Yields of maize (Zea mays l.) and peanut (Arachis hypogaea l.) in intercropping system treated by bokashi plus fertilizer under early growth of teak plantation in Napabalano District, Muna Regency, Indonesia

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Abstract. The main objective of this paper was to describe and to analyse the effects of improved agroforestry system through the use of biotechnology bokashi plus fertilizer on the yields of intercropped maize and peanut characteristics in order to maintain biological diversity in agriculture simile forestry ecosystem and to improve the agriculture production to meet human needs in Lambiku, Pentiro and Bonea villages, Napabalano District, Muna Regency. Biotechnology bokashi plus fertilizer produced by local farmers. Three locations as the demonstration plot at the farmers land was selected to search the growth and yields performances of intercropped maize and peanut under improved agroforestry system of early growth of teak trees treated by the application of various doses of bokashi plus fertilizer. Closed canopy resulted in improved agroforestry practice might contribute to prevent direct rain precipitation to soil and decrease soil erosion as well as to maintain biological diversity. The yields of maize and peanut were recorded and analysed using analyses of variances (ANOVA). The results showed that the higher doses of biotechnology bokashi plus fertilizer produce the higher yields of maize and peanut at one to two years of teak plantation trees, while the further age of teak trees, the suppress the growth and yields performances of maize and peanut if there was no pruning of teak branches and leaves occurred. This was indicated that improved agroforestry system through the arrangement of intercropped maize and peanut under early growth of teak trees might sustain agricultural crops production for maize and peanut yields.

1. Introduction
The integration of cultivation among annual and perennial crops was commonly practiced by the farmers for long time and developed significantly in a proper way to meet the ecosystem function in sustaining biological diversity and improvement of agriculture production. This was relevant to the findings reported by [1] as the integration of agricultural crops from superior local paddy, local maize and local
peanut cultivated between the rows of teak tree plantation that had significant adaptation to the local
condition, indicated to the better growth and yields at the early growth of teak trees. Improved
agroforestry plantation was set up in a certain demonstration plot to search the function of ecosystem
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Muna regency is the place where this activity was carried out that abundant natural resources was
still found. Farmers are being practiced agroforestry system by planting annual crops integrated with
forestry crops. Regretably, until now the productivity of crops cultivated has not yet been sufficient.
Harvest area and production of maize and peanut in Southeast Sulawesi Province since 2013 until 2015
declined[2]. For peanut, since 2013 the crop area might reach up to 6,547 ha with production 4,920 tons
and continues to decline until 2015 to 4,862 ha with production of 3,470 tons. The decreasing production
was caused by more directed to marginal land, low cultivation techniques and using low quality seeds.
The improvement of soil fertility using bokashi plus fertilizer, proper arrangement of crops and
introduction of superior local varieties were highly recommended to solve the problems by the
application of proper doses of bokashi plus fertilizer [3],[4] as well as the introduction of intercropping
system of maize and peanut local superior varieties. Intercropping system is a sort of cropping pattern
that may grow and produce more than one crop in one time and place. This pattern has been practiced
for along time by the farmers. Maize and peanut are commonly cultivated in mixed cropping pattern
without crop space arrangement. Therefore, the productivity of those crops has not yet been fulfilled.
Creation on the cultivation of intercropped maize and peanut under early growth of teak trees up to three
years is interested to be studied. The function of agroforestry system has been reported and proved to
provide important ecosystem services including soil, spring, stream and watershed protection; animal
and plant biodiversity conservation; and carbon sequestration and storage, all of which ultimately affect
food and nutritional security [5] and the proper arrangement of crops planted in agriculture ecosystem
might have a significant contribution to the stability of man-made ecosystem. This finding was relevant
to the fact that closed canopy resulted in improved agroforestry practice might contribute to prevent
direct rain precipitation to the soil and decrease soil erosion as well as to maintain biological diversity,
including protecting soil sedimentation to the river and preserving further impacts on the ecosystem
degradation.

