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Research Paper

Production maximization of rainy season rice (*Oryza sativa*) through effective use of water and solar radiation under modified system of rice intensification in Assam

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ABSTRACT

A field experiment was conducted in a farmers' field at Nepalikhuti, Golaghat, Assam during the rainy (*kharif*) season of 2016 and 2017, to find out the effect of different transplanting dates and hill densities of rice (*Oryza sativa* L.) under system of rice intensification (SRI) which was compared with conventional rice cultivation (CRC). The experiment was designed in factorial split-plot with 2 crop-establishment methods (SRI and CRC) and 3 transplanting dates (26 June, 10 and 25 July) in the main plot; and 4 different hill densities (20 cm × 10 cm, 20 cm × 20 cm, 25 cm × 20 cm and 25 cm × 25 cm) in the subplots and replicated thrice. With an increased grain yield of 5.71 t/ha, SRI-establishment showed a significant yield advantage of 0.83 t/ha coupled with 2.64% more consumptively used water and 1.29 kg/ha-mm more water-use efficiency over CRC. Results showed strong positive correlation (0.95**) between water-use efficiency (WUE) and yield attributes primarily the effective tillers/m^2. Regression analysis revealed that irrespective of establishment methods, the consumptive use (CU) of water, accumulated incident photosynthetically active radiation (AIPAR), radiation-use efficiency (RUE) and heat-use efficiency (HUE) greatly influenced the grain yield. However, in SRI, WUE appeared to be an additional key determinant of grain yield. Between 2 establishment methods, SRI was found to be more competent in utilizing water and solar radiation owing to its ideal canopy environment.

Key words: Conventional rice cultivation, Consumptive use of water, Crop canopy, Radiation-use efficiency, Water-use efficiency

Traditional rice (*Oryza sativa* L.) cultivation utilizes 3,000–5,000 litres water to produce 1 kilogram rice (Bouman, 2009) though the plant does not require flooded water or standing water. Managing the paddy field water via intermittent wet and dry approaches could reduce 50% of the effect of global methane emissions owed by rice cultivation (UNEP, 2021). Moreover, the agricultural production would have to be boosted 60% more from 2005–2007 levels to feed the exploding population of 9 billion in 2050 (Alexandratos and Bruinsma, 2012) and our country has to reap an additional quantities of 1.7 million tonnes of rice to ensure food security (Dass and Chandra, 2013). Assam, the North-eastern state of India is growing rice in an area of 2.36 m ha, contributing an appreciable production of 5.21 million tonnes (Economic Survey of Assam, 2021–22). In Assam, rice is the main staple crop. In present day situation, a productivity level of 2.1 t/ha is sufficient enough; however, in the challenging climate-change situations, the state would need 13 million tonnes of rice by 2050 from limited resources such as cultivable land, nutrient, labour, water and capital to feed its accelerated population, maintain self-sufficiency without unscrupulous exploitation of resource base (Vision 2050: Agriculture in Assam).

In this regard, system of rice intensification (SRI) is a decent alternative of highly input-intensive and climate-threatening conventional production practices. The SRI is an integrated agro-ecological crop-management practice for achieving production maximization of rice utilizing low quantum of resources like land, water, nutrient, time and labour (Pandian *et al.,* 2014). The SRI is a promising environment-friendly farming where instead of continuous submergence; rice is grown under intermittent wet and dry soil

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moisture regime during the whole vegetative stage. In Assam, not enough research work has been done to standardize SRI practices to explore its full potential for local condition. However, in Tripura, the nearby state of Assam, this agronomic practice is quite popular among the farmers as an innovative, productive and remunerative crop (Majumder *et al.,* 2019). Moreover, a study based on recent 30 years of data revealed substantial rainfall variability in Assam. Many districts of the state are witnessing significantly decreasing trend of south-west monsoon along with significantly more number of dry days (Guhathakurta *et al.,* 2020). In this regard, modification of crop microclimate through agronomic management might be a promising option to help create favourable atmosphere at crop micro level that would ensure augmented production.

Therefore, a field investigation was carried out in Golaghat district of Assam during 2016 and 2017 with a medium-duration rainy (*kharif*) season rice variety under medium land situation, to study the crop water use as well as yield response under varied crop-establishment methods, to find out suitable crop microclimate for production maximization with efficient utilization of natural resources, viz. light and water.

