APPENDIX A

Rice Seasonal Calendar

A1: Paddy rice seasonal calendar illustration

Activities	Winter-Spring season	Summer-Autumn
Soil preparation	01/12 – 20/12	05/5 - 25/5
Seedling	25/12 – 05/2	05/5 – 25/5
Transplanting	10/01 – 15/02	15/05 – 15/06
Herbicides application	06/2 – 25/2	21/5 – 15/06
Fertilizers application	1/3 – 10/3 05/4– 10/4	20/06 – 30/6 10/7 – 15/7
Pest and disease management	1/3 – 1/5	20/06 – 5/8
Irrigation management	1/3 – 1/5	20/06 – 05/08
Harvesting	5/5 – 25/5	12/08 – 10/09

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APPENDIX B

Regression analysis of winter-spring rice model

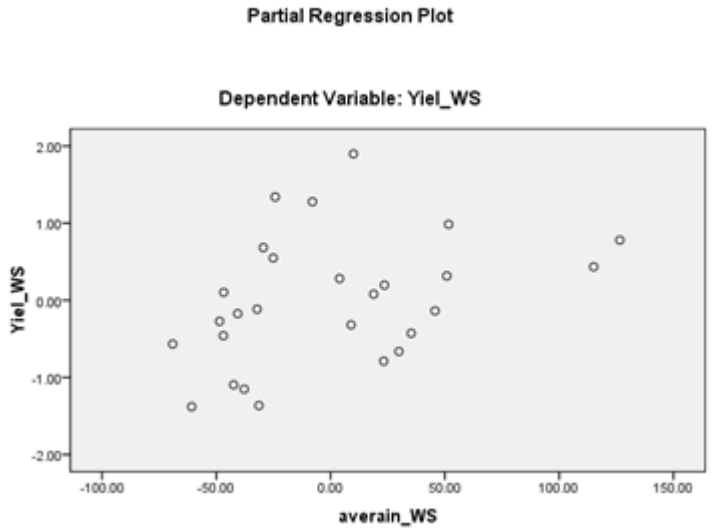

Figure B-1: Partial regression plot of rice yield (Yield_WS) and average rainfall (averain_WS) in winter-spring

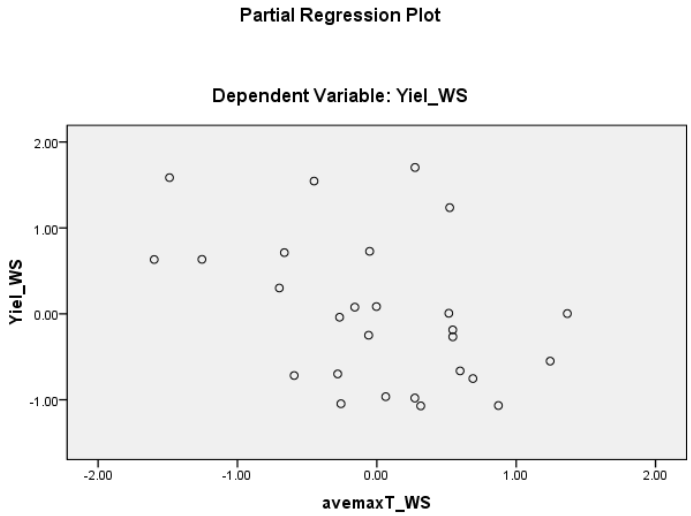

Figure B-2: Partial regression plot of rice yield (Yield_WS) and average maximum temperature (avemaxT_WS) in winter-spring

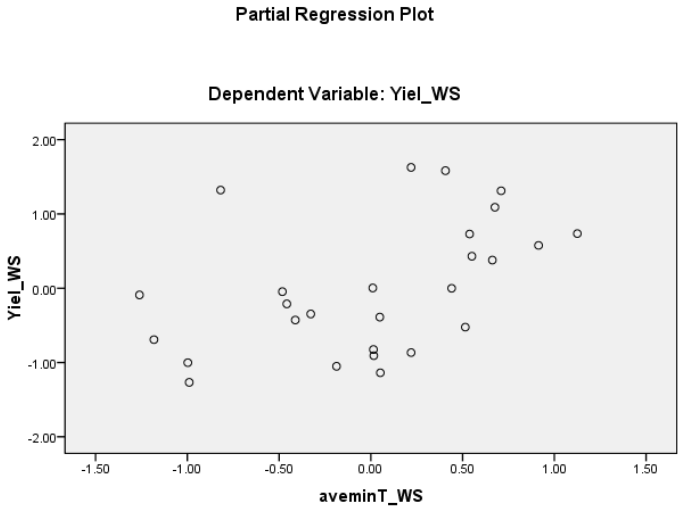

Figure B-3 Partial regression plot of rice yield (Yield_WS) and average minimum temperature (aveminT_WS) in winter-spring

Table B-1 Correlation matrix and one tail test

		LnYield	**Lnrain_WS**	**LnmaxT_SW**	**LnminT_SW**
Pearson Correlation	LnYield	1.000	0.485	-0.429	0.093
	Lnrain_WS	0.485	1.000	-0.617	-0.381
	LnmaxT_SW	-0.429	-0.617	1.000	0.516
	LnminT_SW	0.093	-0.381	0.516	1.000
Sig. (1-tailed)	LnYield	0.000	0.005	0.013	0.322
	Lnrain_WS	0.005	0.000	0.000	0.025
	LnmaxT_SW	0.013	0.000	0.000	0.003
	LnminT_SW	0.322	0.025	0.003	0.000
N	LnYield	27	27	27	27
	Lnrain_WS	27	27	27	27
	LnmaxT_SW	27	27	27	27
	LnminT_SW	27	27	27	27

Table B-2 Result of ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.509	3	0.503	5.493	0.005[a]
Residual	2.105	23	0.092		
Total	3.614	26			

a. Predictors: (Constant), LnminT_SW, Lnrain_WS, LnmaxT_SW

b. Dependent Variable: LnYield

Table B-3 Estimate of ordinary least square

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	7.799	9.879		0.789	0.438		
Lnrain_WS	0.409	0.207	0.402	1.977	0.060	0.613	1.630
LnmaxT_SW	-5.363	2.805	-0.419	-1.912	0.068	0.526	1.900
LnminT_SW	3.652	1.474	0.462	2.478	0.021	0.727	1.375

Dependent Variable: LnYield

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APPENDIX C

Regression analysis of winter-spring rice model

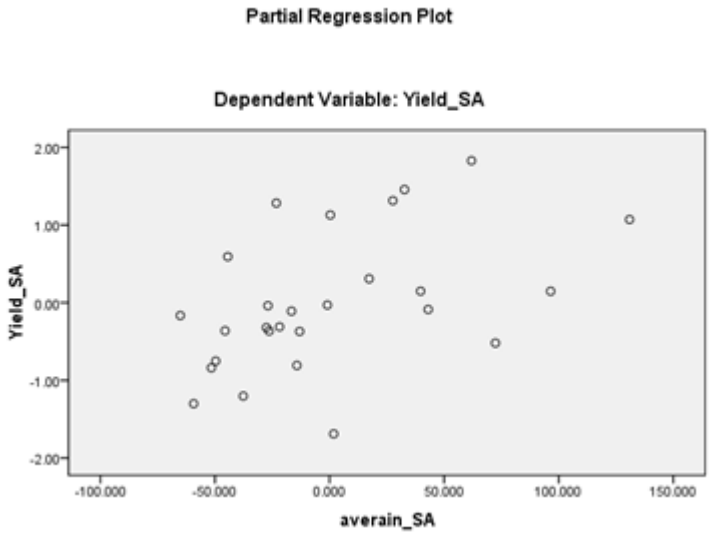

Figure C-1 Partial regression plot of rice yield (Yield_SA) and average rainfall (averain_SA) in summer-autumn season

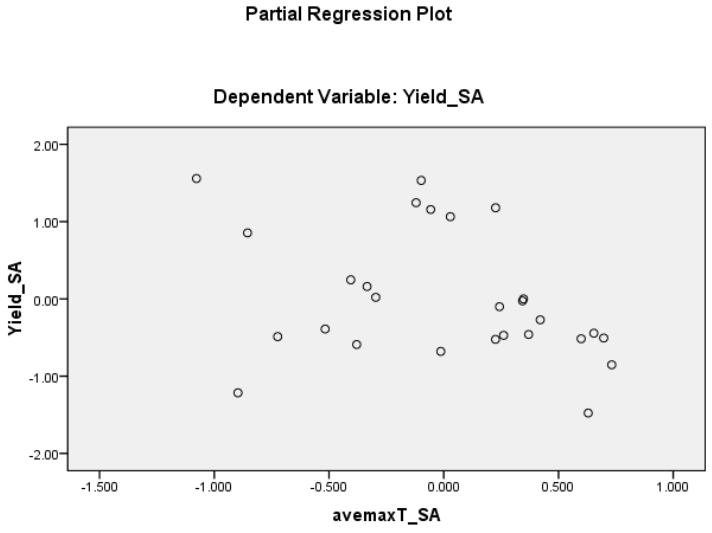

Figure C-1 Partial regression plot of rice yield (Yield_SA) and average maximum temperature (avemaxT_SA) in summer-autumn season

