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# TECHNOLOGICAL DEVELOPMENTS IN MARGINAL LANDMASS UTILIZATION FOR IMPROVEMENTS IN *GOROHO* BANANA (*Musa acuminafe* spp.) QUALITY AND PRODUCTIONS

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**Abstract:** This study was conducted in the rural outskirts of Tomohon, North Sulawesi, 2018-2019, involving 4 local farmers as participators in this study. Each farmer was provided with 0.5 Ha of land to manage, where half (0.25Ha) was managed on their own and half (0.25Ha) was managed alongside with the researcher. Thus on the plots managed by coaching alongside with the researcher, it was introduced the utilization of a healthy bulb sortation, planting distance organization, organic and inorganic fertilization processes, panama disease control by the use of *Trichoderma* spp., plant productivity control. Yields in plots where farm management coaching took place resulted in an increase in productivity up to 442.66 ton/Ha, while farm management according the local famers method traditionally yielded only 17.68 ton/Ha. Yet based on economic analysis, the traditional methods by the local farmers resulted in a better benefit/cost ratio due to the lower production cost, while net profits of a well-managed farm (coached method) produced higher profitability. In aspects of continuity and sustainability as well as agri-economical profits, the improvements in production management (method coached by researcher) proved better than that of the traditional method by the farmers.

**Keywords:** marginal landmass, improvement, goroho banana, Musa acuminafe

## INTRODUCTION

North Sulawesi farmers mostly cultivate banana as an additional cultivation extra on the side of their main agricultural endeavors. Banana is commonly cultivated on just a small area of land or part of an integrated farming practice. Banana farming is most commonly cultivated on marginal land space amongst the main cultivates of coconut, cloves, etc. With minimum and simple farming practices banana productivity on these marginal land space will yield about 8-12 tons/Ha/year (BPS Propinsi SULUT, 2005), whilst in other countries such as Uganda, Kenya and most African countries, banana farming is dedicated as a main agricultural business with a productivity of approximately 40 tons/Ha/year (Jacobson, 2005 and Edmeades *et al*., 2006).

Banana is rich in vitamin A, B1, C and various minerals, also a source of energy replenishment at (136 calories / 100g) that is twice the amount in apples. Banana contains 2.3% fat and 0.3% protein (Wikipedia, 2006).

Goroho banana (*Musa acuminafe* spp.) is a unique variety favored by North Sulawesi people, an endemic cultivate of the area and also a popular plantain. This unique variety is commonly processed

to various products such as crackers and fritters. The fruit itself is mainly bland with a hint of sourness in taste, thus often good substitute for diabetics. Aside of the rural suburbs of Tomohon, other production centers of the Goroho banana would be South and North Minahasa, and Southeastern Minahasa.

Goroho banana productivity that was achieved by local farmers of the Tomohon district areas averages about 10-12 tons/Ha/year (Dinas TPH SULUT, 2010). Considered low and still much under the actual potential plant productivity. This low productivity is due to cultivation techniques that are not optimized. As such with the use of fertilizers, farmers aren't familiar with the use of fertilizers for this cultivate. Furthermore, unorganized planting distances, uncontrolled diseases, asides of unmanaged soil mediums and cultivate growth environment also contributes to the low productivity.

The growing demand of Goroho banana in the Tomohon local markets and in the Minahasa domestic markets indicates the potentials for Goroho bananas as a good source of income for local farmers. Observing this promising prospect, it is apparent that professionally reorganizing cultivation management to maximize productivity to fulfill the growing demands that is multiplying along with the population growth and the growth in awareness of health potentials of the Goroho banana. Thus the importance of Goroho banana productivity and more so since the Goroho banana is a cultivate that recognizes no season.

The purpose of this research is generally to understand the most optimum planting distance, and the necessary combinations of organic and inorganic fertilizers that will promote productivity and produce quality Goroho bananas, also to obtain an improvement in the overall management of cultivation practice.

**MATERIALS AND METHODS**

This research was conducted for 2 years, within the Walian village, within the rulal skirts of South Tomohon. The research area consisted of flat agro-ecosystem to a slight hilly topography.

This research was conducted in a collaborative form with a farmer group of 4 famers, where each planted in an area of 0.5 Ha, totally to a total area of 2 Ha. From within the 0.5 Ha area, 0.25 Ha was completely nurtured by the farmers (the traditional cultivation practice plot), and another 0.25 Ha was managed under the researchers cultivation coaching regarded as PMP (Perbaikan Managemen Produksi Pisang – Banana Productivity Improvement Management).

