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Empirical Study of Growth and Poverty Reduction in Indonesian Farms: The Role of Space, Infrastructure and Human Capital and Impact of the Financial Crisis

Climate Change, Perceptions and the Heterogeneity of Adaptation and Rice Productivity: Evidence from Indonesian Villages

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Climate Change, Perceptions and the Heterogeneity of Adaptation and Rice Productivity: Evidence from Indonesian Villages

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Abstract

This paper examines how change in rainy season induces adaptation strategy among farmers and affects rice production using recently collected household data from seven provinces in Indonesia. The data demonstrate delays in the perceived onset of rainy season and increased uncertainty in rainfall pattern in the region. Empirical analysis shows that (i) delay in the onset significantly decreases land productivity growth in rice production; one month delay offsets the average growth observed in 1999-2007, (ii) irrigation share significantly explains the growth of land productivity, and (iii) farmers change planting timing in response to delays in the onset of rainy season (water availability). Our results show that delays in rainfall decrease returns to irrigation infrastructure. It is also found that individual-level variations in the perceived changes of the onset explain the extent to which such an adaptation strategy is taken as a measure to respond to climate change.

Keywords: Climate change, adaptation, rice productivity, Indonesia

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Introduction

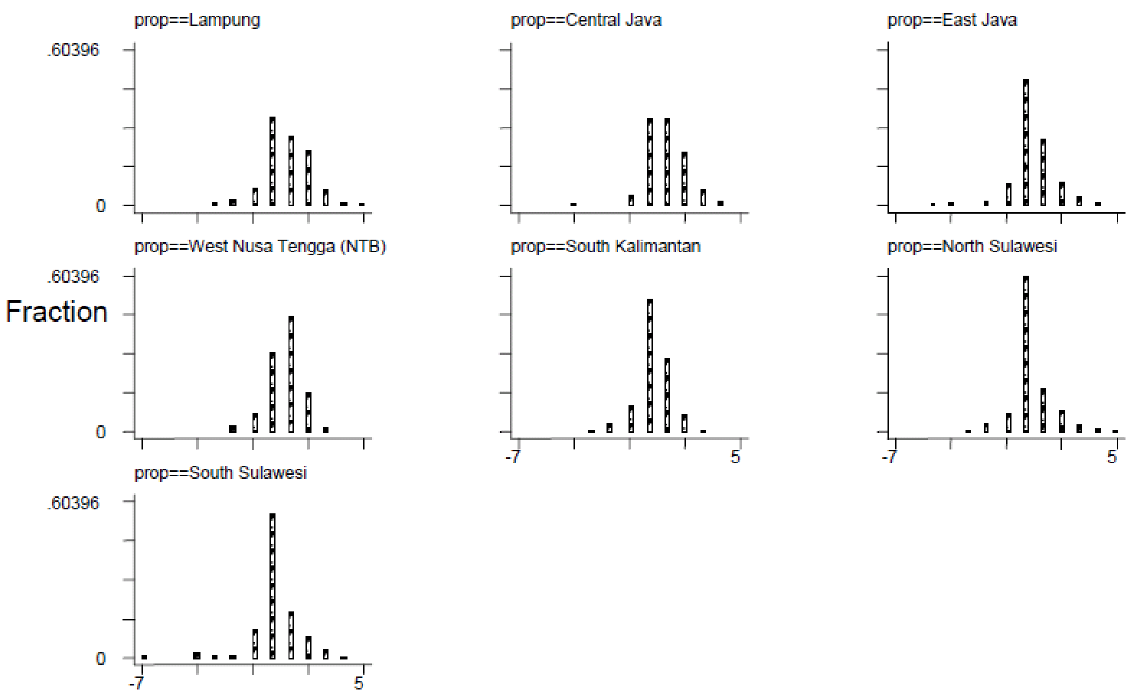
Climate change is currently highlighted in the international community as a potential threat to food security. Evidence has been gradually accumulated to support the linkages between global warming, changes in climate patterns and disasters with a particular focus on (un)predictability of monsoon rainy season (e.g., Adrian and Susanto 2003; Hamada et al. 2002; Haylock et al. 2001; Morton et al. 2007; Naylor et al. 2007; Robertson et al. 2007). However, empirical studies on the way climate change is affecting the livelihood of the poor and food production (e.g., Naylor et al. 2002, 2007) and how they are responding to the change by changing their behavior are still at preliminary stage. To understand farmers' perception of climate change, the impacts and their adaptations, we collected the information directly from farmers in Indonesia in 2007.

Farmers' reactions depend on how correctly they perceive of climate change over a short span of time. In Indonesia, for example, start of rainy season becomes ambiguous, and thus it is becoming hard to identify the onset of rainy season. Even if rainy season has started (or thought to have started), we often experience discontinuity of rainfall in these years. Furthermore, rainfall pattern has become more erratic often with increases in extreme levels, which causes excessive rainfall leading to floods. With these changes in onset of rainy season and rainfall pattern, farmers may face two issues: (i) change in perception (learning), and (ii) difficulty in identifying rainfall pattern due to increased uncertainty. The magnitude of uncertainty determines difficulty in identifying changes in rainfall pattern, and may create variations in their perceptions and adaptation behavior even within a small geographic unit such as village.

