Application of Technology in Farming and Corn Waste at South Sulawesi

Sunanto[1], Eka Triana Yuniarsih[1], and M. Asaad[2]

[1] South Sulawesi Institute for Agricultural Technology
sunanto_bptpsulsel@yahoo.co.id
Jln. Perintis Kemerdekaan KM. 17.5 Makassar, South Sulawesi
Tel. (0411) 556449, Fax. (0411) 554522
[2] Gorontalo Assessment Institute for Agricultural Technology

ABSTRACT. Maize (*Zea mays* L.) is one of the world's most important food crops other than wheat and rice. Productivity is still low at only reached 4.3 t/ha. Corn needs to increase. Corn crops in all the components can be useful directly or indirectly. The research was conducted in South Sulawesi in February until June 2012, with survey methods and observation at 120 farmer respondents. Assessment results indicate that corn farming on dry land and paddy fields after rice in South Sulawesi is a potential, as supported by natural resources and human resources (farmers). The results of the feasibility analysis of maize farming feasible to be developed because it gives the production rate of 5.930 kgs/ha at a cost of Rp 6,220,600/ha and revenue of Rp 14,825,000/ha. So that the income of Rp 8,604,400/ha with the R/C 2.38. Corn wastes can be used as animal feed, the farmer is often used among other components of the leaves, stems, and klobot by providing support equal 3 cows for 312 days. The advice given is guidance to farmers should be increased because farmers have a responsibility to change the level of technology is quite high, but it also supported the willingness and ability of farmers. Continued integration of crop assessment - cattle on dry land and paddy fields to utilize agricultural wastes, agricultural wastes that have added value.

Key words: maize, technology application, waste corn.

Introduction

Maize (*Zea mays* L.) is one of the world's most important food crops other than wheat and rice. Communities in Indonesia, also use corn as a staple food. Aside from being a source of carbohydrates, maize is also produced as an animal feed ingredient and industrial raw materials (Anonymous 2012). In fact, corn has an advantage because it contains a functional food as dietary fiber, elemental Fe, and beta-karoten/pro vitamin A (Suarni 2009).

National corn production is dramatically increased from 9.7 million tons in 2000, to 17.8 million tons in 2010. While yields increased from 2.8 t/ha to 4.3 t/ha (Fauzi *et al.* 2011). South Sulawesi Province as the nation's largest corn producer after East Java, Central Java, Lampung, North Sumatra and East Nusa Tenggara. ROOF (fixed rate) 2010, maize production in South Sulawesi in 2010 as many as 1.34 million tons of dry grain, obtained from the harvested area of 303.38 thousand hectares and the productivity of 4.43 t/ha. ARAM III (figures divination) 2011, maize production in South Sulawesi Province was estimated at 1.37 million tons of dry grain. Compared to production in 2010, there is increased production of 28.47 thousand tons of dry grain (2.12%). The increase was due to an increase in productivity of 0.35 t/ha or 7.81% (South Sulawesi BPS 2011). Productivity is still low, because of the potential productivity of corn reached 4.5-10 t/ha, depending on the potential of land and production technology applied (Subandi *et al.* 2006).

Corn needs are increasing with population growth and poultry. Over the last five years, demand for corn feed industry raw materials, food and beverages increased by 10-15% per year (Zubachtiroddin *et al.* 2007). Increased demand needs to be balanced with adequate production, so imports of corn could be reduced.

Maize farming in South Sulawesi, is still largely done on dry land farmers. Varieties that are used mostly local varieties, but in some areas, high yielding varieties of hybrid in recent years developed rapidly (Tandisau and Thamrin 2009). Cropping patterns adopted by farmers based on rainfall conditions and field typologies. With the potential of land resources and a highly variable climate, sufficient to support agricultural commodities corn developed in the area is quite extensive in some districts in South Sulawesi, one of them in the District Bantaeng (Herniwati and Syafruddin Kadir 2009).

Maize is generally not consumed in the community as well as eating rice. Community consumes only as a sideline food, but the opportunity to develop in South Sulawesi is

very large. Despite this effort to increase maize production remains encouraged by the government since the year 1996/1997 through the planting of corn hybrids and pollinated corn free or composite (Margareta SL *et al.* 2003).

Productivity of corn can only be improved when using fertilizer according to crop needs and the use of hybrid varieties such as superior (Syafruddin *et al*. 2007; Zubachtiroddin *et al.* 2007). While the desire to increase production at farm level can only be done if the exchange rate of the farming quite decent (Djamaluddin Sahari 2004). When the technology is already available and passion increase the productivity of farmers had been living capital, the availability of means of production and marketing of products that must be built or facilitated (Sinar Tani 2005).

