SRI- EVALUATION FOR ITS POTENTIAL TO ENHANCE PRODUCTIVITY oF RICE AND ITS IMPACT IN INDIA

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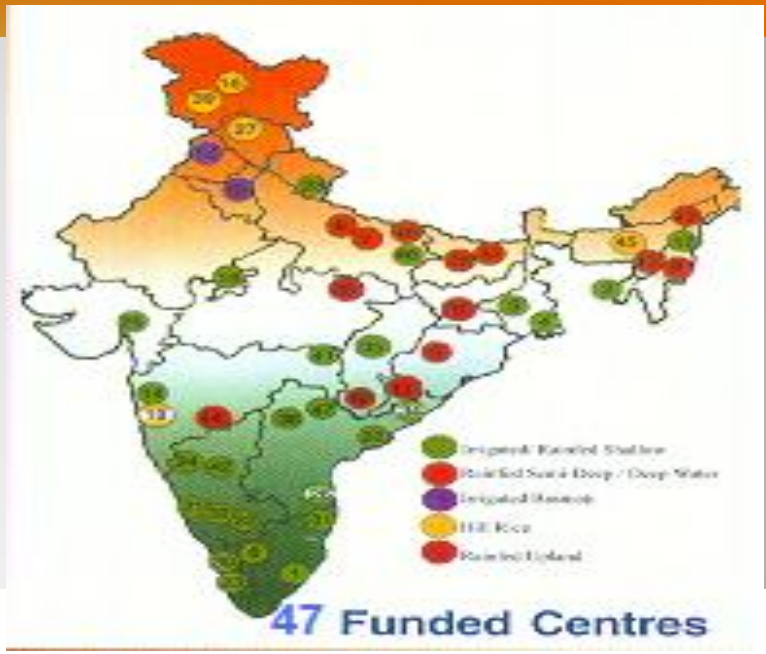
About DRR



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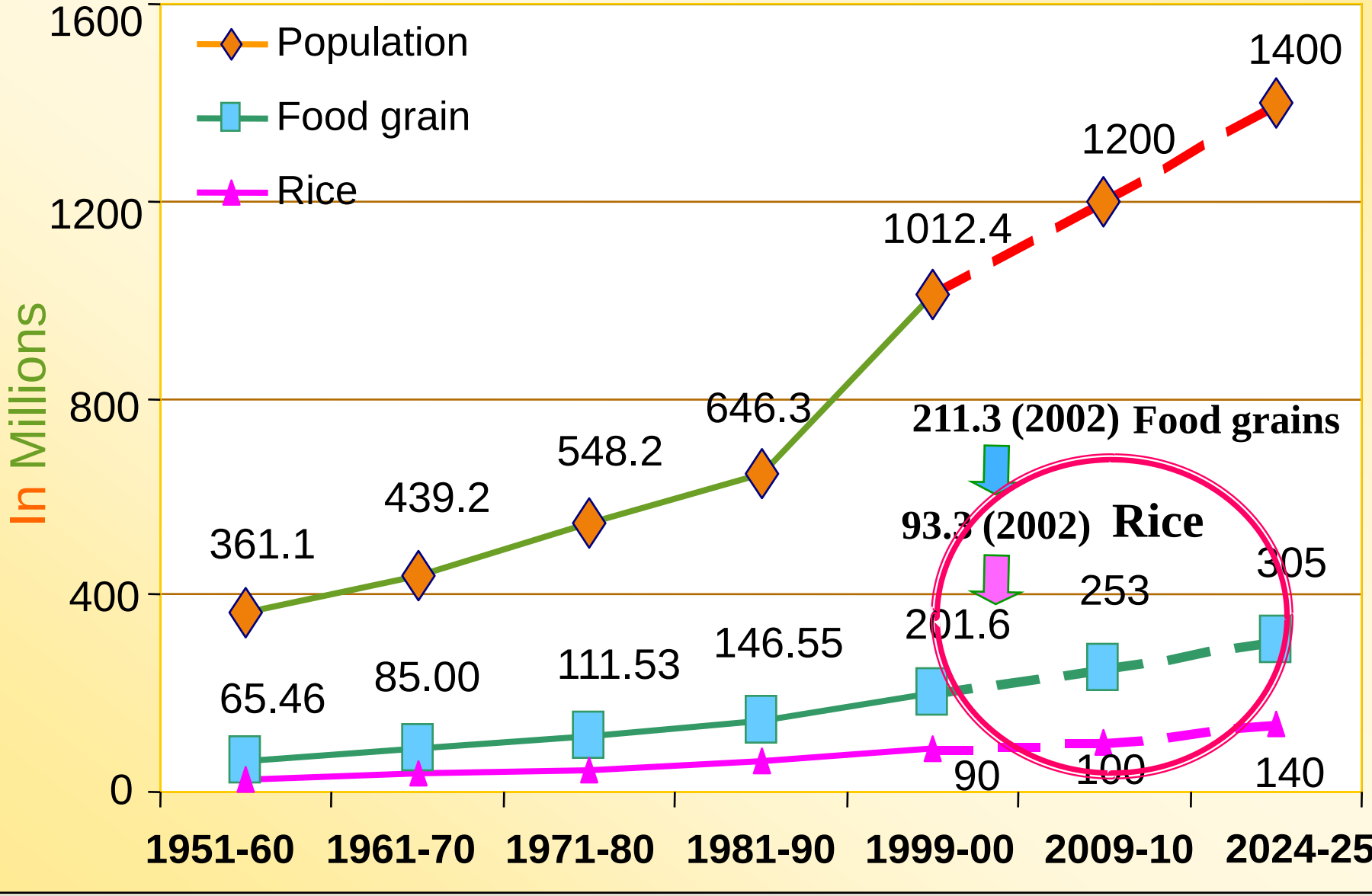
Population, production of food grains and rice Trends and Projections



Challenges for enhancing rice production

- **Declining resource base**
  - **Land**
  - ***Water***
  - **Labour**
- **Deteriorating soil health**
- **Increasing environmental concerns**
- **Increasing cost of cultivation**

Among these water is becoming a critical factor

Water – A critical limiting factor for rice production in future Rice and Water

- 80% of fresh water is used for agriculture.
- More than 50% of this is consumed by the rice crop.
- Rice consumes about 4000-5000 ltr. of water to produce 1 kg of grain.
- Irrigated Rice cannot be ignored as it contributes significantly to food security.
- Little scope to save water from other irrigated dry crops.
- Hence pressure would be on ric cultivation to cut down the wate requirement.

1 kg seed = 5000 lt of water (one tanker)

Prof Norman's presentation at International Agronomy Conference At IARI 2002

Dr. Alapati Satyanarayana's SRILANKA visit,2004

Highest yields reported by Mr. Nagaratnam Naidu, 2004-05

Major Accomplishments

SRI

Aspects covered from 2004

- Evaluation of methods
- Time of transplanting
- Varietal evaluation
- Effect of each principle
- Long term effects of SRI
- Water quantification
- Modification of SRI
- Delineation of SRI potential areas
- Impact and future work

Multilocation Trials on SRI under AICRIP

- Multilocation trials on SRI under AICRIP were conducted during kharif 2004 to 2007 seasons

Number of Locations - 21

State	Location
Andhra Pradesh	Rajendranagar (Hyderabad)
Assam	Karimgunj, Titabar
Bihar	Patna, Sabour
Chhattisgarh	Jagdalpur
Gujarat	Nawagam
Himachal Pradesh	Malan
Jharkhand	Ranchi
Karnataka	Mandya, Siriguppa

Contn….

Multilocation Trials on SRI under AICRIP

State	Location
Orissa	Chiplima
Punjab	Kapurthala
Pondicherry	Karaikal
Tamil Nadu	Aduthurai, Coimbatore
Tripura	Arundhatinagar
Uttar pradesh	Varanasi
Uttaranchal	Pantnagar, Almora
Meghalaya	Umiam

Multi-location trials on SRI

Effective comparison among the following methods (*Kharif* 04 -07)

- System of Rice Intensification (SRI)
- Integrated Crop Management (ICM)
- Normal Recommended Transplanting (NTP)

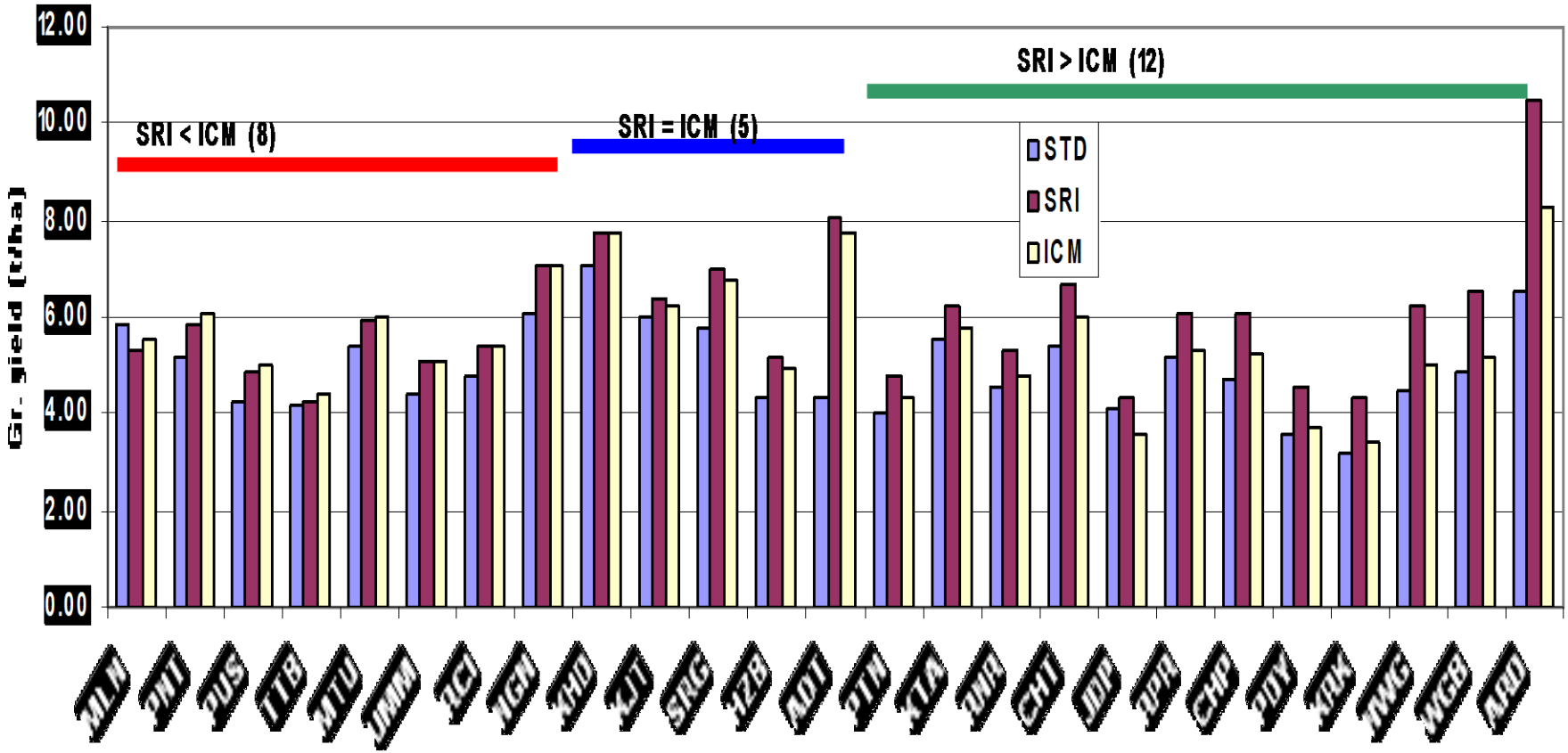
Summary of Multi location trials (2004-2007)

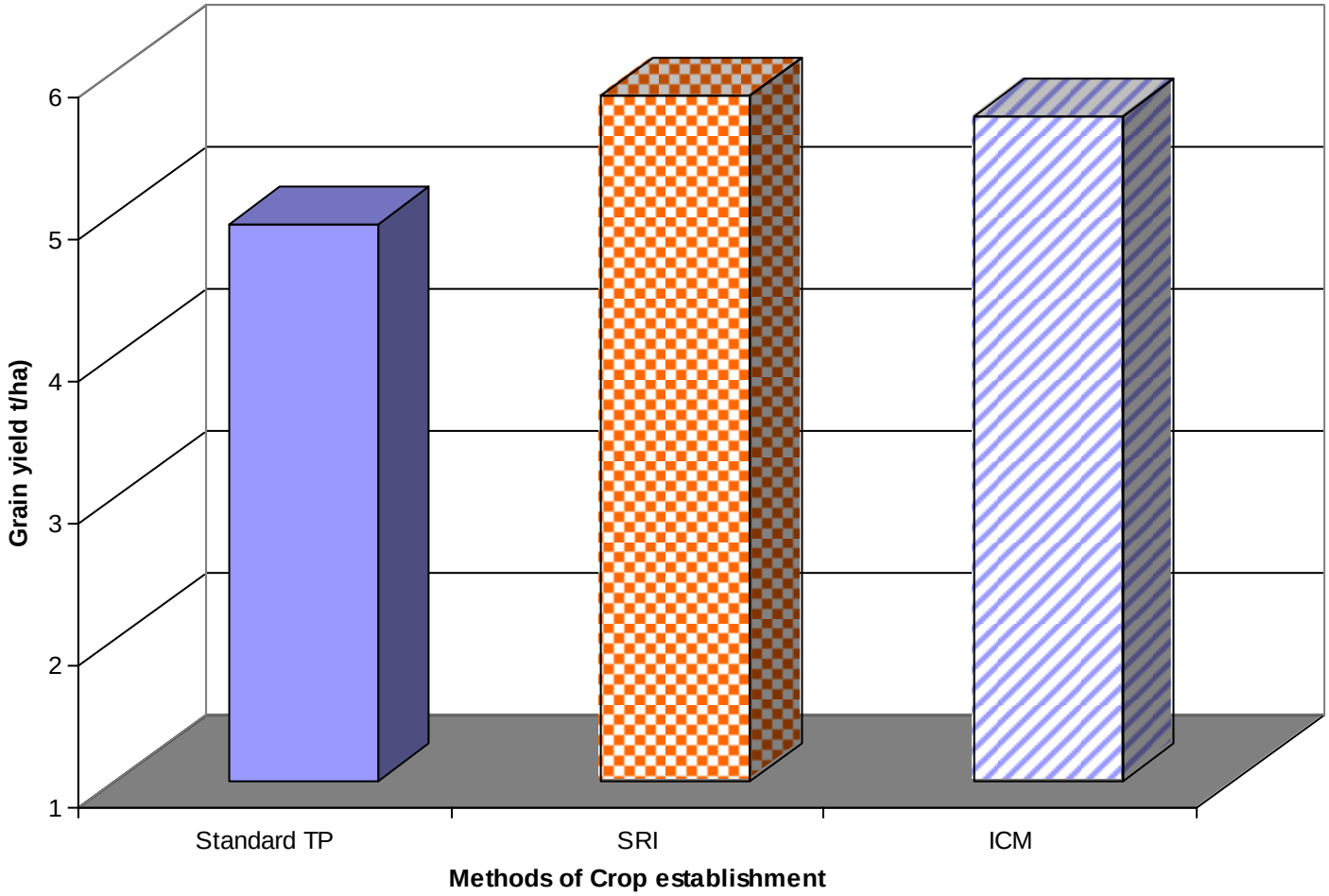
S No	Item	Yield Adv	No. of loca-tions	Name of the locations
1.	SRI superior over NTP.	5 - 65.2 %	19	ADT, ARI, ARD, JGD, KRT, PTN, RNG, SRG, TTB, CHT, CBT, PNT, UMM, MLN, MND, MTU, NWG, PSA
3.	SRI superior over ICM	5-10 %	17	SRG, RNC, PTN, NWG, ARD, ARI, RPR, KRJ, JGD, CHT, ADT, UPS, PDY, MTU, MND, CBT, ALM
4.	ICM over SRI	5-10%	5	KRK, KRG, CHP, SBR, KPT
5.	STD over SRI	5-10%	3	KPT, KRK, SBR