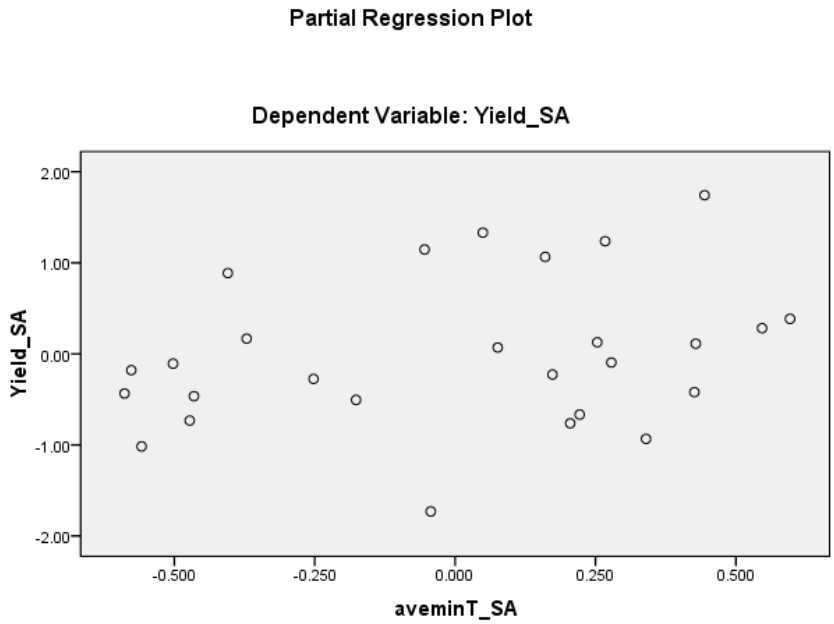

Figure C-3 Partial regression plot of rice yield (Yield_SA) and average minimum temperature (aveminT_SA) in summer-autumn season

Table C-1 Correlation matrix and one tail test

		Lnyield_SA	**Lnrain_SA**	**LnmaxT_SA**	**LnminT_SA**
Pearson Correlation	Lnyield_SA	1.000	0.573	-0.453	-0.045
	Lnrain_SA	0.573	1.000	-0.448	-0.390
	LnmaxT_SA	-0.453	-0.448	1.000	0.358
	LnminT_SA	-0.045	-0.390	0.358	1.000
Sig. (1-tailed)	Lnyield_SA	0.000	0.001	0.009	0.412
	Lnrain_SA	0.001	0.000	0.010	0.022
	LnmaxT_SA	0.009	0.010	0.000	0.033
	LnminT_SA	0.412	0.022	0.033	0.000

\

Table C-2 Result of ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.327	3	0.776	5.997	0.004[a]
	Residual	2.975	23	0.129		
	Total	5.301	26			

a. Predictors: (Constant), LnminT_SA, LnmaxT_SA, Lnrain_SA

b. Dependent Variable: Lnyield_SA

Table C-3 Estimate of ordinary least square

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	8.224	20.918		0.393	0.698		
Lnrain_SA	0.808	0.271	0.543	2.986	0.007	0.739	1.354
LnmaxT_SA	-8.886	5.137	-0.310	-1.730	0.097	0.760	1.316
LnminT_SA	6.647	4.161	0.278	1.597	0.124	0.806	1.241

a. Dependent Variable: Lnyield_SA

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APPENDIX D

Cronbach's Alpha coefficients

D-1 Cronbach's Alpha of farmer's attitude indicators

Decision	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PlanD	18.15	26.061	0.574	0.610
SeedD	19.88	36.041	0.220	0.693
BrewD	19.17	33.339	0.222	0.696
HerbiD	19.17	32.654	0.308	0.678
PestD	17.91	26.975	0.479	0.638
FertiD	19.10	33.956	0.241	0.690
IrriD	18.36	28.690	0.502	0.634
HarvaD	17.91	27.639	0.480	0.638

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D-2 Cronbach's Alpha of farmer's attitude indicators

SWF use benefit	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Gooplan1	26.83	55.518	0.639	0.832
Suitseed1	27.50	62.173	0.487	0.845
SaveCos1	27.03	57.692	0.571	0.838
PesMan1	26.69	60.470	0.479	0.845
IrriMan1	26.69	59.635	0.519	0.842
BestHar1	26.62	55.309	0.665	0.830
HighYie1	27.42	59.518	0.605	0.836
Pestpos1	26.93	60.570	0.474	0.845
Ricequa1	27.03	63.033	0.319	0.857
AvoiBW1	26.94	57.796	0.578	0.837
Foodse1	27.38	58.415	0.603	0.836

D-3 Cronbach's Alpha of indicators of subjective norm factor

Subjective norms	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Spous2	21.01	37.033	0.336	0.701
Child2	22.62	41.756	0.245	0.711
Relatio2	21.62	37.802	0.456	0.680
Niegbor2	21.51	32.888	0.564	0.651
Wni2	20.79	42.626	0.086	0.738
LOff2	21.58	35.810	0.416	0.684
Exten2	21.57	32.884	0.596	0.645
Tivi2	21.44	31.588	0.634	0.634
Radio2	22.45	43.087	0.109	0.729

D-4 Cronbach's Alpha of indicators of perceived control factors

Perceived controls	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Acceabi3	25.64	45.616	0.544	0.730
Undeabi3	25.53	47.569	0.525	0.735
Diversi3	25.39	53.246	0.192	0.776
Accuri3	25.89	45.771	0.622	0.721
Availa3	25.09	44.421	0.532	0.732
Time3	25.58	51.406	0.310	0.762
Relia3	25.23	45.127	0.530	0.732
Easy3	25.63	44.356	0.656	0.714
Appli3	25.55	51.511	0.305	0.762
Local3	25.54	55.970	0.063	0.787

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APPENDIX E

Confirmation Factor Analysis

Table E-1 Covariance between structures

Structures			Estimate	S.E.	C.R.	P	Label
Belief	<-->	Control	0.628	0.103	6.121	***	
Belief	<-->	Norm	0.179	0.090	1.985	0.047	
Norm	<-->	Control	0.368	0.114	3.230	0.001	
Belief	<-->	Decision	0.688	0.119	5.801	***	
Norm	<-->	Decision	0.561	0.143	3.937	***	
Control	<-->	Decision	0.825	0.122	6.785	***	

Table E-2 Model Fit Summary - CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	39	276.392	192	0.000	1.440
Saturated model	231	0.000	0		
Independence model	21	1754.141	210	0.000	8.353

Table E-3 Model Fit Summary - RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	0.123	0.872	0.846	0.725
Saturated model	0.000	1.000		
Independence model	0.639	0.294	0.224	0.268

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Table E-4 Model Fit Summary - Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	0.842	0.828	0.946	0.940	0.945
Saturated model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000

Table E-5 Model Fit Summary - RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.050	0.036	0.062	0.510
Independence model	0.203	0.194	0.212	0.000

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APPENDIX F

Structural equation model analysis

Table F-1 Regression Weights

Structures	Standardized estimate	S.E.	C.R.	P
Decision <--- Belief	0.531	0.214	3.531	***
Decision <--- Norm	0.218	0.063	2.952	0.003
Decision <--- Control	0.276	0.163	1.893	0.058

Table F-2 Covariances (Default model)

Structure	Estimate	S.E.	C.R.	P	Label
Belief <--> Control	0.620	0.102	6.050	***	
Belief <--> Norm	0.180	0.090	1.995	0.046	
Norm <--> Control	0.362	0.115	3.146	0.002	

Table F-3 Model Fit Summary - CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	38	243.275	172	0.000	1.414
Saturated model	210	0.000	0		
Independence model	20	1651.379	190	0.000	8.691

Table F-4 Model Fit Summary - RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	0.123	0.882	0.856	0.722
Saturated model	0.000	1.000		
Independence model	0.629	0.305	0.232	0.276

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Table F-5 Model Fit Summary - Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	0.853	0.837	0.952	0.946	0.951
Saturated model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000

Table F-6 Model Fit Summary - RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.048	0.033	0.062	0.576
Independence model	0.207	0.198	0.217	0.000

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APPENDIX G

Thesis Defense Presentation

THESIS DEFENSE

MASTER OF SCIENCE (AGRICULTURE)
IN AGRICULTURAL SYSTEMS MANAGEMENT

Assessing Rice Famers' Seasonal Weather Forecast Data Use to Adapt with Climate Variability in Central Highland of Vietnam

Presented by:

NGUYEN THI CHUNG (TINA)

1

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

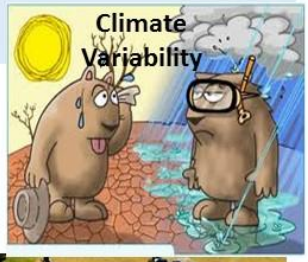
Contents

1. Introduction
2. Study objectives
3. Data collection and analysis
4. Research Results

2

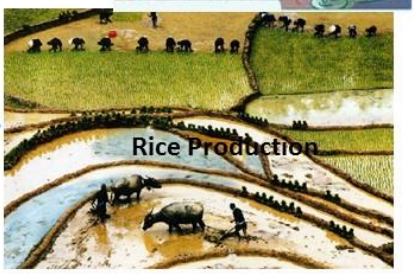
INTRODUCTION

- Yield will decline by 0.6 tons/ha per 1°C average Temp. increase.
- Rice yield will decrease from 4.2% to 12.5% in 2030 all climate change scenarios