Institutional development of agriculture through the development of farmer groups may spur increased production in the long run (Purwanto 2007). Institutional directed to be empowered to self-sufficiency in farming. So in this study will answer the level of technology implementation and utilization of waste corn in South Sulawesi.

Methodology

The study was conducted in February to June 2012 in South Sulawesi Province. Sample is determined by purposive sampling district, namely district site selection is done deliberately by certain considerations such as the district is the center of the corn crop production. Based on these considerations, the district determined Jeneponto, Bantaeng, Bulukumba, Gowa, Bone, and North Luwu as a research location. While the sample of farmers conducted by the method of random sampling, the sample selection of eligible farmers began to cultivate corn and have cattle. The number of samples taken of farmers is 20 farmer/county, so there were 120 respondents.

This research with survey methode. The survey was conducted in six areas of each district with 20 corn farmers and cattle ranchers. The number of respondents there were 120 farmers. Data will be take interviews with a list of questions.

Data collected includes secondary data, primary, and observes field. Primary data obtained from samples taken by farmers are equipped with a questionnaire interview. Data were obtained from institute related secondary. Parameters measured include:

a. Application of technology.
b. Financeal maize farming (Rp).
c. Receipts and revenue (USD).
d. Waste components of maize (t/ha).
e. Waste utilization of corn

Data collected and analyzed the feasibility of using, among others;

a. Receipts (TR = Q. Px).
b. Income (π = TR - TC)
c. Revenue cost ratio (R / C = TR/TC)

Results and Discussion

Characteristics of Farmers

Farmers as a manager in farming and ranching activities have a very big role on the pattern of management. The farmers charracteristic affected by the decision. The farmer characteristics are presented in Table 1.

Average age of farmers belong to productive age (43.5 years). Farmers aged between 27 to 65 years old sari and KK 10.9%. This condition illustrates that at the age of productive ability, willingness, and motivation for farming is very high. Because of this age needs time farm households are the top increased. So that a given

Table 1. Characteristics of corn and cattle farmers in South Sulawesi, 2012.

No	Description	Range	Mean	HK (%)
1	Age (years)	27 – 65	43,5	10,19
2	Education (years)	5 – 12	7,85	2,25
3	Number of Family Members			
	a. The Male (soul)			
	- 0-15 years	0-4	1,28	1,11
	- 15-60 years	0-3	0,93	0,89
	- > 60 years	0-1	0,03	0,16
	b. female			
	- 0-15 years	0-4	1,1	1,13
	- 15-60 years	0-4	1,43	0,84
	- > 60 years	0-1	0,03	0,16
4	Help the farm (the soul)			
	a. Male	0-3	1,33	0,62
	b. Female	0-3	1,03	0,73
5	Land holding (ha)			
	a. belongs to the tiller	0-7	1,02	1,03
	b. lease	0-0,22	0,01	0,03
6	Distance (km)			
	a. House to the garden	0,3-3	1,18	0,66
	b. House to the highway	0,0-3	0,85	0,73
	c. Garden to the store saprotan	0,35-35	4,75	9,13
	d. Home to traders	0-6	1,38	1,76
	e. Home to the owners of capital	0,3-10	4,12	3,51
	f. Home to the BPP	2-12	4,53	3,31
	g. Took home the saprotan	0,5-35	7,06	10,03
	h. Home to posluhtan	0-4	0,24	0,88

Resources: Data primer analysis (2012).

technological innovation in an effort to increase revenue will get a good response.

The range of fairly good education for the farmers because the farmers do not have an education (can read and write). Thus the transfer of technology to the print media can be absorbed, understanded, and understood by farmers.

Household members who become quite relatively few dependents who about 5 people/head of household (HH). At least the family members of the successful family planning program (FPP). Burden on families to meet the needs of households, especially on: the need for food, shelter, clothing, and education can be fulfilled with the ability of each farm household. Farming activities assisted by members of the household about 3 people/families.

Corn and cattle farmers in South Sulawesi, have different characteristics, including age, education, family size, gender, tenure, and distance of the farmhouse to the various strategic places.

Women's involvement in the process of corn and cattle farming are also visible from the table above. Women farmers and the important role large enough to help the corn and cattle farming families. This means that there are no gender issues in women's participation.

Most of the land owned by a tenant-owned land and leased land just a few. The distance between the farmers' land with strategic places an average of close to very far away. As the distance between the houses to the highway is only ranged from 0.01 to 3 km. However, for access to other places like the store saprotan, farmers should take up to a distance of 35 km or to the BPP within up to 12 km, which requires motor vehicle and a long time to arrive.

