Study on the effects of no tillage and perfect tillage on maize growth and biomass production for livestock feed

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Abstract. Land management techniques in this study are grouped into a full tillage and no tillage practices. Full tillage which generally uses simple tools for heavy equipment is basically aimed at controlling weeds and loosening the soil so that aeration and soil infiltration capacity increases. This study aims to examine the effect of land preparation and land preparation on maize growth and maize production. This research was conducted at the location of farmers in Takalar Regency in the dry season. The effects of the planting system indicate that the system is without soil; plant height (240.6 cm), biomass in cobs (7.3 t / ha), straw weight (22.1 t / ha), cob length (16.6 cm) and corn production (10.1 t /ha ). OL Perfect Land technology results; plant height (239.2 cm), biomass on cob (6.7 t /ha ), straw weight (19.1 t /ha), cob length (16.4 cm) and corn production (9.8 t /ha ). The effect of varieties shows that Bima-2 and Bima-3 varieties are higher in the growth and yield components of corn than other varieties. While the interaction effect shows that the Bima-2 variety with the No Grounding planting system gives straw weight (27.6 t /ha) and corn production (13.5 t /ha) higher than the same variety as the fully Soil Cultivation system, namely weight straw (26.6 t /ha) and corn production (13.2 t /ha). The Gumarang variety in the Soil planting system gives a straw weight (18.2 t /ha) and dry shell corn production (7.9 t /ha) while the Perfect Earth planting system gives a straw weight (15.1 t /ha) and dry production shells corn (7.9 t /ha). t /ha) lowest among other interaction treatments. Potential yield of corn biomass is between 15-27 t /ha. The weight of straw produced from corn biomass is generally used as a source of animal feed consisting of stems, leaves and cob. The composition of corn biomass containing cellulose, hemicellulose, lignin, ash and extractives with their chemical composition, utilization of stems, leaves and cob for the fulfilment of nutritious livestock feed is very prospective.

1. Introduction
Sulawesi is a center for corn development. Maize plants have a fairly wide area of adaptation from dry land agroecosystems, rainfed lowland agroecosystems and irrigated rice fields. Nationally, the largest development of corn is in the dry land agroecosystem (60-70%), but recently the development of corn in the rainfed lowland agroecosystem is expanding to 20-30% [1]. Optimizing the use of rainfed lowland in this area is still relatively low. Generally, most of the land is planted with rice once and only a small portion is planted with rice twice, then fallow land. This fallow land has the potential to be used for planting other food commodities, such as corn. Corn plantations at the beginning of drought in rain-fed rice fields usually experience drought in the flowering phase so that subsequent crops almost always suffer from drought during their growth [2].

Corn planting in rainfed lowland is an effort to increase corn production through an increase in cropping index. Increasing the crop index is an effort to increase production through the density of the
planting schedule. Maize cropping system with the No Groundwater technology in rainfed lowland supports the improvement of Planting Index. The application of technological innovation without Land Cultivation, in addition to supporting the increase of national corn production, also meets the availability of animal feed from corn straw. Corn straw has the second undigested dry matter value after rice straw [3]. Corn straw consisting of leaves and stems, after harvest can be used as ruminant animal feed. Among food commodities, maize is a plant that can produce and accumulate the highest biomass of plants [4]. Utilization of corn plant biomass as animal feed can be in the form of: 1) old leaves under the cobs, 2) plant biomass on cobs in the physiological cooking phase, and 3) corn straw which is harvested at the same time harvesting dried corn production.

Corn cultivation at farm level still varies between local corn, composite corn, hybrid corn, and hybrid hybrid corn. But in most developing countries there are 61% of farmers growing composite corn or free-standing [5]. This is possible because composite corn can adapt well to marginal land conditions Besides that, composite corn derivatives can still be used as seeds for planting the following season, different hybrid maize can be planted only F1. However, hybrid corn has a higher yield potential than composite corn. The purpose of this study is to look at the effect of the planting system and its interactions on the growth and production of dry shelled and the potential utilization of corn biomass for livestock Feed.

2. Research Methodology

2.1. Place and time
This research was carried out on a rainfed lowland agroecosystem in Pattallassang sub-district, Takalar district South Sulawesi Province. This area is one of the corn production centers in the South Sulawesi region and is a regional development center for the corn seed independent region. The research time was carried out in may-august 2018.