MATERIALS AND METHODS

The field experiment was conducted during the rainy (*kharif*) season of 2016 and 2017 at farmer's field located in Department of Agronomy, Assam Agricultural University, Nepalikhuti (26°66′99″ N and 93°68′26″ E, 76 m above mean sea-level) in Golaghat district of Assam. The soil was sandy loam, acidic in reaction (5.82), medium in organic carbon (0.59%) with good drainage ability. The site belonged to sub-tropical humid climate with high rainfall and high relative humidity. During the period of experimentation (June to November 2016 and June to November 2017), an amount of 1,242.60 mm and 1,618.80 mm rainfall was received in 2016 and 2017 respectively. The distribution of rainfall was uneven throughout the entire growing period. The mean maximum temperature was 27.8–34.4°C and 27.9–35.2°C and the mean minimum 16.4–25.8°C and 19.1–26.7°C in 2016 and 2017 respectively. The weekly mean bright sunshine hour (BSSH) was 0.5–6.8. hr and 1.1–8.8 hr in 2016 and 2017 respectively. Both the amount of total rainfall and mean BSSH were recorded to be high in the second year of investigation. The experiment comprised 24 treatment combinations with 2 crop-establishment methods, viz. C_1, modified system of rice intensification (SRI); C_2, conventional rice cultivation (CRC); 3 transplanting dates, viz. D_1, 26 June; D_2, 10 July; D_3, 25 July; and 4 hill densities, viz. H_1, 20 cm × 15 cm (i.e. 33 hills/m^2); H_2, 20 cm × 20 cm (i.e. 25 hills/m^2); H_3, 25 cm × 20 cm (i.e. 20 hills/m^2); H_4, 25 cm × 25 cm (i.e. 16 hills/m^2). The design was factorial split-plot design with crop-establishment methods and dates of transplanting in the main plots and hill densities in the subplots which were replicated thrice.

For nutrient management, well-rotten FYM @ 10 t/ha along with rock phosphate and muriate of potash @ 10 kg P_2O_5 and 40 kg K_2O/ha, respectively, were applied for both the SRI and CRC crop during field-preparation time. Before transplanting, the seedlings were treated with inocula of *Azospirillium amazonense* A-10 and *Bacillus megaterium* P-5 @ 4 kg/ha. Cono weeder was run in SRI plots 10 days after transplanting (DAT) and later at 10 days interval if needed, whereas paddy weeder was used at 20 and 40 DAT in CRC plots. The depth of water in the main field was maintained at ≤ 2 cm and 5 cm for modified SRI and CRC method, respectively. The age of the seedlings was 12 days for SRI and 21 days for CRC system. 'Shraboni', a medium-duration high-yielding variety was used. For determination of the total consumptive use (CU) of water or the evapotranspiration (ET) of the crop in the main field, i.e. from transplanting to dough stage was estimated by drum culture technique as described by Dastane *et al.,* (1967). The amount of water is expressed in mm. Water-use efficiency (WUE) was calculated for each treatment and expressed in kg/ha-mm. The WUE with respect to ET was computed as:

$$\text{WUE}(\text{kg/ha-mm}) = \frac{\text{Grain yield}(\text{kg/ha})}{\text{ET}(\text{mm})}$$

The light intensity was recorded with the help of Lux meter at various growth stages at the middle layer of the canopy and expressed in photosynthetic photon flux density (μmole/m^2/s) by multiplying with standard conversion factor 0.0185 for sunlight (Thimijan *et al.*, 1982). Light transmission ratio (LTR) was computed by dividing light intensity at ground level by light intensity received above the crop canopy and expressed in %. The incoming solar radiation was calculated by the modified Angstrom formula from which incident photosynthetically active radiation (IPAR) was computed following standard formula and the sum total was taken for AIPAR (Heris, 2014). The HUE was calculated by dividing the grain yield with total growing degree-days and expressed in kg/ha degrees-days, while RUE was obtained by dividing the biomass with cumulative incident photosynthetically active radiation and expressed in g/MJ. The data were finally subjected to analysis of variance technique for factorial split-plot design and the treatment means were compared at 5% significance level. Relationship study was done by using SPSS version 20.

