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# Is Complete Land Property Rights Increase Productivity of Rice Farming?

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**Abstract:** This study examines how changes in the status of agricultural land property rights affects the productivity of rice farming, taking the case in Indonesia. By employing the two-period difference-in-differences (DiD) approach, we examine the productivity of 686 rice farming households that were covered in the IFLS longitudinal data panel survey in 2007 and 2014. IFLS itself is a survey with a sample that is considered to represent about 83 percent of the Indonesian population which was held in 13 provinces of the 34 existing provinces. The advantage of this research is the use of longitudinal data with observations on the same household and is a panel related to rice farming households. We find that changes in land property rights status from incomplete to complete property rights, has no effect on the productivity of rice farming, suggesting that to improve rice productivity, the government can not relying solely on land registration program. In Indonesia, land registration program solely implemented on land that is dispute free, therefore, there is no significant impact on creating maximization behaviour in input of production that can increase productivity.

**Keywords:** Asset legality, difference-in-differences analysis, land status, maximization behavior transferability

## INTRODUCTION

In the last few decades, studies on the legality of land assets have received serious attention in economics literature, where the relationship between land property rights and productivity in the agricultural sector is still widely debated. Various studies, such as in Vietnam, Phillipines, Ethiopia, Malawi, Thailand, and Panama show a positive relationship between the change of land status from incomplete to complete property rights with productivity in the agricultural sector (Ghebru & Holden, 2015; Newman et al., 2015; Koirala et al., 2016; Chen, 2017; Cordoba, 2017; Pochanasomboon et al., 2020). Meanwhile, studies in Madagaskar and Tanzania showed an insignificant relationship between legality of land assets and agricultural productivity (Bellemare, 2013; Hombrados et al., 2015). Lawry, et al. (2017) revealed that the observed impacts of land reforms or land property rights policies differed across regions.

Some literature shows that the relationship between land property rights status and productivity in the agricultural sector is not appear directly (Hombrados et al., 2015). Then, land property rights can improve the perceived tenure security of the land (Udry, 2011; Lawry et al., 2017). Land property rights can increase agricultural productivity and

production by improving land transferability. Its immobility as an indestructible asset makes land available as wealth and collateral (Galiani & Sened, 2014). Due to there are inconsistence results in existing studies, it becomes an opportunity to conduct further research related to the legality of land assets in the context of Indonesia, whether the change of land status from incomplete to complete property rights has a positive relationship with productivity of rice farming households.

This paper discusses the effect of legalization of land assets on productivity in the agricultural sector, particularly rice farming. The fundamental question that this study aims to answer is the extent to which changes in the status of agricultural land property rights have an impact on the productivity of rice farming in Indonesia. In the last few decades, Indonesia is aggressively carrying out a comprehensive systematic land registration program. The case of Indonesia could provides a particularly good opportunity to evaluate how complete land property rights affects rice farming productivity, especially using longitudinal panel data with a quasi experimental design.

Theory of rights in general is what 'people actually can exercise' while making 'no attempt to determine what rights people should have' (Holcombe, 2014). Ownership of property rights can affect individuals to be responsible for their ownership and provide motivation to further maximize the utility of ownership of the property (Groenewegen, et al., 2010). In the understanding of property rights, a metaphor is known as a bundle of rights or a bundle of sticks which describes the rights and responsibilities attached independently of the ownership of an object. There are at least three exclusive rights that can be owned by someone who holds the right to property which includes, (1) the right to get the use of goods; (2) the right to earn income from ownership of goods; and (3) the right to manage and sell or transfer ownership rights to another person (Mello, 2016). Property rights can be intepreted as a law that guarantees the owner of his right to do everything to his ownership according to his will, whether to use it or not to use it and can transfer ownership rights or release ownership if they feel they no longer need it.

In general, private property rights are considered capable of stimulating one's productivity and creating efficiency. Kubitza et al., (2018) states that the provision of land titles can contribute to agricultural intensification. Complete property rights could reduce externalities, the more the private and social net benefits of resource use coincide and the associated losses of the common pool. Better alignment of incentives for investment in the resource; provision of collateral for accessing capital for investment; more flexible exchange; greater information generation; and improved cost savings in meeting conservation or environmental objectives, are the advantages of property rights arrangements (Libecap, 2007).

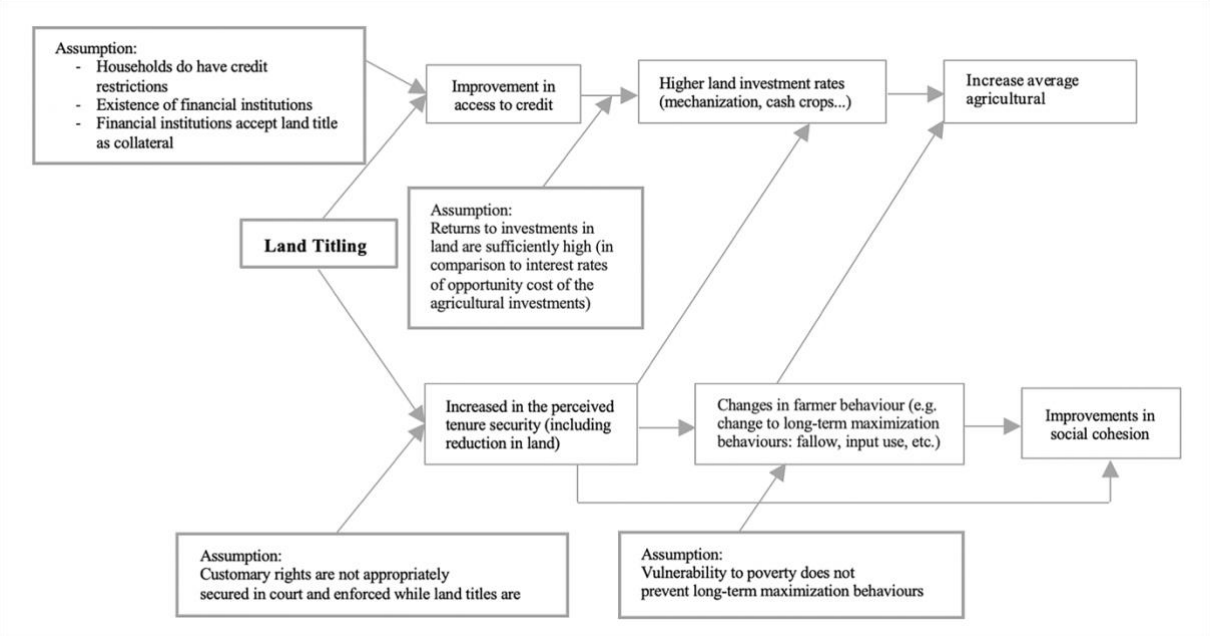


Figure 1. Theory of Change for the Impact of Complete Land Property Rights on Agricultural Outcomes
Source: Hombrados et al. (2015)

On issues more specifically related to agriculture, property rights have the potential to increase agricultural investment, productivity and land value, through at least three channels (Besley, 1995). First, property rights increase the incentive to invest only by increasing the confidence of the land owner that he will be able to benefit from the investment (the guarantee effect). As an empirical example, in Kavango West region of Namibia, complete or secure property rights being a stimulus to increase investment and productivity in the agricultural sector (Uchezuba et al., 2019). Second, property rights can also affect productivity by making access to credit easier (Hombrados et al., 2015). Third, property rights can increase agricultural productivity by facilitating land trade (Hombrados et al., 2015).

