

# The 6<sup>th</sup> Cambodia Rice Forum Climate Smart Rice Varietal Improvement in Cambodia: Presence and future

22-23 January, 2018      Sofitel Phnom Penh Phokeethra



# History of Research for Rice Improvement in Cambodia

- In 1962, Toul Samrong Agricultural Technology Center was established with financial assistance from JICA and technical assistance from IRRI. Two late maturing rice varieties released: Toul Samrong 1 and Toul Samrong 2.
- In 1985, His Excellency Chhea Song visited IRRI officially in order to establish a new collaboration between Cambodia and IRRI for rice improvement.
- In 1986, three IRRI scientists visited Cambodia and then Dr. M. Swaminathan, IRRI Director General, visited Cambodia and was invited to pay a courtesy visit with Samdach Techo Hun Sen. A mutual interest was exchanged and an agreement of proposing an IRRI project in Cambodia was put as agenda.
- In 1988 with financial assistance from AusAID, the Cambodia-IRRI-Australia project (CIAP), led by IRRI, was established focusing on rice production improvement.

Dr OUK Makara



# History of Research for Rice Improvement in Cambodia

- Continuing from CIAP, in 1999, RGC established the Cambodian Agricultural Research and Development Institute (CARDI) responsible not only for rice but also for other agricultural crops improvement.



Official Opening Inauguration  
21<sup>st</sup> Nov 2000

Dr OUK Makara



Official Opening Infrastructure  
Inauguration, 9<sup>th</sup> Jan 2007



# Rice Production Improvement from 1989-Present

- Conservation: 2,782 accessions and 3,839 samples
- Varietal released: 44 varieties-increase yield at least by 10%  
1989-1995: improving yield  
1996-2002: improving grain quality and yield  
Since 2002: improving popular released varieties for grain quality, resistance to biotic and abiotic stresses
- Seed purification: increase yield by 15%
- Rice soil groups x nutrient management x rice maturity groups: increase yield by 30%
- Land preparation including leveling: increase yield by 30%

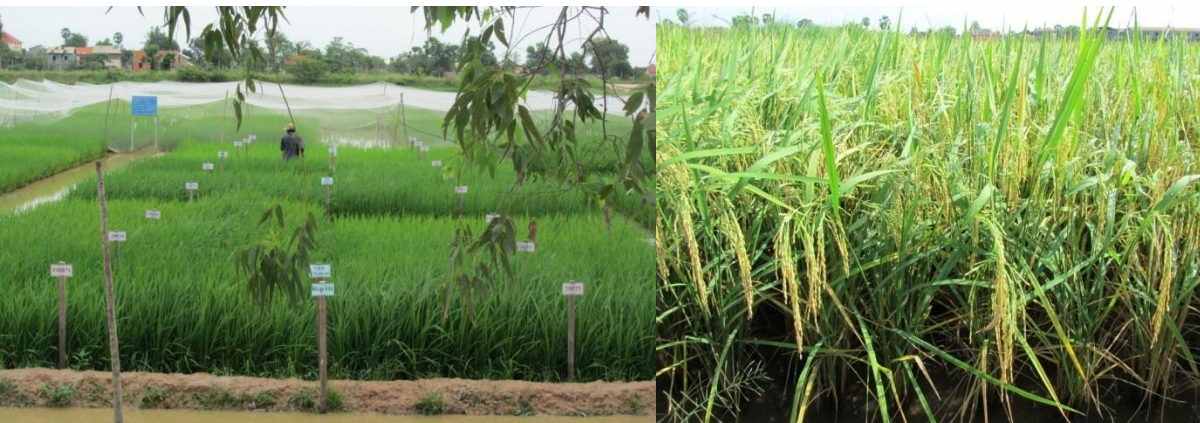
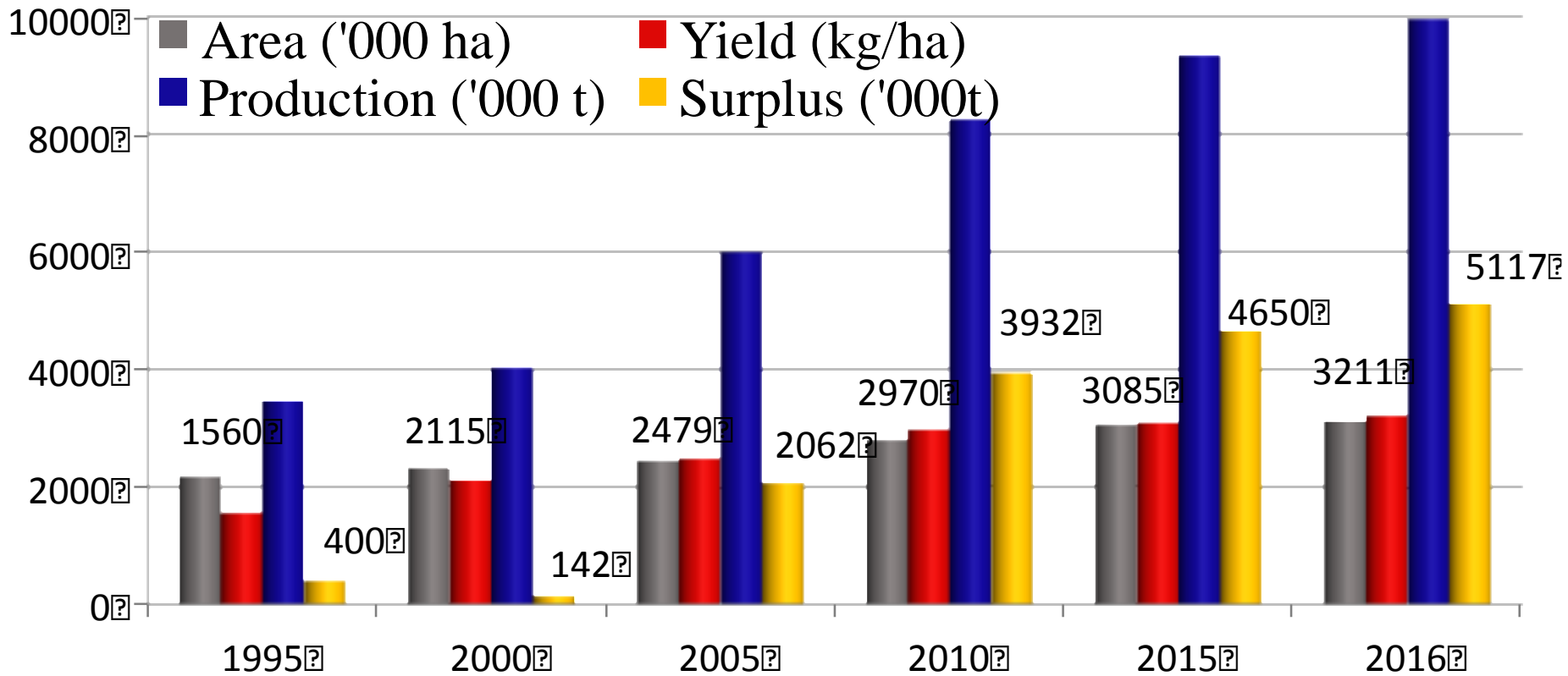


