Management of Agro-ecological Knowledge and Social Change (MAKS)
Department of Social Science - Wageningen University and Research Centre

MSc Thesis Technology and Agrarian Development

Do farmers use climate forecast information to respond to climate variability?

Technographic studies on impact of Climate Field School in year 2003
on crop management strategy of farmers in Indramayu District, Indonesia

January 2009

Prakarma Raja

Supervisors:
Prof. Dr. Paul Richards
Dr. Todd Crane

TAD Group

WAGENINGEN UNIVERSITEIT
WAGENINGEN UR

Acknowledgements

This research thesis would not have been finalized without the support, input and review from several persons and institutions.

First off all, I wish to thank to farmers in Karang Mulya and Santing Village for welcoming and allowing me to conduct interviews and observation in their villages Special thanks to Pak Sarma of Karang Mulya, Pak Didi, Pak Soepandi, Pak Sirwan, Pak Kasbah, Pak Sarma of Santing, Pak Rasim, Pak Kamsari, Pak Abdullah, Pak Tomo, Pak Kalihin. Another special thanks to Mas Yono and Kang Ihin who provide transportation, field guidance, and also translation during the observations and interviews.

I would like also to thank Dr.Rizaldi Boer, Srimulya and Endang Purwani who to allocate time for interviews and documentation on the curriculum and the process of the Climate Field School.

I was surrounded by nice and supportive peoples while I am staying in Wageningen. I am indebted to all Indonesian students in Wageningen University who have been nice and supportive while I am studying together with them. A special thanks to Joni Adiansyah, Alfi Syakila, Ahmad Kamarulzaman, Vivi Andriani, Farida, Hadiyanto and Adian, Tia, Reza, Arfi, Meis, Rizal, Zacky, Pak Jay, Pak Marasabessy, Pak Herman Ibnu, Zefri, and others who made studying in Wageningen become easier and more fruitful than I would expect. Sometimes I did not feel I am away from my hometown.

I am grateful to all the MAKS students that are following the program with me together. Special thank to Laurence, Dennis, Geke, Matthias, Kul, Basu, Pettunia, Rose-Mary, Salih, Reinier, Nahla, Astrid, Arnica, Allesandro, Kirsten and Maaike who offer warm friendship. A special thanks to Bossman who helped me with grammar check of this report. It creates a constructive environment for studying.

A special thanks to Chalid Mohammad and Farah Sofa who supported me in application for scholarship and admission letter the university. Other thanks to Longgena Ginting who offered his nice house for me to spend weekend.

Special thanks to my niece Quesqi Siregard and Glenn, and Glenn’s parent Om Frans and Tante Lieke who welcome me to their house while I am studying here. Their Indonesia foods make me fell being home.

I would like to express many thanks to my supervisors, Prof. Dr. Paul Richards and Dr. Todd Crane who have given guidance, support and input in realizing my thesis research, from the proposal’s writing process, presentation and producing final report. I would not have finalized this report without their patience and supportive comments.

A very special thank to my mother in law, Mama Riolina Ilyas, who have done many thing to make me confident and who cared my family while I am away.

Dedication

This thesis report is dedicated to: my wife Irina Rafliana and my son Lentera Nusa Siregar: the source of inspiration and motivation in my life. This 16 months journey in Wageningen is not possible with their constructive support and brave heart.

Summary

Seasonal climate forecast information is provided regularly to farmers and is expected to be input for strategy of cropping management of farmers. The application of seasonal climate forecast is regarded to be important in current emerging concern on the impact of climate change to agriculture.

However, the seasonal climate forecast information is not used widely. The characteristic of seasonal climate forecast is regarded to be the obstacle to apply it. Government and scientists agree that the forecast is not easy to be understood by farmers. Translating the seasonal forecast into *farmer language* is regarded to be the main challenge to improve understanding and application of the seasonal climate forecast for farmers' strategy.

Government and scientist are searching for an effective mechanism to communicate the forecast to farmers. Climate Field School (CFS) was established in year 2003. It was considered to be an effective mechanism for institutionalizing the communication of seasonal climate forecasts. The first Climate Field School was started in 3 villages in Indramayu District, Indonesia. This area frequently suffers from crop losses due to extreme climate (drought and flood). The three villages are rain-fed agriculture lands, which rely on rain to irrigate crops. Majority of crop losses in Indramayu are associated with climate variability. After following the Climate Field School (CFS), farmers were expected to understand and to apply climate information in setting up crop management strategy.

Five years after farmers attended the Climate Field School, no study has been done nor knowledge available on the impact of the Climate Field School in changing perceptions and practices of farmers for reducing climate related risks. It is claimed to be successful. Replication of the program is being implemented in several places throughout Indonesia. The knowledge is significantly needed under the emerging concern on the impact of climate change to agriculture and broader aspects.

This study is conducted to asses the impact of the Climate Field School (CFS) to strategy of cropping management of farmers. It investigates the application of the seasonal climate forecast information for cropping management of farmers. The study looks the existing context on the ground and find explanation for the reason of farmers choose the current strategy of cropping management.

The research is conducted in a *technographic* approach, which is to investigate society and technology interaction. Observation and interview are mainly focused to farmers who attended the Climate Field School. The outcome of the Climate Field School is analyzed with theoretical framework of Artificial Neural Network (ANN) for supervised or unsupervised learning that emerges from the program. The relation between the context at the ground, the mechanism, and the outcome is elaborated and synthesize with

Pawson and Tilley (2004)' analytical framework of 'Context, Mechanism, and Outcome (CMO) relation'.

The study finds that the impact of the program does not correspond with the planned outcome of the Climate Field School (CFS). The seasonal climate forecast information is not being used as input to strategy of cropping management of farmer. In addition, the strategy of cropping management of farmers is not change. The existing context at the ground is not supportive to the intervention to produce the planned outcome. There are social and technical constrain to apply crop adaptation that responding climate variability. In a rice crop -dominant environment, a crop adaptation at individual level is not feasible.

The main important conclusion of the study is that we have the fact that changing a crop pattern into a new one is a long term process. Therefore, the idea of having a flexible crop pattern that responding climate variability would be far from possible. Farmers would change a crop pattern and maintain it for long period. Recommendation requests government/scientist to redesign the concept the Climate Field School and to consider providing farmers with a detail and updated forecast. ***

Table of Content

Acknowledgement		ii
Dedication		iii
Summary		v
Table of Content		vi
Chapter I	**Introduction: The Climate Field School in Indramayu**	1
1.1	Background…………………………………………………………………..	1
1.2	Indramayu District ……………………………….……………………	2
1.3	Farming Calendar ………………………………………………………	3
1.4	Climate Change…………………………………………………………	3
1.5	The Climate Field School………………………………………………	4
1.6	Problem Statement………………………………………………………	6
1.7	The objective of the study………………………………………………	6
1.8	Existing research on dissemination of climate forecast....………………	6
Chapter II	**Theoretical Framework and Methodology**	7
2.1.	Theoretical Framework ………………………………………………….	7
2.1.1	Artificial Neural Network………………………………………………	7
2.1.2:	Analytical Framework: Context-Mechanism-Outcome Configuration ...	8
2.2	Research Methodology…………………………………………………...	10
2.2.1	Research strategy…………………………………………………………	10
2.2.2	Preparatory activities.……………..……………………………………	10
2.2.3	Methods of Data Collection………………………………………………	11
2.2.4	Design of the Research.…………………………………………………	12
2.2.5	Methods of data analysis…………………………………………………	13
2.2.6	Location of the Study…………………………………………………….	14
2.2.7	Time of the Study…………………………………………………………	14
2.2.8	Compensation of the community………………………………………..	14
Chapter III	**The Context**	
3.1	Introduction ………………………..……………………………………	15
3.2	Agro-ecology condition of area of the study ……………………………..	15
3.2.1	Karang Mulya Village ……………………………………………………	15
3.2.1.	Flood in first season………………………………………………………	18
3.2.2	Drought in second season………………………………………………	19
3.2.2	Santing Village……………………………………………………………	20
3.2.2.1	Regular flood in first season……………………………………………..	20
3.2.2.2	Drought in second season………………………………………………	21
3.2	Cropping Pattern…………………………………………………………..	21
3.3.1	Decision to Time Planting ………………………………………………..	22
3.3.2	Selecting a Crop Pattern ………………………………………………...	23
3.3.2.1	Synchronizing on planting time and selected crop ……………………..	23
3.3.2.2	Agro-ecological Environment ……………………………………………	24
3.4	Land Preparation …………………………………………………………	25
3.5	Seedling Preparation and planting………………………………………	26

3.6	Planting ……………………………………………………………………….	26
3.7	Harvesting Time…………………………………………………………...	26
3.8	Rice crop for second season……………………………………………	27
3.9	Crop History	27
3.9.1	Karang Mulya Village..	28
3.9.2	Santing Village...	29
3.10	To manage drought and flood ……………………………………………..	30
3.10.1	Karang Mulya to manage drought……………………………………….	30
3.10.1.1	Exploiting ground water………………………………………………..	30
3. 10.1.2.	Water transferred from other village ……………………………………	31
3.10.1.3.	To Reduce Planting Time ………………………………………………..	31
3.10.2	Santing Village to manage flood………………………………………….	32
3.10.3	Santing Village to manage drought……………………………………..	32
3.11	Existing Knowledge on Climate Forecast………………………………	33
3.11.1	Traditional Callendar Pranata Mangsa………………………………….	33
3.11.2	Scientific Climate Forecast ………………………………………………	35

Chapter IV The Mechanism: The Climate Field School

4.1	Introduction ………………………………………………………………	36
4.2	The Content of Climate Field School………………………………………	36
4.3	Understanding Climate Terminologies……………………………………	38
4.4	Session on Probabilistic forecast………………………………………..	40
4.5	Farmers Make Rainfall Observation and Recording……………………..	41
4.6	Session on Crop Adjustment...	44
4.7	The seasonal climate forecast ……………………………………………..	47

Chapter V The Outcome: The Impact of the Climate Field School

5.1	Introduction……………………………………………………………….	48
5.2	Application of seasonal climate forecast ……………………………….	49
5.3	Change in cropping pattern………………………………………………	52
5.4	Improvement on Pest Management…………………………………….	52
5.5	Constrain to Crop Adaptation……………………………………………	53
5.5.1	Crop Preference ……………………………………………………….	53
5.5.2	The preference of influential farmers ……………………………………...	54
5.5.3	Agro-ecological condition……………………………………………….	54
5.5.4	Synchronizing…………………………………………………………….	55
5.5.5	Perception on The Reliability of a Forecast…………………………….	56
5.6	Rainfall Observation ……………………………………………………...	56
5.6.1	Farmers Interpretation …………………………………………………	57
5.6.2	Extension Officer Interpretation………………………………………….	58
5.6.3	Scientist Interpretation …………………………………………………	59
5.7	Predicting Rainy Day ……………………………………………………..	59

Chapter VI Discussions, Conclusions and Recommendations.

6.1	Discussion……………………………………..…………………………….	61
6.1.1	Existing contexts are not supportive to the mechanism………………….	61
6.1.1.1	Social and technical constraints ………………………………………….	62
6.1.1.2	Changing a crop pattern takes time……………………………………..	62
6.1.2	Farmer's perception on the reliability of the forecast……………………..	64
6.2	Unsupervised learning ……………………………………………………	65

6.3 Approach of Climate Field School ……………………………………… 67
6.4 Conclusion:……………………………………………………………… 68
6.5 Recommendation:……………………………………………………….. 69
6.6 Epilogue ………………………………………………………………… 70

References………………………………………………………………. 71

Appendix 1: A complete description on individual farmer in Karang Mulya Village 74
Appendix 2: A complete description on individual farmer in Santing Village 83
Appendix 3: A sample of Seasonal Forecast on Rain Season year 2008/2009 91

LIST Of Tables

Table 1. Land ownership on Indramayu agriculture ………………………………….. 2
Table 2: A set of context-mechanisms-output pattern configuration as expected by government and possible alternative context-mechanisms-output Pattern configuration…………………………………………………………… 9
Table 3. Common Planting Schedule at rain-fed land in Indramayu …………….. 23
Table 4. General Description on Cropping Schedulle for rice farming In Karang Mulya Village and Santing Village 27
Table 5. Comparation of investment, maintenace and revenue of secondary crops and rice. ……………………………………………… 29
Table 6. The Javanese Seasonal Cycle Pranata Mangsa………………………… 33
Table 7. Schedule of 2003 Climate Field School (CFS) in Indramayu District ….. 37
Table 8. Characteristic of Rainfall………………………………………………….. 38
Table 9.The accuracy of forecast on rain season during EL Nino years in Java and eastern part of Indonesia ……………………………………….. 47
Table 10 Comparison of decision making process for each key farming stages Before and after participated in the year 2003 Climate Field School……. 50
Table 11 Comparison of Characteristic of Cultivate Rice and Secondary crop according to interviewed farmers from Various Aspects………………... 53
Table 12. Cropping Pattern of Influential Farmers and Common Farmers………… 55
Table 13 Participant and Rainfall Observation in Karang Mulya and Santing Village………………………………………….. 57

List of Picture

Picture 1: Map of Indonesia…………………………... 2
Picture 2. Location of Karang Mulya and Santing Village from sateliite photo…… 16
Picture 3. An example of ommunity owned irrigation canal at village level……………………………………………………………… 18
Picture 4: An illustration of ideal rain season for rice crop twice a year……………. 19
Picture 5. S*owing* or *transplanting*……………………………………………………. 22
Picture 6 A farmers drain water out from a rice field

about 10 days before harvesting time………………………………………. 25
Picture 7 shows a water pump being used by farmer to pump ground water for irrigating secondary crop………………………………………………… 30
Picture 8 shows standard instrument for rainfall measurement (A) and a simple instrument for rainfall measurement that was made by a farmer (B)……. 42
Picture 9: a sample of rainfall record from farmers' observation ……………………. 42

LIST of Box

Box 1 Definition of Climate and Weather ……………………………………………. 4
Box 2 Definition of Climate Variability and Climate Change……………………….. 4
Box 3: Exercise on Understanding Rainfall Characteristic ………………………….. 39
Box 4: Exercise on Probabilistic Forecast …………………………………………….. 40
Box 5: Exercise on Calibrating Farmers' Rainfall Data ……………………………… 43
Box 6 Cropping Pattern 2006/2007 (long drought months of El Nino' years) ……………………………………… 50
Box 7 Cropping Pattern year 2008 Increasing percentage of rice crop for second season ……………………… 51

List of Graphic

Graphic 1**.** Institution involve in disseminating the seasonal forecast information ………………………………………. 46

Chapter I

Introduction: The Climate Field School in Indramayu

1.1. Background

The seasonal climate forecast is provided to farmers twice a year. It was provided before the first planting season and before the second planting season. The information contains conclusion on rainfall forecast, the onset and duration of wet season, and recommendation for strategy of cropping management to respond the forecast (BMG, 2008; Boer, et al 2003).

The seasonal climate forecast has been introduced to farmers since several decades ago. However, the seasonal climate forecast information is not easy to be understood by farmers. Translating the seasonal forecast into *farmer language* is the main problem to encourage farmers to use the forecast information for setting up crop management strategy. The characteristic of scientific forecast and terminologies being used in the climate forecast is regarded as obstacle to application for farming practices (Boer, et al 2003; Roncoli, 2003; Ministry of Agriculture, 2007). The forecast is translated into potential impacts assessment that is produced by Climate Analysis and Mitigation of the Directorate of Plant Protection under the Ministry of Agriculture. Indramayu Regency prepare response options (recommendation) and approved by regent (*Bupati).* At the end of this process, extension officer disseminate the information to farmers (ADPC, 2006).

Government and scientist are searching for an effective mechanism to communicate the forecast information to farmers. In year 2003, Climate Field School (CFS) was established. It was considered to be a mechanism for institutionalizing the communication of seasonal climate forecasts. After following the Climate Field School (CFS), farmers were expected to understand and to apply climate information in setting up crop management strategy. The Climate Field School was established under the emerging concern on the impact of climate change, especially climate extreme (floods and droughts) to farming activity (Indramayu, 2003; APDC, 2006).

This study is conducted to asses the impact of the Climate Field School (CFS) to strategy of cropping management of farmers. It investigates the application of the seasonal climate forecast information (the forecast for short) for cropping management of farmers under the existing context on the ground. Therefore, the study should provide answer to the following Research Questions, which are:

1. Does the Climate Field School (CFS) have an impact on crop management strategy of a farmer?
2. Why do farmers choose the current strategy of cropping management?

1.2 Indramayu District

Indramayu District is part of West Java Province, and is about 2.5 hours drive, from the city of Jakarta. It reaches 70 km long straight from west to east and 40 km from north to south and comprises 31 sub-districts and 302 villages. Most of its topography are flat land or areas with average gradient 0- 2 % and lies on 0- 100 meter above sea level. Such topography influences water drainage, in which some areas suffer flood during high quantity of rainfall (Indramayu, 2008). Picture 1 shows the map of Indonesia. Indramayu District is located near to the city of Jakarta.

Picture 1: Map of Indonesia.

Average annual rainfall in 2007 was 1.509 mm, and the highest annual rainfall about 2.022 with number of rain days is 102. The lowest rainfall is about 1.090 with number of rain days being 88 at Gantar Sub-district (Indramayu, 2008).

Agriculture is the main source of livelihood for Indramayu people. About 54.65 percent of the population works in the agriculture sector, including marine and fresh water fishery. The sector contributes 43.05 percent of Indramayu's total GDP.

Indramayu District covers 204.011 hectares of land, comprises 110.877 hectares of rice field (54.34 %) and 93.134 hectares of dry land (45.65 %). Rice production reaches 762.951,76 tons, more than consumption level of the population. Indramayu District is one of main rice producer in Indonesia. The majority of people (61.94 percent) who work in agriculture are not the owners of the land (Indramayu, 2008). The ownership of the lands in Indramayu is presented on Table 1.

Table 1. Land ownership on Indramayu agriculture

No	Land Ownership	Total	%
1	Owner	110.626	16.52
2	Owner-Farmer	144.231	21.54
3	Farmer on rented land	115.977	17.32
4	Hired labor	298.831	44.62
	Total	669.665	100

(source:Indramayu, 2008: 6)

About 65 percent of the agricultural lands theoretically lie on irrigation system and 17 percent are fully rainfed (Indramayu Office of Agriculture, 2008). Usually, in the dry season, most of lands at the end-tail of irrigation system do not receive irrigated water as the up streams farmers use it up. Farmers at this part of land rely on rainfall for farming.

In general, famers on irrigated land plant rice twice a year. In fact, farmers on agricultural land near irrigation canals (near dams) cultivate rice three times a year. Planting schedule in irrigated land is determined by the local government after meeting with Water Users Association and after considering the water level in the dams. The planting time can be prepared long before it starts. On the contrary, farmers on rain-fed lands should depend on estimation of rain season.

1.3 Farming Calendar

Farmers on rain-fed land or end-tail irrigation system completely depend on anticipated rain seasons to make farming strategies. Farming schedule and cropping pattern is based on assumed rain season. Rice farmer prepare seedling and do land preparation several days in anticipation of the rain season. Seedling is transplanted when regular and good rain drowns land 5-10 cm in height.

Miscalculation of rainfall leads to failure in seedling or seed transplantation. Well-predicted rainfall can secure successful crops production. Heavy rain could be better for rice crop, on the other hand would be bad for some secondary crops like chili, onion, tomato, potato and other vegetable and fruit crops. Frequent losses on rice crops happen, as rainfall is ends prematurely while crop is still in need of water. The impact is worse in areas where water resources are limited, on degraded lands and forest.

From one generation to the other, farmers at several places in Indonesia applied farming schedules based on traditional climate calendar, known as *Pranata Mangsa*. It comprises a set of knowledge on rain and dry season, peak of rain season, and present of several rice predators. The knowledge was gained from observation on farmer's local environment. Hence, each place has different calendar describing farming stages. Farmers said the traditional climate calendar was not used anymore for farming activity.

1.4 Climate Change

Climate scientists reported that climate change influences the pattern of rainfall; multiyear rainfall data indicates annual rainfall tend to decrease, wet season[1] tends to be shorter and dry season. Raindrop mainly occurs in the rain season; therefore, rain season tends to be wetter, and dry season drier. The report was drawn based on reports from 63 weather stations, throughout Indonesia during the last 40 years (Aldrian, 2007). The impact would be diverging between different places, even within the same district.

[1] The onset of wet season is defined as rainfall has been reaching 50mm, and then followed with 50mm rainfall on the next two ten-days period, and vice versa for dry season.

Ratag (2007) showed that the change pattern at the start of **rain and dry season** during 1991-2003 were relative to that during 1961-1990 (WMO Standard). All climates monitoring stations throughout Indonesia reported 22% of regular start of the dry season, 33% of early one and 45% of late one. As for the rain season, 36% of the BMG stations reported regular start, 40% of early one and 24% of late one. These showed that climate change varied with areas. Box 1 and Box 2 provide definition of climate, weather, climate variability and climate change.

Government suggests that climate extreme event is frequent causes for failure of crops (Ministry of Agriculture, unknown year). It is concluded that farmers at the tail-end of the irrigation system or in rain-fed lands are particularly vulnerable to climate variability and extreme events, such as floods and drought. About 86 percent of crop losses in Indramayu from 1997 to 2003 are attributed to climate variability (Syafiuddin, 2006).

Box 1
Definition of Climate and Weather

Weather is defined as the general condition of the atmosphere at *a particular time and place*, with regard to the temperature, moisture, cloudiness, and etcetera.
Climate is defined as the prevailing or average weather conditions of a place, as determined by the temperature and meteorological changes over a period of years.

In this report, the term “seasonal climate forecast information” is used to indicate information on the forecast for weather condition in several months ahead that is provided by the authority. This term is commonly used in many publications.

(source: Your Dictionary.Com)

Box 2
Definition of Climate Variability and Climate Change

Climate Variability: the term denotes the inherent characteristic of climate which manifests itself in changes of climate with time. The degree of climate variability can be described by the differences between long-term statistics of meteorological elements calculated for different periods. The term is often used to denote deviations of climate statistics over a given period of time (such as a specific month, season or year) from the long-term climate statistics relating to the corresponding calendar period. Climate variability usually is termed anomalies.

Climate Change: denotes any change in global temperatures and precipitation over time due to natural variability or to human activity. Variations in climate on many different time scales from decades to millions of years, and the possible causes of such variations.
The measure of climate variability is the same as the measure of climate change.

(source: Answer.Com; National Snow and Ice Data Centre)

1.5 The Climate Field School

Government and scientist are searching for an effective mechanism to communicate the forecast information to farmers. The Climate Field School (CFS) is regarded an effective solution to manage the impacts of floods and droughts. The District Government of

Indramayu, together with ADPC, IRI, Bogor Agriculture University (IPB), Indonesian Agency for Meteorology and Geophysics (BMG), and the Ministry of Agriculture (MoA) has conducted a Climate Field School (APDC, 2006, Indramayu Office of Agriculture, 2003).

The objectives of the (CFS) are to increase farmers knowledge on climate and ability to anticipate its phenomena such as extreme events for their farming activities base on their past experiences and current knowledge; to assist farmers in observing climate variables and using them to support their farming activities; and to increase farmers' ability to translate climate forecast information into management decision (Ministry of Agriculture, unknown year).

After following the program, farmer is expected to apply the information in setting up crop management strategy (APDC, 2006, Indramayu Office of Agriculture, 2003). The longer term objective is to form farmers groups that have strong motivation to develop their own agribusiness activities and use climate forecast information as one of inputs for making plans, strategies and taking decision (Ministry of Agriculture, unknown year).

The concept of the CFS is adopted from Farmer Field School (FFS) on Integrated Pest Management (IPM). The principals of the programme; it has to be on field education, learning through experience, assesment of agro-ecosystem and climate, the method has to be simple and target-oriented, and the curiculum based on skill needed **(**Indramayu, 2003).

The first CFS was started in 3 villages of Indramayu District in 2003. A total of 90 farmers from Kandanghaur Sub-district, Losarang Sub-district and Juntinyuat Sub-district participated in the program (Indramayu, 2003). Farmers who participated in the program came from different villages and represented several farmer groups. The CFS was conducted in villages where drought and flood frequently have made farmers loss their rice crops (Ministry of Agriculture, 2003).

The CFS is claimed that it proved to be an effective mechanism for changing perceptions and practices for reducing climate related risks among farmers (ADPC, 2006: iii). The CFS in Indramayu District in 2003 was the first attempt in Indonesia, and probably worldwide. It has been adopted by the Ministry of Agriculture as a medium term strategy in building human resource capabilities and in anticipating the impact of climate extremes (ADPC, 2006). From 2003 to 2006, CFS has been extended to 11 other sub-districts, and now benefiting more than 1,000 farmers (Syafiudin, 2006 in APDC, 2006). In 2007, Ministry of Agriculture organized 145 units of CFS in 19 provinces and will organize 100 units more in 2008. The Secretariat of Southeast Asian Nation (ASEAN) expressed interest to replicate the program to other Southeast Asian countries. It is now is being replicated in Philippines and in Bangladesh (ADPC, 2006).

However, no study has been conducted to evaluate the impact of the CFS on farmers' strategy to respond climate variability and climate change. The claim for being successful was based on evaluation to knowledge's improvement of farmers after attending the training. The evaluation was made by interviewing farmer with a questionnaire form. Field assessment on impact of the program has never been conducted.

1.6 Problem Statement

Climate Field School is claimed to be an effective mechanism for changing perceptions and practices for reducing climate related risks among farmers. Replication of the CFS program is being conducted in several districts in Indonesia. However, no study has been done nor knowledge available on the impact of the Climate Field School in changing perceptions and practices of farmers for reducing climate related risks. The knowledge is significantly needed under the emerging concern on the impact of climate change to agriculture and broader aspects.

1.7 The objective of the study

1. To improve our knowledge on interaction of scientific climate knowledge and people knowledge on by studying the impact of climate field school and regular dissemination of climate forecast information on farmer practice.

2. To identify constraints and possible action to respond climate variability on crop farming in Indonesia.

1.8 Existing research on dissemination of climate forecast

To communicate climate forecast has been studied by several researchers. Most of them address the probabilistic trait of forecast as obstacle to communicate to end user. Long-standing question of whether and how farmers understand the probabilistic nature of climate forecasts and how they assess the credibility and accuracy of such information is remained unsolved (Roncoli, 2006). Luseno, et al (2003) argue that probabilistic climate forecasts inherently pose an obstacle to dissemination of retention among poor target populations. The obstacle can be cognitive as well as material. Some of these obstacles are inherent in the climate system's complexity. Not all relevant climate variables can be predicted and the skill, accuracy and reliability of forecasts is not well characterized or understood. The obstacle can lead to undesired responses. Users may ignore the forecasts and may not change decisions in response to forecasts (Patt & Gwata 2002).

