ADIKAVI NANNAYA UNIVERSITY
RAJAMAHENDRAVARAM

DEPARTMENT OF MANAGEMENT STUDIES

In Collaboration with

Andalas University, Padang, Indonesia

Certificate

2nd International Conference on Green Development in Tropical Regions - 2017

This is to certify that Prof/Dr/Mr/Mrs/Ms Rudi Febriamansyah

has participated / presented a paper entitled Climatic changes and Natural Resource Management: finding and lesson learn in West Sumatera.

in "Challenges and Strategies for Global Sustainable and Green Economic Development (CSGSGED) 26th - 28th July 2017" organized by Department of Management Studies, Adikavi Nannaya University in collaboration with Andalas University, Padang, Indonesia.

Prof. Rudi Febriamansyah
Co-Chairman

Prof. S. Teki
Chairman

गैल GAIL Rajahmundry

ओएनजीसी ONGC Rajahmundry Asset

Webpros Solutions (Exell International Group Inc. NJ, USA)

State Bank of India Diwancheruvu

"STUDIES ON CLIMATE CHANGES AND NATURAL RESOURCES MANAGEMENT: FINDINGS AND LESSON LEARNED FROM WEST SUMATERA, INDONESIA"

by: Rudi Febriamansyah

Department Social and Economic of Agriculture
Faculty of Agriculture, Andalas University

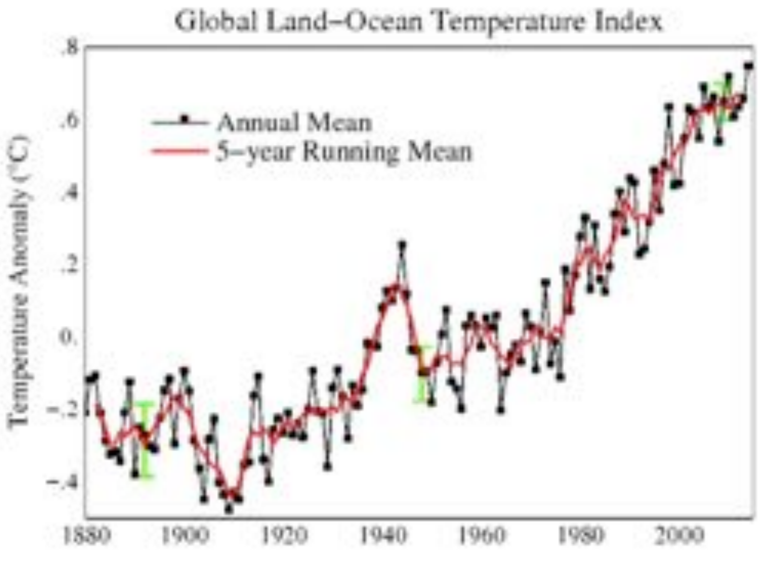
presented in IC on GDTR, 26-28July 2017, ANU, INDIA

