



# Contribution of Food Crops Mutant Varieties to the National Demand

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# General Information



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- Population continues to increase ( $\pm 1.3\%$  per year;  $\pm 257.9$  mill. in 2017)
- Rice and soybean are the main staple food for Indonesia.
- National demand is bigger than supply.
- Rice production is facing problem with shrinking growing areas due to land utilization for the non- agriculture purposes such as industries, roads and properties.
- Tempe, on the other side, is also a protein source side-dish based on soybean.
- Nuclear technology has been proven to help Indonesia to increase food crops production including rice, soybean, sorghum etc.
- In collaboration with the Ministry of Agriculture, BATAN has conducted joint research on increasing food crops productivity and quality by using mutation breeding.

# Background: Agriculture Threats



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## 1. Climate change:

1. Increasing temperatures → **increase pest and diseases**
2. More frequent extreme climate events → **flood and drought**
3. Sea level rise → **saline water intrusion and reduction of agricultural land in the coastal areas**

## 2. Import:

1. Low quality food crops.
2. Inadaptive varieties (cannot be grown).



# National Objectives



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**In response to increasing demand on food crop varieties and concern re negative effect of climate change for food security, BATAN:**

- 1. Enhances the adaptability of crops to climate change using mutation breeding techniques**
- 2. Strengthens capacity for mutation breeding**
- 3. Develops improved rice varieties with special focus on drought tolerance and disease resistance**
- 4. Disseminates rice mutant varieties to farmers in different provinces**
- 5. Collaborates with local governments and the Ministry of Agriculture, to establish Agro Techno Parks (ATPs) in some provinces which are expected to become Center of Excellence for developing qualified seeds of mutant varieties**
- 6. Reduces imports.**



# Support for mutation breeding



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## Joint FAO/IAEA Division supports Indonesia mutation breeding programme through:

- Promoting the establishment of Collaborative Centre for Plant Mutation Breeding for Climate Smart Agriculture (PMBCSA)
- Technology transfer and support to enhance R&D activities in collaboration with Plant Breeder Lab;
- Human capacity building through FE, SV, EM and training courses
- Provide policy advice and technical support in mutation breeding
- Upgraded facilities for plant breeding and genetics



# Mutation breeding scheme



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Determination breeding objective & Preparation breeding materials