Critic is directed to effort on disseminating seasonal forecast as if it is simply 'inputs" into the production process, rather than complex dimensions of knowledge and meaning. People talk about application of seasonal climate forecast as if it was a bag of fertilizer, with the main challenge being to deliver it at the right time and convince farmers to use it (Roncoli, 2003, Roncoli, 2008 pers.comm). In fact, climate information should be processed and integrated into a knowledge and value systems that are dynamic and diverse. In doing so, its message should be changed and adapted to fit that cognitive landscape. Technology adoption framework would not suitable to deal with this complexity. It is important to address the interface of knowledge, power, and vulnerability in communicating climate forecast (Roncoli, 2008 pers.comm, Roncoli et al 2003).

Chapter II
Theoretical Framework and Methodology

2.1. Theoretical Framework

2.1.1 Artificial Neural Network

Climate Field School (CFS) trained farmers to attain what is assumed to be the correct strategy to respond climate variability, especially to respond extreme climate situation (drought and flood). Adaptation on crop pattern that responds to climate variability is the planned outcome. The process can be modelled as Artificial Neural Network (ANN). The seasonal forecast information, which is provided to farmers twice a year, is regarded as artificial neural being introduced to a network (farmers as a group, society). The outcome can be corresponding to the planned outcome, in which it indicates a supervised learning. The study takes learning of Artificial Neural Network as theoretical framework in explaining the impact of the Climate Field School (CFS) on farmer strategy to respond climate variability.

Neural networks were concerned with designing software to emulate the way the nervous system works (human brain). Human brains contain million of nerve cell neurons that communicate with each other with electrical and chemical impulse. Each nerve cell synthesizes all of the impulses from neighbouring nerve cells and decides, based on this synthesis, whether it will send an impulse (Fassino, 1997). A brain is understood to use a massively parallel computational where each computing element (the neuron) in the system is supposed to perform a very simple computation (Roy, 2000).

The basic functions of each neutron in the whole network are to evaluate all the input vectors directed towards the neuron, to return or calculate the sum of all inputs, then compare the sum of the inputs to the threshold value at the neuron (node), and lastly determine the output through the non-linear function provided at the neuron (Chen, 2000) The output can be an input for the next node in the next layer or could simply be the final output.

When values of both input (the independent variable) and output (the dependent variable) are provided to the network, this type of neural network is known as a supervised learning network. Within the input (the independent variable) there could be a series of hidden units exist. Thus, it is where the neural network faces difficulty in computing the output. When the network is not given values of both input and output, it is known as *unsupervised learning* and reinforced learning (Fassino, 2007).

Artificial Neural Network (ANN) emerged as a way of modelling brain functions, as a way of understanding pattern recognition (learning) activity in a variety of networks (neural, electronic, social, etc) (Richards, 2007). In *supervised learning* a network of artificial neurons is constructed and the network is trained by showing it a correct outcome (Picton, 2000; Richards, 2007). It seems plausible to extend this basic model of brain

function to the “distributed cognition” and shared (cultural) learning apparent in social interaction, in example in seed systems (Richards, 2007).
The study on the impact of Climate Field School (CFS) to strategy of cropping management of farmer could provide a good case to see how the learning process occur in a network (farmers group) when a number of farmers (can be regarded as neural) were trained by showing it a correct outcome to respond climate variability. A supervised learning would show that the network’s practice correspond with the planned outcome. On the other hand, unsupervised learning would indicate that the practice does not correspond with the planned outcome.

It is started with two *propositions that:*

1. Adaptation to climate variability in a form of adjustment on crops would work similarly like model of brain system. Society is the brain system consists of several individual farmers who perform a very simple computation. Each neutron (farmer) in the whole network (society) is to evaluate all the input. It is in the head of each farmer the process take place (the first layer). In second layer, the society, each farmer exchange input with neighbouring neutron (farmers) and then synthesizes all of the impulses from neighbouring neutron (farmers), to return or calculate the sum of all inputs, then compare the sum of the inputs to the threshold value at individual farmer (neuron) and make decision based on this synthesis.
2. Selecting crop is an output made of various aspects (value). Knowledge on climate forecast is one of many aspects that influence farmer to a crop adaptation (the output). Another aspect (independent variables) is not considered or hidden hence it will produce unsupervised learning.

The CFS is expected to produce a supervised learning if the values of both input and output are known, as displayed below.

Farmers are informed that the rainfall level will be low in second season ⟹ Farmer will make adaptation on crop (change to shorter duration variety, less consume water)

↑

If only famer do not know, the information (on weather forecast) i s provided

2.1.2 Analytical Framework: Context-Mechanism-Outcome Configuration

The outcomes of the Climate Field School will be investigated using the framework of realist evaluation that is established by Pawson and Tilley (2004). Realist regard programmes as sophisticated social interactions set amidst a complex social reality. It is an analytic framework to break down systems of programmes into their key components and processes. Pawson and Tilley (2004) propose a basic concept in the explanation and understanding of programes. It stresses on four key linked concepts; ‘mechanism’, ‘context’, ‘outcome’ pattern’, and ‘context-mechanism-outcome pattern configuration’.

Mechanisms is describe as programmes and intervensions that bring about any effect. Mechanisme are often hidden. Pawson and Tilley (2004) proposes it is not programmes that work but the resources they offer to enable their subjects to make them work. This process of how subjects interpret and act upon the intervention statagem is known as the programme “mechanism’. An intervention may work in different ways or they may triger differerent mechanism work in different mechanisms (M1,....,Mn). Intervention also often involve long sequences of steps before the outcome.

Programe mechanisms will be active only under particular circumstances, that is, in different *contexts*. It is describes those features of the conditions in which programmes are introduced that are relevant to the operations the programmes mechanisms. Certain contexts will be supportive to the programme theory and some will not (Pawson and Tilley (2004: 7). *Context* both enable and constrains and the individual capacities of the learner are obviously relevant and so characteristics of learner. Certain types of subjects are in with a better chance and that certain institutional arrangements are better at dilevering the goods.

Mechanisms activated by the interventions, which intoroduced into multiple context, will vary and will do so according to saliently different conditions. Because of relevant variations in context and mechanisms tehereby acrivated, any programme is liable to have mixed *outcome-patterns*. It comprise the intended and unintended consequences of programmes, resulting from the activation of different mechanisms (Pawson and Tilley (2004).

To start the idea of how the C,M,O framework will be used in the case of Indramayu's Climate Field School, the study proposes a set of context-mechanisms-output pattern configuration as expected in the Climate Field School and any possible alternative context-mechanisms-output pattern configuration. It is described in the Table 2 below. During the field research, the contexts and mechanisms in which activate outcomes will be hunted.

Table 2: A set of context-mechanisms-output pattern configuration as expected by government and possible alternative context-mechanisms-output pattern configuration.

C	**M**	**O**
Farmers are in need and trust the information (C1)	Seasonal climate forecast is provided (M1)	The information is used for strategy of cropping management (O1)
C2	M2	O2
C3	M3	O3
C(n)	M(n)	O(n)

As demontrated in the Table 2**,** seasonal climate forecast information is used for startegy of cropping management of farmers if the information is provided to famers that are in need and trust the information. This is the expected outcome of the Climate Field School. However, there is possibility that the context on the ground would be different than it is asummed in the Climate Field School. A mechanisme that is introduced in different context on the ground would produce different outcome.

2.2 Research Methodology

The research question can be best answered by means of a technographic approach, which is to investigate society and technology interaction. The data is generated through several methods. For this research purposes, the main methods are discussion interview, informal conversation, and observation. Several source of literature, which are the module of Climate Field School, the report of the program, and some publication on the program are used as to support the method of data collection. The method will be carried by focusing the observation to on participating farmers.

The technograpic approach is not simply a program evaluation to a program that produces merely a binary respond (Yes/No) to the research question being asked. It is an attempts to find explanation for impact of the program, intended and unintended. It is an attempt to find relation of various aspects in a messy situation.

2.2.1 Research strategy

As a research strategy, case studies were chosen to allow better explorations in answering the research questions. Case study is selected because the research is focusing on gaining answers for “how” and “why” questions (Yin, 1984). It enables researcher to provide an explanation behind the applied crop management strategy of a farmer. Through case study, it is more possible to reveal interactions of various aspects that influence farmer’s crop management strategy. Case study is preferred as a research strategy when *the research topic is less known (*de Vaus, 2001*).*

The most important use of case study is to explain the causal links in real life (Yin, 1984), which can not be provided by surveys or experimental strategies in addressing research questions which were raised in this study. A generalization could be made by completing the causal links with relationships to theories (Yin, 1984) on the basis of logical inference (de Vaus, 2001).

2.2.2 Preparatory activities

Two key informants, one is the chairman of a farmer organization at district level (IPPHTI) and the other is a farmer who participated in the 2003 CFS (Climate Field School) program were interviewed at a very early stage by phone from Netherlands. This interview was intended to gain preliminary knowledge on the 2003 Climate Field School in Indramayu District. The key informants had provided introductory information on the Climate Field School program, participating villages, and number of participating farmers. This information provided directions to researcher on how to formulate sampling designs.

In order to gain a background on general rice farming practices in Indramayu, an interview was undertaken with an expert (Indonesian PhD student at WUR who worked for research institution on rice nearby Indramayu). An exploratory visit was also undertaken for 2 days to several villages in Lelea Sub-District, nearby the case study areas. Exploratory visit is needed, in the case that the researcher has no education background on rice farming and local situation.

Exploratory visit had succeeded in providing the researcher a broader vision on the case study areas and also its surrounding environment. Only through exploratory visit, that the researcher gain knowledge on the behaviour of farmer on the upper stream of irrigation system and its impact to water scarcity on the case study areas, which lies mostly on downstream irrigation system.

From this preliminary research, some key issues on rice farming and secondary crops were identified. The key questions for interviews and observations on the case study areas based of this preliminary information.

2.2.3 Methods of Data Collection

A various source of research instrument were employed on the study. Primary sources were gathered through interview with farmers, government officer and expert and through participatory observation. Secondary sources were gathered both from government documents and public documents. These are data for triangulation sources that increase internal validity and reliability of the study.

Semi-structured interviews were the main instrument to gain information from individual selected farmers, both the CFS participating and non participating farmers. Some questions were prepared during the preparatory phase and gradually improved by analyzing the feedback given by interviewed farmers. Improvements in questions design were driven the researcher's expectation for further information, as well as anticipation for conflicting feedback, and unclear respond and framing towards the proposition. Questions were also enriched from observation on agro-ecological landscape and ongoing crops farming.

A multi-visit interview is employed, which allowed the researcher to clarify, to confirm and to confront the feedback given by interviewed farmers before. Number of visits is not similar to every selected farmer. Farmers who held much information or provide unclear information or inconsistent were visited more often. Interviews were mainly took place in the evening at home during break hours for farmer who performed off farm activities. Interviews were also took place and in mid day at farm for farmers who were still cultivating secondary crops during dry season. Interview conducted two to three times everyday, and for 1 - 2.5 hours each interview.

Interviews with expert and government officer were also conducted. These interviewees were; a climate expert from university (Bogor Agriculture University) who designed the program, an officer of Indramayu District Government who coordinated activities within the program, an officer of Ministry of Agriculture in Jakarta, an extension officer, and two head of the village administration office. Except for climate expert, all government officers were interviewed during the mid-stage of the field research.

The above interviews allowed the researcher to gain both practical and theoretical background of the CFS, in which this information was further used to improve questions to farmers. As some information has been gathered from the farmers during their interviews, the opportunity to interview experts and government officers allowed the researcher to ask for further clarifications. The interviews expert were conducted at the later stage of the study on climate theory and its relation to the use of farmers' rainfall record, which was only partially explained by government officers interviewees.

The research was conducted during dry season, which is between the end of second planting schedule until mid third planting schedule. Hence, observation had mainly provided information on what had farmers cultivated during the period, what were the proportion of land that are not cultivated, what were the source of water for farming during dry season and observation on agro-ecological landscape.

By living in a farmers' house, participatory observation was employed. It allows the researcher to observe what people do while not doing any farm activity and being involved in informal conversations.

Observations on some key rice farming stages (seedling, planting and harvesting) conducted in a village in Patrol Sub-District, nearby the case study areas. These keys rice farming stages were applied in the same manner as in the case study areas. Farmers in this village were able to cultivate rice during dry season as water provided from the irrigation system, while no farmers at the case study areas have waters left to cultivate rice during dry season.

Data were gathered from various sources: village administrative level, climate expert, Meteorology and Geophysics Agency (BMG), and Ministry of Agriculture. The data provide background information of the case study areas, basic statistical information, the curriculum and processes taken place for the Climate Field School, and characteristic of weather forecast provided to farmers.

A local assistant was hired during interview as guide and translator for some farmers over 50 years of age, who can not speak Indonesian language fluently. To his experiences, the field assistant had also provided brief introduction and background of selected farmers before interviews were conducted, as well as information of agro-ecological condition while passing some lands.

2.2.4 Design of the Research

The sampling population of the study took all of the farmers who participated in the 2003 Climate Field School in Indramayu District. The Climate field School was conducted in three villages, which were Karang Mulya Village of Kandanghaur Sub-district, Santing Village of Losarang Sub-district and Junti Kedokan Village of Juntinyuat Sub-district (Indramayu, 2004).

The sampling frame of the study is a list of farmers of Karang Mulya Village and Santing Village who participated in the 2003 Climate Field School. The two villages were selected on the basis of affected villages with extreme climate events, such as drought and flood. Farmers were assumed to be highly in need of climate knowledge to manage flood and drought (Indramayu, 2003). Hence, those were the right place to test the impact of Climate Field School.

The research units are the selected farmers of Karang Mulya Village and Santing Village who participated in the 2003 Climate Field School (participating farmers for short). The unit of observation is the case study areas, which were the agro-ecological environment where farmers cultivate crops.

Purposive Sampling Design is employed for the purpose of this study. The purposive sampling allows the researcher to gather information needed most. It suits the naturalistic inquiry (Yin, 1984). Participating farmers were selected to represent different agro-ecological condition for crop farming, especially water availability, and level of commitment to record rainfall.

Extended sample unit were several farmers of Karang Mulya Village and Santing Village who become neighbors of the participating farmers. From the extended sample units the researcher gathered knowledge about farming practices of participating farmers, rainfall observation and recording applied by particular participating farmers. Researcher also gathered how the rainfall record being used and disseminate to other. The purpose is to have verification on information gathered from participating farmers, known as triangulation sources. Extended sample were used as control when the researcher investigate any significant difference on crop management strategy practices applied by participating farmers.

Samples were determined by taking into account the degree of heterogeneous of selected farmers. Samples were continued being determined until information has been saturated. Karang Mulya's farmers exposed by more heterogeneous agro-ecological condition than Santing's farmers. Hence, the number of sample units in Karang Mulya both for participating farmers and neighbor farmers was higher than in Santing.

2.2.5 Methods of data analysis

Data collected during the field research is presented in descriptive format, which entail the description, analysis and interpretation of the impact of The Climate Field School. During the data recording, field note and recording was made to record conversation from individual. The field note was made to record the outline of the result from conversation and theme that are covered.

A full record of interviews was transferred into computer on individual basis: the background of respondent, individual context and outcome. The information on individual basis is presented in Appendix 1 and Appendix 2. In following step, the data was categorized into context and outcome for collective farmers. The context was categorized social, technical, and physical constrain. The outcome was categorized by application of seasonal climate forecast and attempt of farmers in making the rainfall observation and how to use the rainfall record.

Presentation of the findings is presented in the descriptive phase and divided into three main elements: Context, Mechanism, and Outcome. Each of the elements is presented in a chapter (Chapter III, IV, and IV). Analysis is conducted by looking the relation of these three elements, and combined with the theoretical framework.

It emphasizes on interrelation of various contextual and perception on climate forecast, which at the end influence farmers' decision on crop management strategy. From these two aspects, the answer to current strategy applied by a farmer could be revealed. Hence, the explanation to the impact of climate field school on farmers' crop management strategy could be generated.

2.2.6 Location of the Study

The observation and interviews for the study were conducted in Karang Mulya Village, Kandang Sub-district and Santing Village, Losarang Sub-district. These are two of three villages where the Climate Field School initiated for the first time in Indramayu District in 2003. The third CFS was conducted in Junti Kedokan Village, Juntinyuat Sub-district. It was considered by the organizer as unsuccessful as level of farmers' participation and improved knowledge was low.

2.2.7 Time of the Study

The observation and interviews for the study were conducted in mid July until mid September 2008.

2.2.8 Compensation of the community

Visits were conducted during break time at home in the afternoon or break time in mid day at farmers' hoods at the farm. Farmers did not show expectation for remuneration after interview. Visit for interviews considered as an honorarium for farmers in having guests. Remuneration itself would potentially create unpleasant atmosphere. Bringing a light snack or share cigarette is culturally accepted. Remuneration was arranged for farmers, who provided lodge or sleeping room where the researcher stayed for several days.

Chapter III
The Context

3.1. Introduction

This chapter describes the existing context on the ground, both on Karang Mulya and Santing Village. The chapter contains section on ecology of the study area, on the problem of water availability, on current strategy of cropping management, and on existing strategy to manage the problem (flood and drought). These are the contexts on the ground where the intervention (the seasonal climate forecast information that is educated in the Climate Field School) was introduced to farmers in Karang Mulya and Santing Village.

The section on the current strategy of cropping management is considered to be the main part of this chapter. It presents the key farming practices in detail. This section is crucial as it would provide the explanation for the impact of the Climate Field School (CFS), which is presented in the following chapter. Having the key farming practices being elaborated, it shows constrain, challenge and possibility to implement crop adaptation as strategy to respond climate variability.

A section on the crop history is presented at the end part of this chapter. The section provodes information of driving force that makes farmers changed their cropping pattern in the past. The section shows the strategy on cropping pattern that was taken by farmers to respond the driving force for change. By oloking back to the history, it allow us to see the possibility in the future to implement crop adapation that responding climate variability.

3.2 Agro-ecological condition of the area of the study

Karang Mulya Village and Santing Village are located near the end of river (mouth). The both villages lie only several kilometers from coastline. The shallow ground water at this area has higher salinity level (local term: *anta*). In some part of the lands, the salinity level is not tolerable by crops. For drinking water, local people find it from deeper layer of ground water, about 80-110 meters from surface. Picture 2 presents location of Karang Mulya and Santing Village from sateliite photo.

Agriculture lands here mainly depend on rain water and river. Both villages technically are on Water Irrigation System of Jatiluhur. The irrigation water is abundant on first planting season (peak of rain season) and can reach agriculture land at Kandang Haur District and Losarang District. In second planting season (second season for short), most of the water has been used by farmers at the upstream (near the dam gate) in Purwakarta District, Subang District and several sub-districts in Indramayu.

Competition for irrigation water is high during second season. It is a common practice that farmers at upstream of the irrigation system or the river remove the water from one part of land to another. Several local entrepreneurs are emerging to operate large size of water pump-engines. They remove water from upstream and mid stream of river to several block of agricultural land. Farmers have agreed in advance to pay the provided service. This practice allows farmers at upstream side of the irrigation system or the river to cultivate rice crop two or three times a year.

Agricultural land near the coastline, such As Karang Mulya and Santing Village, barely receive the water in that season. They have to deal with water deficit for cultivating rice twice a year. Almost every farmer in Karang Mulya and Santing Village use pump engine to support crops in second season. Very small portion of irrigation water reach these area in second season.

Picture 2. Location of Karang Mulya and Santing Village from sateliite photo

Practically, both farmers of Karang Mulya and Santing Village rely on rain water to irrigate their crops. Rain-fed agricultural lands receive greater impact of climate change than irrigated lands. Change in rainfall pattern, as a result of climate change, directly bring negative impact to crop. Uncertainty on rainfall pattern leads to difficulty in making decision on cropping pattern. Unanticipated water deficit (drought) or excessive water (flood) is associated to several crop losses occurred in Indramayu District. Planting callendar that is traditionally become refrence for planting schedule and cropping pattern is not reliable anymore. Accesable seasonal climate forecast is regarded as one solution to such situation (Boer et.al, 2003; Ministry of Agriculture, unknown year).

3.2.1 Karang Mulya Village

Karang Mulya Village located at the end tail of Bojong River and at the end of Rentang sub-irrigation canal. Farmers' crop in this agricultural land frequently suffered from water deficit in second season. Meanwhile, in first season, water of the river is overflow. Though, it does not cause a serious problem to rice crop in Karang Mulya.

One month after rain is fall, abundant water flow from Bojong River and from a water spring at Sumur Watuto Karang Mulya. Sumur Watu is about 30 kilometers from Karang Mulya Village. Farmers of Sumur Watu release the water after they have used it for first planting season. It takes about one month after rain season coming before the water arrive to Karang Mulya.

In second season, in March to June, rarely water is transfered from Sumur Watu to Karang Mulya. Only sometimes, there is small amount of was transferred. Farmer experience water deficit in second season. Farmers said Head of Karang Mulya Administrative regularly persuade water users association at Sumur Watu to release remaining water for second seascon crop. Money is offered as compensation.

"Since 2000 we have a new head of village administrative. He never makes any effort to find additional water from Sumur Watu" some farmers of Karang Mulya explained. They concluded that several crop loss in rows occurred since year 2000, the same year new head of village administration was selected. The new head of village administration was known having low involvement in negotiation meeting over water irrigation with Irrigation Authority. 'Hence, after 2000 we completely receive no water from Jatiluhur Irrigation System' some farmers reported.

When the role of village administration is absent, farmers turn into "preman air"[1], a person who acts as middle person to persuade water user to release water when it was not needed. Money is offered for compensation. When the deal on the compensation is reached, the "preman air" hired several persons to ensure all water gates from Sumur Watu to Karang Mulya are opened.

Karang Mulya has community irrigation canal at village level. Some of block land is located near the entry gate of canal, and the others are located at the end of the canal. The study was conducted in Sukamelang Block (middle part of canal) and Kemped Block (at the end of the canal). Agricultural lands at the end of canal, the Kemped Block, the last receive water and experience frequent water boiled over as well. Picture 3 presents an example of ommunity owned irrigation canal at village level.

[1] The word of "preman" socially contains negative image, a person who has no permanent and formal job and part of a group of people who frequently ask for money by threatening or reach deal by intimidation. The word was originally from Dutch "*freij man*" (free man, English)

Picture 3. An example of ommunity owned irrigation canal at village level.

3.2.1.1 Flood in first season

All of farmers in Sukamelang block of Karang Mulya, except on about 5 hectares at higher ground land (*tengger* land), cultivate rice crop in first season. Farmers of Karang Mulya have no serious flood problem on first rice crop. Crop attacked by pest (mainly white butterfly, local term *sundep*) or harvest being eaten by rats is the main problem in this season. Though, it is not regarded as major cause of crop loss.

On peak of rain season, water from the Bojong River sometimes boiled over the bank. In Sukamelang block of Karang Mulya Village, the overflow water reachs agricultural land several meters from the bank. It caused no serios problem to farmers' crops. Only in Kemped block of Karang Mulya overflow water can reach about 50 cm height. Though, it does not create crop loss as only half of the trunk of rice crop was drown. Hence, farmers in this area do not cultivate non-rice crop during first season. Excessive water will damage secondary crop (short life duration of vegetable and fruit crops).

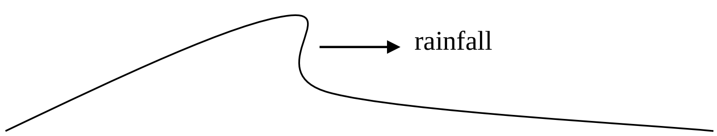
Karang Mulya agricultural lands has different agro-ecological environment. There are several plot of land are lower than its surrounding ground and others are higher than its surrounding ground. The first type of land is called as *lebak* land and second type is called *tengger* land. *Lebak* lands areexposed by overflow water during peak of rain season than it is on tengger land. Overflow water sometimes remain up to a week. Therefore, in this type of land, farmers never cultivate non-rice crop (secondary crop) for first season. After harvest time of first season, remaining water is accumulated in *lebak* land.

3.2.1.2 Drought in second season

About 50-60 percent farmers of tem cultivate rice twice a year (Karang Mulya, 2007). The rest of farmers cultivate secondary crop in second season. Most of them are on higher ground land.

Water deficit during second season is the main problem faced by any farmers. Rain is end while rice crops were not mature yet. In the same time water at canal was limited. Rice crop is in need of water during the first month and during the *panicle initiation* stages, which is 70 to 90 days after transplanting (sowing). If farmers were not able to find additonal water, development process of rice-grain will be low. It will be smaller than normal (was not growth compeletely). Farmers named it *gabah hampa (*empty husk). Under situation of water deficit, usually farmers let the crop dying (*puso*). Meanwhile farmers who are able to find alternative source of water will save the crop.

In year 2008, for example, the second rice crop faced early premature end of rain season. The rain was end in May, while the rice crop was about one month old only. Some farmers used ground water to irrigate the crops, while the others let the crop dying. Picture below shows an example of ideal rainfall or wanted rainfall condition. Rain is still falling until second rice crop is mature. Picture 4 presents an illustration of ideal rain season for rice crop twice a year.



seedling	Transplanting and growth	mature	seedling	Transplanting and growth	mature	Secondary Crops
First Rice Planting			Second Rice Planting			Third Season

: Rice-grain is being developed inside husk (panicle initiation stage)

Picture 4: An illustration of ideal rain season for rice crop twice a year

Water demand is higher than available water in second season (local term: *gadu* season). Since 2000, farmers of Karang Mulya have have lost second rice crop several times due to water deficit. Farmers were assuming that rain will go on until second rice crop mature. Some were confident that water on canal would be available.

Water deficit is seen as the problem faced by farmers today. Some farmers expressed it as "When we met extention officer during regular consultation twice a year, we repeatedly said that farmers do not need technology and skill anyomore. We already have known how to prevent pest attack. We have sufficient knowledge on that issue. What we expect most from government is on how to find additional water".

During dry season, which is *unofficial* third season, about 10 percent of the land is cultivated with secondary crops. There are about 4 to 5 different kind of vegetables are commonly cultivated by farmers. Meanwhile the rest of lands, about 90 percent, are unoccupied in this season. Having secondary crops in dry season is possible since the end of 1990s thanks to the presence of water-pump. Prior to that, only farmers near canal cultivate secondary crops when water is remaining.

