Is no-till farming more or less efficient than till farming?: the case of tobacco farms in East Lombok, Indonesia

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Abstract. No-till farming is farming techniques that could better conserve the fertility of the farmland than till farming. Technically, it is greatly linked with the global sustainable agriculture framework. However, it needs to be economically sound for adoption by farmers. Scientific analysis of this aspect is rarely reported in the literature, accessible to the authors. This paper attempts to fill the gap by taking as a case study: the efficiency of tobacco Virginia farms in East Lombok (Indonesia), involving 15 no-till farming farmers and 15 till farming farmers as the sample. This sample was randomly selected from the population of Virginia farmers in purposively selected two villages in the research areas. Data collection was carried out during 2018 planting session using an individual structural interview technique. Farm efficiency was measured as Return to Cost (R/C) ratio. The significance of the efficiency difference between no-till and till farming was analyzed using a t-test. The analysis found that the R/C ratio of Virginia tobacco farms using no-till farming system (mean = 2.21) was significantly lower at 95% degree of confidence than the R/C ratio of virginial tobacco farms using till farming system (mean=3.47). In spite of this significant difference, the value of the R/C ratio was larger than one, indicating each of the systems was financially feasible. This explained the adoption of no-till farming by some of the Virginia tobacco farmers in the study areas. However, the wider adoption of the no-till farming system needed some improvements to reduce farm cost and increase revenue.

1. Introduction

Agriculture is one of the main and strategic sectors of the Indonesian economy. In 2017, the sector accounted for 13.14 percent of the GDP in 2017, absorbing 31.86 percent of the workforce [1]. Tobacco is one of the main commodities in the plantation sub-sector that has high economic value [2,3], especially for several production centers in Indonesia, such as in East Lombok Regency of West Nusa Tenggara Province. The type of tobacco cultivated by farmers in this area is Virginia tobacco. Based on the land preparation technique, the cultivation system applied by farmers can be differentiated into two, namely: tillage (OT) and no-till cultivation system (TOT). The TOT system is relatively new and has been implemented by part of the farmers in the study areas since 2014.

Globally, TOT was introduced in the 1940s. It is a form of conservation farming systems that can increase the amount of water infiltration in the soil, reduce groundwater evaporation, protect organic
matter and soil nutrient cycles, prevent soil surface erosion, increase soil biological fertility, shorten the time for carrying out land preparation activities; so as to increase farming efficiency [4,5].

2. Methods
This paper applies a descriptive approach, which is to describe and explain the object under study to provide scientific answers to the research question by collecting data, compiling, explaining and drawing conclusions [6].

The study areas are Rensing Barat village and Borok Toyang village in East Lombok Regency. These two villages were purposively selected because of two reasons. First, tobacco Virginia farms that apply no-till and till farming coexisting in the villages. Second, the two villages have great similarities in terms of agro-ecosystem, one another. The study randomly selects 15 no-till farmers and 15 till farmers as the respondent, from 314 tobacco Virginia farmers in the two villages.

This study uses an individual field interview technique to collect data necessary, based on a structured questionnaire. Data collected are farming costs and revenues in one planting season (2018). Their ratio (revenue-cost ratio) will give the farm efficiency measure [7]. The farming costs include variable costs and fixed costs incurred by the no-till and till farmers for farming Virginia. The farming revenues are the production values, based on local price during the field visit.

The significant difference of the no-till and till farm efficiency is statistically tested using a t-test at the 5% significance level, which is run by IBM SPSS 20.

3. Results and discussion

3.1. The Respondents
The demographic characteristics of the farmer respondents in the no-till system were slightly different from the characteristics of the farmer respondents in the till system; in terms of age, formal schooling, farming experience, and farmland size. Their ages ranged between 24 and 52 years in the no-till system and between 29 and 69 years in the till system. Their formal schooling backgrounds were identical, 12 years or lower. Their farming experiences were between 5 and 25 years in the no-till system, and between 4 and 30 years in the till system. Their farmland sizes were also identical, between 0.25 and 1.5 hectares per person.