RESULTS AND DISCUSSION

Influence on grain and straw yield

Grain yield recorded under SRI management in both the years was significantly superior to conventional method of establishment, being 1.18 and 1.16 times higher than that of conventional one respectively (Table 1). This enhancement of grain yield was also reflected in the pooled analysis, revealing an increased yield of 5.71 tonnes grains/ha, amounting to 1.17 times more compared to CRC. Moreover, the straw yield was also found to be 1.06 times more in SRI than that of CRC which was statistically significant. As compared to conventional method, transplanting of younger seedlings at wider spacing encouraged faster completion of phyllochrons before anthesis is due to zero transplanting shock and no multiple seedling competition (Uphoff, 2003) as well as formation of favourable crop micro-environment (Thakur *et al.*, 2015) eventually increased the crop yield in SRI system.

In 2016 and 2017, the early transplanting (26 June) registered the highest grain yield of 5.49 and 5.82 t/ha respectively, followed by subsequent delayed planting, viz. 10 July and, lastly by 25 July. The grain yield of early crop increased significantly with a magnitude of 1.02 and 1.09 times more than that of 10 and 25 July planting, respectively, as revealed by the pooled analysis. Increased grain yield of early crops might attribute to prevalence of favourable weather condition specially the light intensity (Garcés-Varon and Restrepo-Díaz, 2015), resulting in better plant stature that contributing plentiful synthesis and uniform distribution of assimilates (Sharma *et al.*, 2018). In case of straw yield also, similar trend as that of grain yield was observed. Progressive reduction in straw yield was noted due to delaying of planting dates, the highest being registered in early-transplanted crop, i.e. 26 June. The improvement in both grain and straw yields may be the result of improvement in growth parameters, especially the leaf-area duration in early-planting treatment because of better influence agro-meteorological factors especially utilization of incident PAR and heat units (Jayapriya *et al.*, 2016) as well as temperature and relative humidity (Vishwakarma *et al.,* 2016) enhanced the yield. Furthermore, the enhanced grain yield under wider spacing was noticed which might be the outcome of improvement in yield parameters, resulting in larger number and size of sink together with efficient translocation of photosynthates to the sink of individual plants under best possible planting density that lowers the intra- and inter-specific competition for both above- and below-ground resources. The pooled analysis revealed 1.12 times increase in grain yield owing to adoption of 16 hills/m^2 over the closest density (33 hills/m^2). Improvement of grain yield under wider spacing owing to lesser intra-specific competition resulting in improved photosynthesis (Dass and Chandra*,* 2012) was also reported. However, the highest straw yield was recorded at 20 hills/m^2 in both the years which was about 1.13 times higher than that of closest density (33 hills/m^2) in the pooled analysis.

Table 1. Grain and straw yield (t/ha) of 'Shraboni' rainy season rice as influenced by crop-establishment method, transplanting date and hill density

Treatment	Grain yield (t/ha)			Straw yield (t/ha)		
	2016	2017	Pooled	2016	2017	Pooled
Crop-establishment methods						
SRI	5.56	5.90	5.71	6.03	6.25	6.14
CRC	4.71	5.05	4.88	5.68	5.91	5.79
SEm±	0.07	0.07	0.06	0.12	0.11	0.10
CD (P=0.05)	0.21	0.21	0.18	0.33	0.33	0.31
Transplanting dates						
26th June	5.49	5.82	5.65	6.09	6.31	6.20
10th July	5.21	5.51	5.36	5.94	6.17	6.06
25th July	4.72	5.06	4.89	5.53	5.76	5.65
SEm±	0.08	0.08	0.07	0.13	0.13	0.12
CD (P=0.05)	0.25	0.26	0.22	0.41	0.41	0.38
Hill densities						
20 cm × 15 cm	4.47	4.83	4.65	5.34	5.57	5.46
20 cm × 20 cm	5.16	5.48	5.32	6.00	6.23	6.11
25 cm × 20 cm	5.39	5.71	5.55	6.08	6.29	6.18
25 cm × 25 cm	5.52	5.83	5.68	6.01	6.23	6.12
SEm±	0.15	0.13	0.12	0.17	0.19	0.17
CD (P=0.05)	0.43	0.38	0.36	0.49	0.54	0.50

SRI, system of rice intensification; CRC, conventional rice cultivation

Influence on crop-water use

More volume of water was consumed by the SRI crops for CU in both the years (Fig. 1). The quantum increase in CU of water in SRI method was estimated 14.83 and 12.94 mm which is equivalent to 2.80 and 2.48% more in comparison to CRC in 2016 and 2017 respectively. Higher amount of consumptively used water in SRI might be owing to ability in tapping of more water through its vigorous root mass than that of CRC. In WUE also, the values were higher under SRI in both the years which could be well understood from its quantum that to produce 1 kg of grain, SRI recorded 944.5 litres consumptively used water, while CRC recorded 1,076.6 litres. Better use of water in SRI might attribute to increased grain yield as a result of more uptakes and water along with nutrients by its massive root-system and their efficient utilization in all the activities related to yield improvement. Thakur *et al.,* 2014 also reported higher WUE under SRI management practice sowing to larger root biomass influencing extraction of more water and nutrient.