3. 2. 2 Santing Village

Santing Village is located at the end tail of Cipanas River. It is about 3 - 4 kilometres from coast line. Agriculture land technically is on Jatiluhur Irrigation System. Though, irrigation water barely reachs Santing Village. Meanwhile, water of the Cipanas River is limited in second season. Farmers explained it "There are about thousands of water-pump engine at the upstream of the river that are taking most of the water from the river. Every farmer must have one pump. As a result, remaining water is mainly available only for about ten days for second crops'.

Before entering dry season, water level of the river is become lower. Salt water is flowing into upstream of the river and contaminated the remaining fresh water. Hence, the water can not be used for agriculture. Farmers in this village are expecting a flexible dam to separate fresh water from being contaminated by salt water. (It is known as rubber dam (*bendung karet*). They have asked for this dam to local government.

Supporting rice crop in second season from ground water is not possible in Santing Village. The salinity of ground water in this village is higher (local term: *anta*), hence it is not not tolerable by crops. There is no farmer here use ground water for irrigation.

3.2.2.1 Regular flood in first season

Flood is regularly occured at the end of January to February. This is the peak of rainfall in Santing Village. Farmers has experienced crop losses due to extreme flood. Farmers reported that flood occured since 1970s and become worse as a result of forest degradation.

Based on observation, farmers concluded that crop losses occur when it is in *panicle initiation* stages (local term *bunting*, or *pengisian malai, translated literally into English as: pregnant stages*). It is time when rice-grains being developed within its husk. The *panicle initiation* stages go on 70 to 90 days after transplanting (sowing). Farmers found that the crop will survive if it is tall enough and is not completely drown under water. Farmers said " As long as the husk above water level, there is a good change it will be survive. What we have to do is to fertilize it again after the flood began to ebb". Having the rice too young when flood is coming, less than one month old, the crop will dying under water.

3.2.2.2 Drough in second season

All interviewed farmers have experienced crop loss on second rice crop more about three to four times since year 2000. All of interviewed farmers in this village cultivate rice crop twice a year. Crop losses due to water deficit were far more than it is caused by flood. Farmers experienced once or two times crop losses only due to extreme flood within the last two decades (Kamsari, 2008 pers.comm.).

Farmers do not find solution to water deficit. To find additional water by involving middle man (local term: *preman air*) is useless. ”Because water at upstream the river or the irrigation network is already used by farmers there. There is no water is remain to be transferred” a farmer explained. Because ground water is not useable, farmers have no option but give up in responding water deficit.

To respond water deficit in second season, Local Government of Indramayu District launced crop diversification program several years ago. Seed were distributed to farmers for free. Some farmers tried it on a small portion of their land. However, the plants were damage due to heavy rain. Farmers blamed it to inaccurate climate forecast. Farmers do not want to try it anymore, disregard any seasonal climate forecast that predicted long drought season.

Having no continuous water resource made farmers reluctant to cultivate secondary crops. “Ground water can not be used to waters crops. If sustainable water is not available**,** secondary crop is not possible”. All interviewed farmers have no long term experience on non-rice crops. Two farmers have tried it once and several times, but iwas not continued anymore. Some farmers on about 7 hectares land cultivate secondary crops. The land was on higher ground (*tengger) (Sarma, 2008 pers.comm.).* During the interview process, I met two farmers of Santing Village were culivating secondary crops during dry season. The crops were cultivated in another village after second rice crop were failed. One of the farmer said it is the first time for him cultivating secondary crops).

One farmer give another explaination “ Rice crop in second season is not a real battle front for farmer here. Farmers have alternative income from salt mine.“ After second season, all of the lands here are unoccupied. Most of farmers went to salt mine. Working on salt mine is important economic acitvity for farmers at Santing[2]. Some of the farmers owned several plot of salt mine. For those who do not own the land, they can work as hired daily labor. At glance, economic activity in Santing is more dinamic than in Karang Mulya Village.

[2] Losarang District is the largest salt producer in Indramayu District and West Java Province. The activity has been started since 1960s.

3.3 Cropping Pattern

The section presents the key farming practices in detail. Observation and interviews on key farming practice is started with a question: 'What are the current crop strategies applied by farmers?' Investigation was designed to see various aspects that shaped a current cropping management of farmer. During the interview I look for any change that has been made on the key farming practices. The focus attention on this section is how farmers make decision on time to plant and what influence farmers to choose a particular crop.

3.3.1 Decision to Time Planting

On rain-fed lands, the planting time on first season is determined by the level water on rice field (local term: *sawah*). If the rice field have been filled by rain waterthe planting time is started. Farmers prefer to have the land surface is covered water about 6-7 centimeters hight. The rice field would be like a shallow pond. Farmers remove seedling from seedbed to this wet rice field. It is defined as *sowing* or *transplanting,* as it is shown in Picture 5.

Seedling has been prepared in the *seedbed* 20 to 30 days before the transplanting. Some farmers have different preferance on what how old (in days) the seedlings are removed to rice field[3]. Seedling was prepared during the onset (the beginning) of rain season, when rain is still weak. After having two or three time rains, the land becomes wet. It is sufficient condition to be seedbed and farmers to spread unhusked rice-grains (seed)[4] on top of the soil and cover it. This is known by local farmers as *dry-seedling* (local term: *semai kering*, or *ngipuk*). All of farmers on rain-fed lands applied dry-seedling.

The other method is *wet-seedling* (local term: *semai basah*). The seed is spread on muddy soil. To have the land become muddy, farmers have to wait until regular and heavy rain fall. Wet-seedling is applied only on irrigated land. Farmers on rain-fed lands would loose several days if they choose this method.

[3] Farmers who have attended Training On System Rice Intensification have shorter time for preparing seedling, about 15 days.
[4] The unhusked rice-grains (seed) were immersed in water for three days before it was spread on seedbed.

Picture 5. *sowing* or *transplanting*
The problem emerges if regular and heavy rain does not fall when the seedling has reached 30 days old. Too old seedling on seedbed would produce lower number of tiller. Hence, the rice production wiould be low. Ideally, seedling should be transplanted between 15 days to 30 days old. A farmer has two choices when dealing with this situation; either to restart the process of seedling or to continue with this too old seedling It is rarely happen a farmer restart seedling proces. If a farmer restarts the seedling process, harvest time will be late. So does planting time of second season. There is consequence to have risk of having rain season end before the second crop being mature.

A farmer must make estimation on when regular and heavy rain would fall before the seedling process is started. It is the most crucial element on rice farming. At this point, climate variability brings negative impact to rice farming. Farmers frequently experience 'false rain'. After a weak rain and farmers start the seddling process, rainfall is absence for long days.

Goverment repeatedly asks farmers to start planting time as soon as possible. The sooner the first season is started, the bigger chance for second season to be successful**.** That is the theory. Meanwhile, farmers have to estimate the perfect time to start the seedling process. It should not be too early or too late.

Rain season in Indramayu District regularly start in September or October. Several weak rains are falling. It is the time for farmers to start seedling process. The onset of rain season could be different in different village. Regullar and good rain fall usually in November or early December. It is the time for transplanting the seedling (*sowing).* Both *seedling* and *sowing* stages are usually mentioned together as *planting time*.

Table 3 provides common description of planting schedule at rain fed land in Indramayu. Farmers of rain-fed land follow strictly the planting schedule determined by rain season, while farmers at irrigated land are informed in advance when irrigation will be delivered.

Table 3. Common Planting Schedule at rain-fed land in Indramayu

Rain Season		Dry Season
First Cultivation Season (*rendeng* season)	Second Cultivation Season (*gadu* season)	Third Cultivation Season (*dry* season)
(November-February)	(March-June)	(July-September)
Rice Farming	Rice Farming/Secondary crops	Seondary Crops/None

(source: Indramayu 2007)

3.3.2 Selecting a Crop Pattern

Every interviewed farmer claimed that they have freedom in selecting cropping pattern. There is no influence from central figure. However, there is various condition and aspects that make farmers are not free in making the decision.The decision on planting time and on a crop pattern followis decision of majority of farmers on the neighborhood.

3.3.2.1 Syncronizing on planting time and selected crop

Every farmer wants to start planting time coincidentally with other farmers on his/her neighbourhood. It is a strategy to distribute the risk of the harvest being attacked (eaten) by rats. If a farmers have rice crop being mature earlier than other farmers, the harvest can be completely eaten by rats on that village. Meanhwile, having the rice crop being mature coincidentally will make the risk is distributed among the famrers on the village. At the end, there is still the remaining harvest for every of farmers.Rats will not able to eat all of the harvest in the same time.

Before preparing seedling, every farmer will seek information of when and what type of rice variety their neighbour farmers will cultivate. Then, the farmer will syncronize his planting time. Most of farmer will grow rice variety that has similar life duration, eventhough it is different variety. This is arranged so that farmers will have the rice crop being mature coincidentally.

There are two type of rice variety that is commonly used by farmers in Karang Mulya and Santing Village There is shorter duration variety and longer duration variety. Shorter duration rice variety such as IR Ciherang, IR Cimelati, that is mature in 105 -115 days. Meanwhile there is only one longer duration variety is available. That is IR Kebo that takes 125 days to be mature. The IR Kebo is recently used by a number of farmers on first season. For second rice crop, all farmers choose shorter time duration variety.

3.3.2.2 Agro-ecological Environment

Some farmers have limited choice because of the agro-ecological condition. Inexistence of separate drainage and land tophographic (lower or higher ground) become the contrains to implement crop adaptation at individual level. A farmer has to choose rice crop if farmers near his land cultivate rice.

Without separate drainage, a farmer in the middle of rice crop-dominant environment does not confident with secondary crops. The secondary crops can be damage if excessive water is transported through the crop. This is the case in Karang Mulya and Santing Village. Because of inexistence of separate drainage, water to irrigate rice crop is transported from one land to another land that needs the water.

The land with rice crop also needs to be dried about ten days before the rice crop mature. Farmers will drain the remaining water on the rice crop out, as it is shown on Picture 6. In a case where that land far from drainage canal, farmer will ask neihgbour farmers to open the dike of rice field. The water will be flowed into that land, and through several pieces of lands until the water reach the drainage canal. This situation put a farmer who cultivates secondary crops in risk. Secondary crops that are commonly planted by farmers, such bonteng, pare, tomato, do not tolerant excessive water.

The situation will be worse for a farmer whose land is lower than it's surrounding (*lebak* land). Water usually remains abundant after harvest time of first season. Farmer in Karang Mulya and Santing Village who work on *lebak* land promptly continue to culativate rice crop for second season. It takes time and energy to drain the water out if a farmer wants to cultivate secondary crop.

Picture 6 A farmers drain water out from a rice field
about 10 days before harvesting time

3.4 Land Preparation

Farmers have prepared their land in the onset of rain season. It is started by hunting rats together (local term *'grebek tikus' or 'grobyokan'*) on the land and rehabilitate drainage network (*parit*). Hunting rats and rehabilitating drainage canal is the main and only activity that are conducted together among farmers in Karang Mulya and Santing Village nowdays. During this period, Head of Village Administration distributes poisons for rats to every farmer.

Nowadays, land preparation is done with hand tractor and hired labour. None of farmers today prepare their land alone anymore. Preparing seedbed, spraying fertilizer and pesticide is the only farming activiy that are handled by farmer himself. Farmer who has more than one hectares land usually hired labor to handle all of the work. Harvesting also rely on hired labor, which are paid with some percentage of the harvest.

The soil is ploughed very early before the onset of rain seson. The land is stiil dry and dusty. Farmers believe that the egg and larvae of the main insect predator (locar term *sundep)* will be dead by being exposed with sun light. The eggs are usually buried at the decay roots under soil. Farmers are expecting that land preparation are done coinsidentally on vast area, so that no larvae will suvive and migrate to another place that land.preparation has not done yet.

3.5 Seedling preparation and planting

Seedling is prepared during the onset of rain season (early rain season). Rain is falling weak and irregular. Unhusked rice grain (*gabah*), is distributed on soil and then it is covered with soil. The land is slightly wet by the first two rains. Farmers purchase labeled-seed from agriculture shop or prepare it himself.

Seedling is tranplanted from the seedbed (local term: *persemaian*) to rice field after it reached 25-30 days old and the rice field have been wet enough.(*macak-macak).* There will a problem *i*f heavy rain does not arrive yet when the seedling has reached 30 days old or more. Too old seedling will produce less tiller, which lead to lower production.Some farmers prepare new seedling again, which cause delay in cropping schedulle, some continue with the risk of having low production. Any delay on first season lead to delay in second season. It increase the risk that rain season would be end when the rice crop is still in need of water.

3.6 Planting

Seedling is transplanted when the rice field has been covered with water about 5-7 cm hight.Farmers prepare the rice field before the seedling is transplanted. Most of the work is done by hired labor and hand tractor. The work consist of repairing the dike/ bunds (local term: tanggul/ *pematang*), repairing internal drainage, leveling land surface, and then transplanting.

A group of hired labor and hand tractor has made working days of planting time become shorter. A group of hired labour, consist 8-10 peoples, is hired on daily basis for transplanting. For one hektar rice field, it needs half to one day working hours. Since many farmers are requiring labor and hand tractor coincindentally, competition to this resource is high. It explains that some farmers are not able to start planting time coincidentally, despite government's campaign to start planting time as soon as possible.

In some places in Indramayu, there is a cultural ritual before the first season is started. Farmers of Karang Mulya have its won tradition. Through the ritual, farmers are asking permission to the God for starting the planting season. It is also an expression of gratefull to the Earth for the resource (food) that has been produced. Farmers provide a *sesaji* (made of several kinds of flowers and foods) to the Earth.

3.7 Harvesting Time

To harvest the mature crop takes 10 – 15 days. Nowadays, all farmers hired labor to harvest the crop. One hectare was harvested by 1-3 persons. By having hired labor, farmer can reduce harvesting time and able to prepare land for second season faster. About ten days before the rice crop mature, farmers drain remaining water on the land out. Water is transferred out in estaphet way. First, it was transferred to the nearest farmers' field, and then it was transferred again until it reach draimage canal. There is a concensus that farmers have to open their dike to allow water from one farmers' land to go out. Tabel 4 presented a general description of cropping schedulle for rice farming in Karang Mulya Village and Santing Village

Tabel 4. General Description on Cropping Schedulle for rice farming
In Karang Mulya Village and Santing Village

Planting Schedulle	Activity	Time	Duration
First	Seedling preparation	October/November	25-30 days
	Transplanting and Growth	November/December-March/April	105 days (IR Ciherang), 120 days (IR Kebo)
	Harvesting and land preparation for second rice season	April	10-20 days
Second	Seedling preparation	March/April	10-15 days*
	Transplanting and Growth	April-July	105 days (IR Ciherang)
	Harvesting	July	10 days
Third	*Unoccupied/ or secondary crop*	July-September	

:* for a farmer who prepared seedling about ten days before the harvesting time of first season, known as "nyulik" method.).

3.8 Rice crop for second season

After harvesting rice of first season, farmers directly prepare land for second season. At this point farmers have to make decision of what crop will be grown. From observation and the record of Village Administration, about half of farmers in Karang Mulya cultivate rice twice a year. The rest of farmers, cultivate some vegetables plant. Meanwhile, majority of farmers in Santing Village cultivate rice twice a year. Farmers said the decision was made by considering availability on water storage (river, irrigation canal or remaining water rice field.

However, from further interview finds that the decision is based on given condition and preference. Some farmers have no choice but cultivating rice on second season because of their land has lower ground (*lebak* land) and the majority of farmers in the neighborhood cultivate rice on second season. The rest of farmers have preference on rice crop for second season. They will cultivate non-rice crop when the water at that moment is limited and the planting time is late. Rice crop for second season on rain-fed land is increasing since mid 1990s.

3.9 Crop History

Rice crop for second season is started since mid 1980. Before that, farmer of rain-fed land cultivate rice once a year. At that moment, farmer used *Gogo Ranca*, a long duration and dry-resistant rice variety. Seedling was prepared at early rain falls. Sometimes before no rain has fallen to ground. Seedling was prepared on rice field. Seeds were distributed evenly in rice field. When rain season coming, the seed growth higher. Gogo Rancas' rice is tasteless and tough. When, shorter time duration and better taste rice variety introduce, farmers gradually shifted to the new variety.

Farmers in Santing start to cultivate rice twice a year since mid 1980s. While in Karang Mulya, only a small number cultivate rice twice a year. At that moment, farmers were intrested in cultivating water melon during second planting schedulle. Farmers of Santing started cultivate rice twice a year since 1995-1997.

3.9.1 Karang Mulya Village

Most farmers of Karang Mulya For for a decade, between periode of 1985 to 1995, cultivated water mellon during second planting schedulle. They use the remaining water after harvest time. Pump-engine were used since mid 1990s by small number of farmers. Water melon was cultivated widely in several sub-districts of Indramayu.

Village administration provided several pump-engine for free to a number of farmers. Water melon was the trademark crop for Karang Mulya Village. "In fact, about 100 hundreds farmers also emigrated to Subang, nearby district during dry season. I was one of them. We rented unoccuppied irrigated-land' Tjasli explained. He was head of Village Administrative in period 1988-1994.

Since 1995, fertilizer and pesticide price was increase. At the same time selling price of water melon declined consistantly. Number of farmer who cultivated water melon decreased. At the end of 1990s, water mellon was not cultivated anymore in Karang Mulya.

Some farmers looked into rice and the rest to other to other secondary crops for second planting schedulle. *Bonteng* (another species of cucumber) and *pare* (bitter gourd) are the common crops. These vegetable crops require lower investment than water mellon. 'We have lost our money at that moment. We were reluctant to a crop that requires high investment'. Maintenance for both *bonteng* and *pare* are less complicate than water mellon. "We feel comfort with *bonteng* and *pare*. Eventhoung the revenue is low, we feel save as the selling price is less fluctuate' they explain the reason behind the decision.

Farmers who cultivate secondary crops did not used whole part of the land. Only small portion of land , maximum 1.500 to 2.000 m2, was cultivated with secondary crops. It is about quarter of average land owned by a farmer in Karang Mulya. Rice crop was cultivated on the bigger portion of land. About half of farmers in Karang Mulya cultivated rice for second planting shedulle**.** Farmers who own *lebak* land were the first group who intiated cultivate rice crop twice a year. Water-pumped engine, which has been used for water mellon, is now used to support rice crop during deficit water.

Having water-pump engine allows farmer to cultivate secondary crops during dry land, informally called as third planting schedulle. Nowadays, about 10 percent of land is cultivated with secondary crop during dry season. All of them are vegetable crops,such as bonteng, pare, timun suri, and tomattoes. These are the common four secondary crops planted by farmers in Karang Mulya Village.

Each farmer has one particular crop as the favourite one. There are several reasons to make a crop become the favourite one. Good and stable selling price and less complicate maintenace are repeatedly mentioned by interviewed farmers. Once a farmer feels comfort to that crop, he will keep it for longer time. A farmer explained that price drop in rows will force farmers to shift to another crops. Though, one or two times selling-price drop would not make farmer change into another crop. Farmers always hope that the price will be better in the next season. Farmer will shift to another crop when it is not lucrative anymore for longer period.
Water melon and *pare* need two monts to be harvested, while bonteng needs only 40 days. One month after planted, *pare* can be harvested several times. It gives farmer regular cash-flow.The crops is dry resitant. *Bonteng* is simple in maintenance and require the smallest investment. B*onteng and pare* were commonly planted than other secondary crops. The Table 5 provides comparation of investment, maintenace and revenue of each crop that are commonly planted by farmer in Karang Mulya.

Table 5. Comparation of investment, maintenace and revenue of secondary crops and rice.

Crop	**Investment**	**Maintanance Procedure**	**Maintenance Time (days)**	**Revenue**
Rice	Medium	Less Complicate	Low	Low
Water mellon	High	Complicate	High	High
Pare	Low	Slightly Complicate	High	Low
Bonteng	Low	Slightly Complicate	High	Low
Timun Suri	Low	Slightly Complicate	High	
Tomato	medium	Slightly Complicate	High	Medium

3.9.2 Santing Village

While Karang Mulyas' farmer have tried several secondary crop crops for second planting season, farmers of Santing barely has experience on secondary crops. Secondary crops occasionally on lands higher than its surrounding (*tengger* land). There is only 7 hectares tengger land. Secondary crops widely tried in 1997 second planting schedulle. It was the local government program to respond predicted drught season. Long beans' seed were distributed fro free to farmers. The program was failed as a heavy rain damaged the crop. Secondary crops is never tried again by most of farmers. Despite several crop loss on second planting schedulle, farmers continue to cultivate rice twice a year.

Farmers said higher salinity level of ground water is the reason for not cultivating secondary crops. Secondary crops needs to be waterede constantly at least every two-three days. Since sustain water source is not available, secondary crops is not possible.

Farmers of Santing find regular source of income on salt production during dry season. Farmers find income from salt production to be the saftey net for crop losses. It provide explaination for why farmers in Santing did not enthusiastic to cultivate secondary crops.

3.10 To manage drought and flood

3.10.1 Karang Mulya to manage drought

Water deficit on second rice crop is the central problem faced by farmers of Karang Mulya. They have applied several attemp to solve the problem, which can be divided into two approaches. First, is to find additional water when farmer have rain season end before the rice crop mature. Having ground water and water transferred from other village are common solution to the problem. Second is to shorten time duration of planting process. The objective is to have second crop mature when the rain season is still go on.

3.10.1.1. Exploiting ground water

For almost one and half decade, some farmers of Karang Mulya have used ground water to watering rice crop and secondary crop when rain season end and no water on canal. Farmer makes small-diameter well and less than 15 metres depth, known locally as *sumur pantek*, and raise water with pump-engine. Some farmers find tolerable water for crop, some were not. Water pump engine also used to collect water from river and irigation canal. Ground water raised by pump-engine became the main water source for secondary crops during dry season. Picture 7 shows a water pump being used by farmer to pump ground water for irrigating secondary crop.

Picture 7 shows a water pump being used by farmer to pump ground water for irrigating secondary crop.

For rice crop, it is used mainly as additional when the rice crop was nearly mature. Most farmers said they will maintain the rice crop by using ground water if it has been 60 - 70 days old. Farmers will think twice to maintain the crop if it was younger.
It will consume a lot of fuel to run water-pump engine for a young rice crop. Every farmer will have different decision based on financial situation and level of confident.

In 2008, rain season end in May. Second rice crop was still one month old. Most of farmers in Kaang Mulya let the crops (*puso*). A small number farmers maintain it with support of ground water. In the same time, they are hoping that rain will fall again. Farmers have to water it in three shifts, where each shit is 7 days of watering.

A lot of fuel was used to raise the ground water. In the middle of the struggle to save the crop, Government applied a new higher oil price on June 1, 2008. Later, the crop produced only 1.5 to 2 tons per bahu (1 bahu= 7.500 m2), which was 40-50 percent of normal production of second rice season. These farmers have spend more money on fuel alone than the money they can earn from selling the crops.

3.10.1. 2. Water transferred from other village

First attempt made by farmers to save rice crop from dying is looking for excess water at another village. They hope the authority at that village will allow the excess water being transferred to Karang Mulya with some compensation. Sumur Watu is the main hope for Karang Mulya farmers to get additional water. It is the role of head of village administrative to find additional water.

Farmers reported that head of village administration has shown no attemp to find additional water since he was elected in year 2000. In that situation, farmers were turn into “*preman air*”. Several farmers joined in a group offered a request to *preman air* to deliver water with some money as compensation to the service. *Preman air* made the deal to any farmer within the canal line between Sumur Watu and Karang Mulya. Any farmer whi want to use the water transported to Karang Mulya should pay money to *preman air*. In Karang Mulya, Babe Lodra (46 years old), is the only person who provide the service for an area between Sumur Watu and Karang Mulya with the distance about 10 kilometers.

3.10.1.3 To Reduce Planting Time

Farmers in Karang Mulya have a specific method to reduce time for planting rice crop for second season. They prepare seedling earlier before harvesting rice crop of first season. They harvest about 10 to 15 percent of rice crop of first season earlier, about 15 days before the crop fully mature. On this percentage of land, seedling for second season is prepared. The rest of rice crop is continued until they are mature. This early harvested rice crop is not fully developed, thought the rice grains mature enough to be consumed or sale.

This unique technic is known as ’nyulik ’ (can be translated as ’kidnapping’ in English), It was applied by all of farmers in Karang Mulya whose land is limited.They have no separate land to prepare seedbed.

Having the seedling process in advance can reduce time of process for second rice crop. Farmer would need at least ten days to harvest the mature crop. Therefore, when the work to harvest the crop is finished, the seedling has already been reach 20 -25 days old.

Some farmers remember that the technic was invented since 1990s. It was the moment where rice crop for second season is started on rain-fed lands. Meanwile, a number of farmers in Santing Village have applied it recently. A number of farmers at Santing Village have heard the method before. They did not apply it until the majority of farmers committed to apply it. These farmers were afraid of having their rice crop mature earlier than others and be eaten all by rats. Since 2006, the method’ was insisted by head of Losarang Sub-District (*camat*). Many farmers apply it. Hence, they can have their second rice mature coincidentally.

3.10.2 Santing Village to manage flood

To manage the rice crop survive from flood, farmers decide to delay planting time several days before common time. It is expected that the crop is not reach panicle initiation stages when the peak of rain season is coming. The panicle initiation stages (local term: bunting, pengisian malai) is 70 to 90 days after transplanting (*sowing*).

The crop should be tall enough when the flood coming, so that it will not completely drown under water. Having the unhusk rice-grain above the water will increase the change to survive. Farmers said the crop can survive from flood for about one week as long the crop was nof fully drown. At least the crop has been one month older when the flood occured. The crops has reached 60 cm height, which is tall enought to deal commonly 40 cm height flood.

To have the rice older than one month, but before the *panicle initiation* stages is the challengge for farmers in Santing. Therefore, making right decision on planting time is the crucial part.

To delay planting time of first rice crop is the strategy of Santing's farmers to manage regular flood. Seedling preparation is started at the end of November or even early of December. Sometimes some farmers start it on January.It is almost one month late from common planting time in neighbour villages. Transplanting stages (sowing) from seedbed to rice field was done at the end of December or early January. Farmers anticipated that the flood will occur a month after the sowing time.

Having planting time delayed, planting schedulle for second rice would be delayed as well. It would increase the risk of having rain season would end before second rice crop mature. According to Rasim, one of interviewed farmer, the strategy was inspired by lesson learn from flood event in mid 1990s.

3.10.3 Santing Village to manage drought

Farmer of Santing Village have different situation when second rice planting face drough condition. There is barely effort done, unless expecting river water will come. Ground water have a higher salinity (known locally as 'anta', which can not be tolerate by rice plant.

