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The Prospects of Brown Cane Sugar–Cattle Integration for Rural Economic Development in South Sulawesi, Indonesia

Absract

Sugar is a strategic commodity that has become one of the leading import commodities in recent years. Integration of brown cane sugar (BCS) with cattle is a great business opportunity that can be developed for rural economic development. This integration can optimize the use of marginal lands, and facilitate the development of environment friendly organic farming. The research objective was to identify the potential for the development of BSC-cattle integration based on land resources, technology, culture, labor force, and markets. Data were collected through focus group discussions and interviews of 75 randomly selected farmers in three districts (Barru, Wajo, and Bone). The results showed that there is a huge potential for cultivated farm land of around 302.771 ha, comprising of 10.355 ha rice fields, 86.753 ha dry land, and 205.663 ha paddock grazing. Cattle raising is a cultural activity and major source of income for most rural households. BCS-cattle integration can generate employment opportunities, promote sugar and meat import substitution, produce biogas as an alternative energy source, organic fertilizer, and promote organic-based farming system. For this system to be successful, government support is needed in establishing pilot projects at various locations which are expected to encourage farmers to adapt and develop the integrated farming system for rural economic development.

Key words : Integrated farm, brown cane sugar, cattle, organic farm.

Rationale

An irony has occurred in Indonesia as a tropical agricultural country where most of the agricultural products can be generated, but has imported almost all foods. Meanwhile, a lot of agricultural land is not utilized in the form of concession or controlled individually with many landless farmers. These conditions make less attractive of countryside sector and encourage high urbanization. The unemployment rate in urban areas is higher than in the country side. Unemployment rate has increased from 3.2 percent in 2000 to 8.9 percent in 2009. In 2009, the urban unemployment rate was 11.4 percent higher than in the country side *about* 7.6 percent in the rural sector, and the same thing happened to women unemployment than that of men; amounting to 10.7 and 7.8 percent respectively. Potential areas for sugar cane development in South Sulawesi are approximately 91.108 ha which consist of 10.355 ha of paddy fields and 86.753 ha dry land. Pasture land is also a partly potency converted into sugarcane fields for the small scale sugarcane industry development and at the same time integrated with cattle development.

Sugar is a strategic commodity in Indonesia's economy as it belongs to the group of a nine-basic for daily consumption. In 2010, total national sugar consumption both industrial and

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household consumption amounted to 4.55 million tons, while domestic production is only 2.44 million tons of sugar, the rest met by imports (Karmana et al, 2012). Production to keep pace with consumption of sugar due to several reasons, namely the decline in sugar cane plantations because the land is converted to residential and industrial areas, the decline in yield, continuesly declining price of sugar , and decrease plant efficiency (Aries and Tinaprilla, 2012).

Characteristics of the cane sugar industry is developed in household scale, which is suitable to be developed for rural population; including the poor and women, and much more work items suited for labor in rural areas, including women. The development of brown cane sugar (BCS) can be integrated with cattle so that the resulting production is from beef cattle with feed material from the shoots and leaves of sugar cane. Cow feces and urine waste can be processed to produce organic fertilizer and biogas. Manure as fertilizer is a substitution of part chemical fertilizers and supporting organic farming development and biogas as an alternative energy source. The research objective was to identify potential land resources, technology, culture, and the market for the development and BCS-cattle.

Increased production of sugar cane serves as import substitution, export commodities, drive regional economic development, support an increase in the cattle population as a source of animal protein, meet import substitution, as well as organic fertilizer or substitution of chemical fertilizers that encourage organic agriculture. Development of integrated sugar cane with cattle is an appropriate concept for rural economic development because it will generate huge employment opportunities for the rural population, especially for poor households through agricultural land less productive using.

Conceptual Framework

Integrated BCS-cattle Development

Markets, natural resources, appropriate technology, and culture are a great potential for the development of integration BCS and beef cattle. Sugarcane can be developed easily on marginal lands or not utilized. In intuitively, many sugarcane is planted on asphalt sidewalk in both rural and urban areas, and can grow without well maintained. Cultivation of sugar cane has long been known to the farmer in Indonesia, including processed into brown sugar or palm sugar substitute such as specific used as *Saka*, raw vinegar, and sweetener in Japan (Astuti, 2009).