# Rice Production Improvement from 1989-Present

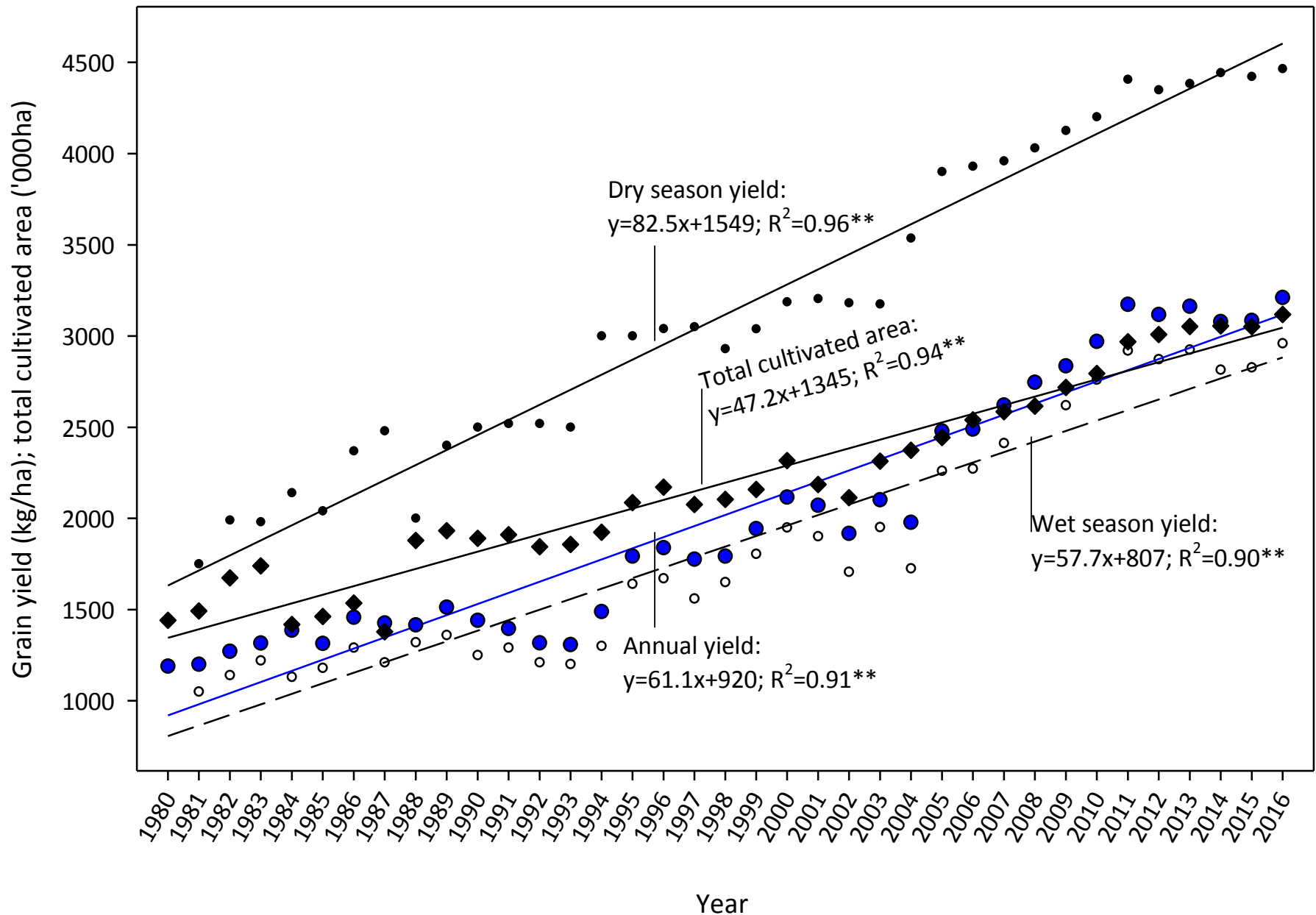
- Crop x pest management: minimize yield lost by 20%
- Post-harvest technology: increase head rice recovery by at least 10% and maintain seed germination (>80%) for a year.
- Introduced early wet season rice: growing area increases from zero in 1990 to  $242.10^3$  ha in 2012.
- Replaced deepwater rice by recession rice: from 1967 to 2013, deepwater rice decreased by  $330.10^3$  ha, while dry season rice increased by  $340.10^3$  ha.