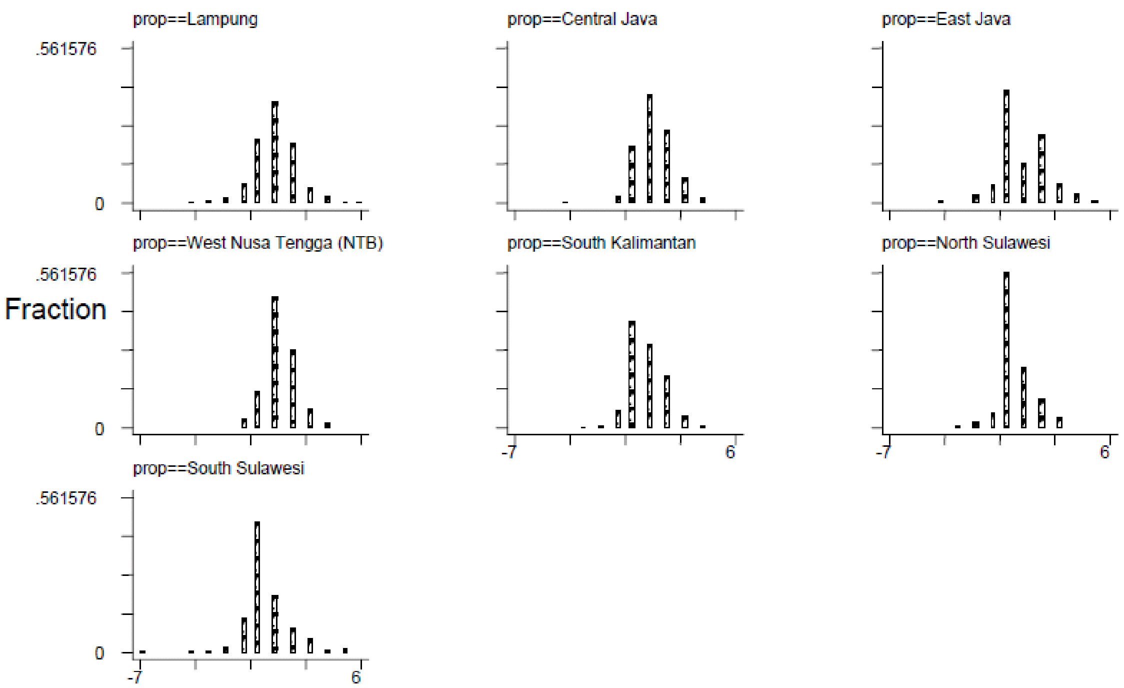
This paper uses data collected directly from farmers to elicit their knowledge (perceptions) on the onset of rainy season in recent years, changes in rainfall pattern, and their reactions to adapt to these changes. Perceptions vary even within a village, which explains the variations in farmers' reactions.

Figure 1. Change in onset (delay in months)

2005



2006



Figures 1 show changes in the onset of rainy seasons in 2005 and 2006 respectively. The reference point is farmer's reported month of onset in the past - 20 years ago. Therefore, the figures show perceived changes (delays in months) that occurred over the past 20 years. Though we see some variations across provinces, we observe on average delays in the onset in all provinces. Annexes A1 and A2 show tabulations of delays in month for the onset and end of rainy season respectively. The above observations motivate this paper.

Next section describes qualitative changes in rainfall pattern that farmers reported. We observe some interesting heterogeneity across provinces. In Lampung, Central and East Java, and NTB, the patterns are different from that of South Kalimantan, North and South Sulawesi. The duration of rainy season became shorter and the total number of rainy days decreased in the former group, while they show the opposite in the latter group. However, the onset of rainy season tends to be delayed in all provinces. The delay of onset seems to be a good signal to explain these qualitative changes, though complexity in the realization of climate change appears to be important.

Section 3 analyzes the effects of onset change and adaptation on land productivity in rice farming. We focus on rice farming because the onset of rainy season critically determines planting timing, which affects the yields (e.g., Rosenzweig and Binswanger 1993; Naylor et al. 2007). First, the analysis shows that farmers change planting timing in response to delays in the perceived onset of rainy season. Farmers are not changing crop variety at this stage. Second, irrigated land significantly increases land productivity, but the positive effect of irrigated land decreases as the onset of rainy season delays. Policy implications are discussed in the discussion section.

1. Data

We describe production data construction in this section. The study uses two household surveys. The first is the 1999 Patanas survey of the Indonesia Center for Agriculture and Social

Economic Policy Study (ICASEPS) focused mainly on agricultural production activities. We built panel data based on this survey by conducting the 2007 IMDG survey. The 1999 Patanas survey captured the structure of agricultural production in 1574 households in 48 villages (7 provinces) representing Indonesia's agro-climatic zones. The 2007 IMDG was a general household survey designed to capture a variety of household activities. We expanded the sample by adding 51 new villages in the 7 provinces. In the revisited villages, we re-sampled 20 households per village from the original Patanas sample. In the new villages, we sampled 24 households. Since we were not able to revisit one of the original Patanas villages in NTB for safety reasons, in 2007 we had 47 revisited and 51 new villages.

