University of Tsukuba
Graduate School of Life and Environment Sciences

Economic analysis of GHG emission reduction options for rice cultivation: A case study in Nam Dinh province, Vietnam.

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5. Primary conclusion and discussion
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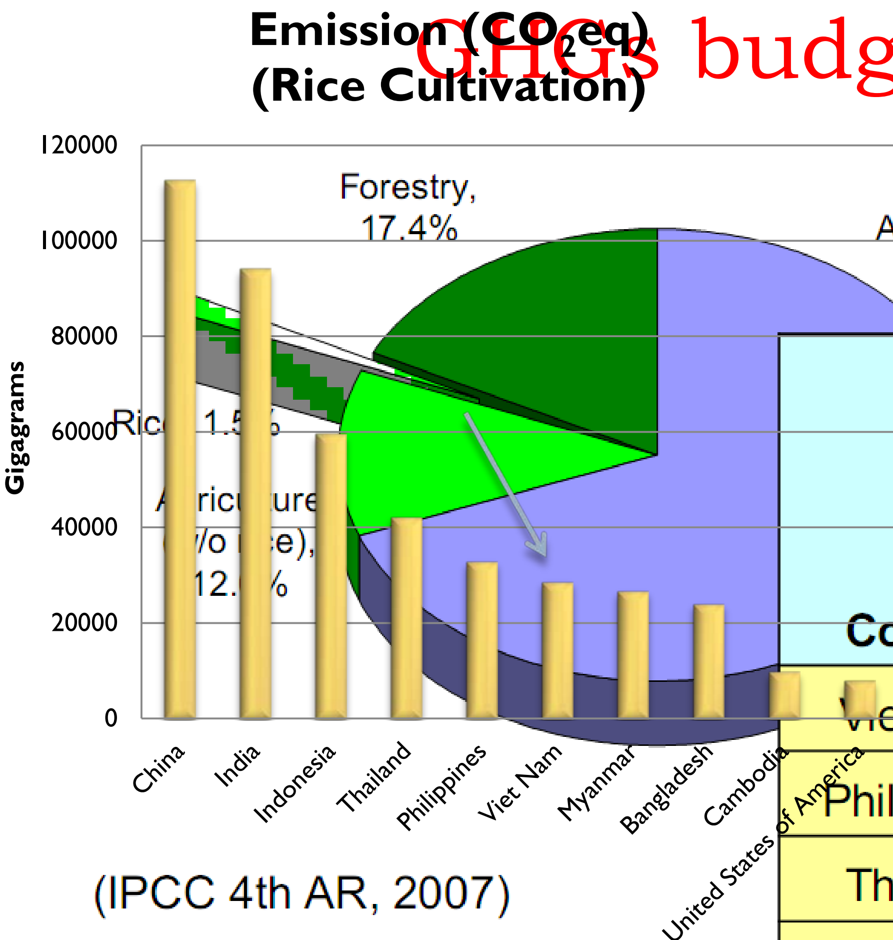
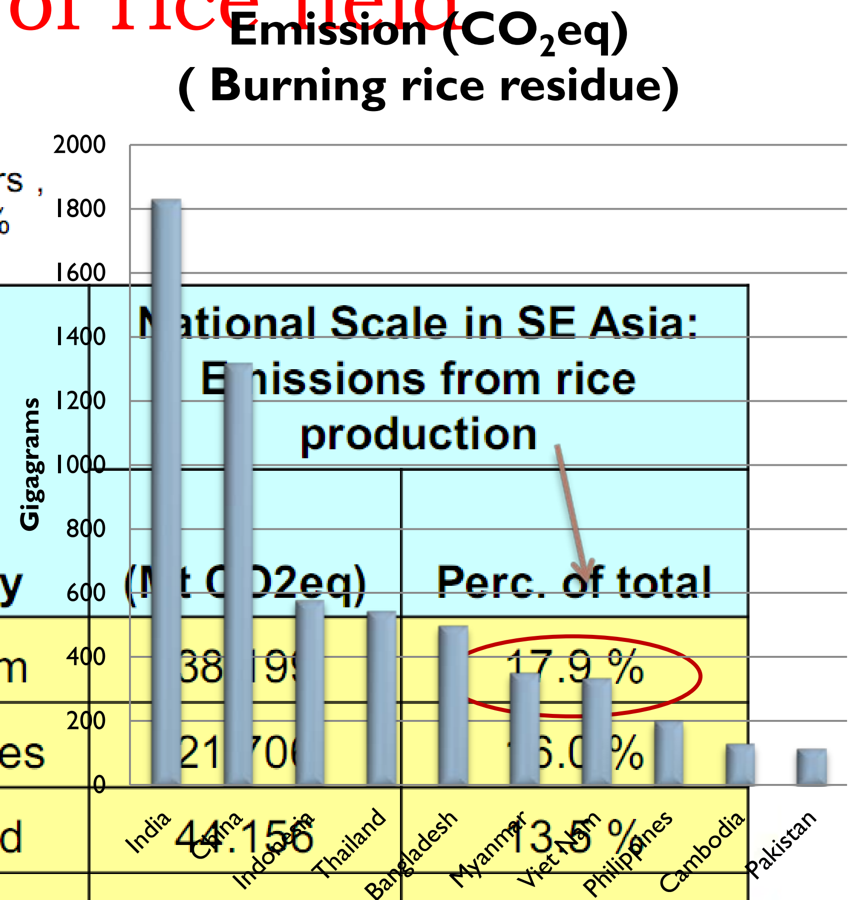
1. Background

Top 10 emitters

GHGs budget of rice field



(IPCC 4th AR, 2007)



National Scale in SE Asia: Emissions from rice production

Country	(Mt CO2eq)	Perc. of total
Viet Nam	38 19[illegible]	17.9 %
Philippines	21 70[illegible]	[illegible]6.0 %
Thailand	44.156	13.5 %
Indonesia	53.856	1.9 %