Perceived controls
+ Accuracy
+ Reliability
+ Understandability

Making Decisions



Farmer's goals
- High yield
- High income
- Food security
- Avoid extreme climate

Social norms

3

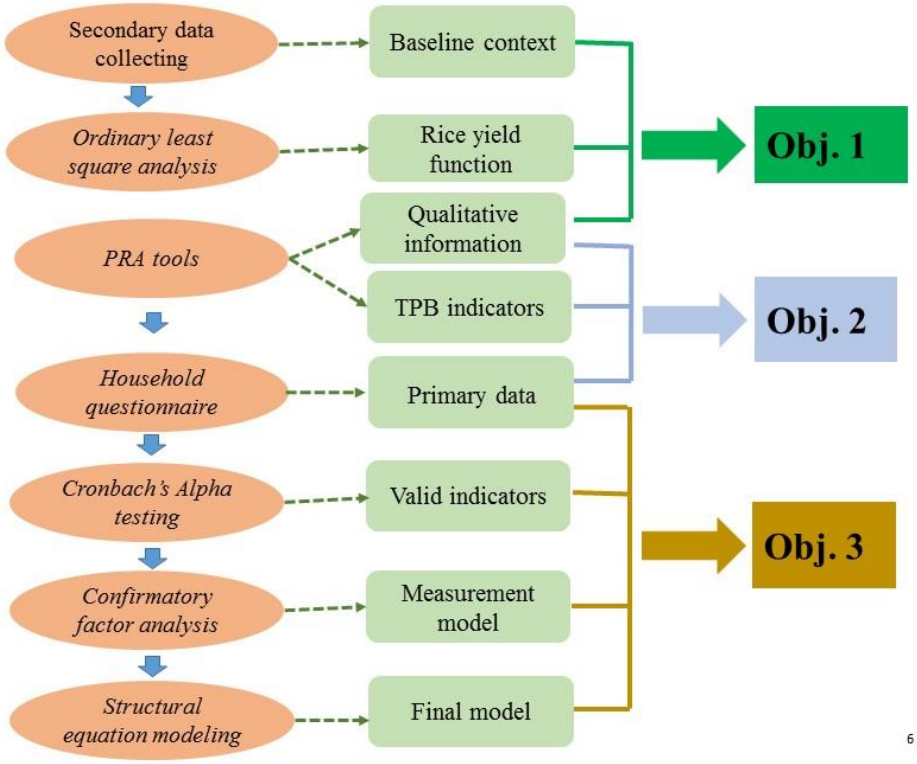
MAI UNIVERS

STUDY OBJECTIVES

1. To investigate the impacts of climate variability on rice production in the Central highland of Vietnam
2. To explore rice famers' SWF data use to cope with climate variability in the Central highland of Vietnam
3. To assess the factors influence the farmers' SWF data use in rice production decisions

4

Methodology Framework



6

Ordinary Least Squares (OLS)

$$LnYs_t = \beta_0 + \beta_1 Ln\ (rain_t) + \beta_2 Ln\ (maxT_t) + \beta_3 \text{Ln}\ (minT_t) + \varepsilon_t$$

Ys_t: : rice yield (ton/ha) of two seasons (winter-spring and summer-autumn)

$rain_t$: the average rainfall (mm) by seasons

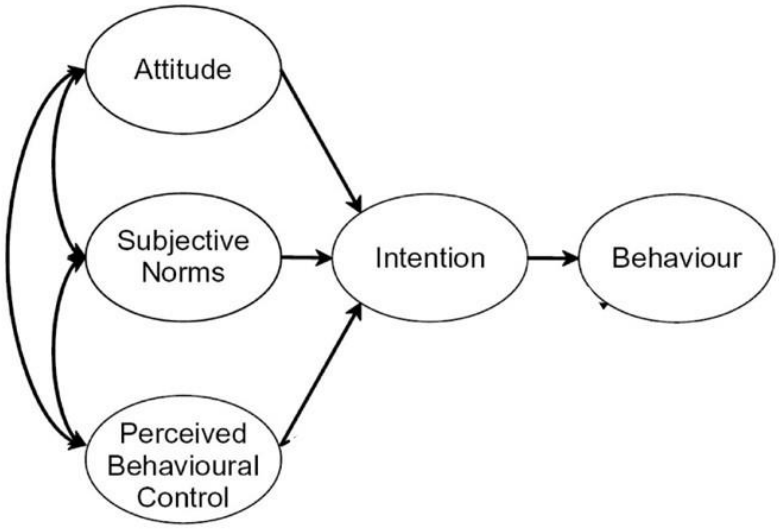
$maxT_t$: the average maximum temperature (^{0}C) by seasons

$minT_t$: the average maximum temperature (^{0}C) by seasons

ε_t : the error term and t is the time (year)

7

Theory of Planned Behavior Framework



Ajzen, 1991

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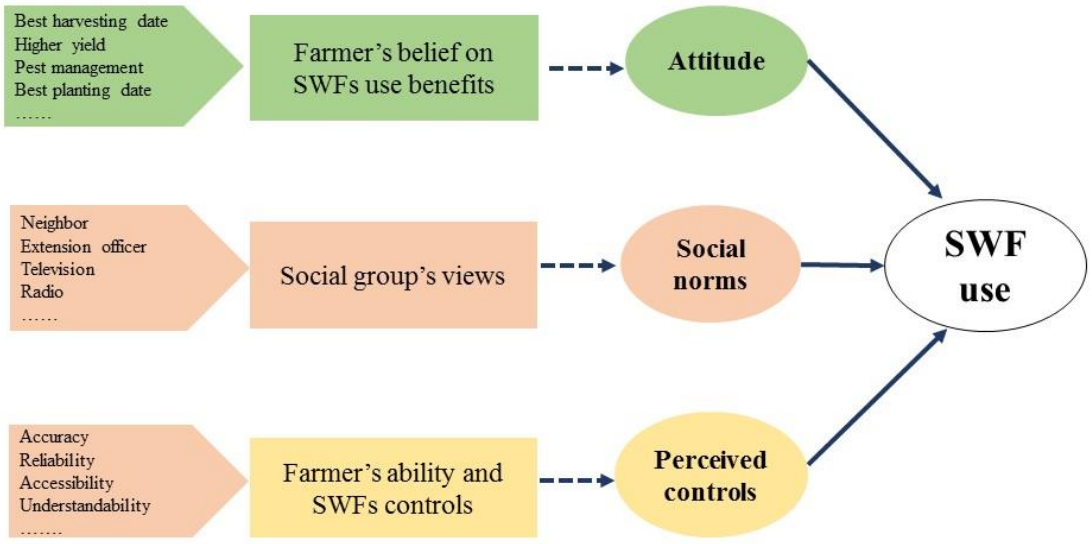
Study Theory Framework



A= f(attitude, social norms, perceived control)

9

Agricultural and Rice Production System

11

Study Area

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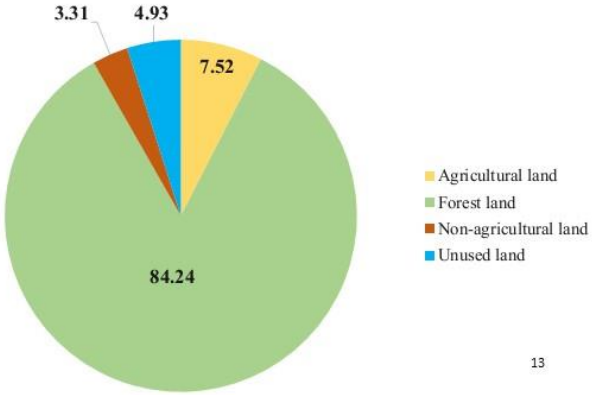
Annual crop	Percentage (ha)
Rice	29.13
Maize	8.60
Root crop	48.02
Vegetable	12.52
Annual industrial	0.86
Other annual crop	0.86

Population	People	24,815
Ethnic population	People	11.044
Density	People/km^2	37.98
Average income per capital	USD	572
Poor household	%	13
Number of labor	People	13,553