Mean Grain yield increase under SRI and ICM over NTP

Year/Season	SRI over NTP	ICM over NTP
Kharif 04	12.0	10.0
Kharif 05	7.0	5.0
Kharif 06	12.0	6
Kharif 07	20.5	14.1
Over all GY	12.6	8.8

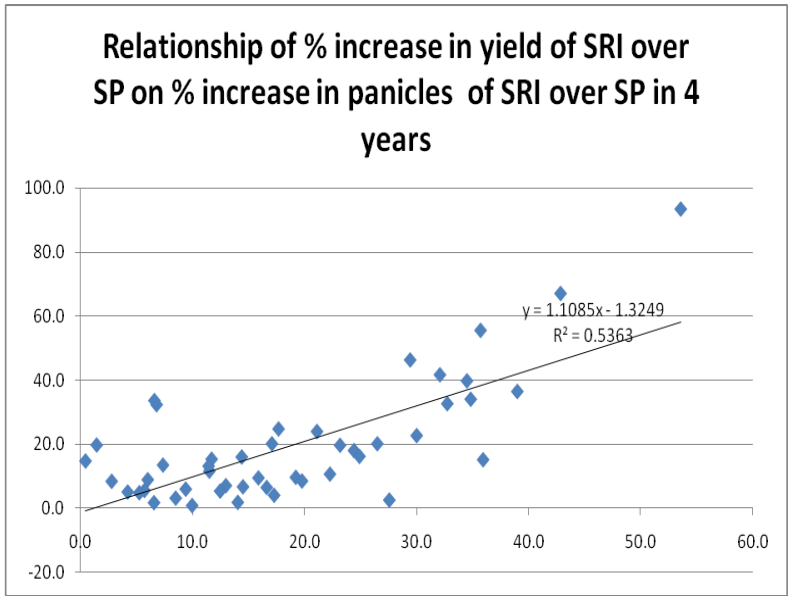
Performance of cultivation methods in different locations Kharif 2007

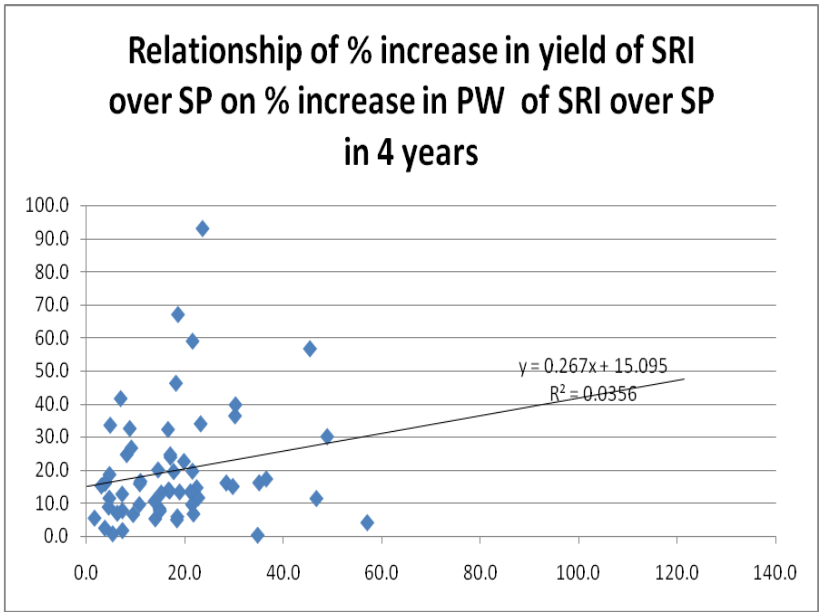




Effect of crop establishment methods on grain yield (Mean of 18 locations)

(additional 0.8 q)





R=.732; Note –%Increase in grain yield SRI over standard Normal Transplanting practice is related to % increase in panicles/sq.m of SRI over standard practice.**	**R=.187ns; % increase in panicle wt has no relation ship with % increase in grain yield of SRI over standard Practice**

Effect of different establish methods rice grain yield in India. (Kharif-2006&2007)

	Rajendranagar	ai	pa	Karaikal	u	m	Kanjat	Chatha	Patna	Chiplima	r	Umiam	Ranchi	Malan	mean	k
T1	4.38	4.35	5.53	4.12	4.68	4.63	5.52	6.90	4.24	4.87	4.87	4.75	4.81	5.81	4.96	5
T2	5.55	6.72	7.21	3.53	4.76	6.29	5.84	7.74	4.87	5.45	4.97	5.42	5.56	6.42	5.74	1
T3	4.80	6.37	6.66	3.85	4.81	5.22	5.81	7.11	4.49	5.38	4.14	5.42	5.51	6.66	5.44	3
T4	4.26	4.48	5.70	3.59	4.60	4.73	5.35	6.73	4.09	4.92	4.61	4.75	4.76	5.89	4.89	6
T5	4.25	6.67	7.16	4.49	4.71	5.79	5.56	7.45	4.68	5.33	5.17	5.48	5.33	5.17	5.52	2
T6	4.39	6.44	6.84	3.51	5.12	4.92	5.51	6.70	4.37	5.39	4.24	5.67	5.38	5.20	5.26	4

Standard practice of transplanting with 20 X 10 cm (Nursery dates are same)

System of Rice Intensification (SRI) with 25x25 cm (Nursery dates are same) — nursery dares are same — 5.38

Integrated crop management (ICM) with 20 x 20 cm (Nursery dates are same) — Transplanting dates are same — 5.22

Standard practice of transplanting with 20 X 10 cm (Transplanting dates are same)

System of Rice Intensification (SRI) with 25x25 cm (Transplanting dates are same)

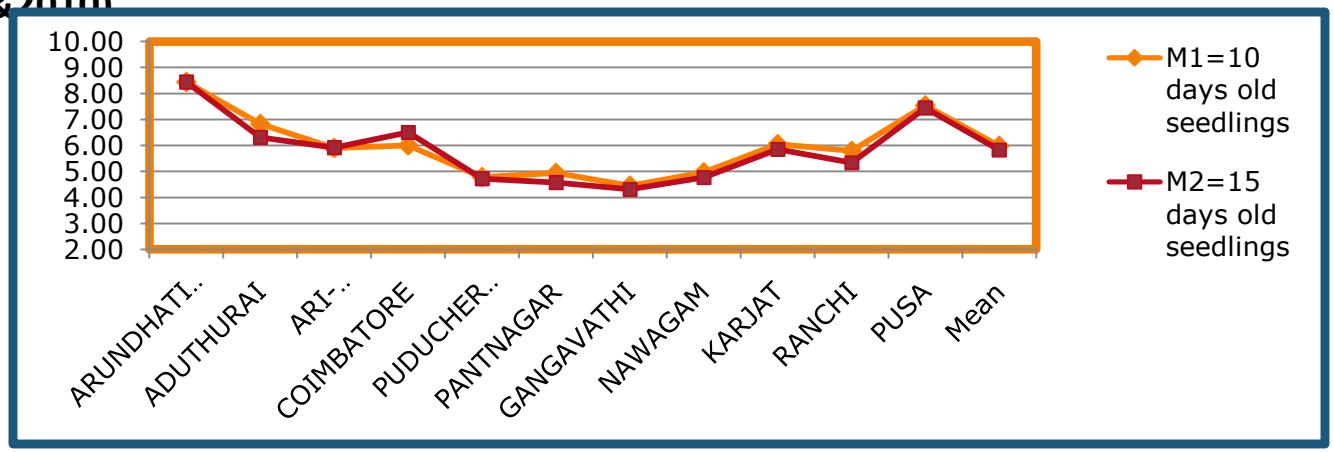
Integrated crop management (ICM) with 20 x 20 cm (Transplanting dates are same)

	SS	DF	MS	F	SEM	SED	CD 0.05	CD 0.01	CV %
Treatment	7.62460704	5	1.52492141	8.64796106	0.11222842	0.158714954	0.316975648	0.421166709	7.92049012
Replication	56.526027	13	4.34815593	24.6587679					
Error	11.4616487	65	0.17633306						
Total	75.6122828	83							

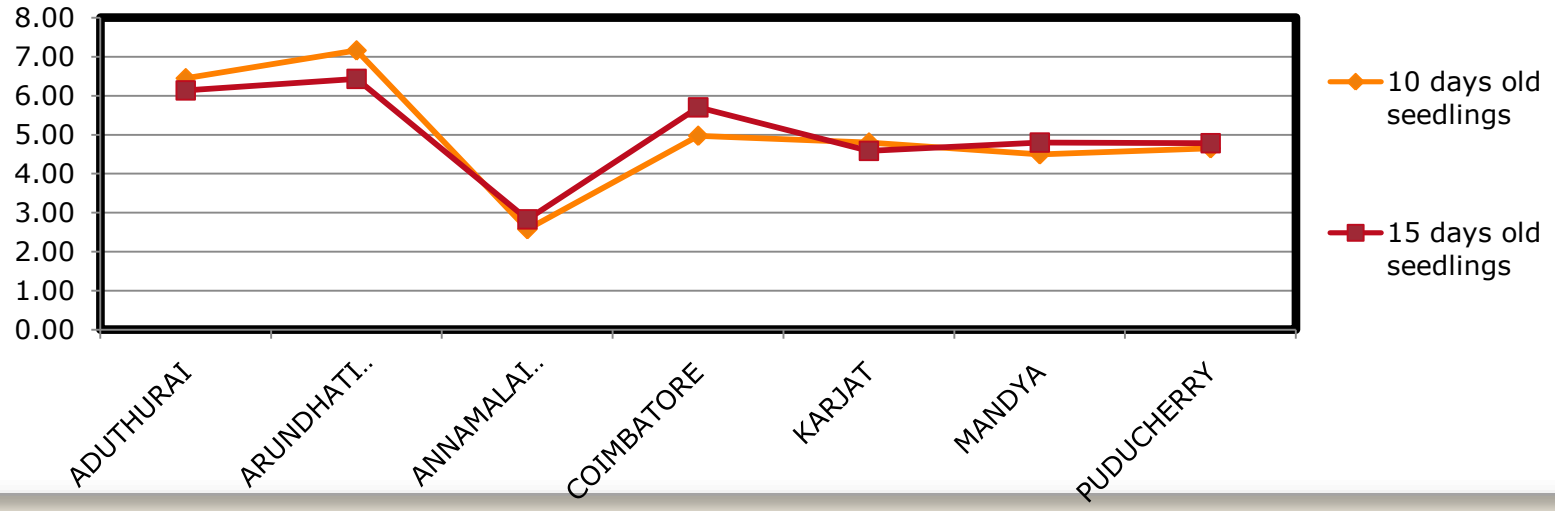
2.36

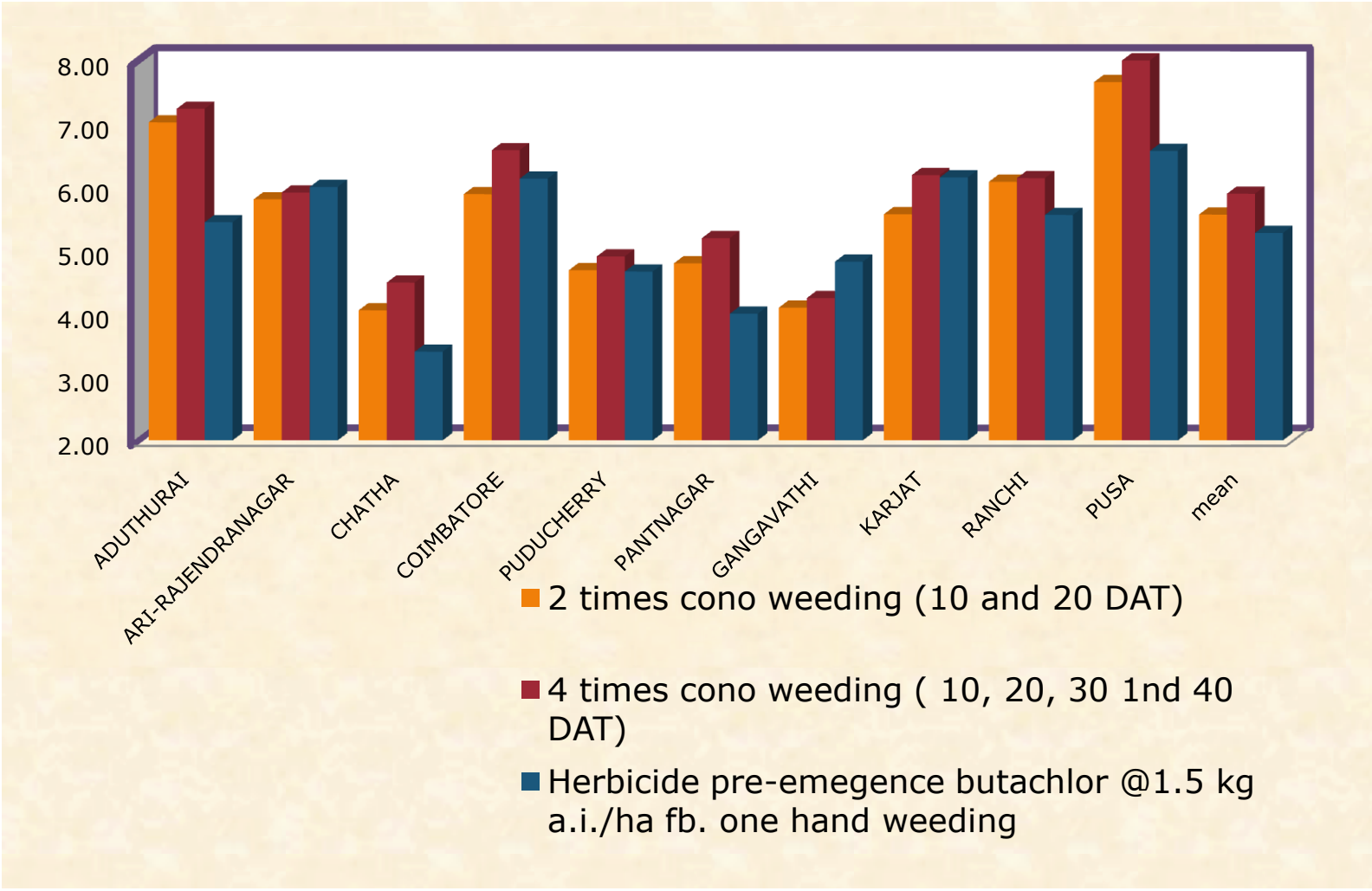
SRI principles

Effect of age of seedlings on grain yield under system of rice intensification in India (Kharif, 2009 &2010)

