Possible future options for Alternate Wetting and Drying

JIRCAS and CTU have been researching Alternate Wetting and Drying (AWD) irrigation, with the objective of reducing Green House Gas (GHG) emissions, in An Giang Province, Vietnam since 2013.

The scientific study has successfully concluded, and it is the time to disseminate the findings on how AWD can help mitigate climate change.

While support from the government and farmers' interests will play key roles in further AWD dissemination, we suggest some potential directions based on our research findings and the local conditions.

Detailed information, including that in the scientific literature, is also available.

Background : Role of agriculture in NDC implementation

12/2015 Paris Agreement
11/2016 Agreement took effect

Vietnam ratified the Paris agreement and submitted its nationally determined contributions (NDC), including AWD

Further dissemination of AWD plays a key role in reducing GHG emissions from the agricultural sector

Input

GHG reduction effects and crop yield increase by AWD
(JIRCAS-CTU research since 2013)

GHG emission from Vietnam
246.8 mil.t CO_2

Paddy **18**%
(44.6mil.t CO_2)

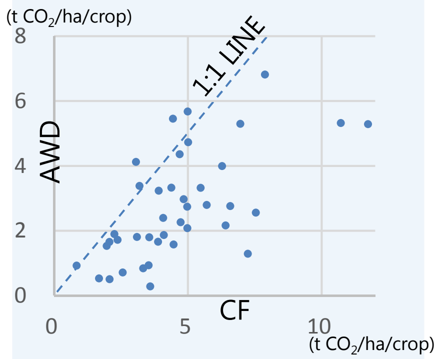
AWD :
It can reduce GHG from paddy by alternating wet/dry conditions.
It was originally developed to save irrigation water.

Outline of the research results: AWD's effects

The figures below show the averages for 40 experimental fields comparing AWD with continuous flooding (CF) in An Giang from the 2015 Spring-Summer crop to the 2018 Winter-Spring crop.
AWD not only reduces GHG emission and pumping costs but also **increases the rice yield**.

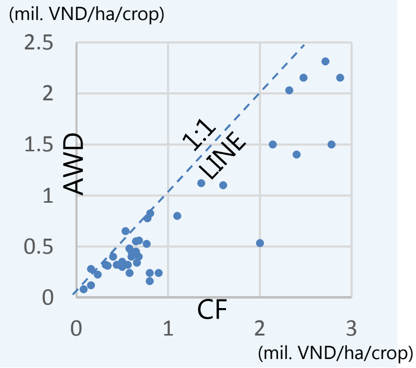
GHG(CH_4)

FAWD : 2.71 t CO_2/ha/crop
CF : 4.63 t CO_2/ha/crop



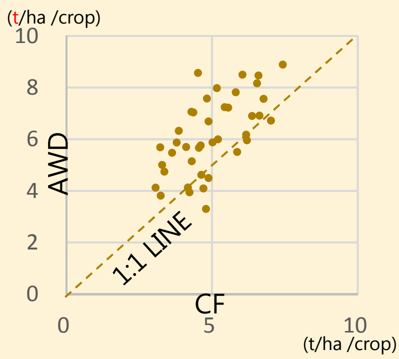
Pumping cost

FAWD: 708,000 VND/ha/crop
CF : 1,013,000 VND/ha/crop



Rice yield

FAWD: 6.17 t/ha/crop
CF : 4.98 t/ha/crop



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Toward further AWD dissemination

AWD dissemination ratio
(Paddy in An Giang Province)

AWD dissemination ratio has been dramatically improved thanks to government efforts in An Giang.
On the other hand, the ratio has plateaued recently, so it is time to consider ways to promote AWD adoption in remaining areas.
Training and extension services have already been widely provided. In addition to continuing extension, another approach is required to boost dissemination.

We suggest using infrastructure development to remove factors obstructing AWD dissemination, as long as the investment is rationalized.

【Obstructive factor and countermeasure】

- Autonomous water control is difficult ▶ **Farmland consolidation**
- Difficulty of water level measurement ▶ **Remote measurement by ICT**

Rough calculation of AWD's costs and benefits (Needs further scrutinization)

In principle, the total cost of investments should be lower than the total benefits of AWD implementation. Considering the positive effects of AWD over a decade, it is possible to roughly estimate the total benefits as 100 million VND/ha.
In other words, public investors and/or farmers may fairly spend up to 100 million VND/ha to implement AWD under the estimates below.