Outline

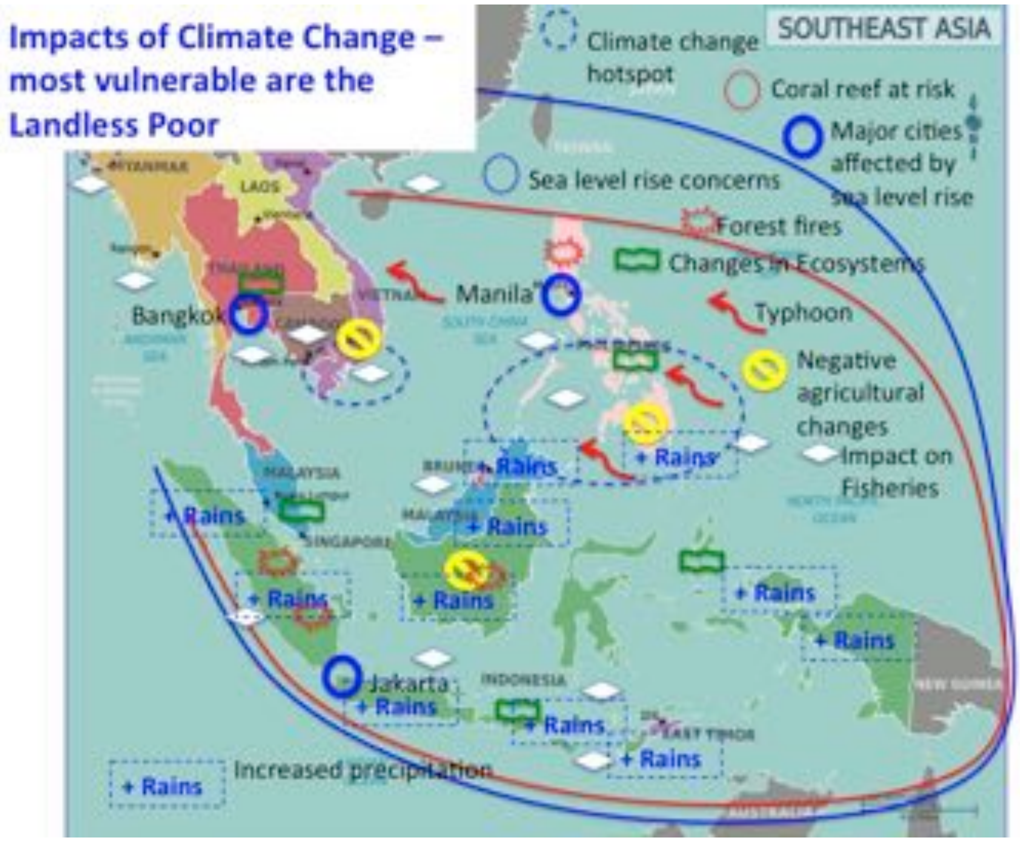
- Introduction: the climate changes
- Overviews of the study site
- Issues in the case site
- The objective of study
- Results of the study
- Lesson learns and further research agenda

Introduction

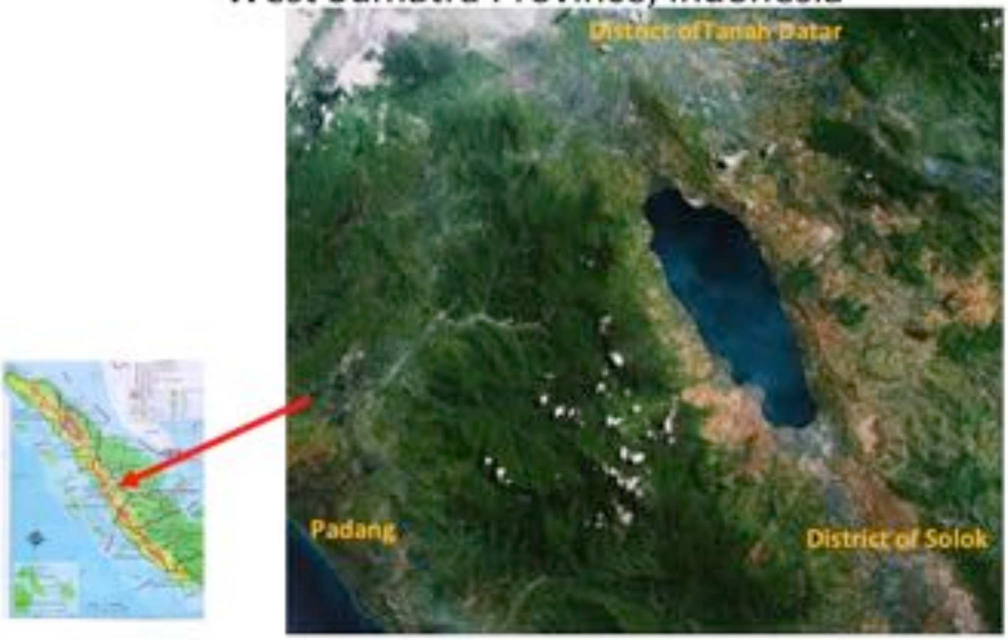
- Climate refers to the atmospheric conditions (sunlight, temperature, rainfall, etc.) of a place in many years, while weather is daily. *Climate is what you expect, weather is what you get.*
- Anthropogenic global warming or climate change (AGW, ACC) is caused by man's spewing of greenhouse gases (GHG) like carbon dioxide, methane, etc. to the earth's atmosphere.
- **GHG allows the sun to heat earth, but it stops heat bouncing back to outer space, causing earth's increased warming!**