Feder & Feeny (1991) note at least four consequences of enforcing the ownership system of land assets, namely creating incentives; solve the problem of asymmetric information and uncertainty; unlocking potential formal credit transactions; and creating land security guarantees. Various studies have confirmed a positive relationship between land titles and access to credit (Payne et al., 2009; de Moura & Bueno, 2013; Kassa, 2014). Second, land certificates can improve perceptions of land ownership security (Hombrados et., 2015). If land titles make farmers more confident that their crops are less likely to be disputed, they can lead to greater agricultural investment in terms of crops and inputs, the sense of security can grow and create maximization behavior. Based on several results of studies on property rights in the agricultural sector and empirical studies from various

countries regarding the impact of land property rights on agricultural productivity, research to see the extent of its impact on the Indonesian context, especially the Indonesian government is intensively conducting land certification programs, is relevant to carry out. The research question that is trying to be answered is how the impact of changing the status of agricultural land certificates from incomplete to complete property rights on the productivity of rice farming households in Indonesia.

## METHODS

This study uses IFLS wave 4 in 2007 and IFLS wave 5 in 2014 due to the availability of data related to the status of land ownership at the household level of rice farmers in Indonesia. The IFLS data, organized by the RAND Corporation, has the advantage of being limited to large-scale, population-based longitudinal surveys available over a long period of time in developing countries and being the only large-scale longitudinal survey available in Indonesia. The data shows that there are 6,329 households in IFLS 4 and there are 6,275 households that can be re-interviewed in IFLS 5, the IFLS data subset is carried out on farmer households for rice plants that have agricultural land in waves 4 and 5, the results are 686 rice farms that can be analyzed as the unit of analysis in this study.

This study uses the DiD method to see the impact of changes in land property rights status for rice farming households in Indonesia. With the DiD method it is possible to calculate the difference between control and treatment groups constantly over time (Gertler et al., 2011). Through the DiD method, rice farming households that experienced a change in land property rights status from previously have incomplete land property rights status (include: Patok D certificate, Letter C certificate, and no certificate) become complete land property rights status (SHM certificate) were analyzed as the treatment group. Meanwhile, rice farming whose land remained incomplete land property rights status also remained complete land property rights status during the two wave observation periods was designated as a control group. Letter C is a land register book that is in the Village office and is not legal or can be reffered to as incomplete property rights. Patok D is proof of land ownership that existed before the issuance of Law Number 5 of 1960 concerning Basic Agrarian Regulations. After the Basic Agrarian Regulation Law was enacted, Patok D's land status did not become proof of legal ownership, so it was classified as incomplete property rights. Proof of ownership after the Basic Agrarian Law which is legally recognized, namely SHM classified as complete property rights.

The limitations of the data in this study, which only consisted of two observation points (IFLS wave 4 and 5), made it impossible to running pre-treatment trends test to ensure that the trends in the treatment and control groups had the same trend. The basic model equation in this study is defined in the following model form:

$$PRODUCTIVITY_{it} = \alpha + \theta Change\ of\ land\ property\ rights\ status_i + \gamma BeforeAfter_t + \beta(Change\ of\ land\ property\ rights\ status_i \times BeforeAfter_t) \textbf{(1)}$$

In equation (1) $PRODUCTIVITY_{it}$ is the dependent variable in the form of rice farming productivity in the form of harvested dry grain on land planted in units of kg/ha in household i in year t. Then $Change\ of\ land\ property\ rights\ status_i$ is the dummy change in the status of the largest agricultural land ownership, that owned by rice farming households with 1 = rice farming households that "experience" changes from incomplete property rights to complete peroperty rights, and 0 = rice farmers households who "do not experience" change the status of the largest land ownership, that remained incomplete or remained complete property rights status. At $BeforeAfter_t$ is the IFLS survey wave dummy with 1 = IFLS wave 5 in 2014, and 0 = IFLS wave 4 in 2007. To provide a more in-depth explanation, the above basic equation is also added with several control variables, with a description of the equation as follows:

$$PRODUCTIVITY_{it} = \alpha + \theta Change\ of\ land\ property\ rights\ status_i + \gamma BeforeAfter_t + \beta(Change\ of\ land\ property\ rights\ status_i \times BeforeAfter_t) + \sum_{c=12}^{n} \delta Control_{it} + \mu_{it} \textbf{(2)}$$

$Control_{it}$ is the control variable and $\mu_{it}$ is the error term for each rice farming household i in year t. The control variables used are, 1) Land rented; 2) Times of harvested paddy in 12 month; 3) Area harvested by others; 4) Cropsharing; 5) Farmers expenditure in 12 month; 6) Rain as main water sources; 7) Irrigation as main water sources; 8) Well or Water Pump as main water sources; 9) Tractor ownership; 10) Small equipment ownership (Plows, hoes, etc.); 11) Small farm category; and 12) Middle size farm category. This study does not consider the employee variable considering the limitation of IFLS data survey.

The importance of considering agricultural area to productivity is related to the evidence summarized by Kadapatti & Bagalkoti (2014) related to most studies during the 1960s and 1970s which have provided compelling evidence that crop productivity per unit of land decreases with increasing land area. This is also in line with Amartya Sen's (1964) view regarding "diseconomics of large-scale", which assumes that input use can be optimized for small farms managed through personal systems. The main water source is considered as a control variable based on the research findings of Mahananto et al., (2009), stated that rice fields with a technical irrigation system were able to increase rice productivity compared to rainfed rice fields. This study also considers other capital variables such as tractor ownership and small equipment ownership such as saws, axes, machetes, forks, plows, hoes, and so on. It is assumed that rice farming which owns tractors has better productivity than those who only have small equipments. The use of the land rent variable is to find empirical evidence whether the smaller land is managed will increase

productivity, as stated by Kadapatti & Bagalkoti (2014) and Sen (1964). In the end, there will be optimization of the use of production factors in the rice farming being carried out. Evidence for this assumption was also presented by Chen & Restuccia (2017) who say that land leasing increases the proportion of agricultural utilities with better capital intensives technology, which then contributes to increased productivity.

