EVALUATING WATER USE, WATER SAVINGS, AND WATER USE EFFICIENCY IN IRRIGATED RICE PRODUCTION WITH SRI VS. STANDARD MANAGEMENT

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Can enhanced crop yield with reduced applications of water be achieved with range of conditions?

- 400+ articles at SRI – Rice, CIIFAD
- 120 articles have some information on water
- 29 articles with direct comparison between SRI and non-SRI methods
- Different trials classified as per actual trials and not just name
- 251 trials with data on agronomic practices, water management and use, and crop results
- Trials from South Asia (India) 55%; Africa (Gambia, Kenya, Senegal) 30%; East and Southeast Asia (China, Japan, Indonesia) 14%; and Middle East (Iraq) 1%. All samples.

Differentiating SRI and non-SRI

1. There could be some variation within each category, such as the depth of continuous flooding or the intervals for AWD, but such gradations were not assessed in this analysis as not all data sources provided enough information on these refinements in water management practice.
2. The assessment matrix was used to evaluate *the degree to which* SRI methods were put into practice in the respective trials. Each trial had a cumulative score that could range between zero (certainly not SRI) and 15, approximating the 'ideal type' for SRI management.
3. 122 SRI and 129 non- SRI trials adhering to 60% of the SRI crop management practices

Contextual / environmental factors

- Cropping season (Wet and Dry)
- Climatic differences (map prepared by NASA, the National Aeronautics and Space Administration)
- Soil texture (Sand to Clay and loam as intermediate) as per U. S. Department of Agriculture (USDA) (http://soils.usda.gov/technical/soil_orders/).
- Soil acidity/alkalinity (College of Environmental Science and Forestry of the State University of New York)
- Variety duration (Short < 120, Medium 121- 140, and Long > 141 days

Water savings and Water Use Efficiency

Water Saving (in %)

$$\text{Water savings} = \frac{[\text{Water use in non-SRI}] - [\text{Water use in SRI}]}{[\text{Water use in non-SRI}]} \times 100$$

- *Water use efficiency* (WUE): amount of crop production or output per unit of water consumed during the production of that yield (Chapagain and Yamaji, 2010).

- Total Water Use Efficiency (TWUE) and Irrigation Water Use Efficiency (IWUE)