Cane processed into BCS can be regarded as a culture of rural communities for some farmers in Indonesia. Brown sugar is widely used for household consumption as a sweetener, flavor and color enhancer. Brown sugar can change the soft food texture than crystal sugar and used as a raw material for small food and beverage industries such as soy and *Tauco* industries using brown sugar as a sweetener (Akzar, 2012). In addition, brown sugar is one alternative that can meet the needs of sugar in Indonesia (Sinaga, 2009).

Growing cane and cattle simultaneously to produce BCS and beef is an integration of farming and organic agriculture as well. Integrated BCS-Cattle farm is an innovation to the farmer which will increase their knowledge and skill for organic farm and sustainable

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agriculture. The importance of organic farming for sustainable agriculture perspectives can be found in several studies (Eghball, et al, 2004; Kaur, et al, 2005; Kihanda, et al, 2006 ; and Yaduvanshi, 2003), A set of agricultural technologies or innovation which were simple, effective and need based were selected and implemented to improve the knowledge, skills and abilities of farmers (Kalyani, et al, 2013). Cultivated crops and livestock is an integrated system for efficiency resource used, maintaining productivity , protecting the environment and the health of farmers and their families and at the same time adopting sustainable agricultural system (Hesterman and Thorburn, 1994). Integration of farming will also provide higher revenues due to reducing the use of external inputs. Integratedfarmingis a pattern ofland useon a regular basis, takes placenaturally, andnotusing theexternal input(El Titi, 1992). The integration of farming also encourages farmers to develop organic farming. According to Mannion (1995), organic agriculture is an integrated farm that aims to reflect the strong linkage between farm biota, production and the environment as a whole. Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil biological activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony (IFOAM, 2007).

BCS-cattle integration is a combination of two effective technology that can be easily developed by farmers. Appropriate technology (AT) is an alternative method to overcome the problems encountered in agriculture, whether in relation to the development, production, development opportunities, or the creation of employment opportunities. AT is a technology appropriate to the needs of the community, address the problem of society, preserve environment, BSC easily utilized by the community, and generate additional value from the economic and environmental aspects (President Act No. 3, 2001). AT is cheap and easy which has the potency to overcome the problem in converting natural resources, absorbing unemployment,encouraging domestic industry, and increasing incomes.

Rural Employment Development

Rural workers have low skills and flexible in entering the employment opportunities available in rural areas, especially in agriculture and the informal sectors. Therefore, it is necessary to develop a relatively inexpensive investment in which can be easily developed locally so that rural unemployment and urbanization can be resolved. The skill level of work needed for the BCS-cattle integration is generally lower as well other rural employment.Low human capital, education and experience are dominant characteristics for rural labors (Renes and Ridder, 1995; Gorgens, 2002; Wolf 2002).

The problem of unemployment is not only economic issues but more related to social issues. Types of jobs created in the economy must be in accordance with the capabilities and expectations of the work force (Suryadarma etal, 2007). One of the efforts to boost growth through human resources investment is creating economic activity which has a potential market of products, available local resources, and supported by innovations for appropriate technology. In an era of global trade liberalization tends to drive demand for specific products

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environmentally friendly, and is produced naturally will have a strong bargaining position because it can be developed as an industrial super labor intensive, involving many members of rural communities (Darma, 2012). Small scale Integrated BSC-Cattle is a new technology easily adopted by rural people or famer with low level of education and skill, large number of family labor, especially with female labor. It could be also considered as training process for low input for external sustainable development.

This is the reverse of many intensive or commercial commodity. The study conducted by Baffoe-Asare etal (2013) that social capital and training are variable strongly and significantly influencing adopt technology on cocoa farm. The small scale industrial development based BCS-cattle integration is a concept of labor transformation from urban to rural area. althoughthisis contrary tothe conceptproposed by Feridhanusetyawan & Stahl (2001) that there is the transformation of labor in the global competition from rural to urban areas, from low-technology-based industry to modern technologies, or employment from low-tech and labor-intensive industries to capital-intensive modernindustry.

Employment in agriculture and the urban in formal sector can be expanded due to the labor market and the social structure of the sector which is sufficiently flexible to absorb the workers who are not absorbed in the formal sector (Wie, 2007). At the same time, the capacity of community is needed to be improved through intensive labor investment with appropriate technology as a potential way to improve rural employment and the quality of human resources (Darma and Arsyad, 2010), so the development of BSC-cattle integration is an economic development concept for rural economic development. the rural labor development is a key strategy for rural development and agricultural countries as well (Ellis,1998; Foster and Rosenzweig,1995).