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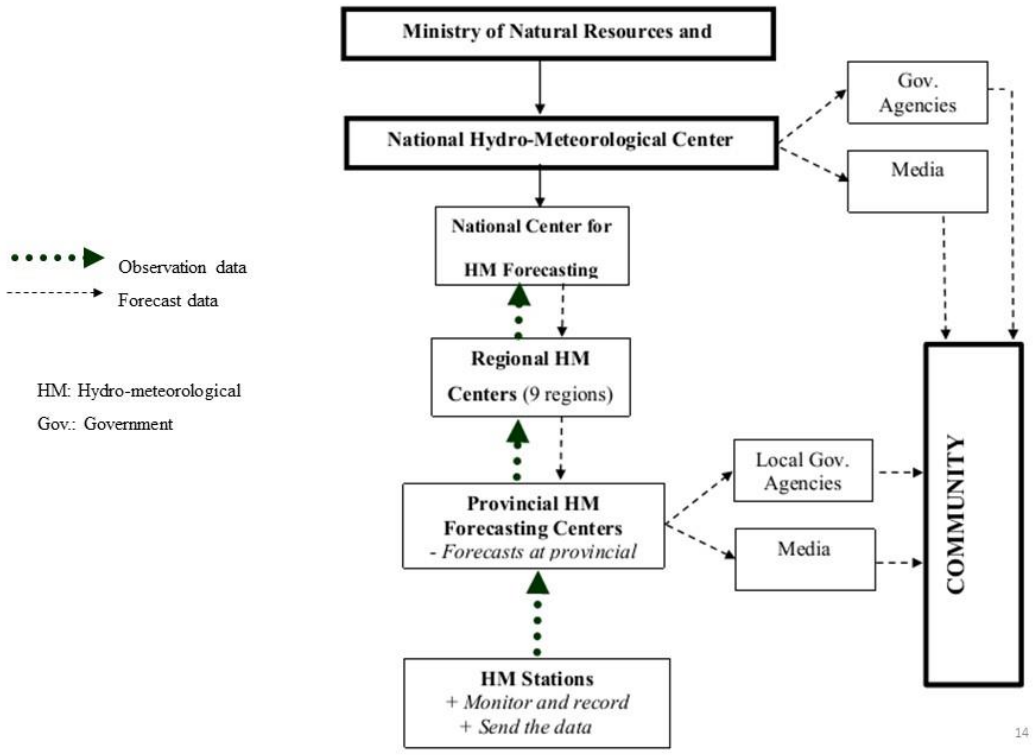
Weather forecast system status in Vietnam



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Characteristic of the sample households

Items	Classify	Sample amounts (N=180)	Percentage (%)
Gender (people)	Male	117	65.00
	Female	63	35.00
Age (years)	>18	0	0.00
	18-30	28	15.56
	31-60	126	70.00
	>60	26	14.44
Education (years)	No	23	12.78
	Primary	89	49.44
	Secondary	45	25.00
	High school	23	12.78
	University	0	0.00
Ethnicity	Kinh	81	45.00
	Minority	91	50.56
Rice production experience (years)	<10	7	3.89
	>10	173	96.11
Income sources	crop	180	100.00
	Livestock	88	48.89
	Forestry	90	50.00
	No-Agriculture	99	55.00

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Rice area and fallow of sample households

Criteria	N	Mean	min	max	SD
Rice area (ha)	180	0.346	0.1	0.87	0.168
Rice fallow area year (ha)	106	0.029	0.01	0.1	0.014

Irrigation and soil characteristic of sample households

Items	Classify	N	Percentage
Irrigation	Yes	88	48.89
	No	92	51.11
Fallow area	Yes	74	41.11
	no	106	58.89
Landslide	No	66	36.67
	Mild	44	24.44
	Moderate	39	21.67
	Severe	31	17.22

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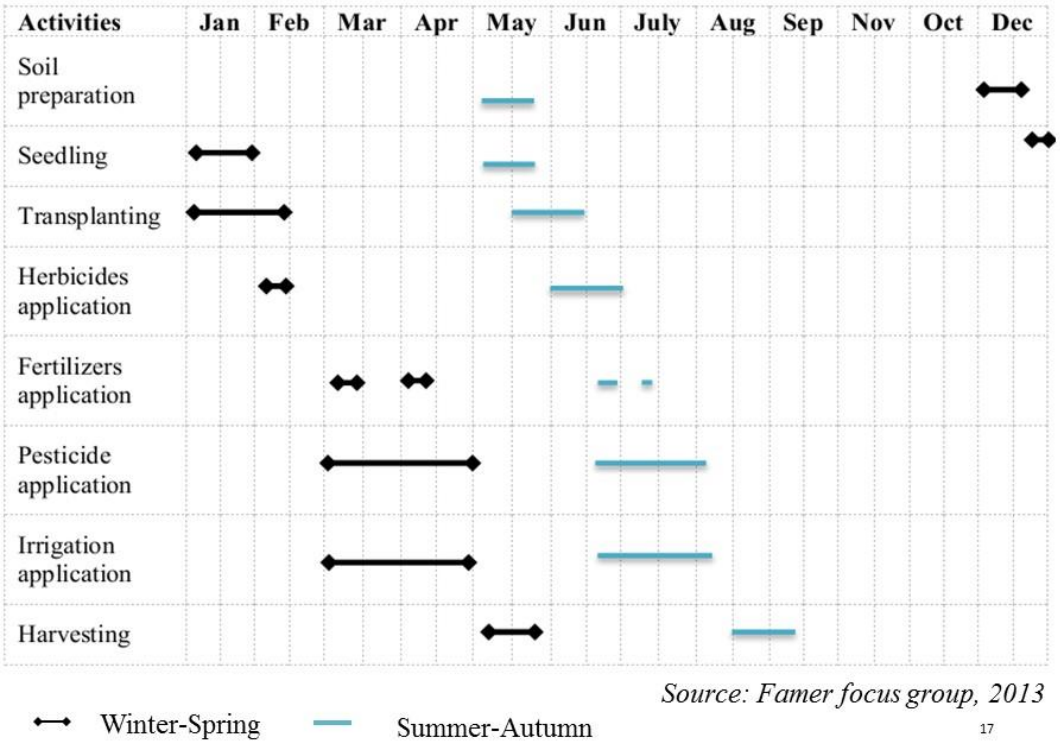
Paddy rice seasonal calendar



Source: Famer focus group, 2013

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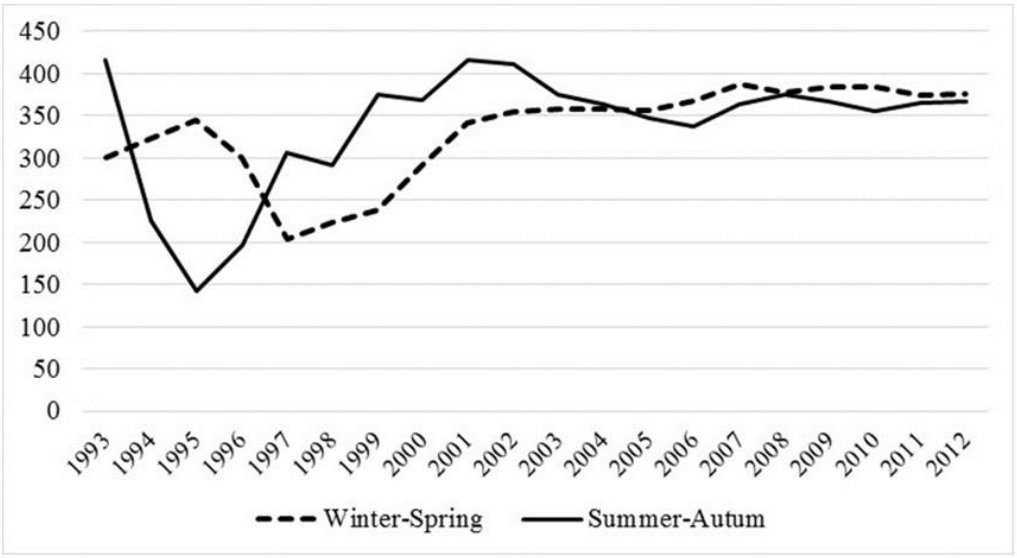
Rice area distribution over 20 years in Nam Dong district



Source: Nam Dong Statistical office, 2012

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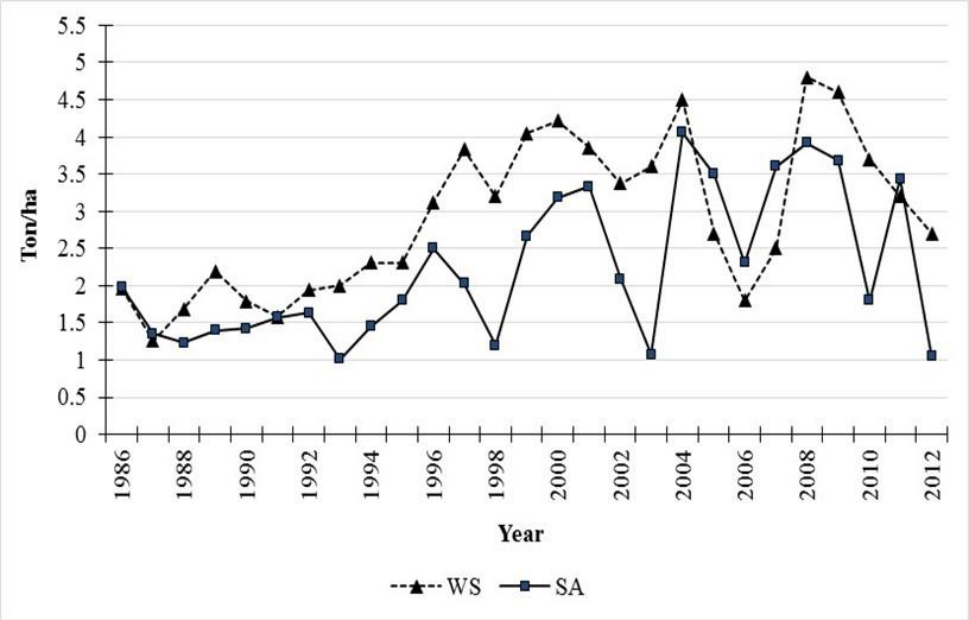
Rice yield change by seasons over 27 years