# Rice Production Status



# Trend in Rice Production:1980-2016



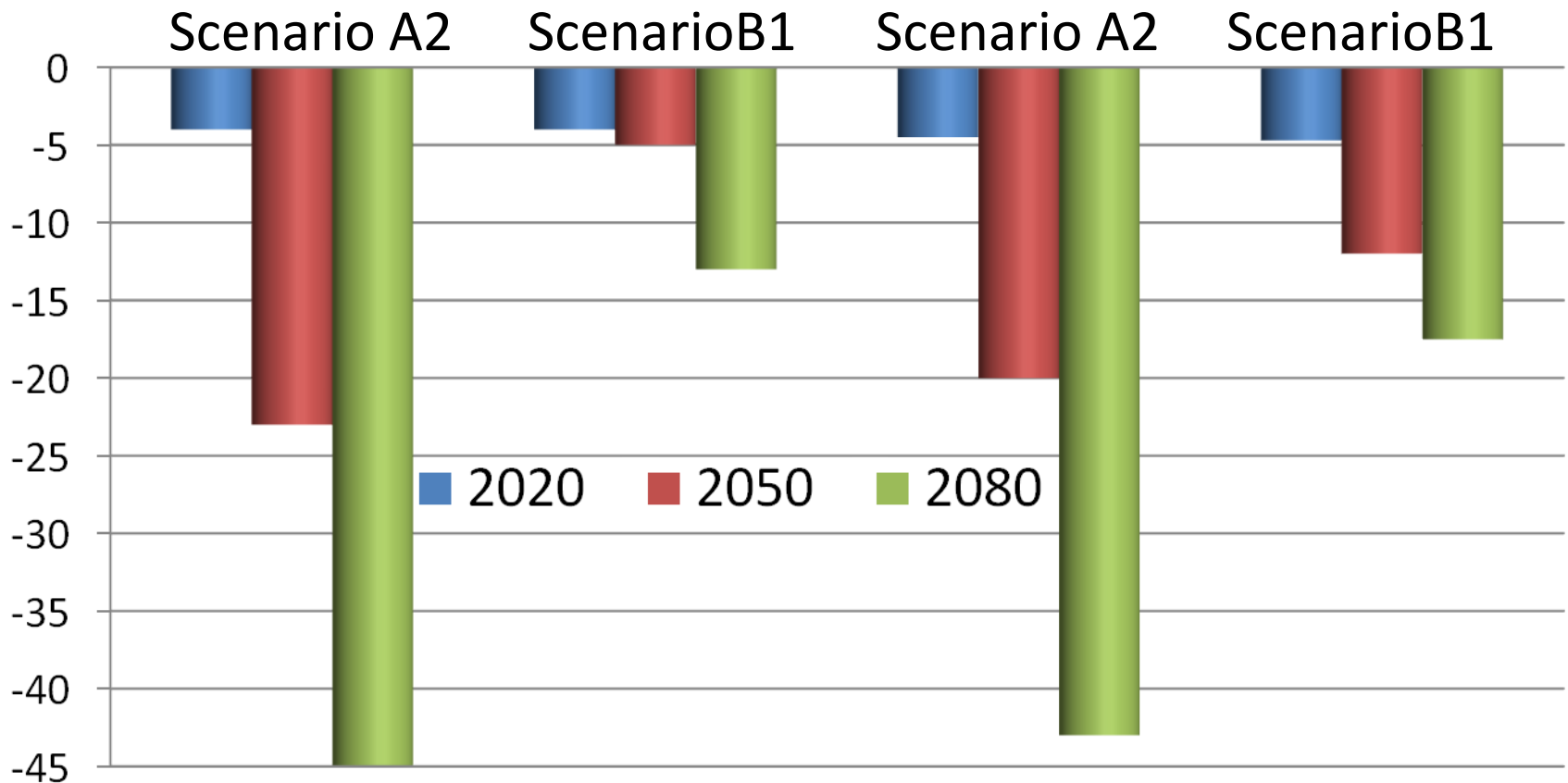
# Main challenge: 1. Climate change- 8<sup>th</sup> among the top 15 countries. Impact on Rice (Source: SNC Project, 2009)