Research Method

The study was conducted in three districts as the center of the development of cattle in South Sulawesi. Specifically Barru districts the center of Bali cattle germplasmdevelopment, Wajo district is an area that generates BCS in the 1960s, and Bone district is an area of the largest sugar cane planting area in South Sulawesi. Primary data was collected by the method of focus group discussions and interviews with a sample randomly selected farmers of 30 farmers in Barru district, 25 farmers in Wajo district, and 20 farmers in Bone district. The data collected include methods of animal husbandry, the potential development of intensive stall, cane planting and cultivation of BCS. Secondary data covering the area of unutilized agricultural land, the area of grazing, sugar cane planting area, and the BCS development site are taken from the office of South Sulawesi Statistical Berau. Qualititative analysis method used to describe the development prospects of integration BCS-cattle based on the potential of natural resources, appropriate technology, culture, labor force, and market.

Result and Discussion

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Land Resources Potency

The development of cane and cattle in South Sulawesi has a huge potency. Cane can be developed in the area of non cultivated agricultural land and grazing land, while cattle can be developed by utilizing an abundant unutilized agricultural waste. Farmers who have business extensive orientation and supported by labor, paddock grazing land can be converted to cane farm and integrated with cattle.

Agricultural land resources in South Sulawesi consists of wetland and dry land with a total area of 2,434,968 ha in 2010. A total of 582,444 ha of rice and about 62,14 per cent of irrigated, while dry land (not paddy) 1,852,524 ha. Approximately 10,355 ha of rice fields are not cultivated or 1.78 percent of the total paddy fields, while 86,753 ha or 4.68 percent of the total area of dry land in South Sulawesi.

Table 1.The potency land cultivated and non-cultivated for cane development (ha)

No.	Kinds of Land	2007 (ha)	2010 (ha)	Changes (ha)	Percentage (%)
1.	Unutilized rainfed	7,527	7,368	159	2.11
2.	Temporary Unutilized rainfed	4,194	2,987	1,207	28.78
3.	Uncultivated Dry Land	114,297	86,753	27,544	24.10
4.	Paddock Grazing	111,500	108,555	2,945	2.64
	Total	237,518	205,663	31,855	13.41

Source: South Sulawesi Provincial Office of Food and Horticulture

There are still around 97,108 ha consisting of 10,355 ha of paddy fields and 86,753 ha dry land. Pasture land is also partly converted into sugar cane for the development of household scale sugar cane industry and cattle development in an integrated manner. If the 50 percent land (205,663) is used for sugar cane development that there is about 52.5 thousand hectares with average of 70 quintals / ha and 10 percent of sugar cane conversion factor of sugar cane production potency. Meaning that, sugar production is about 367.5 thousand tons or about 13 percent of national production or about 20 percent sugar imports can be substituted, and additional cattle that can be kept at least 500 thousand head of cattle, or about 50 percentcattle population in the South Sulawesi.

Human Resource Potency

BSCisabusiness thatcan be developedinsmalland medium-scale andverysuitabletoencouragethe ruraleconomyin Indonesia. BSCProvidingemployment opportunitiesthroughout the year, so therisk offood shortagesis not supportedwitha continuousincomecan be overcome. The development strategyof farmerswithlimitedresourcescan be donewiththe development ofintegratedBSC-Cattle withlowcostfarmingcanprovidehigher revenues(Blanc,et al, 2004)

Large population and less optimize resource use cause unemployment. The population of South Sulawesiin 2010 was 8,034,776, approximately 3,272,365 employment and 298,952

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unemployment, including open unemployment about 0.14 percent of total population. BPS (2013) reported that the employment opportunities in South Sulawesi has increased with very little growth. The total labor force in South Sulawesi Province reached 3,634,355 people in February 2011 with an increase of nearly 97.5 thousand or 2.76 percent compared to the total labor force in February 2010. The total labor force in South Sulawesi in 2012 reached 3,642,426 people, an increase of more than eight thousand people compared to the total labor force in 2011 to as much as 3,634,355 people. The total working population in 2012 as much as 3,407,181 workers or suffer an increase of almost 16 thousand employees compared 2011. The rate participation in the labor force is 65 percent in 2011 getting down to 64.6 percent in 2012, the open unemployment rate open is 6.7 percent in 2011 getting down in February 2011 down to 6.5 percent in 2012 , the number of people employed in the agricultural sector reduced about 123 thousand workers, i.e. from 1,592,299 workers in 2011 to be 1,469,325 workers in 2012; while other sectors have increased by about 2,2 thousand in the processing industry and around 60 thousand in trade / restaurant /accommodation services. GDRP (Gross Domestic Regional Product) for processing sector increased by about 6.10 percent and trade sector, hotels and restaurants 10.07 percent per year during the period 2005-2010.