Appropriate arrangement of annual crops between the rows early growth of teak trees may
sustainably use natural resources provided in terms of nutrient, space and time in the development of
simile forest ecosystem which lead to the prevention of soil erosion in one aspect and the contribution
the success of sustainable growth and production agroforestry system. For the case of conventional
agroforestry system, poor arrangement of space and dissimilar of plant growth and yields has been
experienced by the farmers for a long time at the study region. Therefore, it is needed to have a new
strategy on controlled agroforestry system to achieve sustainable biological diversity and to maintain
the productivity of agricultural crops. The provision of organic fertilizer derived from natural secondary
vegetation has been studied to increase soil fertility[6]. The use of organic fertilizer in Muna Regency
to improve agricultural production has been predominantly proclaimed as priority program of the
government [7]. Annual crops such as paddy, maize, peanut and various types of food crops are
cultivated using bokashi plus fertilizer. They are planted under the early growth of one to three years
of teak trees, mahogany, rambutan and mango, integrated with the cultivation of horticultural crops such
as tomatoes, chilly and mungbean. When a plant from annual crops grows well without disturbances,
then it will produce a better quality of grain. If a plant that is cultivated in two or three crops in one time
and space, they will compete each other to absorb nutrients and water.

In the conventional agricultural system, maize and peanut are planted either in intercropping or in
monocropping. However, in intercropping system under controlled agroforestry approach, maize and
peanut might grow and give good yields with less adverse effect on the growth performances of early
growth of teak trees. How the yields behave in intercropping system of maize and peanut treated by
bokashi plus fertilizer under early growth of teak trees has been unknown. The main objective of this
paper was to overview and to analyse the effects of biotechnology bokashi plus fertilizer on the yields
of intercropped maize and peanut under early growth and teak trees in controlled agroforestry system in Napabalano District, Muna Regency.

2. Materials and Methods
An improved agroforestry system has been set up to analyse the effects of bokashi plus fertilizer on the yields of intercropped maize and peanut under early growth and teak trees in Napabalano District, Muna Regency. New technology applied in this controlled agroforestry system was the use of selected and high adapted local crops such as maize and peanut cultivated in intercropping system under early growth of teak trees.

2.1. Place and Time
The extension services was located in Napabalano District, Muna Regency about 4 hours by public transportation of bus and ferry from Kendari to reach the location. Three farmers land of Lambiku, Pentiro and Bonea villages was carried out. Analysis of the soil contents and bokashi plus fertilizers was conducted in the analytical laboratory of the Faculty of Agriculture, University of Halu Oleo, Kendari, Southeast Sulawesi Province, Indonesia. This activity of research was held from November 2018 to March 2019.

2.2. Materials and Equipment
Intercropping system of maize and peanut under controlled agroforestry field was designed in the integration of agricultural crops cultivated in the farmer’s land between or along the rows of tree crops covering teak, mahogany and plantation crops. The materials used in this activity were local maize and local peanut ecotype, bokashi plus fertilizer, paper labels, pouches of plastic and newsprint, while equipment used in this activity were soil processing tool, sieve the soil, analytic scales, meter, water pump, watering tools, ropes, plastic pouches, scissors, digital camera, stationery writing, waring net, electric oven, leaf area meter, measurement of moisture content and tools for laboratory analysis of soil and plants.Materials used in the agroforestry experimental field for annual crops were local maize seed, peanut local variety, bokashi plus fertilizer, mulch of secondary vegetation, EM4, chicken manure, micorhiza, rice bran, water, sugar, label, rope and chemicals for proximate analyses. The instruments used in the field test were hoe, knife, balance, sprayer, oven, camera, measurement, soil thermometer and scissor. Hand tractor was used for land preparation in three farmers areas of Lambiku, Pentiro and Bonea villages, Napabalano district.

2.3. Methods
There were two types of data collection applied for this extension services. Non physical method was applied to compile information regarding the respondent perception on the improved agroforestry system using 15-listed questionnaire. 30 selected respondents were intentionally asked on the importance and potential development of controlled agroforestry system including intercropping system of maize and peanut in the early growth of 1-2 years teak trees and the contribution of this practice to maintain biological diversity and to preserve the stability of coastal line ecosystem. All data (primer and secondary) were tabulated using excell program and were analysed using descriptive analyses. Physical method was set up in the form of demonstration plot at the three farmer’s land of Lambiku, Pentiro and Bonea villages as the experimental design. Physical method of this extension services was designed into experimental pattern with two annual crops cultivated of local maize seed and local peanut variety, cultivated in three villages of Lambiku, Pentiro and Bonea with a similar design of demonstration plot. Each location was designed using factorial pattern within a Randomized Block Design. The first factor was local agricultural crop variety (V), consisting of local maize seed and local peanut variety. The second factor was the doses of bokashi plus fertilizer (B), consisting of four levels, i.e. 0, 6, 12 and 18 t ha⁻¹. From the two factors tested, there were eight combinations. Each combination was repeated three times, so in all there were 24 experimental units. Yield performances of annual and pirennual crops planted in controlled agroforestry systems were recorded using excell program. Components of yields
performances of intercropped maize and peanut together with teak vegetative growth were recorded. The generative variables were recorded for the components of flowering time (calculated from when the corn flower opens perfectly), 100 seeds dry weight (weighing 100 seeds of plant samples that have dried oven with 10 percent water content), total biomass dry weight (measured by inserting plant parts in newspaper bags and drying in an oven at 80°C until the weight is constant), and yield (weigh crop yields per plot then convert to ha). Data were analysed using analyses of variances (ANOVA) and if significant difference, followed by Honestly Significant Difference (HSD) with 95 percent confidence level.

