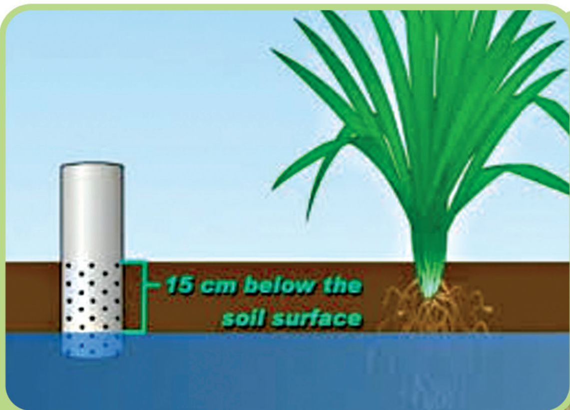
IWMI
International Water Management Institute

Alternate wetting and dry in Rice Cultivation

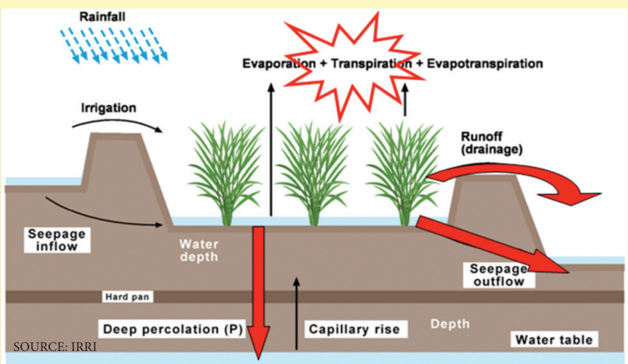


AP SERIES - 8 - 2014

ClimaAdapt
Adaptation through Innovation

Rice is one of the most important staple foods for more than half of the world's population. Most of the world rice grows under lowlands in puddle soil under permanently flooded condition. Such practice in the earlier days was made especially to control weeds in the lowlands. Among the total developed water in the world, 80% of it going for irrigation purpose in which around 40% of the water used only to grow rice. Where as in case of Asian countries rice growing alone exhaust 50% of total water used for irrigation. By 2020, it is required to produce an additional amount of 50 to 80million tons of paddy to feed the growing population which is equivalent to an additional amount of 125 to 200 Km3 of fresh water for irrigation. India alone has to produce 130 million tons by 2030 to meet the growing food demand. Hence, there is a need for the development of efficient rice cultivation methods that uses relatively lesser water than traditional practices while at the same time sustaining rice production to meet the ever-increasing national food demand.

The traditional paddy practice often leads to losses of water via surface run-off, seepage and percolation that accounts for 50-80 percent of total water input. The water losing through evapotranspiration is only useful for crop growth.



With the growing demand for food production, decreasing trend in water resources availability, the traditional paddy cultivation will face tremendous difficulties in near future. On the other hand growing demand from domestic and industrial water needs will lead to conflict among the water users and farmers. By 2025, about 15 to 20 million hectares of irrigated rice fields will suffer some degree of water scarcity as a result of climate change and competing water uses (Richards and Sander, 2014), which requires rethinking of the current management practices of rice.

How much water do people use ?

	Litres of water
Daily drinking water	2-5 litres of water
Daily household use	20-500 litres of water
1 kg of Rice	3000-5000 litres of water input to the field

Recent studies indicated that rice agriculture is a big source of atmospheric methane, possibly the biggest of man-made methane sources. The warm, water-logged soil of rice paddies provides ideal conditions for methanogenesis, and though some of the methane produced is usually oxidized by methanotrophs in the shallow overlying water, the vast majority is released into the atmosphere.

CH4–C (Methane)average emissions from AWD and NI rice field

Country/site	Unit	AWD	NI	References
India (Tamil Nadu)	mg C/m2/d	28.1	32.5	Lakshmanan et al. (2014)
India (Punjab)	mg C/m2/d	18.0	42.0	Sidhu & Benbi (2011)
Indonesia (Central Java)	mg C/m2/d	9.1	13.8	Hidayah et al. (2008)
Average		**18.4**	**29.4**	

Water usage among different sectors in Andhra Pradesh and Telangana

The total water resources (surface and ground water) of Andhra Prades[h a]re estimated to be 108,200 million cubic metres (MCM) (100 per cent) of which about 65,169 MCM (60 per cent) was utilized (CWC 2005). Irrigation uses 64,252 MCM (98.66 per cent), drinking uses 601 MCM (0.9 per cent), industry uses 288 MCM (0.4 per cent) and power generation uses 28 MCM (0.04 per cent). By 2025, total water requirements for drinking water, industrial and power generation purposes is estimated to reach 3,468 MCM; 1,445 MCM; and 56 MCM, respectively. The estimated irrigation water requirement is reaching 108,050 MCM. This would mean a total water resource requirement of 113,019 MCM, which is approximately 4,819 MCM, more than presently available water resources in the state.

