Private sector experiences with GE crops in the US and India

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Breeding Excellence

Seven billion humans: technology has saved us before, and can do so again

predictions of doom are nothing new

In 1798, an English clergyman, the Rev Thomas Malthus, predicted that one day the population of the world would outstrip the globe's ability to feed it

HOW TO FEED THE WORLD 2050

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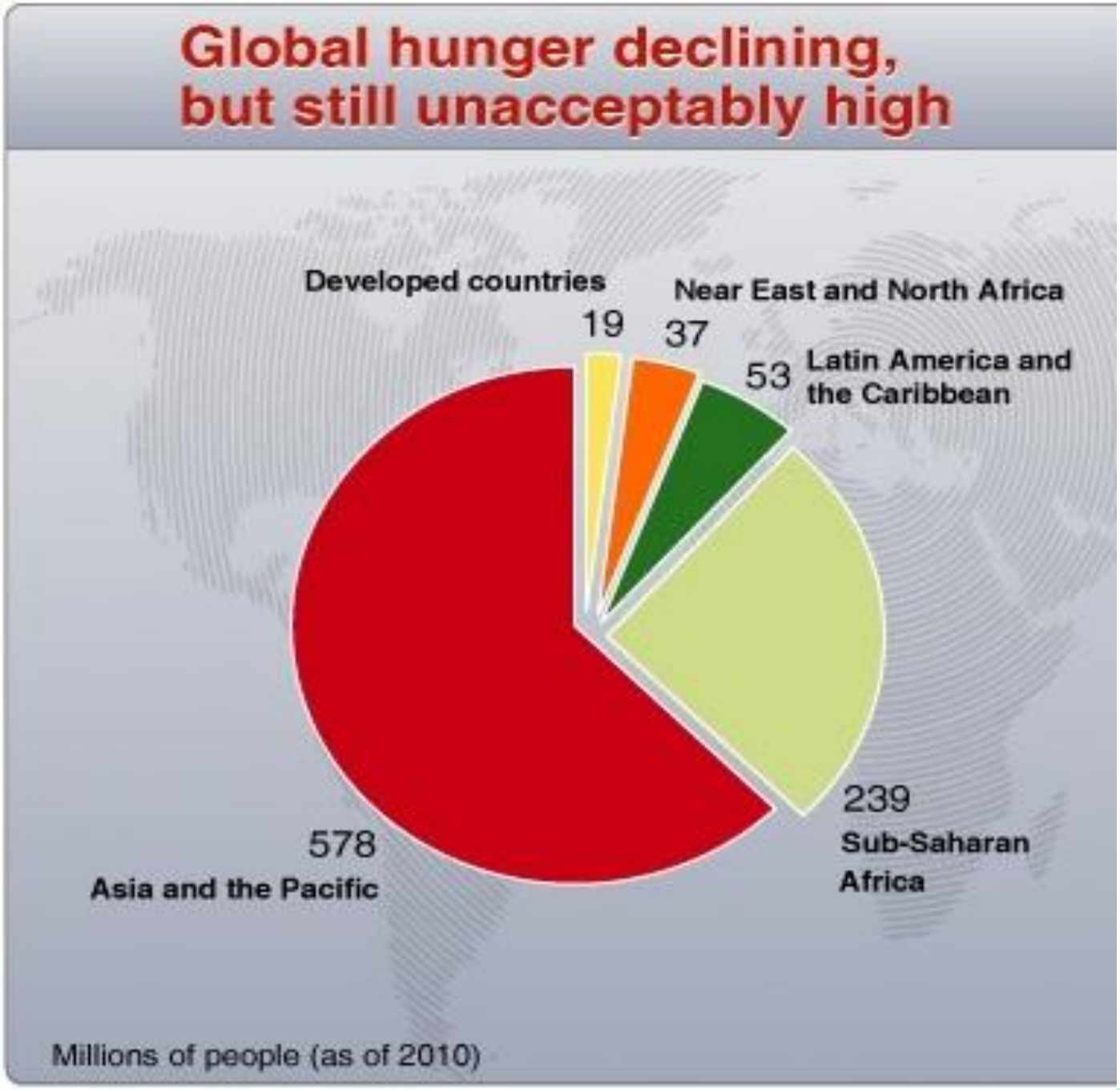
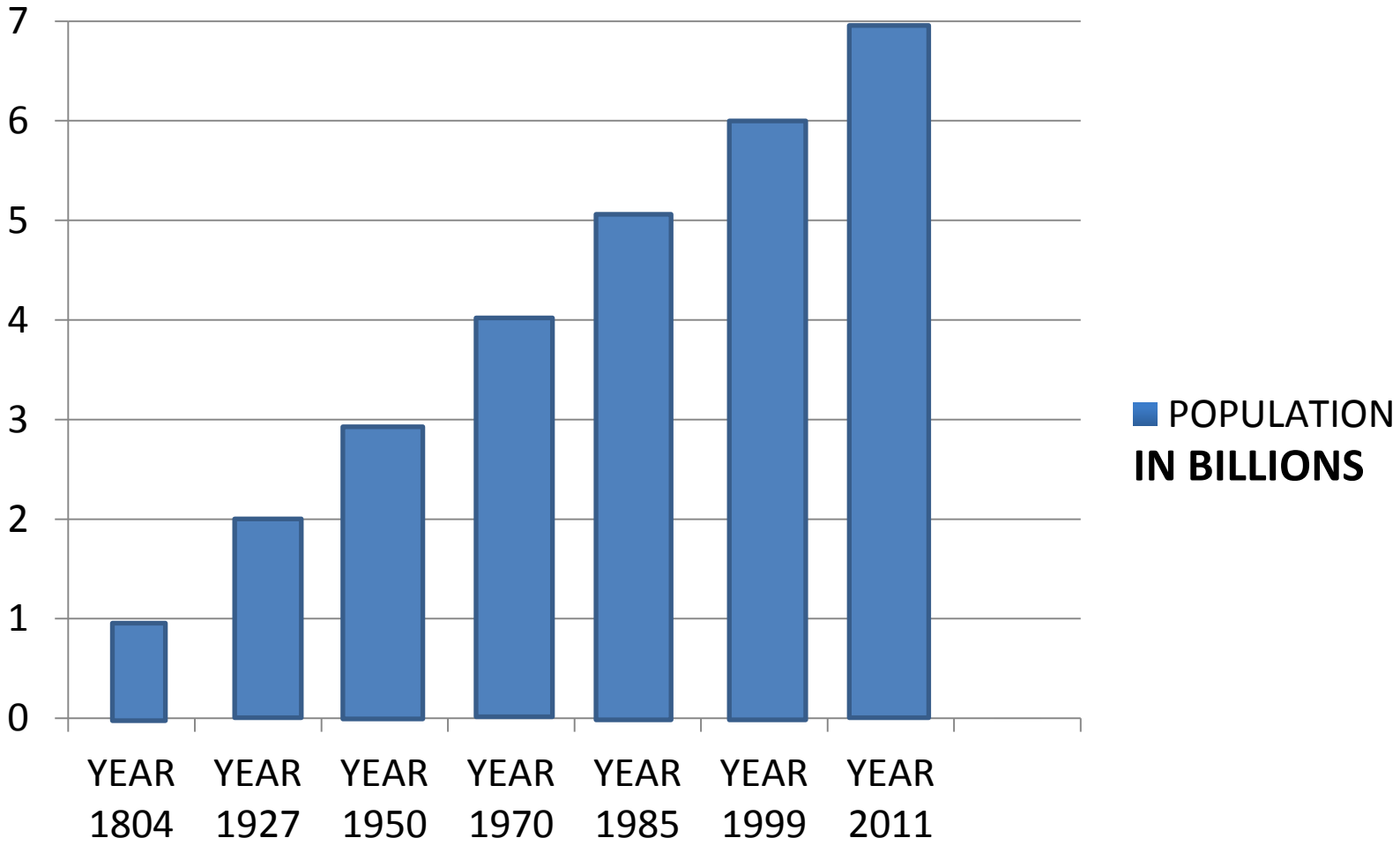
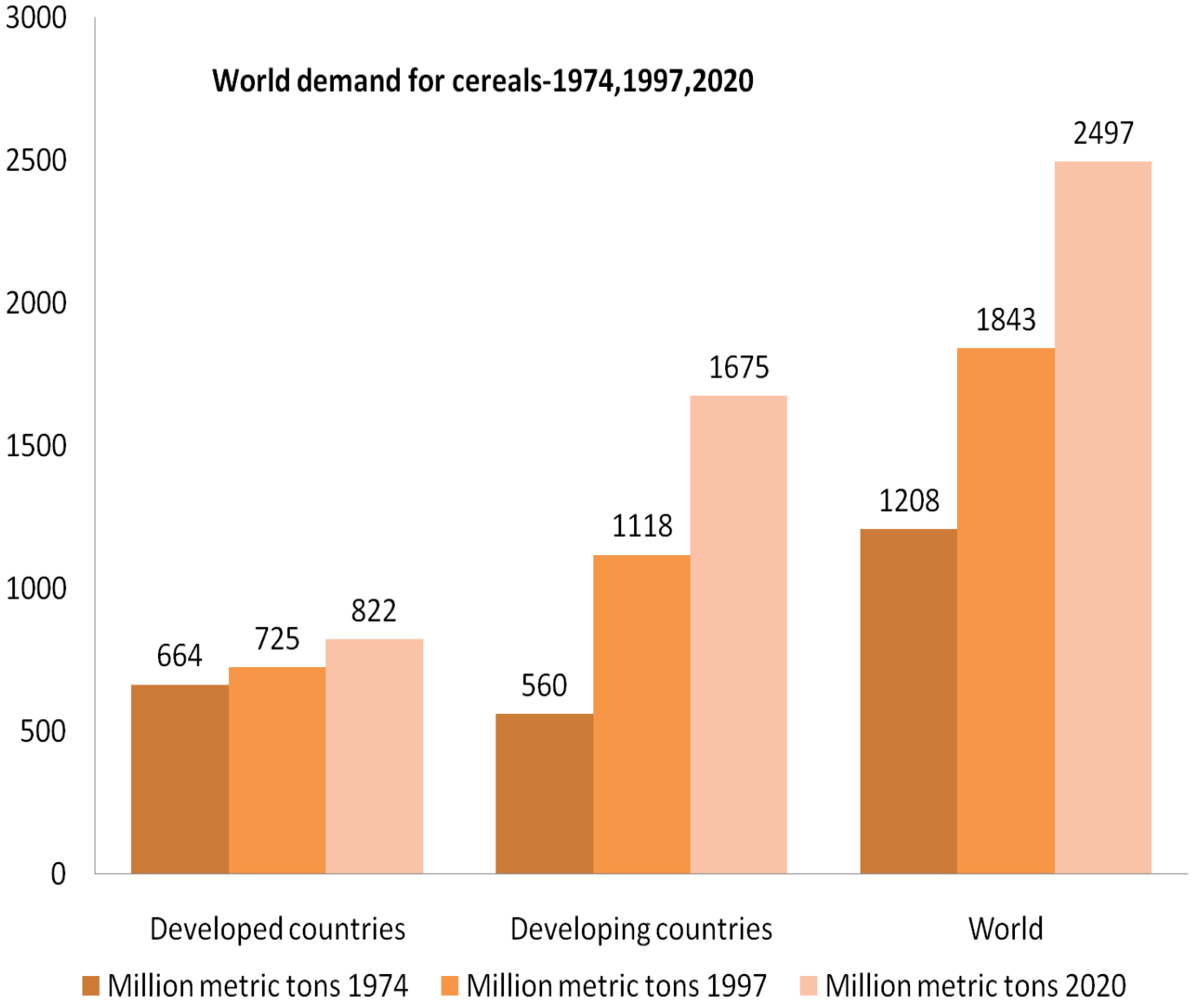