3.11 Existing Knowledge on Climate Forecast

3.11.1 Traditional Callendar *Pranata Mangsa*

The Javanese calendar is used for cultural and metaphysical purposes. It was formulated based on the lunar month system. The calendar includes a number of intermediate cycles, the usual seven-day week, month-long cycles (*mangsa* and *wulan)*, cycles of a year, and cycles of 8 years (*windu).* It is used as a divination tool to predict character traits of persons born during that time period (Arciniega, 2005). People of Indramayu are still using the calendar to determine "good day" for various important events, such as wedding, installing houses roof, migrate and harvesting crops.

One of the elements of the Javanese calendar is *Pranata Mangsa. It is once* used as the main reference for planting time. In Pranata *Mangsa*, a 365-day cycle is divided into twelve *Mangsa*, and each of them contains description of weather-affected condition (Arciniega, 2005).

Table 6 below provide basic Pranata Mangsa cycle. The exact date for each place is vary following local climate. Farmers said Pranata Mangsa is not used widely anymore as guidance for agricultural activity. In Karang Mulya Village one senior farmer was acknowledged as expert on the knowledge. The knowledge is inherited to family member.

One element of Java calendar is eight years cycle unit (windu). It is sort of like a Javanese decade. There are four windu in the Javanese calendar (Arciniega, 2005), which are Windu Adi, Windu Kunthara, Windu Sengara and Windu Sancaya (Arciniega, 2005). Farmers of Indramayu believed that climate is repeated every 32 years, which is in 4 windus periods.

Table 6. The Javanese Seasonal Cycle Pranata Mangsa

Starts	Season	Days	Literary Description*
Jun 23	1. Mangsa Kaso	41	The dry season; leaves are falling from the trees; the ground is withered and arid, bereft of water "like a jewel that has come free of its setting."
Aug 3	2. Mangsa Karo	23	The dry season; parched earth lies in hard clumps; the mango and cotton trees begin to bloom.
Aug 26	3. Mangsa Katelu	24	The dry season; spice roots are harvested; the gadung tree begins to bear fruit.
Sep 19	4. Mangsa Kapat	25	Rain begins to fall, as "tears well up in the soul", marking the end of the dry season; birds are singing and busily constructing nests. The Labuh Season is at hand.
Oct 14	5. Mangsa Kalima	27	The rainy season, sometimes with fierce winds and flooding; mangoes are ripe; snakes are driven from their nests; "a fountain of gold falls across the earth".
Nov 11	6. Mangsa Kanem	43	The rainy season; lightning strikes and there are landslides; but it is also the season of many fruit.
Dec 23	7. Mangsa Kapitu	43	The rainy season is at its peak; birds are hard pressed to find food, and in many areas there is severe flooding.
Feb 4/5	8. Mangsa Kawolu	27	The rainy season; rice fields are growing and the cat is looking for his mate; grubs and larvae abound.
Mar 2	9. Mangsa Kasanga	25	The rainy season; rice fields are turning yellow; "happy news is spreading"; water is stored within the earth, the wind blows in one direction, and many fruits are ripe.
Mar 27	10. Mangsa Kasadasa	24	Rain yet falls, but is diminishing; the wind rustles and blows hard; the air is still chilly. The Mareng Season is at hand.
Apr 20	11. Mangsa Desta	23	The dry season has begun; farmers are harvesting the rice fields; birds tend their young with affection, as if they were "jewels of the heart".
May 13	12. Mangsa Saddha	41	The dry season; water begins to recede, "vanishing from its many places".

(source: Doyodipuro,1995 in Arciniega, 2005)

One of the CFS participants is Kadillah. He is considered by his neighbor as a resource person for Pranata Mangsa. After following Climate Field School, Kadillah agreed with scientist that climate is change. He is trying to revise the existing traditional Pranata Mangsa. He observed his local environment and made a new date for each Mangsa. He used a local species of trees, Kedondong Rajeb, as main indicator. The tress commonly found far enough from river. When leaves are falling from the trees, it indicates the beginning of Mangsa 1. Other environment condition indicates another *mangsa*s. Each mangsa has un-even duration days.

In the same time he asked his secretary of farmer association to record rainfall observation. It has been five years they made the rainfall record. The rainfall record is not used to predict rainfall pattern that is needed for input on crop management strategy. Kadillah concluded that it take 32 years to record rainfall and then have a new rainfall calendar.

The notion of 32 years of climate repetition, divided into four 8 windu, is retrieved again from collective memory after following the CFS. The trigger is the information given by trainer that weather in one particular year could be similar with a particular year in the past (Though it was not stated by the trainer and climate expert that it would happen in regular time period).

Pranata Mangsa does not recognize intensity of rainfall, hence it basically does not provide answer to the question either or not rainfall will be sufficient during second planting season (April to June).

Sarma of Losarang said Pranata Mangsa provide prediction number of day with rain. Let say, next rain season will have 60 days of rain. If during first planting schedule from October till harvest on March has 30 days with rain, there is great possibility for second planting schedule will have 30 days with rain left.

3.11.2 Scientific Climate Forecast

Before the rain season coming, Indramayu Office of Agriculture provides information of weather forecast on rain season and dry season made by Badan Meteorology dan Geofisika (BMG, Indonesian Meteorological and Geophysical Agency). Base on this weather forecast, Indramayu Office of Agriculture prepare detail strategy and recomendation on cropping pattern to farmer. A small number of farmers participate in this farmer-extention officer consultation. Theconsultation was conducted twice a year, before first planting schedulle (before rain season) and before second planting schedulle.

Farmers do not always follow the recomendation. Though, farmer mainly started land preparation and rat hunting after following the consultation. Cropping pattern mainly is based on regular habit. That is preparing seedling and planting is started after a number of rainfall down into rice field. In that sense, farmer waiting for rainfall to start planting time, instead of anticipate it in advance. Cropping pattern become a rutinity, hence climate forecast information was not used.

Chapter IV
The Mechanism: The Climate Field School

4.1 Introduction

The previous Chapter describes the existing context of farmers' practices on crop pattern management in Karang Mulya and Santing Village. The Climate Field School established in year 2003 in Karang Mulya and Santing Village. This chapter explains the program mechanism or intervention that was introduced to that existing context. This program mechanism can be break down into several elements. Encouraging farmers to use seasonal climate forecast information as input for crop management strategy to respond climate variability, is one of the elements. How the seasonal forecast can be used by farmers as the main mechanism, is discussed in this chapter.

The seasonal climate forecast has been introduced to farmers since several decades ago. Indonesian Meteorology and Geophysics Agency (BMG) produces two types of seasonal climate forecast every year. These are Seasonal Forecast on Dry Season, released in early March, and Seasonal Forecast on Rain Season, released in early September (BMG, 2008)[1]. Appendix 3 provides the example of the forecast.

Translating the seasonal forecast into *farmer's language* is the main problem in encouraging farmers to use the forecast information for setting up crop management strategy. The characteristic of scientific forecast and terminologies being used in the climate forecast is regarded as application obstacle for farming practices. Government and scientist are searching for an effective mechanism to communicate the forecast information to farmers. The Climate Field School is regarded an effective solution to the problem.

4.2 The Content of Climate Field School

The Climate Field School (CFS) was established to institutionalize a mechanism in communicating seasonal climate forecasts. It was aimed to change perceptions and practices among farmers to reducing climate related risks (Ministry of Agriculture, unknown year; ADPC, 2006)[2]. After following the Climate Field School (CFS), farmers were expected to understand and to utilize climate information in setting up crop management strategy.

---

[1] After seasonal forecast on Rain Season is released in September, a 3 monthly rainfall forecast is released and distributed to district government. Appendix 3 presents a sample of information from BMG on seasonal forecast on Rain Season for 120 different climate zones established in Java Island, and Appendix 4 presents a sample of rainfall forecast for 3 month on several climate zones. The forecast contain information of *the beginning of rain season for each climate zones in Indonesia and characteristic of rainfall (Normal, Below Normal or Above Normal)* Evaluation on rainfall forecast of the previous month is attached to the forecast for 3 month. For example, on a forecast for July, August and September that was released on end of July, evaluation on rainfall forecast for previous month (June) is attached.

[2] Prior to the process mentioned above, the CFS in Indonesia was started with the training by agricultural extension specialists who are working at the district level. In turn, these extension specialists trained agriculture extension workers who are working at sub-district level. Finally, the agriculture workers conducted dialogues with farmers to communicate climate information in the farmers' language, disseminate adaptive farming practices, and facilitate farmers' application of seasonal climate forecasts in making farming decisions (Boer, et all, 2003, Ministry of Agriculture, unknown year).

Two main obstacles were identified in communicating seasonal climate forecast information. The first is problem in translating the seasonal forecast into farmer language. Terminologies being used in climate information were not easily understood and ready-used by farmers. The mainframe behind the Climate Field School is to translate scientific language of climate forecast into *farmer's language.*

The second obstacle lies on nature of seasonal climate forecast. The seasonal climate forecast is probabilistic forecast, which means it has margins for error. Farmers were often disappointed if they have followed forecast information and later it was inaccurate. They will not use the climate forecast information anymore on the following seasons. The Climate Field School was targeted to change perceptions of farmer and attitude towards application of seasonal climate forecast.

The CFS was designed to solve the identified problems mentioned above. A module was prepared as guideline for trainer to achieve the objective. The module is divided into 12 sessions of class meeting and outdoor practices. Table 7 below shows topics for each session (meeting) of Climate Field School (CFS) in Indramayu District in year 2003.

Table 7. Schedule of 2003 Climate Field School (CFS) in Indramayu District

Meeting 1st	Study Contract: Introduction to Field Observation on Climate, Pest, Diseases, and Plant Growth
Meeting 2nd	Basics of climate and weather
Meeting 3rd	Rain formation
Meeting 4th	Terminology in seasonal climate forecasting
Meeting 5th	Understanding probabilistic forecasting
Meeting 6th	Understanding Weather/Climate Observation Tools and how to calibrate
Meeting 7th	Field Trip to Climate Station in Darmaga, Bogor Session
Meeting 8th	Application of information on weather forecast for Planting Strategy
Meeting 9th	Understanding water balance, irrigation water requirement, flood risk
Meeting 10th	Economic value of climate/weather information.
Meeting 11th	Developing cropping strategies to minimize impacts of floods and drought;
Meeting 12th	Field Day

(Boer et. al. 2003)

Of all topics given on the program, the topics can virtually be categorized into four themes. The *first theme* is sessions on basic knowledge of climate science and on commonly used terminology. It was given in the first 4 sessions out of the CFS's 12 total sessions. The *second theme* is building famers' understanding on concepts of *probabilistic* forecast. The *third theme* is to encourage farmers to apply the seasonal forecast information in setting up crop management strategy. Finally, the *fourth theme* is to train farmers on how to make rainfall observation using simple home-made instruments and how to record the rainfall data. The following section of this chapter discusses these themes in detail that were provided in the Climate Field School, except on the first theme.

4.3 Understanding Climate Terminologies

Translating seasonal forecast into *farmer's language* is regarded as the main challenge in communicating climate forecast (Boer, et al 2003, Ministry of Agriculture, unknown year, Roncoli, 2003). One session of the Climate Field School was designed specifically to introduce farmers with terminologies that are commonly used in climate forecast.

The common terminologies being used in seasonal forecast are 'Normal', 'Below Normal' and 'Above Normal'. The session on climate terminologies was focused on these three concepts. They indicate characteristics of rainfalls, which are the levels of rainfall and compared to average rainfalls of several decades (average rainfall of 30 years record is used worldwide) (BMG, 2008).

The characteristic of rainfall is defined 'Normal' if comparison between rainfall levels (in millimeter) of a particular time to average value is in between 85 % to 115 %. It is defined as 'Above Normal' if the comparison value is more than 115 % and Below Normal for comparison value below 85%. The following Table 8 shows summary of the characteristic of rainfall and the range of comparison value (BMG, 2008). Average value is different from one place to another (Boer, et al 2003). Example was provided in the module, as follow:

> If average rainfall in January (from 30 years observation) is 200 mm, and rainfall forecast in January that year is predicted to be Normal, then rainfall that month would be between 170 mm and 230 mm. If it is predicted Above Normal, then rainfall would be higher than 230 mm. If it is predicted Below Normal, then rainfall would be lower than 170 mm (Boer, et al 2003).

Table 8. Characteristic of Rainfall	
Above Normal (AN)	If comparision value >115%
Normal (N) :	If comparsion value betwen 85% -115%
Below Normal (BN)	If comparison value <85%

(source: BMG, 2008)

Farmers have no tradition in quantifying rainfall level in millimeter. Farmers are used to define the characteristic of rainfall as 'heavy downpour' (*lebat*, Indonesia), 'medium' (*sedang*), gentle (pelan, *sedikit*) and drops (*rintik-rintik*). Extension officer usually disseminate the conclusion of seasonal climate forecast in a simple conclusion, such as "rain season will be shorter and drier than usual", or "rain season will be shorter and drier than normal".

On this first and basic session, trainers explained definition of these terminologies and how these terms were used in planning of farming practice. Trainers encouraged participants to define each of these terms according their own local condition. They wanted to hear participants making comments, such as 'rainfall above normal in our place would be above Y (mm)" (Boer, et al 2003). At this point, farmers were asked to define characteristic of rain in quantitative measure. It can be an effort to encourage participants to make a random guess since farmers have no idea of quantifying rainfall level in real life.

Farmers were reminded that Normal does not necessary mean rainfall would be sufficient for their crops. After having knowledge on rainfall characteristic and on qualitative measure of rainfall, farmers were encouraged to define sufficient rainfall level (in millimeter) for each place, and each time their crops were commonly cultivate. An exercise to build understanding on rainfall characteristic was provided in this session. Box 3 provides the summarized process of the exercise.

Box 3:

Exercise on Understanding Rainfall Characteristic

An exercise on how to interpret the characteristic of rainfall for farming practice is conducted. Participants were divided into two groups. Two papers were written with histograms of 200 mm rainfall and histogram of 300 mm rainfall respectively. One group received the histogram of 200 mm and the other received the 300 mm (it suggest that different place has different value of Normal rainfall). A table with three columns then distributed to participants. The three columns represented three characteristics of rainfall, which are Normal, Above Normal, and Below Normal (Boer, et al 2003).

Trainer prepared several pieces of paper written with different rainfall level. Each group was requested to categorize each of these pieces of paper into one of the rainfall characteristic (into Normal, or Above Normal, or Below Normal column). Each pieces of paper should be put on the right column according to participant opinion.
Then, trainer asked the two groups, of histogram 200 mm rainfall and 300 mm rainfall, to discuss and to compare categorization they have made (Boer, et al 2003).
.
The exercise continued. Trainer asked participant to interpret BMG' information on seasonal climate forecast and to use the information for second planting season. Trainer prepared the BMG's seasonal forecast on several forecasting areas, and distributed histogram of 10 days rainfall forecast of participants' locality (the histograms is 10 days Normal rainfall). Farmers were requested to make their interpretation to the BMG forecast (whether it was Above Normal, or Below Normal, or Normal) and use it for second planting season.

Trainers invited discussion on strategy of cropping management to respond the information on seasonal climate forecast that has been provided. Farmers were asked to combine the information from BMG with farmers' 10 days of rainfall observation (Farmers were asked to plot 10 days of rainfall observation they have been produced on 10 days histogram provided by trainers) (Boer, et al 2003).

4.4 Session on Probabilistic forecast

Farmers were educated that seasonal climate forecast is a *probabilistic* forecast. Building farmers' understanding on the concept of 'probability' was considered to be important. It is considered to be vital in applying climate forecasts. How to present 'probabilistic' forecast to farmers still remains as unsolved question (Orclove and Tosteson 1999 in Roncoli, 2003). Farmers were often disappointed and will not use the climate forecast information when the forecast was once inaccurate. They concluded the forecast being unreliable (Boer, et al 2003).

The concept of 'probability' is introduced in the context related to *forecasting skills* of the authority that produces climate forecast. In Indonesia case, it is the Indonesia Meteorology and Geophysical (BMG). Farmers were educated that value of seasonal forecast should not be judged from experience of applying the forecast for once or twice. It should be concluded from several attempts of applying the forecast information for farming practice.

Forecasting skills is defined through the percentage of accuracy in climate forecasting. (Boer, et al 2003:37). The skill in forecasting is considered adequate if the percentage of accuracy is high and vice versa (Boer, et al 2003).The CFS used an exercise to simulate this concept of probabilistic. Box 4 provides the summarized process of the exercise in this session. To illustrate the concept of forecasting skills, which is used worldwide, an example is given in the module;

> *Supposing that skill of forecast by the authority is 80 percent, it means out of 10 forecasts we will know from experiences that number of accurate forecast is about 8 times. Or out of 5 times of forecast, about 4 times are accurate. Should the authority have good (high score) skills of forecast, level of trust from farmer to the authority will be high as well…. There is high chance that farmer will consider the information provided by the authority as input for decision on planting strategy. The opposite situation happens if the skill of forecast is poor* (Boer, et al 2003*: 21, emphasizes is made).*

Box 4:

Exercise on Probabilistic Forecast

A game was used to build understanding of participants the meaning of 'probability' in seasonal climate forecast. Several marbles, consist of green and white color, were used in this game. White color marble represented accurate forecasts and green color represent inaccurate forecasts.

Participants were divided into several groups of maximum 6 persons per group. Trainer submitted task to participants. A member of each group picked one marble from a jar, looked on the color of that marble and record it on paper sheet. Participant gave '1' value for each marble with pre-selected color, and '0' for the unselected color picked from the marble. Then, the marble was putted back to the jar, mix it with the others. A participant picked the second marble and followed the same process as before. It continued for several times. At the end, participants calculated the value collected by white and green marbles. Value accumulated from white marble was regarded as number of accurate forecast; value from green marble regarded as inaccurate forecast. If value on white marble is higher, it was concluded that the forecast being accurate is often more than being inaccurate (Boer, et al 2003).

In this game, the skill of forecast was assumed to be 80 percent. Trainer asked participants' respond if the forecast said that rainfall on second planting season would be Below Normal. Trainer invited discussion whether farmers will follow the forecast (Boer, et al 2003).

The study interviewed Dr.Rizaldi Boer of Bogor Agriculture University, climate scientist who designed the module. He expected BMG or local government allow farmers to know regional BMG's *skill of forecast* in their area. BMG has good *skill of forecast* in Indramayu District (Boer, et al 2007; Boer, 2008 pers. comm.), though it never shared their level of forecasting skills to farmers in that area. It is not a task for farmers to find out the skill of forecast by quantifying percentage of seasonal climate forecast to check its accuracy. Farmers would not want and able to quantify it (Boer, 2008 pers. comm.).

4.5 Farmers Make Rainfall Observation and Recording

The CFS trained participants to make rainfall observation with simple instrument, and record it. Firstly, participants were introduced with some instruments to measure basic climate parameters, such as temperature, humidity level, and rainfall level. Trainers encourage participants to make simple instrument to measure rainfall level from 1 liter milk can or oil can. Picture 8 shows standard instrument for rainfall measurement (A) and a simple instrument for rainfall measurement that was made by a farmer (B). Trainers provided an exercise on how to record the rainfall data produced by farmers and calibrate it with data produced by standard instrument. Box 5 provides brief information on the exercise to process and calibrate farmers' rainfall data.

By doing rainfall observation and record it, farmers would be familiar with rainfall pattern at their place. Through rainfall data, farmers would understand how many millimeter of rainfall can be regarded as sufficient for a particular crop that is commonly cultivated in a place. It would gradually shift farmers from the tradition of qualitative observation into quantitative observation. The rainfall records would help farmers to better understand the relationship between climate parameters, such as rainfall level and temperature, to growth level of a crop and also its relation to the presence of some pests. Farmers have been aware of this relation. Unfortunately, climate/weather data is not easily accessible for farmers. That farmers make observation on basic climate parameters with simple instruments was regarded to be the solution for the problem (Boer, et. al 2003).

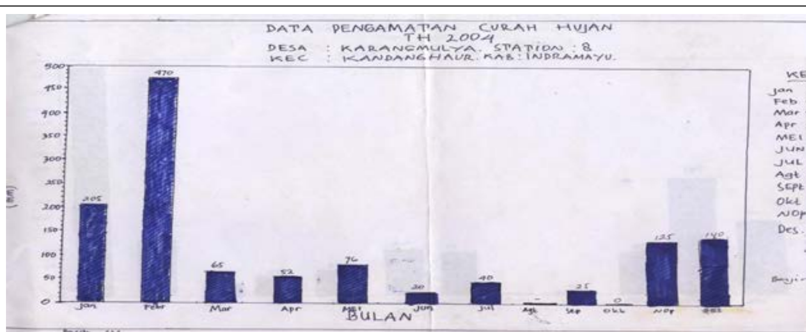
Rainfall observation is recorded since the onset of rain season until the onset of dry season. The rainfall instrument can be installed near house or on field, but it should be installed in open space and far enough from large trees.

(B)

Picture 8 shows standard instrument for rainfall measurement (A) and a simple instrument for rainfall measurement that was made by a farmer (B).

Coordinator of trainer, Srimulya, supported with a government officer at Ministry of Agriculture encourage farmer to use the rainfall record they have produce to make prediction of the trend of rainfall pattern in following days. The trainer claims the data can be used to see the trend of rainfall pattern. Therefore, it can be used as input for strategy of crop pattern on second planting season. Some of participant use rainfall data of several year observations to predict the onset of Rain season, which will be useful for planting time of first season.

The CFS' module does not provide any guideline on how to interpret the rainfall record. One of trainers, Srimulya, said that theory or guideline is not important in interpreting the rainfall record. "If farmers have rainfall data of one or two years, the data will talk for itself. Farmers will see rainfall pattern of their village. It is even better if there is rainfall data collected more than two years".



Picture 9: a sample of rainfall record from farmers' observation

Srimulya said that the rainfall data produced by farmers could be used to predict the trend of rainfall pattern in following days for their second planting season. "For example, farmer had measured rainfall for ten days in April. The data then putted into graphic, and then compared with Normal graphic line. It could either be Below Normal or Above Normal. If the rainfall level at that time is Below Normal, there will be a great possibility that rainfall in the following days would be low".

Guideline on how to interpret the rainfall records was informed after the program ended. Only some participants from Karang Mulya Village, which were heads of farmers association, were directed to interpret the rainfall record. Meanwhile, participants from Santing Village do not know how to interpret the rainfall data, as it was mentioned to participants from Karang Mulya Village.

There is different interpretation on how to use the rainfall record that is produced by farmers. In interview with the designer of CFS module, Dr. Rizaldi Boer, find that interpretation made by trainer and farmers on rainfall record is not possible in view of climate Science. A further explanation on this contradicting interpretation after the program was end, is presented on Chapter V, section 5.6.3 (Scientist Interpretation)

Box 5:

Exercise on Calibrating Farmers' Rainfall Data

Farmers were trained on how to measure rainfall that was captured on 1 liter milk can (or standard UBS water catchment tank), to record it properly and to calibrate it (if the rainfall was captured in non-standard instrument). On first step, trainers explained several terminologies that are used in a graphic, such as Y and X axis, independent variable (X), dependent variable (Y), procedure to make a plot or line between independent variable (X) and dependent variable (Y), and how to use the graphic line that has been produced to calibrate the data generated from non-standard instrument.

Then, trainers asked participants to make a plot on a graphic paper. On X axis is the data generated from non-standard instrument, and on Y axis is data generated from standard instrument. Each plot was made from X value (X1, X2, X3, and so on), and Y value (Y1, Y2, Y3, and so on), that were measured in coincident time. Then a graphic line was made from these plots. This line is defined as Calibration Line. By using this Calibration Line, farmer knows the real value of a rainfall from a data measured by non-standard instrument (made by farmer from 1 liter milk can or oil can).

(From interviews with participants, none of the participants in Karang Mulya and Santing used this procedure of calibration on their record. In Santing Village, one standard instrument for rainfall measurement (UBS) did not functioned, while in Karang Mulya it is held by one farmer. There are two possible reasons to this fact. First, participants may not fully understand and remember the procedure. Second, to calibrate farmers rainfall data with data from standard instrument would be time consuming, meanwhile doing rainfall observation and record it were regarded as time consuming by participants. In fact, after 5 years, only one participant per village who is still doing rainfall observation and records them).

4.6 Session on Crop Adjustment

After following the program, a farmer is expected to apply the information in setting up crop management strategy (APDC, 2006, Indramayu, 2003). Farmers are expected to adjust their crop and planting time according to the predicted climate situation. An example is provided on the module, as follows:

> " ... *if the government provide information that El Nino would take place during second planting schedule, risk of crop loss will be high if farmer maintain the same cropping pattern as usual. It is best if farmer do not cultivate anything or uses dry-resistant variety or cultivate secondary crop that need less water*". To anticipate flood event, an example of recommendation is given in the module: " *Should farmer have information that rainfall on first planting schedule is higher than normal, some places with frequent flood event should postpone planting activities, or farmer to start planting schedule earlier so that crop can be harvested before January. Or farmer's first planting schedule to started after January, right after the peak of rainfall pattern*" (Boer, et al 2003: 30).

On this session trainers provided general explanation on planting season, and relations between characteristics of rainfall and drought/flood events occurred in Indramayu District. An exercised was given. Participants were asked to plot 10 days rainfall data that they have into graphic paper. On the paper, trainers have already put down graphics of 10 days average rainfall (hence participants would see current 10 days rainfall being compared to Normal rainfall: either it was above normal, below normal, or in normal range). The next step, participants were asked to discuss condition of their crops until August 2003 (when the program was being conducted) and its relation with rainfall. Trainers facilitated the discussion and 'lead it to a conclusion of the importance of considering rainfall characteristic for planting time and the importance of seasonal forecast information being used for strategy of cropping management' (Boer, et al, 2003: 32).

The process of this session was continued by asking strategy of cropping management that would be applied by participants if seasonal forecast information is provided. Trainers provided seasonal climate forecasts for El Nino and La Nina year (1990/1991, 1997/1998, 1999/2000). Participants were encouraged to identify any support needed to implement their strategy (Boer, et al, 2003). .

At the following session (Session X) trainers invited participants to calculate economic benefit of using seasonal climate forecast for strategy of cropping pattern. In this session, knowledge on probabilistic forecast was restored. Trainers assumed that farmers would follow the forecast consistently with forecast information provided by the authority that has good skill of forecast. The game was designed to emphasize the benefit earned by farmers if following the forecast, compared to applying strategy without considering the forecast.