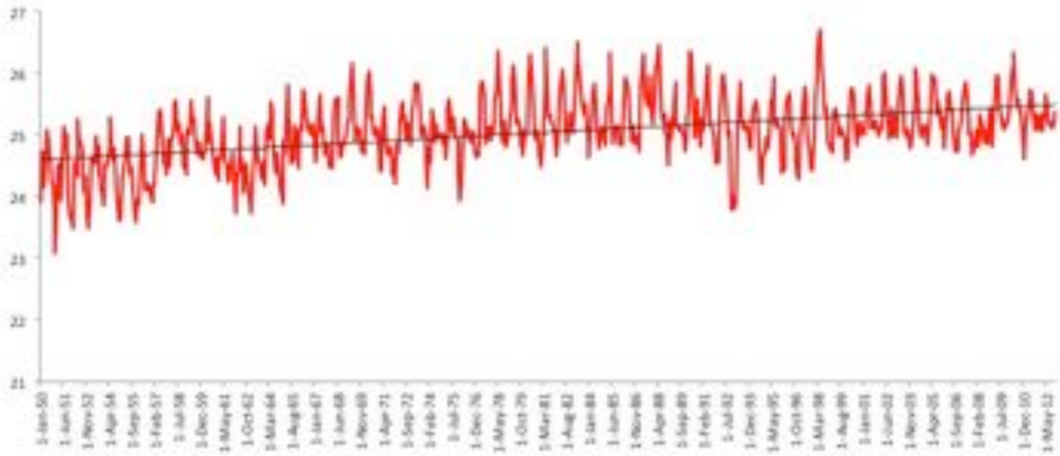
Line plot of global mean land-ocean temperature index, 1880 to present, with the base period 1951-1980. The dotted black line is the annual mean and solid red line is the five-year mean. The green bars show uncertain estimates. Source: Hansen, J., R. Ruedy, M. Sato, and K. Lo. 2010. "Global Surface Temperature Change." Reviews of Geophysics 48: 1-29.



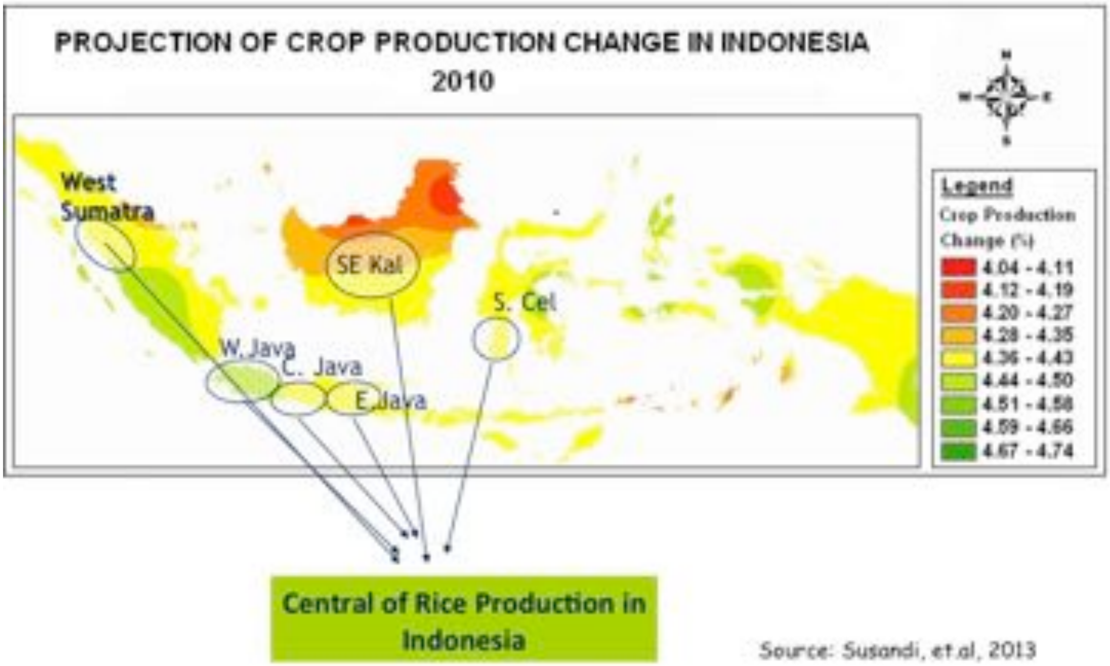
The Study site: surrounding Lake Singkarak, in West Sumatra Province, Indonesia