In Patanas 1999, the questionnaire for production is designed for each plot and season, which includes harvest and sales. The questions for each section covered the plot number, type of commodity, type of production, quantity, and unit quantity. The value and size of Tebasan and Ijon[1] is also provided if they are applicable.

There are several issues to handle in order to generate production data, both in terms of quantity and value. To calculate the production quantity, we first should create production aggregates that are comparable across countries. In order to do that, we apply the following criteria of our measurement by adjusting the unit of production into kilogram unit; and standardizing the format of product in the same level. For example, in the case of rice there are four different types: (i) wet paddy; (ii) unhusked rice; (iii) unhusked rice for storage and (iv) rice. We decided to standardize the format into one format which is „wet paddy' by using SUSENAS conversion.[2]

[1] Tebasan is a harvesting practice in which standing crops, mainly paddy and maize, are sold on area basis just before harvesting at prices close to normal market rates. In this way, farmers and buyers (traders) avoid transaction costs. While Ijon is purchase of crops prior to the harvest at lower price, so that farmers can avoid harvest risks by paying risk premium to buyers (traders).

[2] The conversions based on Susenas 2001 as follows: GKG to GKP=115.6%;GKG to Rice=63.2%;GKP to GKG=86.5%;GKP to Rice=54.7%;Rice to GKP=182.9%, Rice to GKG=158.2%; 1 liter=0.8kg

In general, prices for the crop are generated based on the value of actual sales divided by quantity sales of each product. For household with non-marketed portion of crop output, we usually imputed them from village-average price or from a province average price for the relevant crop and season. In the case of rice farming, the price used is the average of village prices. In line with this, we also estimated the approximate production for the Tebasan system using the same prices above, taking the value or size of corresponding area into account.

After all the adjustments, we built dataset on plot and seasonal levels. Then we created production aggregates at the household level. Therefore, we constructed dataset for each different season (rainy season, first dry season, second dry season and non-seasonal). Since our analysis only focuses on rice farming in the rainy season, we only use data for the purpose.

Information on irrigation type is available at the plot level. Using plot size, we computed the proportion of irrigated land (modern, simple, and none) at the household level. That is the weighted average of irrigation type indicator with weights being plot sizes.

For 2007, we used IMDG 2007 survey data. The main differences of IMDG 2007 from Patanas 1999 are the following: (1) the production data are calculated based on management unit[3] (not plot level), (2) each management unit has information on irrigation type, and (3) the production data only covered production for main commodity.

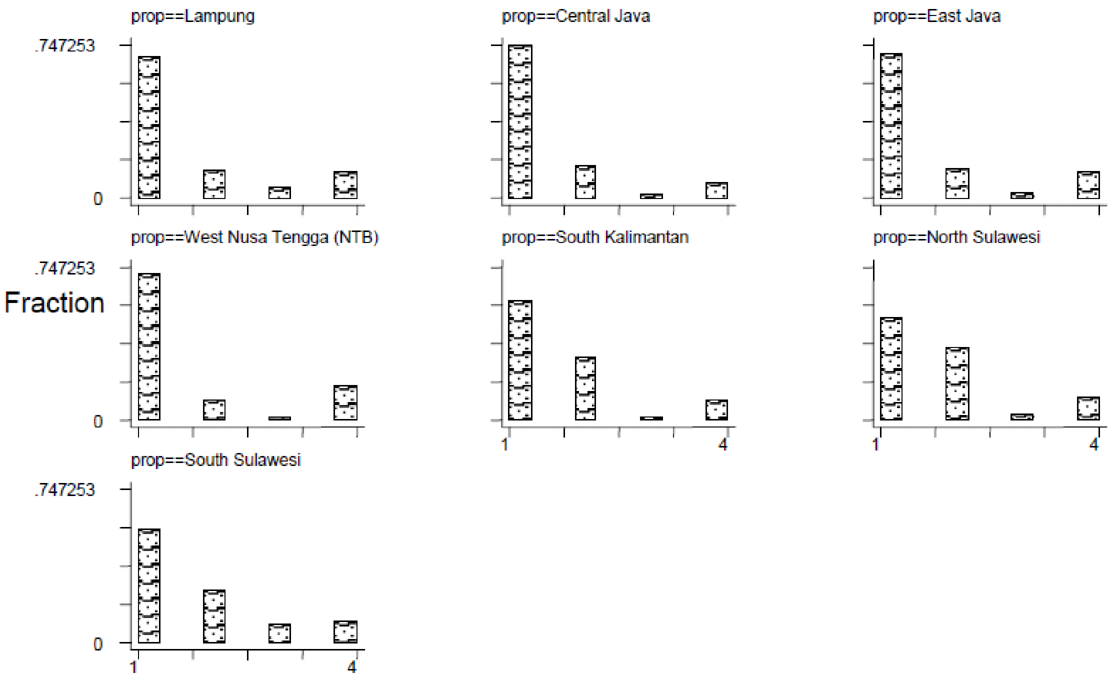
Since IMDG 2007 also captured split households, we aggregated them into their original households so as to make the unit of observations comparable with 1999. All other methods used in 1999 applies to the 2007 data.