The benefit in this case is defined as the investment's lost that can be avoided by following the forecast. Trainers invited participants to calculate how much financial lost they usually have when rice crop in second season suffer from drought or rice crop in first season suffer from flood. Then, participants were asked to list alternative work (on farm or off farm) they used to do, such as on salt mine, labor, or cultivating secondary crops. They were then asked to write down incomes generated from these activities.

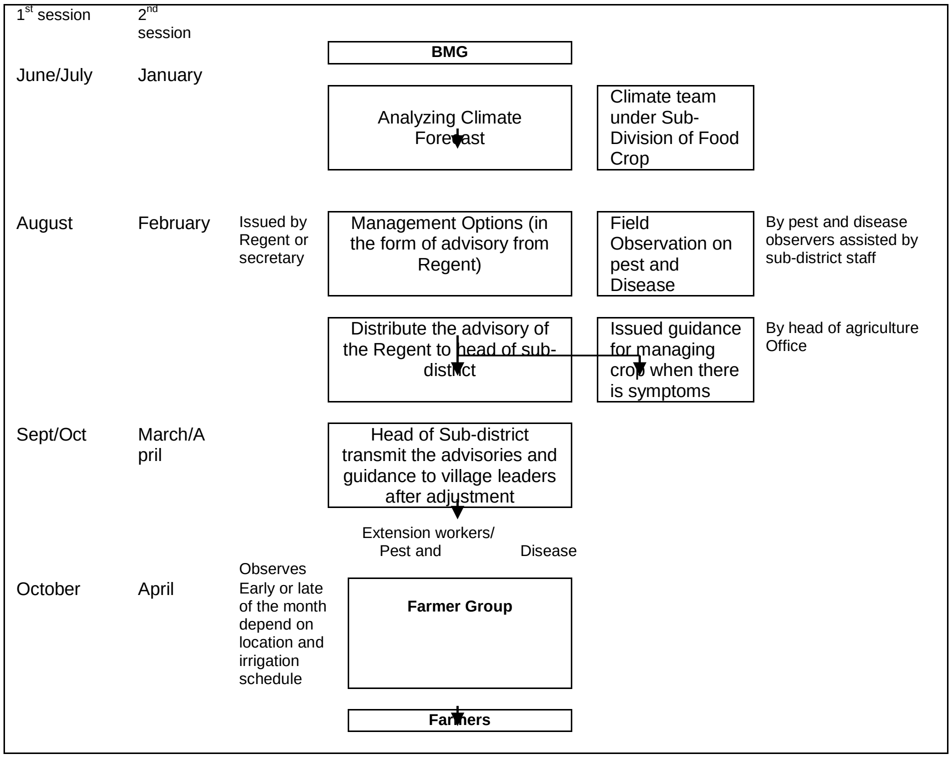
Trainers prepared a game which required participants to compare economic benefit resulted from various respond to season forecast information. The seasonal climate forecast said there will be climate variability or drought season. Participants were divided into four groups of different responds, which: (i) follow the forecast and let their land unoccupied (ii) follow the forecast and find alternative work (iii) following forecast and plant non-rice crop (iv) ignoring the forecast and continue planting rice crop. Each group was asked to calculate financial lost or benefit for both scenarios (correct and false forecast). At the end of this session, trainers showed that farmers bear huge financial lost if they continue planting rice crop and the forecast was correct. The loss is higher than the scenario that the forecast was not correct and farmers let their land unoccupied, or find alternative work, or plant non-rice crop.

4.7 The seasonal climate forecast

The seasonal climate forecast is provided to farmers twice a year, for Rain season and dry season. The information provided to farmers contains conclusion on rainfall forecast, the onset and duration of Rain season, and recommendation on planting pattern in respond to the forecast (BMG, 2008, Boer, 2003). BMG produce monthly updated weather forecast, though they are not disseminated to farmers.

Since 2003, BMG has been providing higher climate forecast resolution to Indramayu Disctrict. The resolution of the forecast has increased from two to six rainfall regions within the district (ADPC, 2006; BMG, 2003). Topographical difference (hill, flat land, coastal, etc) are local settings that increases variation on climate zones in Indonesia from space and time perspective. Higher land experienced earlier and longer rain season. The variation occurred up to sub-district or village level. Climate variations in the smaller regions add to the complexity in producing accurate climate forecast. The forecasts contain prediction on the onset of Rain season, duration of Rain season and characteristic of rainfall. The BMG produce forecasts for 220 climate zones established in Indonesia (BMG, 2008).

Several institutions were involved in the process of developing the forecast received from BMG in order to be received and understood by farmers. BMG is the institution authorized to launch localized seasonal climate forecasts. Then, the forecast information is translated into potential impacts assessment, produced by Climate Analysis and Mitigation of the Directorate of Plant Protection under the Ministry of Agriculture. Indramayu Agriculture Office and Indramayu Regency prepare response options (recommendation) and approved by the Head of the District (*Bupati).* At the end of this process, Indramayu Agriculture Extension staffs communicate the information to farmers (ADPC, 2006). Dissemination process of the seasonal forecast information is outlined on Graphic.1.



Graphic 1**.** Institution involve in disseminating the seasonal forecast information

The accuracy of the prediction depends primarily on the scale of the monitoring stations. To date, BMG can cover areas up to district level. The skill of the forecasters at BMG to predict the onset of Rain and dry seasons in Indonesia is satisfactory (Boer, et. al 2007). The accuracy of climate forecast during the years of El Nino [3] is higher than the years of neutral year).The ability to forecast during El Nino' years is low on January to April.

Table 9 provides information of the forecast accuracy on raining season during years of El Nino in Java Island[4] and eastern part of Indonesia (Boer, et al 2007). It indicates that rain the season on October until December during El Nino year can be well predicted since August (Boer, et al 2007). As the beginning of rain season predicted, farmer can prevent failures which frequently caused by *false rain (a* single rain events that aren't followed by the normal seasonal pattern). Suciantini (2006) still find that forecast for the onset of rain season is frequently being shifted, delayed away from the prediction. While for the onset of dry season, the forecast can be considered being accurate.

[3] The length of the dry season determines the severity of droughts. Extreme climate were frequently associated with ENSO phenomena. The onset dates of rain and dry seasons determine the length of the dry season. El Niño lengthens the dry season and shortens the rain season.
[4] Indramayu is sensitive to El-Nino and La-Nina influence. The onset of dry season usually started 10 days to one month earlier during El Nino year, and 10 to 40 days delay during La Nina year (Suciantini, 2006)

The graphic shows that the forecast is prepared for 3-4 months before the onset of rain season or dry season. For instance on forecast for Rain Season that will be released on October, the observation is started since June/July. Early analysis on the climate forecast is discussed with Local Government for early warning and indentifying necessary respond that should be prepared in case the forecast is correct. The forecast is updated every month until a forecast for rain season is released on September. The forecast is communicated to farmers by extension officer on October.

The challenge would be to provide better forecast on January to April, especially during non-ENSO year. On April, farmer usually makes decision on second planting schedule. Information on the accuracy of forecast (BMG's forecasting skills) on neutral climate condition (non El Nino/La Nina years) is not available on this study.

Table 9.The accuracy of forecast on rain season during EL Nino years in Java and eastern part of Indonesia

Month	**Time to Forecast**	**Accuracy level**
October	August	accurate
November	August	Accurate
December	August	Accurate
January	August	Slightly accurate
February		inaccurate
Maret		inaccurate
April		inaccurate
May	April	Slightly accurate
June	May	Accurate
Julu	May	Accurate
August	June	Accurate
September	July	Accurate

(source: Boer , 2007)

Chapter V
The Outcome: The Impact of the Climate Field School

5.1 Introduction

The Chapter III presents the existing contexts in Karang Mulya and Santing Village), that are associated with strategy of cropping management of farmers. Meanwhile the Chapter IV presents the mechanism (intervention) that is introduced to that existing context. The Climate Field School is regarded as the mechanism. This chapter presents the impact of the mechanism that is introduced to the existing context on the ground. Therefore, the three chapters relate the Context, the Mechanism and the Outcome, which are used by realist as a framework to evaluate the impact of a program.

The impact of the Climate Field School (CFS) is focused on three aspects. *First*, on the application of seasonal climate forecast information (the forecast for short) for strategy of cropping management of farmer. Investigation is focused on the application of the forecast for determining planting time and for cropping pattern, especially in second season. *Second* is on the current cropping pattern. *Third*, the application of rainfall data, generated from rainfall observation that is conducted by farmers, for cropping management strategy or others use.

The study finds that seasonal climate forecast information is not being used as input for strategy of cropping management of farmer. There is no evidence that the forecast has influenced the existing strategy. The decision of farmers on every step of farming process is based on other input, which are the availability of water at that moment and the decision of majority of farmers. These aspects have been used as input for strategy of cropping management of farmers for many years before they participated in the program in year 2003.

The cropping pattern of farmers is not change, including for second season. Despite of several crop losses due to water deficit (drought), farmers are still cultivating rice crop in second season. Cultivating the similar crop pattern is applied by participants of the program too, including in the years when the forecast predicted long drought would occur (El Nino' years). The cropping pattern is determined by the choice of majority of farmers, agro-ecological condition and the preference.

The Climate Field School encourages farmers (participants) to make rainfall observation and record the data. It is expected that farmers would understand rainfall pattern on their local place and use it as input for strategy of cropping pattern. Five years after the program, only one farmer per village are still making rainfall observation and record the data. Majority of participants have never tried. However, farmers who are still doing rainfall observation do not use the data for strategy of cropping management, including not for second season. Only one farmer, who did rainfall observation and later did not continue it anymore, has tried to use the rainfall data for preparation of first season. There is different interpretation, between scientist, trainer and farmers, on how to use the rainfall data that are produced by farmers.

The three main findings of the study are elaborated further in the following sections.

5.2 Application of seasonal climate forecast

The study finds that seasonal climate forecast information is not being used as input for strategy of cropping management of farmer. It is supported by two facts. The first, there is no evidence that the forecast has influenced the decision making process of farming process. Investigation was focusing on key farming stages, which are elaborated on Chapter III-Section 3.3.

Farmers' decision on every step of farming process, of rice crop, is based on non-climate forecast information. Farmers take into account the availability of water at that moment and the decision of majority of farmers as the main reference for timing on planting process. This strategy has been used as reference for many years even before some farmers participated in the program.

The second, there is no evidence that cropping pattern of farmers is influenced by the information on seasonal climate forecast provided by extension officer. Furthermore, there is no evidence that recommendations that was released by local government (and disseminate by extension officer), especially to respond climate extreme (drought) is followed by farmers (participants) both in Karang Mulya and Santing Village. Box 6 and Box 6 present best examples of the seasonal climate forecast were not used by farmers during abnormal climate condition. The cropping pattern in 2006/2007 and 2007/2008 presented the best indicator to asses the use of seasonal climate forecast for strategy of cropping management of farmers, including those who participated in The Climate Field School.

The availability of water and decision of majority of farmers are the only input to start planting time of rice crop. Farmers start planting time only if (rain) water has covered the rice field. All of interviewed farmers also want to have planting time concurrently. Hence, every farmer makes effort to synchronize the planting time. It is a strategy to distribute risk of harvest being eaten by rats among the farmers.

For the second crops, the available water at that moment, after harvesting time of first season, is used to be the main input for cropping pattern in second season. However, all of farmers whose lands are lower that its' surrounding will directly choose to grow rice crop for second season, disregard the forecast and recommendation that has been provided for that season. Table 10 presents comparison of the decision making process for each key farming stages. It shows that there is no significant difference before and after participated in the year 2003 Climate Field School.

Table 10 Comparison of decision making process for each key farming stages
Before and after participated in the year 2003 Climate Field School.

No	Key Farming Stages	Before	After
1.	Timing for Land Preparation	Following habit (regular calendar for land preparation) and combined with the instruction given by extension officer and head of Village Administration.	Following habit (regular calendar for land preparation) and combined with the instruction given by extension officer and head of Village Administration
2	Timing for Seedling (first season)	Wait until rain has fallen during the onset of wet season.	Wait until rain has fallen during the onset of wet season.
3	Timing for Transplanting (sowing) of first season	Land has been covered by (rain) water several centimeters high.	Land has been covered by (rain) water several centimeters high.
4	Cropping pattern (crop for first and second season)	The choice of majority, and preference, and agro-ecological condition	The choice of majority, and preference, and agro-ecological condition
6	To anticipate Drought	Karang Mulya: - searching for additional water - distribute risk with combining crops Santing: no solution	Karang Mulya: - searching for additional water - distribute risk with combining crops Santing: no solution
5	To anticipate Flood (Santing)	- Adjustment on planting time	- Adjustment on planting time - flood resistant rice Variety is used

Box 6
Cropping Pattern 2006/2007
(long drought months of El Nino' years)

Climate forecast for 2006/2007 was the perfect case to test the impact of 2003 CFS on cropping management strategy of a farmer. Since April 2006, climate expert detected the development of a weak El Niño that may delay the onset of the monsoon in the half end of 2006. El Niño condition was predicted to be likely to continue through March-May 2007.

Scientists (at that time had the capacity to) alarm the district. El Nino was attributed to several crop losses. More than 90% of drought years linked to El Niño events. The BMG issued the El Niño forecast in August 2006, and released its monthly issue in October 2006.

Government Responded
The Indramayu Office of Agriculture prepared action plans in order to manage the potential impacts of El Niño, such as delays in second cropping. The action plan served as the basis in formulating management options by the district government. The district

government has contacted agriculture inputs distributors to provide enough fertilizers and seed stocks.

Farmers were encouraged to prepare land and planting time so that rice planting can be started as soon as the rains come. As of November, monsoon onset was already delayed and the first rice crop had not yet been planted. It could lead to higher risk of flooding during the harvest and also delay in second planting season.

In anticipation of the second planting season delay, the district government undertook some actions to assist farmers in implementing management options in dry season 2007 (e.g. planting non rice crops). Funding was provided for 950 ha (700 ha for soybean and 250 ha for maize).

BMG monitored the situation and provided the 2007 dry season forecast in April 2007. Government expected that farmers use these forecasts to decide whether to plant rice as a second crop or to switch to alternative crops, such as maize and soybeans (Boer, 2006 in APDC, 2006).

Famers responded

In planting time 2006/2007, farmers applied the same cropping pattern as they had before. None of the CFS participants, both in Karang Mulya Village and Santing Village , changed their crop pattern that year. Farmers who used to cultivated rice in second planting season did not change their rice crops to non-rice crops.

Box 7

Cropping Pattern year 2008
Increasing percentage of rice crop for second season

In 2008, harvest time for first rice crop occured earlier than normal. It was done in March, which is one month earlier that normal. At that moment, rainfall was high and water from the canal was abundant. Farmers were confident that water would be abundant for the second rice crop. The percentage of farmers who cultivated rice on second season at that year was higher than before.

Sirwan, who used to apply combination of rice and vegetable crops, cultivated all of 4 crop spaces of his land (equal to 3 hectares) with rice crop that year. Didi, who has never cultivated rice twice a year since 2000, also shifted to rice crop. He disregarded the climate forecast information he had received from Indramayu Office of Agriculture. It told farmers that rainfall will be low during second planting season (Didi, 2008 pers.comm). In May, after one month rice was planted, the rain season ended. Most of the rice crops suffered from drought.

5.3 Change in cropping pattern

The study finds that farmers were still applying the same strategy of cropping management and crop pattern they have applied before participated in the Climate Field School (CFS). Farmers who cultivated rice twice a year did not change the cropping pattern even they experienced several crop losses due to water deficit.

Cultivating secondary crops was selected by farmers having higher than its surroundings (*tengger* land) and ground water with higher salinity. Farmers on this type of land pose higher risk for water deficit than farmers on lower ground (*lebak* land) or flat land.

There are a number of farmers in Karang Mulya Village who cultivate rice and secondary crops at the same time in second season as strategy to distribute risk of crop failure. They have applied the mixed crops several years before participated in the CFS. Vegetable crops are planted on smaller portion of land, never exceed quarter of hectare. Mixed crops in second season allow farmer to have regular income from secondary crops while waiting rice crop to be harvested. A complete description on the background of respondent, context and respond to climate variability of each individual farmer in Karang Mulya Village is presented in Appendix 1.

Meanwhile, all of farmers in Santing Village demonstrate no change on cropping pattern. Cultivating rice crop twice a year is homogeneous practice of all farmers. Farmers argue that lack of regular water prevent farmer in trying non-rice crop. Ground water has higher salinity that can not be tolerated by secondary crops. On the other hand, rice crop do not require regular irrigation. It needs only a bulk of water for transplanting and panicle initiation stage (rice-grains development one month before mature. Most of farmers here have no experience on secondary crops. Because of no alternative to rain water, no farming activities were taking place during dry season (third planting season).

Famers claim regular flood has created no room to maneuver. They find it is no use of using seasonal climate forecast for strategy of cropping management. Farmers urge for rehabilitation on river and irrigation water to solve their problem. To respond frequent flood, farmers make adjustment on planting time based on their own estimation. Recently, all of participants use IR Kebo rice variety, which they believe to be stronger and flood resistant, since 3-4 years ago. This variety was chosen coincidently with the increase of the harvest’s selling price. A complete description on the background of respondent, context and respond to climate variability of each individual farmer in Santing Village is presented in Appendix 2.

5.4 Improvement on Pest Management

Farmers did not make any use of climate forecast information provided by BMKG as input to their crop management strategy. Planting period and other stages of rice farming were based on habits. Available water was used as the only input for planting time and crop pattern.

However, the CFS seems has unintended outcome. A number of participants claim it has impact on their practice on pest management strategy. The farmers claimed that they understood better on the relations between climate and pests presence. Pesticide was used only in perfect times. They received knowledge on pest management from Farmer Field School (FFS) on Integrated Pest Management several years before participated in the CFS. The knowledge gained from the CFS has strengthened knowledge on pest management.

5.5 Constrain to Crop Adaptation

The study finds there are social, technical and ecological constrains to apply crop adaptation that responding climate variability. They are presented in the following sections.

5.5.1 Crop Preference

Except two farmers, all of farmers have rice crop to be their preference. They see many advantage of rice crop. The main reason that is repeatedly mentioned is less time required on rice crop. It does not require farmers to be on farm everyday for maintenance and care. It is also considered being less complicated compared to secondary crops. Rice crop can be unattended for several days, even up to three week, after transplanting. Table 11 describes the advantage of rice crop compare to other crops according to farmers.

All of farmers in Karang Mulya have experienced on secondary crop. They have cultivated water melon for several years before mid 1990s. Secondary crop provides slightly higher revenue than rice crop. However, they would prefer to have rice crop when water is abundant.

Secondary crops that are cultivated by farmers now require farmer to be on farm everyday for irrigating, fertilizing and spraying pesticide. Crops like *pare* and *bonteng*, for instance, should be harvested every four days after one month they are planted. During the dry season, to irrigate the crop is harder. Since evaporation rate is higher, farmer irrigates the crop everyday by using ground water and the remaining water in canal.

Table 11 Comparison of Characteristic of Cultivate Rice and Secondary crop according to interviewed farmers from Various Aspects

No	Aspect	Rice	Secondary crop
1	Economi	1. low investment 2. Fair price, less fluctuate 3. Low profit 4. Demand is less fluctuate 5. Harvest can be saved	1. higher investment 2. Prone to fluctuate selling price 3. Higher profit 4. Prone to fluctuate demand 5. Harvest cant be saved.
2	Social	Do not require farmer on fam everyday.	Require farmer to be on farm everyday
3	Cultural	- Crop selected by seeing the majority of farmer	- Crop selected by seeing the majority of farmer

		- Great satisfaction if succeed with rice on second planting season after several time failed.	- Feeling regret find neighbour farmers succeed with rice on second planting season
4	Agro-ecological environment	Require plenty of once during *transplanting* and once during panicle *initiation* stages.	- Requires small amount of water regularly - it should be free from abundant water

(Source: interviewed farmers)

No farmers want to use all of their land to cultivated secondary crop. "*It takes a lot of energy and money to use all of the land for secondary crop. It is impossible*" One farmer explained. Therefore, even though a farmer wants to cultivate secondary crop in second season, he still use the rest of land (the larger portion of the land) for rice crop. For farmer who will cultivate secondary crop in third season (dry season), they are reluctant to be too tired twice a year of cultivating secondary crop. Therefore, rice crop is preferred for second season and secondary crop only on smaller portion of land.

5.5.2 The preference of influential farmers

Farmers with significant social role want to allocate time for social activity or off farm business. Secondary crop would not allow farmer to play his social role and off farm activity. Influential farmers, except one farmer whose land is not suitable for rice crop in second season[1], do not cultivate secondary crop at all. All of them do not work on their land at all during dry land. Table 12 shows cropping pattern of influential farmers and common farmers.

Influential farmer is defined according to social role, education, and wealthy. The latest criteria were subjectively judged from good house and wide land. Influential farmer have better education than less influential farmer. They have significant role on social and activity with an organization. Sometimes farmer could earn access to agriculture input and financial compensation from the organization activity. This farmer frequently meet people, hence have greater to chance to influence others to have similar crop pattern. There is farmer who follows suggestion of influential farmer to grow rice crop in second season, despite his interest on secondary crop.

Full time and common farmers spend less time on social activity. They have sufficient time and energy for working on farm everyday. They also have their wife working on farm. These farmers have lower formal education compare to influential farmers. They also have background working as labor in town several years before turn into a full time farmer.

5.5.3 Agro-ecological condition

There are farmers who have little choice but following the choice of majority of farmers in the village. It is the case of farmers who have no separate drainage system. Should most of neighbor farmers choose to cultivate rice, these farmers will follow it. Without separate drainage, secondary crop would pose a risk being surrounded by rice crops. Water flow

[1] Tjasmadi is a farmer who has significant position on a farmer organization and is the youngest farmer with position on farmer organization. On informal and social live, he is similar with common farmer. During dry season, he is doing farm activities, such working as labor for house construction. His land is not suitable for rice crop in second season due to lack of water and higher salinity of ground water.

from one rice field to another rice field, through that secondary crop, would damage the secondary crop. Under such situation, a farmer does not want to take rick and follow the majority of farmers for cultivating rice crop.

Table 12. Cropping Pattern of Influential Farmers and Common Farmers				
No.	Name	2nd planting season	3rd planting season	Social role on community
	CFS Participants			
1	Sarma	Rice	none	Retired army soldier, former head of farmer association at sub-village unit, former treasury of KTNA farmer organization at district level, member

Farmers whose land has lower ground than it surrounding usually choose to cultivate rice in second season. Water usually is abundant on this type of land in the beginning of second season. Water is coming from nearest lands that drain the water out about ten days before rice crop of first season was harvested.

				and trainer at IPPHTI farmer organization.
2	2.Soepandi	Rice	none	head of farmer association at sub-village unit, cleric
3	3.Didi	Secondary crops	none	head of farmer association at sub-village unit, secretary of KTNA farmer organization
4	4.Kasbah	Rice & secondary crops	Secondary crops	Common farmer
5	5.Sirwan	Rice & secondary crops	Secondary crops	Common farmer
6	6. Kuner	Rice & secondary crops	Secondary crops	Common farmer
7	7. Kadillah	Rice	none	Retired civil servant of office for irrigation, head farmer association at sub-village unit
8	8. Wajuk	Rice & secondary crops	Secondary crops	Common farmer
9	9. Tudi	Rice & secondary crops	Secondary crops	Common farmer
	Non CFS participants			
10	Warji	Rice & secondary crops	Secondary crops	Common farmer
11	Ratim (asisten Soepandi)	Rice & secondary crops	Secondary crops	Common farmer
12	Darji	Rice & secondary crops	Secondary crops	Common farmer
13	Rusmana	Rice & secondary crops	Secondary crops	Common farmer
14	Dasim	Rice	fishing, hired labor	Common farmer

5.5.4. Synchronizing

Every farmer seems want to start planting time concurrently with majority of neighbor farmers. It is a strategy to distribute risk of harvest being attacked (eaten) by rats. At this point to have planting time earlier than other, for instance because of following the seasonal climate forecast information provided by extension officer in the onset of first season, mean the rice crop would be mature earlier than other. A farmer could loose the crop alone being eaten by rats

It shows that application the forecast is not feasible to be conducted at individual level. Being a part of collective decision is considered by farmer as vital strategy to save rice crop.

5.5.5 Perception on The Reliability of a Forecast

Farmers have little confident in using seasonal climate forecast information for strategy of cropping management. Farmer said the forecast “sometimes were accurate, and sometimes were not accurate”. It indicate that farmers perceive that the forecast have equal chance to be accurate and inaccurate.

Farmers' judgment on the accuracy of the forecast is based on bad experience of following a recommendation that was given by extension officer. Farmers once followed recommendation to cultivate secondary crop, to respond predicted long drought in second season, their crops were damage due to heavy rain. This bad experience is used to judge the ability of the authority (BMG) to provide accurate forecast.

This behavior doesn't correspond to the expected behavior of farmers in making judgment on the accuracy of climate forecast. The Climate Field School educated farmers to appreciate the forecast based on skill of forecast. The finding shows that concept of *probabilistic* forecast in the context of *skill of forecast* is not considered by farmers, including those who participated in the CFS, in their interaction with the seasonal climate forecast.

5.6 Rainfall Observation

The Climate Field School encourage farmer to do rainfall observation and record it. Observation on rainfall pattern is conducted by using simple instrument. A 1 liter can (milk can) on top of a stick (bamboo) is used to capture rain. The captured-rain is measured with scale and recorded on paper every day, during rainy season.

It is expected that farmer will be familiar with rainfall pattern on his local environment after conducting rainfall observation for several years. The organizer of the program and staff at Indramayu Office of Agriculture, Srimulya said "*If a farmer rainfall observation for several years, the record itself will talk about rainfall pattern on his local environment. Hence, farmers should not rely on seasonal climate forecast from government anymore*". Trainers of the CFS encourage farmers to use the rainfall data to make prediction on rainfall pattern for several days ahead.

Out of 30 farmers per village participated in the Climate Field School, only one farmer per village are still doing rainfall observation and record it. They are Kuner, Kadillah and Rasim who lived in three different villages. However none of them use the data for strategy of cropping management, including for second season that frequently make farmers loose their crop. About five farmers in Karang Mulya Village and the same number in Santing Village have tried it for less than 4 seasons. The majority of participants had never tried it. Table 13 presents participants of the CFS and rainfall their attempt to do rainfall observation.

Only two farmers from Karang Mulya, Didi and Sarma, have ever tried to use the rainfall record and combined with humidity measurement for input to decision on planting time. They attempted to predict the beginning of rain season and the right time to start first planting season. Since planting season 2006/2007 did not continue it anymore. Meanwhile Rasim, Sirwan and Kadillah did not yet use their rainfall record for input to their strategy on planting management.

