Performance of maize growth and yields of jajar legowo planting system at levels of P and K fertilization based PUTK in South Sulawesi

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Abstract. Maize (Zea mays) is a second main crop after rice. Manipulation of cultural practices of maize by regulation of plant population and establishment of fertilizer requirement could increase production and farmer income. So, to reach that, it needs innovation of technology, i.e. technology of plant population setting via legowo system and technology of fertilization. Innovation of technology can only be reached by assessment. The objective of the assessment was to produce innovation of technology on plant population setting via legowo system and technology fertilization on maize. The activity will be conducted on farm field, collaboration with farmer, field extensionist, and technician. The research was designed based on factorial design in RBD consisting of 2 factors. The first factor was planting method with two treatments and the second factor was fertilization based on nutrient status of soil with five treatments of PUTK (The Dry Soil Test Kit), in three replications. Interaction between legowo planting method (100-40) with population of 71,428 plant/ha x 20 cm tan/ha with fertilization based PUTK 75% (75 kg SP36 ha-1 + 75 kg KCl ha-1) with Urea fertilizer 400 kg / ha could increase productivity by 36.4% with a value of B/C 2.93 and MBCR 6.31. It showed that the technology was economically feasible to be recommended, adopted and used in Gowa district, South Sulawesi.

1. Introduction
Maize is a food to get the attention of the government related to food security to national food resiliency in Indonesian. In some region, maize is still a staple food. Maize is also the main raw material for the feed industry (± 55%), non-cholesterol vegetable oil, low-calorie sugar, maize flour and snacks [1]; [2]. In the future, maize is increasingly needed because it is one of the alternative raw materials for the biofuel industry to replace fossil energy materials which are increasingly expensive and more expensive. Maize demand for both domestic and foreign consumption is estimated to continue to increase. Therefore maize will continue to play an important role in the structure of the domestic and international economy.

In Indonesian, domestic maize production has continued to increase since 2005. In 2015, the increase with a production of 20.67 million tons of dry seed, making Indonesian successfully meet its maize needs (self-sufficiency)[3]. The increasing need for maize in the country needs to be endeavored to meet those needs. Indonesian is expected to be self-supporting continuously and instead is expected to have a surplus. In order to achieve the production target, one way to do this is to increase crop productivity.

South Sulawesi is one of the maize producing regions in Indonesian. In 2014, maize production was 1.490 million tons with an area of 289.736 ha. Thus the productivity achieved around 5.14 t / ha, still far below the potential yield that can reach ≥ 8 t / ha [4]. The low productivity of maize is caused by
the application of maize technology that is not yet optimal. Spatial planning and population spacing are not appropriate and fertilization that is not rational and balanced based on soil nutrient status and crop needs is a limiting factor that greatly affects the productivity of maize. One way to increase crop productivity is to increase plant populations. The recommended general population of maize plants is 666,666 plants with a spacing of 70 cm x 20 cm and one plant / hole. The last few years introduced a technology of spacing and plant population, namely the legowo planting system. The results of research on how to jajar legowo system in several places can increase farmers' yields and incomes [5]; [6].

Nutrients N, P and K are the main nutrients that are needed by maize plants. Each ton of dry seeds produced by maize requires about 27.4 kg N, 4.8 kg P, and 18.4 kg K [7]. Fertilization 180 - 200 kg N / ha (400 - 450 kg urea / ha) is the optimum dose for increasing yield of maize [8]. This dose is large because the efficiency of N fertilization is low, 30-50% [9]. Meanwhile, in East Java farmers used 700-800 kg / ha of urea. An excessive and inefficient amount [10];[11]. In South Sulawesi the use of phosphate and potassium fertilizers is recommended to be around 50 - 150 kg, SP36 and KCl / ha ([12]; [13]; [14]).

One of effort to optimize and streamline the use of fertilizers is through fertilization based on soil nutrient status according to site-specific conditions. Soil nutrient status illustrates the ability of soil to provide nutrients for plants, which reflects the degree of soil fertility. Soil nutrient status can be known through soil analysis in the laboratory or in the field. A simple, practical, fast, and easily applied soil analysis tool in the field has been developed by the Agricultural Research and Development Agency, the Dry Soil Test Kit (PUTK-Perangkat Uji Tanah Kering) [15]. This tool can determine the status of soil nutrients and determine the need for P and K fertilizer for maize, soybean and upland rice. However, this tool still needs further scrutiny and needs verification so that it can be used as a basis for accurately determining site-specific fertilizer recommendations.