[3] A unit management land is characterized as follows: (i) the similarities of type of land cultivated and the commodity; (ii) same cropping season; and (iii) easier for the farmer to answer the question as a unity; for example due to same joint cost (especially in terms of labor used and fertilizers)

2. Climate Change – Onset of Rainy Season, Rainfall Pattern and Heterogeneity in Perceptions

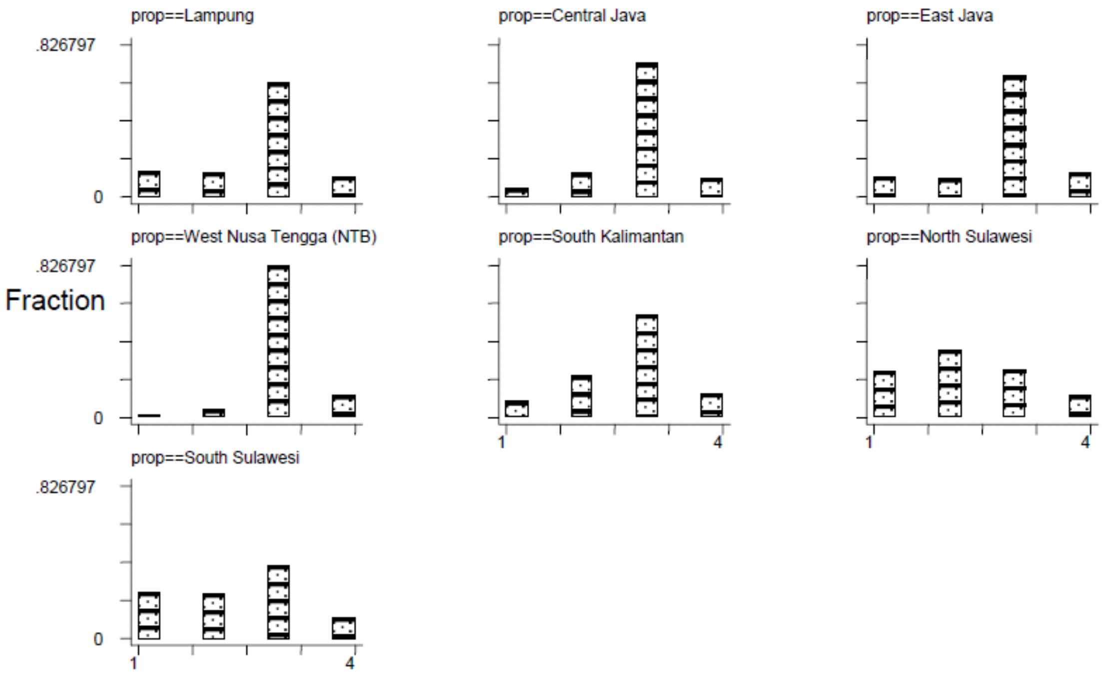
This section describes qualitative changes in rainfall pattern that farmers reported in our survey and estimates the correlation of perceived changes in onset (as described in Section 1) with such qualitative changes in rainfall pattern. In the survey, we asked the following questions: (1) difficulty in identifying onset of rainy season- more difficult, same, easier, (2) change in starting date of rain - sooner, same, later, (3) change in duration - longer, same, shorter, and (4) change in the total number of rainy days - larger, same, smaller.