2.2. Research design
The study was arranged in a design composed of yag consisting of a planting system as the Main Plot and corn varieties as a Plot with 3 replications. The planting system used is perfect tillage and no tillage, the corn varieties planted are Bima-2, Bima-3, Lamuru, Sukmaraga and Gumarang. Thus in the results of statistical analysis there are differences in planting systems and varieties as well as interactions between planting systems and varieties. In soil without soil, soil is sprayed with systemic herbicide made from Isopropilamine glyphosate with a dose of 480 gr / liter. Furthermore, a tractor with a tractor is made every 2 meters apart and a perimeter channel to irrigate the water shortage plant approval. While in the plot of land, the soil is processed by tractor ready for planting. Planting is done well no tillage or with perfect soil is one week after weeds are sprayed systemic herbicide on the plot no tillage. Planting is carried out with a spacing of 75cm x 40cm, 2 seeds / hole.

The type and dosage of fertilizer used is Urea 270 kg / ha and NPK Phonska 400 kg / ha. Fertilization is done 2 (two) times, namely at the age of 10 days after planting (HST) at a dose of 120 kg Urea and 280 kg Phonska / ha. The second fertilization is carried out at the age of 35 days after a dose of 150 kg Urea and 120 kg Phonska / ha. Manure hole is made with Portugal about 5-7 cm beside the stem of the plant, then the hole is filled with fertilizer and then backfilled with soil. The parameters observed were plant height, biomass on cob, corn straw, cob length and dry shelled corn production. Observations were analyzed using Duncan's multiple range analysis and variance test.

3. Result and discussion

3.1. The planting system used is perfect tillage and no tillage
In the land management system, there are three types of processing systems that are often used by farmers, namely a perfect tillage system, minimum tillage and no tillage. The purpose of doing the processing of the land that is expected to be a change in the characteristics of the soil through loose soil. The level of change that occurs is largely determined by the method or method of land management used. Agriculture no tillage is actually a form of traditional agricultural cultivation that has been
modified by incorporating chemical elements to control weeds, in this case is herbicide. Land preparation is only enough to do with spraying.

This method no tillage cannot be applied in all types of land. Only land that has a certain degree of looseness is suitable for this method. Hard soil cannot apply the method no tillage. Usually the method no tillage is suitable to be applied in paddy fields, as is the case with former rice plants that have been harvested. In addition, it can also be applied in rainfed rice fields or technical irrigated fields that want to implement crop rotation. Application of the planting system no tillage on rainfed lowland rice fields in addition to accelerating planting time can also save production costs. The application of a planting system no tillage has a time efficiency of 15-20 days even 30 days compared to a perfect tillage planting system.

Based on the results of research conducted [6], it shows that the highest corn production is in the minimum tillage system which is 5.89 t ha\(^{-1}\), while the lowest corn production in the intensive tillage system is 4.38 t ha\(^{-1}\). The increase in crop production in minimal tillage compared to intensive tillage was caused by several factors including increased availability of ground water and reduced nutrient losses due to erosion.

However, there are several results of studies that show that tillage is capable of producing higher maize crop production compared to minimum tillage. This is evidenced in the study [7] if the perfect soil produces corn production of 7.22 t ha\(^{-1}\), while the minimum tillage is 6.96 t ha\(^{-1}\). Efficiency in land management can be seen from the time, energy, and costs required. Minimum tillage can save time in land preparation, reduce the amount of labor needed, and in the end the costs incurred can be reduced thereby increasing farmers' incomes. Whereas intensive or perfect processing by hoeing and plowing until it is loose and clean not only has a negative impact on increasing soil degradation but also requires a lot of labor and costs in the process of preparing planting land [7].

From some of the explanations above, this research was conducted to study the effect of tillage systems on varieties, growth, and production of corn plants and the potential use of corn biomass. The following can be seen the effect of the planting system, corn varieties and their interactions on plant height, biomass on cob, corn straw, cob length and dry corn seed production (Table 1).