To achieve high production under certain conditions the level of fertilizer (nutrient) requirements at high population levels is expected to increase. How the performance of the legowo planting system maize at various levels of PUTK-based P and K fertilization needs to be examined in South Sulawesi. This study aims to: (a) determine the effect of the planting system, P and K fertilization and its interactions on the growth and yield of maize on dry land in Gowa, South Sulawesi; (b) determine alternative maize planting and fertilizing systems with the highest yield and economic viability.

2. Materials and Methods
The study was conducted on dry land in Pabentengan, Bajeng District, Gowa Regency, South Sulawesi. The location is at 05° 18' 48,12" S and 119° 29' 49,2" E. The activity will be conducted on farm field, collaboration with farmer, field extensionist, and technician, April to August 2016. Soil characteristics of the study area are presented in Table 1. Data show that the soil is organic C - moderate, N-low, P-high and K-moderate.

Table 1. Soil characteristics of the study area, Gowa 2016

| Soil characteristics | Analysis | Category |
|---------------------|----------|----------|
| Texture of soil, %  |          |          |
| - Sand              | 39       | Dusty clay |
| - Dust              | 54       |          |
| - clay              | 7        |          |
| Organik C, %        | 2.69     | moderate |
| N, %                | 0.21     | low      |
| C/N                 | 13       | moderate |
| P2O5 (HCl 25%), me/100 g | 489 | high |
| K2O (HCl 25%), me/100 g | 9 | moderate |
| pH (H2O)            | 4.93     |          |
The research was designed based on factorial design in RBD consisting of 2 factors. The first factor was planting method with two treatments and the second factor was fertilization based on nutrient status of soil with five treatments, in three replications. The first factor is planting method / population: L1 = Legowo 2:1 with spacing (100 - 50) x 20 cm, population 66,666 plants ha\(^{-1}\), and L2 = Legowo 2:1 with spacing (100-40) x 20 cm, plant population 71,428 plants ha\(^{-1}\). The second factor is fertilization based on soil nutrient status, which is the results of the soil test with PUTK. Based on the test results of the tool it is known that the soil P content is high and K soil is moderate so it is determined as follows: P1 = 100% PUTK (100 kg SP36 ha\(^{-1}\) + 100 Kg KCl ha\(^{-1}\) + 400 kg Urea ha\(^{-1}\)); P2 = 75% PUTK (75 kg SP36 ha\(^{-1}\) + 75 Kg KCl ha\(^{-1}\) + 400 kg Urea ha\(^{-1}\)); P3 = 50% PUTK (50 kg SP36 ha\(^{-1}\) + 50 Kg KCl ha\(^{-1}\) + 400 kg Urea ha\(^{-1}\)); P4 = 125% PUTK (125 kg SP36 ha\(^{-1}\) + 125 Kg KCl ha\(^{-1}\) + 400 kg Urea ha\(^{-1}\)); P5 = The treatment of farmers (400 kg Urea ha\(^{-1}\)).

Research stage: land is processed perfectly with a tractor until it is ready for planting. Furthermore, treatment plots were made with a size of 4 m x 5 m. Then the land is planted with Bima 3 hybrid maize with spacing according to treatment, with one plant per hole. The application of fertilizer is carried out twice in a straightforward manner. The first application with ½ dose of urea, all measurements of SP36 and KCl at 7 Days After Planting), and the second application with ½ dose of urea at the age of 35 HST. Weeding is carried out twice in conjunction with piling up at the age of 15\(^{\circ}\) and 40 DAP. During growth, planting is relatively safe from pests and diseases. Maize is harvested at the age of 102 DAP where black layers have formed on the seeds which show physiological signs of maturity. The parameters observed included soil characteristics, plant height, stem diameter, stover weight, weight of the beard, weight of dried seeds of KA 15.5%, and yield of dried seeds. Soil characteristics were measured in the Soil AIAT laboratory in South Sulawesi from 5 composite soil samples taken random in the experimental plot. Soil characteristics measured included soil fraction, C-organic, N-total, P2O5, K2O and pH (H2O). Agronomic parameters were observed at harvest against six crop cobs. Plant height is measured from the base of the stem and cob. Stover weight is the stem weight + leaf weight + clobot weight (dried 4 days of sun drying), while the total dry weight of the upper part of the plant includes dry stover weight, dry weight of the beard and dry weight of 6 cobs, each measured at 4 days sun drying. Furthermore, the standard dry weight yield of maize kernels is determined based on 15.5% moisture content using a moisture tester.