Maize Technology Application

The success of technology transfer from the source to the farmers' ability to apply user dependent. The ability of farmers based on their potential. The more capable farmers both in terms of land ownership, capital capacity, and availability of personnel will be able to support the implementation of the recommended production technology. Corn farmers in the paddy fields after rice in South Sulawesi Province to implement technologies that are presented in Table 2.

Land management by farmers is by no tillage system. This is done because the land immediately after harvest to clear the land and make draenase. It is intended to speed up the time of planting, to harvest the corn tidah much rain falls on and the next planting season is back.

Table 2. Application of technology in the paddy field corn after rice in South Sulawesi Province, 2012.

No	Description	Aplication of technology
1	Processing of land	LT
2	Use of seed varieties	Bisi 2, Pioneer 21, C7, Bima, Lamuru, etc
3	The number of seeds (kg/ha)	15-20
4	Seed sources	
	a. other farmers	7,5%
	b. breeder seed	12,5% (lable)
	c. seedsman	10,0% (lable)
5	Government program	75,0% (lable)
6	Method of planting	Drill/bolt plowshares horse
7	Spacing (cm)	25 X 75
8	The number of seeds/hole	2-Jan
9	Fertilization	
	urea	337,5 kgs/ha
	KCl	80 kgs/ha
	SP18	100 kgs/ha
	NPK	100 kgs/ha
10	Weed Control	Intensif and using herbiside
	Pest and disease control	Intensif
11	Harvest	100-110 DAP

Remark: LT ; low tillage, DAP: day after plant.
Resources: Data primer analysis 2012.

Varieties of corn planted corn farmers are mostly hybrids. Assisted farmers were given loans C7 hybrid corn seed and Pioneer 21, Bima, Lamuru, etc. as much as 15-20 kg/ha. While the non-assisted farmers obtain seed corn hybrids with verietas Bisi 2, Pioneer 21, and C7 of the store/ kiosk farmer. Seed planted by drill any holes is 1-2 seeds and planting distance 25 cm x 70 cm.

Farmers to plant corn in the growing season months of November - May (dry land) and the month of August to December (wet land), using the SP36 and KCl, there is also the fertilizer KCl and SP18 was not in the market at the time the farmer would use it. So the use of SP36 and KCl substituted with NPK fertilizer (15:15:15).

Maintenance is performed in addition to fertilizing the plants, also on the sugar and pest control. Can inhibit weed growth and crop production as well as pest and disease problems can reduce production. Corn farmers have been doing intensive weed control either manually or using herbicides. While the pest control most of the farmers using pesticides.

Old plants ready for harvest. Corn crop by crop farmers after reaching the age of 102-110 days after planting (DAP). Age of these plants are physiologically ripe.

Feasibility Analysis

Farming corn planted in the planting season MKII / III (August-December 2007). Farm management decisions depend solely on the willingness and ability of farmers. Farmers as decision makers in the allocation of attention to the cost of commodities efforted. Corn grown in paddy fields after rice, so its management is different from the corn crop on dry land. The results of analysis of costs, revenues, and corn farm income are presented in Table 3.

Composition of the biggest costs in corn farming is on the allocation of labor. Allocation for personnel costs ranged from 65.11%. The second is the allocation of the use of urea fertilizer. Costs incurred for the cost of urea fertilizer reached 9.75%. Sacrifices are given to the cultivation of corn to the farmers' production of 5,930 kg/ha, at a price of Rp 2,500/kgs, so that revenues reached Rp 14,825,000/ha. Corn farm income of Rp 8,604,400/ha, with the B/C of 2.38. Thus cultivated maize farming profitable.

Corn Waste Components

The main production consists of maize (corn) and production follow-up (waste corn). Production follow-up was categorized as waste, because production is not utilized or have economic value. Farmers drying the waste corn in the fields and then burn them to expedite the processing of the next land. The corn waste components include: leaves, stems, flowers, cob, and klobot. All components were observed in 10 varieties of corn (2 Bima, Bima Super, RK 789, Lamuru, Anoman 1, Sukmaraga, Krishna, Srikandi Yellow, Gumarang, and Arjuna) planted in the garden district farmers Bantaeng. Volume of each waste component of corn are presented in Table 4.

Table 3. Analysis of the paddy field farming jaagung after rice in South Sulawesi Province, 2012.