WS: winter-spring season
SA: summer-autumn season

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Climate variability in Nam Dong district

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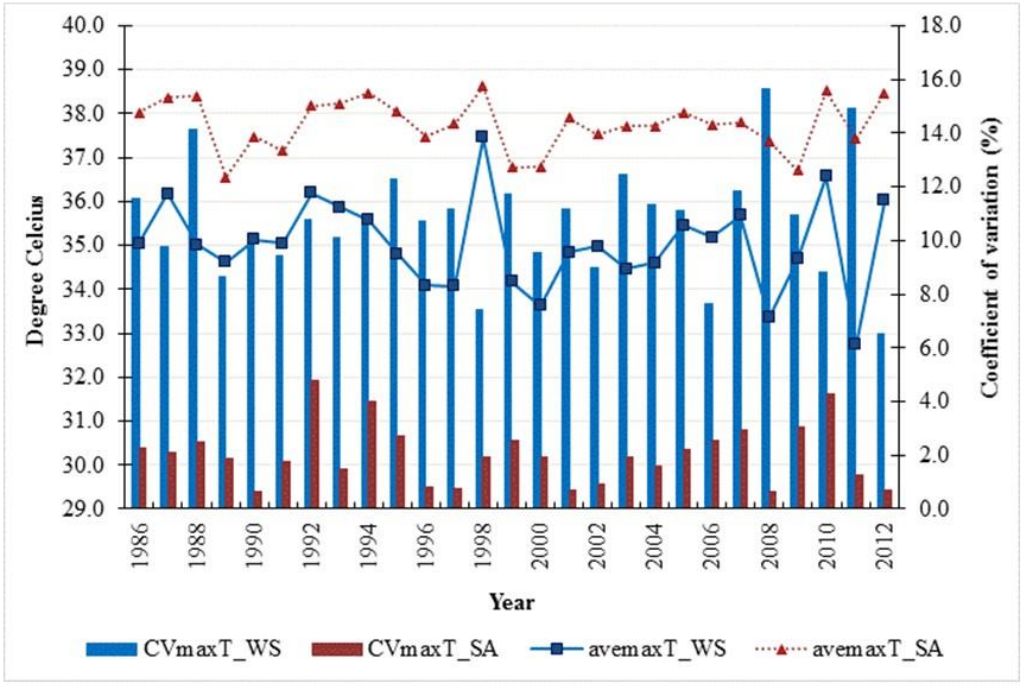
The variability of maximum temperature and its CVs by seasons over 27 years



avemaxT: Average maximum temperature

CVavemaxT: Coefficient variation of average maximum temperature

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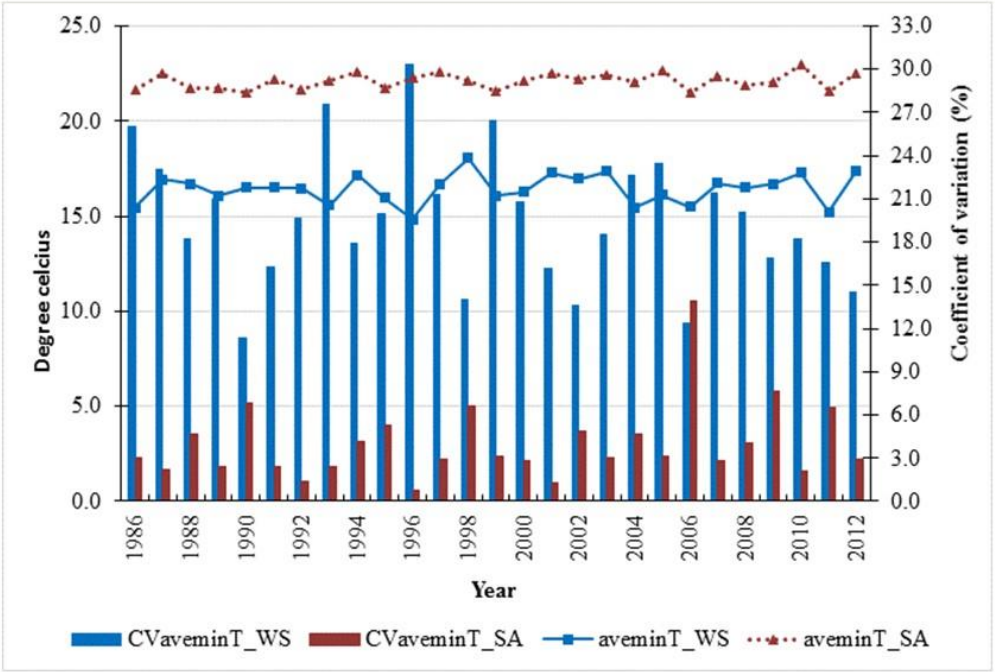
The variability of minimum temperature and its CVs by seasons over 27 years



aveminT: Average minimum temperature

CVaveminT: Coefficient variation of minimum temperature

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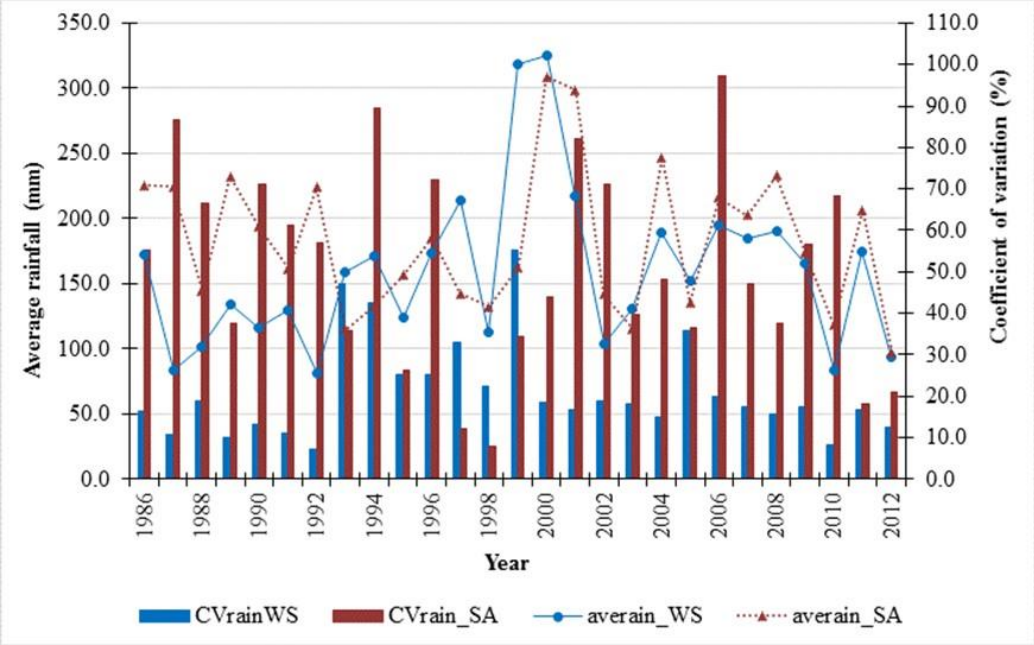
The variability of rainfall by seasons and its CVs over 27 years



averain: Average rainfall

CVrain: Coefficient variation of average rainfall

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Impact of climate variability on rice yield

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Tests of normality of rice yield (dependent variables)

Variables	Kolmogorov-Smirnov		Shapiro-Wilk	
	Statistic	Sig.	Statistic	Sig.
Yiel_WS	0.129	0.200	0.950	0.217
Yield_SA	0.149	0.127	0.896	0.11

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Estimate of ordinary least square for winter-spring rice season

Ln yield = 7.799 + 0.409Ln(averain) – 5.363Ln(avemaxT) + 3.652Ln(aveminT)

Variable	Coefficients	Std. Error	t-ratio	VIP
Intercept	7.799	9.879	0.789	
Ln(averain)	0.409*	0.207	1.977	1.630
Ln(avemaxT)	-5.363*	2.805	-1.912	1.900
Ln(aveminT)	3.652**	1.474	2.478	1.375
R-square	*0.417*			
Adjust R-square	*0.341*			
F value	***5.493*****			
Dubin-Watson test	*1.062*			
Breusch – Pagan chi-square	*2.957*			
p-value of chi-square	*0.3954*			

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** Significant at 5% and * significant at 10%

Estimate of ordinary least square for summer-autumn rice season

Ln yield = 8.224 + 0.808Ln(averain) – 8.886Ln(avemaxT)

Variable	Coefficients	Std. Error	t-ratio	VIP
Intercept	8.224	20.918	0.393	
Ln(averain)	0.808***	0.271	2.986	1.354
Ln(avemaxT)	-8.886*	5.137	-1.730	1.316
Ln(aveminT)	6.647	4.161	1.597	1.241
R-square	*0.439*			
Adjust R-square	*0.366*			
F value	***5.997****			
Dubin-Watson test	*1.283*			
Breusch – Pagan chi-square	*3.741*			
p-value of chi-square	*0.2980*			