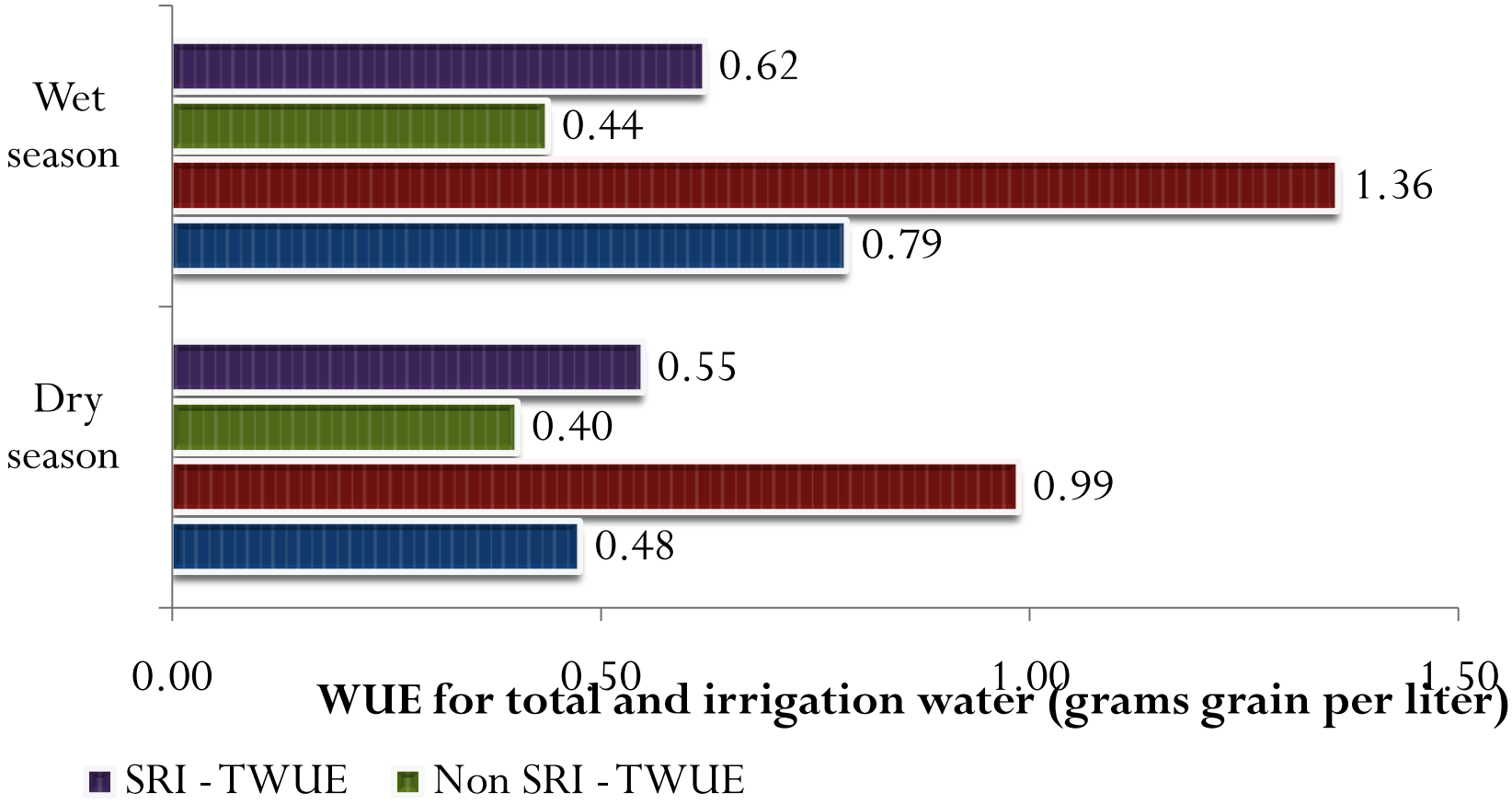
WUE Advantage of SRI in %

$$\text{WUE advantage with SRI} = \frac{[\text{WUE SRI}] - [\text{WUE non-SRI}]}{[\text{WUE non-SRI}]} \times 100$$