A quite noticeable influence of transplanting date on CU of water and WUE was noticed during the entire crop period in the main field (Fig.2). The volume of CU of water was found to be reduced with the delaying of transplanting date in both the years, the highest being ranged from 548.81 to 558.38 mm under early transplanting, i.e. 26 June. The early crop registered 3.11–4.52 and 8.12–8.51% more consumption of water when the planting was delayed by 15 days and 30 days respectively. Moreover, early transplanting showed superior efficiency in terms of use of water in both 2016 and 2017. The incidence of optimum crop microclimate induced by considerably higher quantum of incoming solar radiation leading to efficient use of PAR and air temperature in 26 June-planted crops might result into improved crop yield and WUE through its effect on better water and nutrient uptake causing better growth and development. Nutan (2015) also reported that, early crop experienced the favourable environment and, therefore,

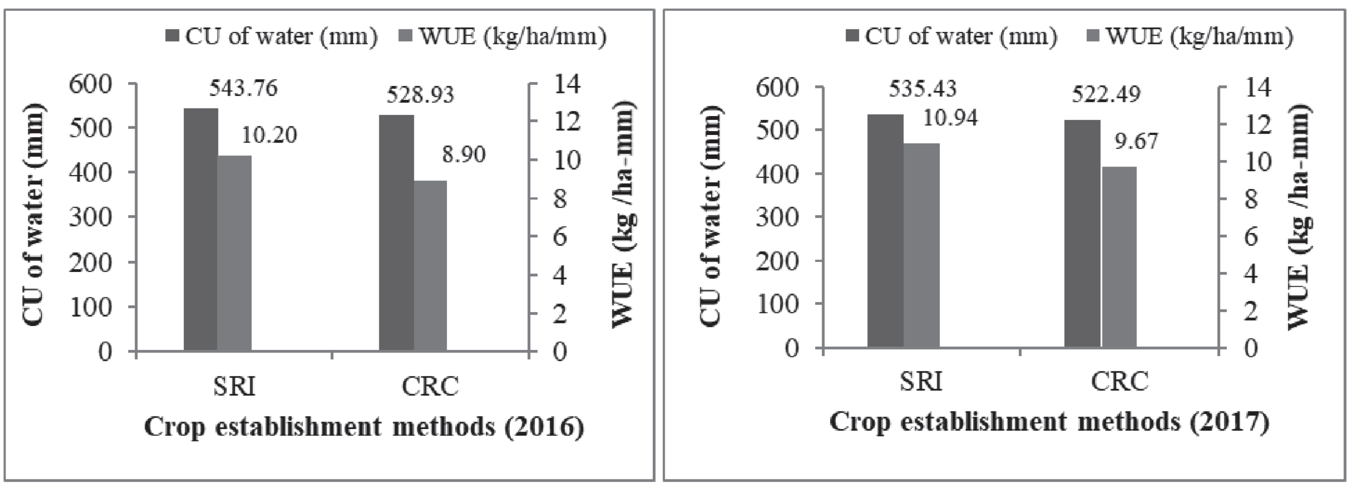

Fig. 1. Crop-establishment methods influencing consumptive use of water and water-use efficiency in rice during 2016 and 2017