The data obtained were analyzed through analysis of variance followed by Duncan's Multiple Range Test (DMRT) at the 5% level if there was a real effect of treatment. Furthermore, the feasibility of applying technological innovation is calculated based on the amount of input used and the output produced. Observation of inputs covers the costs of production facilities and labor used. Means of production include seeds and fertilizers, while labor consists of tillage, planting, weeding / growing, fertilizing, harvesting, frightening, pemipilan. Output is the magnitude of the results obtained measured from the amount and price of the results obtained. While financial feasibility is calculated based on the value of Marginal Benefit Cost Ratio (MBCR) with the formula:

\[
P1 - P0 \over C1 - C0
\]

where:
P1 = Total Profit after the application of new technology
P0 = Total Profit before the application of new technology
C1 = Total Cost after the application of new technology
C0 = Total Cost before the application of new technology
If MBCR > 1, the technology is applied financially feasible. If MBCR <1, then it is not financially feasible (Milian, 2004)
3. Results And Discussion

The results of analysis of variance of all agronomic parameters of each factor and their interactions are described in Table 2. Data show fertilization and its integration by means of planting legowo significantly affect all observed parameters. Where as the planting system of legowo only significantly affects the dry weight of seeds and maize seed yield.

| No | Parameter                              | Factor 1 (jajar legowo system) | Factor 2 (fertilization) | Interaction |
|----|----------------------------------------|-------------------------------|--------------------------|-------------|
| 1  | Plant height                           | No significant                | Significant              | Significant |
| 2  | Stalk diameter                         | No significant                | Significant              | Significant |
| 3  | The dry weight of stover of 6 plants   | No significant                | Significant              | Significant |
| 4  | The dry weight of 6 cobs               | No significant                | Significant              | Significant |
| 5  | The dry weight of Seed                 | Significant                   | Significant              | Significant |
| 6  | Total dry weight of Upper of Plants    | No significant                | Significant              | Significant |
| 7  | The Weight of 1000 seeds              | No significant                | Significant              | Significant |
| 8  | The dry weight Seed of 6 cobs (kg)     | Significant                   | Significant              | Significant |
| 9  | Production (ton ha⁻¹)                  | Significant                   | Significant              | Significant |

3.1. Plant Height and Stem Diameter

Data on plant height and diameter of maize stalks of distance treatment of jajar legowo system and location-specific fertilization and their interactions are presented in Table 3. The results of statistical analysis of plant height and maize stem diameter data show that the legowo planting method has no significant effect, whereas the interaction of the legowo planting system with fertilization clearly influential. PUTK-based maize fertilization 75-125% (75-125 kg ha⁻¹ SP36 and KCl) with additional Urea 400 kg ha⁻¹ has a higher posture and a larger stalk diameter than maize fertilization with only 400 kg Urea ha⁻¹ without SP36 and KCl, and instead of 50% PUTK based fertilization (50 kg SP36 ha⁻¹ and 50 kg KCl ha⁻¹). Furthermore, the data shows that 75-125% PUTK-based fertilization (75-125 kg ha⁻¹ SP36 and KCl) added 400 kg ha⁻¹ urea in both legowo planting systems yielded significantly higher maize plants (193.8 - 198.3 cm) with a larger stalk diameter (15.8-16.7 cm) compared to other fertilizers.