Employment opportunities in the agricultural sector (including farming, forestry, and fisheries) increased by 50.9 thousand workers from 1,569,316 workers in 2009 to 1,620,177 workers in 2010 (BPS, 2011). It is caused due to an increase in undertaking agricultural area around 13.14 percent of the farming acreage coupled with processing of agricultural produce. GDRP of agriculture increased by about 4.03 percent per year during the period 2005-2010. Total female workforce in South Sulawesi reached 1,07 million people or 88 percent in 2009 which was increased from 2005 with 71.10 percent of total of female labor. The proportion of the female workforce was 47.9 percent in agriculture, 29.9 percent in the commercial sector, restaurants and accommodation services, and 12.3 percent in the service sector, community, social and personal.Female is a potential workforce for the development of BCS-cattle integration because many types of jobs are better handled by female labor. This potential can be seen level greater absorption of female labor in the agricultural sector (45.21 %), even in urban areas the majority of women workers are absorbed in the large commercial, retail, restaurants and hotels (47.33 %t) and social service sector (30.06 %). The particular interest is the proportion of female workers absorbed in the processing industry tends to be higher than male employees respectively 7.69 percent and 6.05 percent and that is good in urban areas or in rural area. Based on these data, there is a potential workforce to develop the BCS-cattle integration around 1,289,419 people or about 35.4 percent of the work force available, temporary employment opportunities can be created with the expansion model is at least 150 thousand job opportunities.

The number of female workers in South Sulawesi reached 1,07 million people or 88 percent of the total female labor force in 2009 and has increased when compared to 2005 which reached 71.10 percent. The proportion of female workers was 47.9 percent in agriculture, 29.9

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percent in trade, restaurant and accommodation services 29.91 percent, and 12.3 percent in the social services sector.

Women's employment is potential employment for the development of BCS-cattle integration because many types of jobs that better suit to the women labor performed. This potential can be seen in the level of women's greater labor absorption in agriculture (45.21 %), even in urban areas the majority of women workers are absorbed in the large commercial sector, retail, restaurant and hotel (47.33 %) and social services sector (30.06 %). The proportion of female workers are absorbed in the manufacturing sector tend to be higher than male workers respectively 7.69 percent and 6.05 percent , and it occurs in both urban and rural areas (BPS, 2011). Based on these data, there is a potential workforce to develop the BCS-cattle integration around 1,289,419 people or about 35.4 percent of the labor force, while the employment opportunities that can be created with the development of the model is at least 150 thousand job opportunities.Cane-cattle integrated is an excellent economic activities because it can optimally utilize unproductive agricultural land, develop livestock population, support the development of organic agriculture, create employment opportunities around 2-3 people per hectare, reduce the level of poverty in rural, and empower women workers (Darma et al, 2012).

Market Potential of BCS and Beef

Sugar is a strategic commodity in Indonesia's economy as belonging to the group of nine basic needs for daily consumption. In 2010, total national sugar consumption both industrial and domestic consumption amounted to 4.55 million tons, while production is only 2.44 million tons of sugar (National Sugar Symposium, 2012). Shortage of sugar supply is meet by importing sugar. In Table 1, it appears that national production is unable to meet the needs of overall consumption and so the government had to import sugar. Sugar consumption can not be matched by domestic sugar production due to several reasons, namely the decrease in sugar cane plantations because the land is converted to residential and industrial areas, the decline in yield, sugar prices continue to decline, and decrease sugar plant efficiency (Karmana et al, 2012, Ariesa and Tinaprilla, 2012).

Table 2. Production, import, and domestic consumption of sugar (in million ton)

Year	Production	Import	Total Supply	Household consumption	Industrial consumption	Total demand
2005	2.24	2.37	4.61	2.78	1.21	3.99
2006	2.31	1.71	4.02	3.08	1.22	4.30
2007	2.95	2.84	5.79	3.39	1.31	4.70
2008	2.57	2.04	4.61	3.83	1.51	5.34
2009	2.30	2.75	5.05	2.97	1.57	4.54
2010	2.24	2.91	5.15	2.86	1.69	4.55

Source: National Symposium of Sugar, Surabaya, Indonesia, 2012.