This study assumes that the more land is harvested in one year, it will affect the quality of agricultural land, which in turn will reduce the level of agricultural productivity. Therefore, the use of the Times of Harvested Paddy in 12 month variable is considered. Next, there is the Area Harvested by others variable. The "ijon" or "tebas" is a system of buying and selling the rice yields before harvest, which in turn makes the selling price determined based on the assumption of the amount of harvest to be obtained. Moreover, in this study, the variable amount of rice yields in the form of harvested dry grain was used. Then the cropsharing variable contains the amount of rice yields that the farming household gives to other people because of the production sharing agreement in kg / harvested dry grain. This refers to the results of a study conducted by Ahmed & Billah (2018), that the input provided by smallholders is less than owner farmers, thus, profit sharing farmers are less efficient in rice productivity. This study considers the use of rice farming expenditure variables for the last 12 months. It is assumed that if this variable significantly affects productivity, then there is an indication of selection bias, that rice farming households with large capital have access to changes in land ownership status. This study also tries to analyze the difference-in-difference-in-differences (DDD) by interacting with three variables, namely the variables $BeforeAfter_t$, *Change of land property rights* $status_i$ and *Dummy* $Cropsharing_{it}$ only in basic model. Subset, t-test, and also DDD analysis, whether using control variables or not, done to carry out robustness checks in finding strong and consistent conclusions.

## RESULTS AND DISCUSSION

### Results

In the analysis, several tests were carried out on several models, first, testing the basic model; second, testing the model to check robustness by conducting a variation or combination test on the basic model; third, performing a subset based on the size of agricultural land; and fourth, conducting a difference-in-difference-in-differences model analysis for the basic model (DDD). In the basic model analysis result, the t-test showed that there was no significant difference between the treatment and control groups related to the productivity of rice farming in the form of harvested dry grain, because the value of Pr (| T |> | t |) = 0.4543 or more than alpha 0.5 in confidence level 95 per cent as it showed in Table 1.

Table 1. T-Test on Productivity Variables in the Basic Model

| Group | Observasi | Mean | Std. Error | Std. Dev. | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| 0 | 972 | 8.476,566 | 856,305 | 26.696,940 | 6.796,145 | 10.156,990 |
| 1 | 400 | 7.710,802 | 559,795 | 11.195,910 | 6.610,910 | 8.811,319 |
| Combined | 1.372 | 8.253,311 | 628,168 | 23.267,660 | 7.021,037 | 9.485,585 |
| diff | | 7.657,633 | 1.023,049 | | -1.241,146 | 2.772,673 |
| diff = mean (0) - mean (1) | | | | | t = | 0,7485 |
| Ho: diff = 0 | | | | | Degrees of freedom = | 1371,62 |
| Ha: diff < 0 | | Ha: diff != 0 | | | Ha: diff > 0 | |
| Pr (T < t) = 0,7729 | | Pr (\|T\| < \|t\|) = 0,4543 | | | Pr (T < t) = 0,2271 | |
| Catatan: | | | | | | |
| 1 = Treatment group | | | | | | |
| 0 = Control group | | | | | | |

The results in the basic model, with the treatment group, are rice farming households that experience a change land status from incomplete become complete property rights in the range between 2007 and 2014 and the control group is a rice farmers household whose land status remained incomplete or remained complete property rights, shows that there is no significant difference between the productivity of the rice farming household in the form of harvested dry grain and an increase in the status of land / agricultural land ownership. Table 2 shows the insignificant results between the interaction of the variables (*Change of land property rights status*$_i$ × *BeforeAfter*$_t$) in the basic model with and without control with both robust standard error of 0.674 and 0.735 at a significant level of 5 per cent as shown in column (2) and (3).

Table 2. DiD Analysis Related to the Impact of Changing of Land Property Rights Status on the Productivity of Rice Farming in Indonesia (Basic Model)

| Dependent Variable: *PRODUCTIVITY* (kg/ha harvested dry grain) | Basic Model without Control | Basic Model with Control |
|---|---|---|
| (1) | (2) | (3) |
| *BeforeAfter* | 3162.675* | 2763.911 |
| (1 = IFLS Wave 5; 0 = IFLS Wave 4) | (0.065) | (0.118) |
| *Change of land property rights status* | -336.2484 | -641.685 |
| (1 = No legal status to SHM; 0 = Remains no legal status) | (0.777) | (0.600) |
| *Change of land property rights status* × *BeforeAfter* | -859.0299 | -674.4587 |
| | (0.674) | (0.735) |
| **Control Variable:** | | |
| *Land Rented* ($m^2$) | | .0039157*** |
| | | (0.000) |
| *Times of Harvested Paddy in 12 month* (time) | | -3360.552* |
| | | (0.058) |
| *Area Harvested by others* ($m^2$) | | -.0036276*** |
| | | (0.000) |
| *Cropsharing* (kg harvested dry grain) | | .2686741 |
| | | (0.176) |
| *Farmers Expenditure in 12 month* (rupiah) | | .0000559 |
| | | (0.269) |
| *Rain as Main Water Sources* | | -1841.473 |
| (1 = Rain; 0 = otherwise) | | (0.268) |
| *Irrigation as Main Water Sources* | | 1372.233 |
| (1 = Irrigation; 0 = otherwise) | | (0.503) |
| *Well or Water Pump as Main Water Sources* | | 5144.733 |
| (1 = Well or Water Pump; 0 = otherwise) | | (0.189) |
| *Tractor Ownership* | | 2278.481** |
| (1 = Have tractor; 0 = Don't have tractor) | | (0.024) |
| *Small Equipment Ownership (Plows, hoes, etc.)* | | 398.7132 |
| (1 = Have small equipment; 0 = Don't have small equipment) | | (0.883) |
| *Small Farm Category < 0.5 ha* | | 9351.154*** |
| (1 = land with size < 0.5 ha; 0 = Otherwise) | | (0.000) |
| *Middle Size Farm Category 0.5 ha - 0.99 ha* | | 883.1712** |
| (1 = land with size 0.5 ha - 0.99 ha; 0 = Otherwise) | | (0.019) |
| Intersep | 6895.228*** | 5417.266 |
| | (0.000) | (0.138) |
| Observations | 1372 | 1372 |
| R-squared | 0.0042 | 0.0408 |
| Number of Households (Treated) | 200 | 200 |
| Number of Households (Control) | 486 | 486 |

Notes: Confidence level 99% (***), 95% (**), 90% (*) in robust standard errors
Treatment Group: Rice farming households that experience a change in land status from incomplete become complete property rights
Control Group: Rice farming households that land status remained incomplete property rights and remained complete property rights

The DiD estimation results in Table 2 confirm the results of Lawin & Tamini's (2018) research in Benin which show that there is no positive impact from the guarantee of agricultural complete land property rights. Research conducted by Lawin & Tamini (2018) uses the Output Distance Function (ODP) method to see the impact of property rights

security on owner farmers and worker farmers, the results show that worker farmers are more productive than owner farmers. So it can be concluded from the findings of Lawin & Tamini (2018) that the attachment of complete land property rights cannot create guarantees to boost agricultural productivity.