Present Water Use and Future Needs in Andhra Pradesh and Telangana

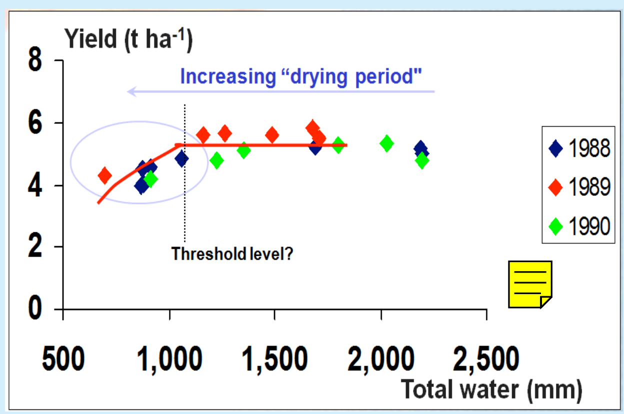
S. No.	Water user	Present utilization (2001) MCM	% to total	Needed by 2025 MCM	% to total	% increase
1	Irrigation	64,252	98.66	108,050	95.55	168
2	Drinking water	601	0.90	3,468	3.10	581
3	Industries	288	0.40	1,445	1.30	510
4	Power generation	28	0.04	56	0.05	200
5	Total	65,169		113,091		173

Source: CWC, 2005

andhra pradesh and Telangana together has a water availability of 1,544 m3 per capita per annum(2011). By 2020, with a projected increase in the population to 90 million, water availability per capita per annum will reduce to 1,150 m3, bringing the state closer to the severely scarce category. To sustain further economic growth and development in the state, available water resources will have to be managed and utilized more efficiently and in an equitable manner to avoid social unrest (Palanisami et al., 2010).

Being rice occupies 65% of total irrigated area in Andhra Prade measures have to be taken to decrease the water consumption. Researchers had been looking for ways to overcome the water scarcity and improve water use efficiency. Alternate Wetting and Drying (AWD) is found to be an important adaptation method to overcome the shortages and climate change impacts. The practice is based on the knowledge that rice can grow even up to 30% reduced water supply during the main growing period compared to conventional irrigation. To determine the timing of irrigation, the water level in the soil is monitored by a perforated plastic tube, which is inserted into the rice field. AWD requires irrigation when the water level drops to 15 cm below the soil surface.

Numerous studies were conducted on the manipulation of depth and interval of irrigation to save water use without any yield loss. The studies show that continuous submergence is not essential for obtaining high rice yields. Hatta (1967), Tabbal et al. (1992), and Singh et al. (1996) reported that maintaining a very thin water layer, saturated soil condition, or alternate wetting and drying could reduce water applied to the field by about 40–70 percent compared with the traditional practice of continuous shallow submergence, without compromising on yield.



Effect of water savings from the reference ponded water treatments and its consequence to yields (Guimba, Philippines, 1988-1991)

Rice is Big Player in world Water

	world	rice	%
Irrigated area (harvested, million ha)	340	79	29
Irrigation water (km3)	2,664	1,030	40

Remember :
Rice does not always need flooding
AWD Saves 10-30% of irrigated water

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Alternate Wetting and Drying (AWD)

Alternate Wetting and Drying (AWD) is a water-saving practice where lowland (paddy) rice farmers can apply to reduce their water use in irrigated fields. In AWD, irrigation water is applied to flood the field a certain number of days after the disappearance of ponded water. Hence, the field is alternately flooded and non-flooded. The number of days of non-flooded in AWD between irrigations can vary from 1 day to more than 10 days depending on the soil type.

A farmer can use field water tube (perforated) in his field to monitor the water levels in the subsurface of the soil, while practicing AWD.

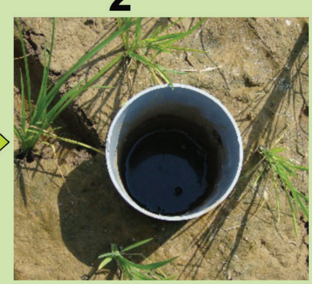
- **Making the field water tube**
  The field water tube can be made from a plastic pipe or of any other similar structures like tube.