Source: FAOSTAT,2012

Source: Wassman, IRRI, 2010

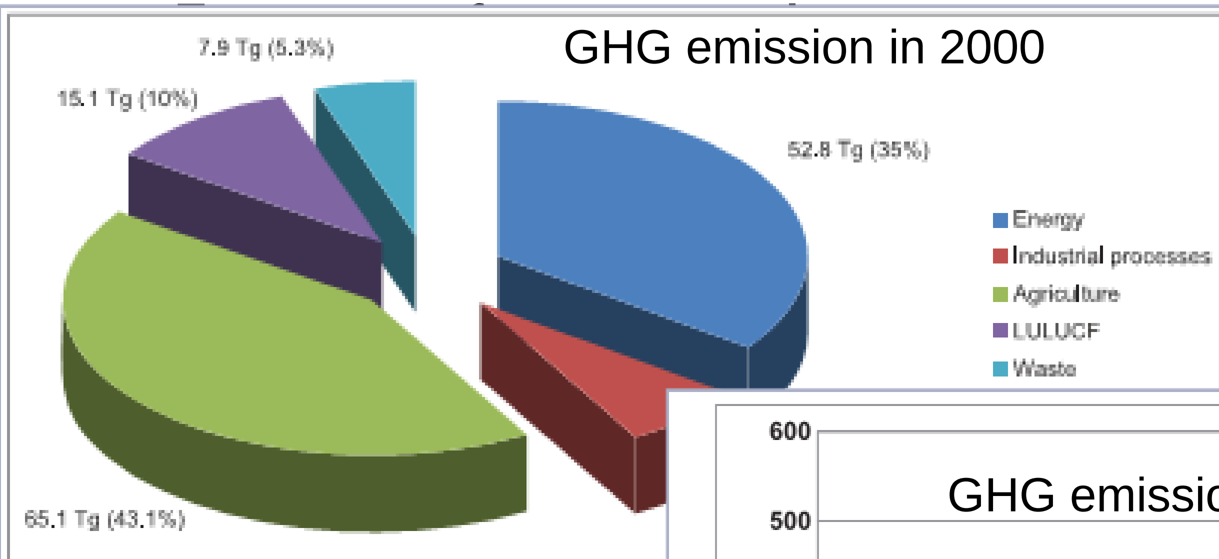
1. Background

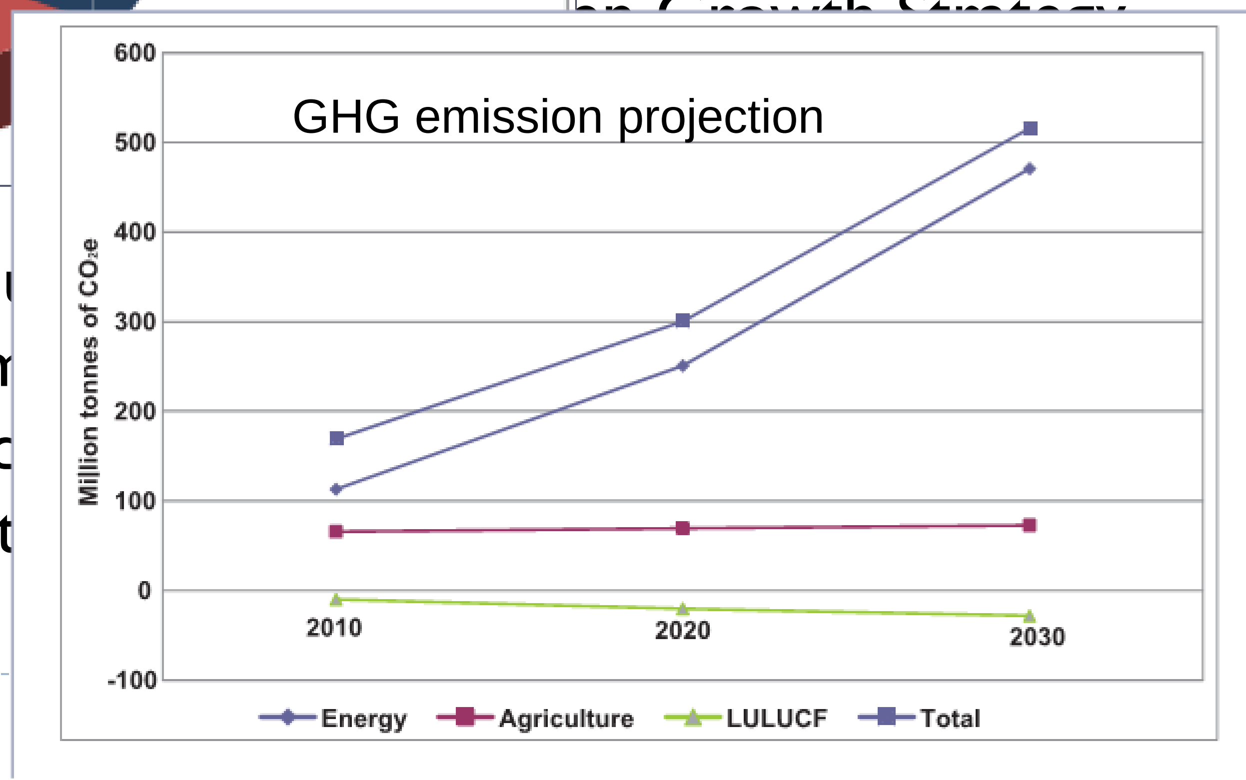
43.1 % of Vietnam's
cultivation
IRE, VSNC, 2010)

n Growth Strategy

objectives

- Ministry of Agric
reduce carbon em
percent, while rec
increasing agricult
20 percent.

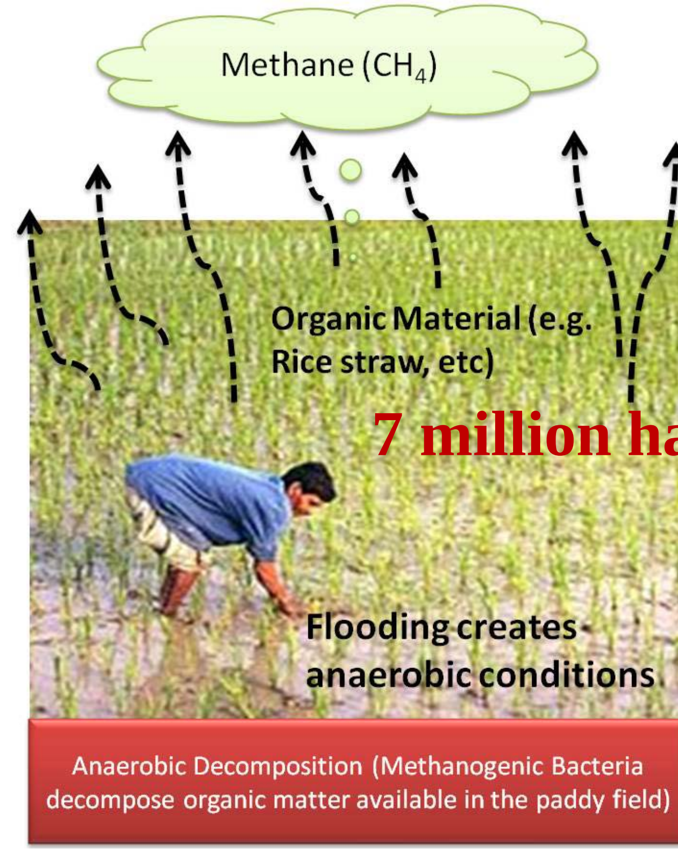




1. Background

80 million tons of agricultural residue

Source: IAE



Source: Wassman,IRRI

A huge amount of carbon emission

Q1: How to solve agricultural residue burnt?

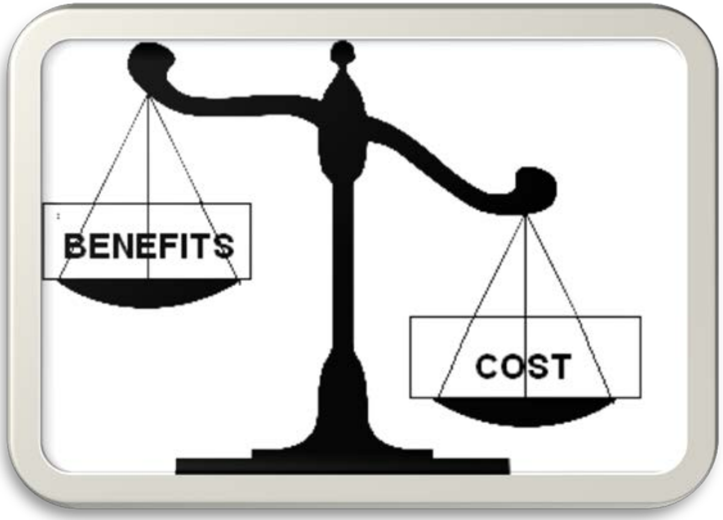
Q2: How to reduce emission from rice cultivation?

Achieving low emission grow for rice cultivation in Vietnam

2. OBJECTIVE

- Assessing environmental consequences of traditional rice farming practices in term of GHG emission.
- Evaluating the cost-effectiveness and adoption of selected GHG reduction options for rice cultivation.