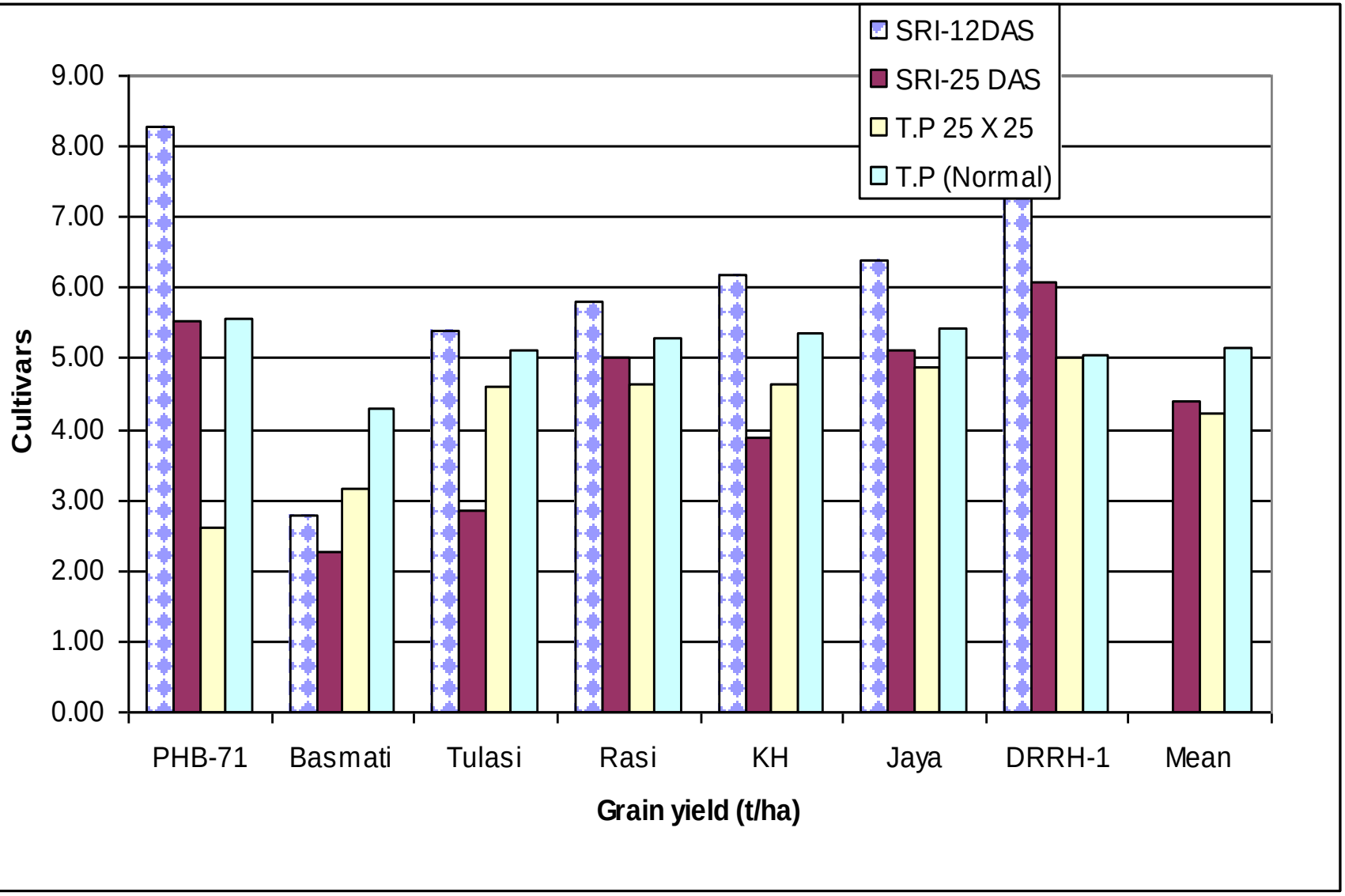


Effect of age of seedlings on grain yield under system of rice intensification in India (Rabi/ 2009 &2010)





:Effect of weed management methods on grain yield under system of rice intensification inIndia (Kharif, 2009 &2010)

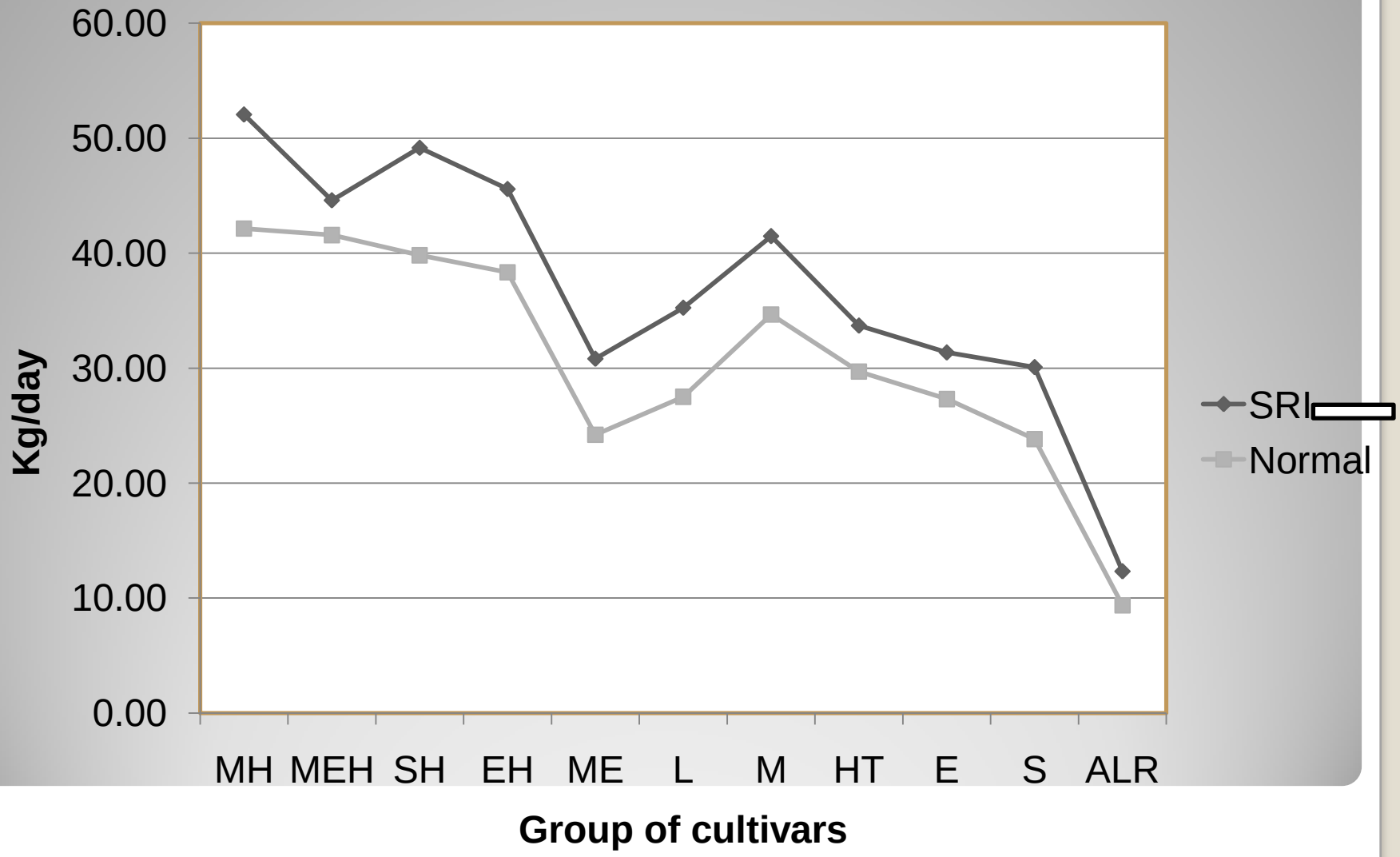


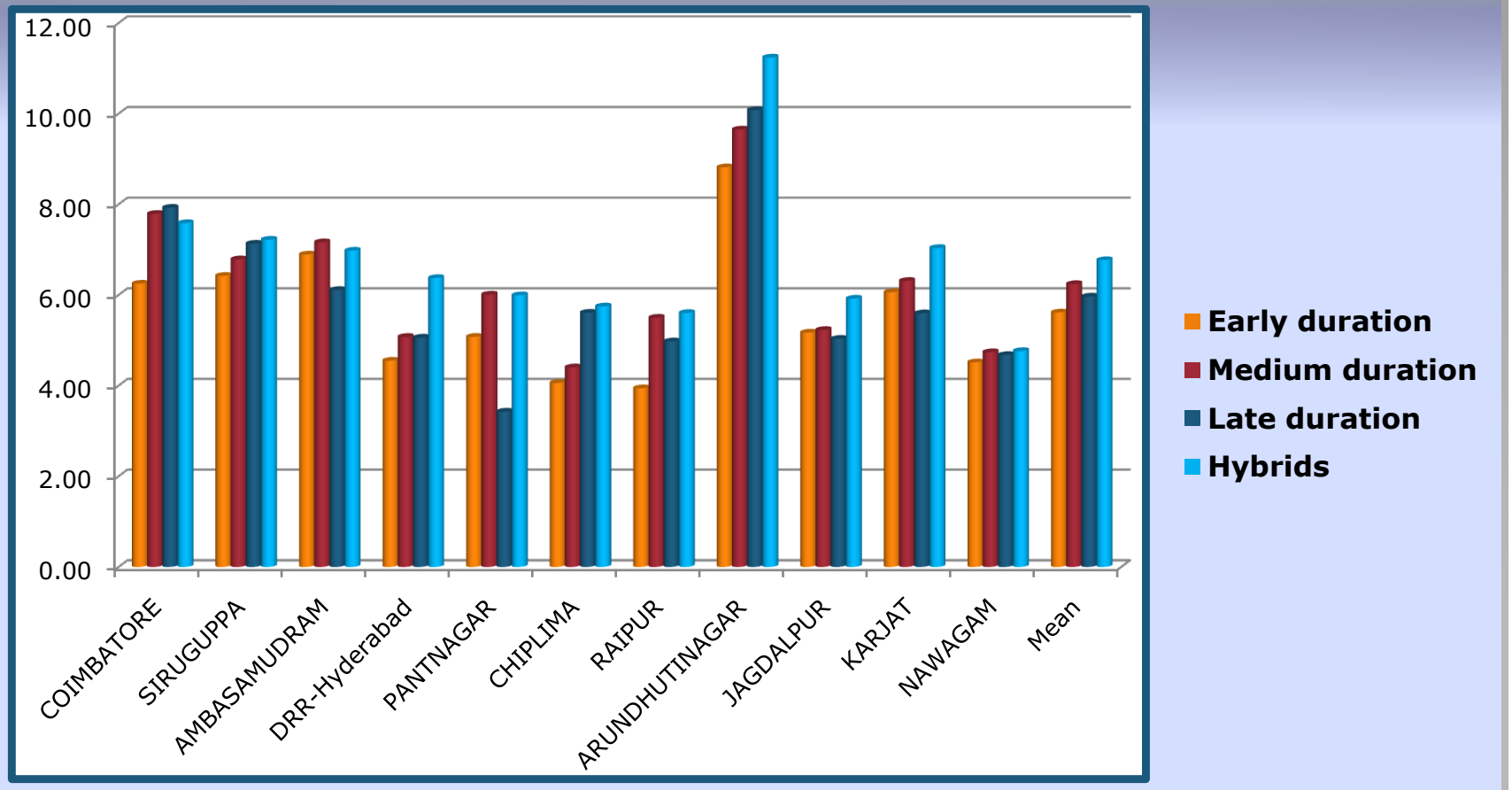
Varieties as influenced by for SRI method

Early maturity

Early maturity of cultivars

Per day Productivity (rabi 2010)

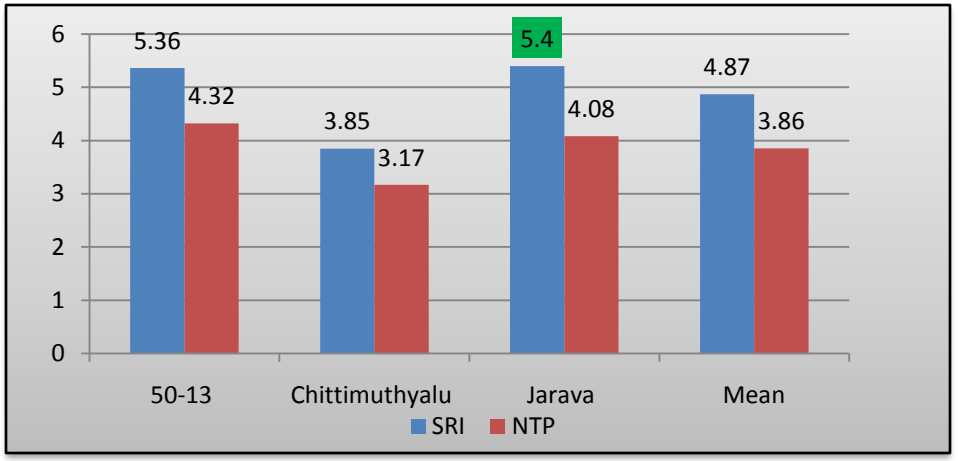




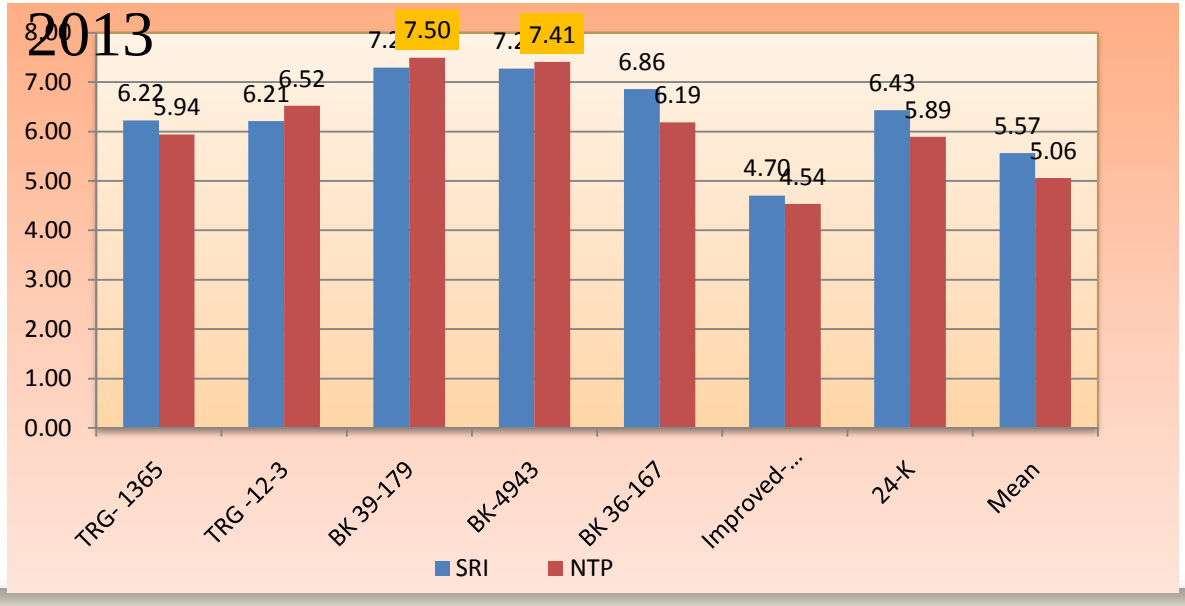
Genotype response to SRI (across locations)

