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Optimization Model of Farming of Rice, Cash Crops, Mango and Cattle Integrated in South Sulawesi (Case Study in Bone Regency and Maros Regency)

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KEYWORDS

Integrated farming,
Rice,
Cash crops,
Mango and cattle

A B S T R A C T

The aim of this study was to determine the contribution of rice, cash crops, mango and cattle farm income based on extensive land holdings in South Sulawesi. The study was conducted from February 2015 to May 2015 in the Bone District Maros Regency. The results show that integrated farming of rice, mango and cattle can contribute to broad based ownership of land revenue. General overview and potential study sites as well as farmers cultivated cropping patterns respondents is an indicator to see how big the contribution of earned income farmers.

Introduction

Agriculture development paradigm has meaning very important role in advancing agriculture, efficient and resilient in supporting the growth of the national economy especially Indonesia as an agricultural country that largely populated livelihood in the agricultural sector. The agricultural sector plays an important role in the national economy. Conventionally, according to Koestedjo *et al.* (2012) is the role of related functions goalkeeper food security (food security), absorbing labor, foreign exchange, provider of industrial raw land and guard the environment.

The roles and functions of agriculture to date have not been optimal. The agricultural sector as the main source of life for farmers and their family members has not been able to provide adequate welfare. This condition,

according to Howara (2011) and Rifki (2012) requires the commitment of all parties including government, researchers, the private sector and other stakeholders to work together to think of a proper regulation targeted primarily to the factors that affect the agricultural sector so that its role and functions have not been optimal.

Today, the livestock sector as the main sector producing animal food protein has been progressing well in Indonesia, although this is not entirely the case in ruminants, especially cattle. According to Hasan and Darwis (2013) that the beef demand in Indonesia has not been fully met in the country, so as to fulfill it, do import activity which is thought to have lasted nearly 20 years

Population growth and an increase in people's income is followed by an increase in awareness of nutrition, urbanization and changes in people's eating patterns that lead to increased animal food causes the increasing demand for livestock products. Indonesian beef consumption in an average of 0.417 kg per capita / year (Food Consumption Statistics 2012) and specifically South Sulawesi amounted to 3.52 kg per capita / year (South Sulawesi Livestock Statistics, 2013). Indonesian beef consumption demand in 2014 is expected to increase 2–3 folds by 2020 (Hasan *et al.*, 2014).

Increased demand and consumption of beef cannot be offset by an increase in domestic production, both in quality and quantity, so that there is a gap between demand and supply (Priyanto, 2011). According Sianipar *et al.* (2002) that one cause is narrowing of the growth of forage land for grazing areas due to industrial development and settlement as well as the availability of animal feed as one of the causes of low livestock population. Meanwhile, according Indrarosa (2012), due to a touch of advanced technology weapons is limited, so the population is low, while the rate of demand and cattle slaughtering level tends to be higher as a result of the increasing demand for meat. To solve these problems required planning can increase farm income, increasing livestock production and at the same time preserving agricultural land (Chukwuji, 2008; Hassen Beshir and Bezabih Emana, 2012). In other words, it needs sound planning of sustainable agricultural farming. According to Ranaweera *et al.* (1993); Karn *et al.* (2005); Franzluebbers (2007); Howara (2011); Kathleen (2011) and Koestedjo *et al.* (2012), that one of the technologies that can be used is the integration between crop and livestock farming, known as crop livestock system.

Based on resources owned by farmers, to achieve the maximum goal of farmers in need of proper planning in terms of allocation of resources as well as the type of commodity to be commercialized and linked to the farming input and output prices (Choosakul and Kobayashi, 1999; Lenne, and Thomas, 2005; Mohaddes and Mohayidin, 2008). Planning it will easily determine the most optimum farming branch obtain the maximum revenue (Chen and Tsai, 2001; Chukwuji, 2008; Mirkarimi *et al.*, 2013; Adejobe, 2003; Masniati *et al.*, 2012; Igwe and Onyenweaku, 2013). One analytical tool that is able to capture the diversity of farming activity variables, constraints and determine the best alternative is Linear Programming (Dantzig, 1963; Sharma and Jana, 2007).

Research Method

Types and research approach

The approach used in this research is a quantitative approach (quantitative research). Quantitative approaches based on

the philosophy of positivism (measurable and observable) that emphasize the phenomena studied objectively and quantitatively. Maximization objectivity positivistic research design is done by using numbers, mathematical processing program set out in the LP.