➢The use of alternative organic fertilizer (biochar and compost)
➢The application of Alternative Wetting and Drying (AWD)



➔Find out the most climate-smart agriculture system

+ Improve rice production

+ Reduce GHG emission

Mitigation option 1: Using Biochar

Picture are taken by IAE, Vietnam)

Mitigation option 2: Using Compost

Avoid high emission from burning residue

Soil fertility improvement

Creates biologically healthy soils

Source: IAE

Option 3: Alternative Wet and Dry (AWD) irrigation method

Picture are taken by IAE, Vietnam)

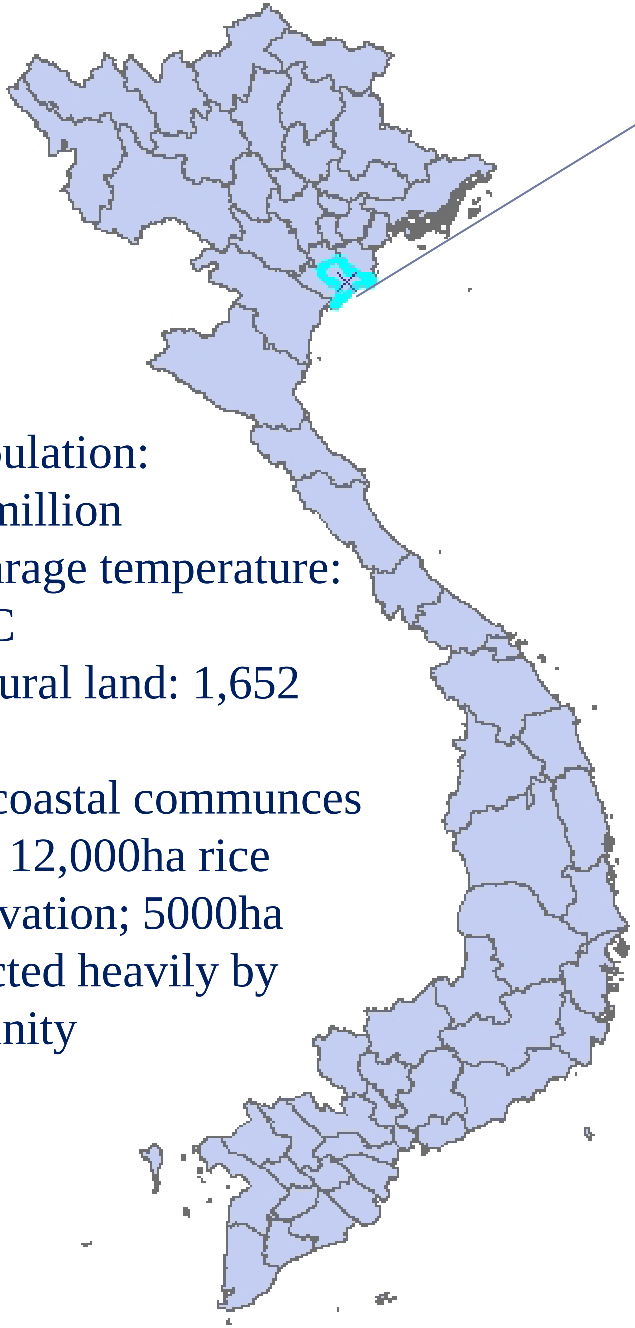
Saving water

Shifting from flood irrigation to AWD irrigation → soil turns from anaerobic condition to aerobic condition