Bellemare (2013), research result conducted in Madagaskar confirmed the results in Table 2 by also finding no relationship between land property rights status and agricultural productivity, even though this study used the method DiD estimates that differ from those of Bellemare (2013), with *ordinary least square* (OLS) analysis. Another study that can support the estimation results in Table 2 is the research of Pender et al. (2004) which shows that complete property rights status also find limited impacts on agricultural production. His argument relates to the insignificance of these findings because pre-existing forms of property rights status eventhougth incomplete are relatively safe and transferable and access to credit is also not the main factor affecting agricultural production in Uganda due to the limited use of inputs. Indonesia context also show that incomplete property rights such as Letter C and Patok D certificate remains transferable although categorized as non-legal property rights.

For the negative coefficient shown in the results of the DiD analysis on the basic model without control variables, it is confirmed by descriptive data in Table A1 (in the appendix) which shows that in the treatment group the average productivity rate is indeed lower when compared to the control group. Whereas the basic model with control variables shows a negative coefficient number which is getting smaller from -859.0299 to -674.4587, the explanation is in the direction of the relationship on the control variables used. The variable Small Farm Category <0.5 ha appears to be very significant with a value of 0.000 at the 1 per cent level. The descriptive statistics alone in the treatment group are less rice farming which has less than 0.5 ha of land. In the treatment group there were only 200 observations, while in the control group there were 486 observations. Meanwhile, the theory shows that the use of input will be more optimized in the form of small agriculture, or what is called "diseconomics of large-scale" (Sen, 1964).

There are six combination models outside the basic model by analyzing the all sampling model and performing a specific subset of samples in cases of more specific changes in the status of land ownership. From the combination or specification of treatment and control groups based on the characteristics of the legal status of land ownership owned by rice farming households, it still shows that there is no significant difference from changes in land certificate status to the productivity of rice farming in Indonesia, as listed in Table 3, even in models that use control variables or not. These results are consistent with the results in the basic model.

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Table 3. DiD Analysis Related to the Impact of Changes in Land Property Rights Status on Rice Productivity

| **Treatment Group:** | **No Certificate to Complete Property Rights** | | | | | | **Letter C and Patok D Certificate to Complete Property Rights** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Control Group:** | **Land status remained complete property rights** | | **Land status remained no land certificate** | | **Land status remained Leter C and Patok D certificate** | | **Land status remained complete property rights** | | **Land status remained no land certificate** | | **Land status remained Leter C and Patok D certificate** | |
| **Dependent Variable:** *PRODUCTIVITY* (kg/ha harvested dry grain) | **Without Control** | **With Control** | **Without Control** | **With Control** | **Without Control** | **With Control** | **Without Control** | **With Control** | **Without Control** | **With Control** | **Without Control** | **With Control** |
| (1) | (2) | (3) | (4) | (6) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| *BeforeAfter* | 5884.893 | 7531.881 | 1267.136 | 728.1079 | 1851.942 | 1456.694 | 5884.893 | 6803.401 | 1267.136 | 271.9402 | 1851.942 | 1536.715 |
| (1 = IFLS Wave 5; 0 = IFLS Wave 4) | (0.176) | (0.171) | (0.628) | (0.812) | (0.579) | (0.669) | (0.174) | (0.177) | (0.681) | (0.929) | (0.578) | (0.649) |
| *Change of land property rights status* | -1700.554 | -390.1903 | -1022.996 | -1542.075 | -2024.246 | -694.1422 | -840.7225 | -713.4499 | -163.1639 | -1361.295 | -1164.415 | -900.1006 |
| (1 = treatment group; 0 = control group) | (0.297) | (0.831) | (0.724) | (0.617) | (0.518) | (0.808) | (0.568) | (0.636) | (0.954) | (0.658) | (0.702) | (0.771) |
| *Change of land property rights status × BeforeAfter* | -4844.713 | -7285.392 | -226.9561 | -995.8581 | -811.7621 | -1501.121 | -3918.372 | -4396.341 | 699.3847 | 1299.823 | 114.5787 | 529.7246 |
| | (0.315) | (0.198) | (0.952) | (0.770) | (0.837) | (0.698) | (0.387) | (0.342) | (0.835) | (0.707) | (0.974) | (0.891) |
| **Control Variable:** | | | | | | | | | | | | |
| *Land Rented* ($m^2$) | | .0191858 | | .0130767 | | .0037298*** | | -.0295045 | | -.0177633 | | .0035671*** |
| | | (0.764) | | (0.594) | | (0.000) | | (0.599) | | (0.463) | | (0.000) |
| *Times of Harvested Paddy in 12 month* (time) | | -6001.25 | | -2124.171 | | -5791.2 | | -3648.029 | | 161.4581 | | -3473.214 |
| | | (0.256) | | (0.508) | | (0.117) | | (0.285) | | (0.919) | | (0.137) |
| *Area Harvested by others* ($m^2$) | | -.0387743 | | -.2066128 | | -.0032763* | | -.100761 | | .2554689 | | -.002962* |
| | | (0.749) | | (0.415) | | (0.066) | | (0.421) | | (0.175) | | (0.071) |
| *Cropsharing* (kg harvested dry grain) | | 1.634874* | | .5141636 | | .3975689 | | .995052 | | .0984218 | | .3146623 |
| | | (0.073) | | (0.831) | | (0.148) | | (0.170) | | (0.921) | | (0.252) |
| *Farmers Expenditure in 12 month* (rupiah) | | -.0001151 | | .000269** | | .0001594 | | -.0000545 | | .0000734 | | .00008 |
| | | (0.143) | | (0.022) | | (0.500) | | (0.316) | | (0.316) | | (0.357) |
| *Rain as Main Water Sources* | | -5183.615 | | -2194.25 | | -1435.526 | | -5468.972 | | -789.5355 | | -2495.052 |
| (1 = Rain; 0 = otherwise) | | (0.193) | | (0.417) | | (0.641) | | (0.207) | | (0.816) | | (0.502) |
| *Irrigation as Main Water Sources* | | 1928.572 | | 2610.16 | | 2657.356 | | -3091.114 | | -2201.606 | | -2030.294 |
| (1 = Irrigation; 0 = otherwise) | | (0.739) | | (0.505) | | (0.327) | | (0.482) | | (0.492) | | (0.527) |
| *Well or Water Pump as Main Water Sources* | | 9403.906 | | -3906.229 | | -2020.159 | | 7672.797 | | -3609.168 | | -3546.342 |
| (1 = Well or Water Pump; 0 = otherwise) | | (0.214) | | (0.173) | | (0.441) | | (0.307) | | (0.370) | | (0.330) |
| *Tractor Ownership* | | 23.4577 | | -1506.224 | | 4992.9 | | 804.1939 | | 81.85652 | | 3062.7878 |
| (1 = Have tractor; 0 = Don't have tractor) | | (0.992) | | (0.466) | | (0.112) | | (0.526) | | (0.952) | | (0.099) |
| *Small Equipment Ownership (Plows, hoes, etc.)* | | -3293.585 | | -16636.04 | | 13023.23 | | 4670.253** | | 3337.118 | | 3177.774 |
| (1 = Have small equipment; 0 = Don't have small equipment) | | (0.643) | | (0.255) | | (0.273) | | (0.034) | | (0.114) | | (0.142) |
| *Small Farm Category < 0.5 ha* | | 10876.07*** | | 8583.357*** | | 10631.44*** | | 9152.926*** | | 8058.574*** | | 9262.057*** |
| (1 = land with size < 0.5 ha; 0 = Otherwise) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) | | (0.000) |
| *Middle Size Farm Category 0.5 ha - 0.99 ha* | | 1271.181 | | 433.5074 | | 1402.658 | | 595.5471 | | 205.9912 | | 1066.893 |
| (1 = land with size 0.5 ha - 0.99 ha; 0 = Otherwise) | | (0.401) | | (0.687) | | (0.193) | | (0.582) | | (0.728) | | (0.117) |
| Intersep | 7654.067*** | 12999.43 | 6976.508*** | 21293.45 | 7977.759*** | 20434.5 | 7654.067*** | 5971.827 | 6976.508 *** | 262.6299 | 7977.759*** | 5149.971 |
| | (0.000) | (0.156) | (0.010) | (0.182) | (0.007) | (0.105) | (0.000) | (0.325) | (0.009) | (0.963) | (0.007) | (0.383) |
| Observations | 376 | 376 | 196 | 196 | 352 | 352 | 594 | 594 | 414 | 414 | 570 | 570 |
| R-squared | 0.0086 | 0.0450 | 0.0033 | 0.1335 | 0.0029 | 0.0462 | 0.0089 | 0.0397 | 0.0048 | 0.0793 | 0.0028 | 0.0370 |
| Number of Households (Treated) | 39 | 39 | 39 | 39 | 39 | 39 | 148 | 148 | 148 | 148 | 148 | 148 |
| Number of Households (Control) | 149 | 149 | 59 | 59 | 137 | 137 | 149 | 149 | 59 | 59 | 137 | 137 |