The above conditions indicate that application without P and K fertilization (only with urea), or with low dose P and K, 50% PUTK (50 kg SP36 ha⁻¹ and 50 kg KCl ha⁻¹) on soils with high P nutrient status and moderate K, growth (height and stem diameter) of maize plants is disturbed. Meanwhile, giving adequate amounts of P and K, 75% - 125% PUTK (75-125 kg SP36 and KCl ha⁻¹) have a positive effect on the growth of height and diameter of maize. This means that land with such nutrient status still needs additional P and K fertilizer to support better maize growth. According to [16] nutrient phosphorus (P) is important in the growth and formation of a good root system so that the uptake of nutrients and water is more optimal, thus better plant growth. While potassium (K) plays a role in accelerating the process of photosynthesis, spurring plant growth, and increasing plant resistance to drought.
Table 3. Plant Height and Stalk Diameter of Maize from Jajar Legowo System, Fertilization and Interactions

| Treatment                                      | Plant Height (cm) | Stalk Diameter (cm) |
|------------------------------------------------|-------------------|---------------------|
| Legowo 2:1 (100 – 50) x 20 cm (L1)            | 187.960 a         | 1.5635 a            |
| Legowo 2:1 (100-40) x 20 cm (L2)              | 188.325 a         | 1.5650 a            |
| 100% PUTK (100 kg SP36 ha⁻¹ + 100 kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P1) | 197.513 a         | 1.6563 a            |
| 75% PUTK (75 kg SP36 ha⁻¹ + 75 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P2) | 193.288 a         | 1.6163 a            |
| 50% PUTK (50 kg SP36 ha⁻¹ + 50 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P3) | 183.613 b         | 1.4613 b            |
| 125 % PUTK (125 kg SP36 + 125 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P4) | 194.013 a         | 1.5938 a            |
| Treatment of farmers (400 kg Urea ha⁻¹) (P5)  | 172.288 c         | 1.4575 c            |

L1 x P1                                           | 196.750 a         | 1.6425 a            |
L1 x P2                                           | 194.350 a         | 1.6200 a            |
L1 x P3                                           | 183.775 b         | 1.5050 bc           |
L1 x P4                                           | 193.750 a         | 1.6100 a            |
L1 x P5                                           | 171.175 c         | 1.4400 c            |
L2 x P1                                           | 198.275 a         | 1.6700 a            |
L2 x P2                                           | 192.225 a         | 1.6125 a            |
L2 x P3                                           | 183.450 b         | 1.4900 c            |
L2 x P4                                           | 194.275 a         | 1.5775 ab           |
L2 x P5                                           | 173.400 c         | 1.4750 c            |

3.2. Dry Weight of the tops of Plant

The dry weight of the tops of plant includes the dry weight of stover, the dry weight of the beard and the dry weight of the seeds. Data on dry weight of the upper part of the plant are presented in Table 4. The results of statistical analysis show that legowo spacing did not significantly affect the dry weight of stover, dry weight of the beard and total dry weight of plants while the dry weight of the seeds had a significant effect. Legowo spacing (100-40) x 20 cm produces higher dry weight of seeds (0.785 kg) than legowo spacing (100-50) x 20 (0.746 kg). Application of SP36 and KCl 75 kg - 125 kg / ha showed better growth, dry stover weight (0.720-0.960 kg) and total dry weight (1,659 - 1,767 kg) compared with fertilization of 0 - 50 kg SP36 and KCl / ha, with dry weight of stover 0.531 - 0.587 kg, dry weight of beard 0.100 - 0.114 kg dry weight of seeds 0.695 - 0.699 kg, dry weight of the upper part of plants 1.339 - 1.409 kg. Fertilization based on PUTK 75-125% and its interaction with the two legowo planting system also have a significant effect.
Table 4. The dry Weight of the Tops of Maize from Jajar Legowo System, Fertilization and Interactions