Description	Volume	Price per unit (Rp/unit)	Sum (Rp)
Input Support			
a. Seeds	15 kg	40	600
b. Urea	337 kg	1.8	606.6
c. KCl	80 kg	2.55	204
d. SP18	100 kg	2.5	250
e. NPK	100 kg	2.4	240
f. Herbiside	2 liter	80	160
g. Pestiside	1 liter	45	45
Equipment reduce	1 paket	165	165
Resources (Rp)	135 OH	30.000	4.050.000
Sum A+3 (Rp)			6.220.600
Revenue (Rp)	5930 kg	2.500	14.825.000
Income (Rp)			8.604.400
R/C {4/(A+3)}			2,38

Resources: Data primer analysis 2012.

Based on the above Table 5 shows the component volumes of waste corn that has the highest weight is on the cob component is 33.6 g/plant or 2348.5 kg/ha or 31.5% of all the components of waste corn. While the smallest component is the component of interest, reaching 3.1 g/tree or 217 kg/ha or 3% of all waste components.

The number of weights of all components of waste corn reached 103.6 g/plant or 7,254.1 kg/ha. But not all of the components used as livestock feed. Utilization of waste as animal feed is limited to the components of the leaves, stems, and klobot (Table 5). So that the usual weight of waste used as livestock feed cattle farmers reached 4,688.6 kg/ha. Thus the availability of such waste is capable of supporting about three cows for 312 days each tail is assumed to consume 5 kg dry matter/cow (2.5 to 3% body weight).

Waste Utilization of Corn

Waste corn crop in South Sulawesi increased, as the achievement of program digalakkannya corn production 1.5 million tons. Waste ranges from 5-6 tons of maize dry matter per hectare (Ruminant Livestock Farming Directorate 2006; Waste for the Ruminant Feed Islamiyati 2012). Large amount of waste is one source of increased emissions of greenhouse gases (GHGs) because it produces methane gas (CH4). This waste is a potential to be used as cattle feed as well as reduce greenhouse gas effect. The utilization of waste corn in South Sulawesi are presented in Table 5.

Potential waste of corn in South Sulawesi can provide food for 1.4 million tonnes. Availability is able to meet the needs of approximately 760 thousand livestock head/year. If all the potential waste of corn used, then in South Sulawesi have a surplus of forage.

Table 5 shows that the waste of corn has been largely used by farmers, amounting to 78%. Waste generated among which maize leaf straw, corn stalks, and cornhusk.

Table 4. Waste components of maize in South Sulawesi, 2012.

No	Komponent	Dry Wiegth		Share (%)
		Gr/ph	kg/ha	
1	leaf	21,38	1.496,60	20,06
2	stem	23,55	1.648,50	22,73
3	interest	3,10	217,00	3,00
4	cob	33,55	2.348,50	31,46
5	Klobot	22,05	1.543,50	22,75
	Number	103,63	7.254,10	100,00

Resources: Analysis of the average on 10 varieties of corn 2012.

Table 5. Utilization of waste corn in South Sulawesi, 2012 .

No	Description	Remark
1	utilization of waste	
	a. utilize	78%
	b. Not to use	22%
2	Section utilized sewage	
	a. leaf	92,5%
	b. stem	57,5%
	c. Klobot	2,5%
3	Utilization of waste corn for	
	a. Cattle feed	92,5%
	b. Organic manure	7,5%
4	Utilization of waste treatment technologies	
	a. already using	25%
	b. not used	75%

Resources : Data primer analysis (2012).

As cattle feed ingredients, such waste has been utilized by 92.5% while the remaining 7.5% for organic fertilizer. As livestock feed, corn plant waste has a low protein content and low digestibility in cattle. Therefore, maize straw waste fermentation technology, is helping raise levels of nutrition and digestibility of corn in cattle waste. However, utilization of waste treatment technology in South Sulawesi is still relatively small at only 25%, compared to the available potential.

Low-quality feed that is usually because the feed material is generally in the form of agricultural wastes that have low digestibility values. Feeding a low quality will also cause the condition and poor rumen function. Therefore, the various technologies required to maintain the availability of food especially during the long dry season, improving the quality of food or employment optimize rumen. One technology that has been known for a long time is to utilize microorganisms. The main purpose of the addition of microorganisms into the feed to 1) preserve food, or better known as the 'silage', 2) improve the quality of feed is low nutritional value, or 3) improve rumen conditions. Microorganisms that can be used probiotics (bacteria, fungi, yeasts, or mixtures thereof) or may be a product of fermentation or extract product of fermentation process (usually an enzyme). Mechanism of action of microorganisms or their products that into the body cattle and affects digestion (Vienna 2005).

Acknowledgement

In this opportunity to thank for:

1. An incentive programme of the Secretariat of the National Innovation Research (SINas) which has been financing it on Kemenristek research activities.
2. Tim implementer the activities who co involved in this activity.
3. Farmer groups who became the location the research on six territory Kabupaten.