CRITICLE QUESTIONS COMPLEX ANSWERS


7
6
5
4
3
2
1
0
YEAR 1804
YEAR 1927
YEAR 1950
YEAR 1970
YEAR 1985
YEAR 1999
YEAR 2011
POPULATION
IN BILLIONS

CRITICAL NEXT 40 YEARS

- In 2050, the world population will reach 9.2 bn. from 6.1 bn. in 2000
- Out of same arable land globally (1.5 bn. ha.) double the food grain production is required
- The food grain reserve is coming down globally and restricted to only 75days supply
- To mitigate multiple challenges , the reserve should be in the range of 100days supply
- **Integrating the best of conventional crop technologies (adapted germplasm) and the best of crop biotechnology applications including novel traits is the optimum solution to achieve this daunting task.**


World demand for cereals-1974,1997,2020
3000
2500
2000
1500
1000
500
0
664
725
822
560
1118
1675
1208
1843
2497
Developed countries
Developing countries
World
Million metric tons 1974
Million metric tons 1997
Million metric tons 2020

2011- A RECORD FOOD PRODUCTION OF 2323 MILLION TONS

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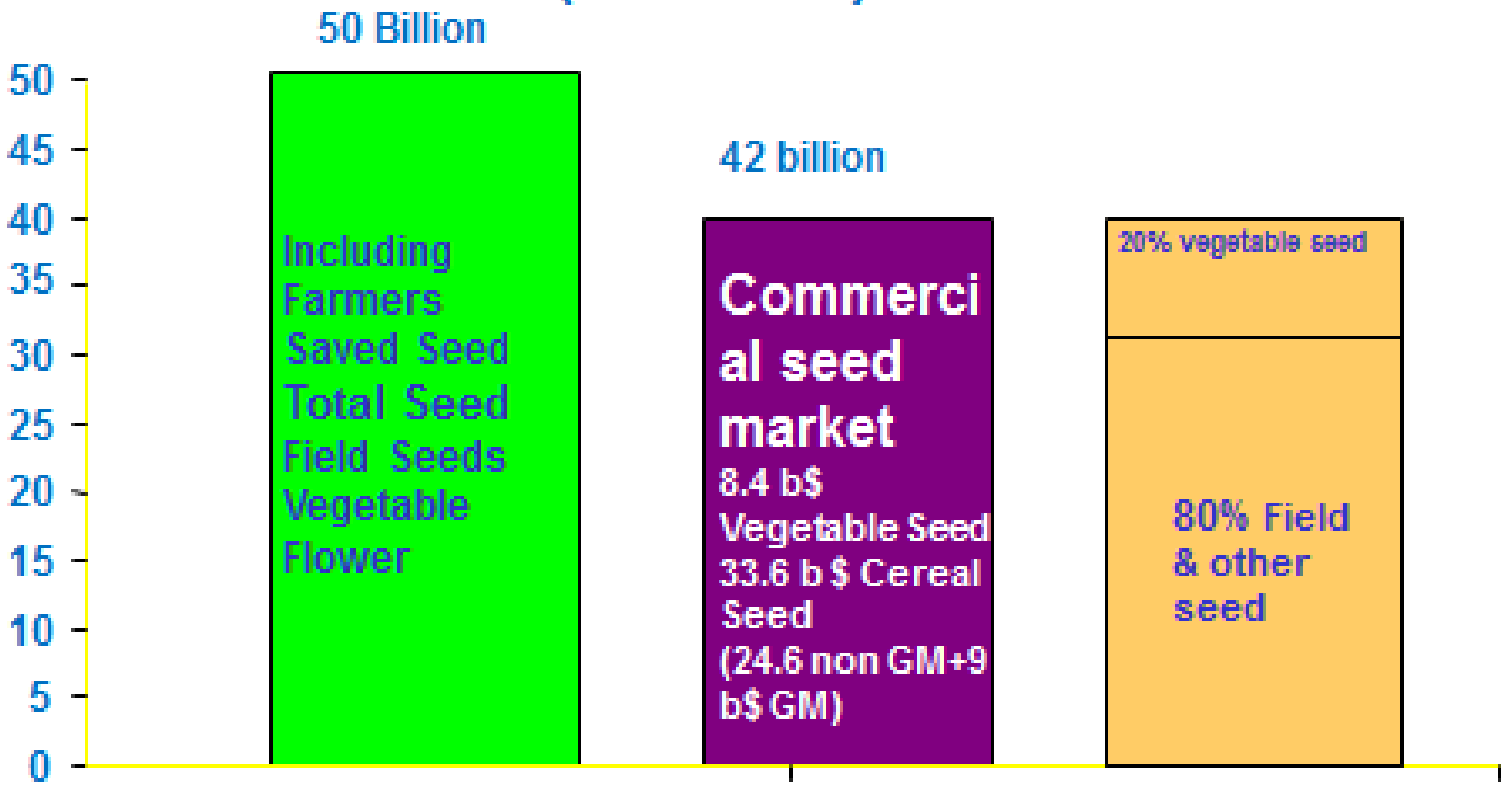
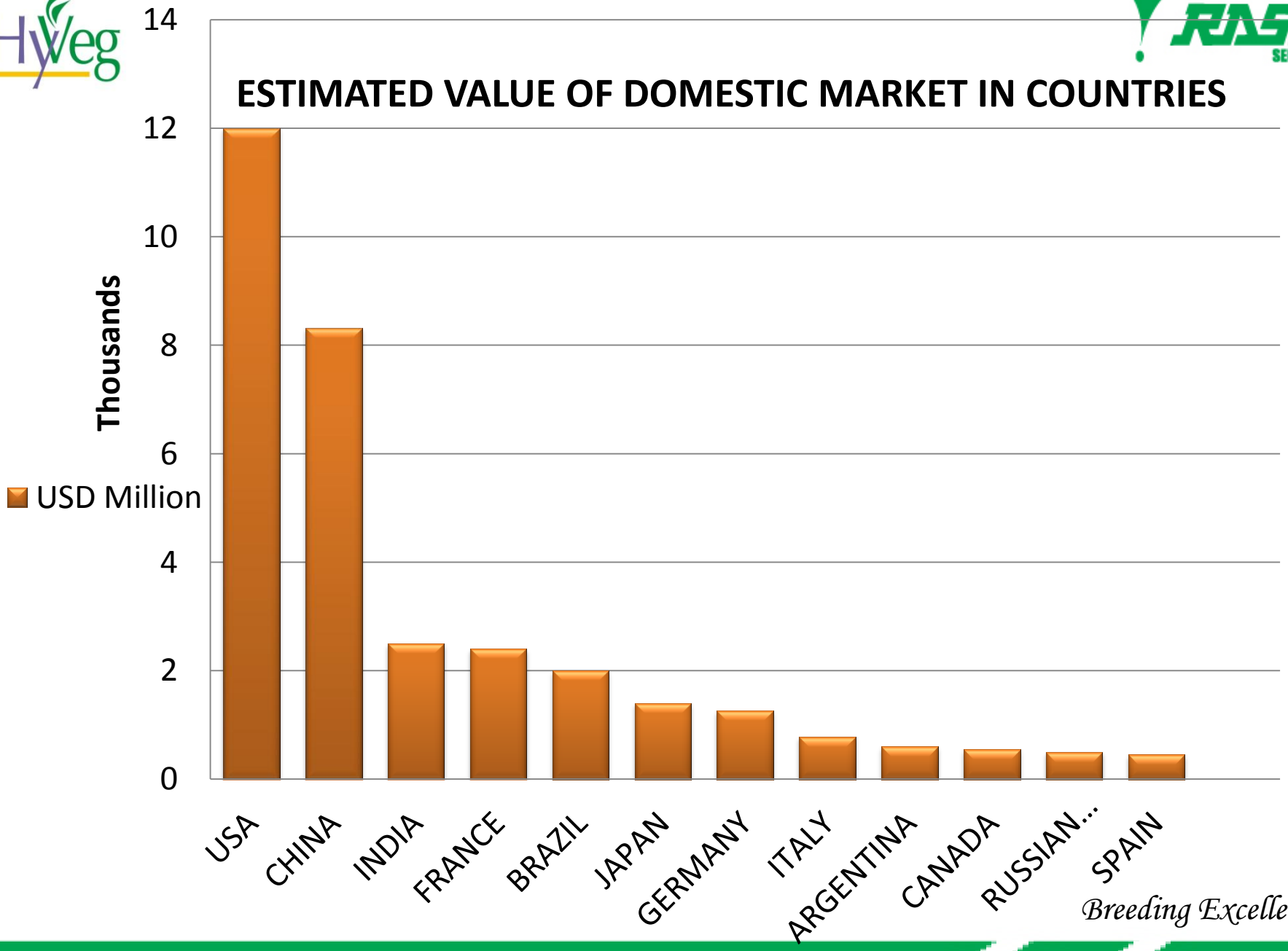
THE WORLD SEED MARKET
(billions $)