2.4. Design of Extension Services
Maize and peanut planted in intercropping system was demonstrated in controlled agroforestry system to find out the most suitable crop arrangement of annual crops between the rows of early growth of teak trees. Extension services for the aspect of physical method was carried out in farmer’s land of Lambiku, Pentiro and Bonea villages. The implementation of this activity was initiated with the preparation of the land and the procurement of annual and perennial crops. Annual crops cultivated, especially local maize and peanuts had tested the adaptation of those crops, including the yields stability in the first stage. The provision of bokashi plus fertilizer was made using Chromolaena odorata L., chicken manure and inoculated with mycorrhiza. The application of biotechnology bokasi plus fertilizer was carried out a week before planting depends on the appropriate treatment. Before planting, maize and peanut seed had been soaked into the water for two hours to accelerate the process of germination. Planting was done manually using wood stick, and each hole planted two seeds. Plant maintenance included peanut heaping, watering, weeding, pest control and fencing. During maintenance of growth, when there was no rain for six days, then watering was needed evenly in accordance with cropping condition. Two weeks after planting, abnormal plants were cut so that there was only one plant per hole and maintained until the time of harvest. Pest attacks especially from wild pig were controlled using strong fence. The observation on maize and peanut yields components, such as flowering time, 100 seeds dry weight, yield and plant biomass of maize and peanut were recorded at the plant sample at the age of harvesting time.

3. Results
3.1 Preliminary Result on the Farmer’s Perception
A week before the extension services was carried out, 30 farmers of the study region as the respondents were asked their opinion to find out their perception on the agroforestry practices and the potential development in the contribution of the increasing agricultural productivity as well as the maintaining biological diversity and preventing environmental degradation including in the coastal ecosystem. The results of extension services on the farmer’s perception showed that the selected farmers as respondents were agreed with the proposed program on the improvement of agroforestry system offered and designed since the extension services in the study region might improve stable yield of agricultural crops cultivated, might sustain biological diversity and the higher species composition of agroforestry that simile forestry ecosystem might help facilitate and realize the achievement of community welfare since agriculture crops cultivated between the rows of early growth of teak trees were found growing well and higher yield of crops planted were obtained. The final conclusion of the selected respondents perception on the improved agroforestry system integrated with intercropping of maize and peanut was figured out in Table 1.

Table 1 showed that all respondents questioned were agreed on the importance of improved agroforestry system for the tenth items asked scored from 90% to 100%, indicating a high importance of agroforestry system recommended. There was no doubt from the respondents point of view from the intercropping system of maize and peanut increased yield and improve income and community welfare in three villages of Lambiku, Pentiro and Bonea with all respondents agreed (100%), slightly higher percentage compared to the previous year collection at the same sites. This perception was relevant to the finding reported by [1] on the farmers perception of controlled agroforestry system after two years of teak trees plantation in Lambiku, Pentiro and Bonea villages. He reported that the fifth importance of
controlled agroforestry system to the improvement of farmer income and community welfare (95%-100%), to the provision of high yield of annual crops without adverse effects on the growth tree crops (85% -100%), to be a better significant effects of bokashi plus fertilizer on the increase growth and yield of annual crops (95%-98%), to the prevention of direct precipitation into the soil, so reduce soil compaction and erosion (95%-100%) and to the maintenance of biological diversity simile forestry ecosystem (85%-100%), mostly lower than that of the recent finding. This finding was revealed a clear fact that the application of improved agroforestry system integrated with intercropping maize and peanut of the farmers significantly contributed to increase crop production, to overcome soil compaction, to conserve plant diversity and to protect environmental degradation. This was caused by the confirmation of increasing basic knowledge and skills of the farmers to use huge amount of secondary vegetation biomass production dominated by Chromolaena odorata L. in the aspects of innovation and new technologies on the formulation of biotechnology bokashi plus fertilizer applied in various agroforestry patterns [4]. Significant influence of organic fertilizer application can be used as an effort to improve the community welfare through additional alternative income from increased crop productivity. The farmers believed that this improved methods of agroforestry pattern was benefited to manage efficiently every piece of land since it had been practiced by the farmers for along time so that they had had familiar to the management of land through the application of agroforestry that might increase human welfare, as confirmed by [3] and [4].