Annual GHG reduction	Annual yield increase	Annual pumping cost saving
3.82 t CO_2/ha/2crop	**2.38** t/ha/2crop	**610,000** VND/ha/2crop
CO_2 transaction rate **230,000** VND/t CO_2	Rice market price **5,500,000** VND/t	
Annual benefit **878,600**	Annual benefit **13,090,000**	Annual benefit **610,000**
≒ **900,000** VND/year/ha	≒ **13,000,000** VND/year/ha	≒ **600,000** VND/year/ha

Present monetary value of AWD implementation for 10 years

$(900{,}000 + 13{,}000{,}000 + 600{,}000) \times \sum_{k=1}^{10}(1-0.06)^k$

≒ 100,000,000 VND/ha + α − β

2 crops for 10 years
Social discount rate: 6%

The estimated values are just for reference.

α includes uncalculated positive values such as productivity improvement by land consolidation, water saving effects, and positive international influence for Vietnam as a result of achieving its NDC

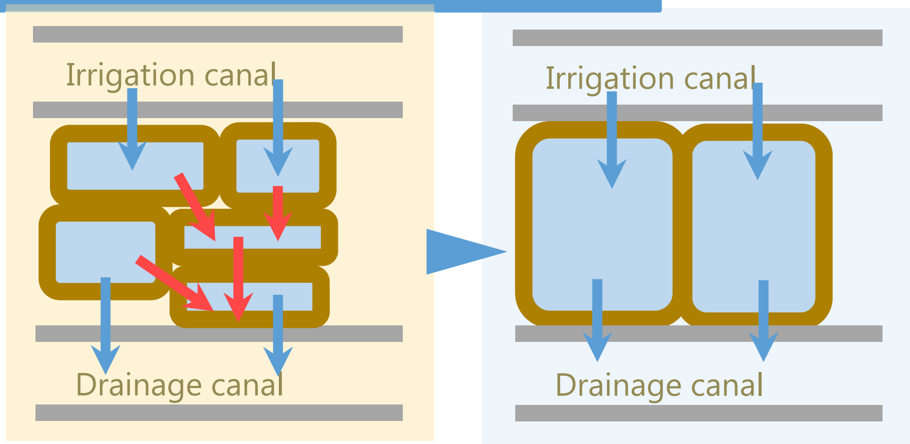
β includes indirect investment costs such as measurement, reporting and verification (MRV) setup

Possible future options for Alternate Wetting and Drying

Option1 : Farmland consolidation

Regardless of a farmer's will, AWD irrigation is difficult in farmland with so-called "plot-to-plot irrigation" and no direct connection to canals. There are plot-to-plot farmlands in An Giang, so overcoming this obstruction can contribute to AWD adoption.

Though farmland consolidation needs large investment, it will contribute not only to AWD but also to agriculture modernization and productivity improvement.



Furthermore, the unevenness of paddy surfaces causes inaccurate water level measurement. Accurate land levelling is also required for effective AWD implementation.

Option2 : Remote measurement by ICT

Daily paddy water measurements to support AWD should not be an obstruction or a burden on farmers.

Since stable 3G or 4G networks are available all over Vietnam, remote water level measurement with inexpensive ICT devices can effectively solve the problem. In addition, the accumulated data of paddy water levels provides solid and affordable evidence of NDC implementation.

Inexpensive water level sensor in paddy field

Send periodic water level data automatically

Farmers receive data by cellphone or PC

JIRCAS has been researching remote water management using ICT devices in Can Tho City since 2018.

The findings will be available in the near future.

A further suggestion : Criteria for AWD implementation

In NDC implementation, it is important to know how widely paddy fields are using AWD and how much reduction in GHG can be expected. The best way is to set up an MRV framework aiming for future CO_2 credit. However, in reality, it takes a very long time to establish such a framework.

Thus, we suggest a simplified approach to estimation of GHG reduction by tentatively determining if each paddy field is under AWD water management. GHG reduction can then be easily estimated using the total AWD area and the average GHG reduction per unit area.

The water management records collected in this study show the differences between AWD and CF (below). This data can be used for setting up such a simplified approach taking into consideration local characteristics.

	AWD	CF
Average dried period(*)(**)	33 days	7.2 days
Average number of times dried (*)(**)	6.2 times	2.3 times

* per crop

** Average from 2015 spring-summer crop to 2018 winter-spring crop