*** Significant at 1% and * significant at 10%

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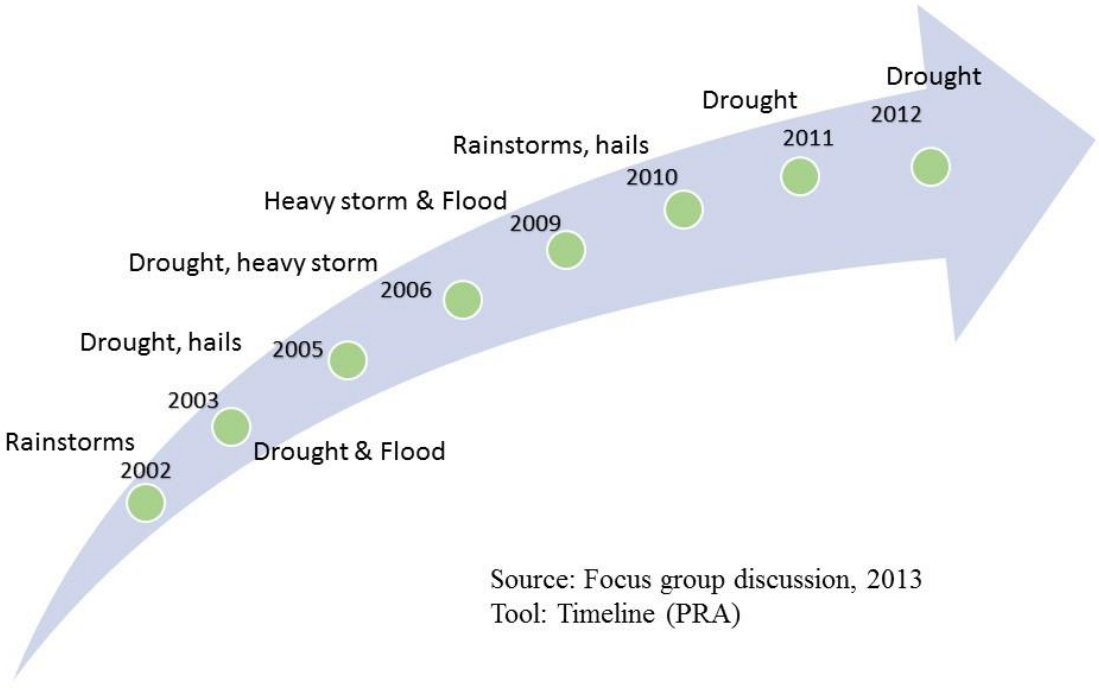
Farmer's Experience of Climate Variability



Source: Focus group discussion, 2013
Tool: Timeline (PRA)

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Losses of rice production cause by climate variability

Crops	Impacted area (%)			Yield loss (ton)	Remarks
	Drought	Storm	Pest & Disease		
SA 2003	7.23	-	-	86	Complete loss
WS 2005	-	-	8.42	3.3	Yield decreasing
SA 2005	2.10	-	-	31.5	No planting
WS 2006	5.96	-	12.24	51	Yield decreasing
SA 2006	2.58	0.68	-	38.4	Complete loss
SA 2009	-	0.48	27.20	24	Yield decreasing
SA 2010	-	-	39.33	56	Yield decreasing
SA 2012	1.77	-	8.90	127.1	Complete loss
Total				**417.3**	

Source: District agricultural office, 2013

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Seasonal Weather Forecast Data Use in Rice Production Decisions

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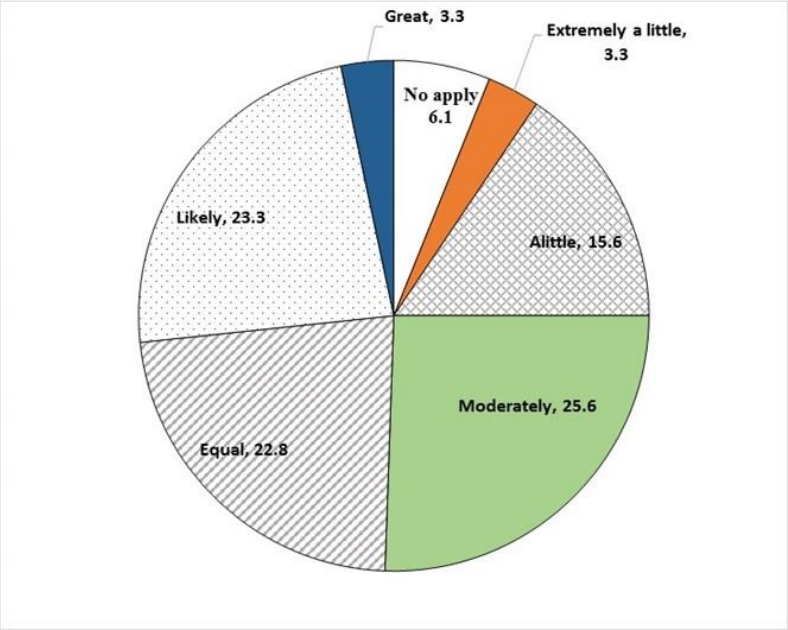
Influence of Seasonal Weather Forecast Data on Rice Production



Source: Household questionnaire survey, 2013

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Score ranking of Farmers' Perception on Seasonal Weather Forecast Data

Attributes	Sum score	Ranking
Accuracy	40	**I**
Reliability	37	**II**
Timeliness	28	VI
Availability	32	V
Understandability	35	**III**
Diversity of channels	25	VII
Localization	34	IV

Source: Farmer focus group discussion, 2013

Tool: Score ranking (PRA)

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Key decisions in rice production decisions as related to seasonal weather forecast data

Activities	Temp.	Rainfall	Drought	Storm	Flood	Total	RANKING
Selecting seed varieties	7	11	57	49	47	*171*	IV
Selecting planting date	23	42	50	47	47	*209*	**I**
Time of brewing seed	39	39	15	14	16	*123*	V
Herbicides application	13	42	14	10	13	*92*	VIII
Fertilizers application	32	18	33	20	14	*117*	VI
Pesticide application	22	35	48	47	32	*184*	**III**
Irrigation application	24	18	33	20	14	*109*	VII
Harvesting date	20	53	38	45	34	*190*	**II**
Total	*209*	*229*	*288*	*252*	*217*	*1195*	
RANKING	V	**III**	**I**	**II**	IV		

Source: Focus group discussion, 2013
Tool: Matrix ranking

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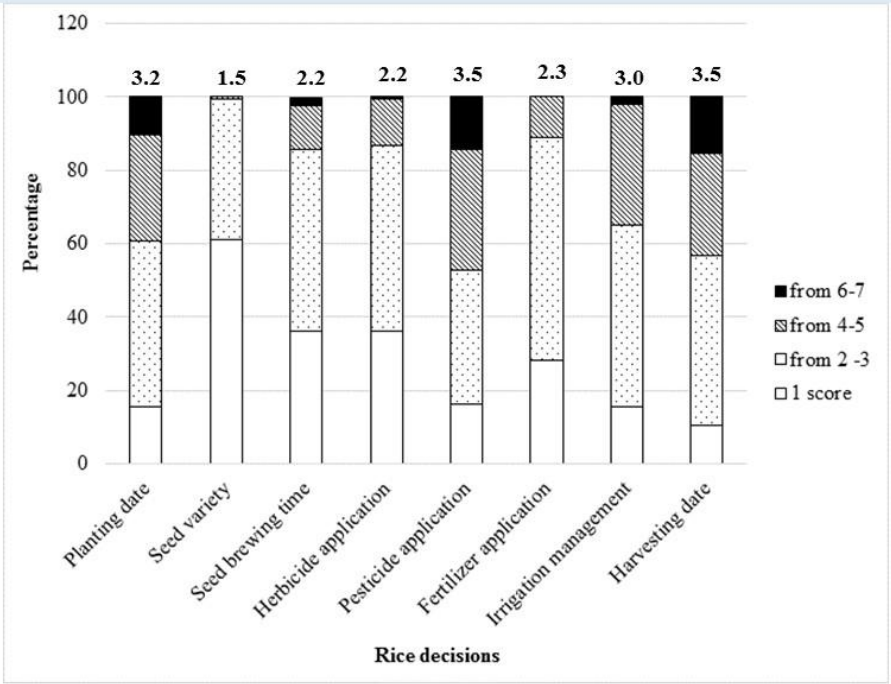
Farmers' SWF Use in Rice Production Decisions



Source: Household questionnaire survey (N=180)

Note: 1= not use; 2= rarely use; 3= occasionally; 4= sometimes; 5=frequently; 6= usually; 7= every time.[34]

Testing the reliability of indicators of farmers' SWFs use in rice decisions

Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha value
Planting date	0.569	0.576	
Seed variety[a]	-	-	
Seed brewing time[a]	-	-	
Herbicide application[a]	-	-	
Pesticide application	0.497	0.667	*0.713*
Fertilizer application[a]	-	-	
Irrigation management[a]	-	-	
Harvesting date	0.530	0.625	