ESTIMATED VALUE OF DOMESTIC MARKET IN COUNTRIES
Thousands
14
12
10
8
6
4
2
0
USD Million
USA
CHINA
INDIA
FRANCE
BRAZIL
JAPAN
GERMANY
ITALY
ARGENTINA
CANADA
RUSSIAN...
SPAIN

INDIAN SEED INDUSTRY-TODAY

- Present size of the seed industry is $ 2.5Bn.
- Cereals , fiber and oil seed industry is about $ 1.4 Bn.
- Market size of the open pollinated varieties in these crops is about $ 450 Mn.
- Vegetable seed industry is worth $ 560 Mn.
- Other traded seed Market is worth $ 150 Mn.

DIVERSION OF FOOD FOR FUEL AND FEED

FEED

- ECONOMY IN DEVELOPING COUNTRIES IS GROWING RAPIDLY
- RESULTING IN SHIFTING OF FOOD HABITS TO NON-VEGETARIANS
- ONE KG OF MEAT PRODUCTION NEEDS 9 KGS OF GRAINS
- MORE GRAIN PRODUCTION IS NEEDED TO FULFILL THE DEMAND OF MEAT

FUEL

- FOSSIL FUEL IS ON THE DECLINING
- PRICES OF CRUDE OIL IS GOING UP
- ALTERNATE SOURCES OF ENERGY IS BEING TAPPED
- NUCLEAR ENERGY FACING STIFF RESISTANCE DUE TO RADIATION DANGER
- STARCH, SUGAR AND CELLULOSIC SOURCES ARE BEING EXPLOITED FOR FUEL
- CORN, VEGETABLE OILS AND STRAW AND WOOD IS BEING DIVERTED TO PRODUCE BIOFUEL

MORE FROM LESS LAND

TECHNOLOGY IS BOOMING AND WORLD IS SHRINKING

Agricultural biotechnology Ensure

More food

Better

Better for the environment

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Where do we go from here?

