Enhancing the Paddy Farmer Income Sustainability with Crop Insurance Policy

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Jakarta
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Barriers and Solutions

FARMERS' CHARACTERISTICS:

Most of the poor households (46.18%) worked in the field of agriculture and husbandry

Low average farming land in Java (0.06 Ha)

Landless farmers

Crop insurance is purchased by agricultural producers to protect themselves against either **the loss of their crops** due to natural disasters, such as hail, drought, and floods, or **the loss of revenue** due to declines in the prices of agricultural commodities.

NATURE: Climate change in Indonesia increases risk of crop failure

Rice Farming Insurance (AUTP)

Goal: Provide protection for farmers from harvest failure as a risk result of flood, drought, disease and attack of Plant Disturbing Organisms.

Coverage: Maximum coverage price is 6,000,000 IDR (average initial capital cost)

Premium: 3% of the coverage = 180,000 IDR (government subsidizes 80% of the premium).

Ownership: Less than 2 hectares per policyholder

Land criteria : Irrigated or rainfed land near the water source

Problems

Producers and Stakeholders

AUTP is using **indemnity policy** only.

High loss ratio → are open for other convenient insurance policy.

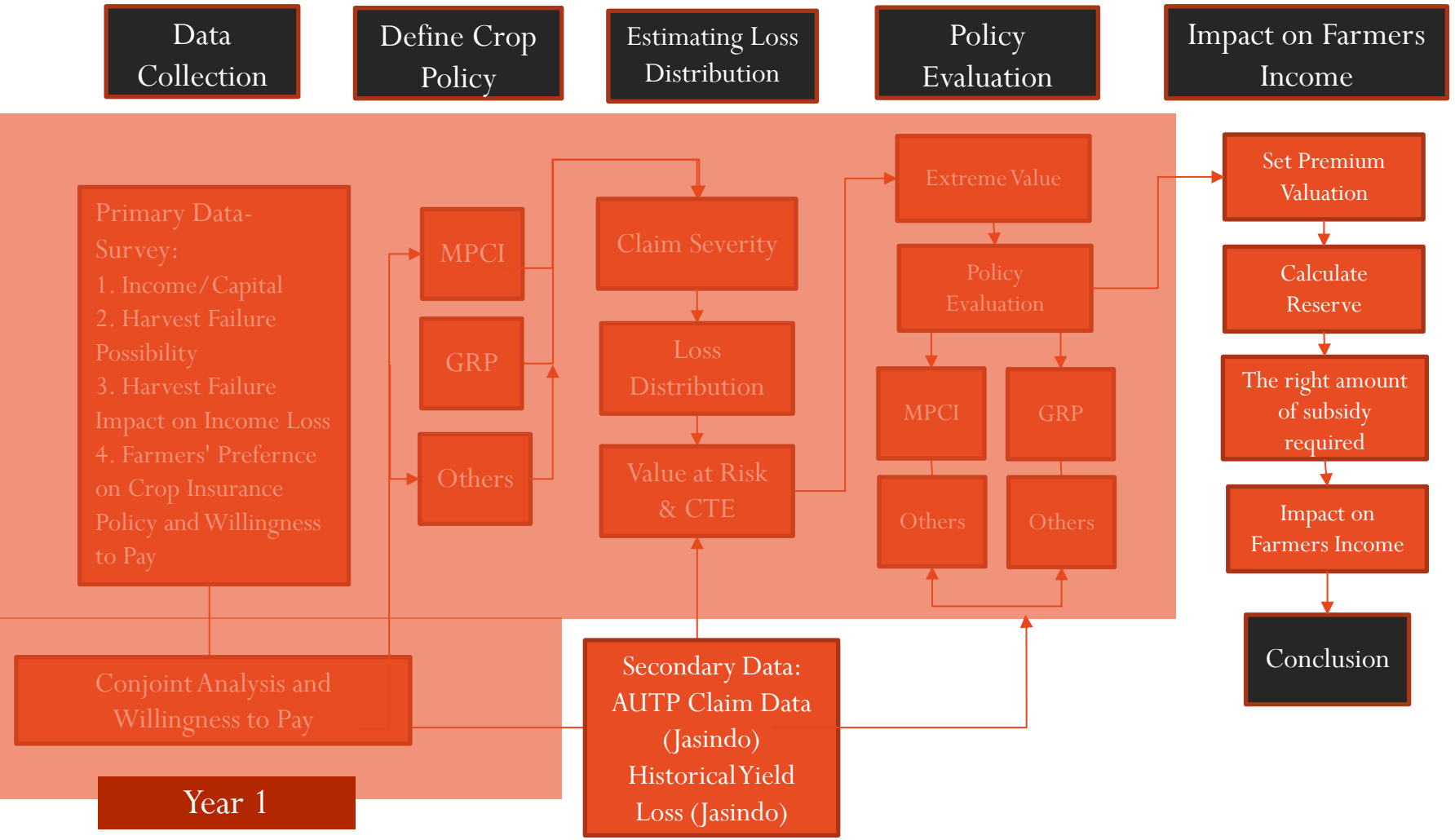
Consumers/Farmers

The willingness to pay for crop insurance is **very low**→ Find farmer's perspective and preferences.

Objectives

1. **Grasping better insights** about farmers perception on crop insurance and which crop insurance policy is the most suitable for them.
2. **Estimating the risk** or yield loss of farmers' harvest failure due to drought, flood, pest, etc throughout surveys and historical data.
3. **Comparing MPCI and GRP** to find the most applicable crop insurance policy for farmers.
4. **Evaluate crop insurance policy effectivity** in enhancing the paddy farmer income sustainability.
5. **Estimating the willingness to pay**.

Methodology



- 200 farmer house hold samples were collected in July – August 2018 in Kerawang and Bogor area.
- Systematic Random sampling was used and the margin of error was 7%
- Researchers also conducted pretest and QC to ensure the quality of data

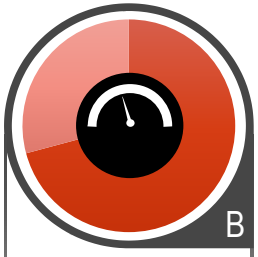
Results

- Farmers Welfare
- Farmers Information and Experience with Insurance
- Risk Factors
- Crop Insurance Conjoint Analysis
- Willingness to Pay and Factors that Effect the Willingness to Pay
- Preliminary Simulation Studies

About The Farmers

41%

- Primary School



53, 25

- Senior Farmers
- Experienced

40%

- Own more than 1 land

57%

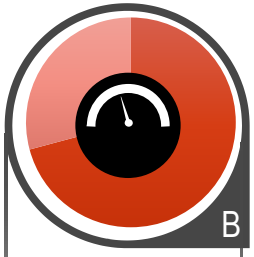
- Own there land

Karawang

The majority of Farmers in Karawang and Bogor low education, are senior farmers Based on Land, Karawang farmers are more prosperous