Table 1. Effects of cropping systems, varieties and on crop height, biomass on Upper biomass, corn straw, and seed production, in Takalar district 2018.

| Treatment          | Plant height (cm) | Upper biomass (t/ha) | Corn Straw (t/ha) | Cob length (cm) | Seed production (t/ha) |
|--------------------|-------------------|----------------------|-------------------|-----------------|------------------------|
| Planting system:   |                   |                      |                   |                 |                        |
| No tillage         | 240.6 a           | 7.3 a                | 22.1 a            | 16.6 a          | 10.1 a                 |
| Perfect tillage    | 239.2 a           | 6.7 b                | 19.1 b            | 16.4 a          | 9.8 b                  |
| Corn varieties:    |                   |                      |                   |                 |                        |
| Bima-2             | 241.3 a           | 8.6 a                | 25.1 a            | 18.2 a          | 13.3 a                 |
| Bima-3             | 236.7 a           | 8.3 b                | 24.1 a            | 17.4 a          | 12.4 b                 |
| Lamuru             | 231.1 a           | 5.7 c                | 18.4 b            | 15.8 bc         | 7.8 c                  |
| Sukmaraga          | 234.4 a           | 7.1 b                | 18.8 b            | 16.2 b          | 8.3 c                  |
| Gumarang           | 231.1 a           | 5.4 c                | 16.6 b            | 15.1 c          | 7.9 c                  |

The treatment of planting systems, corn varieties did not affect plant height. Although genetically the size of the plant height varieties of Bima-2 and Bima-3 are different from the varieties of Sukmaraga, Lamuru and Gumarang, but the always rainy weather conditions make sunlight not optimal and plant development is not optimal. Rainfall at the study site during the activity took place (Table 2). The data shows that there are 3 wet months with rainfall > 200 mm / year, 8 humid months with rainfall of 100 - 200 mm / year and 1 (one) dry month with rainfall <100 mm / year Table 2. These climate types including D4 with a number of wet months 3-4 months and dry months less (<) 6 months) [8].

Table 2. Rainfall during the study took place in the village of Patani, district. Takalar

| Climate          | Month, 2018 |
|------------------|-------------|
| Rainfall (mm)    | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Day rainfall (day) | 27 | 13 | 11 | 14 | 16 | 13 | 12 | 10 | 13 | 16 | 11 | 16 |

The amount of rainfall during the activity (May-August) is high, except before harvest (92 mm / year). Cloudy climatic conditions preclude irradiation of the ongoing process of photosynthesis in maize. Corn plants, including C4 plants that require full exposure. Optimal irradiation inhibits plant growth and the formation of plant assimilates (dry matter).

The biomass weights on the cob and straw weights are significantly affected by the planting system, corn varieties and their interactions. Plant biomass on the cob in the planting system no tillage was significantly higher than in the perfect tillage planting system, while the biomass on the cob in the Bima-3 and Bima-2 varieties was significantly heavier than the Lamuru and Gumarang varieties. The effect of the interaction of the planting system without tana with the Bima-2 variety gives biomass on ear (9.2 t / ha) with the Bima-3 variety (9.6 t / ha) better than the interaction treatment of the perfect tillage plant system with all varieties (Table 1). This is due to the treatment of interactions without cultivation with varieties of competition with weeds is lighter than the treatment of interactions with perfect soils with varieties. The growth of weeds in the planting system without tana is not as fast and as fast as the perfect soil cultivation system. The results indicated that there were fewer weed seeds in plots no tillage than plots that were processed with plow [9]. weed seeds are concentrated at a depth of 5 cm from the topsoil [9]. Soil cultivation causes rizom puzzle to be buried in the soil and rizom growth recovery is more fertile because it is supported by high soil moisture due to always rainy conditions (Table 2).

Corn straw in a planting system no tillage is markedly heavier than corn straw in a perfect tillage system. Corn varieties of Bima-2 and Bima-3 have a higher straw weight than corn varieties of Lamuru, Sukmaraga and Gumarang (Table 1). This is due to both plant height and biomass weights on the corn cobs of Lamuru, Sukmaraga and Gumarang corn cobs smaller than corn varieties of Bima-2 and Bima-3. The interaction of the planting system no tillage with the Bima-2 variety has the highest straw weight (26.6 t / ha), with the highest Bima-3 variety (27.6 t / ha) compared to other interaction treatments. Whereas the effect of the interaction of perfect tillage systems with Gumarang varieties gave biomass on cob (5.1 t / ha) and the lowest straw maize biomass (15.1 t / ha) (Table 1). Corn straw is left over from the corn plant after the fruit is harvested and can be given to livestock, both in fresh and dry form. Corn straw contains 27.8% crude fiber, 1.5% fat, 7.4% protein, 10.8% ash and 53.1% BETN [3].