Table 13 Participant and Rainfall Observation
in Karang Mulya and Santing Village

No.	Name	Measurement practice	Given reason
	Karang Mulya Village		

1	Sarma of Karang Mulya	For 2 season (until 2005/2006	He did not confident with the result of his measurement. The CSFs' trainer did not monitor and make evaluation on the rainfall record with farmers.
2	Soepandi	For 1 season (until 2005/2006	He has no determination. The result of measurement was not able to be used for current planting strategy. So, he used current habit as reference (waiting for rain).
3	Kasbah	Never	He use rain water come into rice field as guideline.
4	Sirwan	Never	He use rain water come into rice field as guideline.
5	Didi	For 3 season (until 2006/2007	Log book to record the measurement is fully written. A new one is not provided by the CSF organizer/Local Government
6	Kuner	still active	He feel have obligatory to measure rain fall since the equipment stored in his place. He considers it as activity during break time, and later he enjoyed it.
Santing Village Village			
1	Sarma of Losarang	For 2-3 season (unknown)	He has lost the record on 2006 and later stop doing it. He claims rainfall observation was not solution for farmers' problem with flood. He argue regular flood provide no room for crop adaptation. He concluded that restoration on Cipanas River and Kali Tuan were the best solution to the problem.
2	Taryono	Never	*He doesn't know the procedure*
3	Abdullah	Never	*He is busy with work*.
4	Kamsari	For one season only	*He is busy with work*
5	Tarman	For one season only	The equipment is broken. He do know how to use the data. It was submitted to extension officer.
6	Kuner	Continued	He feel have obligatory to measure rain fall to represent farmer in the village. He also wants to produce a data that will be useful for next generation.

5.6.1 Farmers Interpretation

No one of the farmers has used the rainfall record they produced to make interpretation on rainfall pattern for second planting season. Having good rainfall forecast for second planting schedule was actually the purpose of the program. Farmers who are still making rainfall observation concluded that the record is not yet able to be used for rainfall prediction several days in advance. They said it would need several years more to understand the rainfall pattern in that village. At least they must have 8 years, a cycle period in Java traditional calendar, before the record will be able to predict rainfall pattern.

Farmers hold traditional calendar Pranata Mangsa principal that said *climate is repeated every 32 years.* All farmers who have tried rainfall observation hold the similar believes. After having the complete 8 years (or 32 years) record, farmer will use it to predict the rainfall pattern. The farmers explain"We are going to find rainfall this year, for example, would be match with rainfall in which year in the past". Farmers believe that climate is repeated in every 32 years, but farmers in Santing Village were expecting 8 years records would tell something. Farmer of Santing does not make any interpretation at all to the rainfall record.

Two of the farmers, Kadillah and Kuner tried to interpret the record for the purpose of forecast. They both want to know if the rainfall record can be used to predict rainfall pattern several days ahead. After observing rainfall since 2003, both Kadillah and Kuner are building a hypothesis on how to use the data for predicting rainfall pattern. The hypothesis is: if rainfall on March-April was extremely high, there is a good possibility that the rainfall in following months will be smaller than normal. They want to test the hypothesis in coming seasons.

One farmer in Karang Mulya, 'Didi" Tjasmadi, used the record of last year to predict the beginning of rainy season in the next year. He said "If the dry season this year was longer, then in following years the beginning of rain season will be delay". He used the information for planting time of first planting time. Another farmer in karang Mulya, Sarma used the rainfall observation to predict the beginning of rain season. Both of them were regarded by other participants as the reference for application of the CFS' knowledge for farming practice. They both do not continue rainfall observation anymore.

Didi and Sarma argued they did continue it anymore because the organizer or local government has never evaluated and discuss the measurement with farmers after the CFS education. Meanwhile, other farmers argue they were busy with works. It seems farmers consider rainfall observation was not significant activity for farming activity. They said one farmer per village is more than enough to represent the village.

5.6.2 Extension Officer Interpretation

How to interpret the rainfall record was not mention on module and during the meeting of the CFS. The coordinator of trainer, Srimulya, said farmers were not provided with any theory on how to interpret the rainfall record. He said "a*s long as farmers continue to record his local rain pattern, the data itself will talk .It will be better if measurement were done for several years. If a farmer did it, seasonal climate forecast from government is not needed anymore. Rainfall record that is produced by farmer is better because it is about localized rainfall pattern".*

Srimulya said the rainfall record can be used to predict the trend of rain pattern in following days. "For example, farmer has measured rainfall for ten days in April. The data is put on a graphic, and then compare it with Normal graphic. Hence, the rainfall trend in following days can be predicted, either it would be below Normal rainfall or above Normal rainfall"**.** A government officer at Ministry of Agriculture in Jakarta who oversee the program gave similar explanation. The data should be used for second season, which is the crucial season where farmers frequently experience crop losses. He did not satisfy with the implementation of rainfall observation for farming practice. He want farmers make prediction on rainfall pattern, at least for ten days in advance.

Srimulya stated that the Climate Field School was actually designed to make farmer independent from using seasonal climate forecast that is provided by BMG (Indonesian Meteorological and Geophysical Agency). He argued that current seasonal climate forecast have low resolution. It is too broad compare to variation exist until village level in Indramayu District. Therefore, Indramayu Office of Agriculture does not provide detail forecast to farmers. Srimulya argued that the information would make farmer confuse. '*The climate forecast is too broad and would not be accurate for local condition. Therefore we did not disseminate it to farmers. What farmer need is a localized forecast at sub-district or village level").*

5.6.3 Scientist Interpretation

There is different interpretation on how to use the rainfall record that is produced by farmers. The designer of CFS module, Dr. Rizaldi Boer, did not agree with interpretation made by trainer and farmers on rainfall record. Dr.Rizaldi Boer provided training on basic climate science for trainers of the Climate Field School, before the program for farmer was started.

Boer said farmers would not be able to make a prediction on rainfall pattern, several days in advance or longer, from a rainfall record. He added that local weather is influenced by broader climate aspect, such as sea surface temperature, regional and global air pressure. Farmer has no knowledge on these aspects. Therefore a prediction is not possible.

Boer said the CFS was designed to educate farmer to understand basic climate science and forecast. When farmers make rainfall observation and record it, they will understand better the knowledge. The rainfall observation was designed to provide direct experience to farmers on understanding rainfall pattern. Farmers would have better understanding on seasonal climate forecast provided by extension officer after they have experiencing rainfall observation. Boer expected that farmers would appreciate the climate forecast information and should prepare land preparation and planting time promptly when the information told them to do so.

Boer responded to farmer‘s believe that climate is repeated every 32 years, following the traditional calendar *Pranata Mangsa*. Farmers said they heard from trainer during the CFS training that rainfall pattern is repeated. One extension officer has the same opinion on how to interpret the rainfall record.

Boer told me that there is possibility that rainfall pattern in one year is slightly similar with a particular year. It means, the rainfall curve is almost identical; similar rainfall peak and the beginning and the end of rain season. Though, it can not be predicted and it is occur in unknown interval year.

5.7 Predicting Rainy Day

From CFS knowledge two farmers make prediction the possibility of a rain will fall within 24 hours. When sky is covered by dark cloud, two farmers measure temperature and humidity of the air with the Psikrometer Assman**.** This instrument was provided for each village during the CFS training. How to use the instrument was trained in the CFS. Only two farmers hold the instrument and develop the skill to make prediction on rainy day.

After exercising for 4 years, these two farmers claim have the skill. To some of their close friends, they both explained how to measure it. Most of farmers want to know only the conclusion and have no interest in learning further. It is only for curiosity and gambling that farmers want to ask. For a certain occasion, these two farmers told their close friends to postpone work if they assumed rain will fall soon. The skill is used to anticipate rainy day before a plan to fertilize crop, or to harvest crop is executed.

Chapter VI
Discussions, Conclusions and Recommendations

6.1 Discussion

This chapter discusses and synthesizes the findings that are presented in the Chapter III (The Context), Chapter IV (the Mechanism: Climate Field School) and Chapter V (the Outcomes). The outcome of the program (the Climate Field School) is analyzed with theoretical framework of Artificial Neural Network (ANN). It provides explanation to the supervised or unsupervised learning emerges from this program. The relation between the context at the ground, the mechanism, and the outcome is elaborated and synthesize here with Pawson and Tilley (2004)' analytical framework of 'Context, Mechanism, and Outcome (CMO) relation'. The framework can provide explanation to the outcome.

The impact of the program does not correspond with the planned outcome of the Climate Field School (CFS). Five years after farmers attended the CFS the study finds that the strategy of cropping management of farmer is not change. The seasonal climate forecast information is not being used as input to strategy of cropping management of farmer.

The study finds that the existing context at the ground is not supportive to the mechanism (or intervention) to produce the planned outcome. There are three significant contexts that prevent the planned outcome to be emerging. *First,* there are social and technical constrain to apply crop adaptation that responding climate variability. Second, it takes time to change a crop pattern into a new pattern, and *third* is perception of farmers on the reliability of climate forecast information. The perception was shaped by their expectation. When the expectation is not fulfilled, farmers have little trust on the seasonal climate forecast. Hence, they are reluctant to rely on the forecast for input to strategy of cropping management. The following sections below will elaborate further these contexts.

Final section of this chapter, in slightly different flow of discussion, elaborate the approach being used in the Climate Field School. The approach is compared with the origin philosophy of Farmer Field School.

6.1.1 Existing contexts are not supportive to the mechanism

The planned outcome of the program built on linear thinking. It implicitly assumed that farmers would apply crop adaptation if only they have received and understood the information on seasonal climate forecast. To make farmer understood the characteristic of scientific climate forecast is regarded as the main challenge. The main obstacle to achieve the objective is translating the scientific forecast information into farmers' language. To build farmers' understanding on climate knowledge is treated as the heart of the Climate Field School. The program is assuming that farmers *want to* and *able to* apply crop flexibility (that is the expecting context) to use the forecast information if they find it useful. Under such context, the planned outcome was shown (trained) to some farmers as participants.

Pawson and Tilley (2004) state that the programe (mechanisms) will be active only under particular circumstances. This context, mechanism and outcome (CMO) provide explanation to why the current strategy of cropping management of farmer does not correspond to the planned outcome. The mechanism, which is the seasonal forecast information that is provided to farmers twice a year, does not able to make farmers change their current strategy of cropping management.

The existing contexts are not supportive to the mechanism. Therefore it produced unintended outcome (unsupervised learning). Further elaboration on existing context at ground would provide answer to the second research question "Why did farmer choose the current applied crop management strategy?"

6.1.1.1 Social and technical constraints

The existing context at the ground were not recognized or considered by the program. It is common phenomena that a program has no full knowledge yet on existing context at the ground. There are technical, biological and physical constrains to apply crop adaptation in responding climate variability (to have *crop flexibility* for short).

Some farmers are *not able* to change their cropping *pattern* or *they* consider it would not be feasible to be implemented at individual level. The study finds it in the case phenomena of s*ynchronizing* and *collective choice* that appear in rice crop-dominant environment. There are also some farmers who *do not want* to change their cropping pattern. These are farmers who have preference on rice crop. These are contextual at constrains to have *crop flexibility*.

6.1.1.2 Changing a crop pattern takes time

There are various facts associated to a crop. These interconnected aspects shape the current crop pattern. As a result, to change a crop pattern to a new pattern would take time. Before a particular crop is chosen, farmers must know a full knowledge associated with the crop. To change a crop pattern mean to change the whole system that construct a crop pattern.

The study shows that a selected crop has been through a range of consideration. It covers social, economic, technical, and cultural aspects associated with the crop. The find, for instance, farmer is looking for a crop that allows him/her to enjoy spare time for social activities. Farmer considers a range of economic aspect, such as good and less fluctuated sale price, on a selected crop. Farmers firstly find out how their agro-ecological environment will interact with the selected crop and vice versa. Broader context, such as oil price, is also taken into account.

In the following step, every farmer tries to find out what is the collective choice of farmers in that village. Farmer wants to have similar crop and have panting time coincidentally with their neighbors. It is a respond to social-biological constraint that is attached in rice crop.

The desire to have similar crop is also applied for secondary crops. The case shows that farmers in the study cultivate only a limited kind of secondary crops for the last two decade. Interviewed farmers said having a crop that is commonly choose in a village would provide incentive in marketing the harvest. A farmer does not have to bring it to a market alone or find out the update it price on that crop. They perhaps can get a credit from middle man who collects the harvest in that village. It is difficult for a farmer to gain such advantage if he/she is alone planting a particular crop.

The choice on a crop is a result of negotiation and compromising of these interconnected aspects. When a crop is being selected, it must offer optimal benefit that a farmer can get. Farmer must have the range of the mentioned-knowledge mentioned before a crop is selected. This process takes time.

To choose a crop pattern takes time, so does changing it into a new one. It makes the equilibrium, that is constructed with complex and interconnected aspects that are attached in a crop, will be change (disturbed). If a farmer change a crop pattern, for instance, his social live could be affected. The new crop pattern would require more time for monitoring and to cultivate. When a farmer changes his/her crop pattern, his/her neighbors could be affected as well. Farmer must find updated information on economic aspect of the new crop (selling price, and etc.). It is not merely about know how to cultivate the new crop.

The study sow that farmers maintain the crop pattern that has been chosen for a long term. Therefore, crop pattern can be regarded of having *inertia*. History of crop pattern in Karang Mulya and Santing Village demonstrate good example for this argument.

Farmers stick to a crop they have known well until an extreme situation, such as price drop or environmental shock, made them unable to bare the loss. For instance, farmers of Karang Mulya experience on water melon. Farmers did not respond instantly when the selling price was drop. It takes several price-drop events before they decided to leave the water melon for another crops. So does when a particular crop was having increasing price. The case indicate that there is a threshold value where an equilibrium state of a crop pattern is disturbed and force farmers to find a new direction (new crop pattern).

Nowadays, farmer of Karang Mulya and Santing continue to cultivate rice crop on second season even though they have suffered crop losses in a row. Some farmers indicate they have no intention to change rice crop with another crop for second season. It shows that a serial of crop losses have not yet disturb the equilibrium of stable state on this crop pattern.

The rational thinking of a farmer in responding the impact of climate variability, such as drought or flood, would be dealing with the problem partially. Farmers of Karang Mulya look for additional water when they face water deficit. While farmers of Santing make such arrangement on planting time and select rice variety that are assumed to be flood-resistant. The case shows that scientist/government and farmers see the problem differently. Hence, the emerging solution from farmers is different than its proposed by scientist/government.

There could be a situation when farmers are not able to maintain the rice crop in second season anymore. Increasing oil price would make exploiting ground water to support rice crop in second season will not economically feasible anymore. It reaches the threshold value and disturbs the equilibrium of stable state of a cropping pattern. Until now, it can be regarded as a ‘wait and see” period.

The idea that to change a cropping pattern takes time, and it seems have *inertia*, could provide a clearer picture of the possibility of having crop flexibility in the future. It would be far from possible to have farmers instantly change a crop pattern as a strategy to respond climate variability. The possible scenario would be farmers change their crop pattern permanently (for longer time). The history of crop pattern both in Karang Mulya and Santing Village, in responding to price drop or to environmental shock (as demonstrated today), supports the hypothesis. This would be an important notion in the middle of emerging concern toward impact of climate variability and climate change.

Bear in mind that the hypothesis suggests that to respond climate variability is not always similar with to respond climate change. The latter could lead to a permanent strategy, while the previous one lead to continuously responsive strategy.

6.1.2 Farmer's perception on the reliability of the forecast

There are majority of farmers in Karang Mulya and Santing Village have little confidence in the reliability of seasonal forecast. This is a result of farmers' perception on the reliability of the forecast, and the quality of the seasonal climate forecast itself. The perception of farmers on the reliability of seasonal climate forecast is shaped by their expectation and existing belief. The climate institution has not yet provided a high resolution that is needed by farmers, and good *skill of forecast* on normal condition.

Farmers made judgment on the reliability of the forecast based on one (or two) bad experience after following recommendation released by local government. From this experience, farmers judged the forecast being inaccurate. This perception did not correspond with the expected outcome. The Climate Field School (CFS) educated farmers that the reliability of the probabilistic forecast should not be judged from one bad experience of using it. Some farmers experience crop loses after following recommendation for second season. Later, this perception was shared with others.

It provides indication that farmers and scientist are having different type of culture in defining the criteria of the reliability of a seasonal climate forecast. Scientists define it on quantitative basis while farmer define it on qualitative basis. The bigger financial loss, the more farmers become reluctant to use the forecast as main reference.

That the perception is guided by the expectation can be traced by from farmers' statement on the crop losses several years ago after following the recommendation of local government. Recommendation was released to respond the predicted long drought on second season. Farmers were recommended to cultivate secondary crops that can be mature in shorter time. Some farmers followed the recommendation. They were expecting rainfall would be equally low during second season. A heavy rain will drawn the secondary crop, and damage it. In following days, there was still heavy rain fall. It made the secondary crop damage. From this experience, farmers concluded that the forecast was not accurate. They were reluctant to follow the forecast and its recommendation anymore.

Farmers' bad experience actually can not be used to judge the forecast at that time. There is still a possibility that the forecast was accurate, which mean it was close to real situation. The information that was given to farmers was the forecast of total rainfall within 90 days. There is a chance that the forecast of rainfall within 90 days was accurate, despite single (or two) heavy rain occurred in between.

The farmers' perception on the reliability of the forecast is also shaped by existing belief. The traditional belief is that any event that is associated with climate/weather is the domain of Gods. Interviewed farmers said there is no chance that people can give an accurate prediction. Farmers considered the seasonal climate forecast as a mere prediction that has equal change being true or being wrong. They treat it equal with other type of predictions, such as from persons with supernatural power.

The current perception on the reliability is also respond to the quality of the seasonal climate forecast itself. First, the forecast has not yet provide high resolution. It still covering a broad area (at sub-district level) meanwhile climate is different at village level.

In fact, the coordinator of CFSs' event, which is government officer of Indramayu District, find that the seasonal climate forecast provided by the authority (BMG) is too broad for farmers. He suggested farmers to rely on their own rainfall data.

Second, detail information and updated forecast is not provided. The seasonal climate forecast information is provided to farmers twice a year. It contains information on the onset of wet and dry season, and total rainfall in wet season. The information is summarized in a recommendation for first and second planting season. Every month, the authority (BMG) updates the forecast. Though, the updated forecast is not disseminated to farmers. It can be justified that farmers do not need very detail information. A good forecast of 90 days period is regarded sufficient enough for rice farmer.

However, the detail information is needed for farmers who cultivated secondary crops (vegetables and fruits). Skill of forecast on the updated forecast (one month forecast and shorter period) is not known. S*kill of forecast* of the institution (BMG) is judged by farmers from the summary and recommendation given by extension officer twice a year.

There is possibility that the information of seasonal forecast information is lost during translation process. It is translated into *farmers' language* and into recommendation. At the end of the process, it relies on the capacity of extension officer to disseminate the forecast to farmers.

6.2 Unsupervised learning

The impact of the Climate Field School does not correspond to the planned outcome. Unsupervised learning is resulting from complex interactions between various aspects that are associated with a crop pattern. Under such situation, the outcome of the program can not be trained. On the other side, unintended consequence is emerging. Some farmers who participated in the program become more efficient and selective in using pesticide. Therefore, the impact of the program can be regarded as unsupervised learning.

There is weak indication that farmers considered seasonal climate forecast for preparation of first planting season, such as land clearing and canal rehabilitation. The preparation for first season is conducted after attending regular consultation meeting with extension officer on October/November. However, farmers always make land preparation before the onset of wet season, coincident with the schedule of the consultation meeting with extension officer. It can be regarded as part of traditional calendar (habit). The planting time of a farmer is decided based on the available water on rice field and collective choice of farmers (synchronizing). There is no indication that farmer would do it differently and would use seasonal climate forecast information to start planting time.

The programme is liable to have mixed *outcome-patterns* because of relevant variations in context and mechanisms (Pawson and Tilley, 2004). Some farmers who participated in the program become more efficient in using pesticide for eliminating pest that attacks rice crop. This unintended consequence of the program (the Climate Field School) is resulting from the activation of different mechanisms within the program. The program offers resources (knowledge) that enable farmers understanding relationship between the season (wet and dry) and the presence of pests that are commonly attack rice crop.

This mechanism is active under particular context that is supportive to the mechanism The context is farmers in need of effective and cost efficient method on pest management. Farmers are able to apply this knowledge into better practice of pest management without requiring any changing in cropping pattern as a whole system, nor requiring collective action. The individual capacities of farmer is obviously relevant (Pawson and Tilley, 2004). It give explanation for why only several farmers applied better practice on pest management.

Unsupervised learning of the program is resulting from complex interactions between various aspects that are associated with a crop pattern. The seasonal climate forecast is considered merely one variable out of many aspects on input layer that produce the outcome (strategy of cropping management of farmer). Under such situation, the outcome of the program can not be trained (unsupervised learning). The study finds that the current cropping pattern is a result of decision at society level (an emerging property of a network). It is a result of recursive feedback that occurred between farmers and their social-physical environment. There is no individual farmer control the current cropping pattern. The conclusion is supported by the phenomena of synchronizing and collective action.

The case shows that Artificial Neural Network (ANN) is appropriate for the study of knowledge states being assessed on a network, as suggested by Richards (2007). ANN recognizes no single brain to overview the task or issuing sequential commands (Picton, 2000, Richards, 2007). ANN suggests that groups can also learn and not all learning is to be contextualized as supervised. Group learning can be an emergent property of systems (Richards, 2007). Therefore it is regarded as unsupervised learning. ANN provides theoretical framework in explaining unsupervised learning of the Climate Field School.

That the cropping pattern is resulting from team work (emerging property of a network) corresponds with the theory of Distributed Cognitive. It suggested that the knowledge is distributed across a working environment. Cognising takes place in the society and no single member of the society control and held a complete picture of the outcome (Richards, 2007) (in this case is cropping pattern). The study finds no single farmer on the study knows and controls the end result of synchronizing (the choice of majority of farmers on planting time and the selected variety of rice).

The notion of distributed cognition provides additional explanation to unsupervised learning of the Climate Field School. It offers theoretical explanation to the fact that crop adaptation at individual level is not feasible. Participants who were trained in the program (they are regarded as individual) do not able to make (to command) the society to produce the planned outcome. The study demonstrated a good case of Artificial Neural Network being converged with theory of Distributed Cognitive.

6.3 Approach of Climate Field School

The Climate Field School claimed adopting the approach of Farmer Field School on Integrated Pest Management (IPM) (Boer, 2003). The approach is to strengthen the process of knowledge generation and dissemination within and amongst the farming community. Having a closer look on the approach being used and the nature of knowledge being trained in the CFS, it shows that the approach is not identical.

In the CFS, the planned outcome is limited and predefined: seasonal forecast being used as input in strategy of cropping management of farmer. It expects binary output (Yes or No). After participating in the CFS, it was expected that farmers would understand the meaning of seasonal forecast and follow the recommendation that is provided by extension officer twice a year. Under this type of process, knowledge generation within and among farmers is not established in the real practice. Knowledge generation is considered the heart of the approach being used in Farmer Field School, At this point the implementation of Climate Field School is separated with the approach of Farmer Field School (FFS).

As a result, it is not allow for active experimentation on the use of the forecast. It against Kolb' (1984) four elements of 'experiential learning cycle' that inspired the philosophy of the FFS. At the end of the process, the result of the program is merely application of seasonal climate forecast for strategy of cropping management. Since there is no active experimentation, new technologies that involving both farmer-based innovations and introduced by researcher/ extensionist that are offered in the FFS (Scarborough, et al., 1997) is not emerge.

A process of knowledge generation of how famers apply seasonal climate forecasts on their own is possible under condition of no predefined planned outcome. It also requires government to provide a more detail and updated (monthly) seasonal climate forecast. However, by disseminating only a summarized forecast in a one-two sentence, such as "characteristic of rainfall in second season is predicted to be Below Normal" or "to be lower than last year', Government provide no resource (sufficient information) to farmers for having active experimentation. The Climate Field School can be regarded a training on how to make farmers understand 'the reason behind a recommendation'.

A farmer may have a wide range of possible respond to the mode detail information. For instance, to use the detail forecast on rainfall pattern to make adjustment on planting time of a particular secondary crop. An indication to that argument is supported by the fact that there are farmers (participants) attempt to use the data of rainfall observation for predicting rainy day within 24 hours, and have tried to make observation on relation between plant growth and humidity of soil.

On the other hand, knowledge generation on how farmers can produce climate data for the purpose of seasonal forecast is not possible due to the rigid and complex relation between various climate forces that shape a particular weather in a particular place. This scientific climate knowledge requires a complete picture before a forecast can be produced. Farmers' own knowledge on seasonal climate forecast is not possible based on this rigid and complexity. The study shows that farmers and extension officer have perception, which is different with scientist; that to generate farmers own knowledge on forecast of rainfall for several days ahead is possible. According to Boer (Boer, 2008, pers. comm.), the climate scientist who designed the module of The CFS, the complexity and influence of global force make climate forecast at local level alone is not possible.

The learning process actually takes place in translation process. It involves government officer who are in charge in interpreting the forecast, making the translation of it, and releasing the recommendation for cropping pattern and extension officer who translate the forecast into farmers' language and disseminate the information. The government officers have an active experimentation.

While applying seasonal climate forecast for cropping pattern do not offer active experimentation, farmers have active experimentation applying knowledge gained from the rainfall observation. There are resources available (information), which are rainfall data and instrument to measure temperature and humidity, allows farmers to do active experimentation on pest management. By doing rainfall observation, some farmers are having concrete experience, observation and reflection, generalization and abstract conceptualization. This possibly could lead to new farmers' knowledge and innovation. It is not necessary directed to substitute seasonal climate forecast. It can be used for broader aspect on farming practice, such as for pest management and for harvest drying.