Data in the form of numbers that have been formulated serve as accurate information in the study.

Population and sample research

Sampling method in this research is done in stages. The first stage to define the study area was determined by the method of intentionally (purposive sampling method).

The second stage, conducted proficiency level of the population sample size determination can be representative of the population using the formula Slovin in Umar (2001) as follows.

Formula:

$$n = \frac{N}{1 + N (e)2}$$

Where: n = Total of Sample
N = Total of Population
e = Allowance level (10%)
Thus obtained the following results:

$$n = = \frac{N}{1 + N (e)2}$$

$$= 1800/(1+1800(10\%)2$$

$$= \frac{1801}{180} = 100$$

The third stage, the study sample was obtained 100 farmers but because the population is heterogeneous so to obtain homogeneous data sampling performed by Stratified Random Sampling namely population is classified into strata based on large-scale land is as follows:

Collecting data method

The type of data in this study are primary data in the form of the perception of respondents regarding the optimization of rice, cash crops, mango and cattle farming in an integrated manner, as well as the performance of which are arranged in the form of a questionnaire. The data collected in this study derived from primary and secondary data. Secondary data was obtained from BPS, Agriculture and Animal Husbandry Department of South Sulawesi province, Bone and Maros Regency. Primary data was collected through research instruments.

Data analysis methods

The data were analyzed qualitatively and quantitatively. Qualitative data analysis was done descriptively that describes the characteristics of respondents, farm characteristics, characteristics of the cattle business. Quantitative analysis was performed with the approach of Linear Programming (LP) which aims to get the combination pattern of business branches and optimal resource allocation. Quantitative data was processed manually then tabulated based on activities and incorporated into a linear program. The tabulated data have been compiled into the equation for the function of the purpose and the inequality constraint functions.

Results and Discussion

Demographic conditions

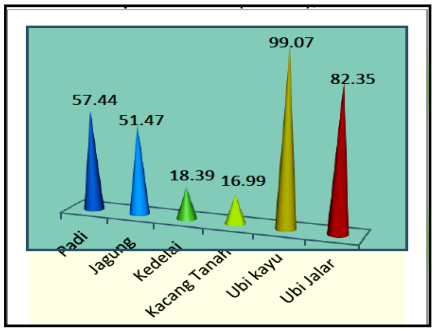
Size Bone County is 4,559 km^2 with a population of 734 119 in 2013 which consisted of men and women 384 402 349 717 souls soul. While the population in 2013 amounted Maros 331 846 inhabitants, spread over 14 districts. In general, the ratio

between the populations of men with women (sex ratio), more women than men with a ratio of 96 men compared with 100 women.

Agricultural conditions

Bone Regency

Rice crop harvested area in Bone regency end of 2013 was 131.903 hectares with a production of 777.733 tons of milled rice or average production of 5.94 tons / ha. Harvested area of 24.658 hectares of corn crops and production reached 136.310 tons or an average of 5.53 tones / ha, soybean 9.391 hectares and 17.616 tones of production, peanut 6.225 ha and production of 11.229, 1.095 hectares of cassava and production reached 10 849 tons, sweet potato 484 hectares and production reached 4.016 tons.



Crop productivity in Bone regency can be seen in Graph 1. Based on chart image productivity of food crops, the cassava plant has the highest level of productivity that is equal to 99.07 percent, followed by 82.9 percent sweet potato, rice 57.44 percent, maize 51.47 percent, soybeans 18.39 percent and the lowest was only 16.99 percent peanuts.

Then for annual horticultural crops like mango, farmers have not done intensively. Generally, fruit trees, especially mango plants maintained as a sideline activity and land filling.

Maros Regency

Maros rice production in 2013 amounted to 308.688.13 tons were harvested from an area of 50,385 ha, or an average of 61.25 quintals per hectare. Most of the rice production in Maros regency generated by this type, it is 322.429.44 tons. While 1.51 percent was generated by rice fields. For more details, crop production in Maros regency which is based on the Central Bureau of Statistics Maros 2012, can be seen in the image (Figure 2)**.**

Crop plantations in Maros regency in 2013 is a plant that produces hazelnut 6.375,4 tons and most of these plantation crops produced by smallholder agriculture. The forest area in Maros area of 65.020.24 hectares which include 14.610,68 ha of protected forests, nature reserves and conservation 2.8610,9 natures, 15.364,49 hectares of limited production forest and 6.343,13 hectares of production forest remain.