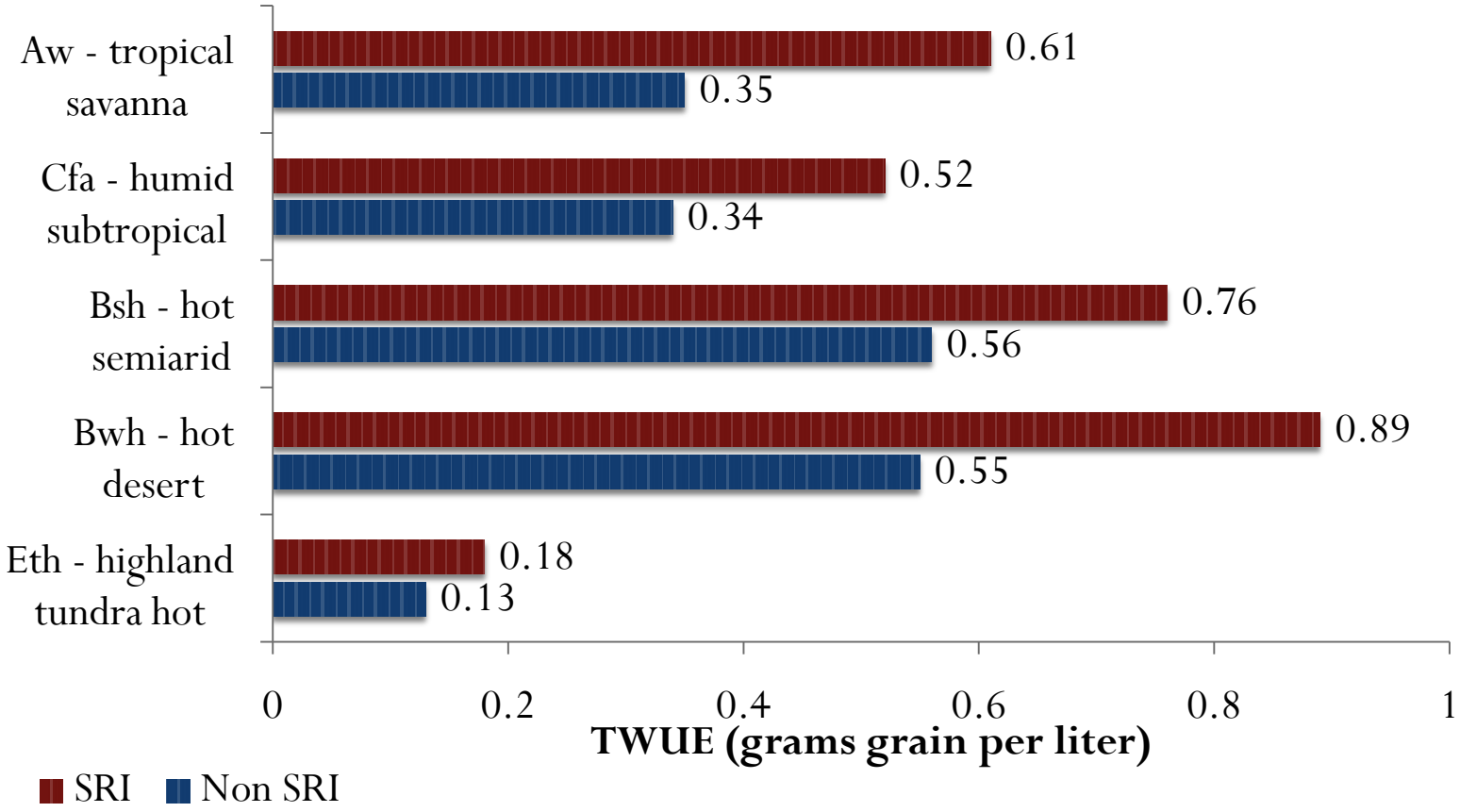
Results

- Yield with SRI of 5.9 tons ha^{-1} , 11% more than the 5.3 tons ha^{-1} with non – SRI trials.
- The mean total water use - SRI 12.0 million liters ha^{-1} compared to15.3 million liters ha^{-1} non- SRI (22% reduction in water use).
- The mean irrigation water use - SRI 7.2 million liters ha^{-1} compared to11.1 million liters ha^{-1} non- SRI (35% reduction in water use).
- TWUE: SRI- 0.6 grams grain per liter, non SRI- 0.39 grams grain per liter (54% advantage)
- IWUE: SRI- 1.23 grams grain per liter, non SRI- 0.69 grams grain per liter (78% advantage)