- Cut this material to a 1 foot length with a diameter of 4 inches to easily see the water level inside the tube.
- Drill the bottom 6 inches of the tube with holes on all sides; these holes should be about 0.5cm each and 2cm away from one another.

1

2

3



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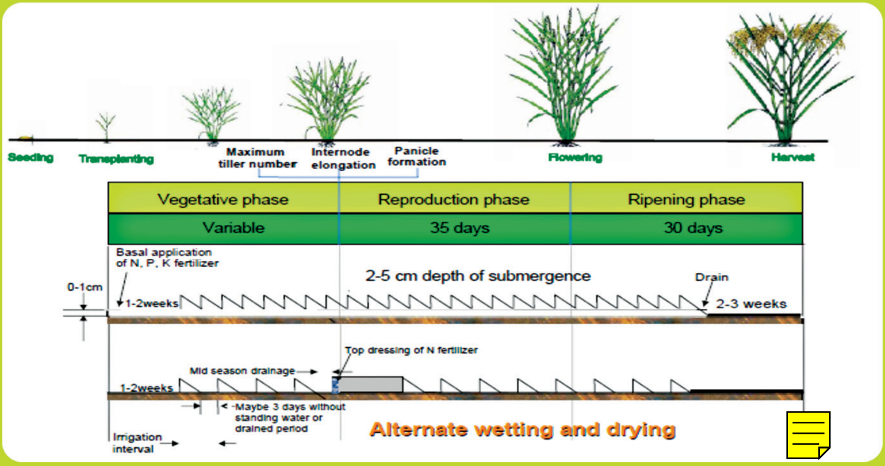
- Place the tube in a readily accessible part of the field, close to the bund (not less than 1m away) for easy monitoring. The location should be representative of the average water depth in the field (i.e. it should not be in a high spot or a low spot).
- Insert the tube up till [illegible]ches depth so that half of its length remains on the surface
- Remove the soil inside the tube so that the bottom of the tube can be seen. Ensure that the level of water inside the tube is the same as the level of water on the field.

Practicing Alternate Wetting and Drying (AWD)



AWD can be implemented and monitored by condiering the depth of ponded water on the filed by using field water tube. The depth of pounded water will gradually decrease after each irrigation.

When the ponded water is dropped to 15 cm below the surface of the soil, irrigation should be applied to re-flood the field with 5 cm of ponded water.

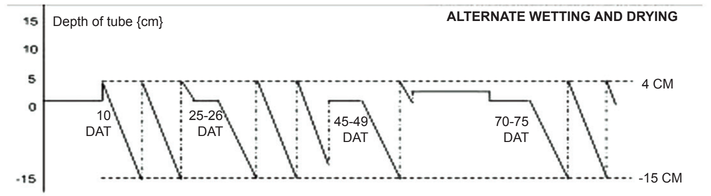
Safe AWD

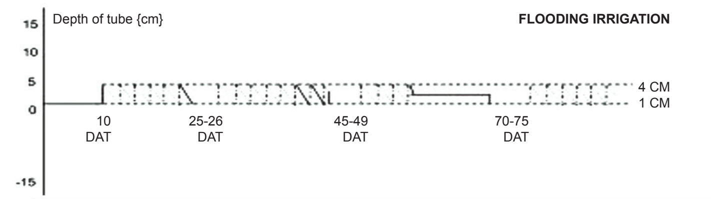
AWD can be started AWD can be started 30 days after transplanting (or with a 10-cm tall crop in direct seeding). when weed population is high, AWD can be postponed for 2-3 weeks until weeds have been suppressed by the ponded water.

The fertiliser recommendations can be similar to that of normal flooded method. Apply nitrogen fertilizer preferably on the dry soil just before flooding.

From one week before to one week after flowering, ponded water should always be kept at 5 cm depth above soil level to avoid water stress which could result to potentially severe yield loss.

After flowering, during grain filling and ripening, the water level can drop again to 15 cm below the surface before flooding.

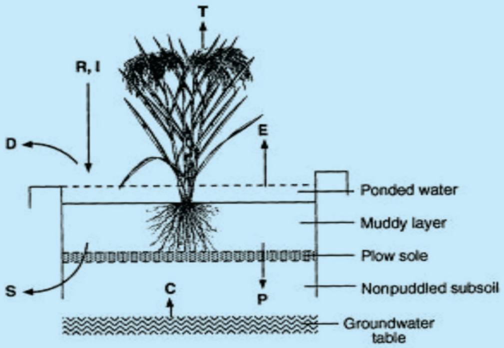




Main idea of safe AWD:
Water is available in the root zone below subsurface, which is not visible.
Water tube can create information to the farmers about scheduling of next irrigation.
Scheduling of irrigation varies with soil type, hydrology, variety
Keep first 2 weeks flooded if many weeds.