Table 1. The respondents perception (percentage) regarding intercropping system applied within improved agroforestry system using bokashi plus fertilizers in Lambiku, Pentiro and Bonea villages, Napabalo District, Muna Regency

| No. | The importance of Improved agroforestry practices | Lambiku village | Pentiro village | Bonea village |
|-----|-------------------------------------------------|----------------|----------------|--------------|
| 1   | Produce high yield of maize and peanut in intercropping system | 100% | 100% | 100% |
| 2   | Obtain additional horticultural crops production | 95% | 95% | 100% |
| 3   | Provide proper labour distribution in a year | 98% | 95% | 95% |
| 4   | Improve income and community welfare | 100% | 100% | 100% |
| 5   | Provide high yield of annual crops without having adverse effects on the growth teak tree crops | 95% | 100% | 95% |
| 6   | Be better significant effects of bokashi plus fertilizer on the increasing agricultural crops production | 95% | 95% | 95% |
| 7   | May decrease direct precipitation into the soil surface to protect soil compaction | 95% | 95% | 95% |
| 8   | Maintain biological diversity simile forestry ecosystem | 95% | 95% | 95% |
| 9   | Decrease surface run off and soil erosion | 95% | 95% | 95% |
| 10  | Minimize soil sedimentation to the river and protect the environmental degradation | 90% | 90% | 90% |

3.2 Effects of Bokashi Plus Fertilizer on the Yield Crops

The application of bokashi plus fertilizer in conventional and improved agroforestry system significantly affected the yields of intercropped maize and peanut in three villages of Lambiku, Pentiro and Bonea, setting up at the farmer locations. The use of organic fertilizer derived from bokashi plus and other sources of organic matter was beneficial to improve soil quality significantly. During early growth of teak plantation, agriculture crops could be planted along the rows of teak and other forestry trees. The increasing age of teak tree lead to the limitation of yields for annual crops as explained by [1]. Yields components of annual crops observed in this agroforestry research were limited to flowering time, 100 seeds dry weight, total dry biomass and yield of annual crops.
The results of extension services on the yields performances of intercropped maize and peanut in conventional agroforestry system for flowering time, 100 seeds dry weight, total biomass dry weight of annual crops and yield (t ha\(^{-1}\)) between the rows of teak trees of one year of age crop in Lambiku, Pentiro and Bonea villages, Napabalano district was shown in Table 2.

Table 2. The averages yields of intercropped local maize and peanut in conventional agroforestry system of Lambiku, Pentiro and Bonea villages, Napabalano district

| Doses of bokashi plus fertilizer | Local Maize | Local Peanut |
|----------------------------------|-------------|-------------|
|                                  | LBK | PTR | BNA | LBK | PTR | BNA |
| Flowering time (days)            |     |     |     |     |     |     |
| 0 t ha\(^{-1}\)                  | 69.44b | 69.69b | 69.88b | 24.50 | 24.53b | 25.24b |
| 6 t ha\(^{-1}\)                  | 68.69ab | 67.21ab | 68.43b | 24.18 | 24.48b | 24.65b |
| 12 t ha\(^{-1}\)                 | 62.50ab | 63.46ab | 62.65ab | 24.03 | 24.37b | 24.55ab |
| 18 t ha\(^{-1}\)                 | 56.13a | 57.92a | 58.32a | 23.64 | 23.54a | 23.54a |
| HSD 0.05                         | 12.86 | 10.02 | 10.23 | ns | 0.54 | 1.20 |
| 100 seed dry weight (g)          |     |     |     |     |     |     |
| 0 t ha\(^{-1}\)                  | 24.65a | 26.44a | 25.61 | 20.25a | 19.82a | 21.35 |
| 6 t ha\(^{-1}\)                  | 25.95ab | 26.98ab | 26.45 | 21.80ab | 21.56ab | 22.52 |
| 12 t ha\(^{-1}\)                 | 27.30bc | 27.64ab | 27.62 | 24.16ab | 23.44ab | 23.76 |
| 18 t ha\(^{-1}\)                 | 28.64c | 27.82b | 28.56 | 25.72b | 25.38b | 24.66 |
| HSD 0.05                         | 2.15 | 1.33 | ns | 4.65 | 5.02 | Ns |
| Total biomass dry weight (t ha\(^{-1}\)) |     |     |     |     |     |     |
| 0 t ha\(^{-1}\)                  | 7.56a | 8.28a | 6.94a | 3.24 | 3.18a | 3.29a |
| 6 t ha\(^{-1}\)                  | 8.22ab | 8.81ab | 8.53ab | 3.65 | 3.55ab | 3.62ab |
| 12 t ha\(^{-1}\)                 | 9.14ab | 9.45b | 8.92b | 3.73 | 3.90ab | 3.85ab |
| 18 t ha\(^{-1}\)                 | 9.66b | 9.83b | 9.18b | 4.25 | 4.22b | 4.34b |
| HSD 0.05                         | 2.06 | 1.24 | 1.56 | ns | 0.86 | 0.81 |
| Yield (t ha\(^{-1}\))            |     |     |     |     |     |     |
| 0 t ha\(^{-1}\)                  | 3.79 | 3.68a | 3.85a | 1.97a | 2.09a | 1.98 |
| 6 t ha\(^{-1}\)                  | 3.96 | 4.04ab | 4.16b | 2.26ab | 2.32ab | 2.24 |
| 12 t ha\(^{-1}\)                 | 4.33 | 4.47bc | 4.30ab | 2.32b | 2.31ab | 2.24 |
| 18 t ha\(^{-1}\)                 | 4.82 | 4.72c | 4.61b | 2.40b | 2.54b | 2.35 |
| HSD 0.05                         | Ns | 0.64 | 0.67 | 0.32 | 0.38 | Ns |