Effect of planting system no tillage was significantly better on dry shelled corn production (10.1 t / ha) than perfect tillage planting system (9.8 t / ha) Table 1. This could be due to weed growth in perfectly cultivated land faster and more fertile which spurred competition for nutrients and water with corn plants which resulted in decreased production. The main nutrient that becomes competitive between weeds and corn is nitrogen. Weeds absorb more nutrients than the main plant. At the same dry weight, weeds contain 2 times more nitrogen, 1.5 times more phosphate, 3.5 times more potassium and 7.5 times more calcium in corn. Furthermore crop losses caused by weeds were 28% [10]. Competition between maize and weeds in the non-tillage cropping system is not as great as that of the perfect tillage system, especially at the beginning of plant growth due to the influence of systemic herbicides so that weeds die to their roots. Planting system no tillage is a conservative planting system that can increase the activity of soil microorganisms and lead to better soil aeration so that plant growth and production are more optimal. Besides the planting system no tillage does not damage soil particles so that soil moisture is better for plant growth [11].

The effect of varieties shows that the Bima-2 variety gives higher dry shelled corn production (13.3 t / ha) than the Bima-3 variety (12.4 t / ha), however the dry shelled corn production of these two varieties is significantly higher compared to Lamuru, Sukmaraga and Gumarang varieties (Table 1). This is due
to the varieties of Bima-2 and Bima-3 having cob as a place to attach seeds that are longer than other varieties (Table 2). The longer the cob is formed, the longer the place is attached to the corn kernels and positively correlated with the production of dry shelled corn. In addition, hybrid varieties produce larger seeds than free-range varieties [5].

### Table 3. Effects of Interaction of the planting system with corn varieties on crop height, biomass on Upper biomass, corn straw, and seed production, in Takalar district 2018.

| Treatment                        | Plant Height (cm) | Upper Biomass (t/ha) | Corn Straw (t/ha) | Cob Length (cm) | Seed Production (t/ha) |
|----------------------------------|-------------------|----------------------|-------------------|-----------------|-----------------------|
| No tillage + Bima-2              | 245.4 a           | 9.2 a                | 27.6 a            | 18.8 a          | 13.5 a                |
| No tillage + Bima-3              | 242.4 a           | 9.6 a                | 26.6 a            | 17.3 abc        | 12.8 b                |
| No tillage + Lamuru              | 236.6 a           | 5.1 e                | 18.7 c            | 15.9 cd         | 7.9 de                |
| No tillage + Sukmaraga           | 241.6 a           | 7.0 bc               | 19.3 bc           | 16.1 bcd        | 8.5 d                 |
| No tillage + Gumarang            | 237.3 a           | 5.7 de               | 18.2 cd           | 15.1 d          | 7.9 de                |
| Perfect tillage + Bima-2         | 237.3 a           | 7.5 bc               | 22.6 b            | 17.6 ab         | 13.2 ab               |
| Perfect tillage + Bima-3         | 231.1 a           | 7.6 b                | 21.5 bc           | 17.4 abc        | 12.0 c                |
| Perfect tillage + Lamuru         | 225.6 a           | 6.4 cd               | 18.1 cd           | 15.7 d          | 7.8 e                 |
| Perfect tillage + Sukmaraga      | 227.3 a           | 7.2 bc               | 18.3 cd           | 16.4 bcd        | 8.1 de                |
| Perfect tillage + Gumarang       | 224.8 a           | 5.1 e                | 15.1 d            | 15.1 d          | 7.9 de                |
| CV (%)                           | 4.6               | 8.6                  | 9.4               | 4.9             | 3.3                   |

The numbers in each column followed by the same letter are not significantly different according to Duncan's multiple test of 0.05.