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Sugar supply shortage will be met from brown sugar as one of the alternatives that can meet the needs of sugar in Indonesia (Akzar, 2012). The potential market BCS magnified by the food industry such as in East Java with the needs of 30-40 thousand tons per year,while the industries can only meet the production needs about 5 thousand tons (Rosdiansyah, 2012). BCS also has export potential with the greatest demand from Canada, USA, Belgium, Australia, and Europe with the amount reach 500 tones per month while the current sugar supply is only 30 to 50 tons permonth (Anonym,2011). East Java province has a sugar can manufactory, owned by Ahmad Rubai, who has became the sole producer and exporter of sugar cane to Japan since 1995. Rubai has exported sugar cane as much as 300 tons per year with a turnover of Rp. 15 M per year. Japan uses sugar cane as raw material for industrial syrup, ketchup, and cake (Astuti, 2009).

On the other hand, beef consumption per capita of Indonesia has reached 1.87 kg. This figure is low when compared to other countries in Southeast Asia. Beef consumption per capita of Indonesia has reached 1.87 kg. This figure is low when compared to other countries in Southeast Asia. Low consumption even then, Indonesia needs at least 448,000 tons of beef per year and from these, only about 85 percent of which can be met by domestic beef production and the remaining approximately 15 percent was derived from imports. Based on these data the number of cattle that is needed is the equivalent of 4.48 million meat weighing 100 kg net per cow or cows imported amount of 672 thousand (15 percent of the 4.48 million head). This deficiency can be met from the cattle population increase in South Sulawesi, about 500 thousand or approximately 74,4 percent as a result of the development and integration BSC-cattle.

Development of Brown Sugarcane

Processing of cane into brown sugar can be considered as a new economic activity known by farmers, especially in the area of cane sugar factories in South Sulawesi. Farmers are presently interested in planting sugar cane for the production of not only sold to sugar cane factories, but also processed to BSC and integratedly with cattle. There is renewed interest in reintegrating crops and livestock because of concerns about natural resource degradation, the profitability and stability of farm income, long-term sustainability, and fostering diverse cropping systems (Russele, et al, 2007; Crews, 2001; Cooper and Gamon, 1991).

In general,sugarcanedevelopedinSouthSulawesion marginal landwithlimited wateravailability. IntegratedBSC-cattle is one formof farmmanagementwithlimited waterin order toutilize thelimitedland resources or marginal land. Improvingthe effectiveness ofland resourceswithlimited water resourcesrequiringknowledgeofgood watermanagement practices(Word etal, 2013)

Sugar cane in South Sulawesi has the potency to be developed based on the availability of land, suitable climate and sugar cane cultivation techniques that are well known by the farmer which has long been cultivated by the farmer in the cane planting area of three factories in

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South Sulawesi. Over the last two years, the total cane area of three sugar cane mills have increased about 5 percent. The increase occurred in the dominant of *PG-Takalar* (Takalar Sugar Factory-PG) while both *PG-Bone* (Bone Sugar Factory-PG) and *PG-Camming* (Camming Sugar Factory) decreased respectively 0.60 and 5.43 percent. This is because for a decade, the three sugar mills suffered losses. The development of sugarcane plantations has occurred in people's cane farm because it is supported by government programs in order to increase the domestic production of sugar and reducing sugar imports.

Table 3.The cane area on the region of three sugarcane factories di South Sulawesi, 2010-2011 (ha)

No.	Factories /Acquisition Land	2010	2011	Change	%
I.	*PG-Takalar*	3,276.86	4,186.03	909.17	27.75
	- Cane of Factory	2,376.68	3,118.49	741.81	31.21
	- Cane of Farmer	900,00	1,067.54	167.54	18.62
II.	*PG-Bone*	3,822.30	3,799.19	(23.11)	(0.60)
	- Cane of Factory	3,822.30	3,743.49	(78.81)	(2.06)
	- Cane of Farmer	-	55.70	55.70	100.00
III.	*PG-Camming*	5,197.44	4,914.99	(282.45)	(5.43)
	- Cane of Factory	4,253.22	3,864.99	(388.23)	(9.13)
	- Cane of Farmer	944.22	1,050.00	(105.78)	11.,20
IV.	Total	12,296.60	12,900.21	(603.61)	4.91
	- Cane of Factory	8,352.20	10,726.97	(2,374.77)	28.43
	- Cane of Farmer	1,844.22	2,173.24	(329.02)	17.84

Sources: South Sulawesi Provincial Office of Plantation , 2012.