Mutagenesis, Radio-sensitivity study & generating M1 Plant population



Generating segregation population of M2 & selection of Putative Mutants



Screening process of Mutants



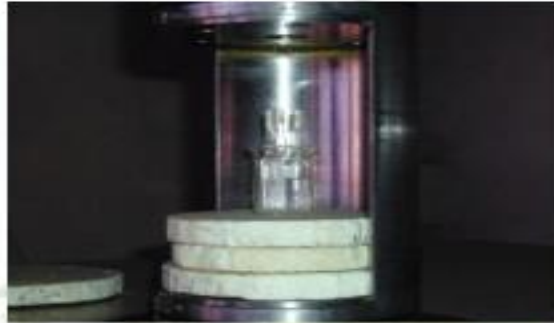
Panoramic Irradiator 80 kCi

Gamma Chamber 4 kCi

Gamma Cell 220 9 kCi

# Gamma Irradiator Facilities – BATAN:

## Gamma Irradiators



GC-4000A



GC-220



Panoramic Batch



Irradiator Lateks

# Major Achievements



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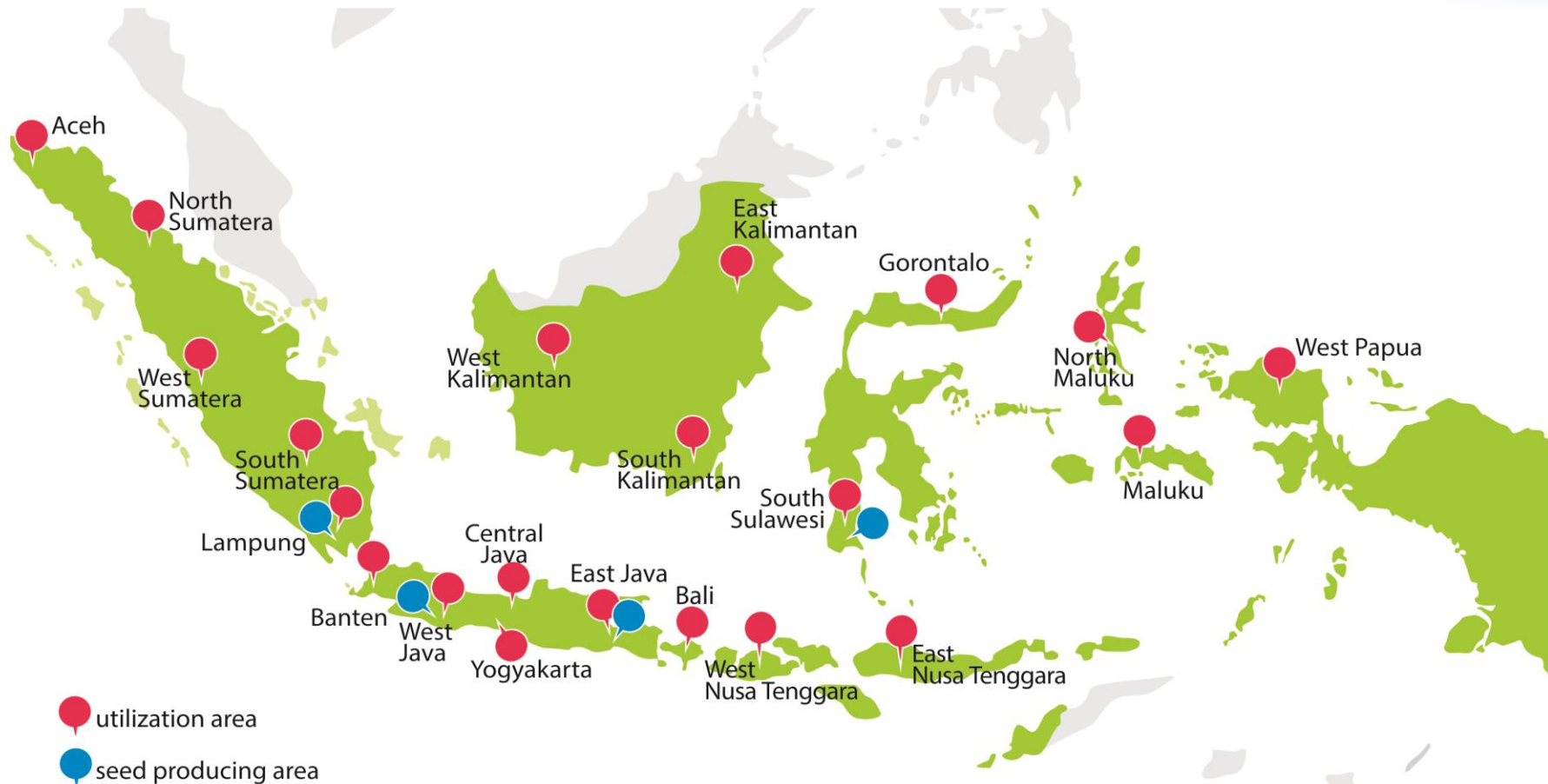
**Nuclear techniques utilized result in mutant crops, particularly rice and soybean, adapt to climate change and increased production proven**

- ❖ 22 rice mutant (+ 1 non mutant) and 10 soybean mutant varieties released;
- ❖ *4.7% of the dedicated area cultivated (average per year ~450 000 ha)*
- ❖ *800,000 farmers profited from rice mutant varieties*
- ❖ *Produced enough rice for 20 million people*
- ❖ *Increased productivity of BATAN rice mutant varieties, 1 – 3.5 t/ha compared to other varieties, and 1 – 1.5 t/ha for soybean.*
- ❖ *Since 2012, officially released 6 rice and 5 soybean mutant varieties.*





# Distribution Map of BATAN Varieties Utilization (Partnership Scheme)



# Down-streaming food crops varieties: The impact



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Province	Regency	Productivity (t/Ha)			Difference (Non BATAN)	GKP Tingkat Petani* (per kg)	Income /Ha	Difference/ha	Remarks
		Regency	Non BATAN	BATAN					
Bali	Klungkung	6,00	7,02	8,36	1,34	4.400	36.784.000	5.896.000	Ciherang
	Tabanan	6,61	7,02	8,46	1,44	4.400	37.224.000	6.336.000	Ciherang
Banten	Pandeglang	5,76	6,3	5,87	-0,43	3.775	22.159.250	(1.623.250)	Ciherang
	Serang	5,78	6,3	7,05	0,75	4.250	29.962.500	3.187.500	Ciherang
Jawa Barat	Subang	6,24	6	5,65	-0,35	4.400	24.860.000	(1.540.000)	IR 42
	Sumedang	6,06	6	7,26	1,26	4.900	35.574.000	6.174.000	IR 42
Jawa Tengah	Boyolali	5,89	6,2	5,71	-0,49	4.025	22.982.750	(1.972.250)	Ciherang
	Jepara	6,09	6,5	7,52	1,02	4.211	31.666.720	4.295.220	Ciherang
	Kebumen	6,58	6,53	7,40	0,87	3.665	27.121.000	3.188.550	Ciherang
Jawa Timur	Jember	6,12	7	7,26	0,26	5.067	36.786.420	1.317.420	Ciherang
	Malang	7,13	7	9,42	2,42	4.700	44.274.000	11.374.000	Ciherang
Sulawesi Selatan	Maros	7,218	7,218	8,65	1,43	3.300	28.545.000	4.725.600	Rata-rata
Yogyakarta	Kulonprogo	6,82	6,2	7,25	1,05	3.650	26.462.500	3.832.500	Ciherang
<b>Rata-Rata</b>				<b>7,37</b>	<b>0,81</b>			<b>3.476.253</b>	

In average, in each hectare of rice fields farmers gained IDR 3,476,252 or 12% benefit raise.