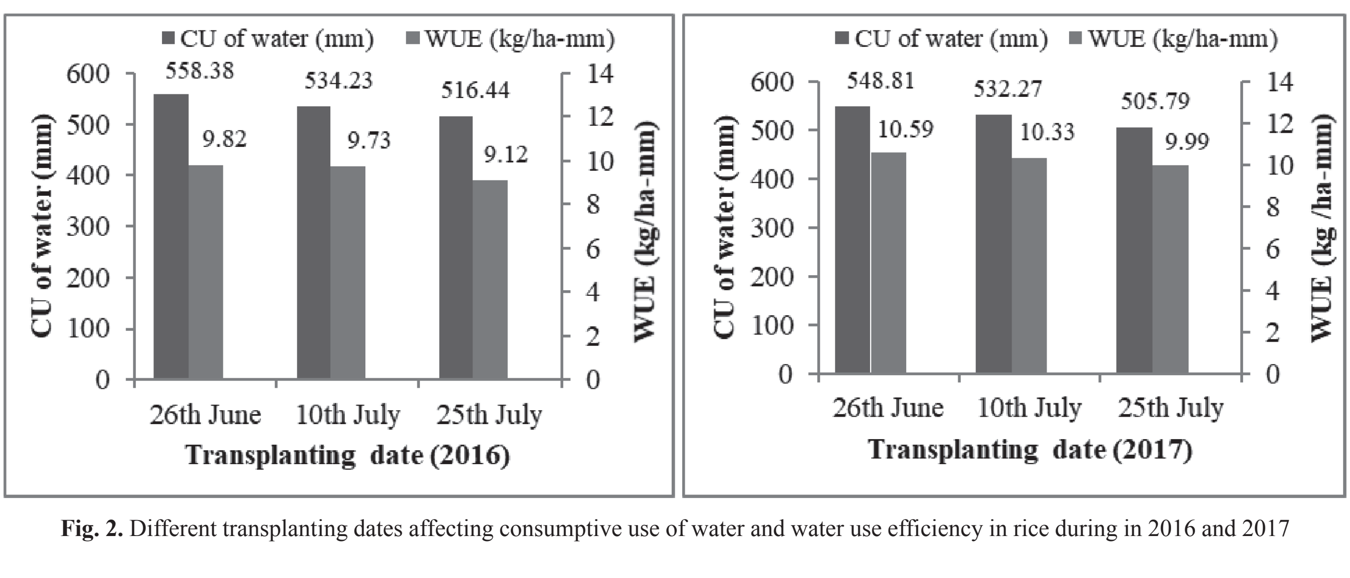

Fig. 2. Different transplanting dates affecting consumptive use of water and water use efficiency in rice during in 2016 and 2017

utilized water and other resources more efficiently that resulting in increased yield and ultimately, the WUE.

The volume of CU decreased with the increase of plant density, recording the lowest magnitude in 33 hills/m^2. Among different levels of hill density, the lowest one, 16 hills/m^2, owed the maximum magnitude of CU which was equivalent to 1.19 to 1.81% more than that of the highest density (33 hills/m^2) under study. The influence was found to be similar in case of WUE. Lower degree of intra- and inter-specific competition in lower hill density might resulted in more absorption of nutrient and water from the soil led to improved translocation and allocation of assimilates in sink, as a result of which crop yield increased and, hence, the WUE. Moreover, better canopy coverage (larger leaf area) in wider spacing might suppress the evaporation from the soil but enhancing the transpiration process leading to improved consumptive use as well as WUE. Hembram and Saren (2015) also reported increased use of water owing to more ET in widely-spaced rice crop. Further, Suzuki *et al.,* (2013) reported that, increased WUE is the outcome of more transpiration of water under thick crop canopy. Adoption of any practices at the canopy level that reduce the soil water evaporation and make more water into transpiration results in higher WUE – also reported by Hatfield and Dold (2019).

The perusal of 2 years of data also indicated that, the amount of CU of water was higher in 2016 than that in 2017 (Figs. 1–3). This might attribute to lower amount of rainfall received during the crop season of 2016, resulting in rise in evaporative demand of air, and hence the increased the ET or CU. In 2016, average rainfall and total rainfall received during the crop-growing stage was 6.4 and 936.8 mm whereas higher values (9.8 and 1,433 mm respectively) were recorded in 2017. Contrary to this, the WUE was found higher in higher rainfall year, i.e. the second year (Fig. 2) which is probably due to relatively more effective transpiration process, longer BSSH as well as higher mean temperature.

Relation of yield and yield attributes with crop water use and solar radiation environment

The relationship between water use and WUE with yield and yield attributes and with solar radiation parameters (Table 2, 3) were carried out with pooled data (2016 and 2017) for crop-establishment method. Under SRI system, very strong correlation was observed between grain yield and CU of water (0.83**) and WUE (0.98**). The relationships with straw yield and other yield-attributing characters were analogous to that of grain yield. However, lower level of significance was noticed with respect to straw yield and CU of water (0.62*) which depict its effectual utilization in translocation of more photosynthates to sink (Table 2). Conversely, though the CRC crops exhibited similar response, but the level of positive relation was quite lower than that of SRI system. Stronger relation between WUE and panicles/m^2 in SRI (0.95**) than that of CRC (0.44*) indicate significant contribution of per m^2 effective tiller production towards formation of grain yield in SRI. This might attribute to more production of effective tillers per unit area with relatively lesser consumption of water.