Notes: 1. LBK = Lambiku village, PTR = Pentiro village, BNA = Bonea village; 2. The figures in column followed by the difference letters were significant difference using Honestly Significant Difference (HSD) at 95% confidence level.

Table 2 showed that for maize, the highest averages of flowering time for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 69.44 days, 69.69 days and 69.88 days, obtained at without bokashi plus fertilizer giving significant different compared to 18 t ha\(^{-1}\)bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. For peanut, the highest averages of flowering time for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 24.50 days, 24.53 days and 25.24 days, obtained at without bokashi plus fertilizer giving significant different compared to 18 t ha\(^{-1}\)bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. Table 2 also showed that for local maize, the highest averages of 100 seeds dry weight (g) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 28.64 g, 27.82 g and 25.6 g, obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. For local peanut, the highest averages of 100 seeds dry weight (g) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 25.72 g, 25.38 and 24.66 g, obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant
different compared to without bokashi plus fertilizer, while among locations and treatments were not significant. The highest averages of total biomass dry weight (t ha\(^{-1}\)) of local maize in Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 9.66 t ha\(^{-1}\), 9.83 t ha\(^{-1}\) and 9.18 t ha\(^{-1}\), obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. For local peanut, the highest averages of total biomass dry weight (t ha\(^{-1}\)) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 4.25 t ha\(^{-1}\), 4.22 t ha\(^{-1}\) and 4.34 t ha\(^{-1}\), obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant.

For local maize, the highest averages of total biomass dry weight (t ha\(^{-1}\)) of local maize in Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 9.66 t ha\(^{-1}\), 9.83 t ha\(^{-1}\) and 9.18 t ha\(^{-1}\), obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. For local peanut, the highest averages of total biomass dry weight (t ha\(^{-1}\)) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 4.25 t ha\(^{-1}\), 4.22 t ha\(^{-1}\) and 4.34 t ha\(^{-1}\), obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. For local maize in improved agroforestry system, the best yields of intercropped maize and peanut for flowering time, 100 seeds dry weight, total biomass dry weight of annual crops and yield (t ha\(^{-1}\)) between the rows of teak trees of one year of age crop in Lambiku, Pentiro and Bonea villages, Napabalano district was shown in Table 3.

Table 3 showed that for local maize, the highest averages of flowering time (days) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 69.21 days, 69.65 days and 69.50 days, obtained at without bokashi plus fertilizer giving significant different compared to 18 t ha\(^{-1}\) bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. For local peanut, the highest averages of flowering time (days) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 24.75 days, 24.59 days and 25.05 days, obtained at without bokashi plus fertilizer giving significant different compared to 18 t ha\(^{-1}\) bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. The highest averages of 100 seeds dry weight (g) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) of local maize was 45.26 g, 43.76 g and 44.83 g, obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. Table 3 also showed that for local maize, the highest averages of total biomass dry weight (t ha\(^{-1}\)) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 11.22 t ha\(^{-1}\), 10.86 t ha\(^{-1}\) and 11.32 t ha\(^{-1}\), obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant. While for local peanut in improved agroforestry system, the highest averages of total biomass dry weight (t ha\(^{-1}\)) for Lambiku (LBK), Pentiro (PTR) and Bonea (BNA) was 4.85 t ha\(^{-1}\), 4.94 t ha\(^{-1}\) and 4.92 t ha\(^{-1}\), obtained at the treatment 18 t ha\(^{-1}\) of bokashi plus fertilizer giving significant different compared to without bokashi plus fertilizer, respectively, while among locations and other treatments were not significant.
Table 3. The averages yields of intercropped local maize and peanut in improved agroforestry system of Lambiku, Pentiro and Bonea villages, Napabalano district