Within the plot cultivated traditionally by the farmers, 350kg / Ha Urea, 150kg / Ha SP-36, and 150 kg / Ha KCl was used by the farmers, since soil medium fertility was considered extremely low and the farmer groups were not accustomed to the utilization of fertilizers. Planting methods and day-to-day care was left to the farmers to manage on their own. Within the PMP plot various modern cultivation techniques were implemented as follow: 1) Clean fresh bulb selection; where selected bulbs were then soaked in warm water of 45 – 50$^0$C for 10 – 15 minutes before cutting 5 – 10 pieces and further planted in polybags with a medium of 1 : 1 ratio of soil to organic fertilizer. The polybags with the bulbs were then treated with 20g of Urea / bulb, and followed by a pesticide treatment of diluted 9cc *Carbaril* in a liter of water. After 2 full months, the young bulb is then moved to plantation in the plotted areas. 2) Planting distances was organized in a 3m x 3m area. 3) 10kg / hole of organic fertilizer was given in between the plants in a hole of 50 x 50 x 50 cm. 4) A yearly fertilization process was also applied as follow: Urea, SP-36 and KCl at 450, 250 and 250 kg / Ha / year respectively, which is administered twice a year (beginning of the year and middle or by the end of a rainy season), excluding the 1$^{st}$ year where ¼ of the amount was administered during planting and the rest was divided and administered after 3 and after 6 months. 5) Managing Fusarium Disease was executed by inoculating the surrounding areas of the cultivate clusters with *Trichoderma* spp. at 200g / cluster. 6) Intercropping with maize for the first year. 7) Managing

cluster growth and production to only 4 plants per cluster. 8) For fruit protection, the fruits while ripening on the tree are wrapped in an ethylene blue plastic fruit cover.

**DATA ANALYSIS**

- Variances in growth, yield and nutritional values, also post-harvest practices were analyzed.
- Growth variances and yield of the traditional plots and the PMP plots were analyzed by T test.
- Quality criteria was adjusted to the farmers local quality control criteria, as follow: 1) Termed '*Mutu Remas*' (R), an indicator of the physical quality and appearance of the bunch in whole, by which is unacceptable at a maximum of more than two (2) crowns in per bunch found of fruit discoloration, scabbed or spots, or any other abnormalities.

**RESULT AND DISCUSSION**

*Soil Characteristics*

Analysis results of soil chemical and texture of the plot locations in general is as in Table 1. The Data expresses the marginality of the soil conditions with the region. While soil texture consists of soft clay and dust particles which is supports plant rooting, but the more portions of dust in the composition has a tendency for exposure to erosion risks, especially in areas with hilly topographies. Soil condition is considered to be acidic (pH 5.5) with a very low content of organic and total nitrogen content, while the P levels are moderate. Meanwhile some advantages of the soil condition rely on the less than 50% soil base saturation. As shown in table 1, Ca-dd, Mg-dd and K-dd are categorized to be in the ranges of moderate to high, but the ion exchange capacity is considered to be extremely low that the cultivates ability to absorb nutrition is much restricted.

Furthermore, the Na-dd levels of the plots are at the same identical level of nutrition fixation, but not at a harmful level.

**Table 1. Texture and Chemical Properties of the plot soil, at 0-30 Cm depth, at an inclination of 8-10 % within the Southern Tomohon Regions.**

| No | Analysis Parameter | Units | Value | Remarks |
|---|---|---|---|---|
| 1 | Sand Granules | % | 38 | |
| 2 | Dust | % | 59 | Dusty Clay |
| 3 | Clay | % | 3 | |
| 4 | C-Organic | % | 1.56 | Low |
| 5 | N-Total | % | 0.19 | Extremely Low |
| 6 | C/N Ratio | | 8 | Low |
| 7 | pH ($H_2O$) (1:1 m/v) | | 5.5 | Acidic |
| 8 | pH (KCl) (1:1 m/v) | | 4.7 | |
| 9 | $P_2O_5$ Bray 1 | Mg kg-1 | 21.56 | Moderate |
| 10 | K | Me 100 g | 0.6 | High |
| 11 | Na | Me 100 g | 0.25 | Low |
| 12 | Ca | Me/100 g | 11.72 | Moderate |
| 13 | Mg | Me/100 g | 2.20 | High |
| 14 | KTK | Me/100 g | 5.5 | Extremely Low |
| 15 | KB | % | 37 | Low |

**Varience in Growth and Yields**

Variences in growth and yields of the banana cultivates presented in table 2 are reported after 11 months from bulb planting. While the total yield represents total of 2 years managing the farm.