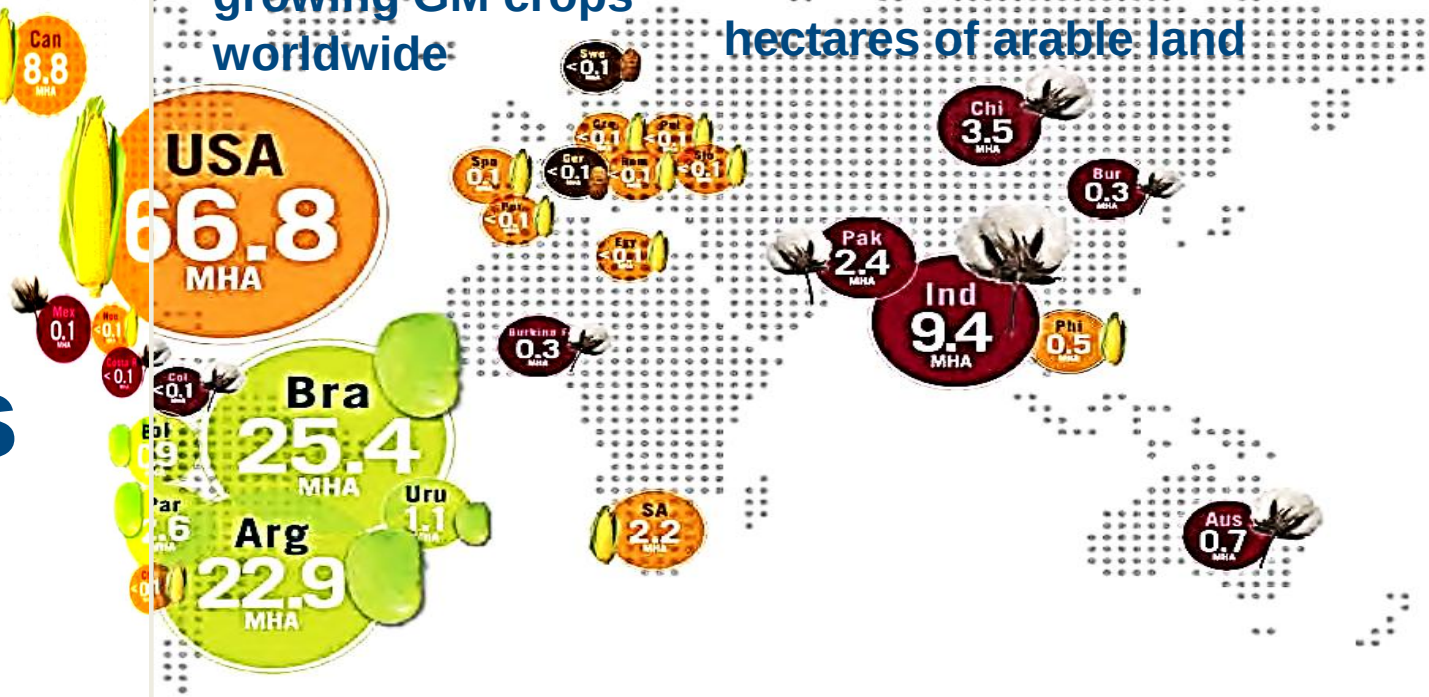

GM:
novel cuisine
or unpalatable
prospect?

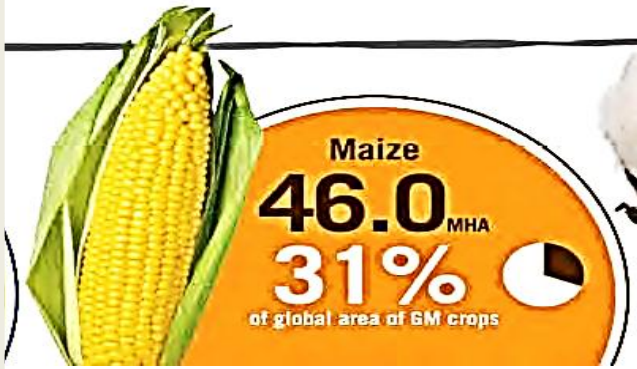
GM food around the world

29 countries growing GM crops worldwide

160m hectares of arable land

15m farmers





SEED INDUSTRY'S APPROACH TOWARDS GM CROPS

- Incorporating difficult and complex traits in crops to find solutions for farmers and consumers
- Sustainagility of crop production and productivity under abiotic and biotic stresses
- Providing health solutions to consumers
- Avoid fancy products just to show the strength of the technology
- Believe in safety and sustainability of technology
- Ensuring thru rigorous experimentation and evaluation of the technology its safety to environment, biodiversity, and food chain