| Doses of bokashi plus fertilizer | Local Maize | Local Peanut |
|----------------------------------|-------------|--------------|
|                                  | LBK         | PTR          | BNA          | LBK         | PTR          | BNA          |
| Flowering time (days)            |             |              |              |             |              |              |
| 0 t ha⁻¹                         | 69.21b      | 69.65b       | 69.60b       | 24.75b      | 24.59        | 25.05b       |
| 6 t ha⁻¹                         | 69.09b      | 68.20ab      | 68.29b       | 24.25b      | 24.32        | 24.72b       |
| 12 t ha⁻¹                        | 62.82ab     | 63.43ab      | 63.22ab      | 24.22b      | 24.15        | 24.34b       |
| 18 t ha⁻¹                        | 58.64a      | 58.08a       | 58.16a       | 23.08a      | 23.44        | 22.96a       |
| HSD 0.05                         | 10.44       | 11.47        | 10.12        | 0.86        | ns           | 2.04         |
| 100 seed dry weight (g)          |             |              |              |             |              |              |
| 0 t ha⁻¹                         | 28.65a      | 30.50        | 31.38a       | 24.46a      | 24.65a       | 25.80        |
| 6 t ha⁻¹                         | 32.60ab     | 33.84        | 36.42ab      | 25.05ab     | 25.46ab      | 26.35        |
| 12 t ha⁻¹                        | 42.84bc     | 39.92        | 41.65ab      | 26.52bc     | 26.18ab      | 27.06        |
| 18 t ha⁻¹                        | 45.26c      | 43.76        | 44.83bc      | 27.81c      | 26.70b       | 27.47        |
| HSD 0.05                         | 11.98       | ns           | 11.24        | 1.64        | 1.86         | ns           |
| Total biomass dry weight (t ha⁻¹)|             |              |              |             |              |              |
| 0 t ha⁻¹                         | 7.98a       | 8.06a        | 8.26a        | 3.82        | 3.86a        | 3.97a        |
| 6 t ha⁻¹                         | 8.34ab      | 8.65ab       | 9.20ab       | 4.02        | 4.16ab       | 4.25ab       |
| 12 t ha⁻¹                        | 10.25bc     | 9.82ab       | 10.71b       | 4.52        | 4.62b        | 4.70b        |
| 18 t ha⁻¹                        | 11.22c      | 10.86b       | 11.32b       | 4.85        | 4.94b        | 4.92b        |
| HSD 0.05                         | 2.62        | 2.34         | 2.15         | ns          | 0.76         | 0.71         |
| Yield (t ha⁻¹)                   |             |              |              |             |              |              |
| 0 t ha⁻¹                         | 4.26a       | 4.55         | 4.38a        | 2.18a       | 2.26a        | 2.16a        |
| 6 t ha⁻¹                         | 4.73ab      | 4.74         | 4.56ab       | 2.32ab      | 2.41ab       | 2.24ab       |
| 12 t ha⁻¹                        | 5.47b       | 5.33         | 5.42ab       | 2.35ab      | 2.54b        | 2.37ab       |
| 18 t ha⁻¹                        | 5.75b       | 5.66         | 5.80b        | 2.64b       | 2.55b        | 2.59b        |
| HSD 0.05                         | 1.20        | ns           | 1.37         | 0.21        | 0.22         | 0.25         |

Notes: 1. LBK = Lambiku village, PTR = Pentiro village, BNA = Bonea village; 2. The figures in column followed by the difference letters were significant difference using Honestly Significant Difference (HSD) at 95 confidence level.