38%

- Primary School



55, 23

- Senior Farmers
- Experienced

11%

- Own more than 1 land

33%

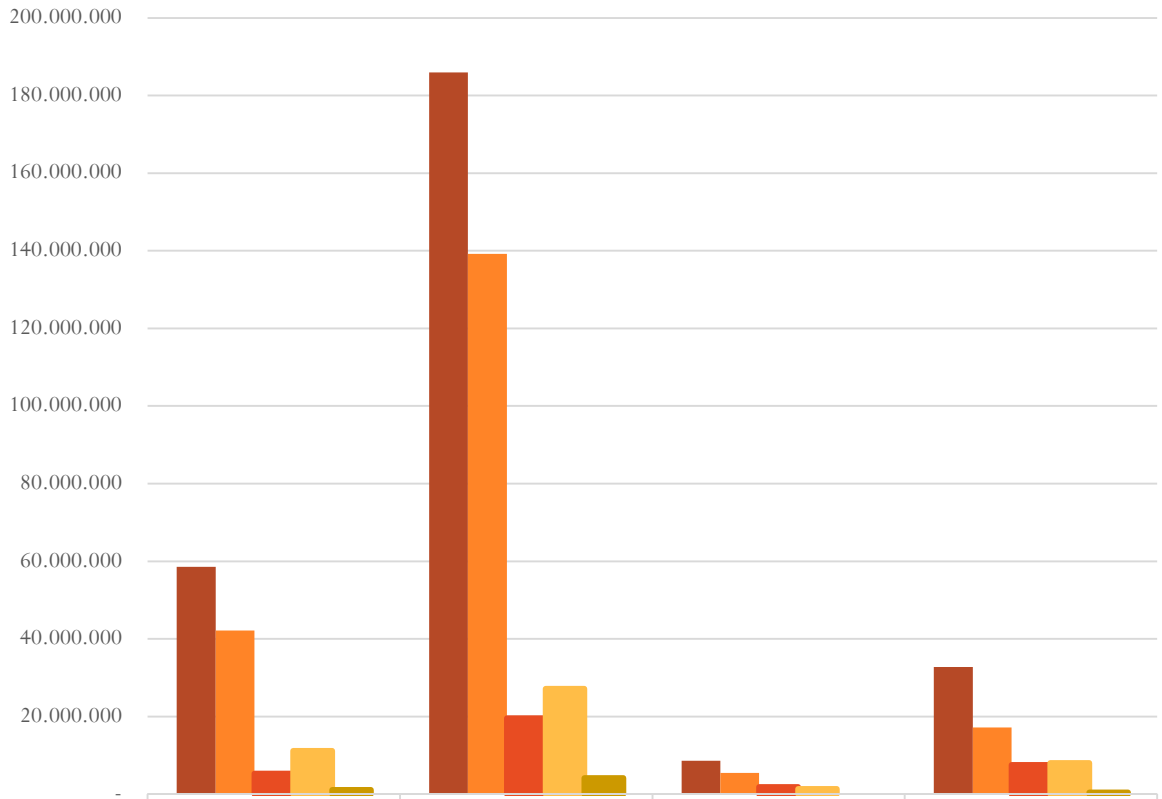
- Own there land

Bogor

- **The distribution of paddy land is skewed to the right**
- **More Farmers in Karawang have land above 2ha and also higher average land 4.83 Ha compared to 0.66 Ha**

Crop Income

	Average of Luas tanam padi/Ha
Karawang	4.83
<=2Ha	1.12
>2Ha	7.23
Bogor	0.66
<=2Ha	0.46
>2Ha	3.42
Grand Total	3.27



	Karawang		Bogor	
	<=2 Ha	>2 Ha	<=2 Ha	>2 Ha
Average of Besar pendapatan	58.572.245	185.938.966	8.604.336	32.720.000
Average of Pendapatan Bersih	42.126.531	139.221.187	5.456.981	17.200.000
Average of Estimasi biaya tanam padi	5.336.122	19.560.737	1.830.797	7.520.000
Average of Estimasi biaya pengelolaan padi	11.109.592	27.157.042	1.316.557	8.000.000
Average of Total Pendptmonth/cpt	1.094.216	4.146.002		418.706

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Other Income and Total Income

Karawang

50% Have other Income

1 in 2

Who have other income has conducted business/trade to increase there family income

- Service 7
- Bus & Trade 35
- Labour 9

69% of the Poor have less than 2 Ha

13%

Are considered Poor .

Bogor

45% Have other Income

1 in 3

Who have other income are labours or conducted business/trade to increase there family income

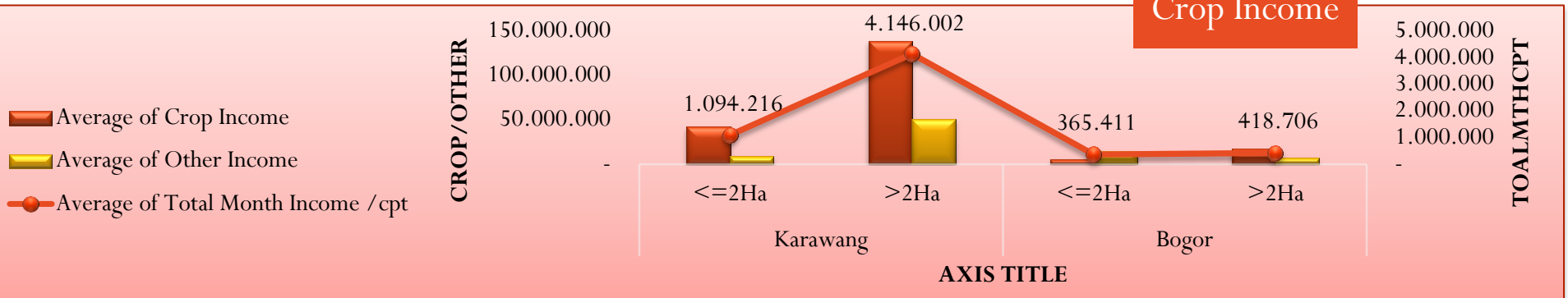
- 6 Livestock etc
- 11 Labour
- 10 Bus & Trade