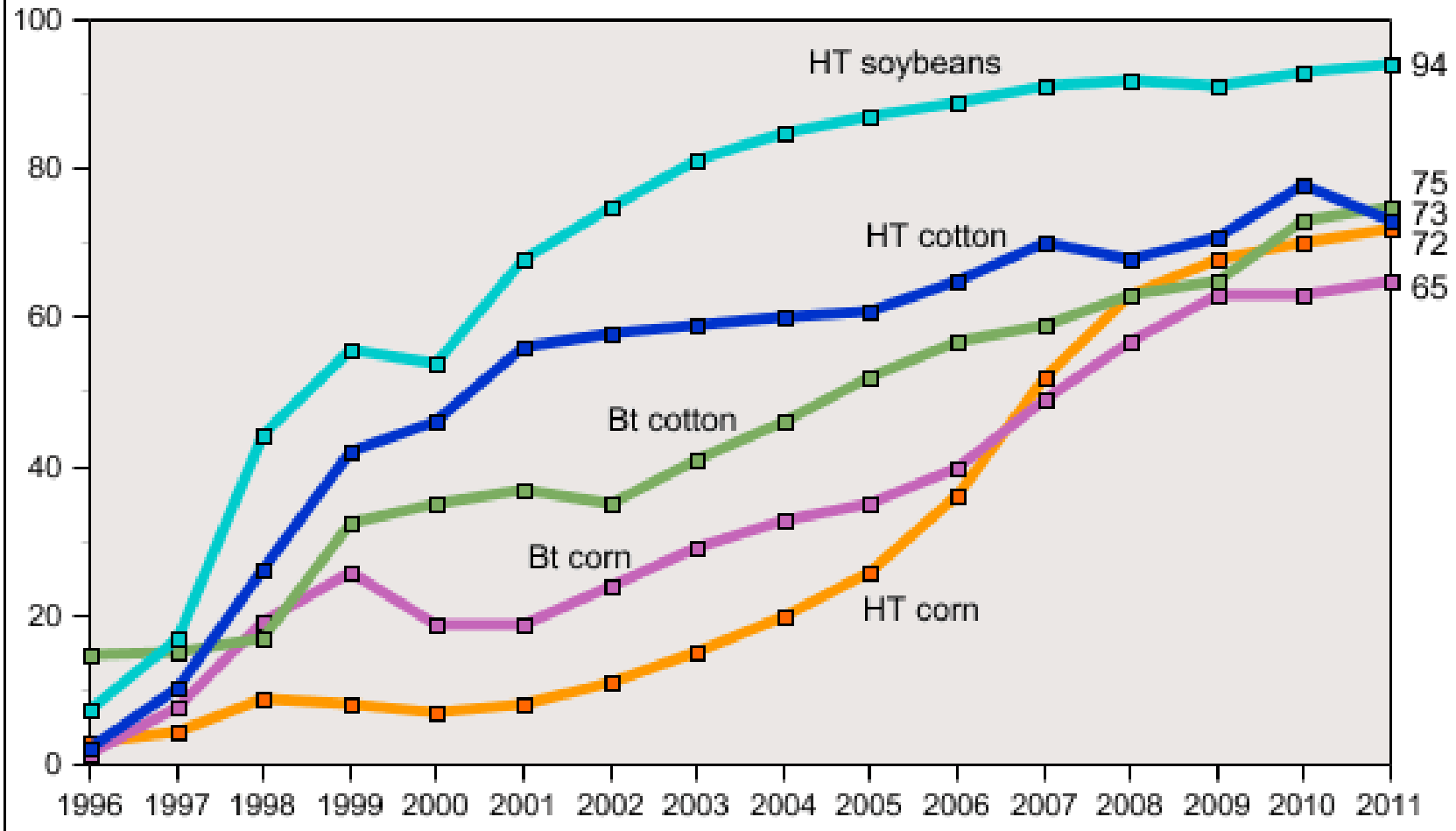
GM CROPS IN USA

- IN USA, around 1% population is engaged directly in agriculture
- Farm holdings are big(More than 250 ha)
- Highly mechanized farming
- Largest GM crops area(More than 69 million ha.)
- GM traits for better agronomy for farmers
- Acceptability by consumer
- Out put traits for industry and consumer
- Clear regulatory and release policies

GE CROPS IN USA

- More than 90 % area under different GM traits in corn
- More than 23 % are is under Bt. trait while,23 % herbicide resistance and almost 54% area under staked genes
- Now new corn hybrids being released with 8 gene stack including drought tolerance
- In cotton more than 90% area with all traits
- In Soybean , more than 95% area under herbicide resistance traits

Growth in adoption of genetically engineered crops continues in the U.S.



Data for each crop category include varieties with both HT and Bt (stacked) traits.
Sources: 1996-1999 data are from Fernandez-Cornejo and McBride (2002). Data for 2000-11 are available in the ERS data product, Adoption of Genetically Engineered Crops in the U.S., tables 1-3.

GM CROPS IN INDIA

- In India , about 60% population is directly engaged in agriculture
- The farm holdings are on average less than 2 ha
- Very low level of mechanization
- Only one GM crop cotton with Bt. Trait covering 10.5million ha
- Farmers prefer better input traits which save their crop production cost
- No food crop yet cleared by regulators

Agriculture

Bt Cotton from Monsanto, USA
Bt Cotton from IIT, Kharagpur
Bt Cotton from Biocentury, China
Bt Cotton from Metahelix, Bangalore