Wet season: 1. Flood

2. Drought 3. Delayed rain

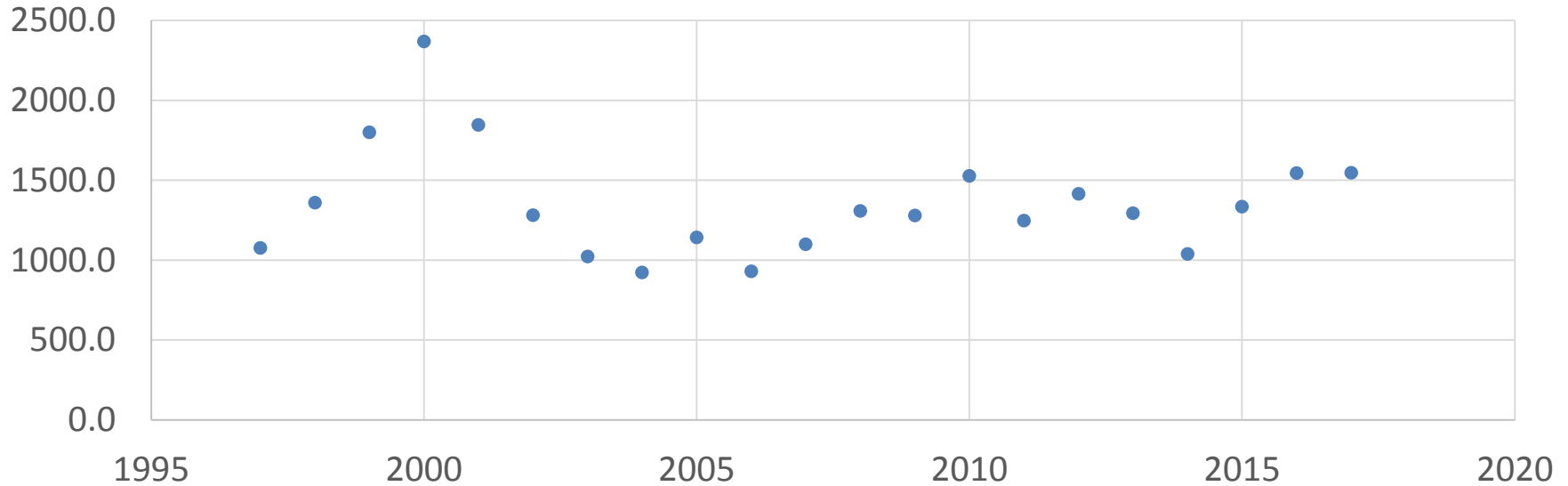
Dry season: 1. Increased temperature

2. H<sub>2</sub>O scarcity 3. Pest & Diseases



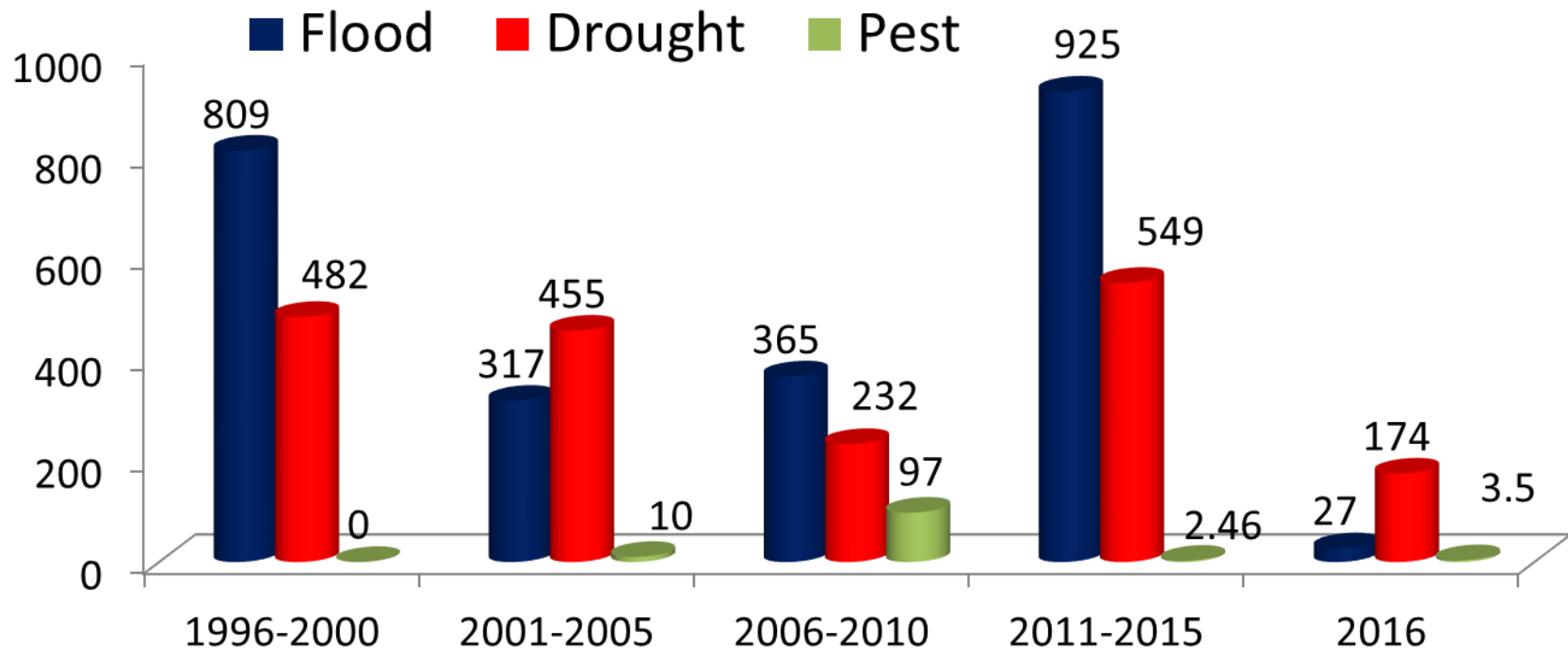


# 21 years rainfall at CARDI



Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	19	7	32	82	99	142	159	159	224	277	115	38
SDV	47	11	39	79	57	55	65	62	71	101	81	65
Trend	-1.3	-0.1	-1.8	2.1	1.9	2.4	0.6	0.04	-0	0.76	4.5	1.9
R <sup>2</sup>	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.16*	0.19*

# Rainfed lowland rice areas affected ('000ha) (MAFF, 1996-2017)



# Challenges for varietal improvement

Very early maturing (<100 days) and high water use efficiency

Heat tolerance

Submergence tolerance

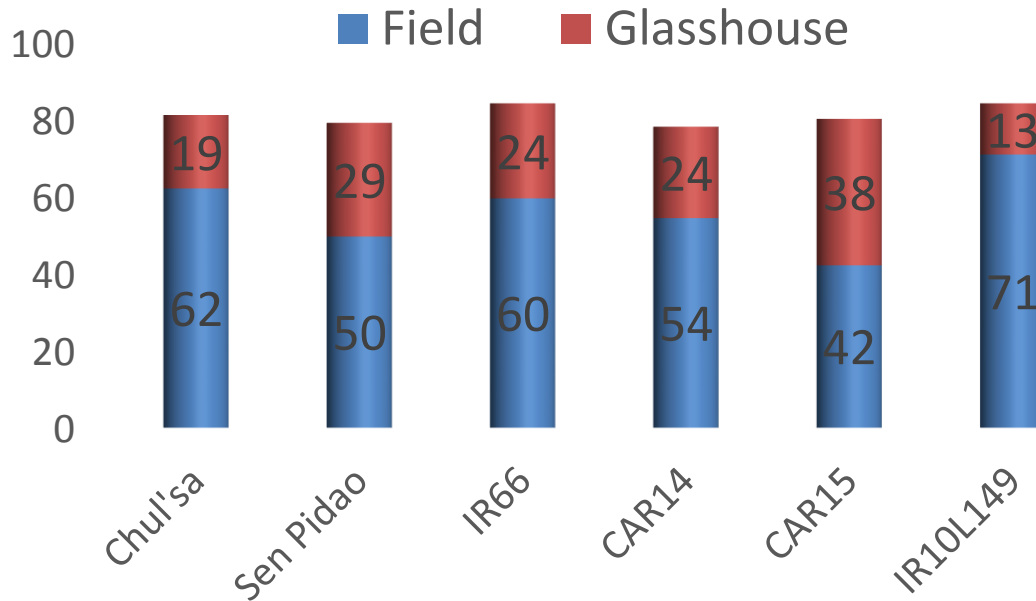
Drought tolerance

Submergence and Drought tolerance

Resistant to major pest and diseases

# Heat tolerance: Research

Source	Selected 2012	Selected 2013, dry	Source	Selected 2012	Selected 2013, dry
Philippine	220	9	Cambodia-BC1F5	18	5
RDA	88	0	Cambodia-BC2F4	19	8
Vietnam	38	19	INGER/IRRI	10	8
Cambodia-F5	38	0	<b>Total</b>	<b>431</b>	<b>49</b>



One variety released in 2016: **CAR16**



Makara

# Submergence: Research

Dr Ismael visited CARDI in 2006 to find a possibility to introduced Mega Varieties-Sub1. In 2007-2009, CARDI involved in Dissemination of Submergence Tolerance Rice Varieties focusing on:

1. Adaptation testing of mega sub1 varieties
2. Testing of local released varieties for submergence tolerance
3. Incorporating Sub1 gene to popular released varieties: BC2F1 of (PRD, PRM, PCSS, RC and CAR6) x IR64-Sub1