Trend of the average Temperature in West Sumatra region



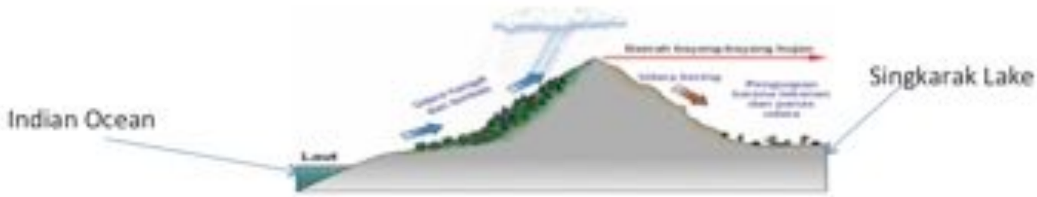
Source: Susandi, et.al, 2013



Source: Susandi, et.al, 2013

Issues in the study site

- The surrounding of Singkarak Lake in West Sumatera have been intensively studied by various experts from various disciplines for almost three decades.
- The issues varies from deforestation in the catchment area, fragile land in the hilly areas, water scarcity in the irrigated and unirrigated paddy-fields, and the degradation of endemic fish species (*ikan bilih*) in the Lake Singkarak.
- One of the main concern of this research (sponsored by PEER-USAID project) is about the agricultural and livelihood changes in the surrounding Singkarak. The region in the surrounding Singkarak Lake is located in the rain-shadow area (*daerah bayang-bayang hujan*).



The objective of the study

- Based on the above mentioned background and research problems, a series of researches have been conducted:
  - to identify the empirical facts of climate change in the study site and
  - to describe the impact of climate change to the agricultural activities and the livelihoods of the local communities in the study site.

  Based on those researches, this study has identified further investigation could be implemented in this region.
- This PEER-USAID research funds has supported 2 PhD, 4 M.Sc., and 2 B.A. Students research projects – most of them started in the mid of 2014

Results of the study

1. Climate variabilities in the study site

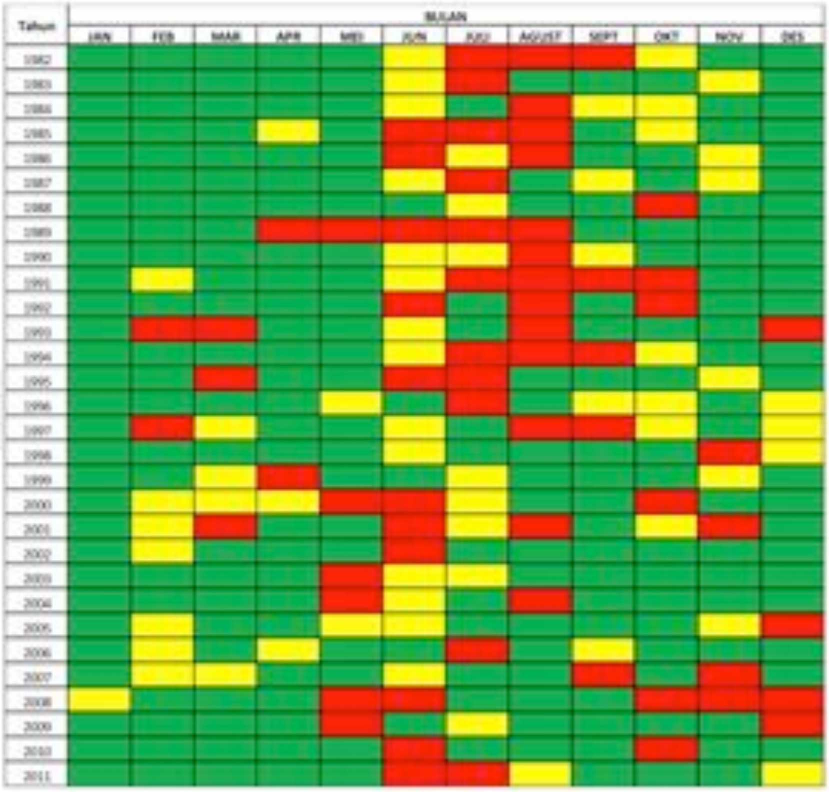
Early climate study mentioned that:

- the western part of Sumatera island get the maximum rainfall in Nopember and December and minimum rainfall in July or August.