Grain yield t/ ha - Elite cultures

Rabi 2012-13



Kharif 2013



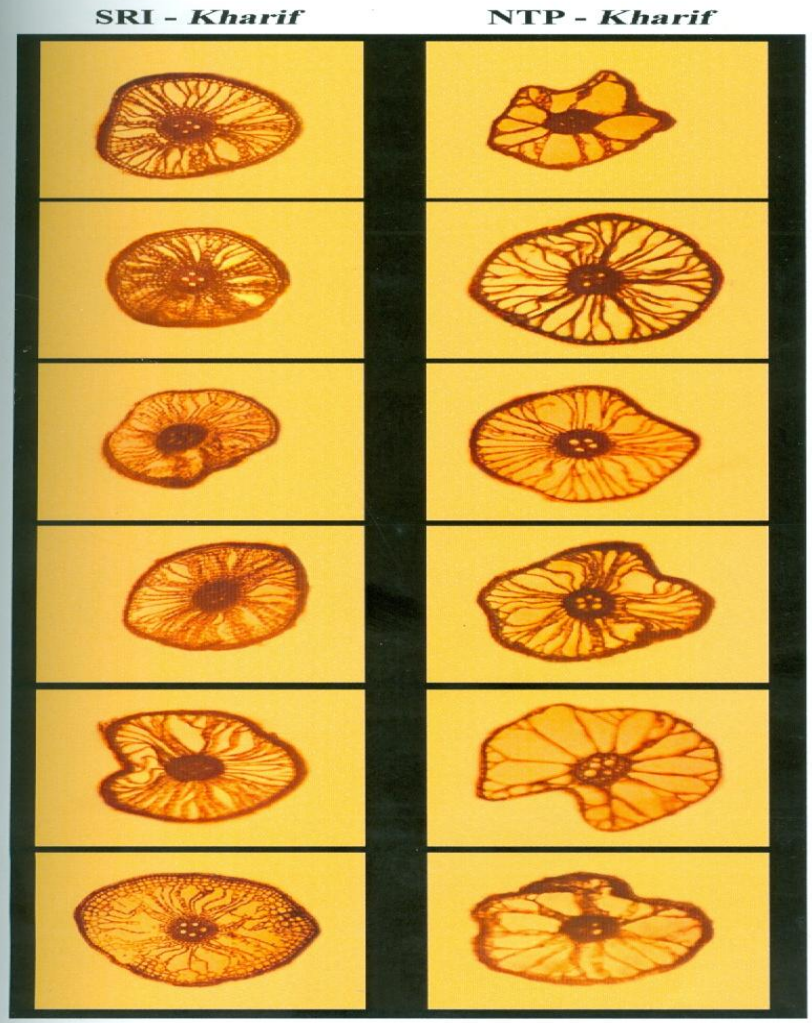


Plate 4.1. Effect on root anatomy of different rice varieties under SRI and NTP methods of cultivation for *kharif*

Bharghavi, ANGRAU

SPAD readings as influenced by SRI method

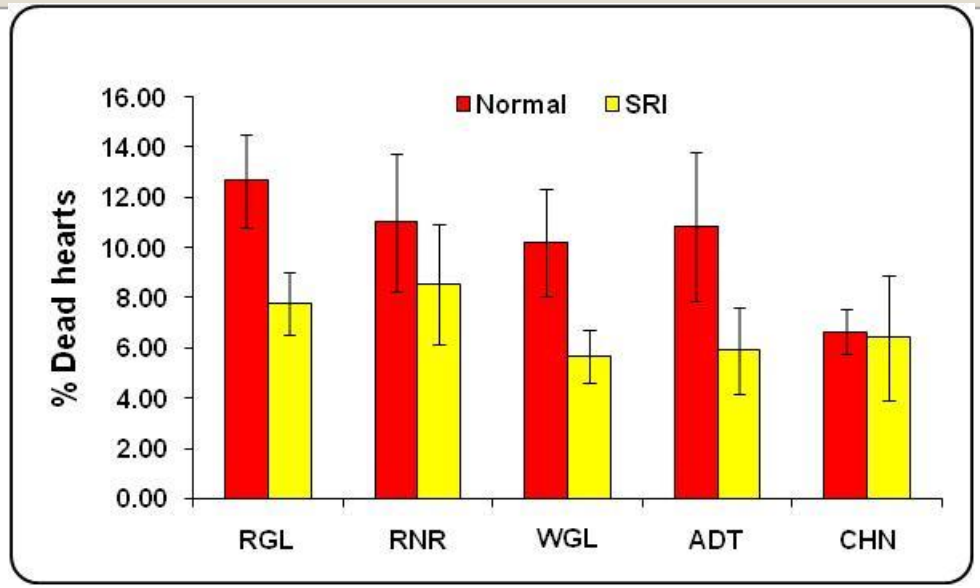

NORMAL

Major insect pests & their damage recorded include:

1. Yellow stem borer – both dead hearts & White ears
2. Gall midge - silver shoots
3. Leaf folder – damaged leaves
4. Brown planthopper – Number found on 10 hills
5. Whorl maggot & Thrips – damaged leaves

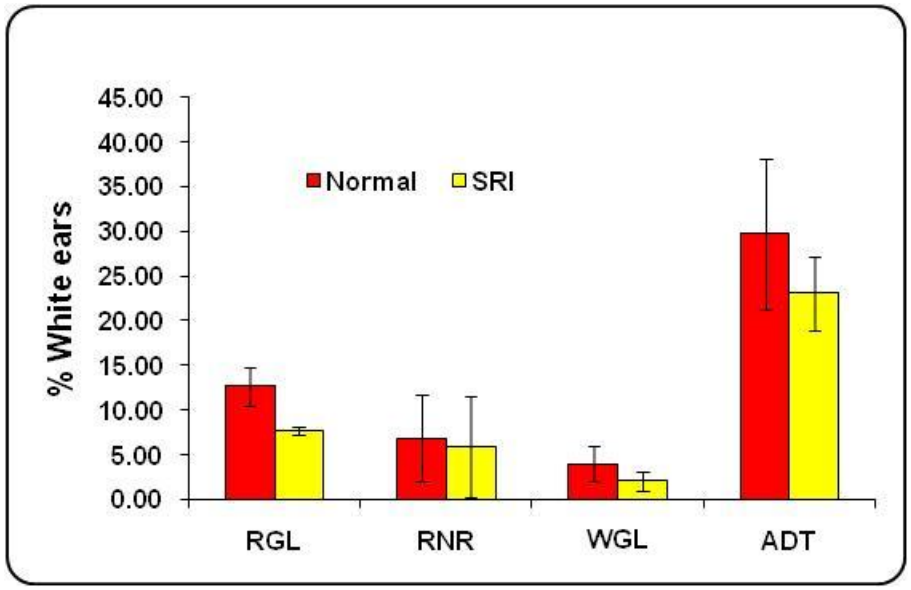
Details of experimental locations across India - year wise

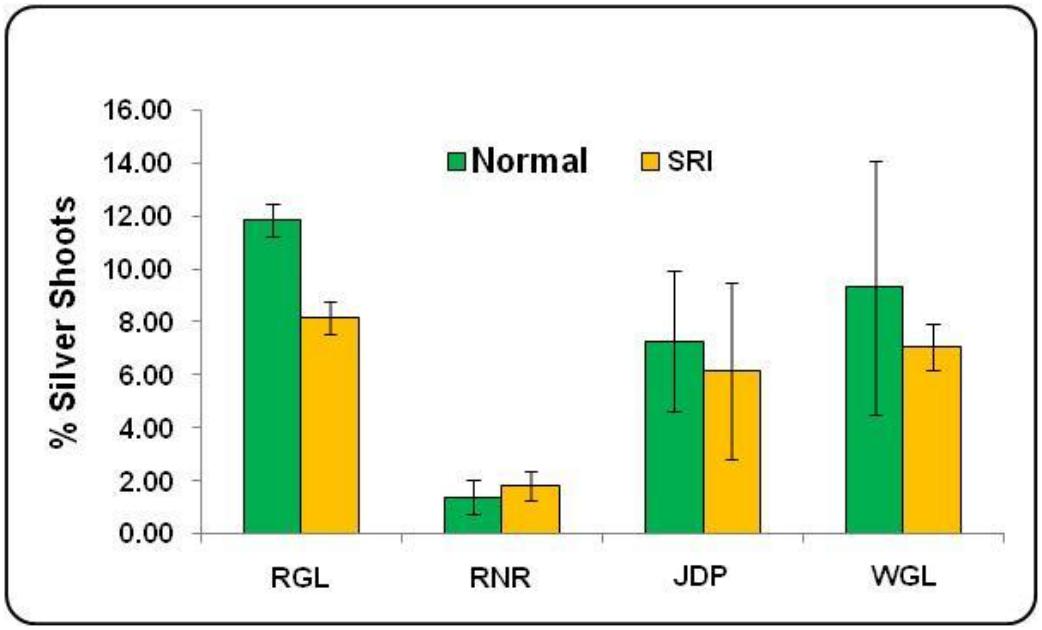
Location	Year	Cultivation methods
Rajendranagar (RNR)	2006 - 2009	Normal & SRI
Warangal (WGL)	2006 -2007	Normal & SRI
Ragolu (RGL)	2007 - 2009	Normal & SRI
Aduthurai (ADT)	2006 - 2007	Normal & SRI
Coimbatore (CBT)	2008	Normal & SRI
Siruguppa (SGP)	2006	Normal & SRI
Jagdalpur (JDP)	2006 - 2007	Normal & SRI



Across the locations, dead hearts were found high in normal method as compared to SRI

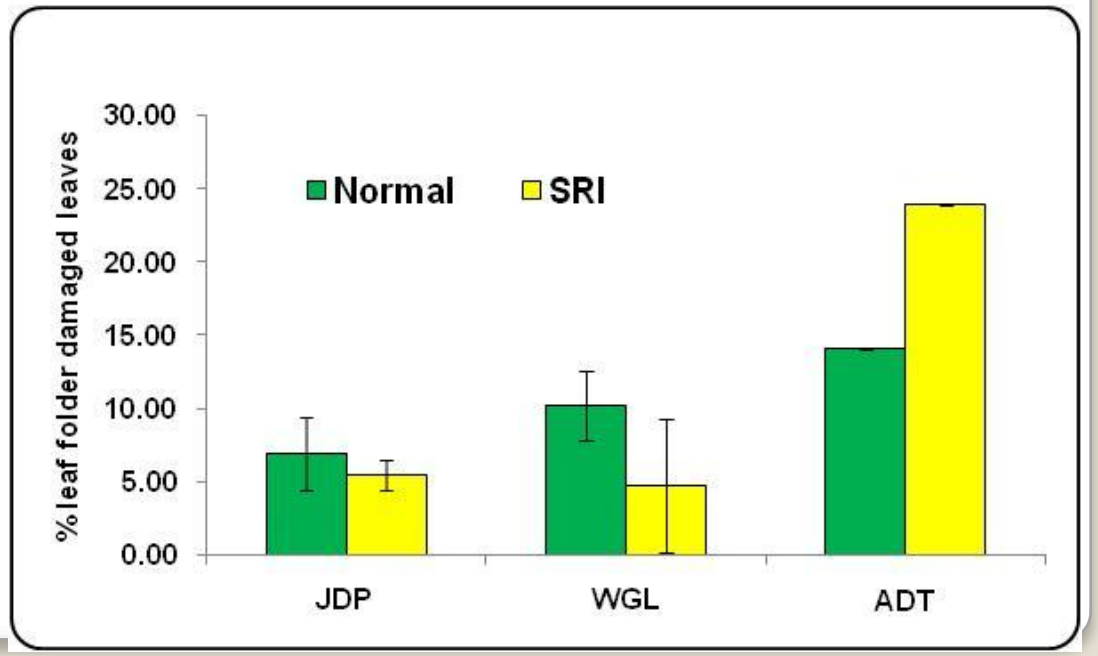
Similarly, white ears were also found high in normal method than in SRI method

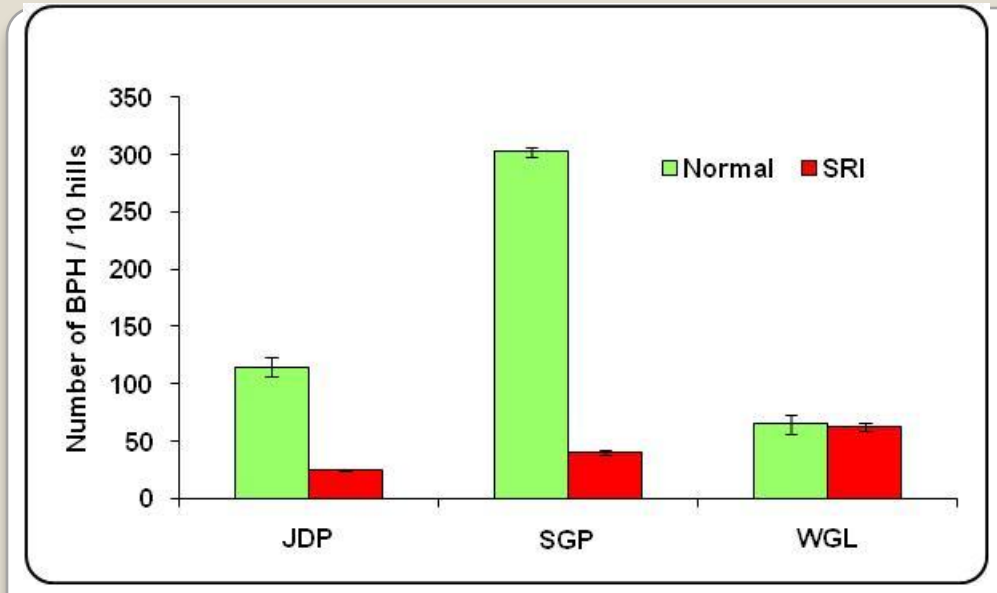




Gall midge damage was low in SRI method than in normal method

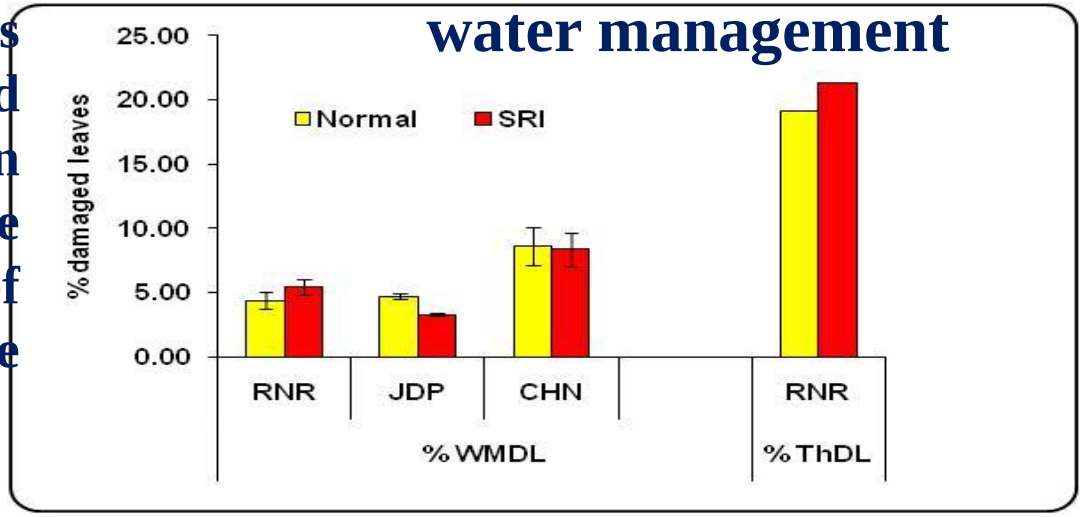
Leaf folder damage was also found high in normal method except at Aduthurai wherein significantly high leaf folder damage was recorded in SRI method





BPH incidence was low in SRI method as compared to normal method which could be mainly due to the wider spacing and water management

