize cultivation technology has been understood by farmers. Farmers plant with a tugal system and without tillage, planting distance 40 x 20 cm with 2-3 seeds per hole, organic fertilizer 200 kg/1,000 m2, urea 20 kg/1,000 m2 and NPK 20 kg/1,000 m2, weeding when plants age 10 and 25 days after planting, watering with deep well pump every week for 9 times or if needed, and harvested at 60 days after planting. Illustration of feed maize can be seen in Figure 1.

Figure 1. Water pump deep well and feed maize harvesting

Harvesting of feed maize wet biomass produced feed biomass of 7.512 tons/1,000 m^2 and root biomass of 0.788 tons/1,000 m^2. After drying, the feed biomass was 2.504 tons/1,000 m^2 and root biomass was 0.425 tons/1,000 m^2. Organic carbon in feed biomass was 1.027 tons/1,000 m^2 and roots was 0.183 tons/1,000 m^2. The total organic carbon in feed maize biomass (feed and roots) were 1.210 tons/1,000 m^2 (Figure 2). Contribution of feed maize biomass were high. According to Subandi and Zubachtirodin (2004) the potential for maize biomass is high because most photosynthates are directed at the formation of feed biomass, while seed formation is stressed.

Carbon dioxide (CO_2) absoprtion by feed maize in the dry season was 3,673 tons/1,000 m^2 in feed biomass and 0.624 tons/1,000 m^2 in root biomass (Figure 2). Feed maize cultivation in the dry season has reduced the concentration of carbon dioxide (CO_2) in the atmosphere, thus mitigating greenhouse gases. Carbon dioxide (CO_2) is one of the atmospheric greenhouse gases.

Figure 2. Carbon, biomass and CO_2 absorption of feed maize



Farmers get benefit by cultivation of feed maize during the dry season. Low profits due to narrow land ownership. Farming analysis can be seen in Table 2.

Table 2. On farm analysis of feed maize in dry season at Playen Gunungkidul

Nu.	Description	Unit	Price / Unit	Volume	Rp. / 0.1ha
A	***Explicite Cost***				***796,000***
I	*Material (I+II)*				*166,000*
1	Seed				80,000
	Maize	kg	20,000	4	80,000
2	Anorganic Fertilizer				86,000
	Urea	kg	2,000	20	40,000
	NPK	kg	2,300	20	46,000
II	*Weeding Labor*	*Person*	*60,000*	*6*	*360,000*
III	*Irrigation*	*Times*	*30,000*	*9*	*270,000*
B	***Implicite Cost***				***220,000***
	Organic Fertilizer	kg	500	200	100,000
	Planting and Fertilizing Labor	Person	60,000	2	120,000
C	TOTAL COST (A+B)	Rp.			**1,016,000**
D	**REVENUE**	Rp.			**3,400,000**
	Feed Maize Price	Rp.	3,400,000	1	3,400,000
E	**INCOME (D-A)**	Rp.			***2,604,000***
F	**BENEFIT (D-C)**	Rp.			***2,384,000***
	Feasibility Indicator				
	R/C (D/C)				3.35
	B/C (F/C)				2.35

Cultivation of feed maize is the choice of farmers in the dry season because it saves labor. Manpower is needed when planting, fertilizing and controlling weeds. Labor in the family minimize the explicit costs paid by farmers. The time needed to grow plants is 2 months, thus reducing the cost of watering. For every 1,000 m^2, the total cost is IDR 1,016,000, revenue IDR 3,400,000, income IDR 2,604,000, profitable for farmers, with R/C 3.35 and B/C 2.35 (Soekartawi, 1995). This condition is more profitable compared to maize cultivation on dry land by Taufik, et al (2015) in South Sulawesi with an R/C value of 2.06. This can be a consideration for farmers in choosing commodities to be planted in the dry season.

4. Conclusion

Feed maize are cultivated by farmers with supplementary irrigation from deep well pumps, with the farmer technology, as adaptation to the dry season. Feed maize cultivation during the dry season are beneficial. Feed maize cultivation during the dry season contributes biomass, organic carbon and absorbs carbon dioxide (CO_2). Feed maize cultivation during the dry season with supplementary irrigation has the potential to continue.

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