Slamet and Berliana (2008) use schmid-fergusson method to identify the shift of rainfal pattern in Solok (close to Rambatan)

The eastern part of "bukit barisan" (mountainous line along Sumatera island) get lesser rainfall as the rain-shadow area.

Current Rainfall variability 1982-2012 in Rambatan/ Singkarak Lake



dry month: < 60 mm
humid month : 60 - 100 mm
wet month: > 100mm

In average:
7,6 wet months
2,1 humid months
2,3 dry months

2. The vulnerability analysis of the region

- This study have used the IPCC concept to measure the vulnerability of the region to the climate changes, through the Exposure Index (EI), Sensitivity Index (SI) and Adaptive Capacity Index (ACI) by applying Focused Group Discussion, Field observation and Secondary data analysis for all 13 Nagaris (Villages) in the surrounding Singkarak Lake.
- In order to measure the vulnerability in the case site, this study applied in-depth interview with relevant key informants, secondary data analysis and conducting focused group discussion (FGD) at each Nagaris with such as agriculture extention officers, nagari leaders and other key persons.

The result of vulnerability analysis

Position	Nagari	Vuln. Index	Category
Eastern Villages (nagaris)	BTB	0.42	Med
	TGK	0.72	High
	TKL	0.53	Med
	KCG	0.81	High
	SMG	1.00	Very High
	SGK	0.58	Med
	SMN	0.72	High
Western Villages (nagari	SMP	0.00	Very Low
	PLM	0.60	Med
	GGM	0.52	Med
	PNG	0.39	Low
	MPG	0.55	Med
	SNB	0.24	Med

the eastern side of the Lake is more vulnerable compare to the western side. Based the vulnerability index at each Nagari, Nagari Simawang (SMG) in the eastern of the Lake is facing the most vulnerable Nagari in this region.

3. The agriculture and livelihood changes in the most vulnerable Village

- In Nagari of Simawang (SMG), for more than 30 years, farmers could not able to cultivate paddy in their rainfed sawah (more than 300 ha).
- Old people even mentioned that since 1980s, their rainfed sawah are getting dryer and dryer.

Research teamwork, 2013

Statistics of Simawang village

- The area of Nagari: 5.400 ha
- Consist of 8 sub-villages (*jorong*)
- Population: 1.952 Households = 9000 inhabitants
- Majority are farmers (80%)
- 525 HH are considered Poor (regularly got rice subsidy)

The impacts to rainfed paddy farmers

SOURCE OF INCOME

Before dried	
average rainfed paddy field	cultivate 0.4 ha rainfed paddy, for almost twice a year
average production	1.400 kg Gabah per season
sold paddy	20% HH sold their paddy for about 25% of yield
dry-land farm *(ladang)*	40% HH cultivate their dry land for cassava, corn and sometimes chili
After dried (current condition)	
% HH cultivate their rainfed paddy field	only 5% (around 5 HH) still able to cultivate their rainfed field, for at least one a year
% HH own cattle	25% HH (started from 1990s)
average cattle per HH	3 cattle (sapi/kerbau) and
	3 goats (kambing)
rice acquisition	20% HH cultivate another paddy fields
	80% HH buy from market
	40% HH got rice subsidy *(raskin)*
other sources of income	42% HH working as farm labour
	25% HH working as building labour
	13% HH working as trader (coffee shop or warung)
	21% HH work in other services
migration	almost 75% of HH mentioned that some of their members migrate to the nearest city, and 10% of them have migrated since 1980s