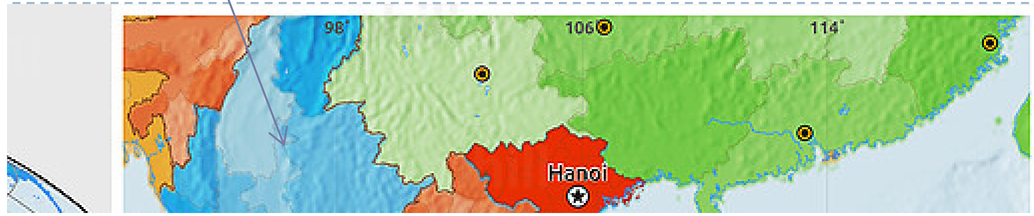
Reducing GHGs emission

Study site

Thinh Long: 40 households
Rang Dong: 40 households

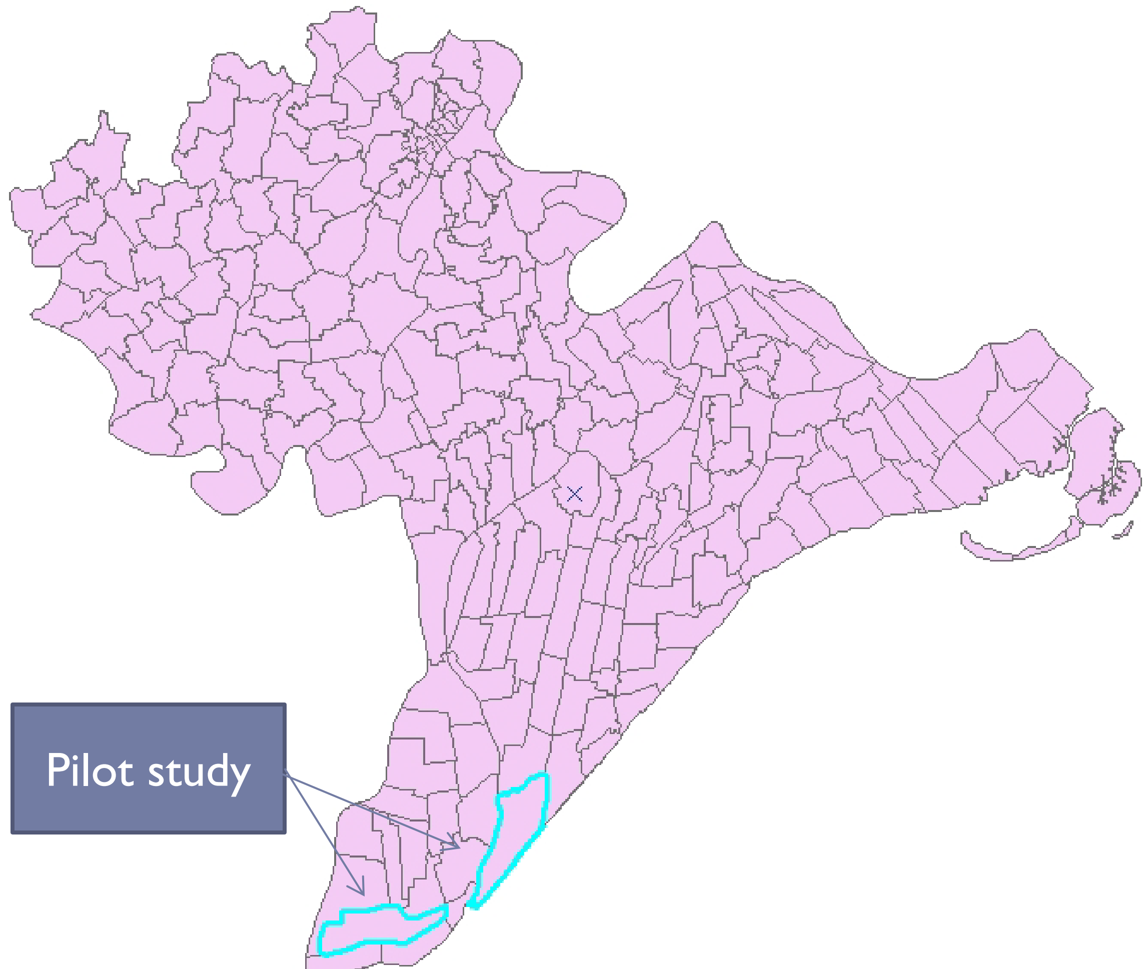


Nam Dinh province

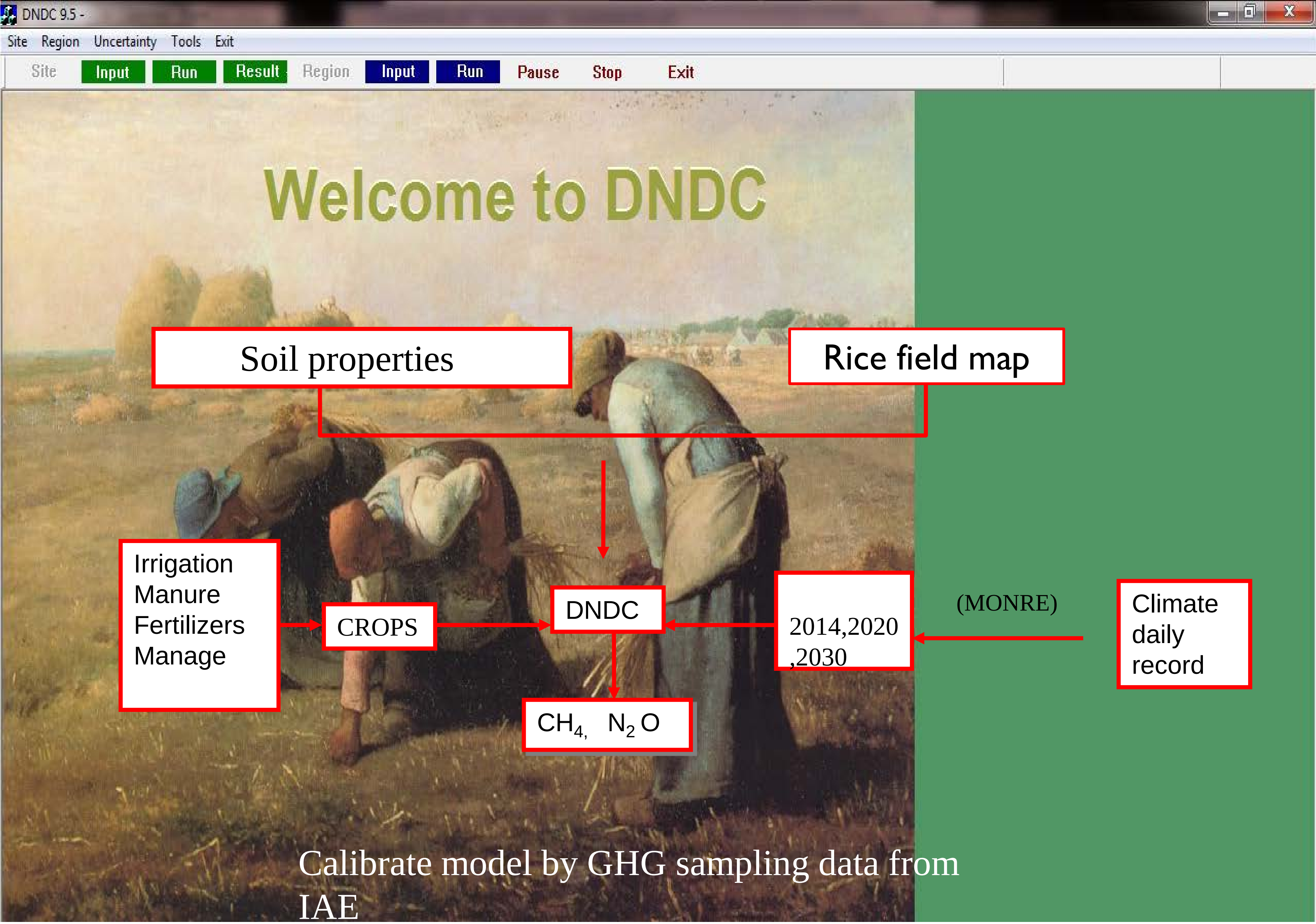


- Population: 0.5 million
- Avarage temperature: 24° C
- Natural land: 1,652 km²

-28 coastal communces with 12,000ha rice cultivation; 5000ha affected heavily by sanlinity



Pilot study



DNDC 9.5 -
Site Region Uncertainty Tools Exit
Site Input Run Result Region Input Run Pause Stop Exit
Welcome to DNDC
Soil properties
Rice field map
Irrigation
Manure
Fertilizers
Manage
CROPS
DNDC
2014,2020
,2030
(MONRE)
Climate
daily
record
CH4, N2 O
Calibrate model by GHG sampling data from IAE

4. Preliminary result

Farming Management information

Ord,	Activities	Date	Biochar application	Composting application	AWD application	Convention application
1	Cultivation:					
	- Tillage:	13 Jan	Plow depth of 30-60mm	Plow depth of 30-60mm	Plow depth of 30-60mm	Plow depth of 30-60mm
	- Sowing:	21 Jan				
	- Transplanting:	17 Feb				
	-Harvest planning:	15 June				
2	Fertilizers:					
	- Base dressing: N, P, K fertilizers, biochar, composting	16-Feb	6.6 ton biochar / ha; 90kg P2O5; 30kg Urea;	11.3 ton compost /ha; 90kg P2O5; 30kg Urea;	10 ton manure/ha ; 90kg P2O5; 30kg Urea;	10 ton manure/ha 90kg P2O5; 30kg Urea;
	1st dressing fertilizer	1-March	50 kg Urea; 30 kg K2O;	50 kg Urea; 30 kg K2O;	50 kg Urea; 30 kg K2O;	50 kg Urea; 30 kg K2O;
	2nd dressing fertilizer in flowering period	19-March	20 kg Urea, 30 kg K2O	20 kg Urea, 30 kg K2O	20 kg Urea, 30 kg K2O	20 kg Urea, 30 kg K2O
3	Flooding		Continuously , water depth of 5-10cm	Continuously , water depth of 5-10cm	AWD irrigation	Continuously , water depth of 5-10cm

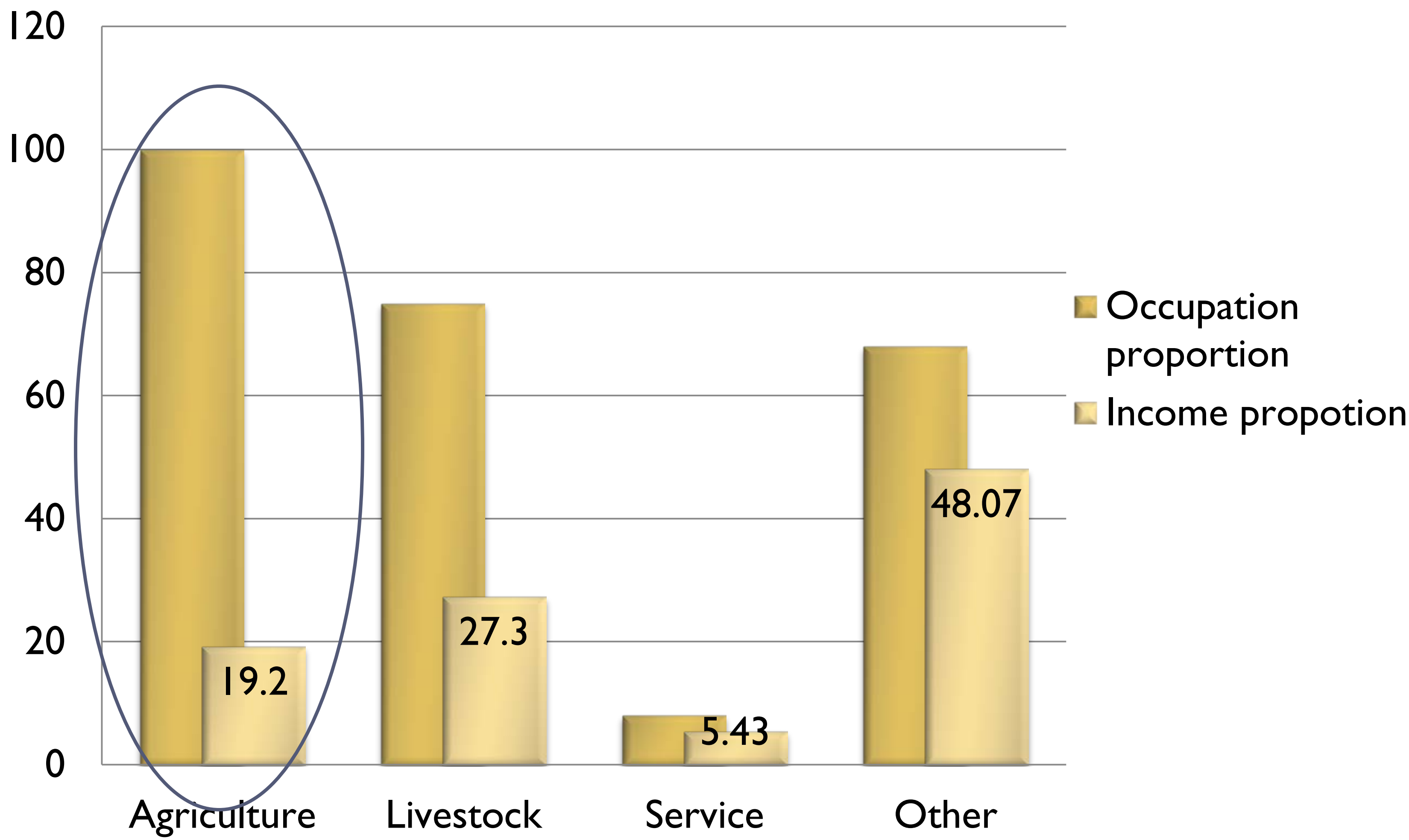
Social characteristics

n I=80

Items	Thinh Long	Rang Dong	Average
Mean age (years)	38.93	40.3	39.6
Schooling (years)	7.93	9.03	8.48
Experience in rice farming (years)	25.33	17.78	21.55
Household size	4.75	4.94	4.88
Number of labor per household	2.30	2.48	2.39
Per capita cultivated land (ha)	0.27	0.31	0.29
Farm size /household(ha)	1.23	1.20	1.21