Figure 2. Difficulty in identifying onset



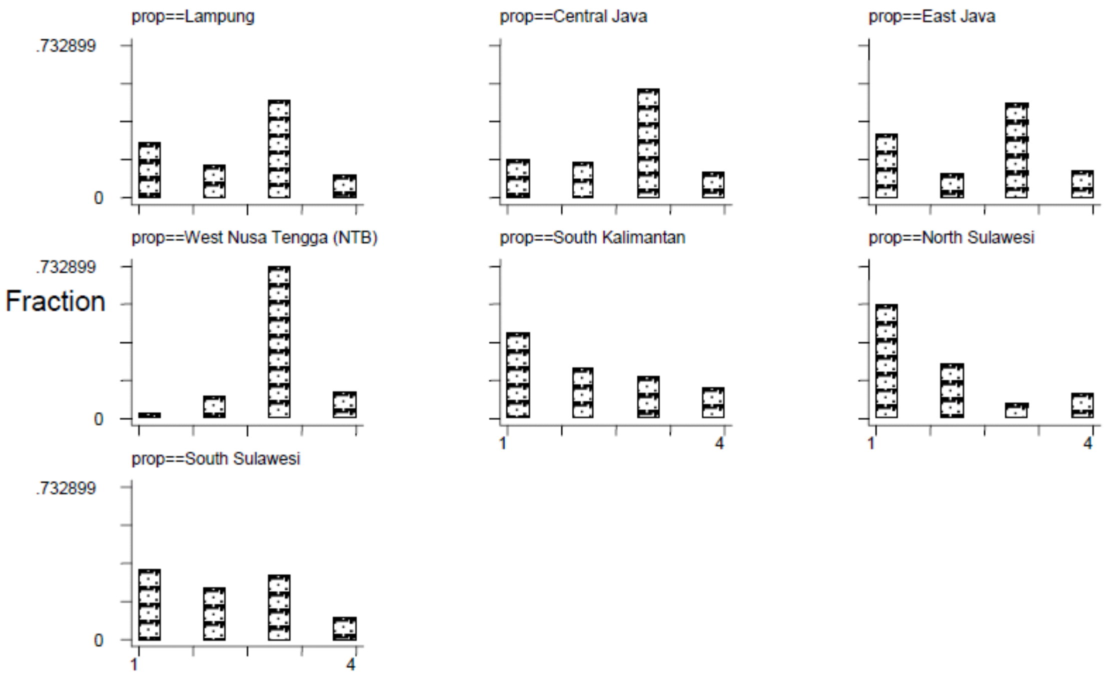
1: more difficult, 2: same, 3: easier, 4: don't know

Figure 3. Change in starting date



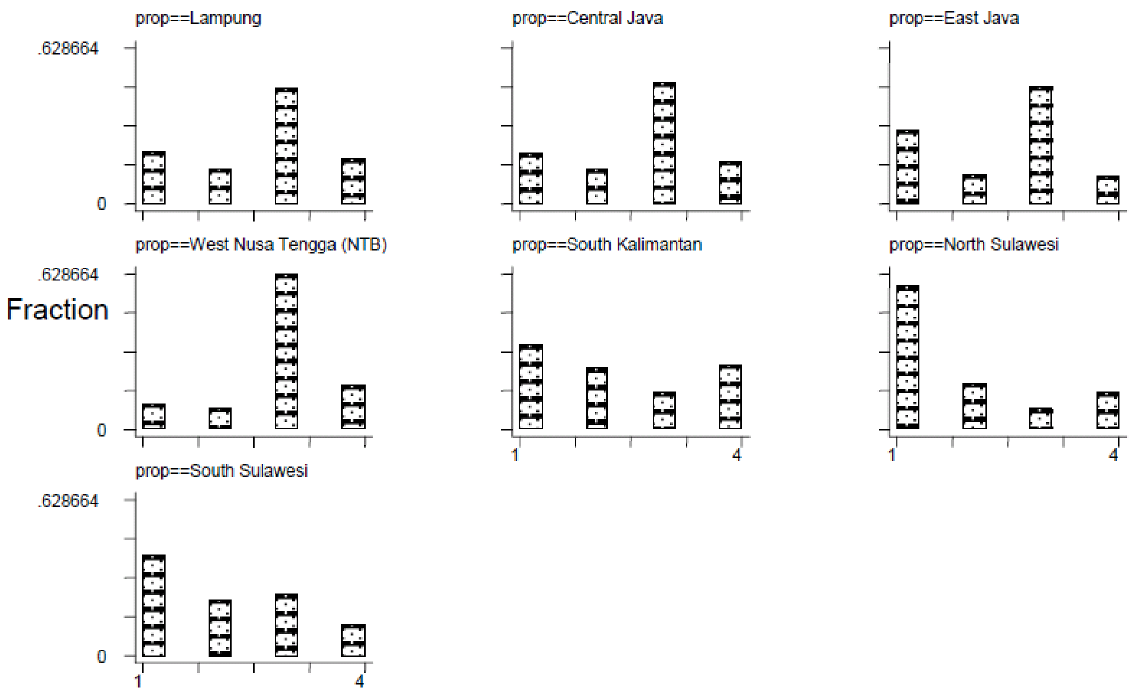
1: sooner, 2: same, 3: later, 4: don’t know

Figure 4. Change in duration



1: longer, 2: same, 3: shorter, 4: don’t know

Figure 5. Change in total number of rainy days



1: larger, 2: same, 3: smaller, 4: don't know

Figures 2 to 5 depict the answers by province to show some possible heterogeneity. In Figure 2 that shows the difficulty in identifying onset, we observe that farmers report more difficulties identifying the onset of rainy season than before in all provinces. In Figure 3, starting date is becoming late in all provinces.[4]

Figure 4 shows changes in the duration of rainy season. Interestingly, we observe that farmers report the duration has become shorter in Lampung, Central Java, East Java and especially NTB, while it has become longer in South Kalimantan and North Sulawesi. The distribution is even in South Sulawesi. Consistently in Figure 5, the total number of rainy days became smaller in Lampung, Central Java, East Java and NTB, but it became larger in South

[4] In Indonesia, meteorological data is also available. The Meteorological Department defines onset of rainy season based on a threshold point in rainfall in decade data (10 days). Correspondingly we asked farmers to report which week rainy season has started. Figures 1 report reported month as we noted large measurement (recall) errors in week data. In the empirical analysis, we take average of reported months within village.