The effect of the interaction of the planting system no tillage with the Bima-2 variety gave the highest dry shelled corn production (13.5 t / ha) but statistically the same as the interaction of the perfect tillage system with the Bima-2 variety (13.2 t / ha), but higher than the effect of interaction with other varieties Table 3.

Although the initial appearance of growth of each variety on perfectly cultivated land is better, the final results obtained are not significantly different from land no tillage [11] because untreated land can preserve soil and water, shorter land preparation and lower farming costs [11]. In the treatment no tillage, soil particles are not damaged so that soil moisture is more conducive to plant growth [11]. Another advantage of the planting system no tillage is that corn cultivation can be done earlier than one month compared to the perfect tillage system, so that the residual ground water after rice can still be utilized by corn plants [12].

### 3.2. Potentials of Corn Biomass Utilization For Livestock Feed

Corn is the most widely developed food crop in Indonesia after rice. BPS data in 2015 states that the level of national corn production in 2015 reached 19.6 million tons [13]. This value increased by 610,000 tons compared to corn production in 2014 of 19.0 million tons. The large production result certainly raises opportunities for the use of corn by-products other than seeds for utilization, especially in the livestock sector, especially ruminants [14]. Based on the results of research conducted by [15] states that the average weight of corn biomass reaches 29.04 t/ha and high biomass production is followed by an increase in high seed yields as well. Along with the increase in national corn production indirectly increases the production of corn biomass where biomass is very closely related to feed requirements.

Corn biomass is all parts of corn plants that are not used or not taken as staple food, such as stems, leaves, and cob. The most common by products of plants are litter (stems and leaves) and cloves that make up between 50-73% of all corn yields [16]; [17]. Biomass is the amount of organic material produced by organisms (plants) per unit area at a time. Biomass can be expressed in terms of weight,
such as dry weight in grams, or in calories. Because of the different water content of each plant, biomass is measured based on dry weight. The biomass unit is gr per m² or tons per ha. Corn biomass is generally used as a source of animal feed [18].

The biomass that is commonly used as a source of animal feed is the stem, leaves and cob. Corn biomass contains 39.47% cellulose, 27-32% hemicellulose, 3-5% lignin, 12-16% ash and 1-3% extractive [19]. Meanwhile corn cobs contain 40% cellulose, 36% hemicellulose, 16% lignin and other substances as much as 8% [20]. With this chemical composition, the utilization of the stem, leaf and cob parts for the fulfillment of nutritious animal feed is very prospective. According to [21], by products from corn cultivation in the form of stems and leaves provide a higher portion while the portion of corn beard is relatively smaller, which is under 1 ton per ha.

The availability of forage quality feed, especially in the dry season is one of the obstacles in the development of livestock (ruminants). Other problems commonly faced in the development of animal feed sources include the availability of local food is not continuous, the application of forage technology is still low, and the quality of the resulting feed does not meet standards [22]. Therefore biomass management is needed so that there is an increase in the quality of nutrition and storability of the biomass / feed produced [23].

The Ministry of Agriculture through the Agricultural Research and Development Agency for the period 2000-2014 has released more than 20 types of hybrid maize (Bima 1 to Bima 20) with superior character ie high yield potential (reaching 13.0 t / ha), adapting the area in optimal land and optimal and stay green (leaves are still green at harvest) so that it has the opportunity to be used as biomass for animal feed [24]; [25]. The study aims to evaluate the biomass potential of the national hybrid corn varieties released by the Ministry of Agriculture.

3.3. Economic Analysis of Maize Cultivation

To find out the extent to which corn farming can contribute or be beneficial for improving the welfare of farmers, it is necessary to conduct an income analysis or feasibility study on the farm, the following is table 4 Economic Analysis of corn cultivation systems no tillage and perfect tillage.