Education level quite high
High experience year involve farming activities

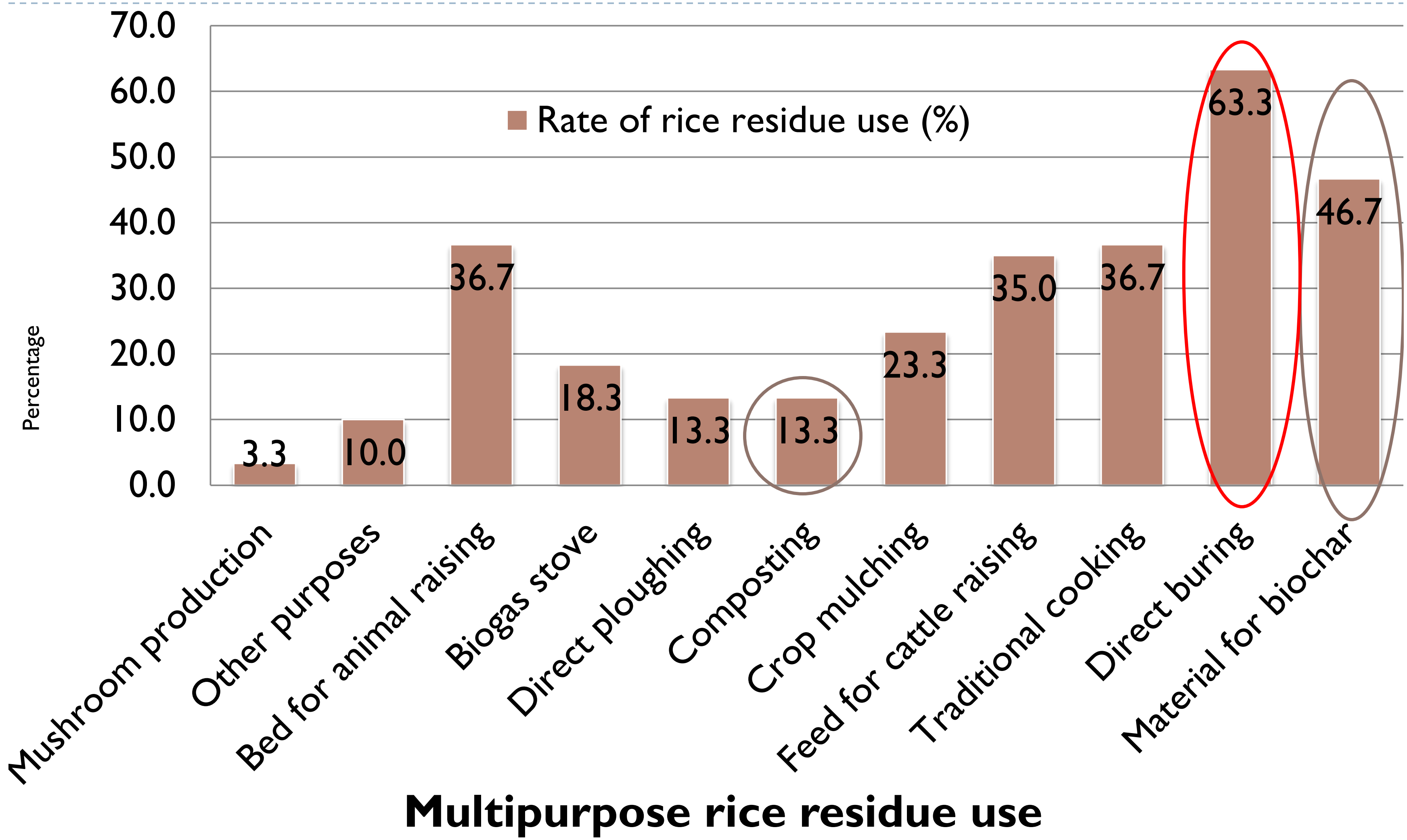
Occupation and income proportion



Main occupation: agriculture
Lower income

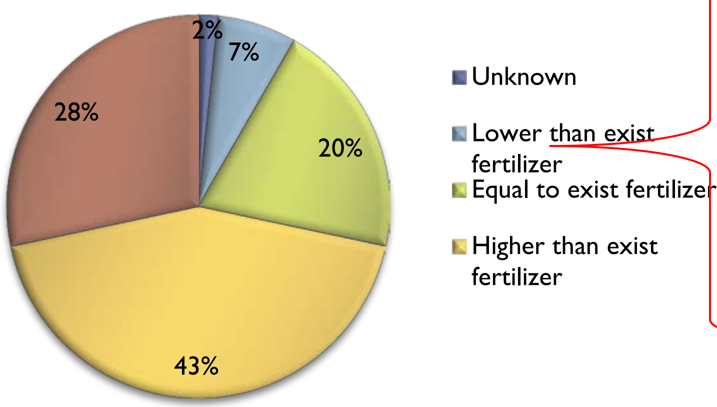
Proportion of crop residue use in surveyed sites