The CU of water under SRI system was significantly positive for mid canopy light intensity at maximum tillering stage (MTS) and also with RUE (Table 3). Both CU and WUE exhibited appreciably strong correlation (0.84** and 0.83**) with AIPAR in SRI. Similar response was also noticed between WUE of SRI crop with RUE (0.97**) and HUE (0.73**). In CRC, on contrary, CU of water showed positively very strong relation with light intensity (mid canopy) and LTR throughout the crop growth except at MTS. The relationship with RUE and AIPAR was compa-

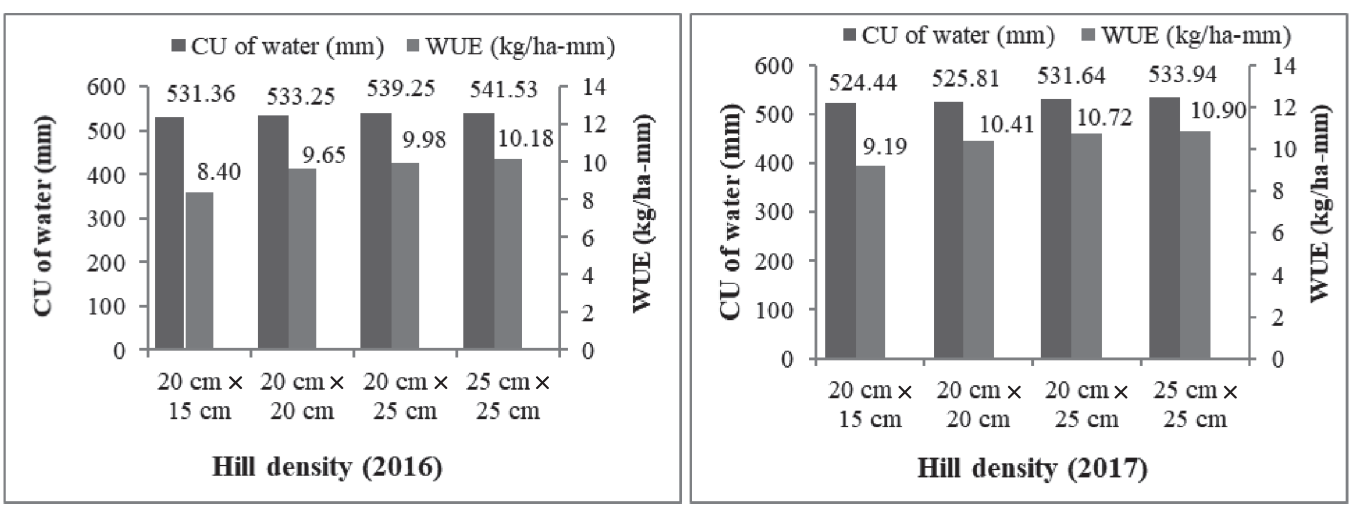

Fig. 3. Different hill densities of rice influencing consumptive use of water and water-use efficiency during 2016 and 2017

Table 2. Correlation study between yield and yield parameters with crop-water use under different crop establishment in rice

Yield and yield attributes/ water use parameters	Grain yield (t/ha)	Straw yield (t/ha)	Panicles/ m^2 (No.)	Panicle length (cm)	Filled grains/ panicle (No.)	Test weight (g)	Harvest index (%)
System of rice intensification							
CU of water (mm)	0.83**	0.62*	0.79**	0.68**	0.80**	0.70**	0.78**
WUE (kg/ha-mm)	0.98**	0.91**	0.95**	0.91**	0.97**	0.92**	0.72**
Conventional rice cultivation							
CU of water (mm)	0.71*	0.68*	0.72*	0.60*	0.73*	0.55*	0.61**
WUE (kg/ha-mm)	0.87**	0.79**	0.44*	0.86**	0.91**	0.87**	0.83**

*P = 0.05; **P = 0.01

CU, Consumptive use; WUE, water-use efficiency

Table 3. Correlation between solar radiation and water-use parameters with crop water use under different crop-establishment method in rice