The use of production costs in a system no tillage is more efficient when compared to a perfect tillage system, this is caused by the expenditure used to cultivate the land perfectly. The use of production costs in a system no tillage is more efficient when compared to a perfect tillage system, this is caused by the expenditure of the costs used to cultivate the land perfectly. To find out the feasibility of farming systems no tillage and perfect tillage systems, the following is table 5. Analysis of the feasibility of planting systems for corn farming no tillage systems and perfect tillage systems

**Table 4. Use of production costs in the planting system no tillage and perfect tillage**

| No | Items                      | Planting system | No tillage | Perfect tillage |
|----|----------------------------|-----------------|------------|-----------------|
| A. | Production Facilities Cost |                 |            |                 |
|    | Seed costs                 |                 |            |                 |
|    | Fertilizer cost            |                 |            |                 |
|    | - UREA                     |                 | 600 kg     | 1,800           |
|    | - NPK                      |                 | 400 kg     | 2,300           |
|    | Herbicide and pesticide costs |              |            |                 |
|    |                            |                 |            |                 |
|    |                            |                 |            |                 |
| B. | Land Processing Costs      |                 |            | 1,000,000       |
| C. | Labor Cost                 |                 | 4,600,000  | 4,350,000       |

3,960,000 | 5,210,000

| Volume | Unit cost (IDR) | Total (IDR) | Volume | Unit cost (IDR) | Total (IDR) |
|--------|-----------------|-------------|--------|-----------------|-------------|
|        |                 |            |        |                 |             |
| A.     | Production      |             |        |                 |             |
|        | Facilities Cost |             |        |                 |             |
|        | Seed costs      |             |        |                 |             |
|        | Fertilizer cost |             |        |                 |             |
|        | - UREA          |             | 600 kg | 1,800           | 1,080,000   |
|        | - NPK           |             | 400 kg | 2,300           | 920,000     |
|        | Herbicide and   |             |        |                 |             |
|        | pesticide costs |             |        |                 |             |
|        |                 |             |        |                 |             |
| B.     | Land Processing |             |        |                 |             |
| C.     | Labor Cost      |             | 4,600,000 | 4,350,000 |     |
Analysis of the benefits of the planting system no tillage is more profitable due to lighter weed competition compared to the interaction of Perfect Land processing. The growth of weeds in the Soil Without Soil cropping system is not as fast and as dense as compared to the Soil If Soil planting system. The results of this study are in line with research [9] which states that the plots no tillage of weed seeds are less than plots that are perfectly cultivated. Weed seeds are concentrated at a depth of 5 cm from the top layer of the soil so that if the cultivation is carried out then weed seeds will arise to the surface of the soil.

Table 5. Analysis of the feasibility of planting systems for corn farming no tillage systems and perfect tillage systems

| No | items            | No tillage | Perfect tillage |
|----|------------------|------------|-----------------|
| 1  | Production       | 10.100 Kg  | 9,800 Kg        |
| 2  | Price/Kg         | 3,000 Rp   | 3,000 Rp        |
| 3  | Revenue          | 30,300,000 | 29,400,000      |
| 4  | Advantage        | 21,740,000 | 18,840,000      |
| 5  | R/C Ratio        | 4          | 3               |

Source: primary data, 2018.

4. Conclusion
1. A system without soil cultivation provides a component of growth and yield components that are better than a perfect soil processing system
2. The effect of the planting system shows that there is no difference between the system without soil cultivation and perfect soil processing on plant height. However, the biomass weights above the cobs, straw weights, cob lengths and dry shelled corn production, the No Groundwater planting system is better than the perfect round cropping system.
3. The Bima-2 and Bima-3 varieties have the highest straw weights and their stay green characteristics are very suitable to be integrated with livestock.
4. The system without soil cultivation gives higher dry shelled corn production (10.1 t / ha) compared to the perfect soil processing system (9.8 t /ha).
5. Interaction of Bima-2 varieties with the No-Ground cropping system produces the highest dry shelled corn (13.5 t / ha) compared to other treatments, but is not different from the interaction of the perfect soil-planting system with Bima-2 varieties (13.2 t / Ha).
6. Biomass are generally used as a source of animal feed consisting of stems, leaves and cob. Composition of corn biomass containing cellulose, hemicellulose, lignin, ash and extractive with the chemical composition, the use of the stem, leaf and cob for the fulfillment of nutritious animal feed is very prospective.

7. The use of production costs in a system no tillage is more efficient when compared to a perfect tillage system, this is caused by the expenditure of the costs used to cultivate the land perfectly, and analysis of the benefits of a planting system no tillage is more beneficial when compared to planting Perfect Land. Perfectly cultivated land can cause weed seeds on the surface of the soil to appear during processing so that along with the growth of maize can be inhibited by weeds so that it can automatically reduce the amount of crop production.

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