Livestock conditions

Bone regency

Bone regency is one farm commodity production centers. The population of large livestock (cattle, buffalo, horses and goats)

in Bone regency during the timeframe 2012-2013 increased 1.46 percent from 339.095 head in 2012 rose to 344.056 head in 2013. While poultry (chicken laying, broiler, domestic poultry and ducks) in 2012 the population amounted to 3.531.127 head, tail dropped to 2.737.453 in 2013 or a decrease of 22.48 percent.

Maros regency

Maros is a center of farm commodities such as meat, eggs originating from small livestock, large livestock or poultry. Breeds cultivated in Maros regency in the form of large livestock, small and poultry. In 2013 the number of cattle is 69.944 head, 2.632 head of buffalo, 5.636 of horse, 23.171 sheep and 729 pigs. While the number of poultry in Maros is 788 989 chicken, 278.567 laying hens, broilers 11046.37 290 386 ducks and manila.

Potential each district / location research

Land Use

Land Use of Libureng District

Raw vast land of Libureng District was recorded 34 425 ha. Wetland has the highest area, approximately 53.94 percent. Garden land area is 17.175 ha. The type of soil in Libureng districts is grumosol Mediterranean and Latosol. Soil pH ranged from 2.4 to 6.5.

Land Use of Simbang District

The land area in Simbang District is 105, 31 km^2. Wetland for agriculture is 4,212 Ha. The land area that is not cultivated for rice farming is 1,368 hectares for dry land, 3,211 hectares for forest, 38 hectares for plantation, and 430 hectares for community forests. While the land that is not cultivated for rice farming is 308 ha for residential land, 751 ha for industrial land /office and 1,958 ha another.

Livelihood communities around the research locations

The livelihoods of residents in Libureng and Simbang district are quite diverse, but the largest percentage is farmed. While other jobs are scattered in the fields of industry and services. Grouping people base on their job can be seen in table 2.

The State Agriculture of Research Area

The main products of the agricultural sector in Libureng and Simbangdistrict are food crops, rice, crops, horticulture and fruit. Agricultural products are generally marketed directly to consumers or to the intermediary traders. The existence of traders is sometimes detrimental to farmers because of less favorable purchasing system. Pricing System is determined by traders so that farmers have a bargaining power that is low. An overview of the types of crops, crop acreage and productivity can be seen in table 3.

Overview of Livestock

Livestock that are commonly breed by farmers in Libureng and Simbang district besides farming is ruminant, non ruminant and poultry. Poultry, ruminants and non ruminant population in Libureng and Simbang district can be seen in Table4.

Table 4 shows that chickens have the highest percentage of the population in Libureng and Simbang District. Based on the economic value of cattle can provide value-added significantly to the income of farmers in Libureng and Simbang district. This is due to the selling price of cattle per

head is quite high when compared to the selling price of poultry per head. Selling prices for various types of livestock can be seen in seen in table 5.

The population growth of large animal and small animal during 2012 and 2013 at two study sites, namely Libureng and Simbang can be seen in Table6.

In the table 6, the development of the livestock population in 2013bothin the Libureng and Simbang district, there are an increasing and decreasing population. Ruminant population (cattle, buffalo, and horse) in Libureng and Simbang increased. But, small animal population (layers, broilers, local chicken) decreased. In Simbang district, broilers population increased from 1.545.312 in 2012 to 1.654.310 in 2013. While in Libureng district, layers population decreased from 6.890 in 2012 to 4.920 in 2013 and at the same condition was happened in local chicken. Duck population in Simbang district is more than Libureng district.

In the table 7, explaining that the highest percentage of slaughtered livestock were goats (28.57–45.5%), and then cattle (11.98 to 13.62%). Goats much cut to the needs of public consumption

In Table 8 explains that the cow is the most demanding public cattle to be traded although only (9.62 to 35.29), while the goats (5.0 to 42.85) percent per annum. Buffalo, horses purchasing activity is very slow sales.

Table.1 The result of calculation sampling

No	Scale Land	Population	Calculation	Sample
1	< 0,5 Ha	793	793/1800 x 100	44
2	0,5 – 1 Ha	661	661/1800 x 100	38
3	> 1 Ha	356	356/1800 x 100	18
Total		1800		100

Source: Results of primary data processed in Libureng District, Simbang Regency.