Radiation parameters / water use parameters	LIm	Lif	LIpm	LTRm	LTRf	LTRpm	RUE	AIPAR	HUE
System of rice intensification									
CU of water (mm)	0.64*	0.39	0.14	-0.59*	0.29	0.33	0.70*	0.84**	0.20
WUE (kg/ha/mm)	0.34	-0.07	-0.32	-0.82**	-0.22	-0.18	0.97**	0.83**	0.73**
Conventional rice cultivation									
CU of water (mm)	0.89**	0.89**	0.72**	-0.62*	0.65*	0.76**	0.58*	0.79**	0.21
WUE (kg/ha/mm)	0.41	0.29	-0.01	-0.53	-0.05	0.05	0.81**	0.63*	0.58*

*P=0.05; **P=0.01

WUE, Water-use efficiency (kg/ha-mm); CU, Consumptive use of water (mm); Lim, mid canopy light intensity (μmole/m^2/s) at MTS; LIf, mid canopy light intensity (μmole/m^2/s) at 50% flowering; LIpm, mid canopy light intensity (μmole/m^2/s) at physiological maturity; LTRm, light transmission ratio at MTS; LTRf, light transmission ratio at 50% flowering; LTRpm, light transmission ratio at physiological maturity; RUE, radiation use efficiency (g/MJ); AIPAR, accumulated incident photosynthetically active radiation (Mj/m^2); HUE, heat-use efficiency (kg/ha degrees-days)

rable with that of SRI crop. A negative but strong correlation was noticed between WUE of SRI crops and LTR at the maximum tillering stage (MTS) which reveals more absorption and utilization of PAR during the vegetative stage. The response of WUE under CRC towards RUE, AIPAR and HUE was significant and positive; however, positivity was much strong with RUE. The result indicated that, the weather parameters especially incoming PAR and temperature significantly influenced the CU of water and its efficient utilization in formation, translocation and eventual accumulation of photosynthates in grains. Hatfield and Dold (2019) reported that, more uniform light environment at canopy level increased RUE and WUE as well. Throughout the crop growth, strong correlation of CU of water with light intensity and LTR was observed in CRC, while SRI showed no significant effect except light intensity at MTS. The thick canopy due to heavy tillering in SRI absorbs more light energy, whereas the thinner canopy of CRC allows more penetration of light into the ground level of the crop canopy and promoting evaporative loss while adding more to CU value. As a result, lesser portion of CU got utilized for crop's physiological processes in CRC system which led to lower grain yield and WUE in comparison to SRI. Interception, absorption and utilization of light energy at vegetative stage had a strong and positive bearing on WUE. Garcés-Varon and Restrepo-Díaz (2015) also reported a high correlation of solar radiation with leaf area and dry-matter production and thereby, the yield.

An attempt was made to develop a regression model equation for both the crop-establishment methods separately using stepwise regression methods for presuming grain yield from crop water use and solar radiation parameters. The fitted multiple regression equations are stated in Table 4 indicated significant linear relationship for grain yield with crop water use and radiation parameters. The models showed the value of R^2 for the combination of water use and radiation parameters to explain the variability of grain yield were 0.988 and 0.956 under SRI and CRC system respectively. Both the water-use parameters, i.e. WUE and CU as well as RUE and AIPAR collectively explain 98.8% variation in grain yield of SRI crops, while 95.6% variability in grain yield of CRC crops were found to be determined by CU, RUE, AIPAR and HUE. The models exhibits that irrespective of methods of crop establishment, the CU of water, RUE and AIPAR are the most decisive factors for predicting grain yield of rice. The efficiency of

Table 4. Regression equations for estimating grain yield under system of rice intensification and conventional rice cultivation involving solar radiation and water-use parameters

Multiple Regression equations			R^2
GY_{SRI} (kg/ha)	=	-5554.83+561.3WUE (kg/ha-mm) + 12.28 CU (mm) - 244.73RUE(g/MJ)-1.05AIPAR(MJ/m^2)	0.988
$GY_{CRC.}$ (kg/ha)	=	-1280.05 - 15.90 CU (mm) + 7425.03 RUE (g/MJ) + 9.40 AIPAR (MJ/m^2) -1207.42 HUE (kg/ha degrees-days)	0.956

** GY_{SRI}, Grain yield under SRI; GY_{CRC}, grain yield under CRC establishment; WUE, water-use efficiency (kg/ha-mm); CU, consumptive use of water (mm); RUE, radiation use efficiency (g/MJ); AIPAR, accumulated incident photosynthetically active radiation (Mj/m^2); HUE, heat-use efficiency (kg/ha degrees-days)

water use was, however comes out to be the key factor for determining the yield of SRI crops besides these parameters. The ambient solar radiation environment and any agronomic practices which create conducive light environment in crop canopy that divert more water for transpiration while lowering evaporation from the soil eventually enhance WUE (Hatfield and Dold, 2019).