**Notes:** Confidence level 99% (***), 95% (**), 90% (*) in robust standard error

Table 4. DiD Analysis Related to the Impact of Changing the Status of Land Certificates on the Productivity of Rice Farming in Indonesia for Farmers with Land Size < 0.5 ha and > = 0.5 ha

| Dependent Variable: *PRODUCTIVITY* (kg/ha harvested dry grain) | Land Size < 0,5 ha (Small Farmers) | | Land Size > = 0,5 ha (Non-Small Farmers) | |
|---|---|---|---|---|
| | Without Control | With Control | Without Control | With Control |
| (1) | (2) | (3) | (4) | (5) |
| *BeforeAfter* | 1879.769 | 2091.691 | 395.7521 | -188.2242 |
| (1 = IFLS Wave 5; 0 = IFLS Wave 4) | (0.388) | (0.325) | (0.264) | (0.486) |
| *Change of land property rights status* | -1404.845 | -1330.366 | 447.4345 | 658.9257* |
| (1 = treatment group; 0 = control group) | (0.479) | (0.511) | (0.295) | (0.078) |
| *Change of land property rights status* × *BeforeAfter* | -144.6385 | 380.6079 | -585.6205 | -897.496* |
| | (0.955) | (0.890) | (0.346) | (0.086) |
| **Control Variable:** | | | | |
| *Land Rented* ($m^2$) | | .0042414*** | | .0072916 |
| | | (0.000) | | (0.595) |
| *Times of Harvested Paddy in 12 month* (time) | | -3921.966** | | -135.3401 |
| | | (0.028) | | (0.655) |
| *Area Harvested by others* ($m^2$) | | -.0032333*** | | .0013135 |
| | | (0.002) | | (0.979) |
| *Cropsharing* (kg harvested dry grain) | | 2.663616 | | .2955468*** |
| | | (0.424) | | (0.000) |
| *Farmers Expenditure in 12 month* (rupiah) | | -.0000249 | | .0001113*** |
| | | (0.572) | | (0.000) |
| *Rain as Main Water Sources* | | -4743.551* | | -710.4068 |
| (1 = Rain; 0 = otherwise) | | (0.068) | | (0.133) |
| *Irrigation as Main Water Sources* | | -414.6362 | | 461.2449 |
| (1 = Irrigation; 0 = otherwise) | | (0.874) | | (0.373) |
| *Well or Water Pump as Main Water Sources* | | 5130.255 | | 5645.057 |
| (1 = Well or Water Pump; 0 = otherwise) | | (0.377) | | (0.155) |
| *Tractor Ownership* | | -848.4562 | | 705.8649** |
| (1 = Have tractor; 0 = Don't have tractor) | | (0.684) | | (0.049) |
| *Small Equipment Ownership (Plows, hoes, etc.)* | | 3716.574** | | |
| | | (0.049) | | -156.8639 |
| (1 = Have small equipment; 0 = Don't have small equipment) | | | | (0.869) |
| Intersep | 9206.454*** | 13623.13*** | 2665.934*** | 1814.138 |
| | (0.000) | (0.002) | (0.000) | (0.140) |
| Observations | 732 | 732 | 318 | 318 |
| R-squared | 0.0030 | 0.0219 | 0.0053 | 0.0086 |
| Number of Households (Treated) | 115 | 115 | 38 | 38 |
| Number of Households (Control) | 251 | 251 | 121 | 121 |

**Notes:** Confidence level 99% (***), 95% (**), 90% (*) in robust standard errors

**Treatment Group:** Rice farming households that experience a change in land status from incomplete become complete property rights
**Control Group:** Rice farming households that land status remained incomplete property rights and remained complete property rights

In column (10) and (11) Table 3, the coefficient results of the interaction variable in DiD show a positive value, namely in the model test with the treatment group, rice farming households that experience a change in land status from Letter C certificate and Patok D certificate to complete property rights with control of rice farming households which in two periods of observation of the land still does not have legal status or complete property rights status. This means that it is indicated that the productivity level of the rice farming tends to be lower than that of rice farming households that experienced a change in land property rights status from Letter C certificate and Patok D certificate to complete property rights, as shown in Table A3 (in the appendix). Although specifically this requires a more in-depth study, there are indications that the land in the control model group has stronger common property principles compared to private property rights, which in the case of a Letter C certificate or Patok D certificate can still be proven private ownership even though it does not have formal legality with strong legal position such as SHM certificate as complete property rights. This is evidenced by a fairly large coefficient value, namely 699.3847 without control variables and 1299.823 with control variables compared to the model in column (12) and (13) Table 3, although it is also positive but is still lower.

The absence of property rights can create excludability problems, and things that are not private tend to create inefficiencies, such as when someone grows rice on land with no clear personal ownership status, then when rice is ready to harvest, the rice can be considered joint property. This in turn will degrade a person's desire to provide maximum production input or that person requires high security costs to keep the planted rice from being harvested by other people. Productivity can increase from changes in farming behavior due to an increased sense of security for the land that is owned due to the legality of land assets in the certificate. So in the case of the model in columns (10) and (11) Table 3, the sense of security for land ownership can be rated the lowest compared to other control groups in the model tested in this study. So that the coefficients in the columns (10) and (11) of Table 3 have a tendency to be positive compared to other models.