# Economic Impact



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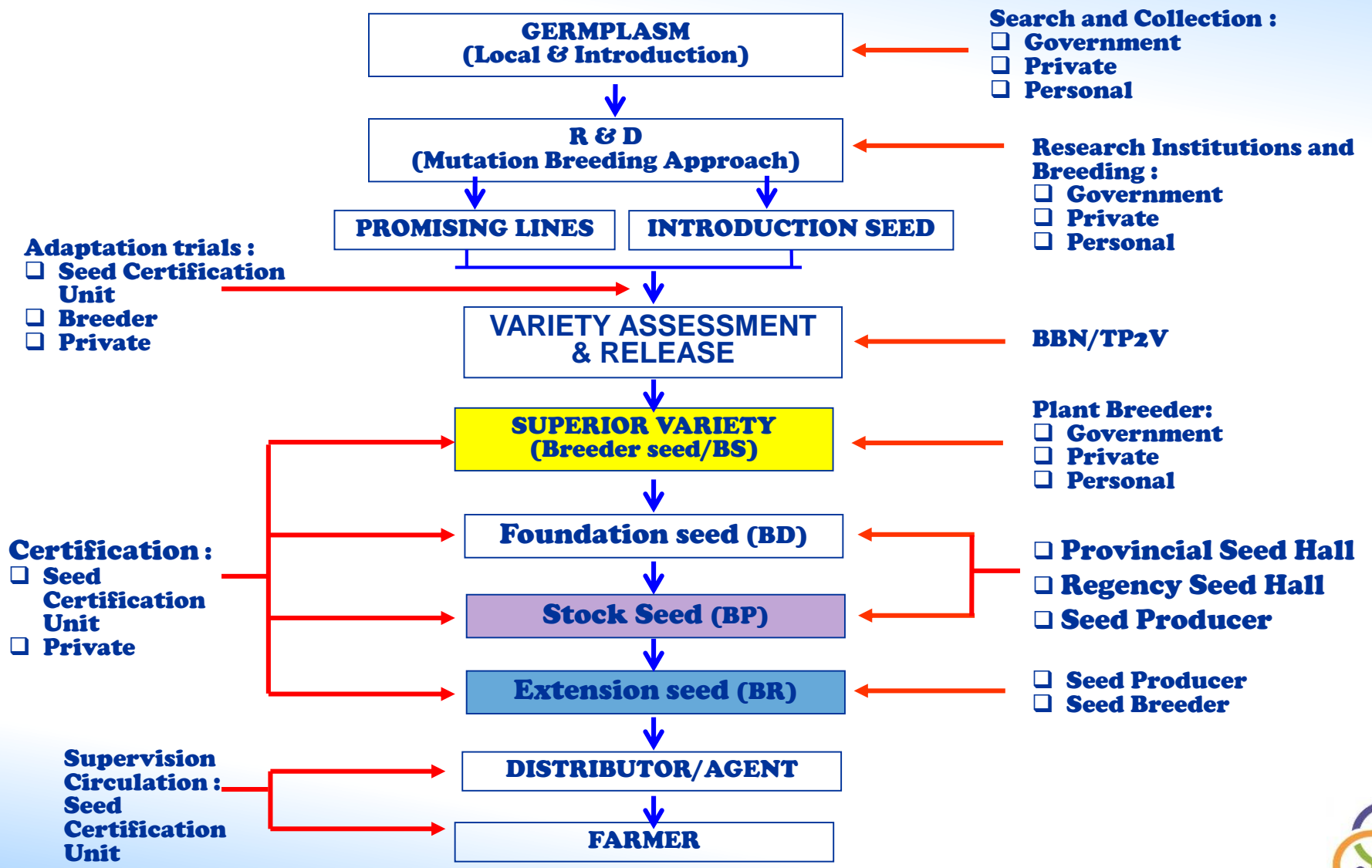
- At national level, 22.8% increase in farmers income was measured during 2016
- in the last 10 years, almost 6M *ha* of rice fields utilizing the mutant varieties.