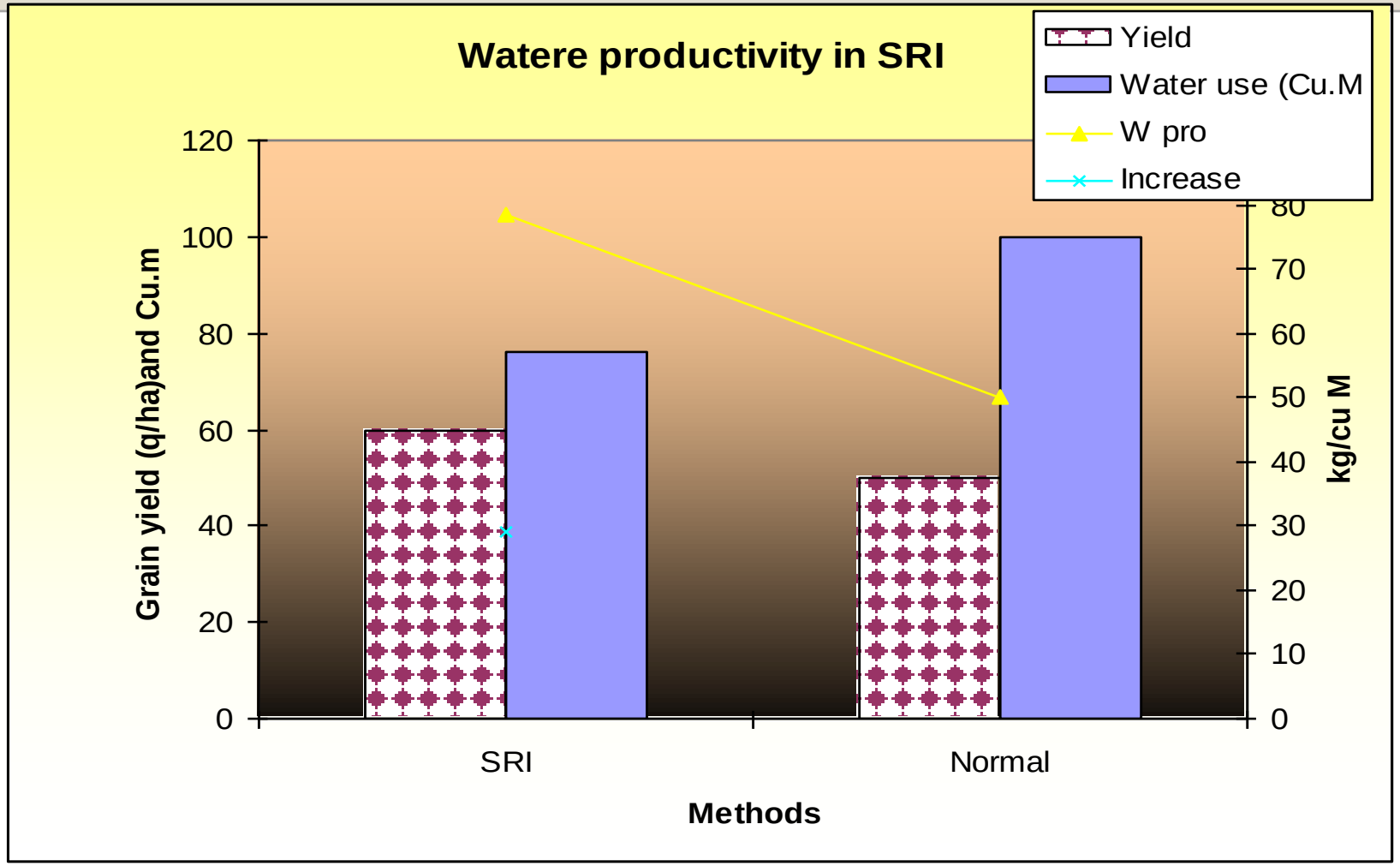
However, early stage pests like whorl maggot and thrips damage was high in SRI method. As early in the season, SRI plants are of young age, need to be cautious about these pests



Conclusion

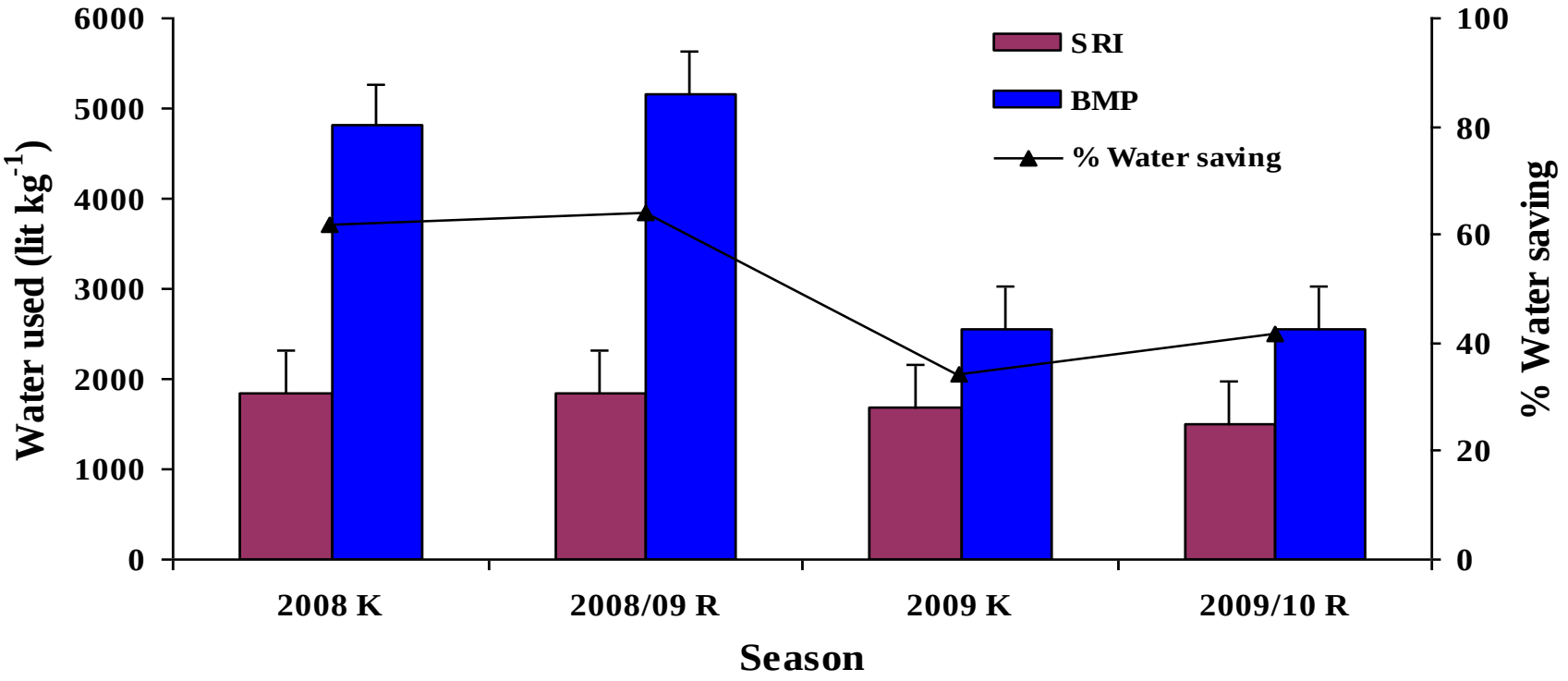
In general, the insect pest incidence was low in SRI method as against normal transplanted method

Experiment at ICRISAT, WWF collaboration



- **Grain Yield increase by 10% in SRI**
- **Water Use decreased by 29% (SRI 79 Cum)**
- **Water Productivity by 46%**

Water productivity as influenced SRI vs



Water input and water use efficiency in different methods of rice cultivation

Effect of establishment methods on soil enzyme activity (0-15 cm)

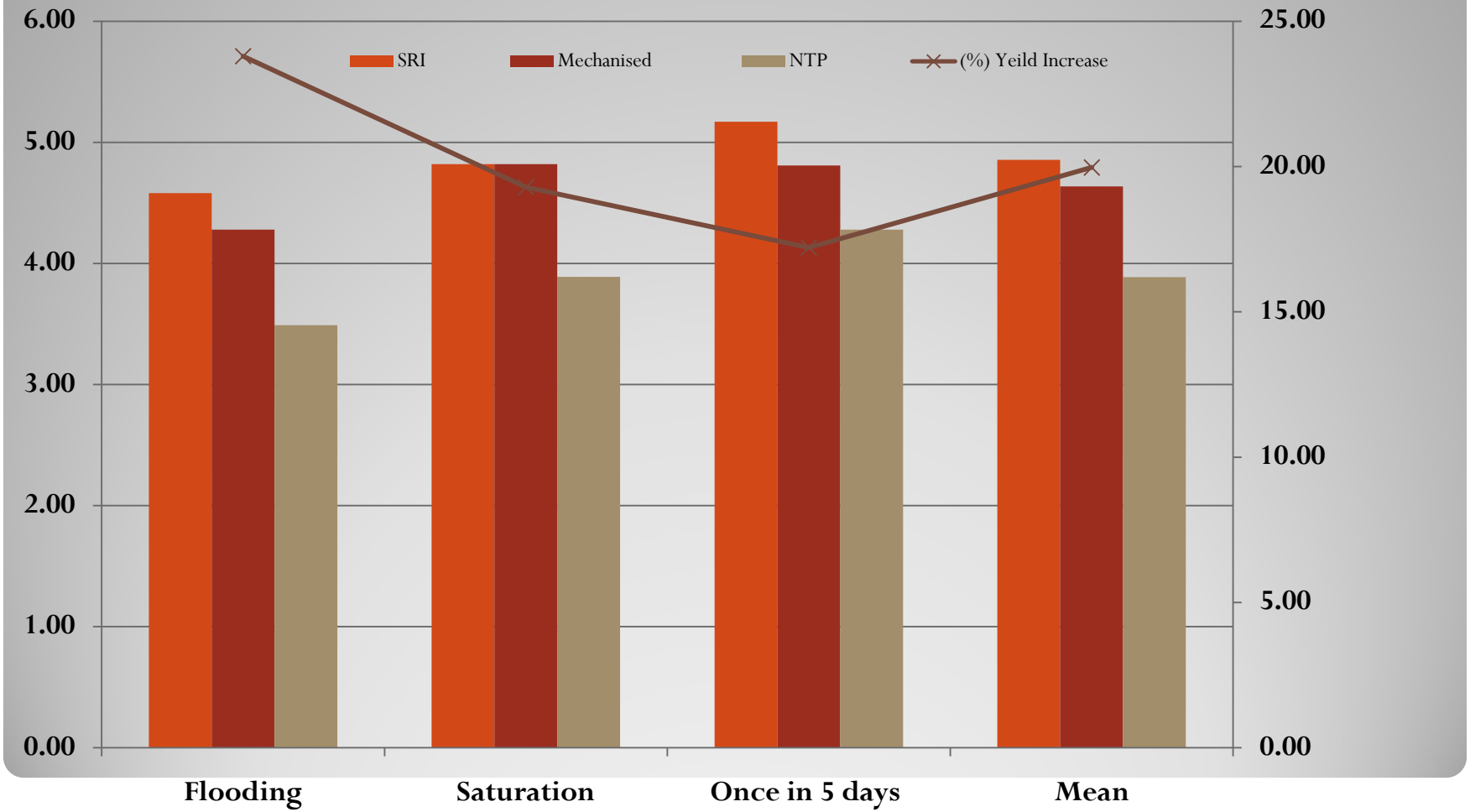
Treatments	Glucosidase activity*	Phosphatase activity**	Arylsulfatase activity**	Arginine Ammonification***	Dehydrogenase activity****
Method of establishment					
SRI	91.24	1.23	7.61	4.90	133.00
NTP	51.18	1.18	7.35	4.37	126.93
CD (0.05)	11.91	NS	NS	NS	NS
Fertilization					
Control	16.42	0.74	6.65	3.22	73.30
100% organic	97.69	1.69	8.04	5.71	145.83
75% organic + 25% inorganic	96.29	1.39	7.82	5.06	144.00
50% organic + 50% inorganic	51.79	1.23	7.56	5.02	141.33
25% organic + 75% inorganic	46.62	1.04	7.24	4.94	127.72
100% inorganic	44.32	1.15	7.57	3.87	126.50
CD (0.05)	10.60	0.20	2.77	NS	47.77
CD (0.05) Main x Sub	14.99	0.28	0.39	2.96	NS

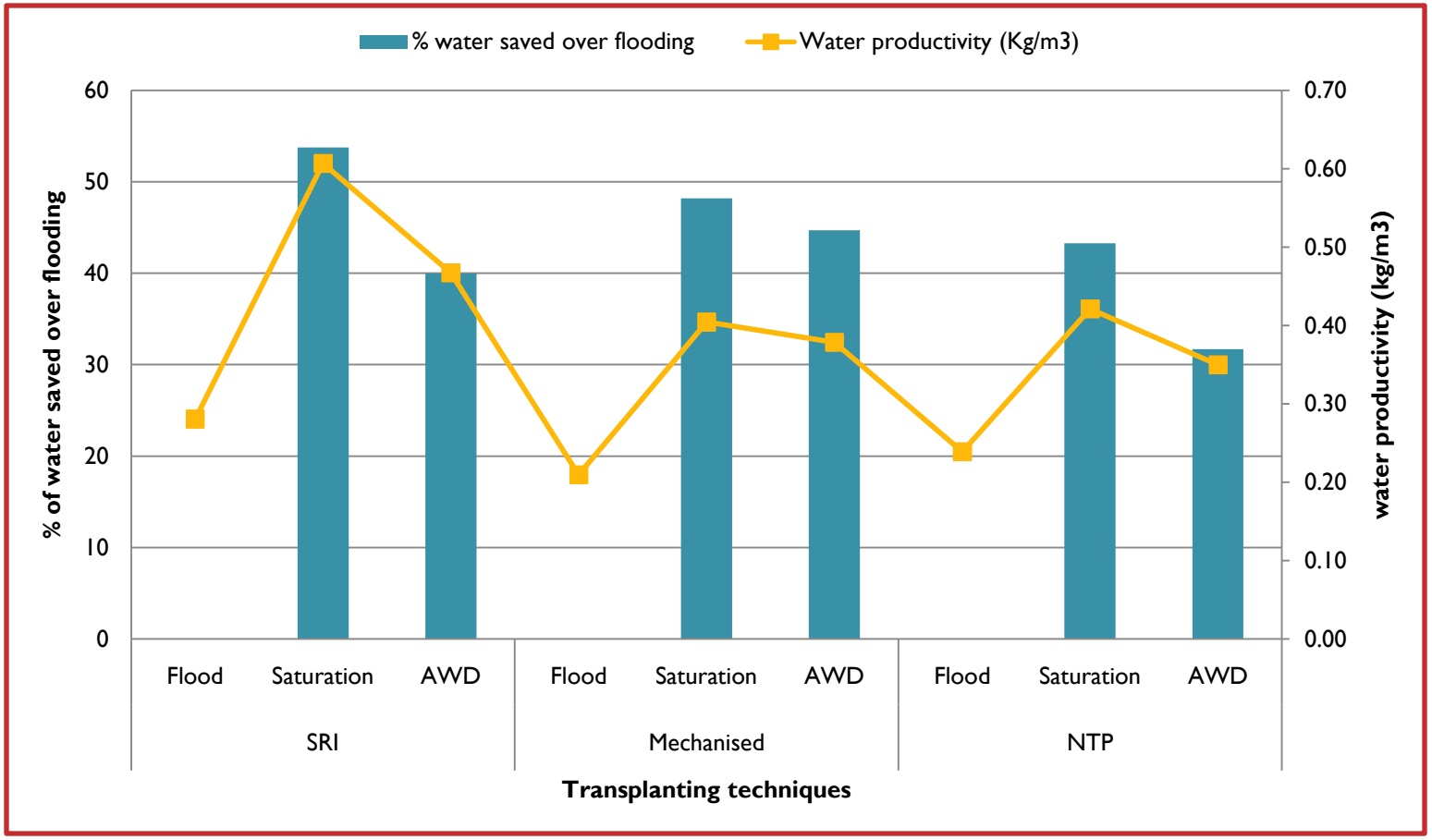
* µg *p* -nitrophenol/g soil/h, ** mg *p*- nitrophenol/g soil/h, *** µg NH_4-N/g soil/h, **** µg TPF/g soil/h