73% of Poor have less than 2Ha

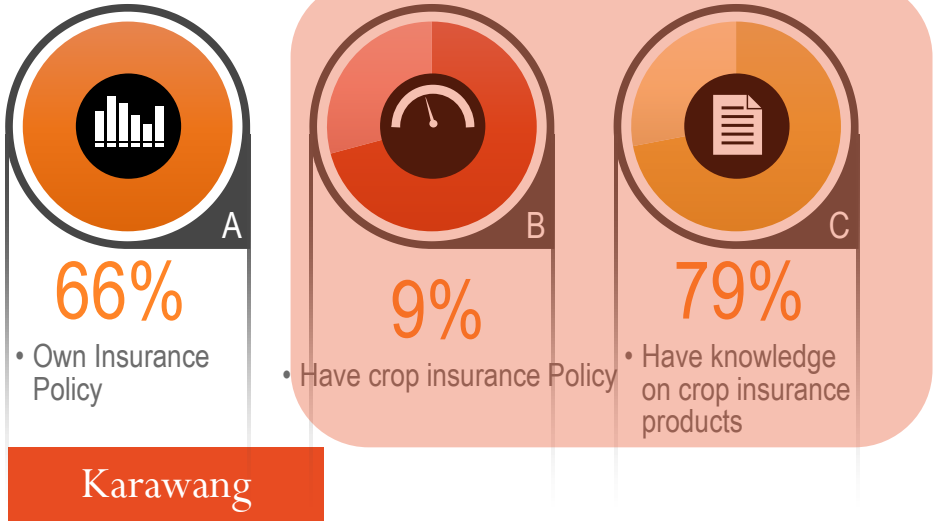
73%

Are considered Poor

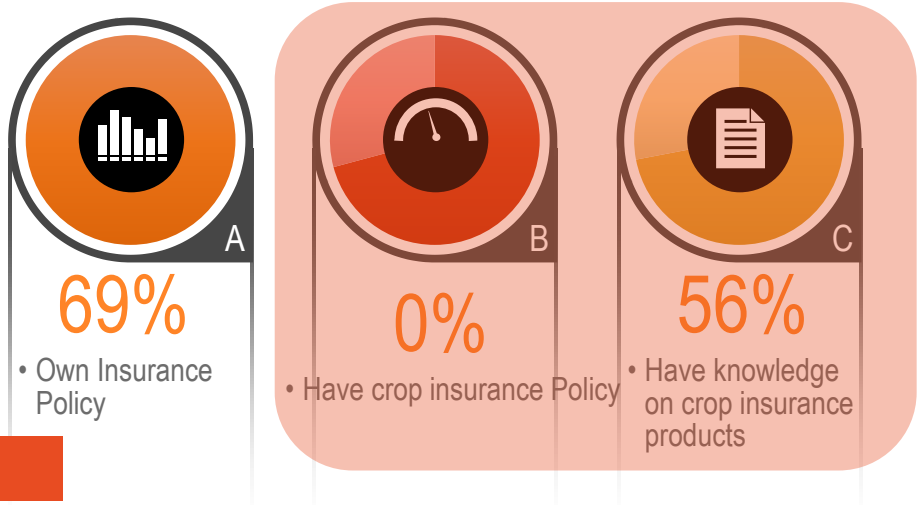
Above 75% Crop Income



Insurance Policy



The majority of Farmers in Karawang and Bogor have insurance policy Karawang farmers are much more exposed to crop insurance and crop insurance product knowledge



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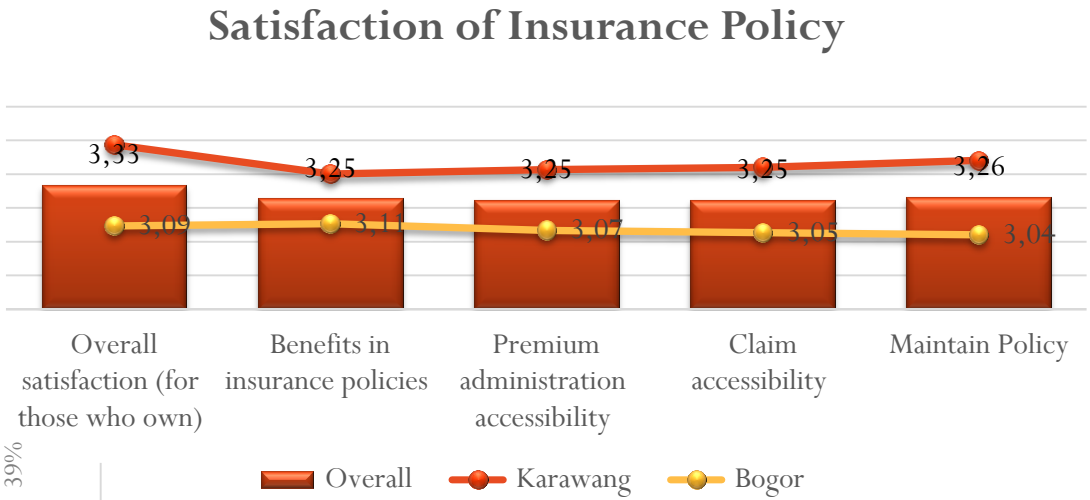
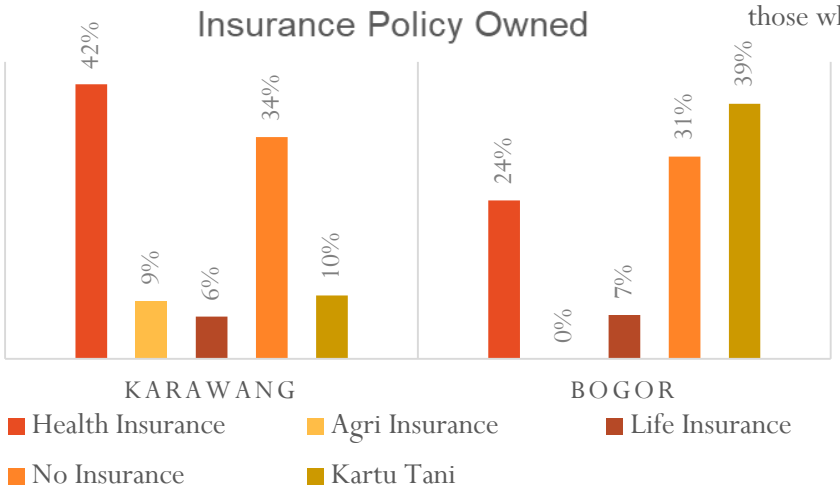
Insurance Policy Satisfaction

3.33 - Good

Proof…





- Most Farmers have health Insurance and have kartu tani
- As for crop insurance provider, most have known Jasindo
- Based on a score 1 to 5, in average the farmers overall satisfaction is 3.3
- Bogor has a slightly lower satisfaction compared to Karawang
- Based on Types of Insurance policy the satisfaction was also quite good

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Extension Workers and Farmer Group

Need Improvement

In general not all farmers have interacted with extension workers or join farming groups. Karawang is slightly better in these matters
They don't join/interact because they are not interested or have limited information
And for those who have join/interact the frequency of interaction is quite well
Major source of insurance information, especially in Karawang are from Extension workers, while in bogor they are not informed

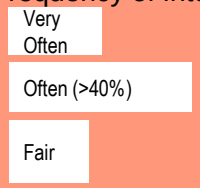
Extension Workers

Interact

52% vs 49%

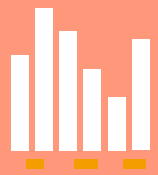
Slightly more Farmers in Karawang interact with extension workers

Frequency of Interaction



The Farmers often interact with extension workers in both areas

Why not interact



Not Interested and no Extension

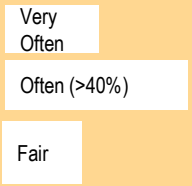
The majority say they don't interact because they are not interested an d there is no extension workers/not informed

Farmer Group

58% vs 42%

Slightly more Farmers in Karawang join farmer group

Frequency of Interaction



The Farmers often join farmer group

Why not join

Not Interested

The majority say they don't join because they are not interested.