Subset analyzis (Table 4) is based on the regression estimation results in Table 2 and Table 3 where the Small farm variable consistently has significant results at the 1 per cent level on average affecting the productivity of rice farming in the form of harvested dry grain. The next investigation divided into two equation models in the basic model sample, namely rice farming households in Indonesia based on IFLS data with planted land areas <0.5 ha and > = 0.5ha. The results of this subset show no significant difference due to changes in the status of rice farming land ownership on productivity. The ladder of rice farming that grows rice on land > = 0.5 ha, actually shows a significant difference at the 10 per cent confidence level, with a negative coefficient of 897,496 as listed in column (5) Table 4, but the direction is opposite to the assumption that changes in land status can increase productivity in the agricultural sector. The results of robustness checks with various

characteristics of the analysis unit characteristics carried out in this study consistently show that changes in the status of land certificates to SHM certificate or from incomplete property rights to complete property rights in rice farming households in Indonesia do not show a significant difference or positive impact on productivity rice farming in the form of harvested dry grain. To further strengthen this conclusion, this study tries to re-conduct robustness checks by performing DDD analysis by interacting three variables, namely the variables BeforeAfter, Change of land property rights status, and Small Farm and also variables BeforeAfter, Change of land property rights status, and dummy cropsharing (see Table A4 and Table A5 in the appendix). The results show that there is no significant difference in the productivity of rice farming due to changes in land status in small farm and rice farm household who does cropsharing.

**Discussion**

In this section, we will discuss some potential explanation of why changes in land property rights status in Indonesia do not have a significant impact on increasing the productivity of rice farming based on various statistical tests in this research. There are at least four explanation based why in Indonesia context, complete property rights do not have a significant impact on agricultural productivity. First, the underdeveloped agricultural labor market in Indonesia; second, the credit market for rice farming is low; third, the slow mechanization of paddy farming in Indonesia; and fourth, transferability of land assets. These four things become explanatory in the findings of this study, although in particular it is necessary to conduct a more in-depth study. In this discussion section, the review conducted also uses several descriptive statistical data on the condition of agricultural labor, credit for food and energy security, and the gap in agricultural mechanization in Indonesia.

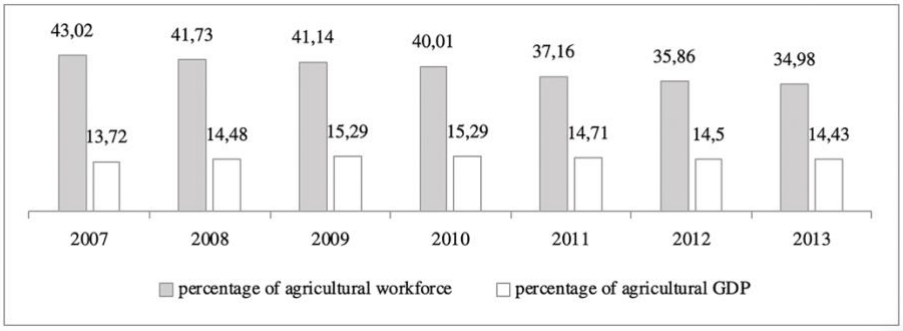


Figure 2. Development of Agricultural Labor Absorption and Agricultural Sector Contribution to GDP, 2007-2013
Source: BPS (2020)

In Indonesia, the agricultural labor market shows an underdeveloped condition and tends to experience a decline (Figure 2). During the observation period used in this study, namely 2007 to 2014, with available data, the percentage of agricultural labor in Indonesia shows a decreasing trend, although the contribution to the percentage of GDP in the agricultural sector tends to be stagnant. This shows that there is an incentive or motivation for the workforce to engage in the profession as a farmer in Indonesia which continues to experience degradation. Another thing that can be noted is the insufficient number of farmers as a sovereign profession so that they can have control over their own production inputs and outputs.

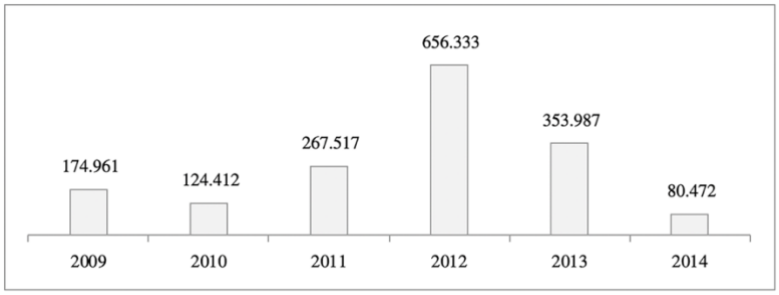


Figure 3. Development of Food and Energy Security Credits in Food Plants from 2009-2014 (in Million Rupiah)
Source: Ministry of Agriculture Indonesia (2020)

Other data also show that the agri-food credit market during the observation period in this study did not show a significant development. This can be the answer why changes in land certificates in rice farming in Indonesia do not show a significant impact on productivity, as shown in Figure 1 regarding the channel for changing land certificates on productivity in the agricultural sector, one of which is through increasing access to credit. The Food and Energy Security Credit (KKPE) data shows a not very encouraging development in the food crop cluster, which includes the rice commodity. Food and Energy Security Loans are investment funds or working capital loans provided in the framework of supporting food security programs and are provided through Farmer Groups and / or Cooperatives. On average, the data shows that the food crop cluster only gets about 12 per cent of the total KKPE ceiling, with most of it being used more by sugarcane farmers (Ministry of Agriculture Indonesia, 2020).

Complete land property rights status such as SHM certificate do have the advantage of accessing credit at formal financial institutions as collateral. However, it does not mean that evidence of Letter C certificate or Patok D certificate cannot be used to access loans outside formal financial institutions. Rural communities often make loans even without interest to their relatives and neighbors. This can occur due to the absence of asymmetric information, given the strong communal ties and each transacting party is usually based on the thrustworthy principle because they already know each other personally with each other. In the end, these things can be the answer to the context in Indonesia, why the change

in land property rights status from incomplete property rights to complete property rights in the form of SHM certificate does not have a significant impact on increasing the productivity of rice farming. To prove the above assumptions, it is necessary to have a more in-depth study related to the issue of land property rights and rice farming productivity, to further clarify the reasons for the insignificance of complete land property rights on agricultural productivity.

In terms of agricultural mechanization, Indonesia has a very high gap. This shows that technology in agricultural management in Indonesia is showing stagnant trend. The illustration in Table 5 can be an answer that changes in the status of land property rights do not create an increase in investment to increase the productivity of agricultural businesses. This is in line with and related to the limited use of credit in rice farming through KPPE scheme in food crops (see Figure 3). Indonesia experiences a quite high deficit of Plant Cultivation Equipment and Machinery (Alsintan).