**Table 2. Variences in Growth and Yield of Goroho Banana under the traditional cultivation techniques and under the PMP management.**

| Management | Trunk Circumferences (Cm) | Plant Height (Cm) | Number of Crown/Bunch | Bunch Weight | Yield Ton/ha |
|---|---|---|---|---|---|
| **Traditional** | 46.87 b | 204.18 b | 4.8 b | 11.40 b | 17.68 b |
| **PMP** | 58.40 a | 272.75 a | 5.87 a | 17.58 a | 42.66 a |

Remarks: Average value in each column followed by the same letters indicates insignificant differences at 5% error rate by LSD.

Statistical analysis indicated a significance difference ($p<0.05$) in the yields and the plant growth of the PMP plots towards the traditional cultivation practice plots. The PMP plots resulted trees that are better in trunk size, plant height, bunch weight and total crown per bunch compared to the trees cultivated in the traditional practice. Productivity in the PMP plots yielded 42.66 ton/Ha while by the traditional practices only yielded 17.68 ton/Ha (table 2). Smithson (2004) reported, poor soil conditions and fertility, and the pressure of diseases due to poor farm management is the major cause for low productivity in banana plantations. Zake et al. (2000) also proved that the correct fertilization technique and improvements in managing organic matter significantly improves banana productivity. In high density planting systems, banana bunch weight can be improved with the application of N, $P_2O_5$, and $K_2O$, at 100-200g, 40g, and 200g respectively per tree (Anonymous, 2007). Furthermore according to Cosico (2000) to optimize growth and yield, fertilization is required, while the necessity of P is less than N and K.

**Banana Quality**

**Table 3. Goroho Banana Quality of the Plots Managed By the Traditional Cultivation Methods and By PMP**

| Management | Total Yield (bunches/Ha) | Bunch Quality | | | |
|---|---|---|---|---|---|
| | | Rames (R) | | Cabutan Rames (C/R) | |
| | | Quantity | % | Quantity | % |
| Traditional | 1302 | 1068 a | 75.67 | 324 a | 22.06 |
| PMP | 2286 | 912 b | 39.76 | 1272 b | 51.28 |

Remarks: Average value in each column followed by the same letters indicates insignificant differences at 5% error rate by LSD.

Table 3 presents the quality of the banana bunch of the total yield. Total production in the traditionally managed plot yielded 1302 bunches/Ha, while from the PMP managed plots yielded 2286 bunches/Ha. Bananas of the traditional cultivation method had a higher *Mutu Remas* (R) value of 75.67% while the PMP production resulted in an R value of 39.76%. *Mutu Cabutan Remas* (CR) of the traditional method was 22.06% while the PMP production was 51.28%. Aside of the use of fertilizers, limiting the number productive plants in a cluster (4 tree per cluster) and the use of fruit wraps, had quite the impact in both quality and weight of the bunches. Insufficient sanitary and fertilizations of the traditional methods leads to poor production quality and quantity. The practice of limiting the productive plants per cluster according to Lagerwall (2005) lessens the competition for air, available soil nutrition and sunlight, thus the productive trees have more access to their necessities to produce at their optimum pace. Highly populated clusters receives less light intensity

therefore produces lower quality fruits (Cahyono, 1996). The use of fruit wraps or bagging (wrapping) without the proper layers of pesticides in the wrap would be less effective in quality improvement. By observation, even the flowers have been well bagged (wrapped) the crowns below is still invested by diseases.

**Economic Analysis of Goroho Farming Practices**

The economic analysis on the practices applied by PMP indicated to be 87% higher in terms of operational costs compared to the traditional methods. The costs of the PMP method appears high due to the cost of fertilization practices and the costs for bulb selections and preparations which was valued at Rp 3.000,- / bulb. Therefore the traditional method in terms of Benefit-to-Cost (B/C) appears to be better than that of PMP practices. Meanwhile observing from a net profit standpoint, the PMP method

Produced a net profit of Rp 14.580.000,- by which is much higher gain than the traditional method that produced a net profit of Rp 9.886.000,-.

A positive impact of this study is the change in perspective on Goroho farming, where this commodity has the potential to generate income as a main agribusiness. The profit produced by the PMP practices had an eye-opening impact on Goroho farming practices, where with proper management the Goroho banana plantation would still be beneficial even if farmed on a marginal land.

## CONCLUSSION

Marginal soil and land if managed well will still be a potential area for such agribusiness as banana farming. By the PMP method, growth and yields of the Goroho banana has better productivity compared to the traditional methods, by which was indicated by the production of 42.66 ton/Ha or equivalent to 2286 bunches/Ha.

Although in terms of Benefit-to-Cost ratio the traditional methods appeared to be at an advantage due to the lower production cost, but in the aspects of continuity and profitability as an agribusiness the PMP method deems to be more profitable.

## ACKNOWLEDGEMENTS

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