Kalimantan, North and South Sulawesi.

Next we estimate the effect of perceived changes in onset (as described in Section 1) on the above qualitative changes by ordered probit. In Table 1a, estimation includes province dummies. Results show that delay in the onset of rainy season explains the above qualitative changes significantly.

Table 1a. Effects of Onset Delay on Rainfall Patterns – Ordered Probit

	Identifying starting date 1 More difficult 2 Same 3 Easier	Change in starting date 1 Sooner 2 Same 3 Later	Change in duration 1 Longer 2 Same 3 Shorter	Change in total rainy days 1 Longer 2 Same 3 Smaller
Change in onset	-0.1812	0.3694	0.1158	0.0788
	(4.380)	(7.500)	(3.120)	(2.250)
Province dummies	yes	yes	yes	yes
Number of obs	1750	1747	1738	1634
Pseudo R squared	0.0593	0.1671	0.1202	0.1014

Numbers in parentheses are absolute t values using robust standard errors.

Table 1b. Effects of Onset Delay on Rainfall Patterns – Ordered Probit

	Identifying starting date 1 More difficult 2 Same 3 Easier	Change in starting dat 1 Sooner 2 Same 3 Later	Change in duration 1 Longer 2 Same 3 Shorter	Change in total rainy days 1 Longer 2 Same 3 Smaller
Change in onset	-0.1372	0.2267	0.1256	0.0649
	(2.830)	(4.760)	(3.100)	(1.680)
Village dummies	yes	yes	yes	yes
Number of obs	1750	1747	1738	1638
Pseudo R squared	0.0492	0.1269	0.1175	0.0977

Numbers in parentheses are absolute t values using robust standard errors.

Estimation in Table 1b controls for village fixed effects, so we examine the effect of within-village variations of perceived onset delay on the qualitative changes. Interestingly, though parameter estimates become smaller in absolute value (due to bias that arises from a correlation between village-level unobserved fixed error components and delays in onset), we confirm that delays in onset significantly explain the qualitative changes in rainfall pattern. This means that heterogeneity in the perceived changes of onset also affects the perceived changes of rainfall pattern.

If farmers have heterogeneity in their sensitivity to changes in the environment such as the onset of rainy season (in their perception), these two answers - perceived changes of onset and the perceived changes of rainfall pattern - can be positively correlated. It can also explain possible heterogeneity in their response to changes in the environment. In other words, we expect to observe heterogeneity in their adaptation behavior.

3. Adaptations and Farm Productivity

This section analyzes the impacts of perceived onset delays on farmer's adaptive behavior, and its effects on rice productivity. First, we examine how delays in onset explain farmer's choices to adapt to changes in rainfall pattern. Our survey asked questions on adaptive behavior, with rankings 1 to 5 in a long list of possible actions. Our analysis focuses on change in planting timing and crop variety since farmers answered these choices as the first or second priority. In the analysis, we define an indicator variable for each of these adaptive choices which takes the value of one if farmers adopt it as the first or second strategy, and zero otherwise.

Table 2. Effects of Onset Change on Adaptation Strategy

Dependent:	Changing planting timing		Changing crop variety	
Change in onset	0.0389	0.0407	0.0047	0.0016
	(2.60)	(3.51)	(0.56)	(0.21)
Province dummies	yes		yes	
Village dummies		yes		yes
Number of obs	1579	1579	1579	1579
R squared	0.0472	0.2954	0.0101	0.2397

The dependent variable takes the value of one if farmer adopt the above strategy as the first or second choice and zero otherwise. Numbers in parentheses are absolute t values using robust standard errors.

Estimation: Bivariate Probit			
Dependent:		planting timing	crop variety
Change in onset		0.0998	0.0254
		(2.570)	(0.680)
Province dummies		yes	yes
Correlation coefficient	0.5453	Wald = 42.14 (0.00)	

The dependent variable takes the value of one if farmer adopt the above strategy as the first or second choice and zero otherwise. Numbers in parentheses are absolute t values using robust standard errors.

Table 2 shows estimation results in Probit controlling for province dummies. Interestingly, in our sample, farmers who reported delay in onset of rainy season are likely to change planting timing, but not crop variety. Therefore, farmers adapt changes in rainfall pattern by possibly delaying planting timing. If they cannot cope enough with the change in this way, they will probably switch to or combine it with changing crop variety. The lower panel in Table 2 shows bivariate Probit results. The results are qualitatively same, but it shows a significant positive correlation between errors, which suggests that both choices are positively related (though the correlation is not statistically significant).