3.2. Farming costs
The average total costs of Virginia tobacco farms in the no-till system were IDR 31,628,941 per hectare, 25.36 percent larger than the total cost in the no-till farming system, which were IDR 25,229,475 per hectare (Table 1). This big difference was mainly due to higher variable costs in the no-till system. The farms in the no-till system incurred much higher labor costs and fertilizer costs than the farms in the till system did. The respondents explained that they had to apply more fertilizers and employ more labor for grass cleaning in the no-till system.

| Table 1. Average Costs of Virginia Tobacco Farms in Till and No-Till Systems in East Lombok Regency (IDR/Hectare). |
|---------------------------------------------------------------|
| Types of Costs | No-Till System | Till System |
| Variable costs | 31,301,577 | 24,860,405 |
| Fixed costs | 327,364 | 369,070 |
| Total costs | 31,628,941 | 25,229,475 |

Source: Primary data calculation
3.3. Farming revenues
On average, the revenue of the Virginia Tobacco farms in the no-till system was IDR 65.74 million per hectare, or 25.04 percent smaller than the revenue of the Virginia Tobacco farms in the till system (Table 2). This large difference was because of a lower yield in the no-till system. The average yield was 1,574 kg per hectare in the no-till system and 1,921 kg per hectare in the till system. The price difference between the no-till system and the till system was insignificant.

| Production/Price/Revenue | No-Till System | Till System |
|--------------------------|----------------|-------------|
| Production (Kg)          | 1.574          | 1.921       |
| Product Price (IDR/Kg)   | 44,503         | 45,595      |
| Revenue (IDR)            | 70,047,722     | 87,587,995  |

Source: Primary data calculation

3.4. Farm efficiency
The farm efficiency was measured as revenue to cost (R/C) ratio. On average, the R/C ratio of the Virginia tobacco farms was 2.21 in the no-till system and 3.47 in the till system (Table 3). The R/C ratios were larger than one, indicating that the tobacco farms were efficient (financially feasible), either in the no-till system or in the system.

| No-Till System | Till System |
|----------------|-------------|
| Revenue (IDR)  | 70,047,722  | 87,587,995 |
| Costs (IDR)    | 31,628,941  | 25,229,475 |
| R/C Ratio      | 2.21        | 3.47       |

Source: Primary data calculation

Is the no-till farming system significantly less efficient than the till system? T-test results in Table 4 confirmed the no-till Virginia tobacco farming system was significantly less efficient than the Virginia tobacco farming system. This, as noted above, was because the no-till system incurred higher costs for fertilizers and laborers, on the one hand, but earned lower yields, on the other hand.

| Levene’s test for equality of variance | t-test for Equality of Means |
|----------------------------------------|-------------------------------|
| F                                      | Sig.                          | T    | df | Sig (2 tailed) | Mean difference | SE difference |
| Equal variance assumed                 | 2.949                         | .097 | -4,522 | .000           | -1,21467       | 26861         |
| Equal variance not assumed             | -4,522                        | 25   | .000 | -1,21467       | 26861           |

Source: Primary data calculated with IBM SPSS 20.
4. Conclusion
- The application of no-till and till farming systems by Virginia tobacco farmers in two village production centers in East Lombok indicated that both farming systems were financially feasible, but the no-till farming system was significantly less efficient than the till farming system. The average R/C ratio of the farms was 2.21 in the no-till system and 3.47 in the till system.
- The difference in farm efficiency was mainly due to higher farming costs and lower yields in the no-till farming system, compared to the till farming system. The average total costs of Virginia tobacco farms in the no-till system were IDR 31,628,941 per hectare, while the average total cost in the no-till farming system was IDR 25,229,475 per hectare. This was largely contributed by the fertilizer and labor costs.

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