Glucosidase - carbon cycling ; Phosphatase – phosphorus cycling ;Arylsulfatase – sulfur cycling

Arginine ammonification – index of N mineralization ;Dehydrogenase activity – indicator of total microbial activity

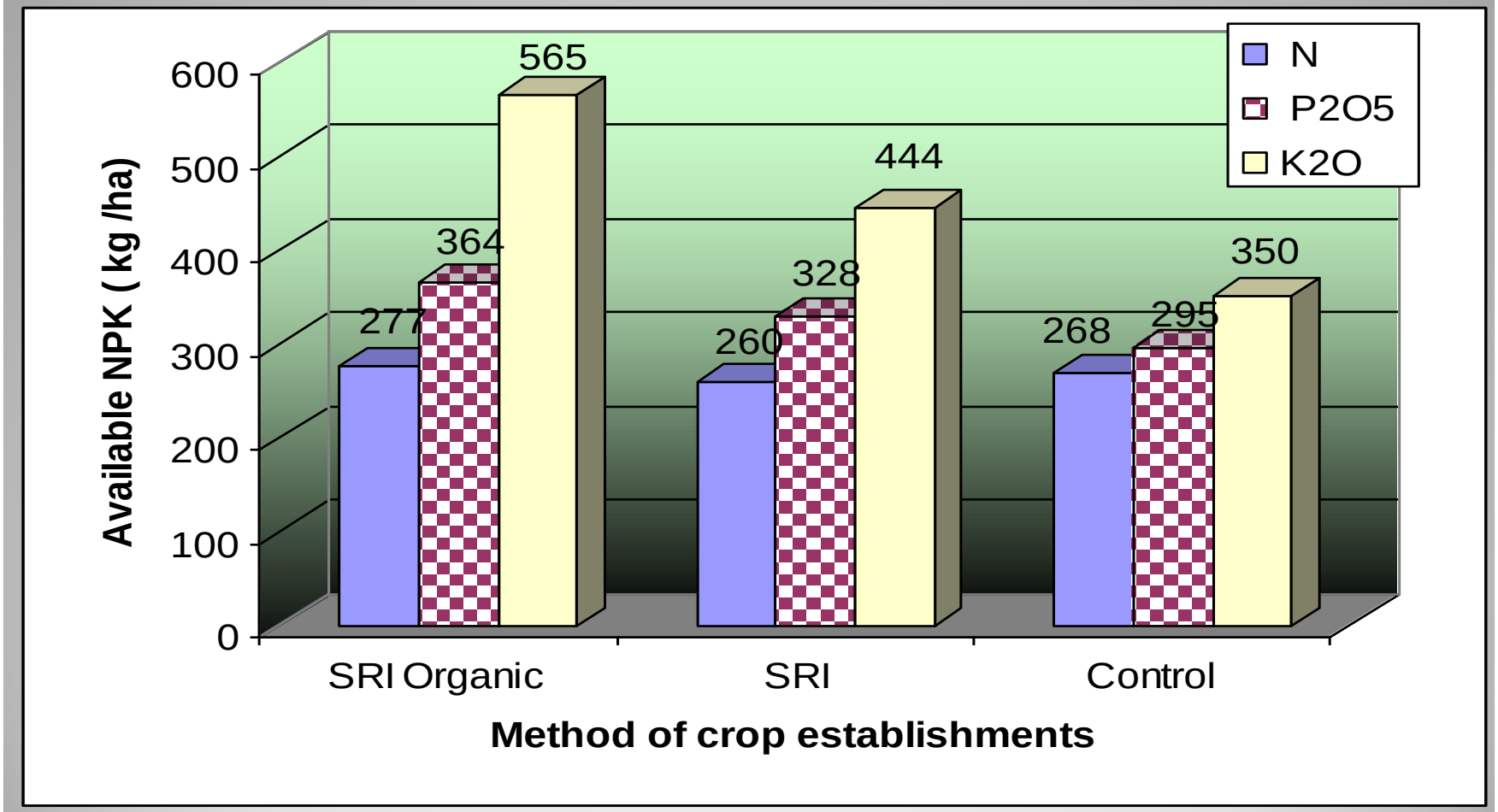
Water management (31-53 % % saved)



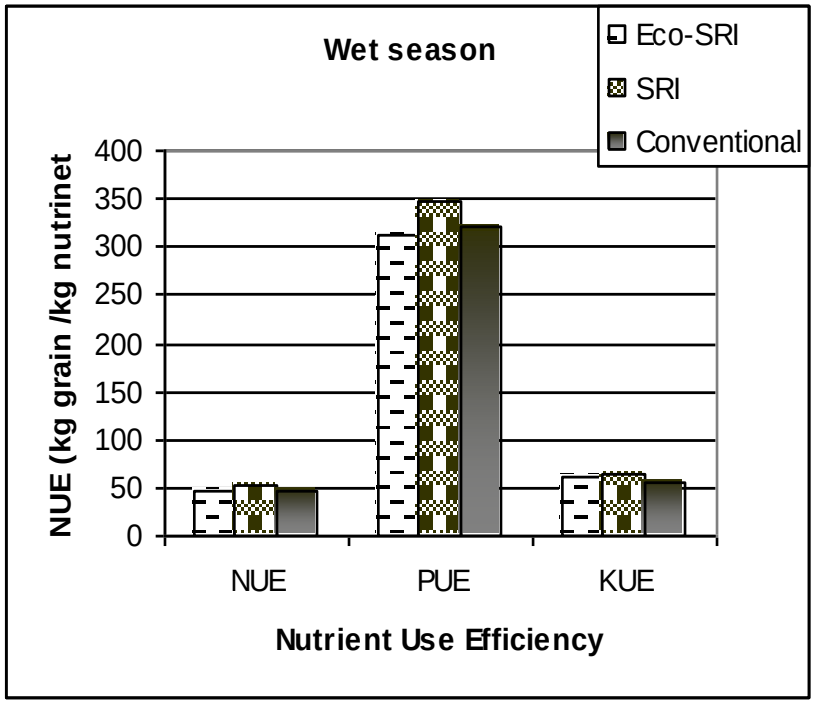


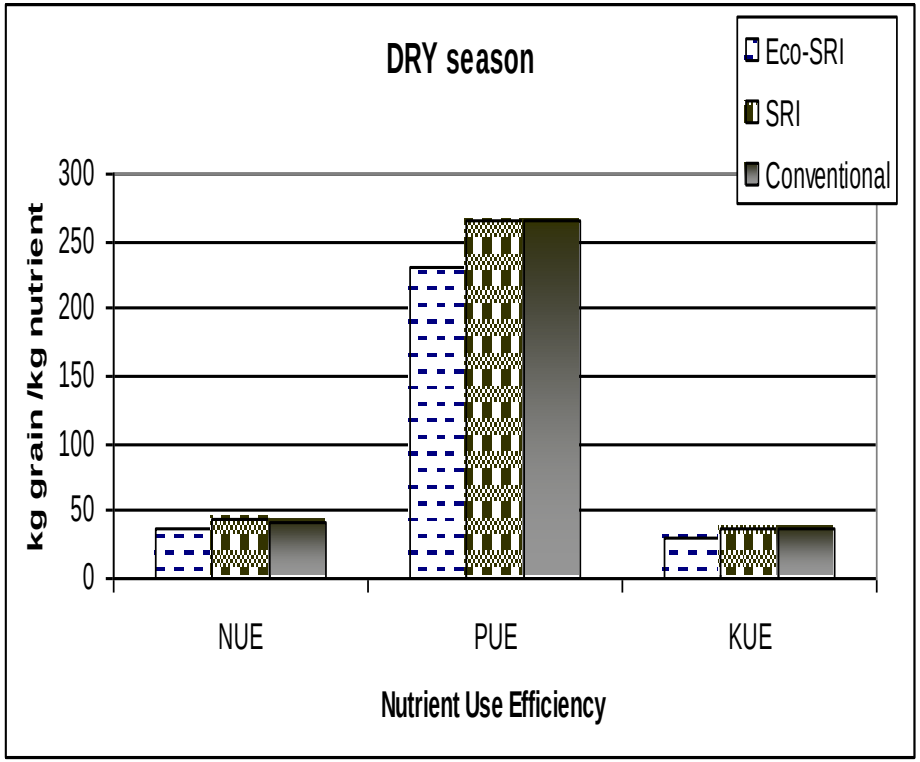
Water saving potential of the SRI over other methods

Available soil nutrient status



Available soil nutrient status as influenced by methods of crop establishments





NUTRIENT USE EFFICIENCY IS HIGHER IN SRI vs NORMAL TP METHOD

Treatments	pH	EC (dS/m)	SOC (%)	Available N (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Eco-SRI	8.51	0.50	1.10	247.0	204	674
SRI	8.43	0.51	1.25	272.0	258	638
Conventional	8.44	0.51	1.18	251.0	256	609
Mean	**8.44**	**0.51**	**1.18**	**257**	**239**	**641**
C.D(0.05)	**NS**	**NS**	**NS**	**NS**	**26**	**34**

Soil properties after 2 seasons as influenced by different crop establishment methods

❖**Experiments were conducted at Directorate of Rice Research, Hyderabad , India during 2008-10 (4 seasons) to assess the potential of System of Rice Intensification (SRI) in comparison to standard normal transplanting (NTP) under flooded condition.**

❖**Long term studies clearly indicated that grain yield was significantly higher in SRI-organic + inorganic (12−23% and 4−35% in *Kharif and Rabi* seasons, respectively) while in the SRI-organic, the yield was found higher (4−34%) only in the Rabi seasons over NTP.**

❖**Sustainable yield indices (SYI = Y - σ/ Ymax) were computed based on the 4 years of grain yield recorded over the years clearly indicated the superiority of SRI - 0.56 (inorganic + organic) over Normal transplanted - 0.52 with similar inputs.**

Identification of suitable areas for SRI cultivation

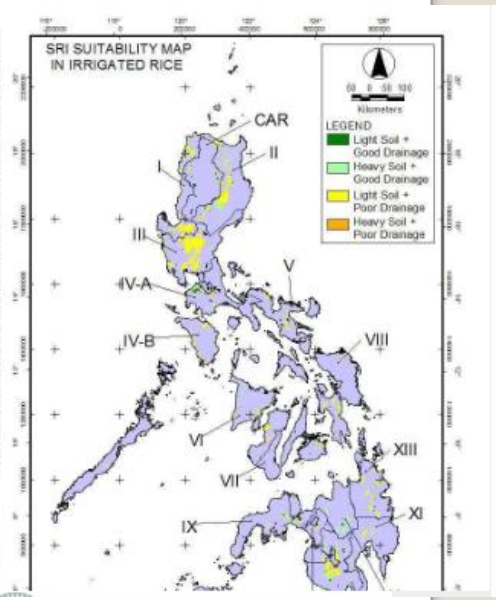
CALCULATING SRI SUITABILITY

ASSUMPTIONS

- Irrigated Rice Areas
- Soil Texture
  - HS: Heavy Soils = Poor Drainage
  - LS: Light Soils = (Good Drainage)
- Slope
  - Flat = Poor Drainage
  - Gently Rolling = Good Drainage

The overlaying of both maps in a GIS resulted in a coincidence map and table showing the convergence of both themes. This was further reclassified to SRI suitability. This is by assuming that good water control provided by light soils

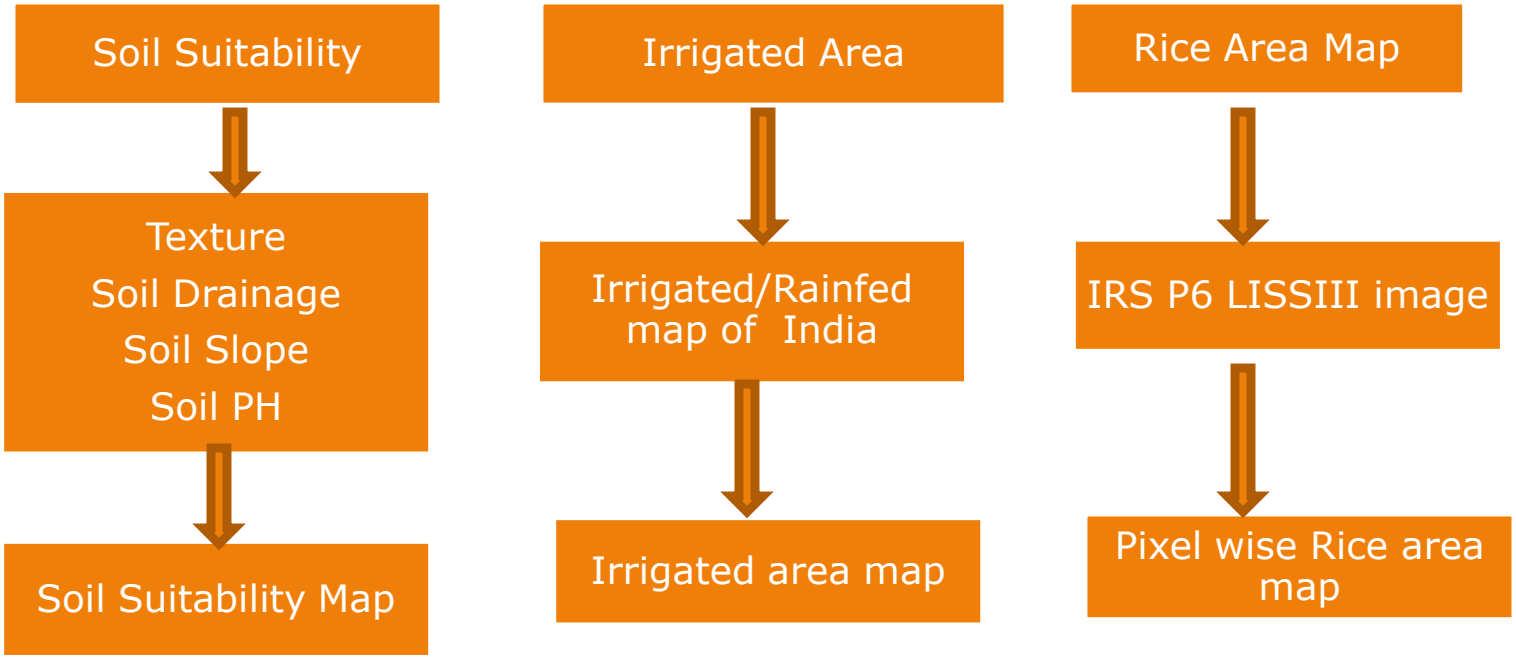
REGION	HS+GD	LS+GD	HS+PD	LS+PD	TOTAL
CAR	10,118.27	4,143.15	14,388.02	4,891.39	33,510.82
I	12,128.82	4,426.84	46,938.27	94,832.57	158,326.50
II	49,249.10	12,048.55	151,354.39	108,919.77	321,571.80
III	8,229.80	6,428.58	142,951.45	265,742.46	423,332.30
IV-A	20,398.52	9,403.67	34,681.42	13,178.92	77,662.53
IV-B	7,960.01	2,353.20	29,418.66	30,292.51	70,124.38
V	3,258.78	1,830.36	43,124.21	23,866.56	72,129.90
VI	13,236.90	3,919.93	76,030.26	25,681.54	118,730.63
VII	3,314.49	3,057.81	3,715.25	6,501.74	16,599.28
VIII	6,645.62	4,419.92	50,032.58	18,611.76	79,709.88
IX	9,780.80	2,410.57	14,871.66	8,977.74	36,040.78
X	39,210.79	1,351.91	47,013.68	7,791.83	95,208.22
XI	8,426.39	1,083.63	117,831.96	18,482.49	145,824.47
XII	34,188.16	5,936.14	65,659.96	72,298.71	178,082.96
XIII	7,968.84	5,358.45	19,315.75	42,157.20	74,800.24
ARMM	1,276.20	3,878.50	51,798.77	20,101.70	77,255.17
TOTAL	232,030.21	69,713.24	851,961.19	749,200.06	1,902,904.70



http://www.slideshare.net/SRI.CORNELL/0518-gis-evaluation-for-sri

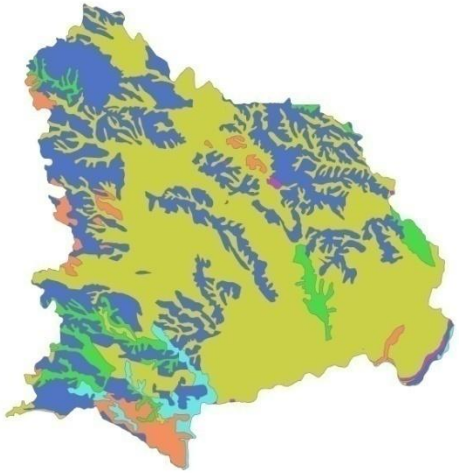
by SRI-Rice, CIIFAD, Cornell University on *Aug 03, 2009*