OLD GUIDELINES

Five Approved Events

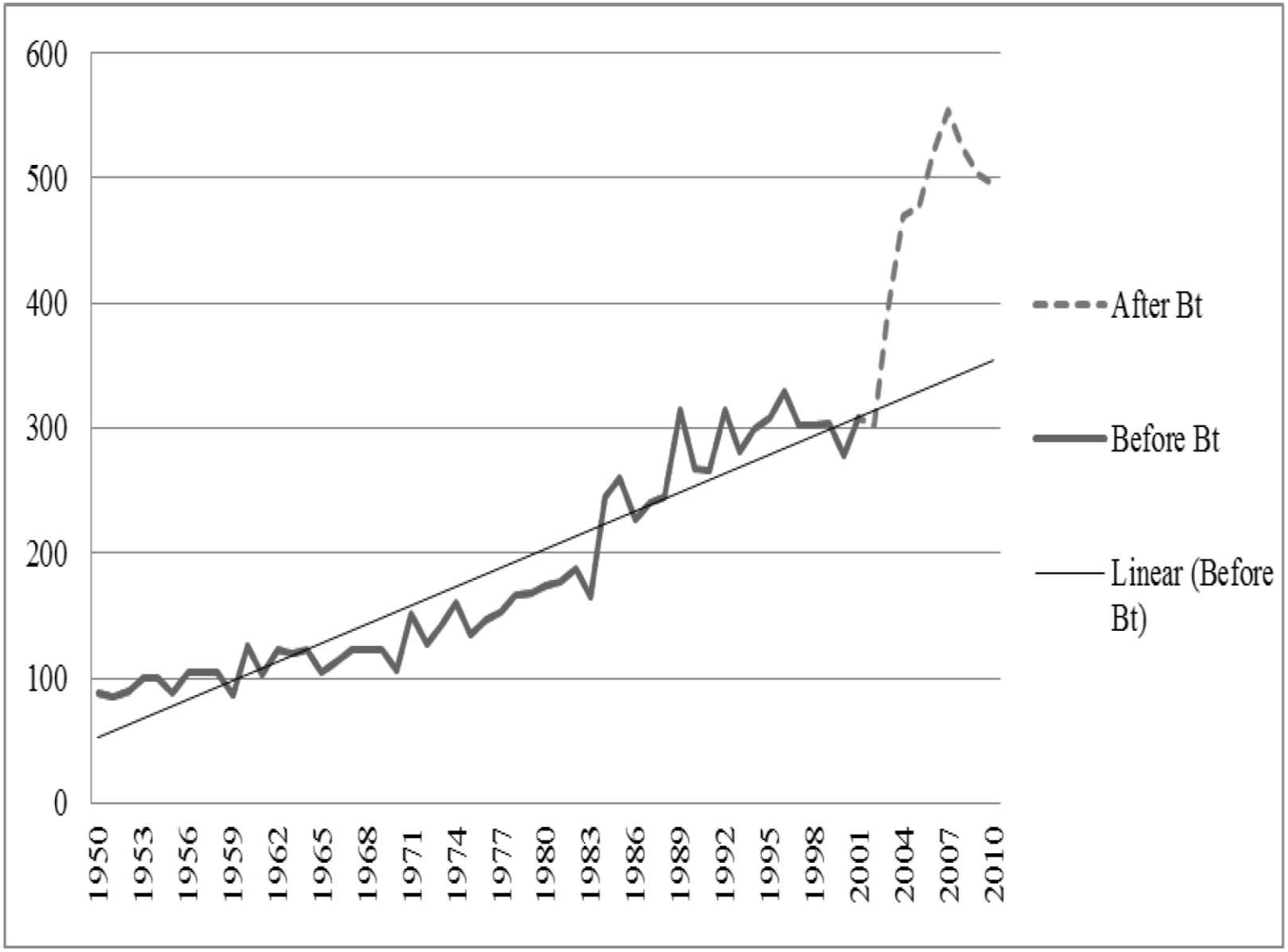
- MON 531(*cry1Ac* gene),
- MON 15985 *cry1Ac & cry2Ab)*
- GFM Cry 1A (c*ry1Ab-cry1Ac*
- JK-1 (c*ry1Ac)*
- *CICR (cry1Ac)*