Table.2 Grouping resident of Libureng and Simbangdistrict based on the type of job

No	Livelihoods	Libureng District	Simbang District
1.	Armed Forces/ Police	45	18
2.	Civil Servant	205	90
3.	Teachers	757	180
3.	Private Employees	189	277
4.	Pensioners/Retirement	275	61
5.	Farmers	15.080	7.495
6.	Trader	1.140	522
8.	Carpenter	340	162

Source: Monograph of Libureng and Simbang District in2014

Table.3 The type of plant, harvested area and plant productivity in Libureng and Simbang District in 2013

Type of Plant	Libureng District		Simbang District	
Food and Horticulture	**Harvested Area (Ha)/tree**	**Production (Ton)**	**Harvested Area (Ha)/tree**	**Production (Ton)**
Rice inIrrigation	9.851	66.644	4.212	27.757
Rice in Field	-	-	165	990
Corn	243	1.282	255	1.428
Soybean	590	1.119	1.250	2.375
Peanuts	1.077	1.955	40	76
Green Beans	25	162	-	-
Cassava	1	10	12	190
Sweet potato	21	186	13	180
Mango	15.400	5.685	460	19.412

Source: Monograph of Libureng and Simbang District in2014

Table.4 Poultry, ruminants and non ruminant population in Libureng and Simbang district, 2013

Libureng District		SimbangDistrict	
Type of Animal	Total (head)	Type of Animal	Total (Head)
Cattle	39.656	Cattle	5.555
Buffalo	569	Buffalo	114
Goat	336	Goat	67
Horse	294	Horse	192
Layers	861	Layers	1.685.591
Broilers	4.920	Broilers	404
Local Chicken	192.477	Local Chicken	21.281
Duck	1.513	Duck	9.663

Source: Statistical office of Bone and Maros regency of South Sulawesiin 2014

Table.5 The selling price of cattle per tailin Libureng and Simbang District, 2014

Animal	Price in Libureng District		Price in Simbang District	
Cattle	Min(Rp.000)	Max (Rp.000)	Min(Rp.000)	Max (Rp.000)
Calf				
Male	5.500	5.500	5.500	6.500
Female	4.000	4.000	4.000	5.500
Young				
Steeer	6.500	6.500	6.500	8.000
Heifer	5.500	5.500	5.500	7.000
Adult				
Bull	8.500	8.500	8.500	12.500
Cow	7.500	7.500	7.500	11.000

Source: Animal Husbandry Office of Libureng and Simbang, 2014

Table.6 The population growth during 2013 in Libureng and Simbang District

Type of Animal	Animal Development in Libureng District			Animal Development in Simbang District		
	2012	2013	Average (%)	2012	2013	Average (%)
Cattle	38.009	39.656	4,33	5.483	5.555	1,31
Buffalo	560	569	1,61	98	114	16,32
Goat	318	336	5,66	59	67	13,56
Horse	273	294	7,69	186	192	3,22
Layers	878	861	-1,94	576	404	-42,57
Broilers	6.890	4.920	-2,86	1.545.312	1.654.310	7,53
Local Chicken	259.613	192.477	-25,86	23.118	21.281	-7,94
Duck	1.450	1.513	4,34	9.503	9.663	1,68

Source: Animal Husbandry Office of Libureng and Simbang, 2014

Table.7 Ruminant slaughter development in Libureng and Simbang District, 2013

Type of Animal	Animal Development in Libureng District			Animal Development in Simbang District		
	2012	2013	Average (%)	2012	2013	Average (%)
Cattle	411	467	13,62	217	243	11,98
Buffalo	15	12	-20	4	3	-25
Goat	11	16	45,5	7	9	28,57
Horse	7	5	-28,5	0	0	0

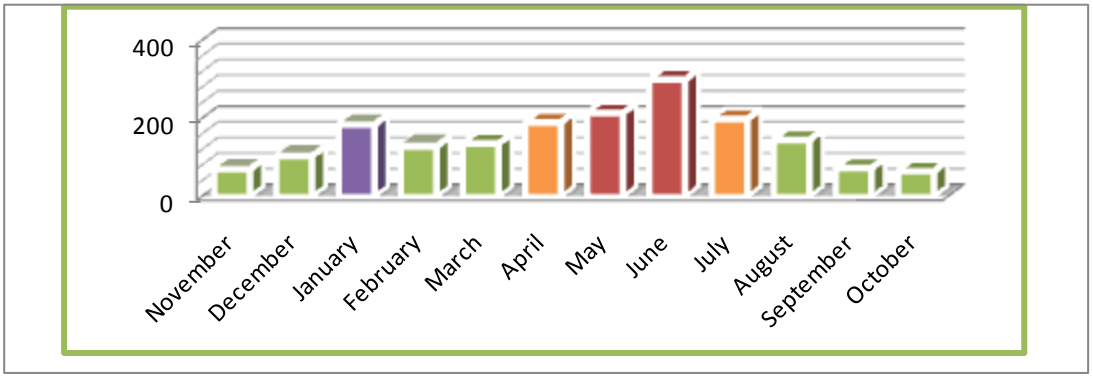
Source: Statistical office of Bone and Maros regency of South Sulawesiin 2014