Table 5. Gap of Agricultural Machinery (units) in Indonesia, 2010-2015

| Year | Tractor 2 Wheels | Tractor 4 Wheels | Water Pump | Rice Transplanter |
|---|---|---|---|---|
| 2010 | (316.066) | (177.827) | (529.881) | (400.128) |
| 2011 | (323.186) | (179.899) | (539.321) | (404.622) |
| 2012 | (323.524) | (180.556) | (541.218) | (406.363) |
| 2013 | (320.488) | (180.269) | (538.805) | (405.452) |
| 2014 | (310.542) | (181.098) | (539.226) | (407.092) |
| 2015 | (301.967) | (180.687) | (529.523) | (404.271) |

Source: Ministry of Agriculture Indonesia (2020)

Agricultural mechanization is an important thing in productivity creation such as in rice farming. Some of the advantages of agricultural mechanization include: 1) increasing production per unit area; 2) increasing farmers income due to additional production; 3) increasing the effectiveness, productivity, quantity and quality of agricultural products; 4) maintaining quality in fresh handling, increasing added value to production results with correct and precise processing, without affecting taste and aroma; 5) improve land and labor efficiency; 6) save energy and resources (seeds, fertilizers, and water); 7) minimizing the factors that cause failure in production; 8) increase the area under cultivation and save time; and 9) maintaining environmental sustainability and sustainable agricultural production, according to Hardjosentono et al. (Aldillah, 2016).

Another explanation is related to the insignificance of the transferability issue of land assets in Indonesia. Most of the agricultural land in Indonesia is located in rural areas, especially for rice farming, making the characteristics of the association or communal ties between its citizens still strong. This makes individual or social relationships between residents in Indonesia still well-established so that the formalization of land certificates become complete property rights does not have a significant impact on deprivation of land assets. Land in rural areas is usually passed down from generation to generation in addition to being obtained through the buying and selling transaction process. What makes it a little different from conditions in urban areas is that people in villages tend to have a low risk of asymmetric information between one individual and another. In fact, one individual often knows the boundaries of the land of each individual or other household. This is different from people in urban areas whose community values are not as strong as rural communities. So that there is no significant transferability issue related to ownership of land assets, such as a prerequisite for the importance of legality of land assets because one of them is related to transferability issues. So that the threat of land grabbing between residents is minimal, because each individual knows the location and boundaries of their respective lands.

The emergence of land disputes in the regions in the cases that occurred was not triggered by boundary problems due to ignorance of information regarding land boundaries between each community, but rather the issue of inheritance of the distribution of assets that were passed down. This does not stem from the absence of formal legality of the assets owned. Even so, these indicative arguments need to be examined in more depth specifically related to the causes of land disputes that often occur on more specific agricultural lands, namely rice farming. People in Indonesia, in conducting land sale and purchase transactions, usually hold on to proof of Letter C or Patok D certificate. Although the two proofs of land property rights status are not legal evidence with legal status recognized in Indonesia, these two certificates do not mean that their land assets cannot be transferred.

## CONCLUSION

Based on DiD analysis on longitudinal IFLS data in this study, the change in status from incomplete to complete property rights on agricultural land does not have a significant effect on increasing rice farming productivity in Indonesia. These results appear consistent in the basic model, and in the robustness check test through the analysis of the all sample model and the combination of several models through a subset of observations by sorting several treatment and control groups into different characteristics, even in difference-in-difference-in-differences (DDD) analysis. Consistency is also maintained both in models without using control variables or with control variables. The results of the two-period

difference-in-differences analysis carried out in this study need to be strengthened by other more comprehensive studies considering the nature of this study as a preliminary study by assuming the direct transmission for complete land property rights to the productivity of rice farming in Indonesia.

Some basic assumptions of changes in land status can increase agricultural productivity in this study are refuted, considering the results show that changes in land status do not create maximization behavior for rice farming businesses to increase incentives in investment in inputs of production. Hombrados et al., (2015) statement if land titles make farmers more confident that their crops are less likely to be disputed, they can lead to greater agricultural investment in terms of crops and inputs, the sense of security can grow and create maximization behavior, was not proven in this study. This is because the government, through the land registration program, only serves status changes from incomplete to complete property rights (SHM certificate) on land objects that do not have disputes, so this does not create a significant change in perception of land security to create maximization behaviour. This study recommends that the government should focus on the agrarian reform program with the main program conducting land redistribution, which can create significant land security on land ownership through property rights that are given to encourage the creation of maximization behavior.

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Appendix A.

Table A1. Descriptive Statistics in Treatment and Control Groups of Basic Model

| Variable | Observation | | Mean | | Standard Deviation | |
|---|---|---|---|---|---|---|
| | Treatment Group | Control Group | Treatment Group | Control Group | Treatment Group | Control Group |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| *PRODUCTIVITY* (kg/ha harvested dry grain) | 400 | 972 | 7710.802 | 8476.566 | 11195.91 | 26696.94 |
| *Land Rented* ($m^2$) | 400 | 972 | 744.2 | 5211.137 | 5158.003 | 144380.9 |
| *Times of Harvested Paddy in 12 month* (time) | 400 | 972 | 1.66 | 1.585391 | .5918409 | .6188862 |
| *Area Harvested by others* ($m^2$) | 400 | 972 | 158.87 | 2268.069 | 1095.973 | 64166.03 |
| *Cropsharing* (kg harvested dry grain) | 400 | 972 | 65.5175 | 135.0298 | 291.8573 | 736.0763 |
| *Size of area planted* ($m^2$) | 400 | 972 | 5636.983 | 12473.28 | 25626.1 | 224490.9 |
| *Farmers Expenditure in 12 month* (rupiah) | 400 | 972 | 3095822 | 2949691 | 6537481 | 6742805 |

Treatment Group: Land status from incomplete become complete property rights
Control Group: Land status remained incomplete or complete property rights

Table A2. Descriptive Statistics in the DiD Analysis on the Basic Model and the Subset Model of Farmer Characteristics with Land Size < 0.5 ha and > = 0.5 ha

| Variable | Basic Model (Incomplete to Complete) | | Land Size < 0,5 ha (Small Farmers) | | Land Size > = 0,5 ha (Non-Small Farmers) | |
|---|---|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | Standard Deviation |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| *PRODUCTIVITY* (kg/ha harvested dry grain) | 8253.311 | 23267.66 | 9682.202 | 21033.95 | 2900.764 | 2629.25 |
| *Land Rented* ($m^2$) | 3908.823 | 121556 | 6237.234 | 166322.6 | 2125.849 | 8879.715 |
| *Times of Harvested Paddy in 12 month* (time) | 1.607143 | .6118511 | 1.747268 | .6102684 | 1.383648 | .5304452 |
| *Area Harvested by others* ($m^2$) | 1653.142 | 54012.03 | 2780.548 | 73921.1 | 563.2075 | 2952.323 |
| *Cropsharing* (kg harvested dry grain) | 114.7638 | 639.9377 | 39.91393 | 174.385 | 260.7516 | 1219.675 |
| *Size of area planted* ($m^2$) | 10480.19 | 189455.7 | 1492.292 | 1124.422 | 14730.77 | 29393.87 |
| *Farmers Expenditure in 12 month* (rupiah) | 2992295 | 6681549 | 2031661 | 6332013 | 4778351 | 6293665 |
| Observations | 1372 | 1372 | 732 | 732 | 318 | 318 |