| Treatment | The dry weight of stover of 6 plants (kg) | The dry weight of 6 cobs (kg) | Total dry weight of Upper of Plants (kg) |
|-----------|------------------------------------------|-----------------------------|-----------------------------------------|
| Legowo 2:1 (100 – 50) x 20 cm (L1)   | 0.682 a                                   | 0.746 b                     | 1.560 a                                  |
| Legowo 2:1 (100-40) x 20 cm (L2)    | 0.665 a                                   | 0.785 a                     | 1.573 a                                  |
| 100% PUTK (100 kg SP36 ha⁻¹ + 100 kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P1) | 0.796 a                                   | 0.829 a                     | 1.767 a                                  |
| 75% PUTK (75 kg SP36 ha⁻¹ + 75 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P2) | 0.734 a                                   | 0.802 a                     | 1.661 a                                  |
| 50% PUTK (50 kg SP36 ha⁻¹ + 50 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P3) | 0.587 b                                   | 0.699 b                     | 1.409 b                                  |
| 125 % PUTK (125 kg SP36 + 125 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P4) | 0.720 a                                   | 0.803 a                     | 1.659 a                                  |
| Treatment of farmers (400 kg Urea ha⁻¹) (P5) | 0.531 b                                   | 0.695 b                     | 1.339 b                                  |
| L1 x P1 | 0.782 ab                                   | 0.816 ab                     | 1.741 a                                  |
| L1 x P2 | 0.712 ab                                   | 0.746 bcd                    | 1.577 abc                                 |
| L1 x P3 | 0.626 bc                                   | 0.668 cde                    | 1.434 bcd                                 |
| L1 x P4 | 0.756 ab                                   | 0.801 abc                    | 1.702 a                                  |
| L1 x P5 | 0.533 c                                    | 0.699 de                     | 1.349 d                                  |
| L2 x P1 | 0.811 a                                    | 0.843 a                      | 1.793 a                                  |
| L2 x P2 | 0.756 ab                                   | 0.858 a                      | 1.746 a                                  |
| L2 x P3 | 0.548 c                                    | 0.731 cd                    | 1.384 cd                                 |
| L2 x P4 | 0.685 abc                                   | 0.804 abc                    | 1.616 ab                                 |
| L2 x P5 | 0.529 c                                    | 0.691 def                    | 1.330 d                                  |

It appears that the interaction of legowo system with low dose PUTK based fertilization, 0 - 50% of PUTK is 400 urea kg ha⁻¹ (L1P5 and L2P5) and 400 kg Urea ha⁻¹ + 50 kg SP36 ha⁻¹ + 50 kg KCl ha⁻¹ fertilization L1P3 and L2P3) adversely affect plant growth, dry stover weight, dry weight of the beard, seed dry weight and total dry weight of the upper part of the plant are reduced. On the other hand, the application of high-dose fertilizer based on PUTK 75% - 125% in the two legowo planting systems shows better plant growth, the dry weight of the top of the plant is more weighted than the other treatments.

In general it can be seen that the interaction of the legowo planting system (100-40) x20 with 75-100% PUTK fertilization, namely a dose of 75-100 kg SP36 + 75-100 kg KCl + 400 kg Urea ha⁻¹ (L2P1 and L2P2) shows the growth of the upper part of the plant one better than the others. Thus the application of legowo planting system (100-40) x20 with 75 Kg SP36 + 75 KCl + 400 kg Urea ha⁻¹ (L2P1) is an effective treatment that has a positive effect on improving the quality of maize plants.

Improvement of the quality of growth of maize shows clearly that the soil lacks P and K nutrients, so it is necessary to add fertilizer P and K. Phosphorus is known to play an active role in a variety of metabolic reactions, cell division, reproductive processes, root development, etc. al, 1990). Phosphorus deficiency will affect the metabolic process further inhibits growth. Furthermore potassium plays an
important role in physiological processes, controlling the movement of parts in plants, cell division, photosynthesis, and various reactions and synthesis of important compounds ([17]; [18]). Potassium deficiency results in stunted plant development [19]. It is suspected that with Legowo 2:1 cultivation and optimal fertilizer application (75-100% PUTK), the maximum photosynthetic activity takes place. Maximum photosynthetic activity of C4 plants such as maize is achieved during full irradiation (400-700 nm) with a CO₂ supply of 50 - 80 mg dm⁻² hours⁻¹ [20].

### 3.3. Yield Components and Yields of Maize

Data on the weight of 1000 seeds, dry weight of seeds (water content 15.5%) and maize production are presented in Table 5. The results of statistical analysis show that the treatment of legowo planting system has no significant effect on the weight of 1000 seeds, but clearly affects the dry weight of seeds (water content 15.5%) and dry seed production (kg ha⁻¹, water content 15.5%). This is consistent with the results of research in several places that show that the legowo planting system in maize can increase farmers’ yields and incomes. Legowo planting system (100-40) x 20 cm (population of 71,428 plants) and (100-50) x 20 cm (population of 66,666 plants) is the recommended crop system (Balisereal, 2010).