Land use changes

1976

2000

2008

No	Jenis Lahan	1976		2000		2008	
		Ha	%	Ha	%	Ha	%
1	paddy-field	131,60	5,33%	245,83	9,96%	185,51	7,52%
2	settlement	156,50	6,34%	159,99	6,48%	209,67	8,50%
3	road	13,40	0,54%	14,56	0,59%	15,66	0,63%
4	dry land (ladang)	503,43	20,40%	628,23	25,46%	1078,2	43,69%
5	water body (talago)	66,21	2,68%	52,98	2,15%	50,48	2,05%
6	pine forest	207,09	8,39%	125,58	5,09%	70,19	2,84%
7	Semak Belukar (shrub)	530,17	21,48%	437,62	17,73%	26,52	1,07%
8	Alang-Alang (grass area)	303,92	12,32%	98,98	4,01%	102,23	4,14%
9	Kebun Campuran (mix farms)	497,20	20,15%	645,75	26,17%	671,06	27,19%
10	Kebun Kelapa (coconut farm)	58,29	2,36%	58,29	2,36%	58,29	2,36%
		2.467,81	100%	2.467,81	100%	2.467,81	100%

Identification of adaptation in their rainfed field

Mitchell and Tanner (2008) defined adaptation as an understanding of how individuals, groups and natural systems can prepare for and respond to changes in climate or their environment

- Intensif cattle management (one farmer group, since 2011)

- Raising cattle in grazing at the dried paddy field(individual action)

4. Economic risk assessment of red-onion in the western of Singkarak Lake *

- Nagari Saning Baka (SNB) in the eastern of Singkarak was known a center of red onion production in West Sumatera province. However, since around 1980s, secondary data from local government showed significant decreased of production area of this crop. Local farmers mentioned factor of climate, especially the uncertainty of rainfall season this region has causes the uncertainty to produce better harvest of this red onion. Since 2000, only 25% of potential area are planted for this crop.
- This study have tried to identified factors that influence the production risk of red onion in this region by using regression analysis to test some hypothetical input factors, like numbers of seed, fertilizer, volume of pesticides, frequency of pesticides applied, labor, and variety of red onion itself.

Production Risk (Y) = $\beta_0 + \beta_1 X1 + \beta_2 D_1 + \beta_3 D_2 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 D_3 + U$

*Laily Fitriana, Rudi Febriamansyah, and Refdinal , 2015

Statistical results

No	Variable	Dry Season			Wet Season		
		Coefficient	t. Statistic	Sig.	Coefficient	t. Statistic	Sig.
1.	Constant	488,267	2,875	0,008	-348,115	-2,541	0,017
2.	Single fertilizer	0,729	615	0,512	0,729	2,621*	0,014
3.	Organic fertilizer	-147,215	-0,215	0,234	-148,346	-1,592	0,123
4.	Leaf fertilizer	75,152	0,715	0,480	250,587	3,076*	0,005
5.	Pesticide	2,422	-0,324	0,748	17,081	5,536*	0,000
6.	Freq. Spraying	-2,911	0,642	0,535	1,555	0,721	0,477
7.	Variety	-146,108	-1,773	0,087	-112,910	-1,084	0,288
F stat			**1,088**	**Sig: 0,394**		**10,439**	**Sig 0,000**
F Table			**2,445**			**2,445**	
R^2			**0,189**			**0,691**	

Dependent variable: Risk *) Significant

The production risk as dependent variable is identified by calculating the variance of production for each farmer. This study uses cross section data by collecting information from 70 farmers as sample.

Economic risk assessment (cont.)

- As a result, the risk analysis showed that farmers are facing high risk in their farm, and higher risk in hot season compare to rainy season. The expected production of red onion is only 3.2 Ton/Ha per planting season.
- The result for regression analysis showed that only three input factors have showed high significance in influencing the production risk of red onion, are; the use of single fertilizer, leaf fertilizer and the uses of pesticides.