Table A3. Descriptive Statistics in DiD Analysis Related to the Impact of Changes in Land Certificate Status on Rice Productivity by Categorization of Change in Land Certificate Status

| **Treatment Group:** | **No Certificate to Complete Property Rights** | | | | | | **Letter C and Patok D Certificate to Complete Property Rights** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Control Group:** | **Land status remained complete property rights** | | **Land status remained no land certificate** | | **Land status remained Leter C and Patok D certificate** | | **Land status remained complete property rights** | | **Land status remained no land certificate** | | **Land status remained Leter C and Patok D certificate** | |
| **Variable** | **Mean** | **Standard Deviation** | **Mean** | **Standard Deviation** | **Mean** | **Standard Deviation** | **Mean** | **Standard Deviation** | **Mean** | **Standard Deviation** | **Mean** | **Standard Deviation** |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| *PRODUCTIVITY* (kg/ha harvested dry grain) | 9232.168 | 30430.05 | 7157.806 | 14225.69 | 8365.236 | 24659.88 | 9201.273 | 27684.51 | 7743.44 | 13060.41 | 8328.802 | 20720.97 |
| *Land Rented* ($m^2$) | 903.3097 | 6298.666 | 1266.582 | 8944.167 | 13320.06 | 239861.3 | 647.8367 | 3955.197 | 789.4444 | 6159.702 | 8363.579 | 188495.2 |
| *Times of Harvested Paddy in 12 month* (time) | 1.617409 | .6284181 | 1.556122 | .6420426 | 1.59375 | .5965386 | 1.671717 | .602111 | 1.649758 | .6150158 | 1.647368 | .5930486 |
| *Area Harvested by others* ($m^2$) | 365.0425 | 2166.593 | 250.2449 | 1610.722 | 5771.727 | 106599.2 | 289.197 | 1858.129 | 161.1111 | 1087.708 | 3595.263 | 83769.79 |
| *Cropsharing* (kg harvested dry grain) | 104.6134 | 415.2728 | 55.42857 | 190.814 | 113.5028 | 688.8689 | 99.75926 | 422.8174 | 56.95894 | 272.2005 | 92.40351 | 578.5762 |
| *Size of area planted* ($m^2$) | 19272.54 | 314810.6 | 4682.786 | 5767.851 | 4428.142 | 6702.017 | 17378.74 | 287809.3 | 5531.423 | 25212.16 | 5141.911 | 21864.1 |
| *Farmers Expenditure in 12 month* (rupiah) | 3413666 | 8097326 | 2247731 | 4581032 | 2455044 | 4515633 | 3699593 | 8582507 | 2905050 | 6797732 | 2853177 | 6237032 |
| Observations | 494 | 494 | 196 | 196 | 352 | 352 | 594 | 594 | 414 | 414 | 570 | 570 |

Table A4. DDD Analysis Related to the Impact of Changing the Status of Land Certificates on the Productivity of Rice Farming in Indonesia (Basic Model)

| Dependent Variable: *PRODUCTIVITY* (kg/ha harvested dry grain) | DDD for Small Farm Category | | DDD for Cropsharing | |
|---|---|---|---|---|
| | Basic Model without Control | Basic Model with Control | Basic Model without Control | Basic Model with Control |
| (1) | (2) | (3) | (4) | (5) |
| *BeforeAfter* | 475.9847* | 613.1366 | 3510.975* | 600.7233 |
| (1 = IFLS Wave 5; 0 = IFLS Wave 4) | (0.080) | (0.161) | (0.068) | (0.172) |
| *Change of land property rights status* | 622.5951** | 1069.605*** | 234.8693 | 1039.348*** |
| (1 = No legal status to SHM; 0 = Remain does not legal status) | (0.040) | (0.003) | (0.853) | (0.004) |
| *Change of land property rights status* × *BeforeAfter* × *Small Farm Category* < *0.5 ha* | -666.968 | 427.5819 | - | - |
| | (0.829) | (0.890) | | |
| *Change of land property rights status* × *BeforeAfter* × *Dummy Cropsharing* | - | - | 2066.19 | 434.4589 |
| | | | (0.634) | (0.888) |
| **Control Variable:** | | | | |
| *Land Rented* ($m^2$) | | .0040062*** | | .0040088*** |
| | | (0.000) | | (0.000) |
| *Times of Harvested Paddy in 12 month* (time) | | -3303.288* | | -3297.989* |
| | | (0.060) | | (0.061) |
| *Area Harvested by others* ($m^2$) | | -.0034601*** | | -.0034599*** |
| | | (0.000) | | (0.000) |
| *Cropsharing* (kg harvested dry grain) | | .2208985 | | - |
| | | (0.219) | | |
| *Farmers Expenditure in 12 month* (rupiah) | | .0000535 | | 0.0000556 |
| | | (0.290) | | (0.273) |
| *Rain as Main Water Sources* | | -1918.73 | | -1932.701 |
| (1 = Rain; 0 = otherwise) | | (0.251) | | (0.248) |
| *Irrigation as Main Water Sources* | | 1350.483 | | 1363.161 |
| (1 = Irrigation; 0 = otherwise) | | (0.509) | | (0.504) |
| *Well or Water Pump as Main Water Sources* | | 5039.581 | | 5031.845 |
| (1 = Well or Water Pump; 0 = otherwise) | | (0.196) | | (0.196) |
| *Tractor Ownership* | | 2430.182** | | 2524.952*** |
| (1 = Have tractor; 0 = Don't have tractor) | | (0.016) | | (0.010) |
| *Small Equipment Ownership (Plows, hoes, etc.)* | | 590.5985 | | 606.6742 |
| (1 = Have small equipment; 0 = Don't have small equipment) | | (0.828) | | (0.823) |
| Intersep | 2559.853*** | 6444.87* | 6544.675*** | 6471.42* |
| | (0.000) | (0.070) | (0.000) | (0.068) |
| Observations | 1372 | 1372 | 1372 | 1372 |
| R-squared | 0.0338 | 0.0424 | 0.0051 | 0.0424 |
| Number of Households (Treated) | 200 | 200 | 200 | 200 |
| Number of Households (Control) | 486 | 486 | 486 | 486 |

Notes: Confidence level 99% (***), 95% (**), 90% (*) in robust standard errors
Treatment Group: Rice farming households that experience a change in land status from incomplete become complete property rights
Control Group: Rice farming households that land status remained incomplete property rights and remained complete property rights