The total area of sugar cane for the third plant in South Sulawesi increased from 12,296 ha in 2010 to12,900 ha in 2011. This increase was comprised 28.43 percent and17.84 percent of the concession and farmer of sugarcane acreages respectively.

The development of sugarcane area owned by farmers is financed by National Development Budget (*APBN-Anggaran dan penadapatan Belanja Negara*), the credits of food security and energy (*KKPE-Kredit Ketahanan Pangan dan Energy*) from BRI Bank, Partnership Program for Environmental Development (*PKBL-Program Kemitraan Bina Lingkungan*) from PTPN-X company. Over a decade ago, the processing period for sugar cane milling of thethree sugarcane factories was short due to limited availability of can raw materials.Sugarcane acreage around 13 thousand hectare and an average productivity of 60 tones of cane per hectare and milling capacity 2,500 TCD (tones canday), so that the production processing period of three plants is only about 70-90 days per year, which should be in normally around 150-180 days per year. Development of BCScould encourage farmers to grow sugar cane then make cane to BSC or sold to sugar factories.

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Cattle Development Potency

Raising cattle is a way of life most of the farmers in the South Sulawesi region and serves as a source of additional income and some even made the main source of income. Various innovations are also carried out by farmers, such as the development of collective cages to streamline workforce needs secure, livestock waste collection that can be converted into organic fertilizer and biogas (Darma, et.al, 2012). Integrated BCS-cattle is one of the important farm model, generating benefits, creating employment opportunities in rural areas, attracting the labor force to work in the agricultural sector where urban-oriented looking for work is predominant for rural labor force. Various forms of employment in non-agricultural sector has become obsolete and towards the agricultural sector in the form of their own business (Darma and Arsyad, 2010; Ellis, 1998; 2000).

Cattle had good prospect sand opportunities to develop as a competitive advantage in South Sulawesi. It is supported by the labor input cost components which are relatively cheap, fast agricultural land, and culture in cultivating cattle. Carrying capacity of the dry matter crop waste as animal feed amounted to 25,807 million of livestock in South Sulawesi on 2006 (BPS, 2010).

Table 4. Cow Population Development in South Sulawesi (2007-2010)

No.	Year	Beef cattle	Dairy cows	Total
1.	2007	666,662	1,867	668,529
2.	2008	703,303	1,919	705,222
3.	2009	769,066	1,826	770,892
4.	2010	848,916	2,198	851,114
5.	2011	1,021,110	1,894	1,023,004
	Growth (%)	11.38	1.12	11.35

Source: South Sulawesi Statistical Livestock, 2011.

Over the last five years (2007-2011), the population growth in South Sulawesi increased about 11.35 percent per year. This happens because the cow is a commodity and development priorities of the provincial government of South Sulawesi. Various forms of financial assistance provided by the government, such as the financing for the development of cattle which shall returned to the participating banks for revolving to another farmers. Revolving fund financing is given to sugarcane farmers through Cane Farmer Group (*KPTR-Kelompok Petani Tebu Rakyat*) distributed by BRI bank. In 2011, BRI distributed revolving funds for the development of beef cattle with six farmer groups or Rp 25 million per farmer group for the procurement of livestock, stall, feed, and drugs.

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The population of cattle in South Sulawesi has reached one million head in 2011 which is a fantastic figure, as it is faster than planned, which one million targeted in 2013. Districts of Bone, Wajo, and Barru are cattle development centers in South Sulawesi, so the proportion of the cattle population of about 40 percent of the total population of cattle in South Sulawesi, or 60 percent of the cattle population is spread in 19 districts in South Sulawesi. The density of population in the two districts of Bone and Barru is very high, respectively 20.73 and 22.68 heads per hectare, while the average cattle density for the South Sulawesi was 5.23 heads per hectare and other areas only 3.74 heads/ha. This figure shows that the development of an integrated sugarcane in the two districts should be promoted, because the cattle business is a main business most of the famer community in both regions.

Cattle, the utilization of agricultural waste, and the intensive stall system are the form of farming activities that can support the development of integrated sugar cane-cattle farming system. Cattle has grown mostly farmers in South Sulawesi with farm system from the traditional grazing system to the system supported by intensive stall with particular grass grown. There are farmers who use agricultural waste from grain and fodder crops as the feed sources, but in small quantities.