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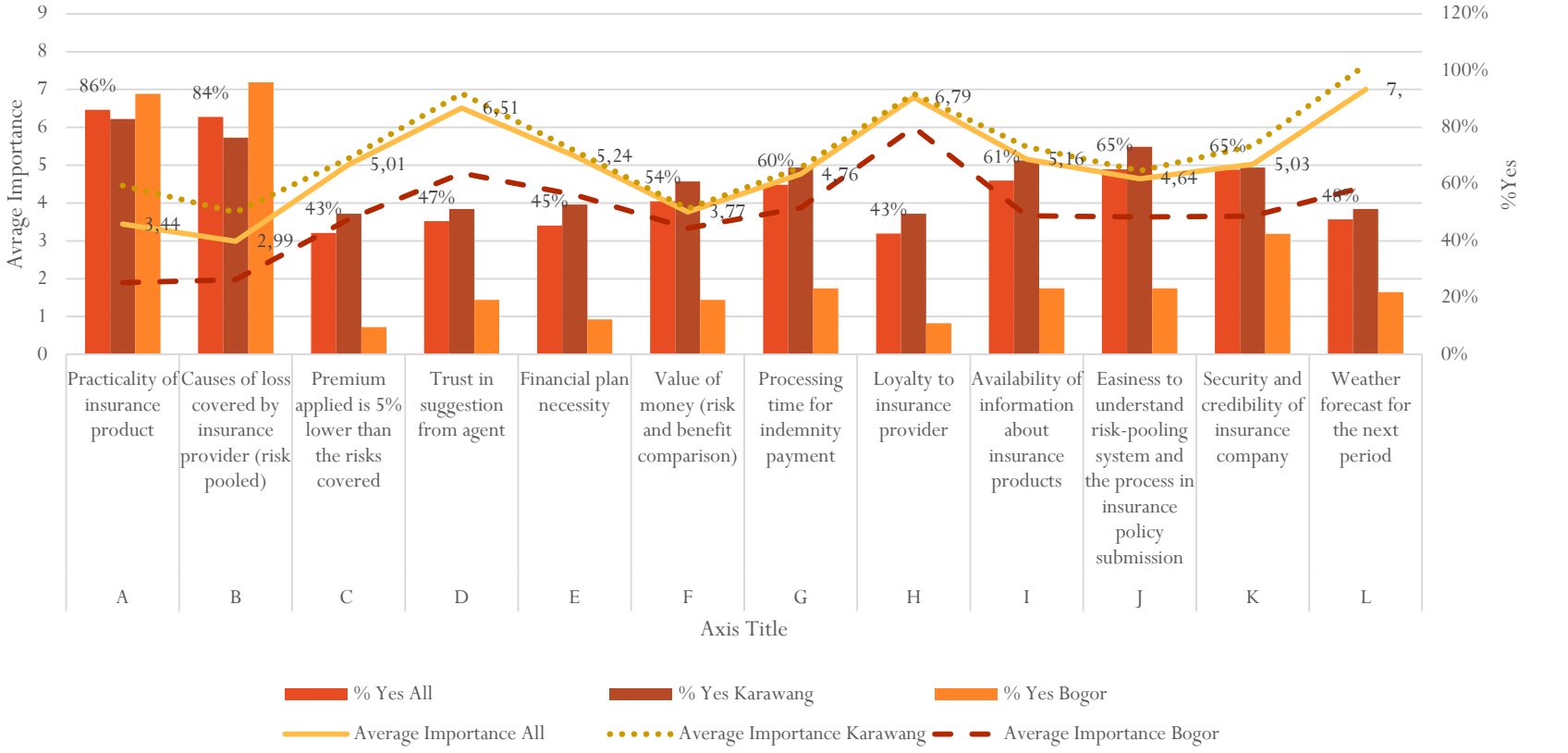
Risk Factors

Risk Factor	Frequency			Impact		
	All	Karawang	Bogor	All	Karawang	Bogor
Nature						
1Drought	**0.80**	0.42	**2.03**	**1.4**	**1.0**	**1.8**
2Flood	**1.03**	**1.06**	0.36	**1.0**	**1.4**	0.9
3Fire	0.00	0.00	0.00	0.1	0.1	0.7
4Lack of Nutrition	0.14	0.19	0.05	0.4	0.4	1.0
5Soil Salinity	0.16	0.26	0.00	0.5	0.5	**1.4**
Human Error						
1Soil Compaction	0.09	0.136	0.01	0.2	0.2	1.0
2Excess of Herbicide	0.14	0.216	0.00	0.3	0.3	1.0
3Unskilled Workers	0.12	0.184	0.00	0.2	0.2	0.9
4Air/soil pollution	0.12	0.168	0.04	0.3	0.3	1.0
5Land Destruction	0.14	0.176	0.08	0.4	0.4	**1.2**
6Commodity Price	**0.90**	**1.384**	0.09	**1.2**	**1.2**	**2.0**
Pest and Disease						
1Fungi	0.34	0.48	0.09	0.7	0.7	**1.6**
2Bacteria	**0.52**	**0.776**	0.09	0.8	0.8	**1.8**
3Virus	0.45	**0.656**	0.09	**1.1**	**1.1**	**2.1**
4Pest	**2.53**	**2.48**	**2.60**	**3.3**	**3.3**	**1.6**
Others						
1Zonk	0.06	0.056	0.00	0.2	0.2	1.0

- **Frequent risk factors include flood, drought, commodity price, and pests**
- **While the highest impact was also caused by those factors and also virus**
- **By using weighted average we have calculated the risk factor**
- **Karawang farmers tend to have higher risk, especially for farmers having land above 2 Ha**

Insurance Attributes



- **The must have crop insurance attribute include practicality of insurance product and risk pooled**
- **As for the most important attribute are weather forecast for next period, loyalty of insurance provider, and trust from agent**

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Insurance Features

Feature	Karawang	Bogor	Total
Risk covered			
1. Flood,	3%	1%	4%
2. Drought,	1%	6%	7%
3. Pest,	**18%**	**15%**	**33%**
4. Disease,	5%	0%	5%
5. All 4 risks mentioned above,	**34%**	**14%**	**48%**
6. Price fall.	2%	2%	4%
Premium basis			
1. Planted area,	20%	17%	**37%**
2. Planting cost,	20%	7%	26%
3. Total harvest revenue.	21%	15%	**37%**
Payment period			
1. Per planting season,	52%	34%	**86%**
2. Per year.	8%	5%	14%
Level of coverage			
1. 50%,	8%	2%	10%
2. 75%,	5%	0%	5%
3. **Maximum coverage.**	**48%**	**38%**	**86%**
Claim assessment method			
1. Quick visit,	**59%**	**23%**	**59%**
2. Detailed visit.	41%	16%	41%
Unit link feature			
1. Yes,	**52%**	**30%**	**82%**
2. No.	8%	10%	18%

- **What features are different from current policy?**
  - Most farmers want there premium based on planted area or total harvest revenue, as for the current policy is based on planting cost
  - Most farmers want a quick visit and are also interested in unit link features