2010-2012:  
Screening BC2F1  
populations and  
developed BC3F1 from  
the survival progenies

From 2015:  
Continuing BC3F1 in field  
screening & testing



# Submergence: Results (Cont.)

## 2. Screening of released varieties and population development

Variety	5 days		7 days		9 days		11 days		13 days		15 days		Mean	
	Score	SD	Score	SD	Score	SD	Score	SD	Score	SD	Score	SD	Score	SD
IR 64-Sub1	1.0	0.0	2.5	1.0	3.5	1.0	4.0	1.2	4.5	1.0	5.0	0.0	3.4	1.5
CAR 9	2.0	1.2	3.0	0.0	3.5	1.0	4.5	1.0	5.0	0.0	5.0	0.0	3.8	1.2
Phka Rumduol	1.0	0.0	2.5	1.0	3.0	0.0	4.0	1.2	5.5	1.0	7.0	0.0	3.8	2.2
Phka Rumdeng	1.0	0.0	3.5	1.0	3.0	0.0	5.5	1.0	5.5	1.0	7.5	1.0	4.3	2.3
Riang Chey	2.5	1.0	3.0	0.0	4.0	1.2	5.5	1.0	7.0	0.0	7.5	1.0	4.9	2.1
CAR 4	3.0	0.0	4.5	1.0	5.0	0.0	4.5	1.0	5.5	1.0	7.5	1.0	5.0	1.5
Phka Romeat	2.5	1.0	5.0	0.0	5.0	0.0	6.0	1.2	7.0	0.0	7.5	1.0	5.5	1.8
Phka Rumchek	1.0	0.0	3.5	1.0	5.0	0.0	6.0	1.2	8.0	1.2	8.5	1.0	5.3	2.8
CAR 5	3.0	0.0	3.5	1.0	5.5	1.0	6.0	1.2	7.0	0.0	8.5	1.0	5.6	2.1
CAR 6	3.0	0.0	5.0	0.0	5.0	0.0	6.0	1.2	7.0	0.0	8.0	1.2	5.7	1.8
CAR 11	3.0	0.0	4.0	1.2	6.0	1.2	7.0	0.0	8.0	1.2	8.0	1.2	6.0	2.1
CAR 1	3.0	0.0	4.0	1.2	6.5	1.0	7.0	0.0	7.5	1.0	8.5	1.0	6.1	2.1
CAR 7	2.5	1.0	4.0	1.2	6.0	1.2	8.0	1.2	8.0	1.2	8.5	1.0	6.2	2.5
CAR 2	3.0	0.0	5.0	0.0	5.5	1.0	7.5	1.0	8.0	1.2	9.0	0.0	6.3	2.2

Tolerant to 10-13 days submerge: CAR9, Phka Rumduol & Phka Rumdeng

Tolerant to 7-10 days submerge: CAR6, Phka Rumchek, Phka Romeat & Damnoeub Sbai Mongkul

No	Population	2010WS-2011DS (BC2F1)		2011WS-2012DS	
		Submerged	Survival		
1	Phka Rumduol x IR64sub1	145	1	BC3F1 (progeny)	10
2	Phka Romeat x IR64sub1	52	0	BC1F1 (seed)	50
3	CAR6 x IR64sub1	175	1	BC3F1 (progeny)	43
4	Riang Chey x IR64sub1	93	0	BC1F1 (seed)	192
5	Phka Chan Sen Sar x IR64sub1	110	8	BC3F1 (progeny)	65

# Drought: Research

1999-2006:

- Identify drought tolerant donors from released varieties: CAR3 and CAR4
- Identified 7 donors from traditional varieties
- Developed Set I of 26 populations
- Drought Response Index as a drought selection trait
- Field screening method for rainfed lowland rice had been identified

2009-2011: -Advancing Set I populations  
-Developing Set II populations

From 2012:

- Advancing Set II populations and testing
- MLT-Set I populations-4 promising genotypes
- MLT-Set II population- several promising genotypes



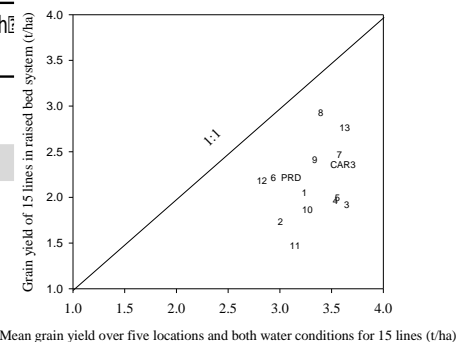


# Drought: Results

- Drought tolerant donors: CAR3, CAR4 and 7 traditional varieties
- Drought Response Index as a drought selection trait had been identified
- Field screening method for rainfed lowland rice had been identified

SD: 28/12/2016, PD: 18/01/2017, Root Evaluation: 20/03/2017, Pot Evaluation: 21/03/2017, Planting Date of field and pot condition are the same)