Conclusion

Based on the results and the above discussion suggests that the farming of maize on dry land and paddy fields after rice in South Sulawesi is a potential, as supported by natural resources and human resources (farmers) with huge potential.

Develop viable farming corn due to a production rate of 5,930 kg/ha at a cost of Rp 6,220.6 million/ha and revenue of Rp 14,825 million/ha. So that the income of Rp 8,604.4 million/ha with the R/C 2.38.

Corn wastes can be used as animal feed, the farmer is often used among other components of the leaves, stems, and by providing support equal klobot 3 cows for 312 days.

Reference

Anonim. 2012. Jagung. http:/Wikipedia.org/wiki/jagung. Diakses hari kamis, 14 Juni 2012.

BPS Provinsi Sulawesi Selatan. 2011. Produksi padi, jagung, dan kedelai di Provinsi Sulawesi Selatan (Angka tetap 2009, 2010, dan Angka ramalan III 2011). Berita resmi statistik BPS Provinsi Sulawesi Selatan No. 56/11/73/Th. V, 1 November 2011. www.sulsel.bps.go.id. Diakses Kamis 14 Juni 2012.

Djamaluddin Sahari, Safaruddin, Nurdiah, Armiati dan Repelita. 2004. Analisis nilai tukar sebagai indikator kesejahteraan petani kakao di Noling Bupon Kabupaten Luwu Sulawesi Selatan. BPTP Sulawesi Selatan. Jurnal Sosek, Fapertahut. Universitas Hasanuddin Vol. 19 Tahun 2005.

Fauzi, Achmad I., Fahmuddin Agus, Sukarman, dan Kusumo Nugroho. 2011. Characteristing the soil for improved nutrient management in selected maize growing areas of indonesia. Indonesian journal of agriculture science. Indonesian agency for agriculture research and development 12 (1): 17-32.

Margaretha SL., IGP Sarasutha, dan MY. Maamun. 2001. Potensi dan prospek pemanfaatan lahan untuk tanaman jagung di Sulawesi Selatan. Prosiding seminar regional pengembangan teknologi pertanian spesifik lokasi di Sulawesi Selatan. Puslitbang Sosek Pertanian, Badan Litbang Pertanian, Deptan. Hal. 26 – 32.

Tandisau, P. dan Muhammad Thamrin. 2009. Kajian pemupukan N, P, dan K terhadap jagung (*zea mays* linn.) pada lahan kering tanah typic ustropepts. Jurnal Pengkajian dan Pengembangan Teknologi Pertanian. Balai Besar Pengkajian dan Pengembangan Teknologi Pertanian, Badan Penelitian dan Pengembangan Pertanian, Departemen Pertanian, Bogor. 12 (2): 126-134.

Purwanto, S. 2007. Perkembangan produksi dan kebijakan dalam peningkatan produksi jagung. Dalam: jagung teknik produksi dan pengembangan. Badan Litbang Pertanian, Puslitbangtan, Hal 456-461

Sinar Tani. 2005. Kemitraan jagung aman dan lebih untung. Dunia masih kekurangan jagung 33 Juta ton. Sinar Tani. Edisi 23-29 Maret 2005 nomor 3091 Tahun XXXV.

Subandi, Zubachtiroddin, S. Saenong, dan U.I. Firmansyah. 2006. Ketersediaan teknologi produksi dan program penelitian jagung. Dalam: prosiding seminar dan lokakarya nasional jagung 29-30 September 2005, di Makassar. Puslitbangtan. Hal 11-40.

Suarni. 2009. Prospek pemanfaatan tepung jagung untuk kue kering (cookies). Jurnal Penelitian Dan Pengembangan Pertanian. Badan Penelitian dan Pengembangan Pertanian Departemen Pertanian. Jakarta 28 (2): 63-71.

Syafruddin, Faesal, dan M. Akil. 2007. Pengelolaan hara pada tanaman jagung. Dalam: jagung teknik produksi dan pengembangan. Badan Litbang Pertanian, Puslitbangtan, Hal 205 – 218.

Wina, Elizabeth. 2005. Teknologi pemanfaatan mikroorganisme dalam pakan untuk meningkatkan produktivitas ternak ruminansia di Indonesia: Sebuah Review. Wartazoa Vol. 17 No. 4 tahun 2005. Balitnak, Bogor. peternakan litbang.deptan.go.id, diunduh tanggal 18 Mei 2012.

Zubachtiroddin, M.S, Pabbage, dan Subandi. 2007. Wilayah produksi dan potensi pengembangan jagung. Dalam: jagung teknik produksi dan pengembangan. Badan Litbang Pertanian, Puslitbangtan, Hal 462-473.