Table 5. Number of Respondents(advanced farmers) inthreedistrictsbased onrice farmingandlivestockcultivated

No.	Farm Classifications	District of Barru(n=30)	District of Wajo (n=25)	District of Bone(n=20)
I	**Commodity**			
	Paddy	76.6 %	60.0 %	90.0 %
	Crops	20.0 %	60.0 %	75. 0 %
	Bulrush	36.6 %	-	62.5 %
	Cane	-	30.0%	82.5 %
	Cattle	86.3%	25.0%	62.5%
II	**Cattle Farming**			
	Range of Ownership (head)	2-14	2-25	5-25
	Average of Ownership (head)	6.5	8.8	7.0
	Farmers as Agricultural Waste Users	80%	15.0%	62.5%
	Intensive Cage	3.3%	5.0%	37.5%
	Seller of Manure	10.0%	25.0%	-

Sources: Primary Data, 2012.

Farmers cultivate paddy, crops, and cattle were on the three study location, but grass and sugar cane cultivation has not been done in all areas. Cattle management systems differ among the three areas. Cultivation of grass and agricultural waste utilization correlated with cattle management development as the casein the District of Bone and Barru. There is great potential

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area for the development of an integrated BCS-cattle the three study sites, Barru, Wajo, and Bone districts.

Communities in Wajo district was the first to know or process cane into brown sugar, but this business was not growing because not supported by processing technological innovations. Cattle business is also done by some farmers, but more in the form of grazing system. Semi-intensive or intensive systems have been introduced by the government, but has not well responded by the community. They are not used to cultivate specifically fodder or using agricultural wasteso that the cattle businessis still a secondary enterprise, eventhough Wajo district is one of Bali cattle development centers in South Sulawesi.

Cattle, especially Bali cows is the traditional business or culture for most farmers and growers as well as the main business, so Barru district is one of Bali cattle development centers in South Sulawesi as well as local germplasm preservation of Bali cattle in Indonesia. Cows is cultured by semi-intensive and intensive. Semi intensive is done using natural sources of feed in the form of forage that grows wild and agricultural waste such as straw, corn stalks, and other crops, while intensive culture is done by using a source of food from the cultivation of elephantgrass *(orchard grass)*, hay, processing manure, and urine to produce organic fertilizers. Farmers in Barru district are not familiar with cane plant that can be processed into sugar and as a food source cattle which every rancher in Barru is raising cattle between 5-10 heads. It can be said that every 5 cows can provide employment opportunities around 1 person. Cow manure and biogas are utilized in this area. Faces as manure is sold at Rp500/kg while the urine is process to liquid fertilizer product, but the concentration and effectiveness of urine use is not known yet by farmers. Cultivation of sugar cane to crystals sugar is well known farmer in the district of Bone since the 1960s when PG Bone was built, however, the processing technique has not been widely known BSC by sugar cane growers in this area, including the top of the cane has not been use extensively as a source of green livestock. This happens because sugar harvest conducted simultaneously, causing time availability of sugar cane tops as cattle forage food source is very short, so it was not a concern by ranchers.

District of Bone is also a center for cattle development in South Sulawesi with the largest cattle population among districts in South Sulawesi. Cattle, especially Bali cows is a traditional livestock or culture most farmers and growers as well as the main business, so the cows is cultured by semi-intensive and intensive. Semi intensive is done by using natural sources of food in the form of forage that grows wild and agricultural waste such as straw, corn stalks, and other crops, while intensive culture is conducted by using food sources of yield grass farming (orchard grass) and hay.

BCS-Cattles Integration Appropriate Technology

Cattle, agricultural waste utilization, and intensive stall system is a form of agricultural activity that can support the integration of sugarcane farm and livestock.BCS could be produced easily by harvesting sugar cane farm routinely and followedbythe growthof new shootsthatcan

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be harvestedaspuppiesafterat leastninemonthsold.Sugar cane can be harvested everyday in rotation for7-8 months per year, or during the off-season of rain. Household farmers can harvest 0.5 to 1 ton per day or depending on the cultivated sugar cane area. The nature of this crop, sugar cane shoot leaves as a waste that can be used as fodder. In addition, there is molasses as waste produced during in the process of cooking cane juice into BCS. Molasses is an excellent mixture of cow's food.

BSC processing is an appropriate technology (AT), using sugar cane juice machine that can be manufactured locally and powered by an engine of 8-12HP (Horse Power), and complemented with a stove cooking using pans lined with 4-6 units for each stove, The processing capacity is about 2 tons of cane per day.