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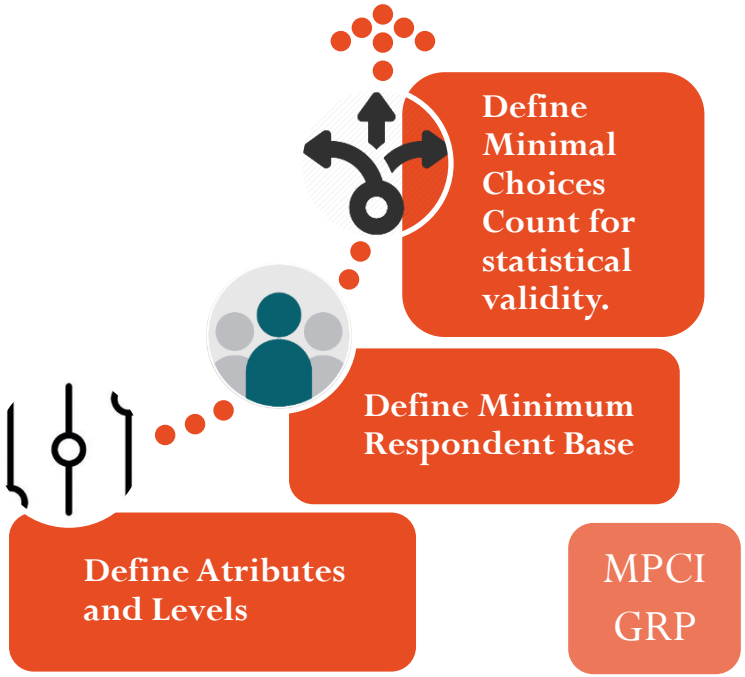
Choice-based Conjoint Analysis and Stimuli

1. Similar to what buyers do in the marketplace

2. CBC can include a "none" option



OptionG	Covered Risk	Premium Base	Payment Period	Level of Coverage	Claim Assessment Method	Unit Link Feature
A	Pest	Planted area	Per planting season	75%	Simple visit	Yes
B	Drought and disease	Total harvest revenue	Per planting season	75%	Simple visit	Yes
C	All risks	Planting cost	Per planting season	50%	Detailed visit	Yes
D	All risks	Planted area	Annually	50%	Detailed visit	Yes
E	Pest and disease	Total harvest revenue	Annually	Maximum coverage	Detailed visit	Yes
F	All risks	Total harvest revenue	Per planting season	50%	Simple visit	No
G	Flood and drought	Planting cost	Annually	75%	Simple visit	No
H	Flood and disease	Planted area	Per planting season	75%	Detailed visit	No
I	Flood	Total harvest revenue	Per planting season	75%	Detailed visit	No
J	Pest	Planting cost	Per planting season	Maximum coverage	Detailed visit	No
K	All risks	Planting cost	Per planting season	Maximum coverage	Detailed visit	No
L	All risks	Planted area	Per planting season	Maximum coverage	Simple visit	No

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Most Appealing Policies

92.5% are interested in choosing the most appealing crop insurance

All	• K, C, E, F, L
Karawang	• C, E, F, K, L
Bogor	• B, K, L, A, E

Option	Covered Risk	Premium Base	Payment Period	Level of Coverage	Claim Assessment Method	Unit Link Feature
A	Pest	Planted area	Per planting season	75%	Simple visit	Yes
B	Drought and disease	Total harvest revenue	Per planting season	75%	Simple visit	Yes
C	All risks	Planting cost	Per planting season	50%	Detailed visit	Yes
E	Pest and disease	Total harvest revenue	Annually	Maximum coverage	Detailed visit	Yes
F	All risks	Total harvest revenue	Per planting season	50%	Simple visit	No
K	All risks	Planting cost	Per planting season	Maximum coverage	Detailed visit	No
L	All risks	Planted area	Per planting season	Maximum coverage	Simple visit	No

L	E/F	K	C
GRP	Crop Revenue	MPCI	Modified MPCI

Willingness to Pay - Insurance Policies

Option	Karawang		Bogor		Average
	<=2Ha	>2Ha	<=2Ha	>2Ha	
A	101.000	40.000	125.000		84.091
B	101.500	110.000	84.231		90.444
C	63.429	87.188	100.000		76.871
D	-	383.754	70.000		158.800
E	65.000	72.867	96.250		79.720
F	106.667	87.800	60.000		83.222
G			50.000		50.000
H	80.000	100.000			85.000
I	180.000	100.000	100.000		126.667
J	106.667	70.000	63.000		75.000
K	122.143	48.500	67.500		76.037
L	50.000	51.333	64.286		54.909
Average	88.764	104.677	80.024		86.730

- Crop Insurance which are appealing tend to have high willingness to pay, except for GRP
- The trend of WTP in Karawang is higher than Bogor

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Multiple Linear Regression and Regression Tree

Multiple regression

- Involves a single dependent variable and two or more independent variables.
- Technique that develops a mathematical relationship between two or more independent variables and an interval scaled dependent variable.
- Need to meet assumptions.

Regression Tree

- Allows **input variables to be a mixture of continuous and categorical variables**.
- Generated when each decision node in the tree contains a test on some input variable's value.
- Flexible assumptions.

Regression Analysis

Regression*

Area	Significant Variables
All	Age, **land**, **Income per capita**, **Satisfaction**
Bogor	**Income per capita**
Kerawang	Age, **Land**, **Income per capita**, Risk of flood, All Risk, Risk of of Disease, **Satisfaction**

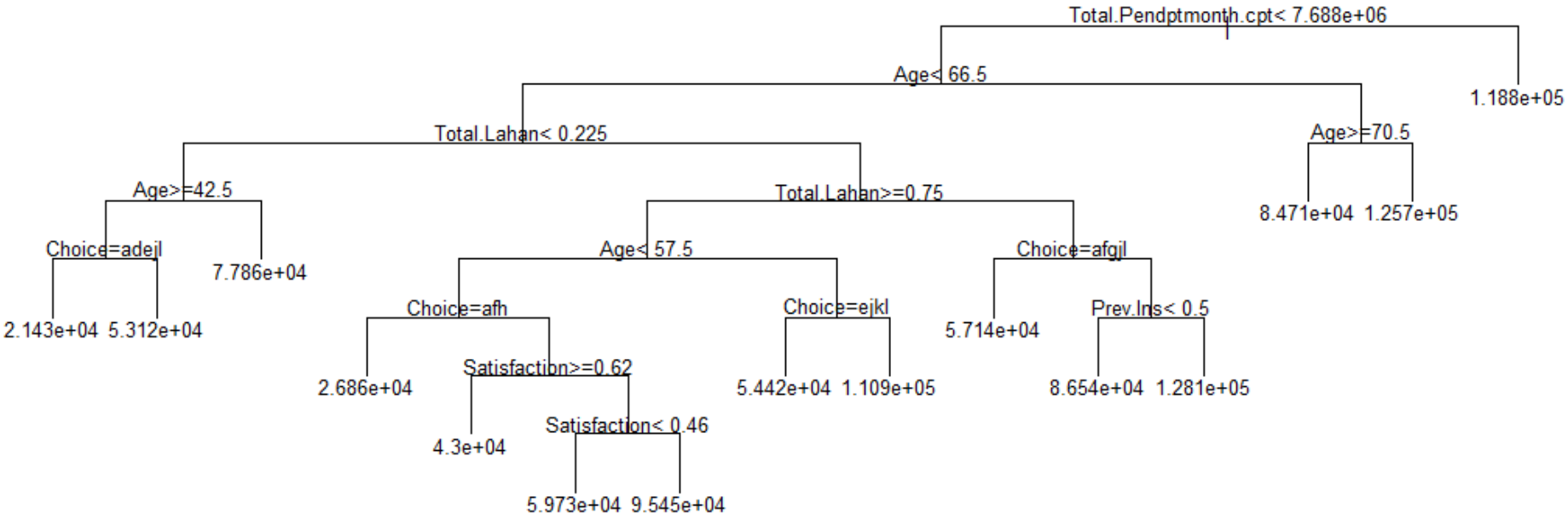
Regression Tree

Area	Important Variables
All	**Choice**, Age, **Income per capita**, **Land**, **Satisfaction**, Previous Insurance
Bogor	**Choice**, Age, **Land**
Kerawang	Farming experience, **Choice**, **Satisfaction**, **Income per capita**, **Land**