Table.8 The development of cattle selling in 2012 in Libureng and Simbang District

Type of Animal	Animal Development in Libureng District			Animal Development in Simbang District		
	2012	2013	Average (%)	2012	2013	Average (%)
Cattle	2.089	2.290	9,62	493	667	35,29
Buffalo	9	27	20	9	11	22,22
Goat	16	24	5,0	7	10	42,85
Horse	14	17	21,43	5	7	40

Source: Statistical office of Bone and Maros regency of South Sulawesiin 2014

Rainfall (MM/Month) Libureng District

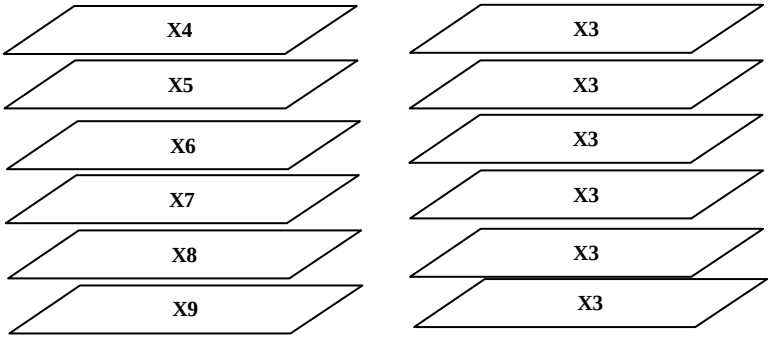


Graph.1 Rainfall and planting pattern alternative in Libureng District

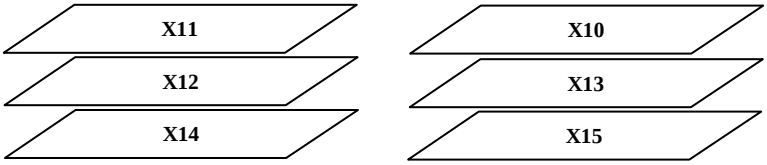
Planting patterns in Libureng District

Field with irrigation

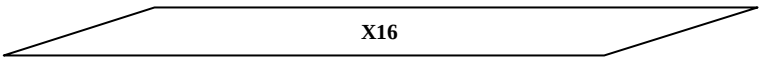
Field without irrigation



Garden Land



Animal

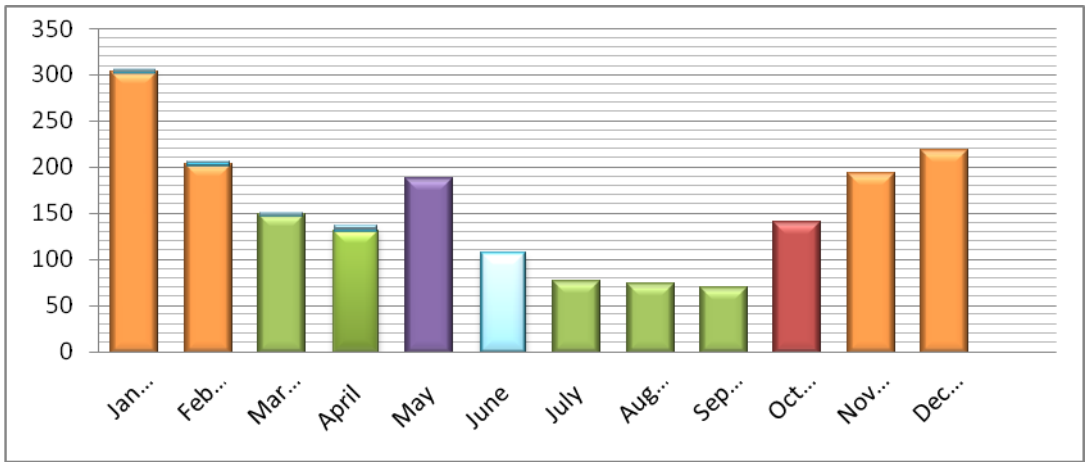


Information:

X1 = Riceplanting season on April-Septemberat field withirrigated
X2 = Riceplanting season on October – marchatfield withirrigated
X3 = Riceplanting season on April – Septemberatfield withoutirrigated

X4 = Cornplanting season on October – march atfield withoutirrigated
X5 = Soybeanplanting season on October – march atfield withoutirrigated
X6 = Green Beanplanting season on October – march atfield withoutirrigated
X7 = Peanutsplanting season on October – march atfield withoutirrigated
X8 = Sweet Potatoplanting season on October – march atfield withoutirrigated
X9 = Intercroppingcornandpeanutsat fieldswithout irrigation
X10 = Cornplanting season on October – marchat garden
X11 = Peanutsplanting season on October – march at garden
X12 = Soybeanplanting season on October – march at garden
X13 = Intercroppingcornandgreen bean planting season april-septemberat garden
X14 = Peanutsplanting season on October – march at garden
X15 = Mangothroughout the year
X16 = Cattlethroughout the year

Rain fall (MM/Month) Simbang District

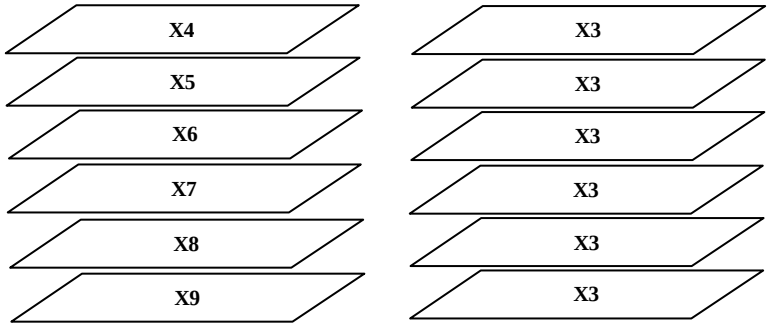


Planting pattern in Simbang District

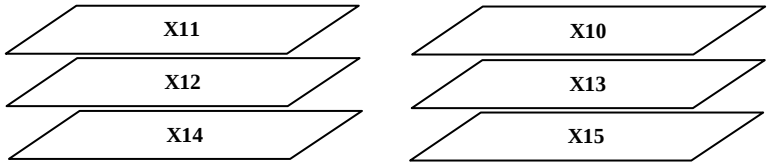
Graph.2 Rainfall and planting pattern alternative in Simbang District

Field with Irrigation

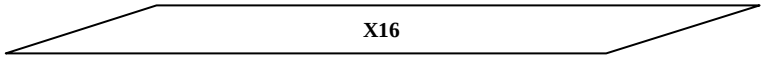
Field without Irrigation



Garden



Animal



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X13 = Intercroppingcornandgreen bean planting season October – March at garden
X14 = Peanutsplanting season on April – September at garden
X15 = Mangothroughout the year
X16 = Cattlethroughout the year

Farming patterns on Research Location

In general, there are two types of planting pattern that have been cultivated by farmer respondents in both research locations as well as in Libureng and Simbang district. It is the pattern of monoculture farming and intercropping patterns.

Libureng District

Farming on irrigated land for growing season from April to September and the planting season from October to March and paddy fields without irrigation during the growing season of April - of September, farmers only cultivate cash crops farming. While the planting season from October to March for wetland without irrigation and agricultural lands cultivated a wide variety of farming patterns intercropping and monoculture for cash crops commodity. Rainfall and alternative planting pattern that can be applied to the respondent farmers of irrigated land, fields without irrigation and

agricultural lands in the District Libureng can be shown in Figure 2.

Simbang District

Planting pattern in locations research between farmers of respondents in the District by District Libureng Simbang occurred differences planting pattern. This is largely attributable due to differences in climate and rainfall. In Sub Simbangrainy season occurs in October to March. April to September is the season of rain-fed and at the time of this season, farmers cultivated farming patterns are rice, cash crop with the intercropping and monoculture system.

Conclusion

Integrated farming plant rice, cash crop, mango and cattle can contribute to revenue based on extensive land holdings in Bone and Maros District. However, the contribution of farming income earned varies. This is because the vast ownership of agricultural land and livestock ownership farmers cultivated different respondents. Extensive land holdings in Bone regency for agricultural land are 56.9% while in Marosonly 38, 6%.

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