4. Discussion

The results of extension services were significant to increase the farmer’s income in three villages of Lambiku, Pentiro and Bonea. It was shown that the perception of the farmers in the three villages were agreed to adopt an improved agroforestry system since it provides sufficient yield of maize and peanut, has the role and function to increase annual crops cultivated under early teak growth of one to three years of age and to increase other agricultural productivity as illustrated in Table 1. This was relevant to the previous finding as reported by [1]. Table 2 and Table 3 showed that there was a significant different between conventional and improved agroforestry system on the yields of intercropped maize and peanut in three villages tested for the components of flowering time (days), 100 seeds dry weight (g), total biomass dry weight (t ha⁻¹) and yield (t ha⁻¹). It also showed that the higher the dose of bokashi plus fertilizer applied to the agroforestry system, the higher the average generative crop components of intercropped maize and peanut. It was also revealed that there was no significant different among location, indicating high adaptability of annual crops planted between the rows of early growth and teak trees. This trend was a good potential to be cultivated between the rows of early growth of teak trees in the form of agroforestry pattern in study region. It was cleared that the growth of annual crops was sufficient and not influenced by the presence of teak trees in its surroundings since the soil media provide enough quantity of nutrient, water and other elements that might affect to the generative component [4]. This finding was relevant to other study [8], [9], [10], [11], as described that the proper intercropping
system of maize and peanut under early growth of teak plantation might maintain the stable production of annual crops and to keep the diversity of plant growth in landscape ecology.

Table 2 and Table 3 also showed that the use of appropriate bokashi plus fertilizer in marginal soil in order to achieve high efficiency and effectiveness through the utilization of natural resources especially secondary vegetation in the study region was compulsory [1]. The yields of intercropped maize and peanut was affected by the application of bokashi plus fertilizer and showed a rapid increase of generative components during the early development growth of local maize and local peanut planted between the rows of teak trees, even though the yield of those crops were not optimally achieved. The low production of annual crops such as local maize and local peanut under agroforestry practices due to low soil fertility can be overcome by the application of bokashi plus fertilizer. Some local ecotype of maize and peanut that have been released to the community did not yet have the level of adaptation to local conditions and is susceptible to various types of plant disease. The prominent effort has been conducted, as propounded by the American colony, but the result has not been satisfactory. This is caused by the dry climatic conditions with marginal lands which include a shortage of nutrient elements, sensitive to erosion and very little organic material content [6], [12], [13], [14], [15]. However, it was through the management and cultivation of good ways, dry land has the potential of very marginal potential for regional development of peanuts and other crops [16], [17], [18], where the application of appropriate technology by using bokashi plus can increase the potential for fertility of land on marginal land, so that the potential productivity of crops planted in demonstration plot might be achieved.

The main principle of agroforestry system is the combination of crops cultivated for more than one plants. The results of extension services showed the function and importance of agroforestry system was clear to the maintenance of biological diversity and protection of soil degradation since all plants canopy might close soil surfaces that lead to stability of ecosystem landscape. This finding was similar to the previous study [1] that agroforestry trees provide important ecosystem services including: soil, spring, stream and watershed protection; animal and plant biodiversity conservation; and carbon sequestration and storage, all of which ultimately affect food and nutritional security [1] and [5]. This indicated that individual farmers can be encouraged to preserve and reinforce functions that extend beyond their farms by payments for ecosystem services, but more important in determining their behaviour is the direct products and services they receive from trees [19]. An improved agroforestry system by using the integration of annual crops cultivated between the rows of early growth of teak trees at 1 to 2 years of age through the application of bokashi plus fertilizer might guarantee and sustain the yield performances of intercropped maize and peanut crops. This indicated that a proper management of annual crops cultivated between the rows of early growth of tree plantations could maintain the stability of high production of annual crops up to three years, then the productivity of annual crops decreased up to seven years, after that wild herbs and shrubs grew between the rows of tree plantation [1].

This was also realized that the acceptance of the respondents on their farmer’s perception to go into agroforestry practices strengthens the potential adoption of this system to improve community welfare and to achieve the stability of global environmental fluctuation of Indonesian region. Therefore, the development of a creative agroforestry system should be maintained. Then, we would like to express our sincere thanks to the Government of Indonesia, via Ministry of Research, Technology and Higher Education for the financial support to carry out this extension services from 2016 to 2018 in West Kulisusu District and from 2019-2021, the extension services will be conducted Napabalano district, Muna Regency. We did like to say at the bottom of our hearts that this activity was highly meaningful to the improvement of community welfare and joyful life of the farmers in Napabalano district.