Based on regression models and regression tree models besides farm experience/age of a farmers variables that effect WTP are income per capita, land, policy, and satisfaction towards previous insurance policy

*Regression models does not meet some classical assumptions, therefore Regression Tree is used as an alternative

Regression Tree



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Regression Tree: WTP Prediction

No.	WTP (IDR)	Rules
1	21,430	Income per capita < 7,688,000 IDR , Land size < 0.225 ha, Age [42.5, 66.5), Choice=ADEJL
2	26,860	Income per capita < 7,688,000 IDR , Age < 57.5, Choice= AFH,
3	43,000	Income per capita < 7,688,000 IDR , Age < 57.5, Choice=BCDEGIJKL, Satisfaction >= 0.62
4	53,120	Income per capita < 7,688,000 IDR , Land size < 0.225 ha, Age [42.5, 66.5), Choice=BCFGHIK
5	54,420	Income per capita < 7,688,000 IDR , Age [57.5, 66.5), Land Size >= 0.75 ha , Choice= EJKL
6	57,140	Income per capita < 7,688,000 IDR , Age < 66.5 , Land Size (0.225, 0.75) ha , Choice= AFGJL
7	59,730	Income per capita < 7,688,000 IDR , Age < 57.5, Choice=BCDEGIJKL, Satisfaction < 0.46
8	77,860	Income per capita < 7,688,000 IDR , Land size < 0.225 ha, Age < 42.5

Regression Tree: WTP Prediction

No.	WTP (IDR)	Rules
9	84,710	Income per capita < 7,688,000 IDR , Age >= 70.5 y.o
10	86,540	Income per capita < 7,688,000 IDR , Age < 66.5 , Land Size (0.225, 0.75) ha , Choice= BCDEHIK , Prev.Insurance=No
11	95,450	Income per capita < 7,688,000 IDR , Age < 57.5, Choice=BCDEGIJKL, Satisfaction (0.46, 0.62]
12	110,900	Income per capita < 7,688,000 IDR , Age [57.5, 66.5), Land Size >= 0.75 ha , Choice= ABCDFGHI
13	118,800	Income per capita >=7,688,000 IDR
14	125,700	Income per capita < 7,688,000 IDR , Age [66.5,70.5)
15	128,100	Income per capita < 7,688,000 IDR , Age < 66.5 , Land Size (0.225, 0.75) ha , Choice= BCDEHIK , Prev.Insurance=Yes

Karawang Paddy Farmer

- We classified the land area which are less than 2 hectares, and greater than 2 hectares, also took the sum insured of farmer cost IDR 3 millions per hectare.
- Generally, paddy farmers used 2-3 times planting season per annum since the harvesting period approximately 3-4 months. Based on the information, we divided into 3 planting season/term :
  - Term 1 will start from november to February
  - Term 2 will start from march to june.
  - Term 3 will start from july to october.
- We have conducted survey in Karawang which gave us essential insight the damage area corresponding to land area. Furthermore, bootstrapping method is applied to the data for each land area and damaged area in 2 different groups of land (less than 2Ha and greater than 2Ha).
- Moreover, we have drawn and calculated the mean for the land area and damage area in each step of bootstrapping method.

Damaged area data term 1 before bootstrapping

Summary of damage area, which land area less than 2 hectare on term 1

Land Area under 2 hectare	Expected Area Yield Loss	Coverage	Critical Yield Loss Index under 2 hectare
0 up to 5,000 m^2	343.81 m^2	90%	309.43 m^2
5,000 up to 10,000 m^2	2332.61 m^2	80%	1866.1 m^2
10,000 up to 16,000 m^2	3194.74 m^2	80%	2555.79 m^2

Summary of damage area, which land area greater than 2 hectare on term 1

Land Area greater than equal 2 hectare	Expected Area Yield Loss	Coverage	Critical Yield Loss Index greater than equal 2 hectare
20,000 up to 25,000 m^2	4372.73 m^2	90%	3935.46 m^2
25,000 up to 140,000 m^2	8196.88 m^2	90%	7049.31 m^2

GRP and MPCI Indemnity Formula

- In GRP (group risk plan), we are using yield loss to determine indemnity function following Miranda's model as :

$$Indemnity = \max(y_c - \hat{y}, 0) \,.\, sum\ insured\ per\ hectare$$

equivalent to :

$$\text{Indemnity} = \max\left(y_c - \tilde{y}, 0\right) \cdot \frac{1}{10000} \cdot 3000000$$

- In MPCI (multi perils crop insurance), we also use yield loss from damage area to determine indemnity function as :

$$Indemnity = damage\ area\ * sum\ insured\ per\ hectare$$

equivalent to : $Indemnity = \frac{damage\ area\ in\ m^2}{10000\ m^2} * 3000000.$

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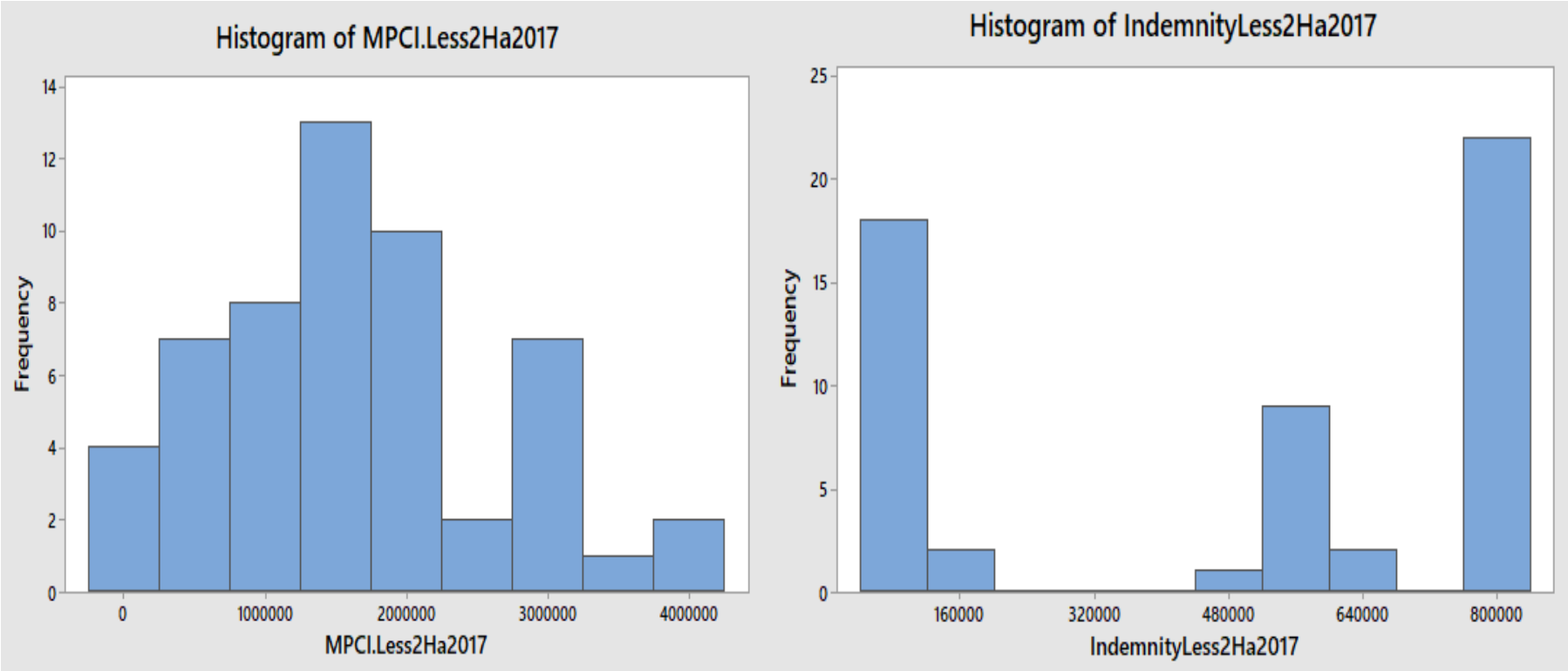
MPCI and GRP Indemnity Term 1