6.4 Conclusion:

1. The outcome of the Climate Field School (CFS) does not correspond to the planned outcome. The program does not influence the current strategy of cropping pattern of farmer. However it has unintended outcome. Some farmers claim practicing better practice of pest management.
2. The existing context on the ground is not supportive to the mechanism (or intervention) to produce the planned outcome. The existing context at the ground were not recognized or considered by the program. There are social, technical, biological and physical constrains to apply crop adaptation in responding climate variability (to have *crop flexibility* for short).
3. The process of the Climate Field School can be modeled as unsupervised learning of Artificial Neural Network (ANN), wherein the outcome (the current strategy of cropping pattern) is a result of recursive interaction between farmers and their social and physical environment. The seasonal climate forecast is considered merely as one variable out of complex interconnected aspects that shaped a cropping pattern. Attempt to attain a planned outcome (supervised learning) under such condition is not possible.
4. The cropping pattern is a result of a group work and no single brain (individual farmer) controls and has complete picture to the outcome (cropping pattern). This finding corresponds with the theory of Distributed Cognitive. The study demonstrates a good case where the Artificial Neural Network converged with the theory of Distributed Cognitive.
5. The notion that cropping pattern is a group work support the idea that crop adaptation at individual level, on the existing rice crop-dominant environment, is not feasible.
6. Changing a crop pattern takes time since there are various facts associated to a crop. Farmers must have knowledge on various aspects that are associated with the prospective crop, such as social, economic and technical consequences and the required agro-ecological environment for the crop. In addition to that, the fact

that cropping pattern is a result of team work (emerging property of a society) it require collective action that inherently takes time.

7. The fact that many aspects affect a cropping pattern, a cropping pattern is tend to be stable until farmers can not hold it anymore. The history of cropping pattern of farmers shows that price drop and environmental shock could disturb this stable stage. Therefore, a cropping pattern can be regarded having *inertia*
8. The idea that a cropping pattern is having inertia have consequence that flexible crops pattern that responding climate variability can be far from possible.
9. The linear thinking of the approach being used in the CFS and the dissemination of the forecast, which only provide summarized forecast and recommendation, provide no room for farmers to maneuver. It has made the program can be considered a 'top down' intervention. It doesn't offer active experimentation.

.

6.5 Recommendation:

1. The CFS can be re-designed to be a process of facilitating farmers in building capacity and institution to facilitate collective action in responding climate variability. It is needed for an environment that collective action become constrain to a farmer applying adaptation at individual level. It can be a process for farmers to identify the possibility and constrains to respond climate variability and climate change.
2. Government officer should disseminate detail and updated monthly seasonal climate information. It would allow farmers to explore the information (resource) on the detail forecast, that lead to concrete experience, observation and reflection, generalization and abstract conceptualization and active experimentation on a particular climate phenomena. It possibly would to unpredicted result, which is defined as farmers' innovation.
2. The Climate Field School (CFS) should not be directed merely toward application of seasonal forecast information for cropping pattern. It offers broader possibility of applying climate knowledge on farming practice. A participatory development of possible application should be considered. Farmers who have participated and experienced application of seasonal forecast information and rainfall observation can generate information of possible application of Climate Field School.
4. Local Government must encourage documentation of consultation meeting of farmers and extension officer. A detail minute report should be made available as it provide resource to asses level of understanding and interest of farmers to the seasonal climate forecast, and to identify problems and challenge in applying the forecast in many places.

Epilogue

Limitation of the study

The thesis would provide more in depth analysis if minute taken on the process of the climate field school is available. The flow of the process and respond that were given by participants during the process would give rich information of knowledge state, respond and interest of farmers to the process. Description on the process of the program described in this study is based on the module and interviews with farmers and one trainer.

There is no documentation (minute taken, number of farmers attended) of farmers-extension officer while having consultation meeting twice a year before planting season is started. This could provide picture interest of farmer to the information that is disseminated by extension officer, including on seasonal climate forecast. A minute taken on this meeting would allow me to assess level of interest of farmers toward the seasonal forecast information

For Generalization:

This finding provides a logical inference to be generalized to broader population where intervention (information on climate forecast) is introduced in rice-crop dominant environment where social, biological and physical facts strongly associated with the crop. The study does not suggest similar hypothesis applied to non-rice dominant environment as no sufficient material is collected yet.

Reflection:

During writing this report, I find a theoretical framework is analog with a car. It can make us move fast and far if we know how to drive. On the other side, it brings us nowhere when we do not know how to drive it, or it is the car that drives us when we can not handle it.

Prior to the field research, I was focusing on farmers' application of the knowledge gained in the Climate Field School for the rainfall observation. Fortunately, during the interview I gather broader and interconnected aspects on rice farming. It allows me to find explanation to the impact of the Climate Field School.

References

Aldrian, E. (2007) Perubahan Iklim di Indonesia: *Anomali dan Cuaca Ekstrim di Laut* Presentation on Focus Group Discussion March 1, 2007. Jakarta: Greenpeace SEA and Oxfam

Aldrian, E. *(* 2006) Bencana Iklim Akibat Perubahan Iklim Global. Jakarta: Kompas 29 March 2006

ADPC (2007) Report on the Workshop on Climate Forecast Applications for Managing Climate Risks in Agriculture. Bangkok: Asian Disaster Preparedness Center (ADPC).

Agriculture (unknown year) Indonesian Ministry of Agriculture. Communicating Climate Forecast to Farmers Through Climate Field School. Brochure. Jakarta: Directorate General of Food Crops, Ministry of Agriculture. 4 pages.

Arciniega, 2002 Javanese Mysticism. The Javanese Calendar (online from: http://xentana.com/java/calendar.htm, accessed October 23, 2008)

BMG (2008) Evaluasi Hujan Juni 2008 dan Prakiraan Hujan Juli, Agustus, September 2008. Jakarta: Badan Meteorologi dan Geofisika (BMG)

BMG (2008b) Badan Meteorologi dan Geofisika. Prakiraan Musim Hujan 2008/2009

(online from: http://www.bmg.go.id/data.bmg?jenis=teks&ids=3093805704743005223, accessed on November 21, 2008)

BPPTP (2004). Pengantar Lapang: *Pengelolaan Tanaman Terpadu Padi Sawah*. Bogor: BPPTP and IRRI.

Boer, R., et al (2003) Petunjuk Latihan: *Sekolah Lapangan Iklim*. Bogor: Pemerintah Daerah Kabupaten Indramayu.

Boer, R. (2008 pers. comm.)

Boer, R. et al (2007) Pedoman Mitigasi Dampak Fenomena Iklim: *Pengelolaan Dampak Kejadian Iklim Ekstrim pada Tanaman Pangan* (draft*).* Jakarta: Direktorat Perlindungan Tanaman Pangan, Direktorat Jenderal Tanaman Pangan, Departemen Pertanian.

Chen, Z. (2000) Data Mining and Uncertain Reasoning: *An integrated Approach*. New York , John Wiley & Sons, inc.

De Vaus, D. 2001. Research Design in Social Research. SAGE Publications.

Fassino, M. (1997) Neural Networks: *understanding back propagation*. Quirk's Marketing Research Review (online: http://www.quirks.com/articles/a1997/19970408.aspx?searchID=22754219&sort=9, accessed on November 11, 2008, 11: 14 pm)

Indramayu (2004) Pemerintah Kabupaten Indramayu. Laporan Akhir: *Hasil Pelaksanaan Kegiatan Perlindungan Tanaman Pangan dan Pengendalian OPT Kabupaten Indramayu Tahun Anggaran 2004*.

Indramayu (2007) Pemerintah Kabupaten Indramayu. Monografi Desa/Kelurahan Karang Mulya: *Keadaan Sampai Dengan Bulan Juni 2007*. Bagian Otonomi Desa Sekretariat Desa Kabupaten Indramayu.

Indramayu (2008) Dinas Pertanian dan Peternakan Kabupaten Indramayu. Profil Pembangunan Pertanian di Kabupaten Indramayu, Indramayu.

Kaimuddin, 2000, Dampak perubahan iklim dan tataguna lahan terhadap keseimbangan air wilayah Sulawesi Selatan : Studi KasusDASWalane Hulu danDAS Sadang, Disertasi Program Pasca Sarjana, IPB, Bogor.

Kolb, D.A. (1984) Experiential Learning: Experience as the Source of learning and development. Englewood Cliffs. NJ: Prentice Hall

Luseno, et al (2003) Information for Pastoralists: Evidence from Southern Ethiopia and Northern Kenya. World Development Vol. 31, No. 9, pp. 1477–1494, Elsevier Ltd. Great Britain.

Mitchell, Richard. 2005. CYMN2 Neural Networks-1 (Introduction). Cybernatics.

Mweri, B.A.M. 2005. Upscalling Farmer Field Schools: *"A Bushfire….?". Technographic studies on livelihoods and participations in FFS by smallholder farmers in Coastal Kenya*. MSc Thesis. Wageningen: Wageningen University

Patt A, Gwata C (2002) Effective seasonal climate forecast applications: examing constraints for subsistence farmers
in Zimbawe. Global Environ Change 12:185–195

Pawson,R. and N. Tilley (2004) Realist Evaluation.
(online from http://www.communitymatters.comau/RE_chapter.pdf accessed March 5, 2008)

Pertanian (2007) Departemen Pertanian. Pedoman Umum Sekolah Lapangan Iklim. Jakarta: Direktorat Perlindungan Tanaman Pangan, Direktorat Jenderal Tanaman Pangan, Departemen Pertanian.

Picton, P. 2000 *Neural networks,* Basingstoke: Palgrave (2nd edn.)

Pontius, J.R. Dilts and A. Barlett (Ed). (2000) from Farmer Field School to community IPM. Ten years of IPM in Asia. Jakarta: The FAO Progam for community IPM in Asia

Purcell, Dennis L, and Jock R.Anderson (1997) Agricultural Extension and Research: Achievements and Problems in national Systems, OED, the World Bank, Wahingthon DC.

Ratag, M. A. (2007) Perubahan Iklim: *Perubahan Variasi Curah Hujan, Cuaca dan Iklim Ekstrem*. Presentation on Focus Group Discussion March 1, 2007. Jakarta: Greenpeace SEA and Oxfam

Richards, Paul. 2007. Understanding Technology For Poverty Alleviation. Tad Lecture 2: The Green Revolution In Technographic Perspective. Wageningen: Wageningen University

Richards, P. (2007). Farmers First? *Towards a neural network perspective on farmer seed systems*. Sussex: Farmer First conference IDS Sussex December 2007
(online from: http://www.future-agricultures.org/farmerfirst/files/T3b_Richards.pdf, accessed on July 12, 2008)

Roncoli, C., Ingram, K., P. Kirshen, and C. Jost. 2003. “Meteorological Meanings: Understandings of Seasonal Rainfall Forecasts by Farmers of Burkina Faso.” In: S. Strauss and B. Orlove eds. *Weather, Climate, and Culture*, Berg, New York, pp. 181-202.

Roncoli, C (2006) Ethnographic and participatory approaches to research on farmers’ responses to climate predictions. CLIMATE RESEARCH. Vol. 33: 81–99, Published December 21. The University of Georgia, Athens.

Roncoli, et al (2008) From accessing to assessing forecasts: an end-to-end study of participatory climate forecast dissemination in Burkina Faso (West Africa) Springer Science + Business Media B.V.

Roy, A. (2000) Artificial Neural Networks: *A Science in Trouble*. SIGKDD explorations 1 (2): 33-38

Sacrborough, V. (1997) Farmer-Lead Approaches to Extension: *Concepts and Practices*, Southampton, London: Overseas development Institute.

Senjay, D.S. 2003. A Comparison Assesment Between Supervised and Unsupervised Neural Network Image Classifier. Thesis Report. Wageningen: Wageningen University

Sones, K.R., Duveskog,D. And Minjauw, B. (eds) (2003) Farmer Field Schools: *The Kenyan Experiences*. Report of the Farmer Field School stakeholders’ forum held 27th March 2003 at ILRI, Nairobi.

Southwood, S. and R. Schipper (2008) Methods, Techniques and Data Analysis for Field Research, course reader, Rural Development Sociology and Development Economics. Wageningen: Social Science Group-Wageningen University

Suciantini (2006) Hubungan SOI (Southern Oscillation Index) Dengan Awal Musim Di Indramayu. Bulletin Penelitian Agroklimat dan Hidrologi

Syafiuddin (2006) Process of tailoring crop management strategy and dissemination to farmers at the district level. In: ADPC (2007) Report on the Workshop on Climate Forecast Applications for Managing Climate Risks in Agriculture. Bangkok: Asian Disaster Preparedness Center (ADPC).

Yin, R.K. (1984) Case Study Research; *Design and Methods*. Beverly Hills: Sage Publications. In: Southwood, S. and R. Schipper (2008) Methods, Techniques and Data Analysis for Field Research, course reader, Rural Development Sociology and Development Economics. Wageningen: Social Science Group-Wageningen University

Websites:

Badan Meteorology dan Geofisika: **http://www.bmg.go.id/data.bmg?jenis=teks&ids=3093805704743005223**

Your Dictionary.Com: http://www.yourdictionary.com/climate)

Answer.Com: http://www.answers.com/topic/climate-change

National Snow and Ice data Centre; http://nsidc.org/arcticmet/glossary/climate_change.html

Appendix 1
A complete description on individual farmer in Karang Mulya Village

- The CFS Participants:

1.Sarma of Losarang (73 years)

Sarma is a retired soldier of an army elite commando (Kostrad). During his service with the Army, Sarma was sent to Egypt under United Nation's mission. In 1991, he came back to Karang Mulya and became a farmer. He has two sons and one daughter. The oldest son is in the army and the youngest son works for private security service. His daughter is married to a farmer and lives in the same village.

He owns 2.5 bahus (1 bahu is equivalent to 7.500 m2) and works alone on his land. In 1993 he cultivated rice during the first planting schedule and watermelon during the second planting schedule. According to Sarma, the crop has been cultivated by Karang Mulya farmers since 1969. At that moment, few farmers cultivated rice on second planting schedule. Like many farmers in the village, in 1995 he did not cultivate watermelon anymore.

Increased cost of fertilizers and pesticides coupled with a decline in price of watermelon on the market makes watermelon cultivation a non-profitable venture.

Comment [B1]: This statement is a suggestion over what has been cancelled.

water melon. During the second planting schedule (local term: *musim gadu)* the land was not cultivated. In 2000, he cultivated rice a second time. At that moment rainfall was high, and he had water pump to extract ground water.

In 2002, he cultivated watermelon again on second planting season. He lost the crop few days before its harvesting time. A heavy downpour made the watermelon drawn half body. It caused decay to the watermelon immediately**.** Because, Out of frustration, he decided never to cultivate watermelon and secondary crop anymore. He felt too old to be on farm everyday, as needed for secondary crop. He is back to cultivating rice twice per annum and leave the land un-cultivated during dry season. About half his land is rented out to other farmers.

Comment [B2]: What does it mean?

Sarma's land is lower than its surrounding (local term: lebak). Lower land seems similar visually as the height differences is less than 1 meter. According to Sarma, about 25 hectares out of the total 400 hectares land of Sukamelang block are *lebak* land. After rice crop of first planting schedule are harvested, remaining water gets concentrated on these lands. Farmers in these *lebak* land promptly prepare for second rice crop.

In 2007, his younger son, Yono, came with his wife from Jakarta and stayed with Sarma. Yono has lost his job in Jakarta and helped Sarma in daily chores and on farm. Yono's nine-year-old daughter from his first wife has stayed with Sarma for several years. His first wife works in Saudi Arabia for several years as house keeper.

Sarma was head of sub-village unit farmer association. Nowadays, he has joined a nation- wide farmer organization, IPPHTI, whose main activity is to increase skill and knowledge of farmer. He is appointed as trainer at district level. At least, once per month he shares skill and knowledge with other farmers of IPPHTI. He earns compensation for the activity. Sarma is the only farmer who joined the organization. He said farmers do not have interest in spending time for knowledge. 'Farmer interested only
.

Comment [B3]: Explain abbreviation the first time they appear.

Comment [B4]: Inconsistent with beginning of paragraph

Comment [B5]: Incomplete

Since 2006, he started to practise organic farming. Sarma and IPPHTI farmers are experimenting with organic fertilizers and pesticides made from local materials. So far, only one farmer, Soepandi, has followed his actitivty on organic farming. Sarma is also involved in IPHHTI program to find a better rice variety by experimenting cross-polination of two different rice varieties. One of the farmers said ' he is an active farmer outside this village'.

Comment [B6]: The idea doesn't sound clear

2. Soepandi (45 years old).

Soepandi graduated from an Islamic boarding school, equivalent to senior high school. Soepandi is active in religious and social activities in Karang Mulya Village. He teaches teenagers to recite Quran and knowledge on islamic religion. He is new coordinator of sub-village unit farmer association, replacing Sarma. Karang Mulya village has several sub-village unit farmer organizations. Soepandi is respected by other farmers. Kasbah, his neighbour said ' because he is clever and active in social activity'.

Soepandi manages 4 bahu of land, out of which three bahu is owned by his parents. One of Soepandis' neighbor, Ratim, helps him take care of his crops. He raises several goats. His wife runs small kiosk to provide daily needs. Since 2007, Soepandi learns from Sarma how to make organic fertilizer and pesticide.

When watermelon was lucrative business, Soepandi cultivated them in the second planting schedule . Since the price of watermelon declined, he cultivated rice twice per year. He said he has no time and energy left to cultivate secondary crops. He depends on ground water to respond to water deficit.

3. Sirwan

Sirwan owns 4 bahus of land. In the first planting season, all of the land was planted with rice. In the second planting season, half of the land is rented out to other farmers. He cultivates secondary crops on small portion of the land and the larger portion with rice. His farmers considered him as "genuine farmer", who spends most of the time on farming. He has no children.

Sirwan is acknowledged by his colleagues as a farmer with good knowledge on secondary crops. He has long expericence on secondary crop. In 2006, he cultivated 1 *bahu* of his land during second planting schedule with *pare*. He succesfully produces several hundreds kilograms as harvest. He is the only farmer so far to cultivate seconday crops on such large scale. . Farmers in the village usually cultivate secondary crops on less than half bahu of land since significant amount of time and investment are needed.

Comment [B7]: Is it different from pear?

Eventhough he has succeeded with secondary crops in 2006, in the following years Sirwan cultivated secondary crops on less than half bahu of land during the second planting season. Sirwan said " it needs a daily care and higher investment than rice. I do not want to be too tired twice on secondary crops because I cultivate secondary crops also during the second planting schedule".

In 2008, Sirwan cultivated all of his land with rice crop during second planting schedule. Sirwan harvested the first rice crop in March. Water was abundant at that moment. The rainy season was expected to continue till l June. Sirwan, like other farmers in the village, were very confident that water will be more than enough for the rice crop.

He was however dissapointed that the rainfall ended in May. He used ground water to save the rice crop. Pump-engine to extract ground water was powered with gasoline. He spent a lot of money to save 1 bahu of his land. He can save the rest of the rice crop. At the end, he produced 1.6 tons of rice. The revenue from the harvest was almost the same as the cost incurred on gasoline alone.

Realizing that the rice crops were not successful, he promptly cultivated secondary crops (tomato plant) on about one-third bahu of his land. He regretly said ' I used to have chas money from secondary crops while waiting rice crop harvested. Now i dont have income at all'. When being asked about his planting schedule on second planting schedule, Sirwan said he will come back to his former cropping pattern: combination of rice and secondary crops.

Comment [B8]: What is that?

Actually it not the first time Sirwan has suffered great lost. At the end of 1990, he cultivated all of his land on second planting schedule with rice crops. He lost the crop due to premature ceasation of rainfall . He said " for several years I am burdened with the memory of that loss. Therefore, I plant secondary crops along with rice crop to distribute the risk. If rice crops do not succeed, I still have income from secondary crops'.

4. Kuner (39 years old)

After several years of working as laborer in town, Kuner became farmer on rented land. He rented land on second planting schedule from farmers who let land due to deficit water. During the first planting season, he worked as hired laborer. None of the farmers let their land to other as water was abudant that moment. For several years, Kuner cultivated secondary crops only on rented land. He moved from one land to another.

Since the year 2000, Kuner started to cultivate rice on 1 bahu of rented land. In the second planting schedule, he cultivated secondary crops on higher part of the land and rice on the lower part. Kuner practices the combined crop to mitigate crop losses.

Kuner lives on the side of discharged channel at Blok Kandang, to collect water out of rice field when rice field is dried ten days before rice crop is harvested. The house was a hut, which was built as the meeting place for the CFS program in 2003. The land was located in the edge of rice field, far from other houses. After the CFS program ended, Kuner lived in the hut and added a sleeping room.

Kuner was born into a poor family. He has never followed any formal education. He learned to read and write when he became a laborer. He can read, but writes very slowly. The couple have no children. Living far from other houses, Kuner and his wife spend much of their time for farming actitivties . He seemingly a work hard farmer. For all the three times that I met him during the study, which was conducted in the dry season, he was working on his farm. Nevertheless, Kuner cultivates secondary crops during the third planting season, which is dry season. Ground water has higher salinity level, which cannot be tolerated by crops.

Comment [B9]: Doesn't make sense

Water storage (discharge channel at Blok Kandang), near his land, sometimes has some water remaining during the dry season. Kuner chooses crops depending on the available water. The shorter time duration is selected if less water is available. In mid July when I visited Kuner, the discharge channel was dry. Some farmers had made several holes in it, hoping to find some water remaining under the soil surface. During the second visit, in mid August, the channel was full of water. A water dealer (local term: preman air) has caused the water to move from upstream places to Karang Mulya Village. The water dealer had to deal with every gate keeper to let the water flow more than 10 kilometers to Karang Mulya Village. The water dealer, Babe Lodra, had made deal before with farmers who are willing to pay him for the job.

Kuner admitted that he does not understand most of the subjects taught in the CFS 2003. As he writes very slow, he does not make notes during the CFS program. "I only try to remember what the trainer said. I cannot put the subject into a note. I am not good at summarizing what people say ". How to measure the rainfall and record it is the main knowledge he gained from the CFS. Through the rainfall record, Kuner tries to understand the pattern of local rainfall. Then, he came with a proposition on how to predict rainfall pattern before entering second planting schedule.

5. Tjachyadi a.k.a 'Didi' (37 years old)

Didi is head of the farmer association at sub-village unit. He joined the KTNA farmer organization at sub-district level and was appointed as secretary. KTNA is known as farmer organization that facilitates government program to farming communities. Government program, such as training and subsidized seed and fertilizer are channeled to farmers through KTNA.

Participants for the 2003 Climate Field School were selected and coordinated by KTNA. In 2006, Didi was in charge on selecting and coordinating budget of "Farmer Field School on Water Efficieny", a program of Local Government of Indramayu District. It is KTNA which invited farmers to participate in farmers and extention officers' consultation meeting (local term: penyuluhan) twice per year.

Didi works on two *bahu* of land, in which one *bahu* is owned by his father. He became a full farmer after graduating from junior high schoo at 16 years. After marriage, he owned a piece of land for himsellf. His land is higher than its surrounding (local term: tengger), meanwhile half of his father's land is lower than its surrounding (local term *lebak*) while the other half is higher. Even though his land is located only several hundreds meters from Sarma and Soepandis land at Sukamelang Block, it is of a different agro-ecological unit. Almost all of the ground water at Didis' place has higher salinity level than that of Sukamelang Block. The land is located at the end of the village irrigation system.

Didi and farmers in this area frequently face water deficit. Hence, Didi cultivate secondary crops during second planting schedule. Since 1986-1997, he cultivated watermelon since 1985-1997. In the absence of favorite water price, he changed to other secondary crops, such as *pare (bitter gourd)* and *timun suri* (a family of cucumber). In 2000, he cultivated rice for second planting schedule. 'The water was abundant at that moment; farmers enjoyed good harvest. . In 2001, water was scarce during the second planting schedule. In the following years, Didi never cultivated rice on second planting schedule anymore.

As the secretary of KTNA, he frequently asked by Srimulya, local government officers who coordinates the CFS program, to meet guests or farmer delegates from different provinces who want to know the impact of Climate Field School in Indramayu. Didi is presented as a farmer who consistently uses climate forecast information as input for crop management strategy and makes rainfall record to some media publications. He once was asked by extention officers to present his rainfall record and shared his prediction with other farmers.

Didi has been making rainfall observations and recordings since 2003. He said 'rainfall record from previous year is used to make prediction on the beginning of rainy season the following year, either it will be the same, earlier or late than last year'. Didi said the rainfall record is not able to be used to make predictions on rainfall quality several days or weeks in advance. 'I only recorded for 5 years. It will need 32 years or at least 8 years, before we can make a rainfall prediction'. He mentioned traditional belief that

Comment [B10]: A.k.a may not be used in thesis, rather use 'alias'

Comment [B11]: Explain abbreviation first time it appears in script

Comment [B12]: Check for consistency.

Comment [B13]: Not clear Raja

Comment [B14]: Construct this statement well climate is repeated every 32 years. Didi explained that 'by having a 32-year record, we will know that rainfall next year would be similar to the past years. . He claimed that the knowledge, that climate conditions repeated regularly in a certain period, was informed by trainers during the CFS.

About Didi giving rainfall prediction on farmer-extension officer meeting before the rain season, his neighbour Rusmana recalled 'some farmers were grumbling; they said 'as if he is the only one knows'. The others responded it positively; they said 'he may have the knowledge after following the CFS'. We come to listens information, thought we do not follow it".

After 2006, he did not make rainfall observations and record anymore. He said 'the local government does not provide the sheet book to record rainfall observations. The only sheet book I have is already written in. No more pages are available'. (I find that the sheet book is a simple plain paper with column and row, which can easily be replicated with copy machine or hand writing). Rusmana said, farmers are following habits in determining time planting.

In 2008, Didi made different crop strategies. He cultivated rice during the second planting season. Like most of the farmers at that moment, he argued "There is plenty water at that moment". He added that land must be dried before cultivating secondary crops on such siatuation. As leader of KTNA farmer organization, he received climate forecast information and recommendation of planting pattern from Indramayu District Government.'The information said the rainfall would not be sufficient for rice planting on second planting schedule. Hence, farmers were advised to cultivate shorter duration varieties'. Didi did not follow the recommendation, instead, he cultivated rice. He lost the crops due to water deficit.

6. Kasbah (48 years old)

Kasbah works on 1 *bahu* land (equal to 7.500 m2) . He has completed elementary school (six year education). His only source of livelihood is farming. He cultivates rice on first and second planting season. Secondary crops are planted on small portion of land (about a quarter *bahu* of land) during secondary planting season, along with the rice, and third planting season (dry season). This year, he chose to cultivate tomato. Kasbah completely depends on ground water to support his crops during deficit water situation. The salinity of the ground water is in the level that can be tolerated by crops.

Kasbah says he understood whatever was taught in the Climate Field School. Nevertheless, he said at the end of the program he forgot everything. He once tried to observe rainfall and record it. He did not do it completely for one season when he quitted due to his busy routines and non-availability of time. After working on farm, I need a rest.' he argued. Kasbah recalled that only Didi and Soepandi make rainfall observation. 'These persons, who have used the knowledge of the CFS, have not demonstrated any result yet. Hence, other farmers do not want to replicate it'. He added "we have Didi who record the rainfall data the others wait and see the use of it".