# Controlling Agencies: Ministry of Agriculture



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# Controlling Agencies: Bapeten

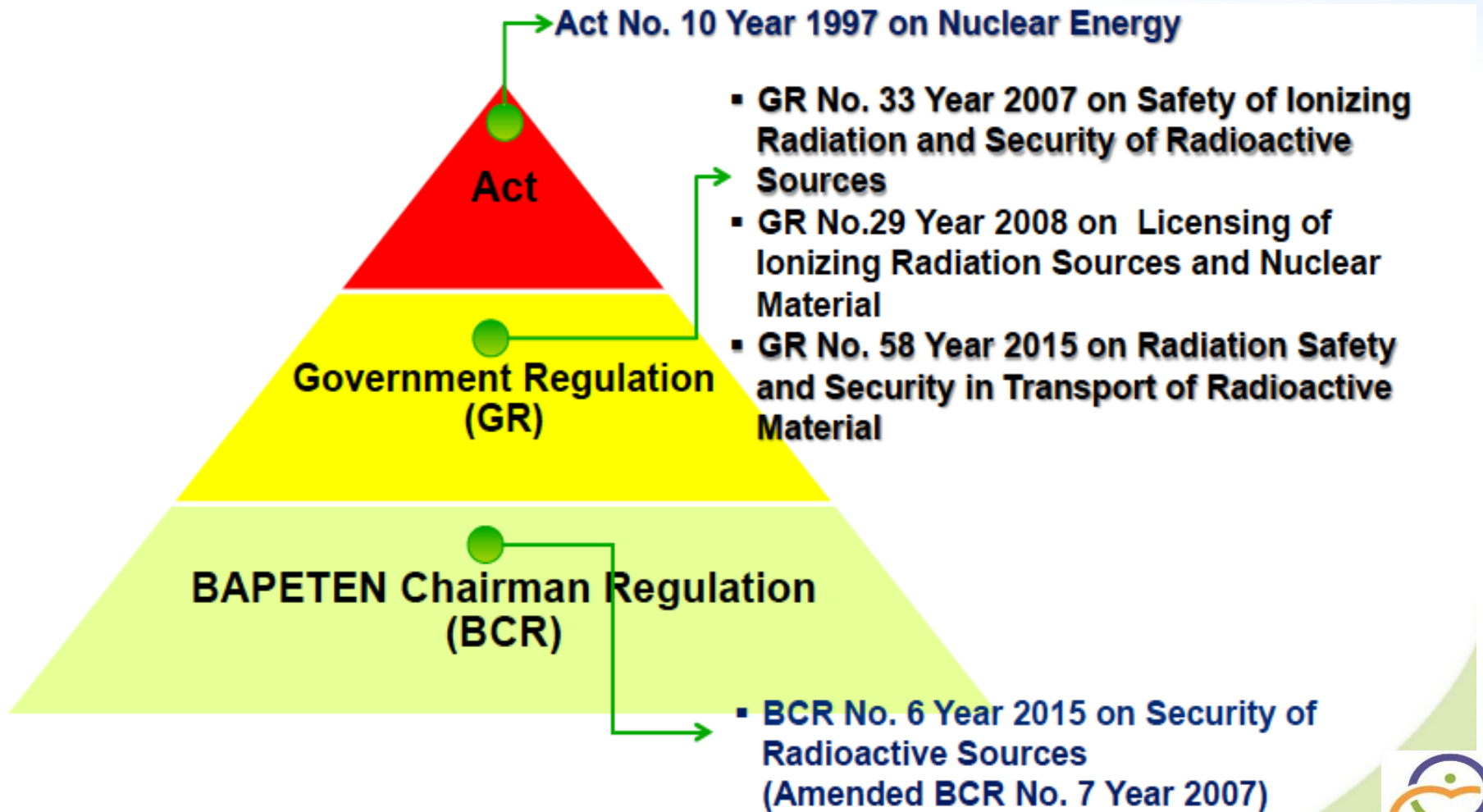
## Legislation and Regulation

### Security of Radioactive Sources



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# Bapeten: Inspection



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Group of Risk	Activities	Year/ Inspection
High	Industrial radiography, Irradiator, Radio-therapy & Nuclear medicine	1
Medium	Well logging, gauging, CT scan, import/ export & transportation	2
Low	Photo-fluorograph, radio diagnostic & others	3 – 4

About 1,200 facilities per year



# In Closing



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Downstream programme for BATAN R & D products is expected to contribute to achieve national seed independency, food security and increasing the competitiveness of national commodities.

- The success of the downstream program can only be achieved with good collaboration between BATAN and partners / stakeholders;
- Gamma irradiator facilities are still a mainstay for mutation breeding process



# Thank You



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