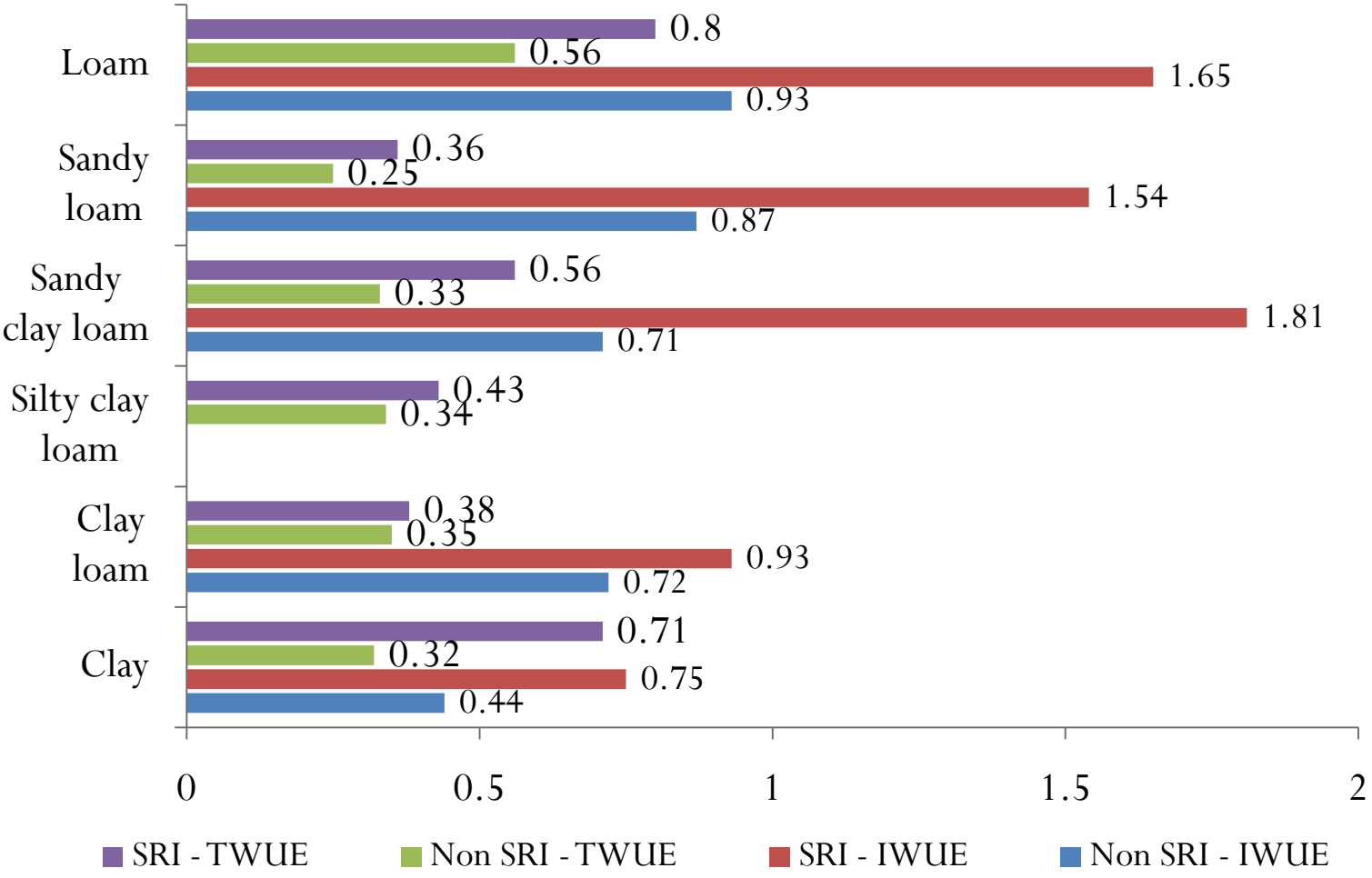
Season wise results



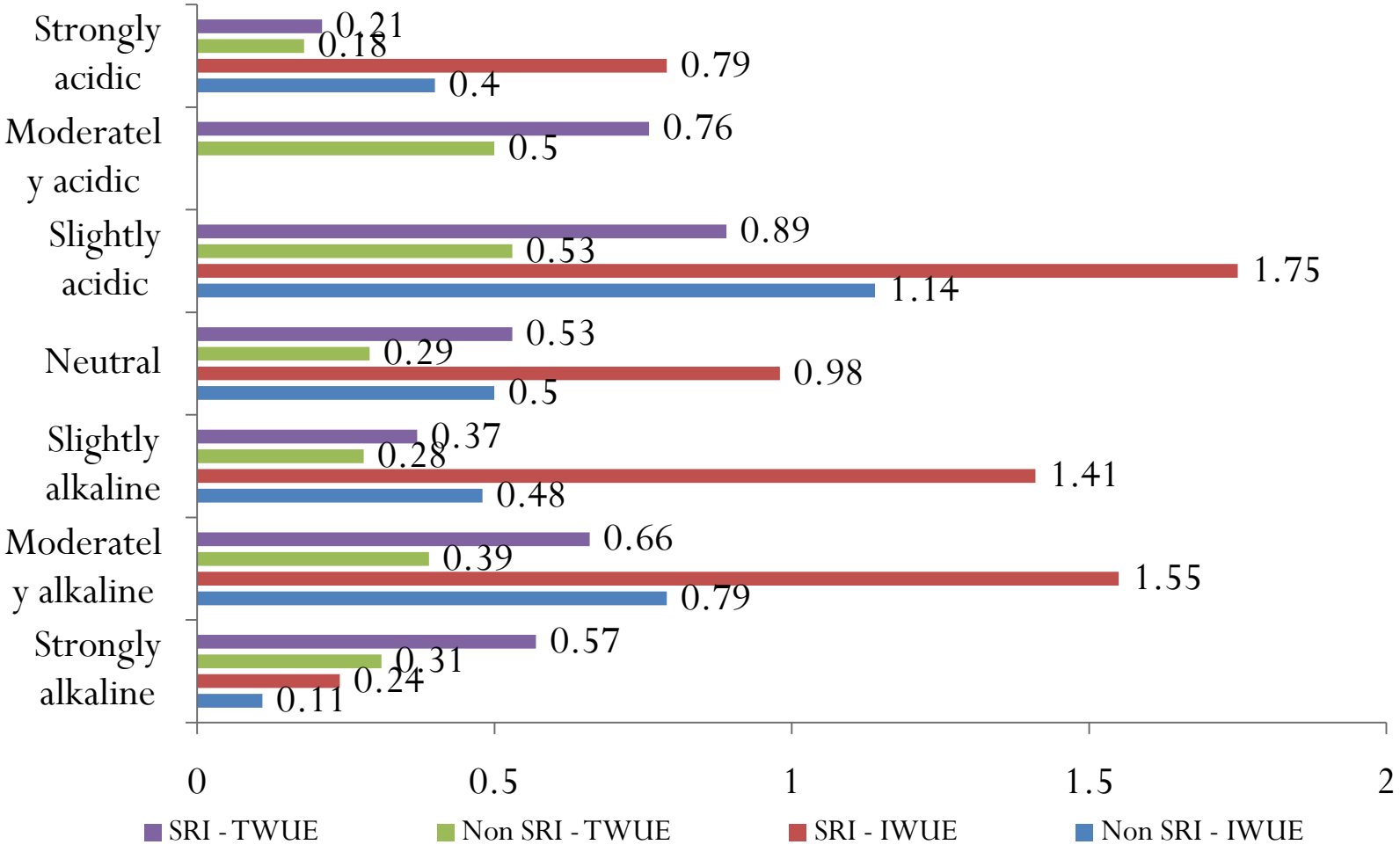
Climate


Aw - tropical savanna
0.61
0.35
Cfa - humid subtropical
0.52
0.34
Bsh - hot semiarid
0.76
0.56
Bwh - hot desert
0.89
0.55
Eth - highland tundra hot
0.18
0.13
0
0.2
0.4
0.6
0.8
1
TWUE (grams grain per liter)
SRI
Non SRI