Calculating SRI suitability Index

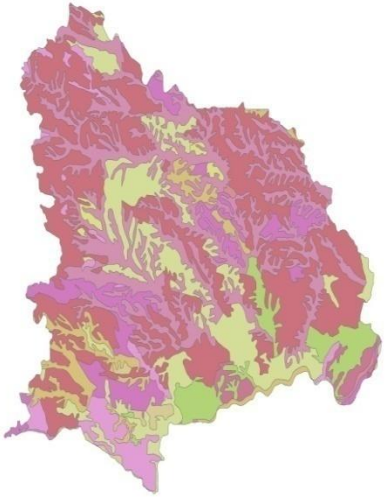


Soil Suitability Map

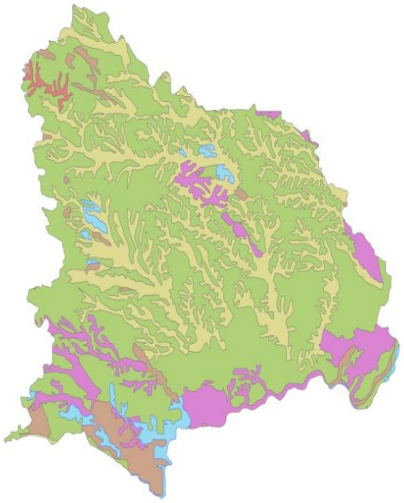
Soil Texture: Heavy and Light
Drainage : Poor and Good
Slope: Flat
PH : 6.5 – 7.5



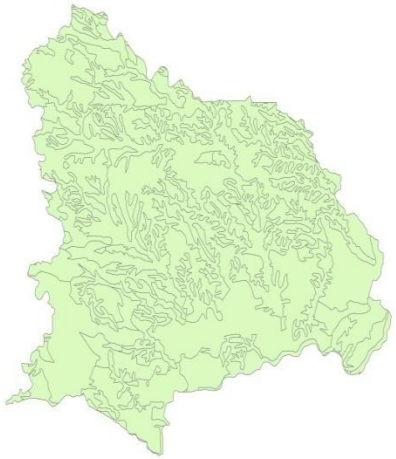
Soil Slope



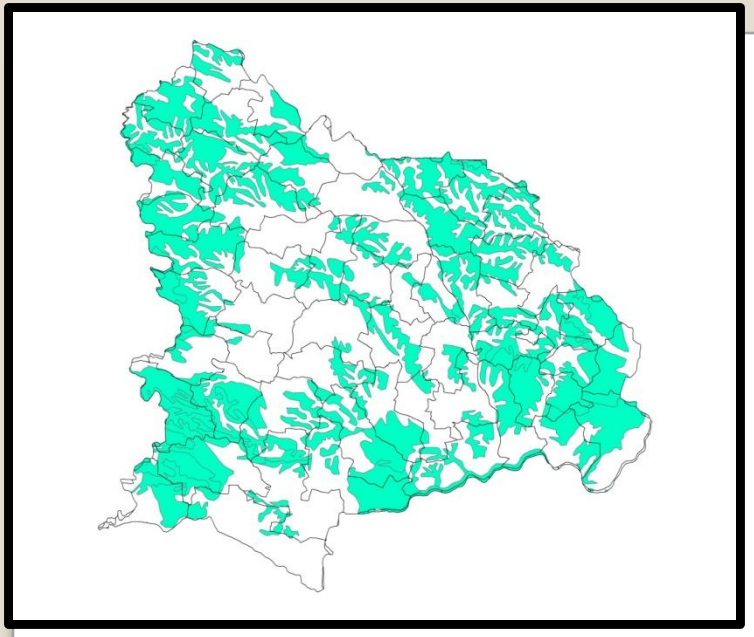
Soil Type



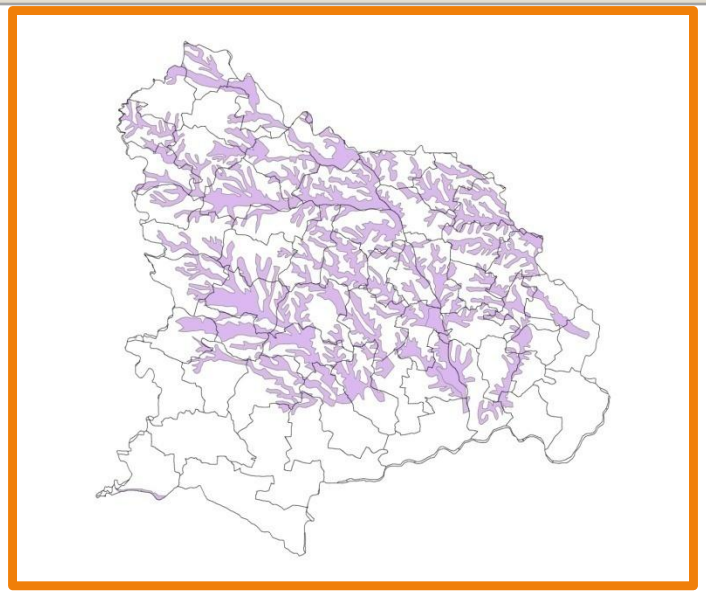
Soil Drainage



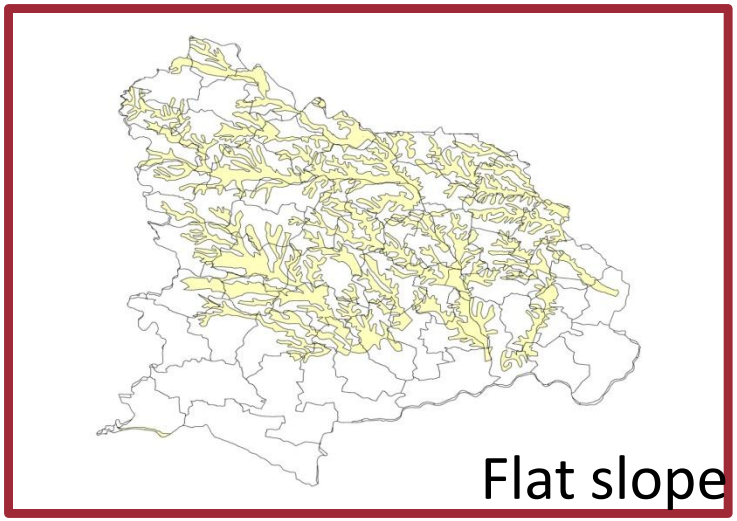
Soil PH



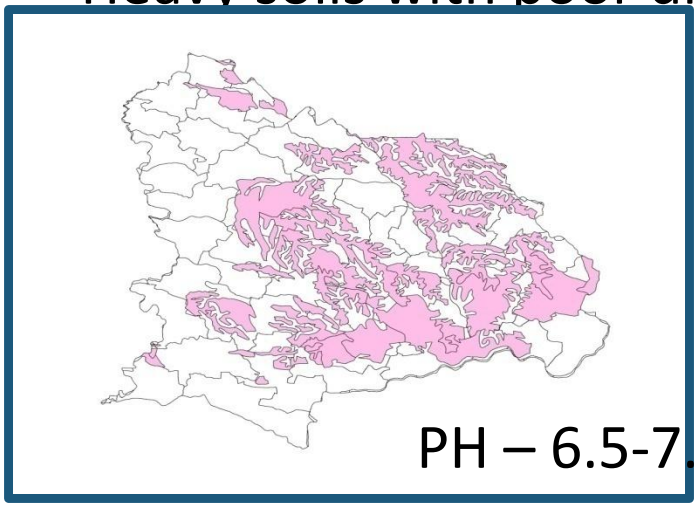
Light soils with good drainage



Heavy soils with poor drainage

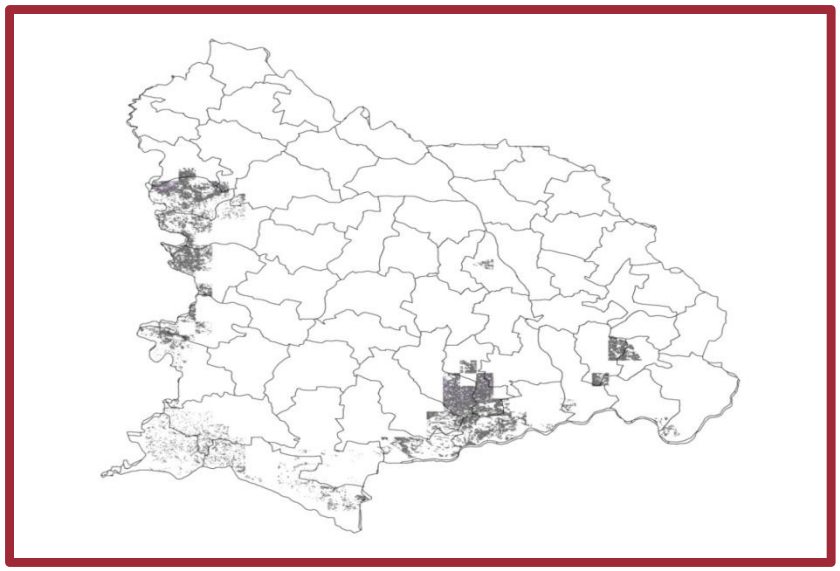


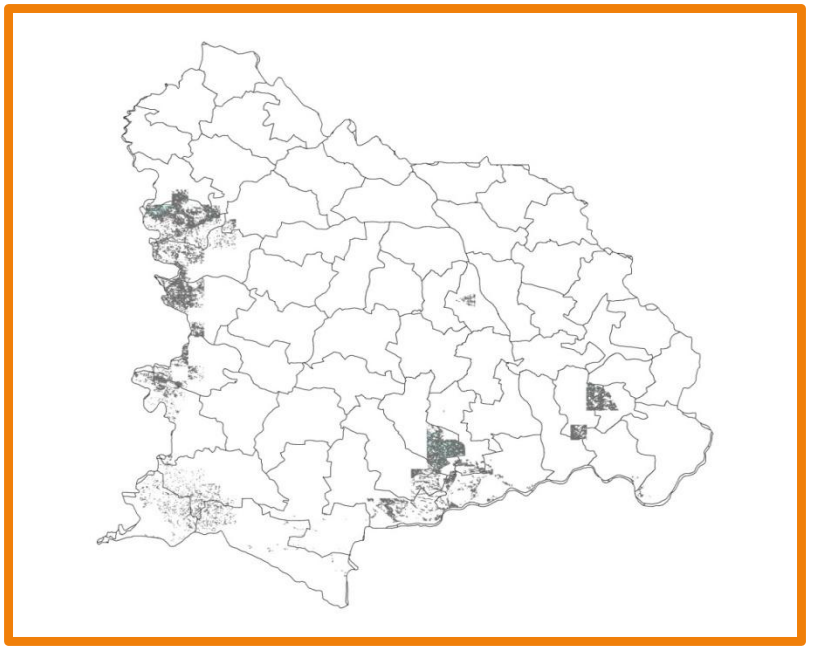
Flat slope



PH – 6.5-7.5

Irrigated Rice Area map – overlaid on rice area map classified from LISS III image

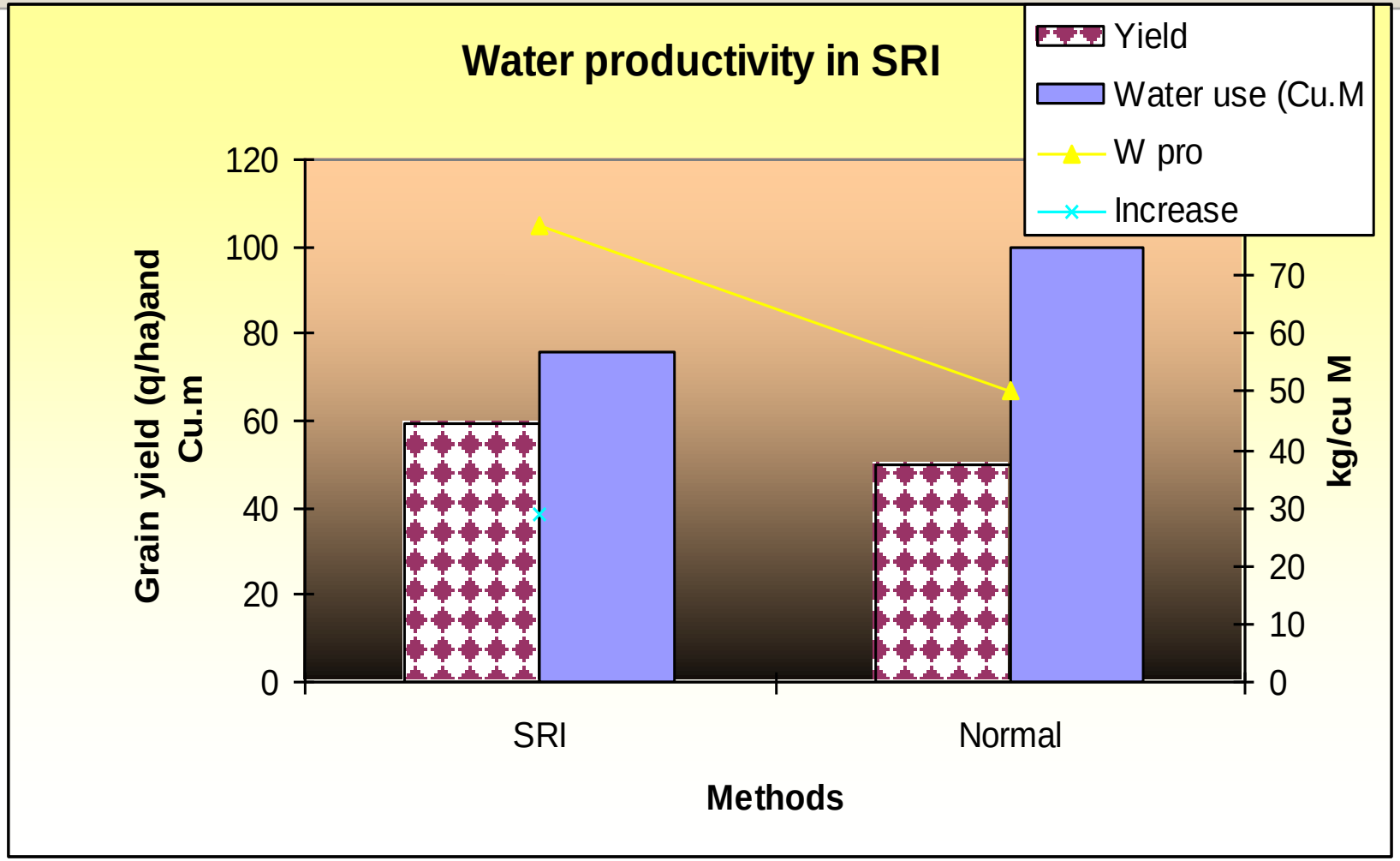




Estimated irrigated Rice area - 284990 ha
Reported Values -273430 ha
4% overestimation

Suitable area for SRI cultivation in Nalgonda district - 219442 ha

Further efforts are in progress to delineate areas in the state as we as in the country.