Economics

The comparative economics of the treatments worked out on the average yield data of 2016 and 2017 (Table 5). The treatment combination of SRI method of establishment on 26 June transplanting at spacing of 25 cm × 25 cm recorded the highest magnitude of per hectare gross returns (₹1,34,691), net returns (₹90,703.73) as well as net returns per rupee invested (2.06). This treatment was immediately followed by 10 July-planted SRI crop at same measure of spacing. The lowest value of all these economic parameters was noticed in conventional crops transplanted on 25 July at 20 cm × 15 cm apart. The enhancement of economic parameters such as gross return, net return and net return per rupee invested in SRI might be owing to the cumulative positive influence of the different treatment components in getting the higher yields out of the inputs saving approaches particularly the lesser seed and labour as well as radically smaller nursery area. This resulted in reduced cost of cultivation while enhanced the labour productivity. Uphoff (2003), Dass and Chandra (2012) and many other

Table 5. Comparative economics of different treatment combinations (pooled data)

Treatment	Cost of cultivation (₹)	Gross return (₹)	Net return (₹)	Net return/ rupee invested
$C_1D_1H_1$*	43,575	1,12,405	68,830	1.58
$C_1D_1H_2$	43,410	1,23,529	80,119	1.85
$C_1D_1H_3$	44,156	1,29,385	85,229	1.93
$C_1D_1H_4$	43,988	1,34,691	90,704	2.06
$C_1D_2H_1$	43,575	1,07,696	64,121	1.47
$C_1D_2H_2$	43,410	1,20,867	77,457	1.78
$C_1D_2H_3$	44,156	1,27,925	83,769	1.90
$C_1D_2H_4$	43,988	1,32,934	88,946	2.02
$C_1D_3H_1$	43,575	94,735	51,160	1.17
$C_1D_3H_2$	43,410	1,08,158	64,748	1.49
$C_1D_3H_3$	44,156	1,17,934	73,778	1.67
$C_1D_3H_4$	43,988	1,21,002	77,014	1.75
$C_2D_1H_1$	48,600	99,352	50,752	1.04
$C_2D_1H_2$	48,225	1,18,329	70,104	1.45
$C_2D_1H_3$	47,985	1,14,873	66,888	1.39
$C_2D_1H_4$	47,775	1,16,164	68,389	1.43
$C_2D_2H_1$	48,600	94,473	45,873	0.94
$C_2D_2H_2$	48,225	1,07,549	59,324	1.23
$C_2D_2H_3$	47,985	1,09,130	61,145	1.27
$C_2D_2H_4$	47,775	1,05,875	58,100	1.22
$C_2D_3H_1$	48,600	87,329	38,729	0.80
$C_2D_3H_2$	48,225	99,664	51,439	1.07
$C_2D_3H_3$	47,985	1,02,243	54,258	1.13
$C_2D_3H_4$	47,775	1,00,737	52,962	1.11

Based on market price of grain, ₹15.50/kg; market price of straw, ₹5.00/kg

*C_1, SRI; C_2, CRC; D_1, 26 June; D_2, 10 July; D_3, 25 July; H_1, 20 cm × 15 cm; H_2, 20 cm × 20 cm; H_3, 25 cm × 20 cm; H_4, 25 cm × 25 cm

researchers reported economic advantages of SRI practices owing to efficient utilization of lesser inputs enhancing crop yield to an appreciably higher magnitude.

Thus, it may be concluded that SRI as a crop-establishment method early transplanting condition nearer to the date 26 June with the spacing of 25 cm × 25 cm (16 hills/m^2) is a potential technology for effectively harnessing solar radiation and water for formation, translocation and accumulation of assimilates resulting in realizing higher yield of rainy season rice with appreciable economic benefit under flood-free medium-land situation of Assam. Strong positive correlation between WUE and production of effective tillers per unit area is an important reason for increased crop yield in SRI owing to more absorption and better utilization of light energy in the tillering stage.

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