5. The Economic analysis of agroforestry *

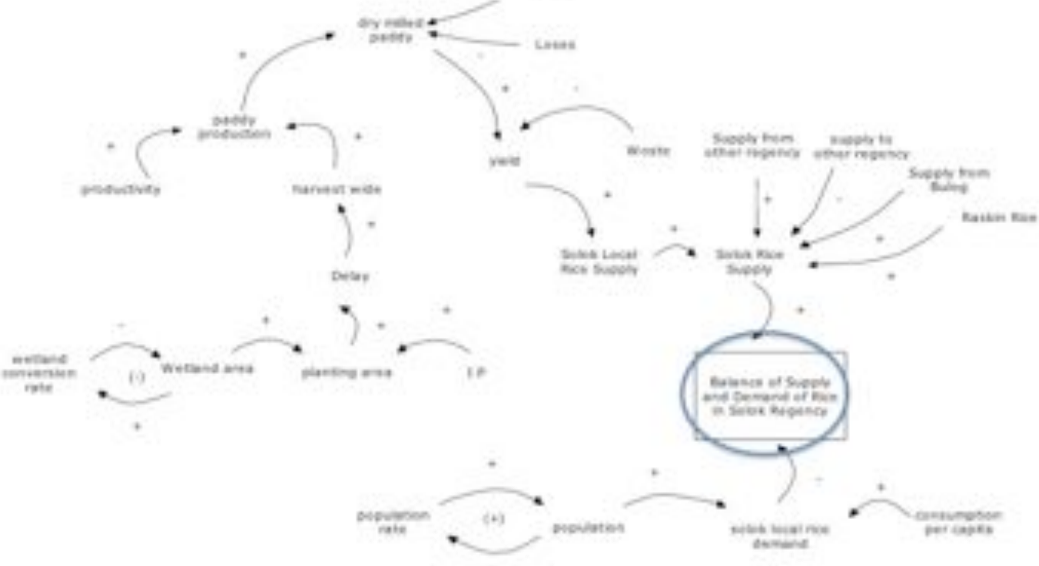
- The Critical land area in the village of Paninggahan (PNG) are around 2.700 Ha.
- The agroforestry project in this nagari has tried to support the villagers to develop agroforestry practices in this critical land area since 2010.
- This study has tried to analyze economic feasibility of this agroforestry project.
- From 2010-2015, the villager has planted several agroforestry crops for around 31,65 ha and absorbed the financial assistance for Rp.1.371.923.020,-
- The result of economic feasibility analysis (5 years period):
  - The B / C Ratio of 1,02, with
  - NPW of Rp 18.533.726
  - EIRR of 12,05%.

* Anugrah Sriwidiasyih and Rudi Febriamansyah, 2015

The Economic analysis (cont.)

- This Agroforestry Project has a positive impact on the community and environment as (1) reduce the critical land, and prevent the occurrence of fires, (2) increase the air absorption of CO_2 impact on the environment, and (3) Increase employment opportunities.
- The results of this research could be used as information for farmers on the improvement of degraded land and for the government as a basis for policy making and extension for agroforestry project development in the local area.

6. Dynamic modeling of rice availability in the study area



Gebry Ayu and Rudi Febriamansyah, 2015,

The result of dynamic simulation

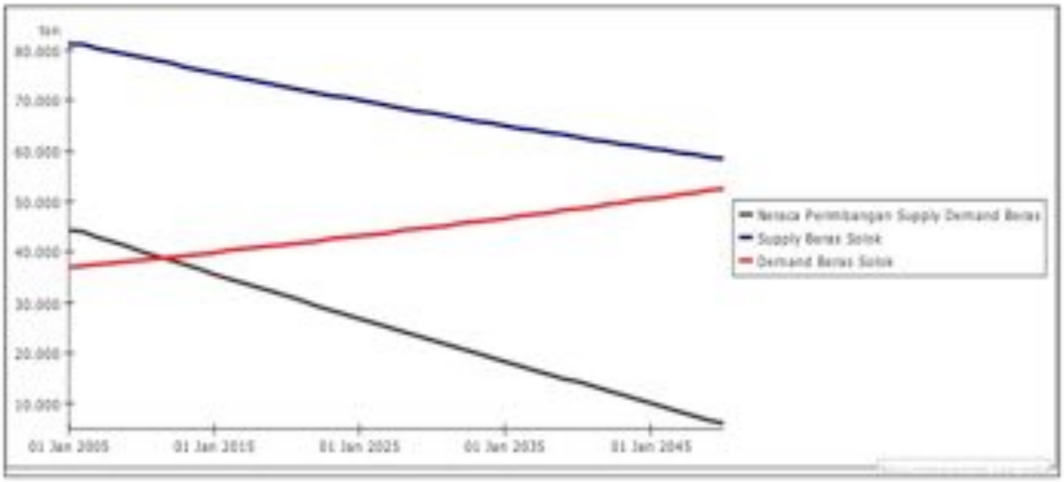
01 Jan 2020	50.533,95	41.513,64	9.020,31
01 Jan 2021	50.130,77	41.841,19	8.289,58
01 Jan 2022	49.731,13	42.171,31	7.559,81
01 Jan 2023	49.335,01	42.504,05	6.830,96
01 Jan 2024	48.942,37	42.839,40	6.102,97
01 Jan 2025	48.553,19	43.177,41	5.375,79
01 Jan 2026	48.167,44	43.518,08	4.649,36
01 Jan 2027	47.785,08	43.861,43	3.923,64
01 Jan 2028	47.406,08	44.207,50	3.198,58
01 Jan 2029	47.030,42	44.556,30	2.474,13
01 Jan 2030	46.658,07	44.907,85	1.750,22
01 Jan [illegible]	[illegible]	[illegible]	[illegible],82
01 Jan 2032	45.923,16	45.619,29	303,87
01 Jan 2033	45.560,55	45.979,22	-418,67
01 Jan 2034	45.201,13	46.342,00	-1.140,87
01 Jan 2035	44.844,87	46.707,64	-1.862,76
01 Jan 2036	44.491,75	47.076,16	-2.584,41
01 Jan 2037	44.141,74	47.447,59	-3.305,85
01 Jan 2038	43.794,80	47.821,95	-4.027,15
01 Jan 2039	43.450,92	48.199,27	-4.748,35
01 Jan 2040	43.110,07	48.579,56	-5.469,49
01 Jan 2041	42.772,21	48.962,85	-6.190,64
01 Jan 2042	42.437,33	49.349,17	-6.911,84
01 Jan 2043	42.105,40	49.738,54	-7.633,14
01 Jan 2044	41.776,38	50.130,97	-8.354,59
01 Jan 2045	41.450,26	50.526,51	-9.076,24
01 Jan 2046	41.127,01	50.925,16	-9.798,15
01 Jan 2047	40.806,61	51.326,96	-10.520,35
01 Jan 2048	40.489,02	51.731,93	-11.242,91
01 Jan 2049	40.174,23	52.140,09	-11.965,86
01 Jan 2050	39.862,21	52.551,48	-12.689,27