The application of PUTK-based fertilizers and the interaction of the planting method of legowo x fertilization were significantly affected by the weight of 1000 seeds dry weight of seeds (water content 15.5%) and yield. The data shows that the interaction of the planting method of legowo (100-40) x 20 with 75-100% PUTK fertilization (75-100 kg SP36 ha⁻¹ + 75-100 kg KCl ha⁻¹ + 400 kg Urea ha⁻¹), has a good effect on the yield components and maize yield, specifically the dry weight of the seeds of six cobs of water content 15.5% (0.923 g and 0.929 g) and the yield of dried seeds (9.901 t ha⁻¹ and 10,123 ha⁻¹) was higher than the other treatments (0.582 - 0.865 g and 7.092 - 9.489 ha⁻¹). Thus the application of legowo technology (100-40) x 20 by fertilizing 75-100% PUTK (75-100 kg SP36 + 75-100 kg KCl + 400 kg Urea ha⁻¹) can increase productivity by 36.4% compared to farmers.

The existence of legowo hose room can provide border effects for plants, so as to increase yield. The legowo planting method is made where every two or more rows of plants are interspersed with one empty row which has a distance of twice the spacing between rows. Thus most of the plants are expected to become edge crops so that they obtain positive benefits as edge plants (border effect). By planting legowo 2:1 means all plants have a position as a side crop. In such conditions the interception of sunlight is more optimal, air circulation works well, the root system develops more nutrient uptake and water smoothly, and the process of photosynthesis is conducive. Thus better plant growth. Legowo 2 lines (2:1) are recommended to maximize the border effect and facilitate the application of fertilization, weeding, pest control and harvesting [21].

Hybrid Maize fertilizer needs vary according to local conditions. The results of research in West Lombok show that with the application of urea fertilizer 200 kg ha⁻¹+ Phonska (15:15:15) 250 kg ha⁻¹, hybrid maize Bima 3 and Bima 4 can achieve results of ± 10 t ha⁻¹ [22]. In East Lombok, by fertilizing 200 kg urea ha⁻¹ + 200 kg SP36 ha⁻¹ + 100 kg KCl ha⁻¹, some hybrid candidate lines can increase ± 10 t/ha [23]. In Jeneponto, South Sulawesi, it was shown that the administration of 400 kg urea ha⁻¹ + 200 kg SP36 ha⁻¹ + 200 kg KCl ha⁻¹ in Ustrobepts soils, dry climate, the condition of NPK deficiency soils yielded approximately 5.5 t / ha [24]. All of the above studies used a general spacing of 75 x 20 cm, a population of 66,666 plants.
Table 5. The dry Weight of 1000 seeds, the dry weight seed and Productions of Maize from Jajar Legowo System, Fertilization and Interactions

| Perlakuan | The Weight of 1000 seeds (kg) | The dry weight Seed of 6 cobs (kg) | Production (t ha⁻¹) |
|-----------|------------------------------|-----------------------------------|---------------------|
| Legowo 2:1 (100 – 50) x 20 cm (L1) | 35,548 a | 0,734 b | 7,926 b |
| Legowo 2:1 (100-40) x 20 cm (L2) | 35,152 a | 0,829 a | 9,261 a |
| 100% PUTK (100 kg SP36 ha⁻¹ + 100 kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P1) | 35,726 a | 0,897 a | 9,287 a |
| 75% PUTK (75 kg SP36 ha⁻¹ + 75 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P2) | 35,726 a | 0,753 ab | 9,026 a |
| 50% PUTK (50 kg SP36 ha⁻¹ + 50 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P3) | 34,934 b | 0,698 b | 7,862 b |
| 125 % PUTK (125 kg SP36 + 125 Kg KCl ha⁻¹ + 400 kg Urea ha⁻¹) (P4) | 35,627 a | 0,869 a | 9,001 a |
| Treatment of farmers (400 kg Urea ha⁻¹) (P5) | 34,736 b | 0,693 b | 7,793 b |

L1 x P1 | 35,825 ab | 0,865 ab | 8,673 b |
L1 x P2 | 35,023 a | 0,582 c | 7,929 bc |
L1 x P3 | 35,231 abc | 0,624 c | 7,092 d |
L1 x P4 | 36,023 a | 0,886 ab | 8,513 b |
L1 x P5 | 34,638 c | 0,713 abc | 7,424 d |
L2 x P1 | 35,627 abc | 0,929 a | 9,901 a |
L2 x P2 | 35,429 abc | 0,923 a | 10,123 a |
L2 x P3 | 34,638 c | 0,771 abc | 8,633 b |
L2 x P4 | 35,231 abc | 0,852 ab | 9,489 a |
L2 x P5 | 34,836 bc | 0,673 bc | 8,161 bc |