[a]*Deleted indicator*

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Factors influence on farmer's SWF use

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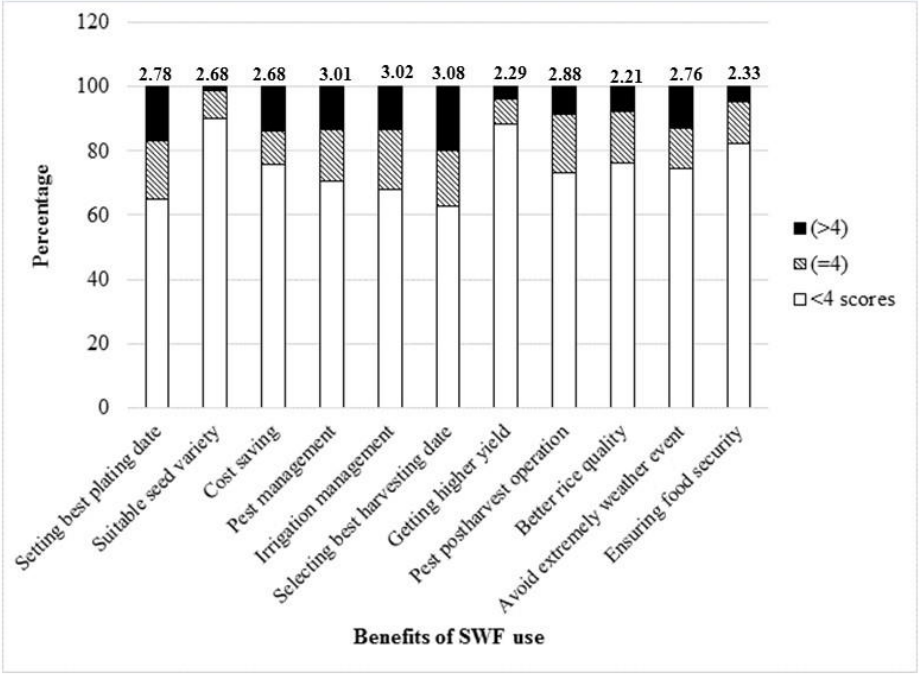
Farmers' Attitude Factor that Influencing on SWFs Use



Source: household questionnaire, 2013 (N=180)

1= extremely unlikely; 2= Unlikely; 3= somewhat unlikely; 4= neutral; 5= somewhat likely 6= likely; 7= extremely likely[37]

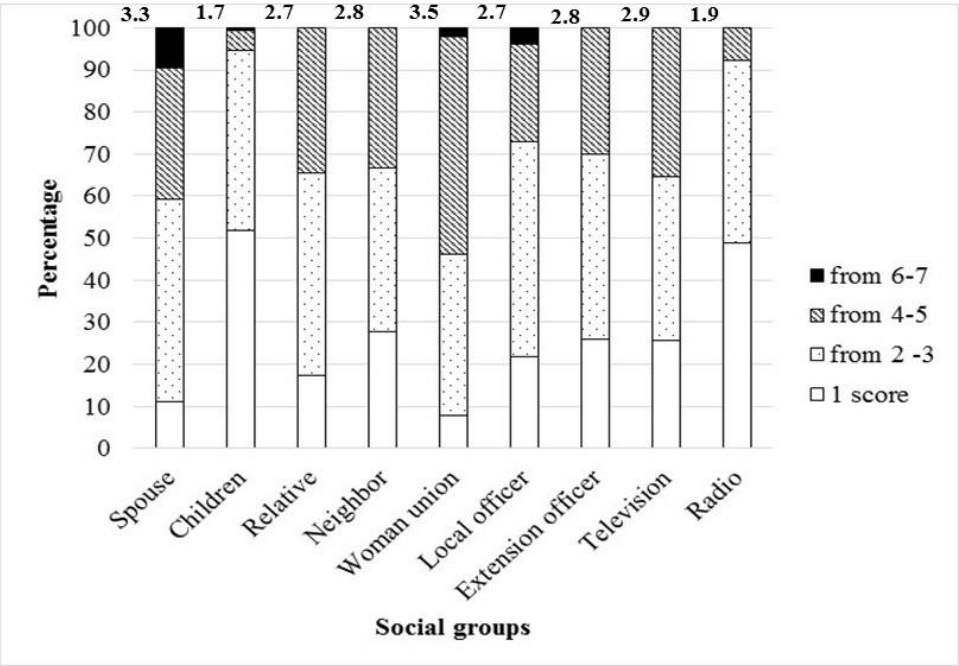
Testing the Reliability of indicators of Farmers' Attitude

Items	Corrected item-total correlation	Cronbach's alpha if item deleted	Cronbach's alpha value
Setting the best plating date	0.637	0.830	
Suitable seed variety	0.490	0.845	
Cost saving	0.580	0.836	
Pest management	0.486	0.845	
Irrigation management	0.493	0.845	
Selecting best harvesting date	0.681	0.825	***0.852***
Getting higher yield	0.618	0.833	
Pest postharvest operation[a]	-	-	
Better rice quality[a]	-	-	
Avoid extremely weather events	0.575	0.837	
Ensuring food security	0.600	0.834	

[a]Deleted indicator

38

Subjective Social Norm Factor Influencing on Farmers' SWF Use



1= not at all influent; 2= slightly influent; 3= somewhat influent; 4= moderately influent; 5= influent; 6= very influent; 7= extremely influent

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Testing the Reliability of indicators of Subjective Social Norm

Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha value
Spouse[a]	-	-	
Children[a]	-	-	
Relative[a]	-	-	
Neighbor	0.742	0.824	
Woman union[a]	-	-	*0.869*
Local officer[a]	-	-	
Extension officer	0.762	0.807	
Television	0.749	0.818	
Radio[a]	-	-	

[a]Deleted variable

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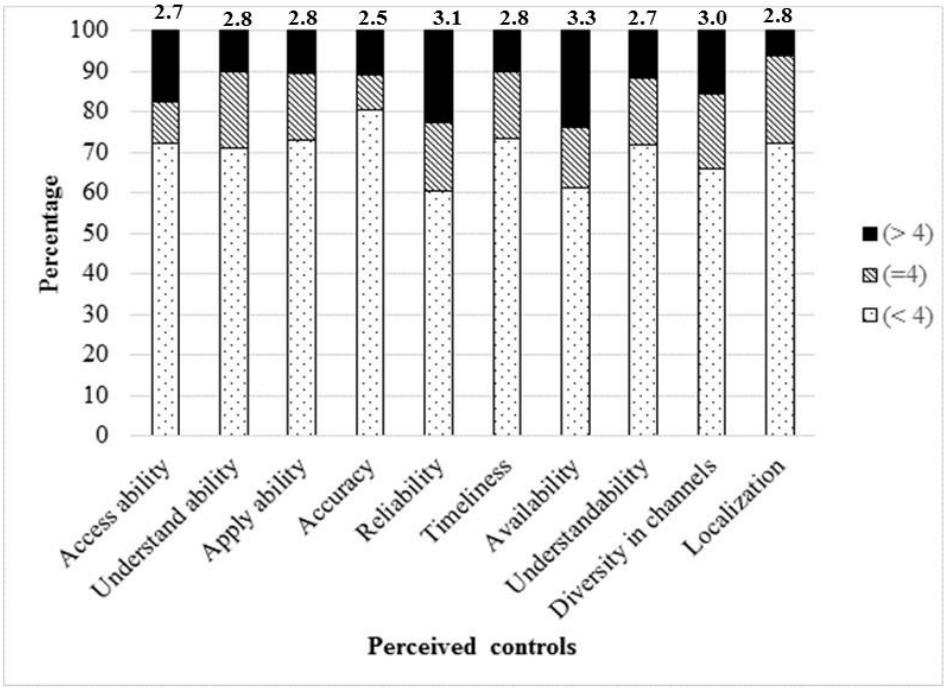
Perceived Control Factor Influencing on Farmer's SWFs Use



1= very low; 2=low; 3= somewhat low; 4= neutral; 5= moderately high; 6= high; 7= extremely high

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Testing the Reliability of Indicators of Perceived Control

Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Cronbach's Alpha value (N=180)
Access ability	0.635	0.822	*0.848*
Understand ability	0.622	0.825	
Apply ability[a]	-	-	
Accuracy	0.694	0.812	
Timeliness[a]	-	-	
Reliability	0.604	0.828	
Availability	0.549	0.841	
Understandability	0.709	0.808	
Diversity in channel[a]	-	-	
Localization[a]	-	-	