AT-BCS is fuelled efficient because the bagasse produced from sugar cane juices as an energy source is enough to cook the sap of sugar cane to the BSC. BCS-cattle integration can be developed locally with a small amount of investment and support the development of intensive stall integration with bio digester which is an AT that has been well known to the rural community, but has not been developed because it is not supported by the availability of adequate feed to grow cow. Economies of scale integration of both ATs can be reached easily and provide enormous impacts toeconomic, social, and environmental aspects.BSCincreases employment opportunitiesin the agricultural sectorandfarmers' income, and simultaneouslyboost employment opportunitiesoutsidethe agriculturalsector. The development ofemployment opportunitiesoutsidethe agriculturalsectorassociated with theBSCwillencouragerural and regional economic development. Thecreating newruralagriculturalemploymentpositivelyinfluencethe growing of non-agricultural sector(Brazil andBukeynya, 2012). This contrasts with other regions, business linkages of agriculture and non-agricultural sectors lowers farm incomes, especially for small-scale farmers who, because of lack of land or capital, are engaging in non-farm employment to supplement farm incomes (ADB, 2003).

BCSwillencourage thedevelopment ofthe cattle populationgrowthboth incultivation andfatteningsystem.The potential of cattle weight increase about 0.25 percent of body weight to about 10% of food forage (plus a bit of concentrate) or 3 percent of dry matter/concentrated. This means that every one kg of concentrate can be changed at least 2.5 percentor every one kg of forage to a minimum of 0.25 % of meat per day. The potential of Bali cattle weight is average of at least 0.25 kg per day of 100 kg cattle weight. Intuitively, the oldcane leavesareremovedfrom the stemsand shoot leaves of sugarcanemixedwithmolassesandsugarcanejuicefoamisagood feed. Whenused asthe mainfeedoncattle, cowweightincreased byat least0.25kg/day. If theprice ofbeefRp80,000/kg or equivalent to Rp48,000/kg of price live weight(60% of theprice ofmeat), whichmeansthatfarmerscanreceivea minimum ofRp12, 000/dayof additional cowweight(0.25 kgxRp48,000/kglive weight).

IntegratedBSC-cattle farmingis a systemwith highlyefficientandenvironmentallyfriendly. This systemcanreducenutrientleachingprocessbecause tillage activitiesare notcarried out, whileolder leavesof sugarcaneused asmulchtoreducenutrient leaching during rainy season.Leachingof Nin sugarcaneisdifficult to avoidgiventhe absenceof cover crops,

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especiallyduring the rainy season (Shoko Ishikawa, 2014). Potential cane shoots are 30 percent of the production of sugarcane and 10 percent of the old leaves, or about 40 percent of food biomass, when about 80-90 tones of sugarcane production, the total weight of approximately 125-140 tones/ha/year of biomass production, which consists of sugar cane, shoots leaves, and old leaves. Potential old and shoots leaves are available for harvest (200 days), about 150-200 kg per day or to meet the needs of cows 8-10 heads per hectare for during harvest. Cattle development in an integrated manner with the BCS could provide a workforce of about 3 people per hectare.

Conclusion and Recommendations

When BCS-cattle integration scenarios developed, household scale BCS industries are also growing with some potential and prospects such as 1) brown sugar product can be marketed in the form of brown crystal sugar (*palm suiker*) which are often found in hotels and as raw materials for food industries; 2) BCS can also be developed as an export commodity in great demand abroad because less or no chemical contain; 3) The BCS-cattle integration will boost as an alternative income source of farmer. The utilization ofagricultural wastesasalternativesources ofincome; and 4) it is expected in the future that there will be a processing technology converts BCS to white crystal sugar, so the raw material for crystal sugar factory is the BCS produced by big amount of cane farmers and the white crystal sugar factories could be operated along the years or it is not depended to the season as well as conventional crystal sugar factories.

BCS-cattle integration is an alternative concept for rural development and sustainable development in South Sulawesi. There is a great potential for cultivated farm land around 302,771 ha that can be developed for the development and BCS-cattle integration because of the cow is a culture and a major source of income for most residents in rural areas that can be improved through the integration of processing BCS. Meanwhile, the development of BCS-cattle integration creates employment opportunities 3 people per hectare, sugar and meat import substitution, biogas an alternative household energy source, organic fertilizers that encourage environmentally friendly farming.

Thegovernment support isexpectedtomakea pilotoneacharea andinvolving advancedfarmers considered as early adaptors to develop BCS-cattle farm integration while encourageother farmersto be followers.

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