Total count: 240



Perception of farmers about the options

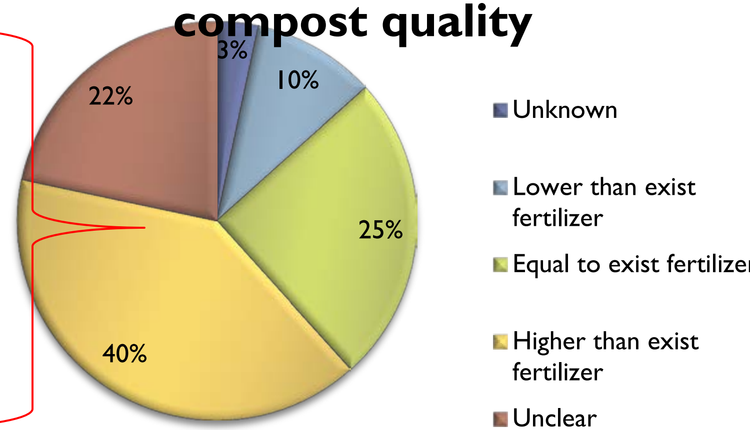
Farmer perception on biochar quality



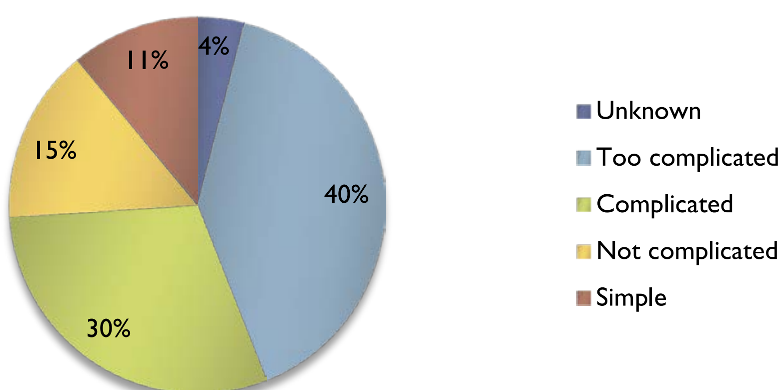
N=80

A significant adoption

Farmer perception on compost quality



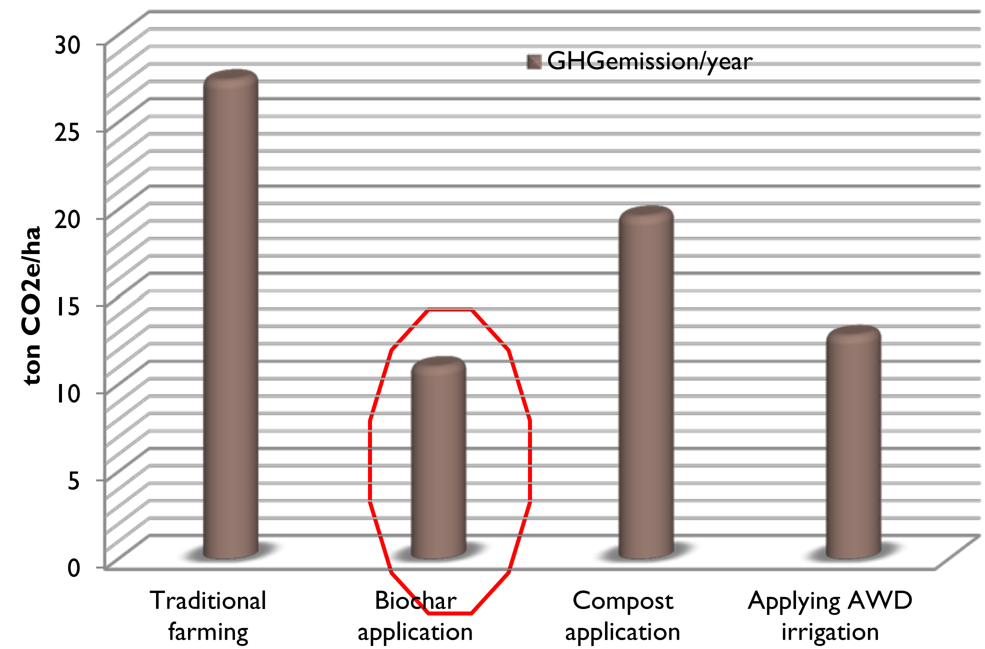
Famer perception about applying AWD irrigation



- More people believed the quality of alternative fertilizers.
- Find difficulty in applying AWD➔ low adoption

Initially GHGs emission from different farming techniques

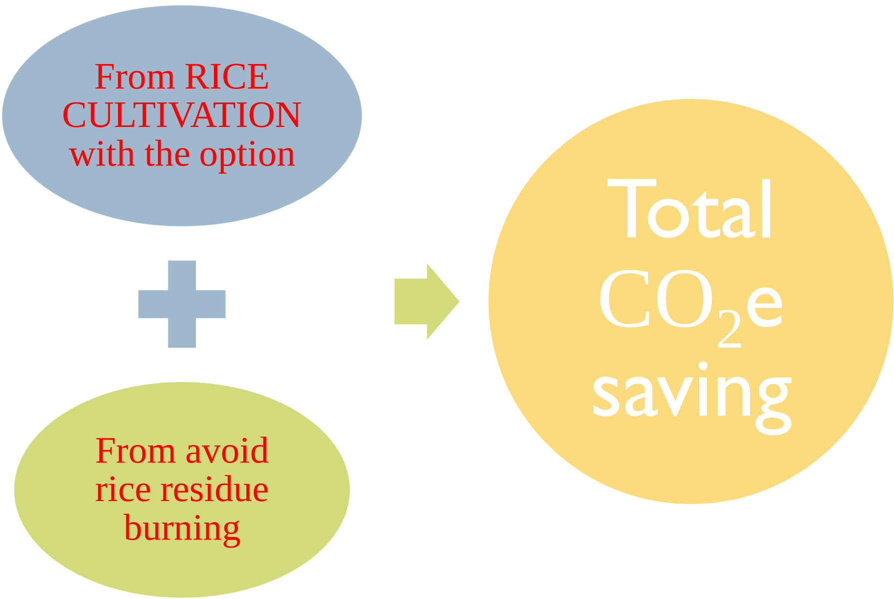
Option	CO_2 eq emission (ton/ha)	% Reduction
Traditional farming (TRA)	27.6	
Biochar application (BC)	11.2	59.42
Compost application (COM)	19.8	28.26
Applying AWD irrigation (AWD)	12.8	53.28