Histogram of MPCI and GRP Indemnity with area less than 2 hectare on 2017 losses.



Distribution Not Clear→Bootstraping 10.000x

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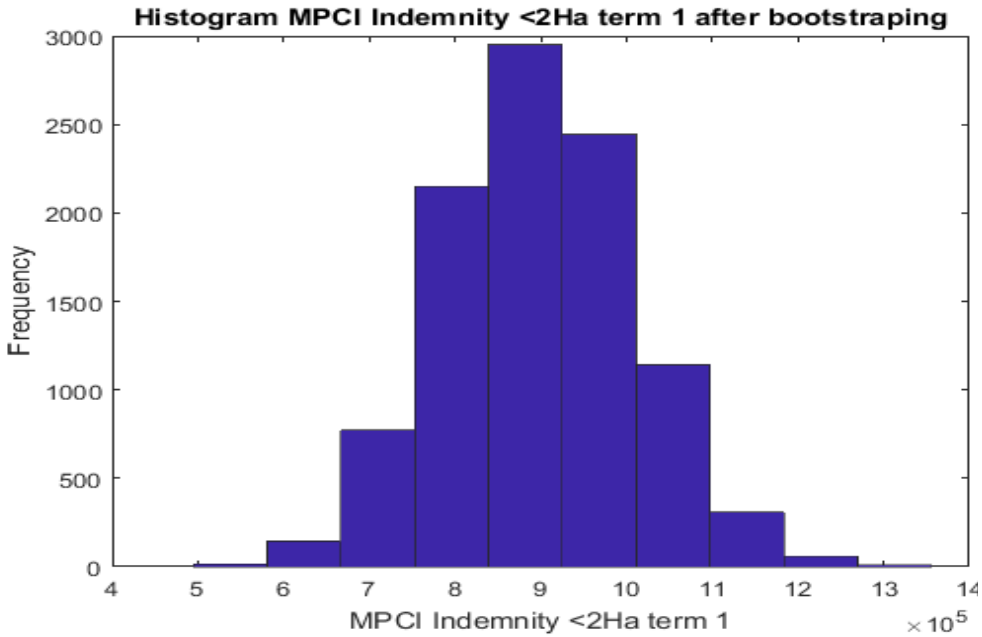
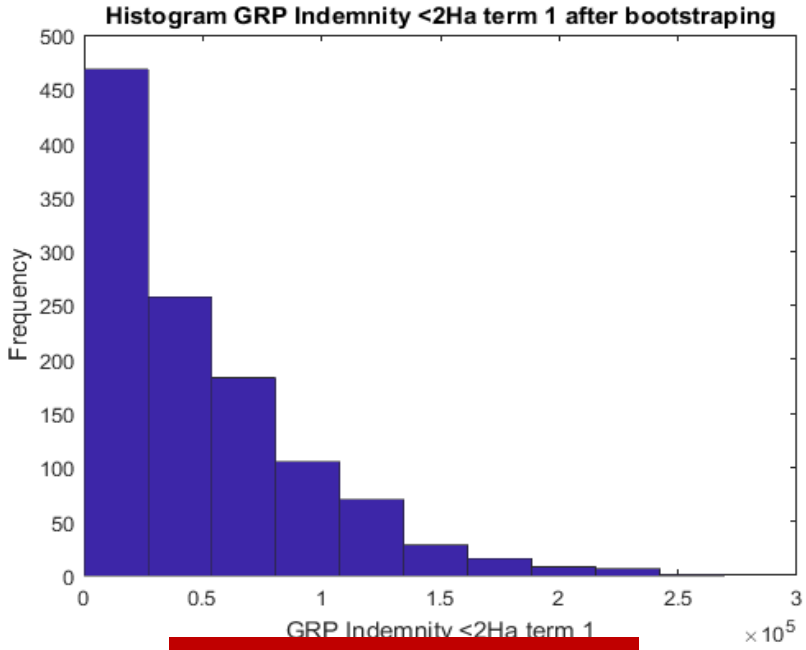
MPCI and Indemnity Term 1 less 2 hectare after bootstraping

Histogram of MPCI and GRP Indemnity with area less than 2 hectare on 2017 losses after bootstrapping