Table 3. Land productivity in rice farming

Dependent: Growth land productivity (value) from 1999 to 2007				
Change in onset (village average)	-1.232	-1.247	-0.806	-0.803
	(2.47)	(2.47)	(1.95)	(1.88)
Change in irrigation share		-0.202	0.933	
		(0.89)	(2.47)	
Change in modern irrigation share				1.017
				(2.45)
Change in simple irrigation share				0.867
				(1.88)
Change in onset (village average)			-1.245	
* Change in irrigation share			(2.91)	
Change in onset (village average)				-1.300
* Change in modern irrigation share				(2.82)
Change in onset (village average)				-1.190
* Change in simple irrigation share				(2.26)
Province dummies	yes	yes	yes	yes
Number of obs	133	133	133	133
R squared	0.2362	0.2422	0.2970	0.2975

Numbers in parentheses are absolute t values using robust standard errors. Sample is restricted to rice farmers.

Next we examine the effects of changes in rainfall pattern and consequent adaptive behavior on land productivity growth in rice production during the period of 1999 to 2007 (Table 3). The dependent variable is growth rate of rice output value per land used. In all specifications, we include province dummies to control province-wise price changes (note that logarithm transformation separates price change from the real growth rate of rice production).

Column 1 shows the direct effect of perceived change in rainy season onset (village average) on rice output growth. The estimate shows that one month delay in the onset of rainy season (-1.232) more than offsets the average rice yield growth (the average growth is 0.8959)[5]. In Column 2, we include change in irrigation share. While delay in the onset of rainy season significantly decreases growth of rice production (value), change in irrigation share does not significantly increase rice production growth.

In Column 3, we include the interaction term of climate change (delay in rainy season)

[5] This is the average of residuals obtained after controlling for province effects in the growth of rice yield value. Therefore, if price change is unique in each province, the residuals reflect land productivity change.

and change in irrigation share. We confirm that change in irrigation share significantly increases rice production growth. The delay in rainy season significantly decreases production growth as well as returns to irrigation infrastructure. Column 4 disaggregates irrigation into modern[6] and simple types. The above finding remains the same only for modern irrigation system.

Our results show that the modern irrigation system does not mitigate the adverse impact of climate change. Climate change decreases returns to irrigation infrastructure. That is, the role of irrigation in rice farming is constrained by emergence of climate change in our empirical context.

In the previous section, we observed that farmers who are sensitive to the altered environment tend to adjust planting timing as part of adaptation strategies. In other words, heterogeneity in perception of the onset delay in rainy season potentially creates variations in rice productivity. Further, if adjustment in planting timing effectively mitigates the adverse impact of climate change, we would expect that the interaction term of planting timing adjustment and delay in rainy season has a positive sign in rice growth equation. In our study, we could not confirm this empirically. Therefore, though farmers are adapting to climate change and such actions are heterogeneous even in a village, we did not confirm the effect on rice production in the 1999-2007 panel data. This is probably because emergence of climate change and adaptation strategies is a recent event in our sample.

4. Discussions

Traditionally farmers in Java have indegenous knowledge ("pranoto mongso") about season and its application in the field of agriculture. At least until the beginning of the 1980s, this indegenous knowledge about climate and its application in agriculture had still existed. However, at the time of green revolution and modern irrigation system development, the habit

[6] Modern irrigation means any system involving pressurized distribution of water by pipeline at the farm or field level.

of observing season and its application gradually disappeared. There are two reasons related to this fact: new technological application has solved the problem of plant diseases and bugs by the use of pesticides; while any threat of drought due to lack of water can be solved by providing good irrigation system in order to increase water supply. Nowadays, the application of "pranoto mongso" is more related to the organization of traditional events such as circumcision, wedding, moving ceremonies, etc.; It is applied mostly in the remote villages of Java (mainly in Central Java).

In general, the rainfall pattern has shifted during the last twenty years. Meanwhile, the supply of irrigation water is still affected by climate condition since the supply of water accomodated in the reservoir orignally comes from rainwater. Empirically there is a tendency that cultivating season during the beginning of rainy season shifts from the end of October – the end of November to mid November - the end of December. This can be observed from the monthly planting distribution in Java as monitored by the Ministry of Agriculture.

One of the main obstacle faced by Indonesia in adapting to climate change is related to the limited meteorology equipment available on site. The number and quality of the existing equipment is far below the demand. In addition to this, the number and quality of manpower available for monitoring, data collection and data processing on climates in Indonesia is also very limited.

There are also two potentially important policy issues to consider. First, we may need to strengthen agricultural extension services at the time of climate change for sharing correct information on rainfall patterns. They are expected to coordinate with the meteorological department. Second, it is worth considering a new variety that mitigates exposure to climate effects, such as the case of NERICA for Africa.

Conclusions

In this paper, we described changes in rainfall pattern that Indonesian farmers reported, and analyzed the effects on land productivity in rice farming. Empirical results show that delays in the perceived onset of rainy season leads to a substantial decrease in rice production growth. Strikingly, one month delay in the onset of rainy season absorbs the average growth of rice production experienced in the period of 1999 to 2007.