3.4. Economic Analysis
The results of an economic analysis of interactions between various treatments of legowo spacing and location-specific fertilization on maize are presented in Table 6. The data show that the interaction treatment of legowo planting methods 2: 1 (100-40) x20 with fertilization based on 75% PUTK (75 Kg SP36 + 75 KCl ) +400 kg Urea ha⁻¹ gives the highest value of yield (10,123 kg ha⁻¹), income (Rp. 25,307,500 ha⁻¹), and net profit (Rp. 18,873,200 ha⁻¹). Furthermore, legowo technology 2: 1 (100-40) x20 with 75% PUTK-based fertilization (75 Kg SP36 + 75 KCl) + 400 kg Urea ha⁻¹ also produced the highest B / C value of 2.93 and MBCR 6.31. The results achieved indicate that this technology increases yields and income by around 36.4%, and 43.8% revenue compared to the way of farmers. Based on the indicator values show that the combination of legowo planting system (100-40) x20 cm and 75% PUTK-based fertilization (75 kg SP36 + 75 kg KCl) accompanied by application of 400 urea kg ha⁻¹ fertilizer is recommended in order to increase the yield of maize in Gowa, South Sulawesi. According to [25], the value of MBCR>1 means that the technology is feasible to be adopted.

The research by [26] stated that the 2: 1 legowo planting system, spacing (100-40) cm x 20 cm was dry in Bajeng Gowa Regency in the two growing seasons showed that hybrid maize Bima 3 and Bima 5 were able to produce results 8.0-10.0 t ha⁻¹, with an income of Rp. 20-22 million ha⁻¹, and B / C ratio of 2.9 - 3.1.
### Table 6. Economic Analysis of Interactions Legowo Spacing and Fertilization Treatments

| Treatment | I. Cost (Rp ha⁻¹) | II. Income (Kg ha⁻¹) | III. Net Profit (Rp ha⁻¹) | IV. B/C | V. MBCR |
|-----------|------------------|----------------------|---------------------------|---------|---------|
| L1 x P1   |                  |                      |                           |         |         |
| L1 x P2   |                  |                      |                           |         |         |
| L1 x P3   |                  |                      |                           |         |         |
| L1 x P4   |                  |                      |                           |         |         |
| L1 x P5   |                  |                      |                           |         |         |
| L2 x P1   |                  |                      |                           |         |         |
| L2 x P2   |                  |                      |                           |         |         |
| L2 x P3   |                  |                      |                           |         |         |
| L2 x P4   |                  |                      |                           |         |         |
| L2 x P5   |                  |                      |                           |         |         |

- **I. Cost**
  - Means Rp ha⁻¹
  - Labor Rp ha⁻¹
  - Total Cost
- **II. Income**
  - Production Kg ha⁻¹
- **III. Net Profit**
  - B/C
- **IV. B/C**
  - MBCR
4. Conclusion

_Jajar legowo_ planting system and P and K fertilization based on PUTK, and their interactions in general have a positive effect on growth components, yield components and yield of maize. While the legowo planting system only significantly affects the dry weight and yield of maize seeds. The interaction of legowo planting system (100-40 x 20 cm with a population of 71,428 tan ha<sup>-1</sup> and 75% PUTK-based fertilization (75 kg SP36 + 75 kg KCl ha<sup>-1</sup>) with the addition of 400 kg / ha urea fertilizer, gave the highest crop yield with an increase in yield of 36.4%. The combination of _jajar legowo_ planting system and 75% PUTK-based fertilization (75 kg SP36 ha<sup>-1</sup> + 75 kg KCl ha<sup>-1</sup>) with an additional urea of 400 kg ha<sup>-1</sup> gives B / C ratio of 2.93 and an MBCR of 6.31. This shows that the technology is economically feasible to be adopted and recommended in the Gowa area. The technology of legowo planting method and PUTK based fertilization needs to be studied in different agroecological zones especially in the maize development center area.

Acknowledgment

Thank you to the Indonesian Agency for Agricultural Research and Development for funding this research. Special thanks to Paulus and Yuliana for helping to the research in the field.

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