5. Conclusion and Recommendation
From the results and discussion of extension services described above conducted in three villages (Lambiku, Pentiro and Bonea), Napabalano district, it could be concluded that as follows:
1. In intercropping maize and peanut, both improved and conventional agroforestry system, the higher the doses of bokashi plus fertilizer applied, the higher the yields performances of annual produced.
2. The various doses of bokashi plus fertilizer application in two different agroforestry system had significant different and better effects on the yields components of intercropped maize and peanut planted between the rows of early growth of teak trees.

3. The best yields of local maize and local peanut treated by various bokashi plus fertilizer might achieve to 5.80 t ha\(^{-1}\) and 2.64 t ha\(^{-1}\), while in improved and conventional 4.72 t ha\(^{-1}\) and 2.54 t ha\(^{-1}\), respectively with the best of bokashi plus fertilizer amounted to 18 t ha\(^{-1}\).

Finally, it was recommended that in order to achieve the best yield of intercropped maize and peanut between the rows of early growth of teak tree was 18 t ha\(^{-1}\) of bokashi plus fertilizer.

References

[1] Karimuna L, Halim, Resman, Rufendi L M, Marfi W E, and Akri S 2018 Growth and Yields Performances of Agricultural Crops Under Controlled Agroforestry System on Maintaining Biological Diversity and Improvement of Community Welfare in Indonesia, Proc.on the 6th Kuala Lumpur Int. Agriculture, Forestry and Plantation Conf., Agriculture, Forestry and Plantations: Challenges in the 4th Industrial Revolution, 24-25 April 2018

[2] Central Bureau of Statistics 2016 Southeast Sulawesi in the Number 2015 Central Bureau of Statistics in Kendari, Southeast Sulawesi p 476

[3] Karimuna L, Halim, Resman, Rufendi L M, Marfi W E, and Akri S 2016 Agroforestry in West Kulissusu, North Buton Regency, Final Report of Ipteksfor Regional, Research and Higher Education, Institution of Research and Community Services, University of Halu Oleo, Kendari, Southeast Sulawesi Province

[4] Karimuna L, Halim, Resman. Rufendi L M, Marfi W E, and Akri S 2017 Agroforestry in West Kulissusu, North Buton Regency, Final Report of IpteksFor Regional, Research and Higher Education, Institution of Research and Community Services, University of Halu Oleo, Kendari, Southeast Sulawesi Province

[5] Garrity D P 2004 Agroforestry Systems 61 5–17

[6] Karimuna L 2000 Floristic Composition and Biomass of Fallow Vegetation in Abandoned Agricultural Fields of Southeast Sulawesi Georg-August-University Goettingen (Goettingen: Cuvillier Verlag)

[7] Central Bureau of Statistics 2018 Southeast Sulawesi in the Number 2017 Central Bureau of Statistics in Kendari, Southeast Sulawesi

[8] Pasaribu P K, Barus A, and Mariati 2014 J. Agrotechnology 2 1391-95

[9] Andila R P, Khumairoh U, Guritno B, and Aini N 2016 Plant Prod. J. 4 624-630

[10] Rahayu M, Prajitno D, and Syukur A 2006 Biodiversitas 7 73-76

[11] Ekowati D and Nasir M 2011 Human Env. J. 18 220-231

[12] Karimuna L, Leomo S and Indriyani L 2009 Application of mulching technology and bokashi vegetation secondary to increased production of intercropping of corn and peanut. Implementation of Science and Technology of Community Service (Kendari: University of Halu Oleo Press)

[13] Kasno A, Setyorini D and Tuberkih E 2006 J. Ind. Agric. Sci. 8 91-98

[14] Nursyamsi D 2004 Some Efforts of Increasing Soil Productivity in Dryland (Bogor: Bogor Agriculture Institute)

[15] Pasolon Y B 1998 Concepts and Strategy for Agriculture Development in Supporting Regional Food Stability (Kendari: Dryland study Center, Research Institution, University of Halu Oleo)

[16] Fachruddin L 2000 Cultivation of Beans (Yogyakarta: Kanisius)

[17] Sopandie D 2006 Physiological Perspectives for the Development of Food Crops in Marginal Soils Report: Permanent Professor Promotion in Plant Physiology (Bogor: Bogor Agriculture Institute)

[18] Karimuna L, Rahni N M and Boer D 2014 Peanut Development of Local Varieties Superior to the Application of BiotechnologyBokashi Plus based on Local Resources on Marginal Dry
Land Final Report of the First Year 2014 of Three Year Plans (Kendari: Institute for Research and Community Service of Halu Oleo University)

[19] Roshetko J M, Lasco R D, Delos Angeles M S 2007 Mitigation and Adaptation Strategies for Global Change 12 219–242