Such environmental change also induces some adaptive behavior, such as changing planting timing, mitigating the negative impact of climate change. We also found that irrigated land significantly increases land productivity, but the positive effect of irrigated land decreases as the onset of rainy season delays.

We also remark heterogeneity in farmer's responses to climate change though the environmental change highlighted in this study is highly-correlated within an area. In the analysis using village fixed effects, we found that individual-level variations in the perceived change of the rainy-season onset explain the likelihood of adopting adaptation strategies such as changing planting timing.

Our results report that farmers change planting timing but not crop variety. This finding could be quite specific to rice farming. Farmers normally feel difficulty in converting paddy rice field to other purposes, or need large investments for using the land for other crops than rice production. It is worth investigating the relevance of crop variety change in non-rice production, but this is beyond the scope of the current paper.

References

Adrian, E. and R.D. Susanto. 2003. Identification of three dominant rainfall regions within Indonesia and their relationship to sea surface temperature. *International Journal of Climatology* 23: 1435-1452.

Hamada, J.L., M.D. Yamanaka, J. Matsumoto, S. Fukao, P.A. Winarso, and T. Sribimawati. 2002. Spatial and temporal variations of the rainy season over Indonesia and their link to ENSO. *Journal of Meteorological Society of Japan* 80: 285-310.

Haylock, M., and J. McBride. 2001. Spatial coherence and predictability of Indonesian wet season rainfall. *Journal of Climate* 14: 3882-3887.

Morton, V., A. Robertson and R. Boer. 2007. Spatial coherence and seasonal predictability of monsoon onset over Indonesia. Manuscript. CEREGE, France.

Naylor, R., D. Battisti, D. Vimont, W. Falcon, and M. Burke. 2007. Assessing risks of climate variability and climate change for Indonesian rice agriculture. *The Preceedings of the National Academy of Sciences* (PNAS) 104: 7752-7757.

Naylor, R.L., W. Falcon, N. Wada, and D. Rochberg. 2002. Using El-Nino Southern Oscillation climate data to improve food policy planning in Indonesia. *Bulletin of Indonesian Economic Studies* 38: 75-91.

Robertson, A. W., V. Moron, and Y. Swarinoto. 2007. On the seasonal predictability of daily rainfall characteristics over Indonesia. Manuscript. International Research Institute for Climate and Society (IRI), Columbia University.

Rosenzweig, M.R., and H.P. Binswanger. 1993. Wealth, weather risk and the composition and profitability of agricultural investments. *Economic Journal* 103: 56-78.

Annex A1 Change in onset (Delay in months)

2005	Freq	Percent	Cum
-7	2	0.10	0.10
-5	2	0.10	0.21
-4	8	0.42	0.63
-3	9	0.47	1.10
-2	36	1.88	2.98
-1	150	7.85	10.83
0	847	44.32	55.15
1	536	28.05	83.20
2	242	12.66	95.87
3	62	3.24	99.11
4	14	0.73	99.84
5	3	0.16	100.00
Total	1,911		

2006	Freq	Percent	Cum
-7	2	0.10	0.10
-4	4	0.21	0.31
-3	5	0.26	0.57
-2	23	1.20	1.77
-1	122	6.37	8.14
0	634	33.09	41.23
1	596	31.11	72.34
2	381	19.89	92.22
3	112	5.85	98.07
4	29	1.51	99.58
5	7	0.37	99.95
6	1	0.05	100.00
Total	1,916		

Annex A2 Change in end (Delay in months)

2005	Freq	Percent	Cum
-6	2	0.11	0.11
-5	3	0.17	0.28
-4	11	0.61	0.89
-3	15	0.83	1.72
-2	76	4.22	5.95
-1	220	12.23	18.18
0	962	53.47	71.65
1	325	18.07	89.72
2	118	6.56	96.28
3	47	2.61	98.89
4	12	0.67	99.56
5	4	0.22	99.78
6	4	0.22	100.00
Total	1,799		

2006	Freq	Percent	Cum
-5	2	0.11	0.11
-4	7	0.39	0.50
-3	10	0.55	1.05
-2	45	2.48	3.53
-1	190	10.47	13.99
0	865	47.66	61.65
1	414	22.81	84.46
2	175	9.64	94.10
3	75	4.13	98.24
4	24	1.32	99.56
5	5	0.28	99.83
6	3	0.17	100.00
Total	1,815		

Abstract (in Japanese)

要約

本稿では、インドネシアの 7 州からの家計データを用い、雨季の変化を農家がどのように認識し、行動を変え、ひいては米の生産性にどのような影響を与えるかを分析する。調査地の農家は、近年の雨季の開始時期の遅れや、降雨パターンの変化（不確実性の増加）を認識している。分析結果からは、①雨季の開始時期の遅れにより、米の（土地）生産性の成長率が下がること、②灌漑面積の割合が高い場合は農地の生産性が高いこと、③農家は雨季の開始時期の遅れに応じる形で作付け時期を遅らせていることが明らかになった。これらの結果から、雨季の開始時期の遅れは、灌漑インフラの効果を減少させる可能性があることが示唆される。

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