A practical indicator to irrigate under safe AWD

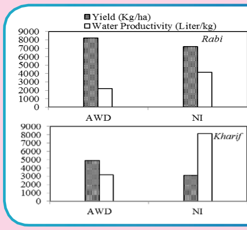
Safe AWD = Irrigate when water depth ~ 15 cm



Keep flooded 10 DAT (weeds) and at flowering

Benefits of AWD technology

- Water savings up to 15-25 percent with no yield penalty.
  In pump irrigation systems, it reduces pumping costs and fuel consumption and an increased income.
  AWD promotes good root anchorage and reduces the crop lodging problems.
- AWD reduces 30-70 per cent of methane emissions depending on the combination of water usage and management of rice stubble. It also promotes higher zinc availability in soil and grains by enabling periodic aeration of the soil, which releases zinc from insoluble forms and makes it available for plant uptake.



Rice yields and water productivity in AWD and NI methods during rabi 2012-13 and khairf 2013.

	Rabi 2012-13 (n = 2 ha)		Kharif-2013 (n = 5.6 ha)	
	Total	Total	Total	Total
	(kg CH4-C)	(ton CO2 equ.*)	(kg CH4-C)	(ton CO2 equ.)
NI	220	5.5	616	15.4
AWD	44	1.1	12.3	0.31

Estimated total CH4-C emissions and CO2 equ. from NI & AWD rice fields during Rabi and Kharif seasons.

- Better root anchorage to reduce lodging

- Increases the number of Tillers

	Rabi 2012-2013		Kharif 2013	
	NI	AWD	NI	AWD
Number of hills/m2	32	32	25	22
Number of tillers (65 DAT)	23	30	22	24.8
Number of panicles	14	16	12	13
Panicle length (cm)	31.3	31.6	22	22.3
Number of grains/panicle	116	114	124	140
1000 grains weight (g)	28	28.6	16	17.6

The AWD method has increased yield upto 14 % compared to the normal irrigation method. The water use efficiency has increased upto 70 % compared to 57 % under normal method during Rabi 2013. There is a general trend of increased yields compared to the previous year (2012) yields. But the increase was more in the fields adopted with AWD compared to the continuous irrigated fields. The increased yields not only attributed to the increased tiller number under AWD, but also to the varietal performance and the congenial conditions like few pest and disease incidence during the crop period

Challanges: Unreliable supply of water and/or energy is discouraging farmers to adopt the technology, as it requires well-tuned irrigation intervals and measures.

Payments for irrigation services are mostly based on fixed rates, traditionally often agreed prior to a season. Thus farmers do not receive any benefits from cost savings.

Block or schemes of minor irrigation systems are organised in groups, where decision making is often dominated by pump owners or operators or bigger farmers

ClimaAdapt

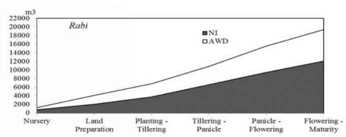
The ClimaAdapt programme is funded by the Royal Norwegian Embassy in New Delhi to focuses on climate change adaptation in agriculture and water sectors. The programme aims at strengthening the links between research, innovation and capacity building, and strongly focuses on stakeholder engagement at different stages. In addition, a major objective of ClimaAdapt is to contribute to the state-level climate adaptation policy framework in Andhra Pradesh and Tamil Nadu states in India.

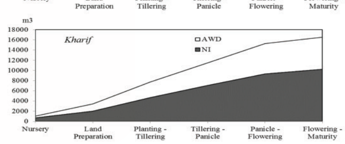
Bioforsk, the Norwegian Institute for Agriculture and Environmental Research in association with IWMI, WALAMTARI & MSSRF has implemented AWD in 365 acres under Nagarjuna Sagar command area. Previously the farmers in the area are going by traditional way of cultivation i.e. maintaining the water in the paddy fields at the height of two – inches level. Under AWD system, the farmers re-irrigate the fields when it develops hair line cracks.

Results :

Costs and benefits of AWD and NI of rice for rabi 2012-13 and Kharif 2013 season

	Rabi 2012-13			Kharif 2013		
	NI	AWD	AWD benefits	NI	AWD	AWD benefits
Variable cost	50576	50314	(+) 262	49795	49,522	(+) 273
Yields (kg/ha)	7220	8247	(+) 1,027	3150	4,883	(+) 1,733
Returns (Rs/ha)	93842	107208	(+) 13,366	56700	87,885	(+) 31,185
Profit/Loss	43266	56894	(+) 13,628	6905	38363	(+) 31,458





THE HINDU • WEDNESDAY, FEBRUARY 12, 2014 HYDERABAD

Norwegian experts interact with farmers

Staff Reporter

NALGONDA: An expert team of the Norwegian Institute for Agriculture and Environmental Research visited the villages in Damarcherla mandal on Tuesday to elicit the response on the alternate wetting and drying (AWD) method of irrigation, which being implemented under the Nagarjunasagar left bank canal.