No.	Designation	Seed Source	Field condition						Pot condition				
			Soil layer (cm)		No. of root		Deepest root length (cm)	Soil strength (kN)			Dried matter (g)		Root length (cm)
			1st	2nd	1st layer	2nd layer		10cm	20cm	30cm	Root	Straw	
1	CIR 827-4-6-B-4-2-1-28-3-1	CUREDS16(3)	27	-	223	-	30	0.74	0.58	0.47	10	28	43
2	CIR 827-2-4-B-5-1-1-27-1-2	CUREDS16(4)	15	12	202	9	28	0.56	0.60	0.77	14	22	43
3	CIR 827-13-15-B-3-3-1-29-1-5	CUREDS16(5)	11	13	127	23	27	0.77	0.84	0.66	12	26	43
4	CIR 827-21-23-B-5-7-47-1-13-1-4	CUREDS16(7)	9	14	114	25	22	0.90	0.72	0.72	12	38	42
5	CIR 827-21-23-B-5-7-47-1-13-4-3	CUREDS16(8)	21	-	127	-	25	0.52	0.58	0.74	26	74	34
6	CAR3		18	6	184	3	25	0.74	0.62	0.76	14	32	38
7	Phka Rumduol		12	9	94	13	24	0.42	0.73	0.76	8	26	36
8	IR64 Sub1		15	8	108	8	20	0.66	0.67	0.74	14	24	44



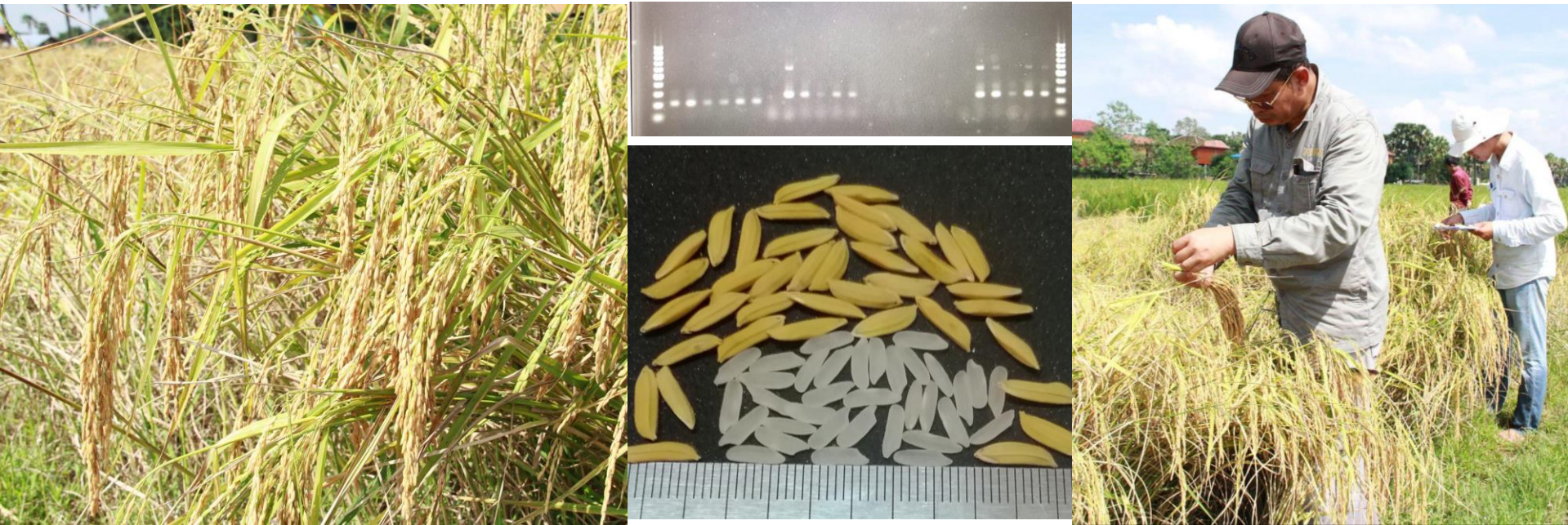
No.	Designation	DS14D	DS19D	DR14D	SS	GL	GT	GC	AC	CK
3	CIR 827-4-6-B-4-2-1-28-3-1	3	7	1	3	7.0	I	82	16	0
4	CIR 827-2-4-B-5-1-1-27-1-2	1	5	3	3	7.0	I	76	16	7
5	CIR 827-13-15-B-3-3-1-29-1-5	1	5	3	3	7.2	L	86	19	2
7	CIR 827-21-23-B-5-7-47-1-13-1-4	1	5	3	5	7.1	L	80	15	1
8	CIR 827-21-23-B-5-7-47-1-13-4-3	1	5	3	3	7.1	I	71	16	8
25	CAR3	3	5	3	7	6.4	I	55	23	5
26	Phka Rumduol	3	7	3	5	7.0	L	81	14	2

# Drought: Results (Cont.)

One promising line is considering for Release:

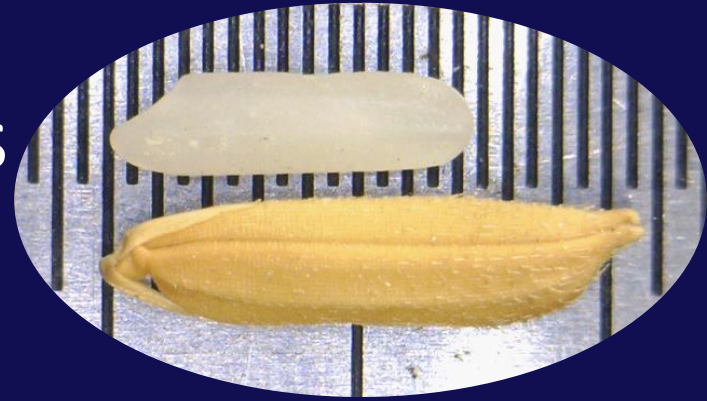
CIR 827-4-6-B-4-2-1-28-3-1

Promising line	GY $\pm$ SD	Farmer preference	Farmer field day (62)
CIR 827-4-6-B-4-2-1-28-3-1	3.16 $\pm$ 0.8	17	50
CIR 827-13-15-B-3-3-1-29-1-5	2.98 $\pm$ 1.1	6	5
Farmer's varieties (PRD&PRM)	2.87 $\pm$ 1.2	7	7

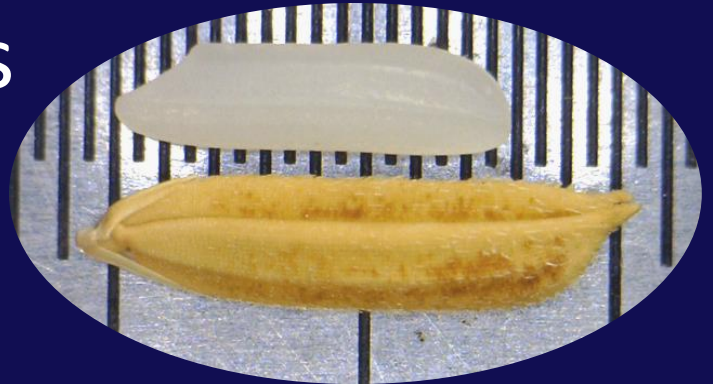


Research for very early maturity and high water use efficiency with resistance to pest and disease is on-going with recent 2 released varieties:

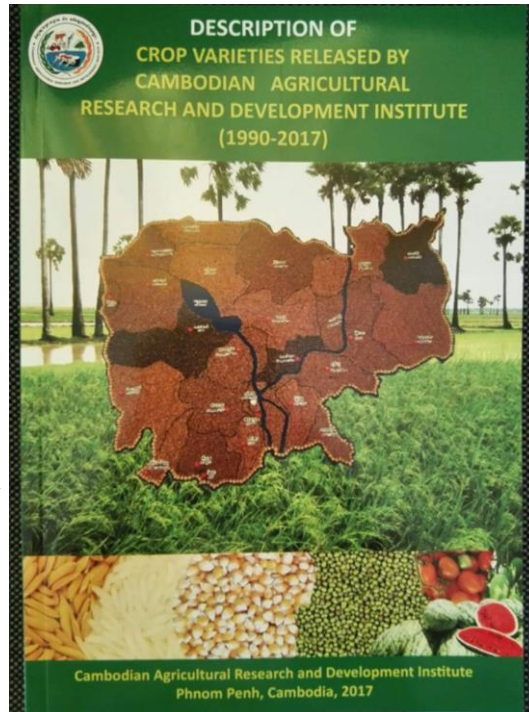
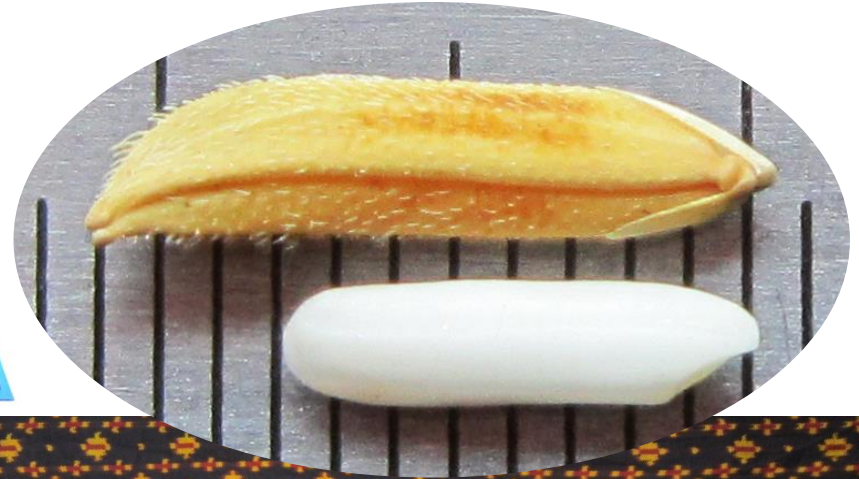
1. CAR14: Maturity in 95 days with resistance to rice blast



2. CAR15: Maturity in 95 days with resistant to brown plant hopper



# PPP: Congratulation for being the worlds best rice in 2012, 2013 and 2014: Phka Rumduol



Thank  
You

Damnoeb Sbai Mongkul