[a]Deleted variable

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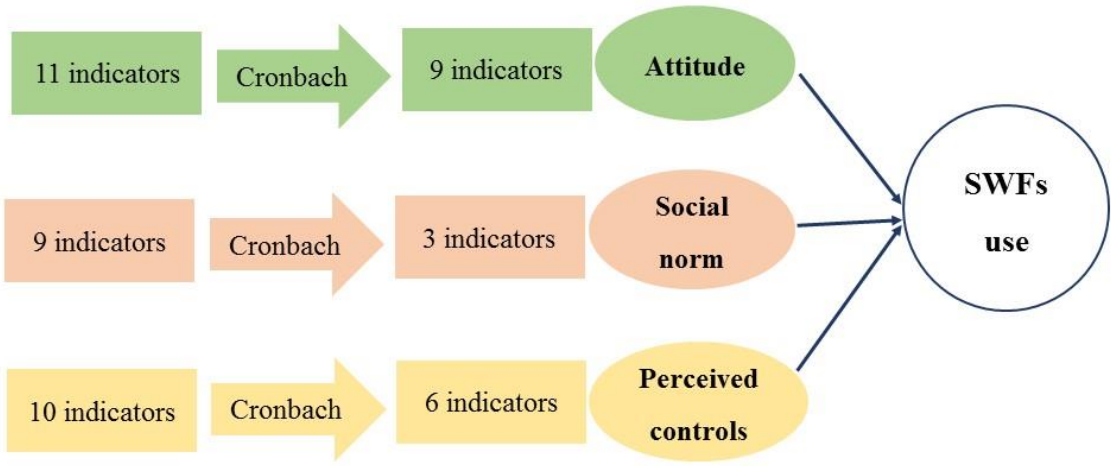
The valid indicators after Cronbach's alpha testing



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The indicators of measurement model

Construct	Indicators	Measurement
Farmer's attitude (9)	Food security	1-7 points Extremely unlikely – extremely likely
	Avoid weather events	
	Higher yield	
	Best harvesting date	
	Irrigation management	
	Best pest management	
	Cost saving	
	Suit seed variety	
	Good planting date	
Subjective social norms (3)	Extension officer	1-7 points Not at all influent –very influent
	Neighbor	
	Television	
Perceived controls (6)	Understandability	1-7 points Very low- extremely high
	Reliability	
	Accuracy	
	Available	
	Access ability	
	Understand ability	

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The Goodness of Fit Indices of Measurement Model by CFA

Fit indices	Suggested value[a]	Study model
Chi-square χ^2		273.129
p-value	≤ 0.1	0.00
df		191
χ^2/df	≤ 2 ≥ 5	1.43
RMSEA	≤ 0.08	0.049
CFI	≥ 0.9	0.947
TLI	≥ 0.9	0.942

[a] Suggested value were based on Hair et al. (1998)

Note: *TLI: Tucker-Lewis Coefficient*

CFI: Comparative Fit Index

RMSEA: Root Mean Square Error of Approximation

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Convergent Validity of Measurement Model

Construct	Indicator	Standardized factor loading	Cronbach alpha value
Farmer's attitude	Food security	0.665***	0.852
	Avoid weather events	0.628***	
	Higher yield	0.659***	
	Best harvesting date	0.762***	
	Irrigation management	0.511***	
	Best pest management	0.491***	
	Cost saving	0.613***	
	Suit seed variety	0.501***	
	Good planting date	0.747***	
Subjective social norms	Extension officer	0.851***	0.869
	Neighbor	0.821***	
	Television	0.819***	
Perceived controls	Understandability	0.754***	0.848
	Reliability	0.680***	
	Accuracy	0.785***	
	Available	0.626***	
	Access ability	0.684***	
	Understand ability	0.689***	
Decisions	Planting date selecting	0.696***	0.713
	Pest management	0.656***	
	Harvesting date selecting	0.675***	

*** Significant at 0.01 level

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The Discriminant Validity of Measurement Model

Constructs			Estimate
Farmer's attitude	<-->	Perceived control	0.839***
Farmer's attitude	<-->	Social norm	0.207***
Farmer's attitude	<-->	SWF use	0.823***
Social norm	<-->	Perceived control	0.288***
Social norm	<-->	SWF use	0.389***
Perceived control	<-->	SWF use	0.753***

*** Significant at 0.01 level

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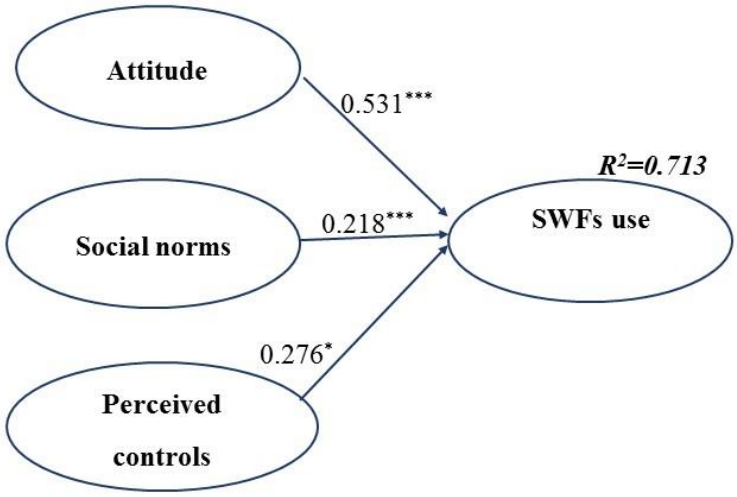
The final study model by using SEM analysis



****Significant at 0.01 level, **Significant at 0.1 level*

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The Goodness of Fit Indices of Final model by SEM analysis

Fit indices	Suggested value[a]	Study model
Chi-square χ^2		243.257
p-value	≤ 0.1	172
df		0.00
χ^2/df	$\leq$ 2 $\geq$5	1.414
R^2	> 0.5	0.713
RMSEA	≤ 0.08	0.048
CFI	≥ 0.9	0.951
TLI	≥ 0.9	0.946

[a] Suggested value were based on Hair et al. (1998)

Note: *TLI: Tucker-Lewis Coefficient*

CFI: Comparative Fit Index

RMSEA: Root Mean Square Error of Approximation

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Conclusions and Recommendations

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Conclusions

- Rice yield in Nam Dong district was different in two seasons, in which winter-spring yield almost was higher than summer-autumn season.
- Seasonal rainfall, highest temperatures and lowest temperatures fluctuated considerably in last period of 27 years in Nam Dong district
- The seasonal rainfall had positive relationship with rice yield in both seasons
- The seasonal maximum temperature affected adversely on rice yield in two seasons
- Rice yield in the WS season had positive impact by seasonal minimum temperatures, but SA did not relate to this weather factor
- The abnormal in climate events as heavy rainfall, drought, storms, floods had negative impact on rice production.
- Loss of rice yield, pests and diseases outbreak, landslide, land fallow and lacking of water for cultivation were perceived as results of CV

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Conclusions

- There was 70% farmers indicated that SWFs influenced on their rice production at different levels
- Five types of seasonal weather forecast products specifically delivered to farmers including seasonal temperature, seasonal rainfall, drought, storm and flood.
- Neighbors, extension officers and television were key sources for farmers getting SWFs
- The accuracy, reliability and understandability of the SWFs were the most consider attributes
- Selecting planting date, harvesting date and pesticide application were main decisions that related and used the SWFs
- Farmers had negative had low belief on SWF use outcomes like selecting the suitable seed variety, getting higher yield and ensuring food security

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Conclusions

- The influence of social groups of SWF communicating was weak.
- Farmers had negative perception on SWF controls
- Farmer's attitude, social subjective norms and perceived controls had positive and significant relation to farmer's SWF use.
- Farmer's attitude was determined as the greatest direct effect on farmer's use of SWF and perceived controls followed by second factor, while subjective norms were the least effect on farmer use of SWFs in rice production decisions making.

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Recommendations

Policy recommendations

- Supplying farmers with new rice varieties which are resilient in climate conditions.
- Encouraging farmers to adopt production seasonal calendar and developing specific strategies in rice production to cope CV
- Training should be organized to rice farmers about CV and its impact on rice production
- Provide some knowledge and skills to farmers about the benefits and the way to access and use SWF data
- Enhancing the SWF communication skills and knowledge for different social groups: extension officers, village leaders, woman union, and farmer union.

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Recommendations

Policy recommendations

- Improving the characteristic of SWFs retail to farmer such as accuracy, reliability, timeliness.
- Improving mandates and ability of meteorological staffs at the local level will contribute to accuracy and localization, understandability for SWFs
- Supports SWFs data in different ethnic languages
- Community media would be useful way to improve the intervention of different social groups in the roles of SWFs communication to farmers
- Applying the model of "Climate field school" to farmers

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Recommendations

Recommendations for further researches

- Further research should focus on analyzing data with comparison in different livelihood contexts, scales
- Further research should do with larger sample size that can generate more useful insight in interpreting the influence factors on farmer's SWF use
- Developing and improving the TPB of factors influence on farmer's SWF use by adding more constructs and applying in different contexts, scales, or regions
- Exploring and validating the local knowledge of climate prediction and it's integration with scientific weather forecasts

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Remarks

- Integrated approach employed in this study: combining theory TPB, PRA, observation, questionnaire, expert opinion (key informant interview)
- Integrated approach in data analysis: qualitative data (focus group discussions information), quantitative data (Cornbrash's alpha, CFA and SEM).
- Especially system approach (based line livelihood context analysis, risk & impact from climate variability and the use of SWFs to adjust rice production strategy to cope with the risk.
- No background about economic

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