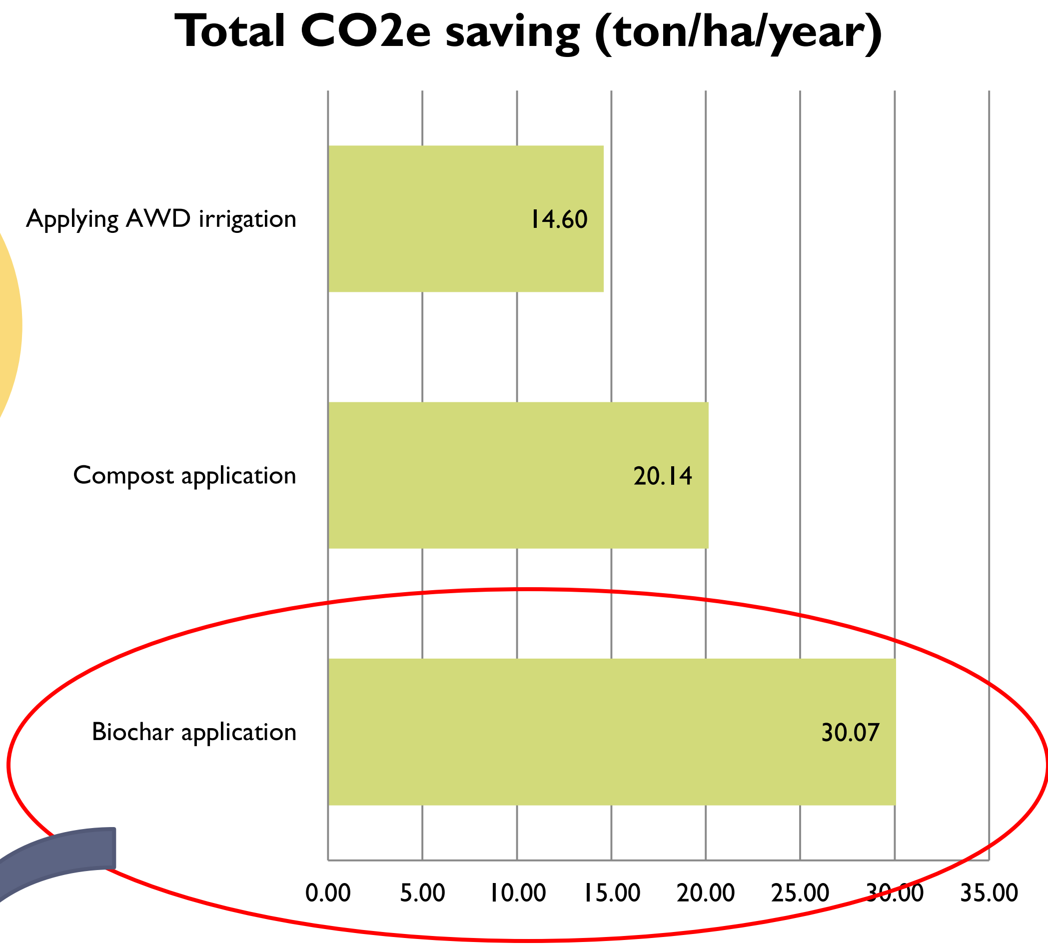


GHG emission from different farming techniques

GHGs emission BC<AWD<COM<TRA

Estimate benefit carbon exchange



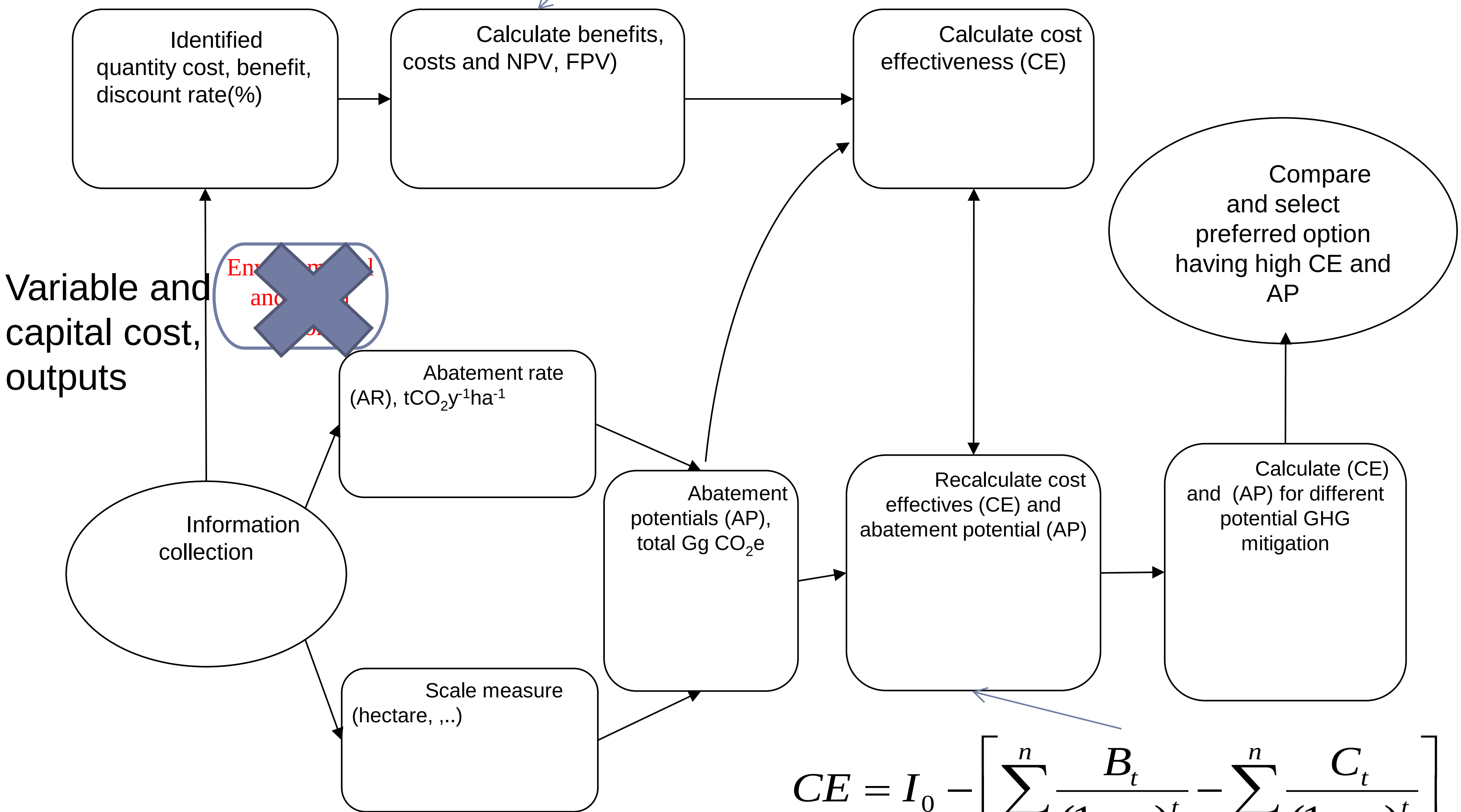


High abatement potential in saving CO_2 eq

- Assume 63.3% rice residue will be burnt if not use for biochar and compost making.

CBA and MACC result

$$NPV = \left[\sum_{t=1}^{n} \frac{B_t}{(1+r)^t} - \sum_{t=1}^{n} \frac{C_t}{(1+t)^t} \right]$$

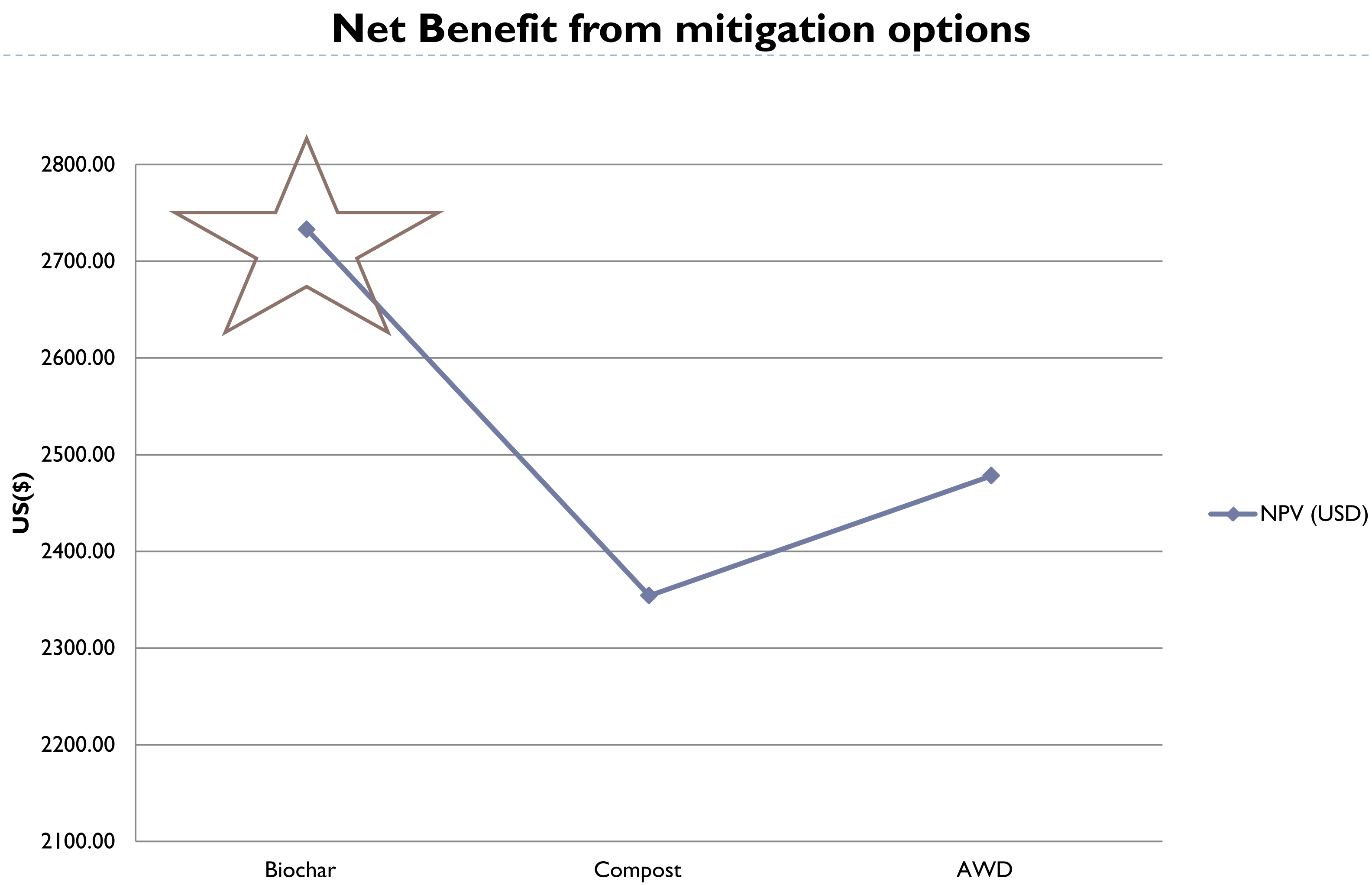


$$CE = I_0 - \left[\sum_{t=1}^{n} \frac{B_t}{(1+r)^t} - \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} \right]$$