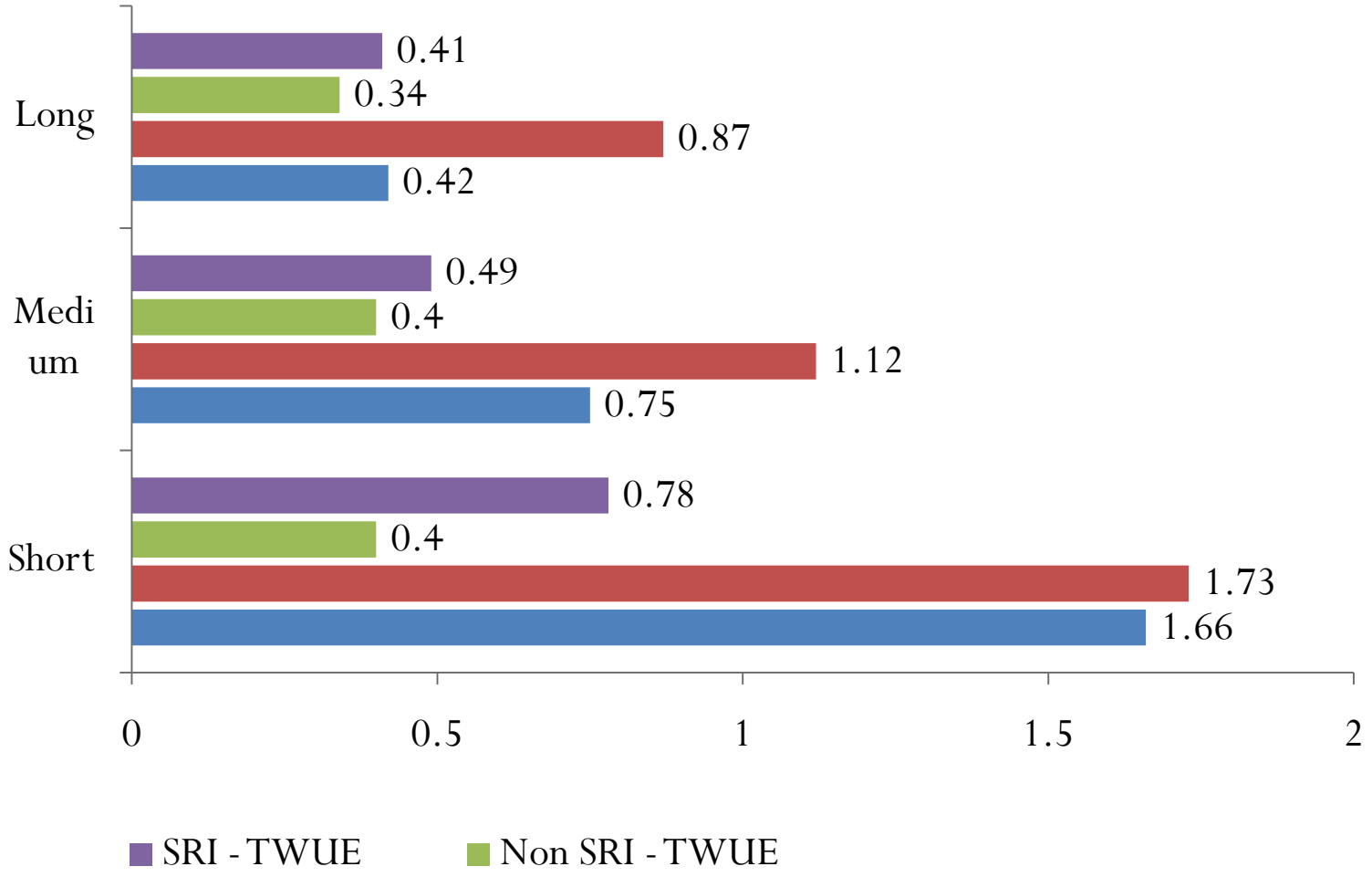
Soil Texture



Soil pH


Strongly acidic
0.21
0.18
0.79
0.4
Moderately acidic
0.76
0.5
Slightly acidic
0.89
0.53
1.75
1.14
Neutral
0.53
0.29
0.98
0.5
Slightly alkaline
0.37
0.28
1.41
0.48
Moderately alkaline
0.66
0.39
1.55
0.79
Strongly alkaline
0.57
0.31
0.24
0.11
0
0.5
1
1.5
2
SRI - TWUE
Non SRI - TWUE
SRI - IWUE
Non SRI - IWUE

Duration of the variety



Multivariate analysis of contextual factors affecting water productivity

- Where the full sample of observations was used, the results indicate that, on average, there is a 37.6% increase in water use efficiency with SRI methods compared to non-SRI methods.
- When the full model was estimated with the contextual factors introduced, the impact of SRI on TWUE in statistical terms increased back to nearly 34% .

Matrix of correlations among the main parameters evaluated in meta-analysis

	SRI score	**Yield (kg ha^{-1})**	**Water use**	**Irrigation water use**	**TWUE**	**IWUE**
SRI score	--	0.186	-0.176	-0.391	0.256	0.357
Yield (kg ha^{-1})	0.186	--	-0.364	-0.304	0.649	0.538
Water use	-0.176	-0.364	--	0.841	-0.785	-0.552
Irrigation water use	-0.391	-0.304	0.841	--	-0.535	-0.706
TWUE	0.256	0.649	-0.785	-0.535	--	0.680
IWUE	0.357	0.538	-0.552	-0.706	0.680	--

Water use and implications on Rice production

- Current water use 860 trillion liters per annum (Pacific Institute, n.d.).
- Rice uses 34-43% of the irrigation water i.e. 24–30% of the world's total developed freshwater resources (Barker, et al., 1998)
- China (93%) and India (52%) use water from irrigation sources.
- Worldwide 55% of total rice production area produce 75% of the rice
- Irrigated rice production almost 150% more productive than rice cultivation relying only on rainfall

Thank You