They inspected the paddy fields and interacted with the farmers to access the implementation of the scheme in the grassroots level.

The Norwegian Institute for Agriculture and Environmental Research, called as Bioforsk, in association with the government's Water and Land Management Training and Research Institute (WALMTARI), International Water Management Institute (IWMI), MS Swaminathan Research Foundation (MSSRF) and Royal Norwegian Embassy, have introduced the AWD irrigation practice in about 145 acres in 10 villages under the Nagarjunasagar left bank canal in Damarcherla mandal.

Going by the traditional practices, the farmers maintain water in paddy fields at the height of two-inch level. Under new system, the ryots irrigate fields for 10 days and ...

... few acres last year and now, ... has been extended to 145 acres this rabi season. To know the response at gross roots level, a Norwegian team led by Bioforsk Director (International Projects) for South Asia, South East Asia and Africa, Nagothu Udaya Bhaskar and organisation senior researcher (Agrohy... Johannes Deelstra ...

that the buzz ... smart agricultu... be possible with ... However, the new practice w... tive.

"We have b... third of water with the alternate wetting and drying method introduced under the Climaadapt project," Miryalaguda irrigation Superintendent ...

..., who has taken up cultivation in 14 acres under the AWD method, said they were ready to practice it if the government supported them.

STOCK-TAKING: *Experts from Norway tak... alternative wetting and drying (AWD) m... of Nalgonda district on Tuesday.* - PHOTO...

- The AWD irrigation practice has been int... 10 villages under the Nagarjunasagar lef...
- Under the new system, the ryots irrigate ... 10 days and keep them dry for seven da... to save water

ప్లాస్టిక్ గొట్టం చెప్పే నీటి ఆదా చిట్కా!

ఆశాకిరణంగా ఆరుతడి

ClimaAdapt

Adaptation through Innovation

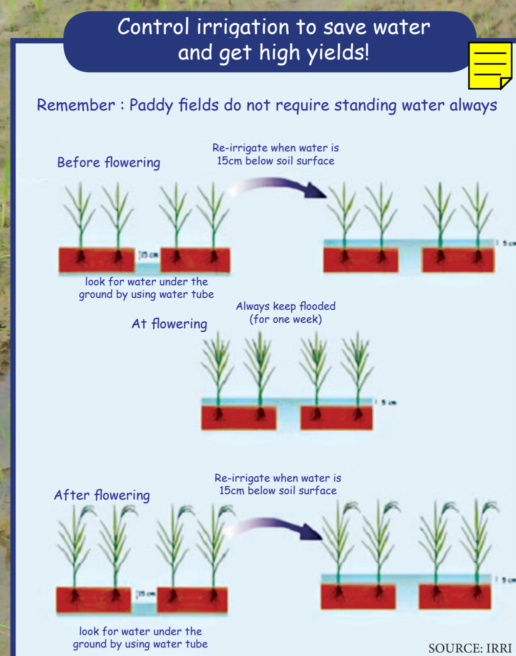
ClimaAdapt

Focuses on climate change adaptation in agriculture and water sectors. The programme aims at strengthening the links between research, innovation and capacity building, and strongly focuses on stakeholder engagement at different stages.

In addition, a major objective of ClimaAdapt is to contribute to the state-level climate adaptation policy framework in Andhra Pradesh, Telangana and Tamil Nadu states in India.

Main programme objectives

- To map vulnerability, gaps and prepared- ness to address impacts on agriculture and water sectors.
- To select and apply suitable future climate and hydrology scenarios.
- To undertake capacity building of stake- holders, including women and farmers.
- To promote most promising adaptation technologies at a systems level, that will help in developing methodologies for upscaling.
- To strengthen the link between research, innovation and capacity building.



Dr. K. Krishna Reddy
Mr. K.Suresh Reddy
Dr. K.Gurava Reddy
Ms. P.D.Maheswari
Mr. Ch.Ram Prasad

Contact details:
International Water Management Institute
C/o. ICRIAST, Patancheru, Hyderabad-34
Tel: +91 40 30713741

Regional Agricultural Research Station
Lam Farm, Guntur - 522 034
Tel: +91 863 2524017`