Normal



Skewed

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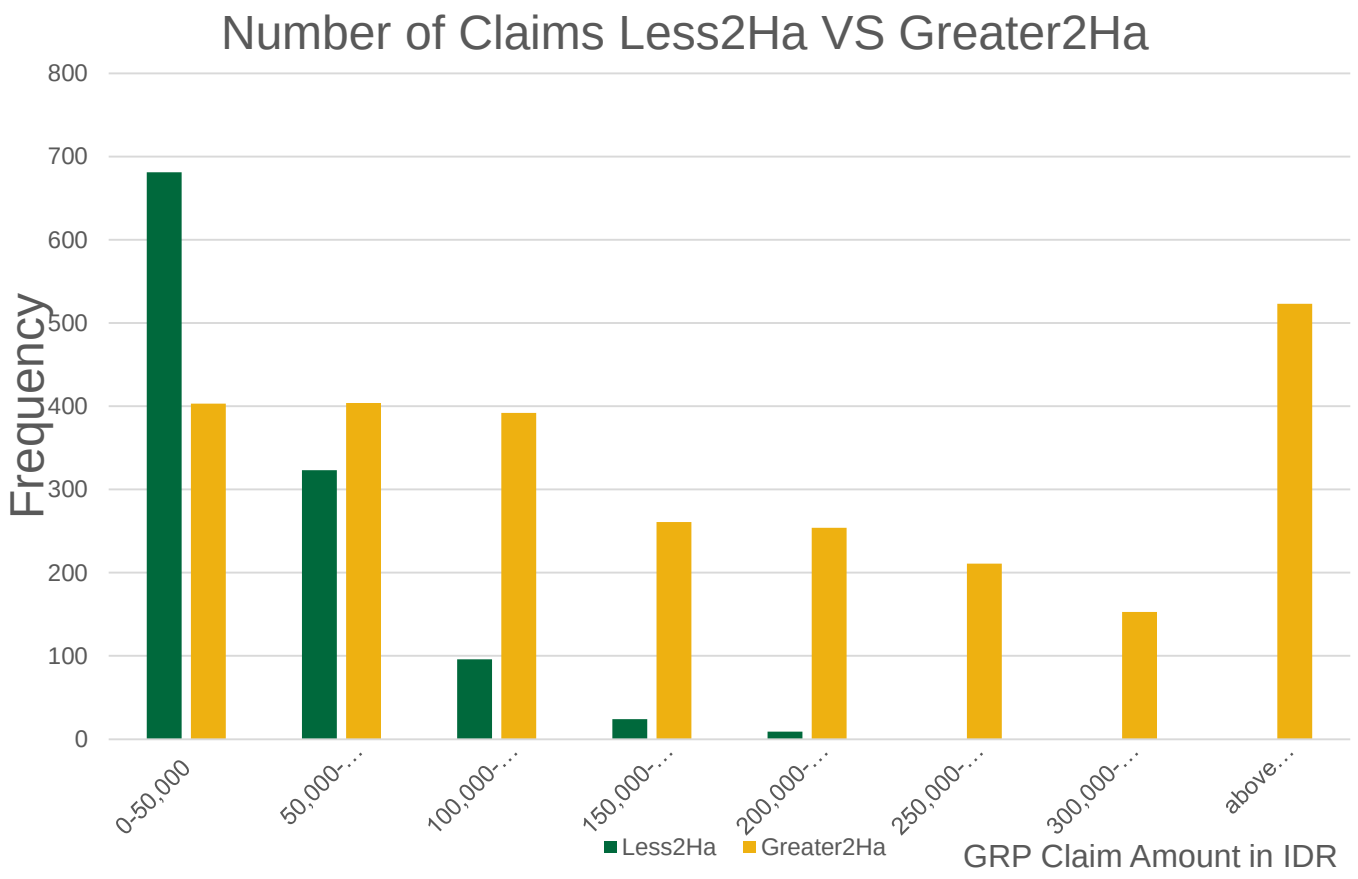
GRP <2Ha VS >2Ha Term 1 after bootstrapping

Comparison number of claims of GRP Indemnity with area less than 2 Ha and >2Ha



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Parameter Estimation and Goodness of Fit Test for GRP and MPCI Term 1 & 2 less than 2Ha

- We modelled using parametric approach for each policy and each term, that summarized in table below.

	Distribution	$E[X]$	$Std\ Deviation$	$VaR_{0.75}(X)$
GRP Term 1	Gamma	50,417.6772	45,641.4115	69,630.87153
MPCI Term 1	Normal	898,088.7475	111,257.3019	973,130.6573
GRP Term 2	Weibull	60,145.8086	50,468.9055	83,946.7702
MPCI Term 2	Normal	838,639.5293	111,825.4996	914,064.6825

Parameter Estimation and Goodness of Fit Test for GRP Term 1 & 2 less than 2Ha

- We modelled using parametric approach for each policy and each term, that summarized in table below.

	Distribution	$VaR_{0.75}(X)$	$TVaR_{0.75}(X)$
GRP Term 1	Gamma	69,630.87153	113,861.6229
MPCI Term 1	Normal	973,130.6573	1,039,508.6038
GRP Term 2	Weibull	83,946.7702	130,828.87
MPCI Term 2	Normal	914,064.6825	980,781.6253

Summary

- Farmers with land <= 2Ha tend to have low knowledge, are more exposed to poverty, and rely 75% of the income is from farming. These farmers are reluctant towards drought, flood, commodity price, and pest. Therefore there is a need to develop a policy that will protect them and also appealing
- Most Farmers due have experience with health insurance BPJS and having good experience. Vice versa with crop insurance and in some areas where only few/none have crop insurance, knowledge on this issue is limited
- Alternative appealing policies L, E, F, K, C (having all risks, payment per planting, simple visit, and the possibility of unit link) also tend to have higher willingness to pay, therefore less subsidy needed. Choosing an appealing policy and also maintaining the satisfaction of insurance policy is one of the key factors that will increase the WTP of a crop insurance policy
- Farmers having area under2Ha need protection, simulation studies show that MPCI is still suitable but the premium is not enough to cover the high loss risk, therefore alternative policies, one of them GRP, that have lower risk and encourages good farming practices is needed.

THANK YOU !

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Summary

Farmers Welfare

- **Most Farmers have primary school education, but experienced**
- Characteristic of land owned and the ownership varies, Karawang is more advanced
- Around half of thr farmers have other incomes, but still 75% of the income is from farming.
- Farmers with land <= 2Ha are more exposed to poverty
- Farmers in Karawang tend to cultivate more land, have higher income

Previous Insurance Policy

- More that 50% Farmers due have experience with insurance but not with crop insurance, especially in Bogor
- The satisfaction towards previous policy is good
- Improvement is needed to increase the interaction of farmers with extension workers and farming groups

Risk Factors

- **Frequent and high impact risk factors include drought, flood, commodity price, and pest**
- **Karawang farmers tend to have higher risk, especially for farmers having land above 2 Ha**

Summary

Crop Insurance Conjoint Analysis	• **The must have crop insurance attribute include practicality of insurance product and risk pooled** • Most appealing policy include Modified MPCI (Unit Link), MPCI, Crop Revenue, and GRP • Policies with this factor tend to increase the willingness to pay of the policy
Willingness to Pay	• **Crop Insurance which are appealing also have high willingness to pay, except for GRP** • The WTP of attractive policy is above Rp 100.000 which is higher than the price of the current policy • **The trend of WTP in Karawang is higher than Bogor (depends on the characteristic of an area)**
Factors that Effect the Willingness to Pay	• Based on regression models and regression tree models besides farm experience/age of a farmers variables that effect WTP are income per capita, land, policy, and satisfaction towards previous insurance policy • Choosing an appealing policy and also maintaining the satisfaction of farmers policy is one of the keys that will incease the WTP of a crop insurance policy
Preliminary Simulation Studies	• Farmers having area = 2Ha need protection, therefore MPCI is still suitable but the premium is not enough , as for farmers that have >2Ha could be given a GRP option that will boost good farming practices and adjust the premium over turn

Summary

- Comparing GRP between term 1 and term 2 which area under 2 hectares shows that the distribution changes from Gamma to Weibull, followed by increasing of expected value, standard deviation, and 75% value at risk. However, the MPCI distribution remains the same of normal distribution with slightly different of expected value or μ.
- It means that if the GRP is implemented then we should adjust the premium over the term.
- Currently, the premium policy of MPCI with area under 2 hectares, which is 3%*6 million rupiah = 180,000, is still not sufficient to cover existing risks of MPCI policy.