Negative CE was considered as win-win decision

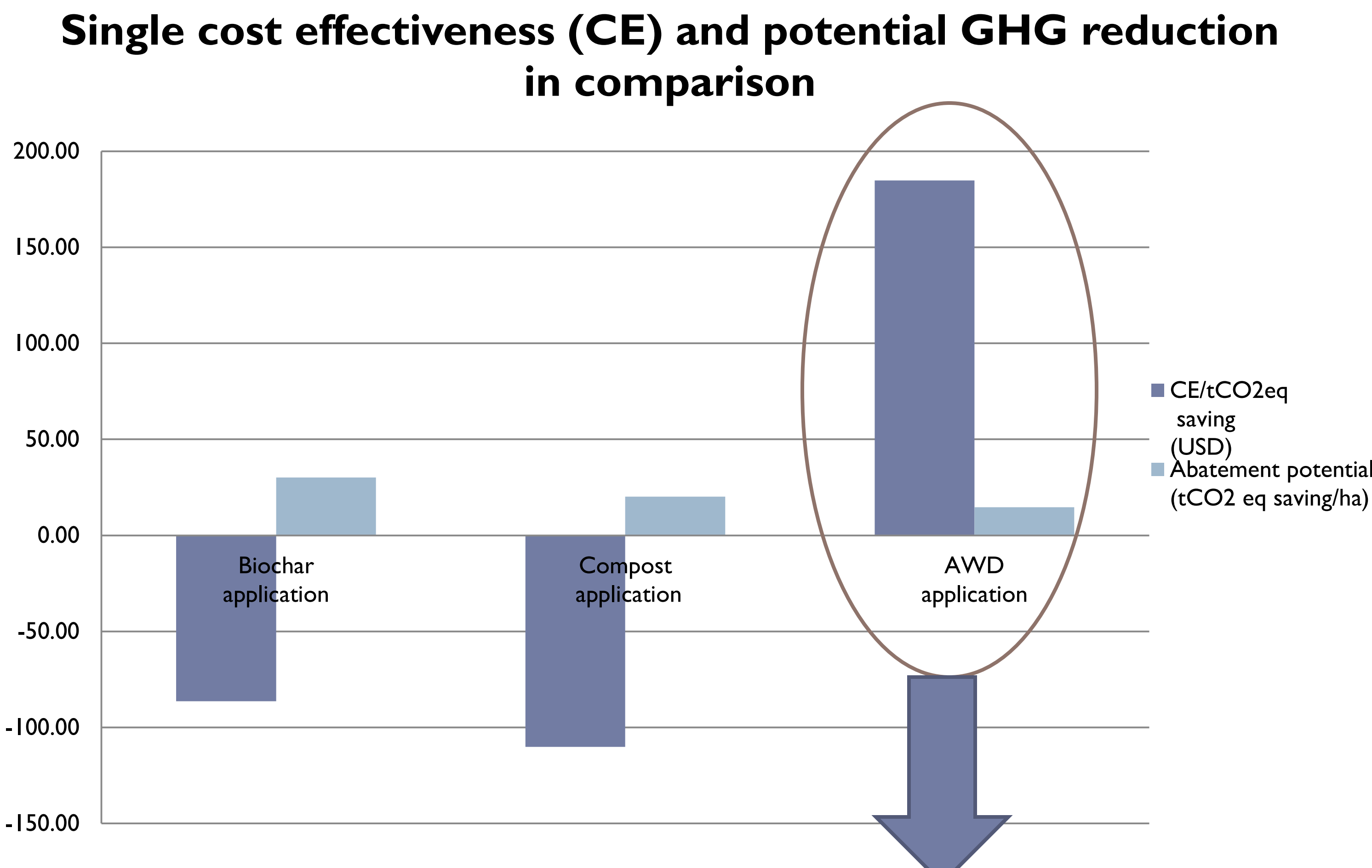
Positive CE was considered expensive options

NPV result from CBA analysis



Biochar has the biggest net benefit

MACC analysis

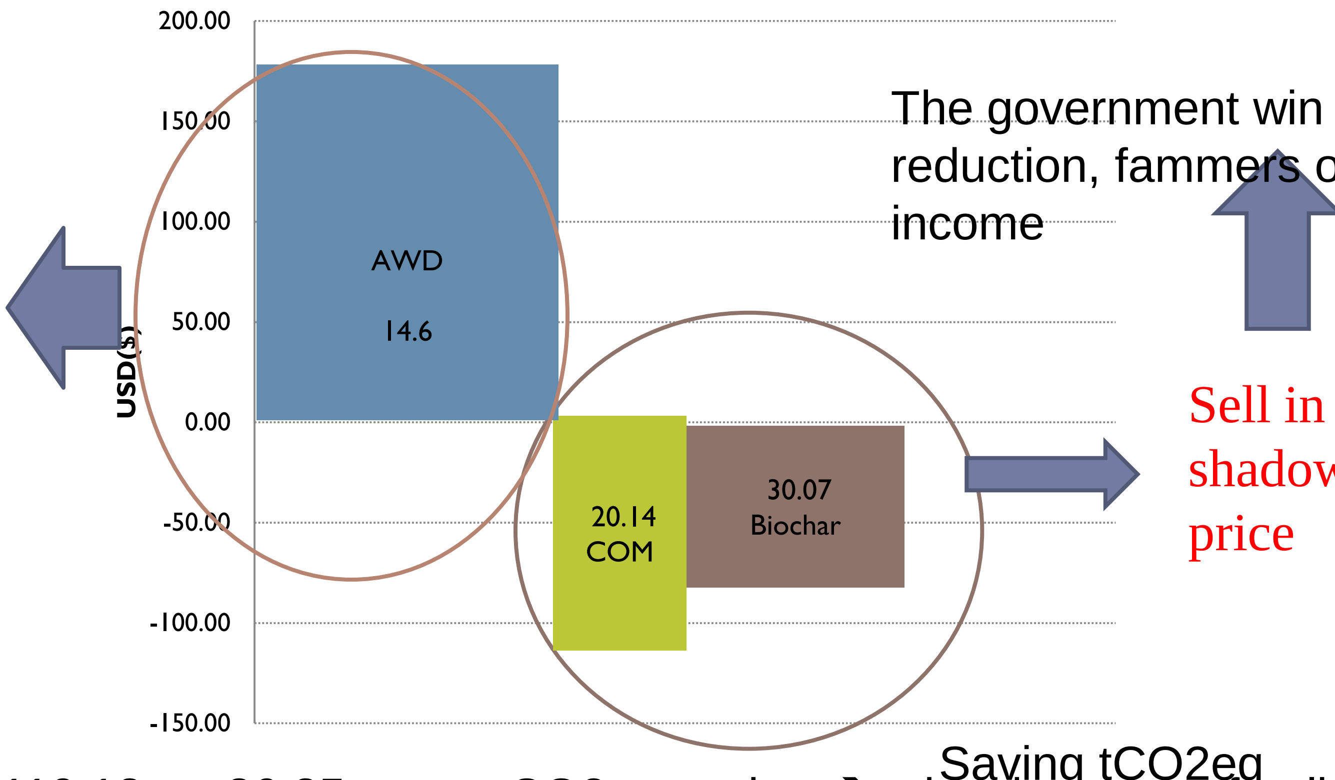


AWD with high intensive irrigation application and high investment for drainage system➔ AWD is expensive option

MACC analysis

Margin Abatement Cost Curve for three options

With positive CE➔ no motivation in GHG reduction



The government win GHG reduction, fammers obtain income

Sell in any shadow price

CE range from -110.12 to -86.35 per tonCO2eq saving ➔ win-win range of policy-making

The best mitigation option in term of cost effectiveness is composting, however biochar option illustrated both high NPV and high cost effectiveness

5. Primary discussion and conclusion

Discussion

➔Some limitations in CBA analysis

+ do not include investment of irrigation system and agricultural infrastructure in costs assessment

+ non-consumed agricultural production such as crop residues, by-products can be sold and earned benefit in abroad countries but it is very limited in Vietnam

+ economic return of these options (from environmental value) was not estimated to calculate CE

➔ Big potential GHG mitigation but weak carbon exchange

Conclusion

Biochar has the lowest carbon emission per hectare , high cost effectiveness and high net benefit for famers, a significant adoption➔ an abatement option for rice cultivation.

AWD implies a higher net cost for farmers because of higher direct costs that do not make up any potential yield increases➔ farmers face constraints in adopting it

–fewer farmers know about it, and those who know do not practice it accurately

6. Future work

- Estimate marginal abatement cost curves and CBAfor potential mitigation options for rice in 2020, 2030
- Calibrate model and interpretation of data and result
- Give conclusion and policy recommendation
- Continue writing thesis

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Thank you for your attention