- **Grain Yield increase by 10% in SRI**
- **Water Use decreased by 29% (SRI 79 Cum)**
- **Water Productivity by 20%**

Water productivity as influenced SRI vs

Current status of SRI adoption

State	Appox. Area (000'ha)
Bihar	750
Tamil Nadu	500
Tripura	80
Karnataka	10
Andhra Pradesh	10 (150)
Orissa	10
West Bengal	10

India: Bihar State results, 2007-2011

State average yield: 2.3 t/ha

	2008	2009	2010	2011
Climatic conditions	Normal rainfall	Water submergence occurred twice	Drought, but rainfall in Sept.	Complete drought
No. of smallholders	128	5,146	8,367	19,911
Area under SRI (ha)	30	544	786	1,412
SRI ave. yield (t/ha)	10.0	7.75	6.5	3.22*
Conv. ave. yield (t/ha)	2.7	2.36	2.02	1.66*

* Results from measurements from SRI and conventional fields of 74 farmers'

Visit to Bihar to assess rice productivity in SRI demonstration plots in farmers' fields
(Date of visit – November 27 – 29th, 2012)

Methods	Population/m^2	Panicle/plant	Grain weight (%) of moisture	Grain weight at 14% moisture (t/ha)	Straw weight at
SRI Crop cut at Ist village	12	25	9.0 (26.5)	7.2	9.0
SRI Crop cut at 2nd village	10	35	9.8 (16.5)	9.0	9.8
Conventional	25	16-19	4.2 (21.0)	3.75	6.7

✓Lot of variation in the adoption of SRI principles even in the demonstration plots.

✓Farmers planted 15 -25 days old seedlings with planting density of 9 – 12 hills per sq,m, (spacing 40x30, 43x35, 35x33, 35x35 cm), with nil to very little organic manuring, and cono weedings of 0 – 2 times.

✓Fertilizer management ranged widely and was about 60 - 80:15 - 25:10 - 20 kg /ha of NPK. About 300 – 400 kg /ha of Vermi compost


राष्ट्रीय कृषि विकास योजना के अन्तर्गत
(वर्ष-2012-13)

Salient findings on SRI

- In trials of AICRIP centers across the locations and situations , SRI method performed well and found superior over Conventional flooded irrigation
- Different principles studies were also found to influence on grain yield
- Varietal performance was different in SRI however most of the varieties tested found promising in SRI over conventional method. Hybrids and medium duration cultivars were promising
- Total number of effective tillers , SPAD values at different growth stages panicle length dry matter and other yield attributes are higher in SRI.
- Root biomass per plant, Microbial biomass carbon was found higher in SRI
- Water quantity for irrigation reduced by 25-30 % there by enhanced water productivity in SRI in different seasons
- Long term trails on nutrient management in SRI indicated that there is no depletion of nutrients from soil due to continuous SRI cultivation

Strategies for upscaling SRI adoption

- Identification of areas suitable for SRI adoption
- Conducting compact block frontline demonstrations
- Imparting training to farmers and farm labourers
- Hands on support for implementation
- Creating awareness through print and electronic media
- Developing mechanized cono weeder to reduce drudgery in weeding
- Labour saving mechnisation
- Promoting organic manure production at Farmer level (Vermi compost , Green manure crops , etc.,)

Proposed area to be covered under SRI by next 5-years

- Total rice area 42.5 m.ha.
- Area under irrigation – 20 m.ha.
- Proposed area to be covered under SRI (25% of irrigated area) – 5 m.ha.
- Proposed states for adoption (A.P., T.N., Karnataka, M.P., U.P., Bihar, W. B., Tripura, Jharkhand, Punjab, Sikkim, J& K.)

Constraints in adoption of SRI

- Initial resistance to go for planting young seedling
- Difficulties in weeding and non-availability suitable cono weeders
- Non-availability of enough quantity of organic manures
- Lack of proper control of water especially under canal irrigation and under bore wells due to electricity problem
- Poor drainage in heavy rainfall areas also affects SRI adoption
- Trained personnel and proper support

Contd…


SRI
(Direct Seeding)
19.03.2012 12:40


15.02.2012 10:25

Impact of SRI in India

By taking in to account all the factors that determine the adoption of SRI such as proper locations, soil conditions, water control facilities etc., it may be possible to cover about 10% of total rice area (about 4.0 m ha) in India which can bring about tremendous benefits for the country in terms of input use efficiency and sustainability.

There could be enormous saving in seed (80,000 tonnes of seeds annually equivalent to RS.200 crores per season) and the system also helps us to save about 30% water which is equivalent to 2200 million m^3 besides, soil health improvement which would be a biggest bonus in adopting SRI

Research focus

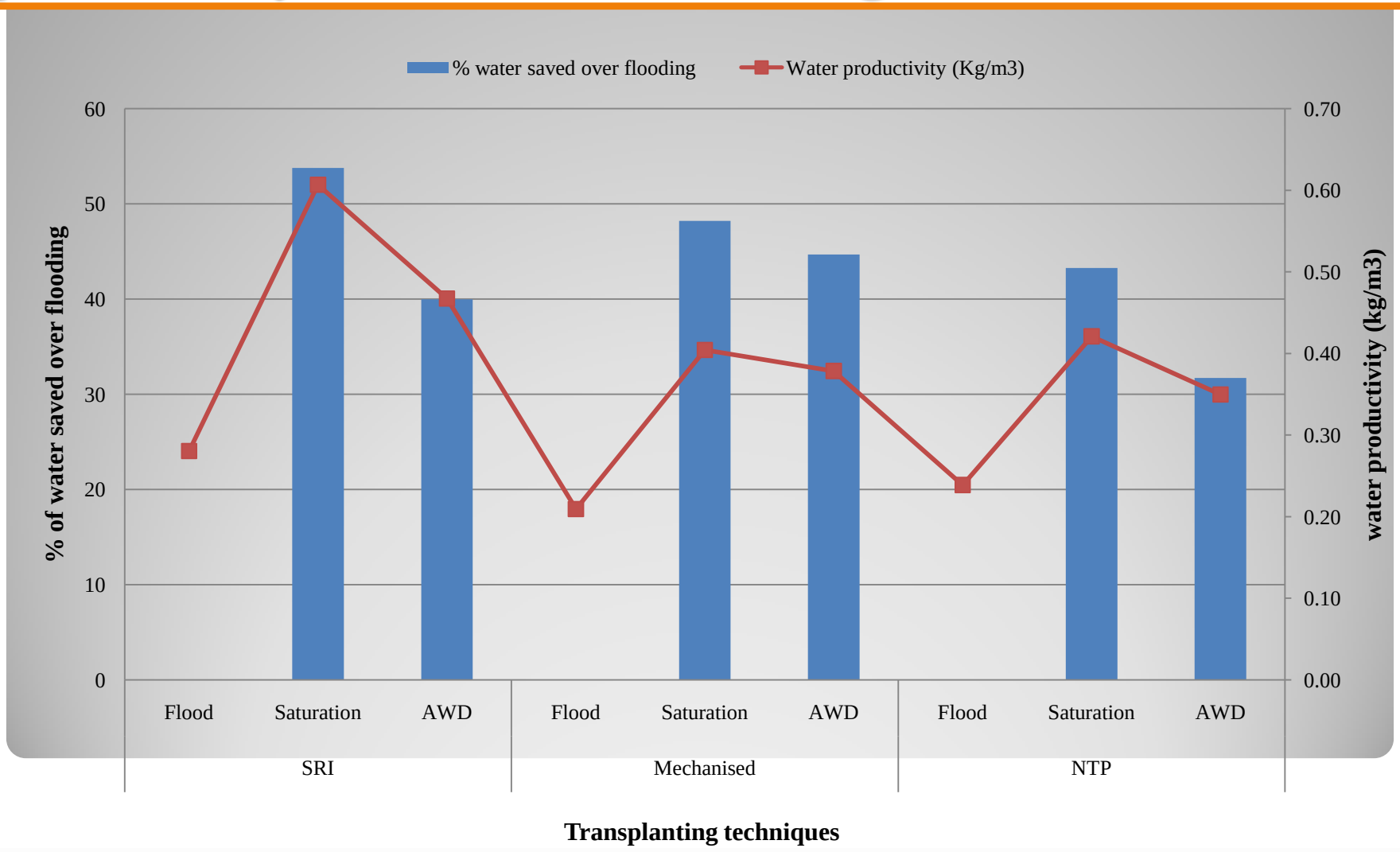
- Systematic assessment of the advantages of SRI in different situations and effect of SRI on the physiology of the rice crop to make suitable modifications
- Long term Dynamics of the soil biological fertility and its effect on enhancing grain yield , pests and disease occurrence under SRI
- Standardization the inter-cultivation with weeder and development of the motorized weeders (cost effective)

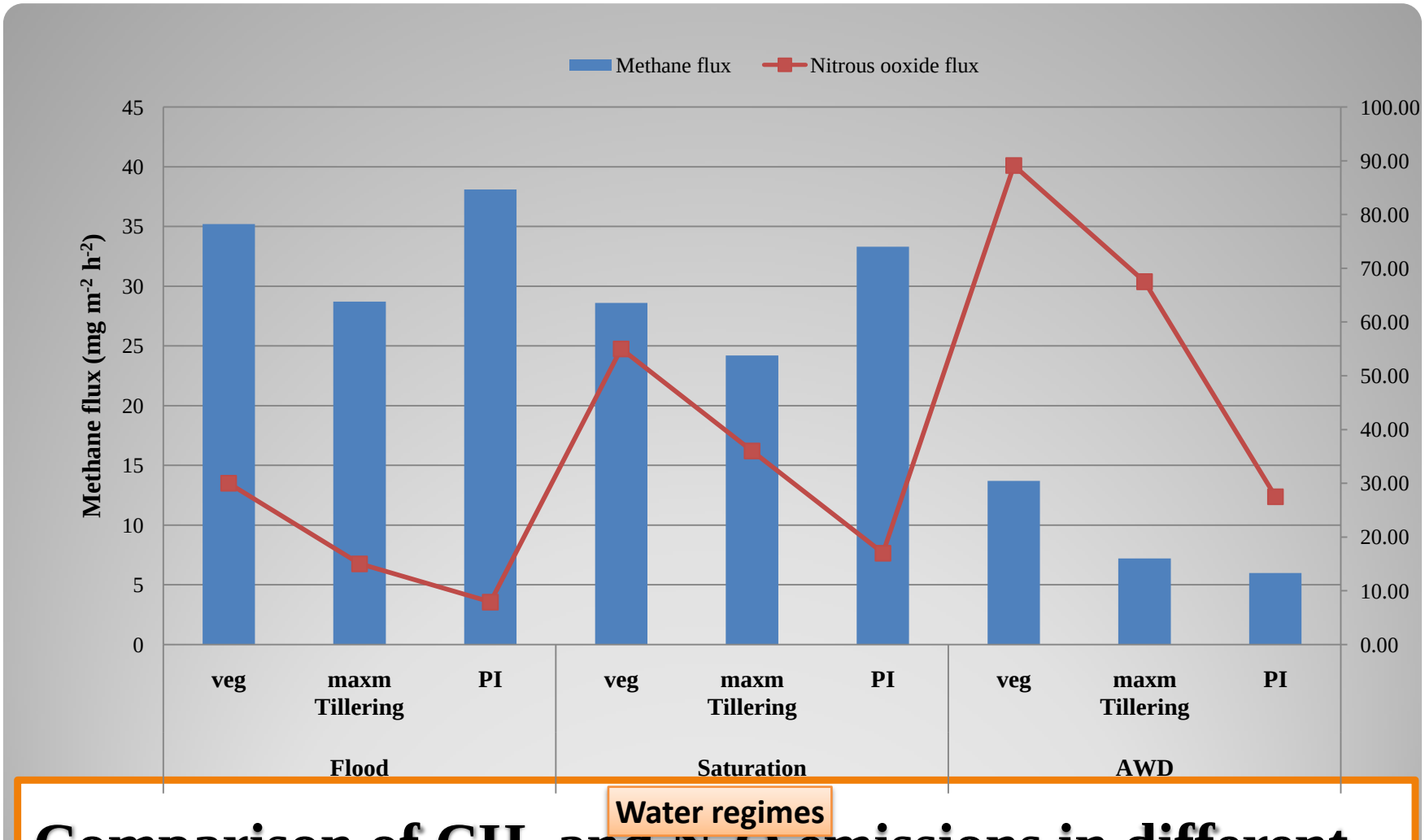
Contd..

- Suitable growing ecosystem, season and varieties have to be identified for SRI and its popularization
- Studies on methane and GHG in different methods to mitigate the effects of climate change
- Soil water balance studies and water saving in SRI in different soils and situations
- Socio- economic impact , gender issues , labour utilization in SRI


Enhancement of water productivity and
weed management under different methods of rice cultivation
B-5

Influence of different water depths on water productivity and % of water saving over flood





Comparison of CH_4 and N_2O emissions in different water regimes

Field water measurements- Perched water tube

- Perched water tube – measurement

PWT = H – Reading

PWT = depth of perched water table

H = Reference Ht from soil surface to the top of the tube

Fixing AWD pipe in Farmers Filed

F2 plot- ICRISAT

Farmer's field visit & AWD pipe

RKMP

Taking the Knowledge to Farmers' door steps

SRI

Taking the Knowledge to Farmers' door steps

Knowledge can lead to Farm Productivity

Right knowledge at Right Time

Customized & Personalized

Land preparation

Nutrient Management

Pest Management

Varietal selection

Good establishment

Water Management

Harvest Management

up-to-date, accurate knowledge, in farmer-friend form

can lead to increased productivity .....IN FARMER

Intensive Campaign using ICTs

Rice Check
Program for SRI
Farmers Forum

Television
Radio
Community
Radio
KCC

SRI

Posters
Flyers
Pamphlets

Internet Kiosks
Video shows
Mobile Phones
Social media

up-to-date, accurate knowledge, in farmer-friend form

can lead to increased productivity .....IN FARMER

Everything can stop but not Agriculture

Thanking you one and all