Kasbah said that farmers do not make use of climate forecast information from BMG or traditional Pranata Mangsa as guidance for planting. 'The decision for planting time is based on availability of water, from rainfall directly falling onto the rice field or through the river. If the land is drowned by water several centimeters, it indicates time to start planting' he explained.

For the second planting schedule, decision is made on the remaining water at that moment. If the remaining water is abundant on field and the rain season is not ended yet, farmers choose to cultivate rice. "We do not question water availability in the following days or weeks. Should the crops fail, we will work again next year. Farmers here behave like that" he explained.

Kasbah selected to participate in the CFS without knowing the purpose of the program. After following the CFS he claimed that the climate change in his place became worse. He expected that the situation will be better in following years. From the CFS, farmers gained knowledge that forest degardation is the cause of the climate change.

7. Kadillah (71 years old)

Kadillah is a retired civil servant from the office of irrigation. He is head of farmers' association at sub-village level. His land and house administratively are located in Wirakanan Village, near Karang Mulya Village. He followed the CFS on Karang Mulya Village to represent farmers of Wirakanan. He is respected by farmer societies for his former position and current position with the farmer association. Once, he was appointed as chairman of KTNA farmer organization at sub-district level, later though he resigned. Some farmers, like Sarma, acknowledges his good knowledge on traditional Java calendar for planting time, Pranata Mangsa.

Kadillah has several bahu of land, in which some were inherited by his married-sons and daughters. He works on 1.5 bahus for himself. Kadillah always cultivates rice for first and second planting schedule. Kadillah argues that "the land here is a delta, an alluvial deposit of land. During the rainy season, the land is muddy. It is not good for secondary crop" (I observed that some farmers at the same place cultivated secondary crops during the third planting schedule). His land was close to irrigation system, in which he gets the water earlier than farmers in Karang Mulya. In 2008, his rice crop on second time was successful. (Compare to other participants, I spend less time on observing agro-ecological conditions of Kadillah place and his social role).

Kadillah has made his secretary of farmer association, Daiman, observe and record rainfall for him. Kadillah said knowledge from the CFS is not enough for a farmer. He concludes that BMG's climate forecast information is inaccurate. . Hence he wants to improve traditional Javan calendar *Pranata Mangsa*. Kadillah said the knowledge provides about 20 percent to his current work on improving Pranata Mangsa. The rest of the knowledge came from self learning process through observation. He knows how to quantify rainfall intensity in a scale (milimiter). Kadillah has released a revised Pranata Mangsa calendar based on the same approach as original Pranata Mangsa. A local tree is used as referance to set new dates for each mangsa (season).

8. **Wajuk (63 years old)**

Wajuk owned 3 bahus of land, which about half are located in lower land (*lebak*) near discharge channel and the remaining is higher land (local term: tengger). Wajuk cultivates rice on first planting schedule. During second planting schedule, he used to cultivate rice on lebak land and secondary crops on tengger land. His lands are located near Kuners' land.

During peak rainy season, water can reach 40 centimeters (knee of adult person) on his lower land (*lebak*). The rice crop can survive as it is not fully drown. Hence, he always cultivate rice second time on *lebak* land since 1980s. Though, for the last four years he has lost rice crop. The water was drained before the rice crop could mature. During dry season, he used to cultivate secondary crops on a small portion of his land, less than quarter *bahu (*2.500 m2*)*.

He has much experience in cultivating secondary crops. Like most of the farmers in the village during 1970s to mid 1990s, he cultivated watermelon after harvesting rice crop of first planting schedule. Wajuk even travelled to several cities and rented lands for watermelon.

ODuring the second planting schedule of 2008, he cultivated all lands with rice crop. Like most farmers in the villlage at that moment, he was convinced that the rice crop would succeed. He borrowed money from bank to finance the rice cultivation. His land certificate was used as collateral. He lost the rice fields and became indebted.

Wajuk promptly cultivated secondary crops after that moment. He borrowed money from his close friends to finance the expenses. Wajuk was hoping that successful crop can help him pay debt installment to the bank. He used ground water, and remaining water from discharge channel to support the crop.

Wajuk participated in the CFS meeting ten times, though he did not understand the topic presented by trainers. He has poor Indonesian language (During interview I used a local person to translate the interview into Indramayu language). He said he received education only for 3 years. 'I participated in the program because it provided money as time compensation. Sometimes, I leave in the middle of the day". What Wajuk understood from the program is that farmers like Kuner observing rainfall and record it.

Comment [B15]: Not clear here.

Wajuk does not use climate forecast information as input for crop management strategy. He does not believe in the reliability of BMGs' climate forecast. He said " In the past I believed it. Nowadays it is inaccurate" . When asked whether he used the Kuner rainfall record to understand climate pattern, he replied " a farmer would not able to do that. Even a fortuneteller has difficulty in predicting weather". Wajuk said he follows the majority of farmers as guidance for his crop strategy.

9. Tudi (39 years old)

Tudi is close friend of Kuner and has 1.5 hectares of land nearby Kuners. He sometimes spends time at Kuner's place after work. Tudi has similar cropping pattern as Kuners, which is rice, and secondary crops; and rice for first, second, and third planting schedules. He has been combining crops in second planting schedule since 1985 in

Comment [B16]: It is better that you maintain a single unit of land measurement, either in hectares or bahus order to reduce risk in case one of the crops fails. Sometimes, beforethe beginning of the rain season he cultivates secondary crops like tomato and *pare (*bitter gourd).

Since 2000, he had lost rice crops five times on second planting season. Though, he determines to cultivate rice crop second time next year.'Farmers will not be discouraged by several rice failures. In addition to that, there is abundant water at the end of first harvest. Farmers find it inappropriate to waste water onsecondary crops. Tudi said farmers will always want to cultivate rice crops twice a year if there is change.

Comment [B17]: Appears incomplete sentence

Being farmer is the main acitivity of Tudi. He did not graduate from elementary school and are not able to write note. Though, he succesfully has sent two of his son to university. During the CFS program, Tudi barely understand the subject delivered by trainers. What he knows from Kuner is observing rainfall and use the record to make prediction of rain event. 'Sometimes it is accurate and some it is not'.

Tudi implicitely find no significant change on climate. He recalled 'Rain season start one month earlier or late. It is natural. Preparation for planting time is always done on November every year'.

After participate in the CFS, Tudi aware that Kuner make rainfall observation and record it. He sometimes asks the result of the acitivity. He knows that if the rainfall shows 100 ml, there is a high posiibility the channel will be flooded. Repeating what Kuner said 'it will take several years more before the data can be used for cropping strategy'. The benefit of participating in the CFS for Tudi is "sometimes we have accurate forecast on flood event from Kuner. Hence we can anticipate it"

Being asked about climate forecast information of BMG as input for cropping strategy, Tudi recalled 'it is sometimes accurate and sometimes it is not. It was fifty fifty. Once in the past farmers were told for not to cultivate rice on second planting schedule because rainfall will short. In following days, there is plenty of rains'. He said nowadays farmer simply ignore recommendation given by extension officer. Farmers gather information from other farmer before making decision on time planting and on crop. "Every farmer want to sincronize cropping pattern with others".

In what month first crop is harvested become guidance for farmer to determine crop on second planting schedule. "If the second planting started on April or May, farmer still have confident with rice crop. If it is started on June, I am afraid water will be over before rice crop mature".

Water ground at Tudi land has salinity level that is not tolerable by crops. He is hoping that government build deep water well. "Like the one in Kroya and Pejaten. Rice crop always succeed twice per year there". (Indramayu Dictrict Government has condcuted a ground water survey in that area. The survey found fresh water reserve is too small to be extratced by large pump engine).

Appendix 2
A complete description on individual farmer in Karang Santing Village

1. Sarma of Losarang (**68 years age**)

Sarma of Losarang is head of Sumber Sris' farmer association at village level, and head of KTNA farmer organization at sub-district level. Several years before, he was deputy head of the Santing Village. Judged from his newly built big house, it is obvious he is a wealthy farmer. Half part of the house is used to storage agriculture input, such as fertilizer and pesticide. He recently opened business providing agricultural input.

During my arrival, he promptly invited some farmers who participated in the 2003 CFS and explaining the purpose of the study. That farmers responded to invitation displayed his strong position within the society. He said sometimes staff at Indramayu District of Agriculture come to the village on his call, instead of he visited the office. It is Sarma who made decision of all farmers participated in the 2003 CFS. As head of KTNA farmer organization, he is in charge in facilitating program and distributing agriculture support (micro credit, input) provided by Indramayu Office of Agriculture.

Sarma was born from simple poor family. He did not graduate from elementary school. He started career as hired labor, farmers on small piece of land. During dry season he worked on salt production mine. Later he owned a piece land of salt mine. Farmers of Santing worked on salt production near coast line since 1960s. His children are all have been graduated from university, married and lived in the same village.

Along with rice crop, he cultivated soy bean in 1980s and other secondary crops in following years on small portion of land. He frequently loss the crops than succeed due to water deficit. He never cultivates secondary crops anymore since end of 1990s. About 15 hectares of land are lies on higher part and suitable for secondary crop.

Sarma do not work on his farm anymore. Since 4 years ago, he hade one person, Tomo, to oversee his land. Everyday Tomo supervises some hired labor working on Sarmas' land. A year a go, Sarma received grant of several goats from Indramayu Office of Agriculture. Tomo regularly bring the goats to pastoral land in the afternoon.

Sarma make rainfall observation and record it for several seasons. Tomo, his assistant, said Sarma did not consistantly make rainfall record. From the CFS, Sarma knows how to measure humidity level that is suitable for secondary crops. From measuring rainfall, he claimed knows the right time for planting rice. Thought, the knowledge was not applied.

He did not continue making rainfall record anymore. He said "It is useless. The main problem is on the river. Eventhough we make rainfall observation, it would not resolve the main problem. Regular flood provide no room for farmers for crop adaptation. What we are doing to manage flood now is to postpone planting time several days. It mean serious problem for second rice crop".

Sarma cultivate rice crop twice a year since mid 1990s. Sarma consider second rice crop is marginalize crop, which is not really expected. Since mid 1990s many farmers at upstream used water-pumped engine. The problem arised. Farmers at upstream river are pursuing to cultivate rice three times a year "There could be thousand engines up there because every farmer have one at least. Within 10 days, water of Cipanas River usually has been gone". He recalled that succesfull second rice crop were one out of three. Harvest of second rice crop never exceed 2.5 tons, which is half or less than harvest of first rice crop.

Before short duration rice variety used by farmers, on 1960s-1970s they cultivate a longer duration rice variety, take 5-6 months to be mature. Rice crop is cultivated at the end of rainfall peak, that is February or March. The crop will be mature on August.

Sarma repeatedly insisted that the flood and drought problem should be solved trough rehabilitation on river ecosystem. He urged " To manage frequent flood in Santing Village during rain season, Cipanas River should be diverted to Kali Tuans River". The river flow is stop since early 1980s due to heavy sedimentation. He suggested that the river should be rehabilitated. "The water can be used to storage water during rain season and use it during dry season" he suggested.   Sarma have raised the issues several time to Indramayu District Government and found no serious respond.

2. Rasim (49 years old)

Rasim are known as ’full time and hard worker farmer’ by his neighbour. Sarma said ”He work on farm and go home after the work on farm is finished. He do not spend much time mingle with others”. Rasim did not finish elementary school. He owned 5 bahu (1 bahu = 7.500 m2), which is more than average. He have sent two of his children to high higher education and become a civil servant and policeman.

Rasim is known by CFS participants as the only Santings’ farmer is still observing and recording rainfall pattern of his village. He used an oil can, attached to a 2 metress high bamboo, to capture rainfall during rain season. It is a simple tool immitated a standard OBS rainfall measurement. An instrument to measure temperature and humidity level is used to predict daily rain event. Rasim explained ”If the difference between temprature and humidity are 4 scale, there is great possibility rain will come that day”. The tool is provided by the CFS organizer one for each participating village.

Rasim do not yet used the rainfall record to predict rainfall pattern several days/weeks in advance. Rasim do not understand how to make use ’the inclination of rainfall’, as presented by trainer, for predicting rainfall pattern several days ahead. (From the evaluation, the knowledge of CFS participants in Karang Mulya was ranked on first place, and Santing farmers on second place (Tjahyadi, 2008 pers.comm)). He explained that ”It will be used for the future. Rainfall pattern is repeated in 8 years according to Java callendar knowledge”. Repetition is known as ”tepung gelang”.

From the 8 years rainfall record, he is expecting a new pattern of rainfall as result of climate change would come. He believe that from the 8 years record he would be able to tell what day rain event would come.   Rasim accepted the idea that climate is change. He observed that direction of rainfall is change. It used to start from mountain area where forest is present. Nowadays rainfall frequently started from ocean.

The CFS knowledge so far is used to predict daily rain event. ”If I think a rain will fail, I cancel my plan to fertilize land, or to harvest the crop at that moment. Sometimes I told my closest friend only about the possible rain. They have known briefly the basis of how to predict rain even”. When I met a group of eight farmers at Sarmas’ house, no one of them have ever asked to Rasim about his rainfall record and its use. Sarma explained ”a farmer would be ashamed if his prediction is inaccurate. So that Ratim would not actively share his rainfall observation, unless to closest friends”.

He expecting the rainfall record he produced would be used replacing traditional callendar Pranata Mangsa. This hope motivates him to continue the rainfall observation while other participants reluctant to do it. He said he was motivated to provide a legacy for his next generation.’ I hope I can produce a new farming callendar as a legacy to next generation. Like a prominent person who have produce traditional callendar Prana Mangsa. The new callendar will be compare to BMGs’ climate forecast for more accurate result’.

Being asked about the BMGs” climate forecast, Rasim responded ” we are frequently informed that rainfall will be normal, later we find the climate was drier. He mentioned government program in 1997 to anticipate possible dry season. Soy been seeds were provided for free. Most of farmers folllow the program. Kasim recalled ”It turn out the soy bean crop were drowned by heavy rain”. Later, farmers decide cropping pattern according habit. Seedling and planting time is decided by present of water to rice field, instead of using climate forecast information.

’Every one or two years, Srimulya of Indramayu Office of Agriculture come and ask me the progress of rainfall observation. He asked me why farmers still loss rice crop”. Kasim said an officer of Indramayu Disrict visited him and check his record if there is a team of climate expert and Ministry of Agricultural in Jakarta visisted the village.

To manage impact of flood during peak of rain season, which frequently take place on February, Rasim postpones planting time. Learning from experience, he arrange that rice crop would be tall enough but has not reach panicle intitiation phase (local term *bunting*, *pengisian malai* that can be literally translated in English as *pregnant*). He cultivated a strong and longer duration of rice, IR Kebo variety, as part of strategy to manage flood. Farmers are encourage to use IR Kebo since four years ago, when the selling price of this variety increases.

”Farmers have preferance on rice crop”Kasim concluded. Under condition of water deficit and lack of regular water source, secondary crop actually is avoided. ”Rice crop can survive from one month dry condition. While secondary crop would be die after several days”. Kasim has lost second rice crop four times after he followed the CFS. Though he will apply similar crop pattern; rice crop twice a year. ’A farmer will not give up cultivating rice. In fact, we are challenged if we fail in the past year’. Kasim also exlained”Having alternative work on salt production during dry season discourage farmer to spend time everyday on secondary crops”.

3. Taryono (24 yeasr old)
Taryono was a student with a university specifically on Islamic Study in Indramayu (Sekolah Tinggi Agama Islam) when participating in the 2003 CFS. He is not a farmer. He helps his father on rice field occasionally. Because his father is illiterate, he succeded him as participant in the middle of the program. He did not participate in previous two meetings about making rainfall observation and recording. After participating in the program, his knowoledge on the CFS program is limited. He did not share the CFS knowledge to his father nor apply it to farming practices. After graduate from the university, he works on micro-credit program funded by Village Administrative for household-scalle businesss acitivities.

4. Rastam (49 years old)
Rastam is relatively a wealthy farmer. He has a medium size house, a car and a small daily wares shop. He own 2.5 bahu of land in three different locations, which are in Santing Village, and Karang Mulya. He also rent land from other farmers. In August 2008, he was appointed by Village Administration as head of water user asscoation of Santing Village. ”I do not know what it is for. We have no irrigation water to be regulated among farmers here”.

Rastam is known as close friend of Rasim. He made rainfall observation and recording for 2 seasons until the tool was broken. He argued that he and other farmer did not apply the CFS knowledge since the program was not continued. According to original plan of the CFS program, implementaion of the program would be assited and monitored by local government (the CFS organizer). It did not happen.

The result of rainfall observation made by Rastam was collected to Rasim. He do not know the purpose of the rainfall record for current cropping pattern." We only record it and then submit it to Rasim. Later, the agricultural officer at sub-district office (*Kepala Cabang Dinas*) will collect it". "Untill 8 years the rainfall can be utilized". He occasionally ask Rasim make prediction of possible rain when they both found dark cloud appeared on sky. "Sometimes he make accurate rain even that day. Sometimes it is only wean and scattered rain".

He cultivates rice twice a year. He cultivate secondary crop on a small portion of higher land (local term: *tengger*). He have lost second rice crops of the latest three years. Before that, during 2002-2005, he earned 70 percent of average harvest. Since 2004 he cultivated IR Kebo, a longer duration rice variety, for better selling price and for having similar harvest time with neighbour farmers."We need to have rice variety that can be harvested on similar time". Longer duration rice variety, such as IR Kebo, is used only for first rice crop. For second rice crop, farmer use shorther duration rice variety, such as IR Ciherang and IR Melati.Like Rasim and other farmers, he postpones seddling and sowing time as a strategy to manage flood.

5. Abdullah (30 years old).
Abdullah is a teacher on secondary level school of Islamic Study. He works on 1 bahu of land. Abdullah and his wife lived with his parent. Two of his uncle, Kamsari and Kasnali participated in the CFS. They both live near Abdullahs' house.

Being asked again about the Climate Field School program, he seemed hesitate to explain it. He said he did not remember anymore the knowledge provided on the program. He never makes the rainfall observation nor aplly the CFS knowledge to his crop strategy. That program was not continued is his argument for not implementing the CFS knowledge.

Abdullah become a farmer since 1998. He cultivate rice crop twice a year. In the last three years, on year 2006 to 2008, second rice crops have been failed. Two years before, on year 2004 and 2005, the second rice crop were succeed. Since 2006, he applied `nyulik method` to shorten time of second rice planting. He has known the method before. He did not apply it before as his neighbour farmers did not apply it.' If I apply it alone, I will have my rice crop mature earlier than others. The crops can be eaten all by rats.' The 'nyulik method' is insisted by head of Losarang Sub-District (*camat*) on 2006. after knowing it from farmers of Karang Mulya. Since some of his neighbour farmers applied it, so did Abdullah. He can have his rice crop mature in the same time as other farmers.

During dry season, he work at salt production from 1 pm to 5 pm. He teachs in the morning. His father, uncle and member of family participated in salt production.

6. Kamsari (42 years old)
Kamsari was surprised when I visited him for interview of the CFS. He have thought the topic has been forgotten. He said he did not remember the knowledge anymore, but from interview I found that he understand well the knowledge and purpose of the program better than other participants.

Kamsari graduated from high school in 1987. After married in 1990, he became full time farmer on his own land. Since one year ago, his wife is working in Saudi Arabic as household assistant. It made him single parent with 2 years daughter.

Kamsari owned half hectares land. He cultivates rice twice a year. For the first rice crop, he selected longer duration IR Kebo rice variety for its good selling price since 4 years ago. He found IR Kebo strength trunk would be suitable to deal with flood. For second rice crop, he chooses shorter rice variety IR Ciherang. Since 2000, he have loss the second rice crop three times, year 2003, 2007 and 2008). He worked at salt production mine during dry season.

Kamsari and his brother, Kasmali, and his nephew Abdullah participated in the 2003 Climate Field School. Their houses are close each other. The OBS rainfall measurement equipment is stored in Kamsari place. Though, it was used to observe rainfall only for one season. That government did not assist and evaluate the continuation of the program make him stops doing it anymore.

He believes that making rainfall observation and recording for a longer time, not only 1 to 2 years, would be usefull for cropping strategy. He did not want to do it for a longer time. He explained that he is busy with making living (It seems farmer considers the rainfall observation and recording is not directly part of making livelihood).

When Kamsari measuring rainfall collected in the equipment, his neighbours asked him the purposes of the OBS. Though, no farmers want to know more about how to measure nor to replicate it. He emphasized 'farmers will replicate something if it bring result, which mean production or money. If the participants of the CFS did not continue, so did others'.

Kamsari noticed the traditional believe hold by most of farmers that climate is repeated every 32 years. He has different opinion. He have observed the rain patten, did not necessary using a tool, since 1990s. He found dry season were not displaying similar pattern of any rainfall at these moment. From the CFS program, he acknowledge that forest degradation have changed climate pattern. Hence, he found no use of making rainfall record and use it for the future. He

Being asked the benefit of the 2003 CFS, Kamsari said his pest management is improve. Nowadays, he uses pesticide in more efficent and effective manner. He followed Farmer Field School on Integrated Pest Management several years before. He claimed the knowledge was improved and strenghtened after folloing the CFS.

Kamsari has never cultivated secondary crops on second planting schedule. He was comvinced that farmers in his village will not change into secondary crops eventhough have failed several times. He remembered that Government of Indramayu District have launched secondary crops program to anticipate drought condition. 'It turn out rainfall level was high. The secondary crops were failed. Farmers decided will not have secondary crops anymore'.

Secondary crops are planted by farmers only on limited portion of land for daily need, and as back year plants. During study, i was informed that there are thwo farmers were cultivating secondary crops during dry season outside of Santing Village. One of them tried it for the first time. Kamsari said ’Most of farmers will cover loss from second rice crops by working at salt production’.

Being asked about the climate forecast information of BMG, Kamsari admitted the instution have human resource and technology to make observation. He believed the data is reliable than record data of CFS participant. Though farmers did not follow recomendation made by government on the basis of BMGs’ climate forecast. He stated”Some times it was accurate, and sometimes it was not.

Non CFS Participants

8. Kalihin (64 years old)

Kalihin own 1.5 bahu of land. He cultivates rice twice a year. During the dry season, after harvest time of second rice, he always works at salt production. He is close friend of Rasim. Their farms are nearby. Rasim claimed that Kalihin is one of few friends he have shared about the rainfall measurement and sometimes give him predicition of rain event.

Kalihin was father of Abdullah, as well as older brother of Kamsari and Kasmali, the CFS participants. The brothers live near to his house. The standard rainfall measurement device, OBS, was stored in front of Kamsaris’ house. He can see the tool was intalled at Kamsaris’ house for one season. He admitted has no knowledge on the purpose of the rainfall record. He recalled ‘The rainfall was captured and measured with ruler. I didn’t know how to measure it and what was the next step. I did not ask further because I am busy at farm’. Kalihin also admitted did not know much about Rasim work on rainfall measurement.

Kalihin do not use climate forcast information for his cropping strategy. Observing cropping pattern’s majority of farmers is input for his cropping strategy. He said ’farmers in one block of farm are harmonious. Eventhough farmers use different rice variety, life duration of the rice must be similar. One block farm could have different choice with other block. He use longer duration variety IR Kebo for first planting schedule since four years ago following other farmers at the same farms block.

He argued ”The IR Kebo is stronger in flood situation than other variety”. Kalihin recalled that river flood has been occured since he was chlidhood. He lost rice crop due to flood on 1982.

Kalihin cultivated rice twice a year since mid 1987. Before that year, he and others cultivated *Gogo Ranca,* a longer duration dry-resistant rice variety. At that moment, farmer cultivate rice crop only once a year. After rice was harvested, farmers went to salt production. The land was unoccupied.

Once, Kalihin cultivated secondary crop on higher part of his land (local term: tengger land) at second planting shedulle. It did not succced as the crop was attacked by worm. He do not continue it anymore. ’ Because I was alone cultivating the secondary crop, no friend can be asked for the crop he has no experience with’. He determined for not going to cultivate the secondary crop anymore.

Kalihin have heard about”Nyulik” method as startegy to shorthen planting time of second rice crop. He do not apply it as he prepared seed on separate land. Seedling was started several days before harvesting time of first rice crop. The objective is similar as in ’nyulik’ method, which is applied by farmer who have limited land.

9. Kasta (46 years old)

Kasta started being a farmer while he was student. He graduate from secondary education (Sekolah Menengah Pertama). He work on his own land after married. He had 2 bahu of land before, and later half of the land was sold to support education of his children.

Like other farmers in the village, he cultivated rice twice a year. He choose long duration IR Kebo for first rice crop since 3 years ago. The production can reach 7 ton per *bahu*. Kasta said he shift from IR Ciherang to IR Kebo for first rice crop because the selling price is increase. Other farmers in the village have started one year earlier. In addition, he did not want to have harvest earlier than his neighbour farmer, which is the case if he choose IR Ciherang. By having harvest in the same time, risk of the mature rice to be attacked by rats will be distribute evely among the farmers.

For second rice he choose shorter duration variety IR Ciherang. In the last three sequent years he have lost his rice crops due to water deficit. In year 2008, for example, the crop produced only 1 ton. In year 2004 and 2005, the production was 2 tons. ”At least 3 ton of harvest can cover all of the exapenses” he explained. From the first rice crop, the average production can reach 4.5 tons.

Kasta has never cultivated secondary crops. ”I have no intention to to that even several fail of seond rice crop” . He implement ’nyulik” method recently to shorten planting time of second rice crop. He apply the method if only water was remain sufficien at that moment or assuming rainfall will not end soon.

Kasta never use climate information for his cropping startegy. He occasionally attended farmer-extension officer meeting. He do not know that the climate forecast information were produced by BMG (Indonesian agency for climate and weather observation). Kasta do not look upon Pranta Mangsa to determine time planting. He depend on water present and cropping pattern of his surrounding farmers as input for his cropping strategy.

During dry season, he work on salt production. The salt mine, cover 2.020 m2, is owned by his family. Everyday, for six day a week, the mine can produce 700 kg of salt. The income from salt production is slightly better than from rice crop. It also provide regular job for people who do not own salt mine. Farmers of Santing Village do not have to go a city to find jon during dry season, like many farmers at different village have to choose.

He did not selected to be participant of the CFS in year 2003. He have heard about the program, but doesn’t know anything about what knowledge has been given. Though he lived in about 500 metress from Rasim, he completely do not know about rainfall measurement and its use. ”We never heard about it”.

Appendix 3
A sample of Seasonal Forecast on Rain Season year 2008/2009

See: **http://www.bmg.go.id/data.bmg?jenis=teks&ids=3093805704743005223**