Alternative policies

5 alternatives policies for model implementation :

1. Adding net wetland
   - Solok has some potential area that can use as wetland 4.564 Ha
   - There are grassland, shrubs, and moors
   - Target of alternatives policies : increasing of wetland 50 Ha per year
2. Irrigation development
   - Consist of two program: develop tersier irrigation syst, and rehabilitate irrigation system
   - Target of alternative policies : increasing of planting indeks 0,5 per MT
3. Land optimalization
   - The program is consist of some subsidy of technology packages, seed, fertilizer, and pesticide.
   - Technology package : JARWO – Jajar Legowo – SRI
   - Target of alternatives policies : increasing of productivity 0,5 ton/ha and increasing of planting index 0,5 per MT
4. Harvest and postharvest improvement
   - Consist of : subsidy for postharvest machinery, rehabilitate rice miller
   - Target of alternative policies : decreasing loses 5%, decreasing waste 4%, and rendemen rate 62,5%
5. Combination alternatives
   - Is a combination of all alternatives, with assumption that Solok Government can undertake all efforts to increase rice production through all alternatives above.
   - Target of alternative policies : increasing wetland 50 Ha/year, increasing planting indeks 0,5 per MT, increasing productivity 0,5 ton/ha, decreasing loses 5%, decreasing woste 4%, and rendemen rate 62,5%

The results of alternative simulation



The model – has moved the defisit of rice availability from 2030 to 2050

Findings and Lesson learned

- Global warming → local climate changes
- Form of climate change → changes of rainfall variability
- Rainfall variability → uncertainty of the water availability for especially the rainfed-paddy area
- As the rain-shadow area, the eastern of Singkarak are getting more dryer than the western side – more Vulnerable
- Agroforestry is potential alternative to reduce critical land and generate additional income for villagers in the catchment area
- If there are no much actions, Solok regency, the region that is currently well known as the central region of rice supply in West Sumatra province → could be lack of supply (defisit) in the year of 2033

Further research agenda

- Indepth study and action research on the institutional and management aspects to support:
  - integrated farming system in the rainfed areas.
  - nursery business and conservation action to their degraded catchment area
- Conducting a pilot project to develop an integrated catchment management model for one specific river basin in the Singkarak Lake basin.
- Developing simulation model of rice availability (Supply-demand model) by including climate as dynamic factor.

Thank you very much for your kind attention