NEW GUIDELINES

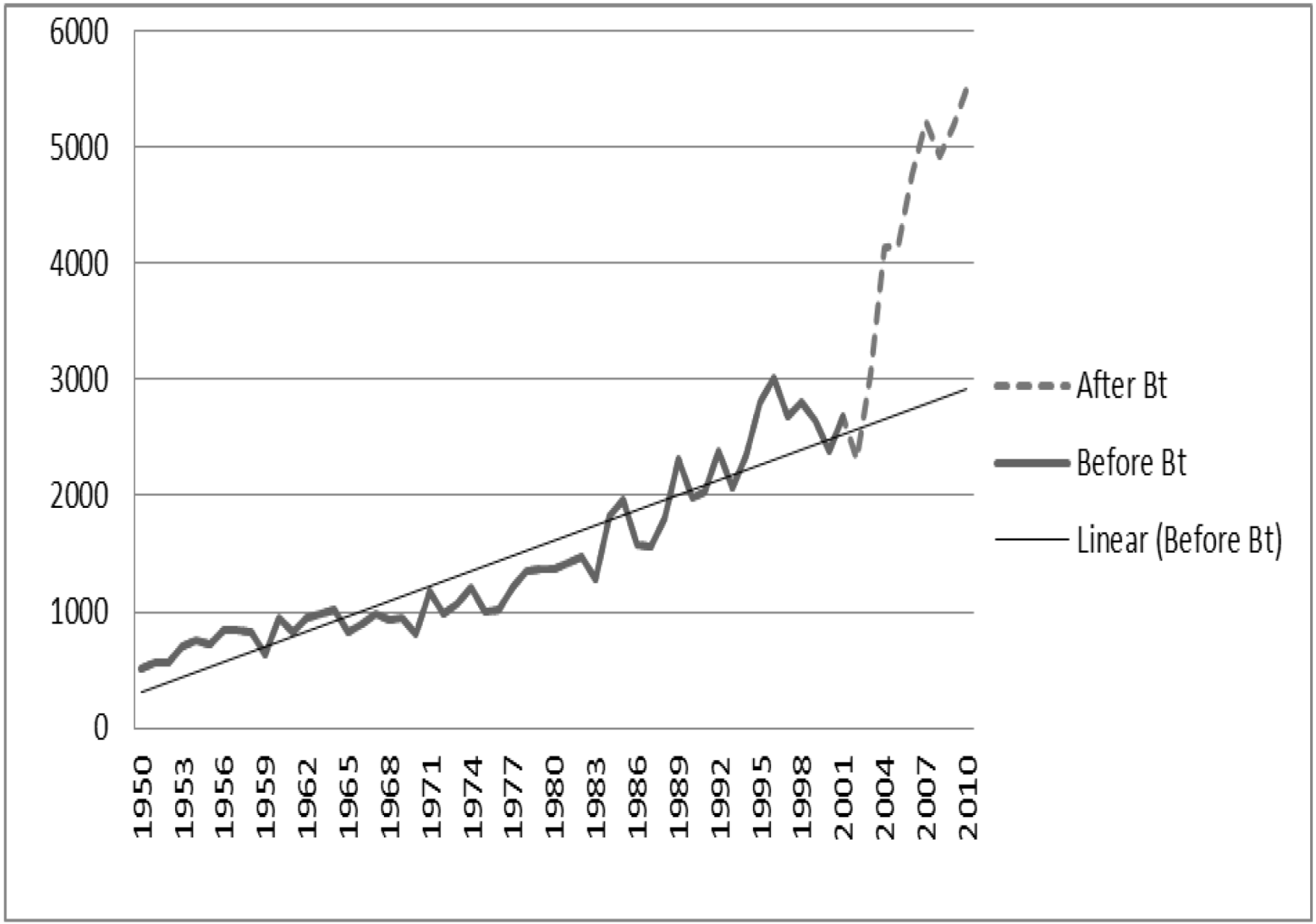
Events Under NEW GUIDELINES

Cotton

- Round-up Ready Flex (RRF) *cry1Ac & cry2Ab* (Event MON15985) & *CP4 EPSPS* (Event MON 88913)
- WideStrike™ (*cry1Ac & cry1F*)Event 3006-210-23 and Event 281-24-236)
- *JK Stack- cry1Ac* (Event -1) and *Cry1EC* (Event-24)
- *Cry1C* (Event 9124)
- Brinjal Event EE1



Total cotton production (in thousands of metric tons), 1950–2010

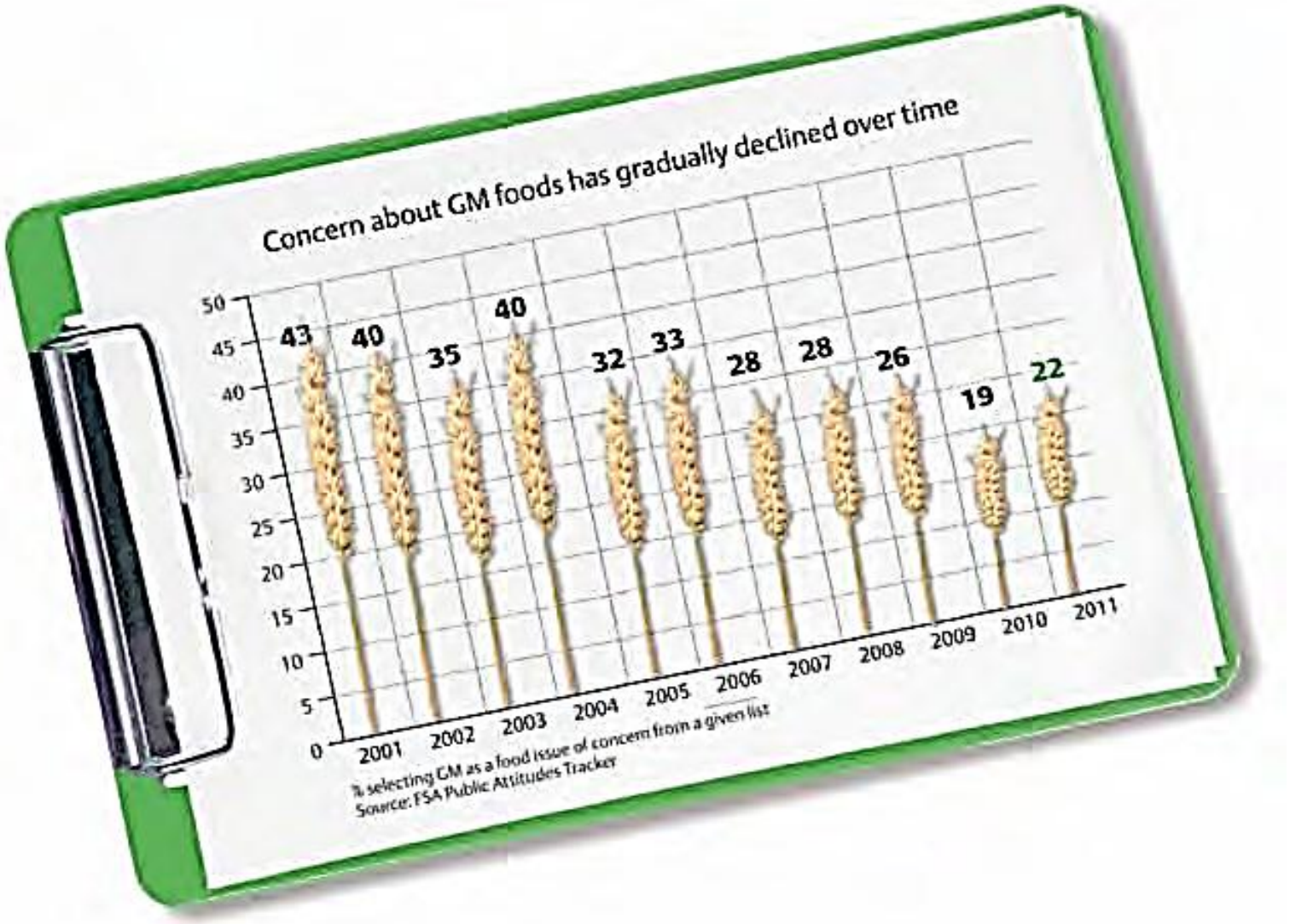


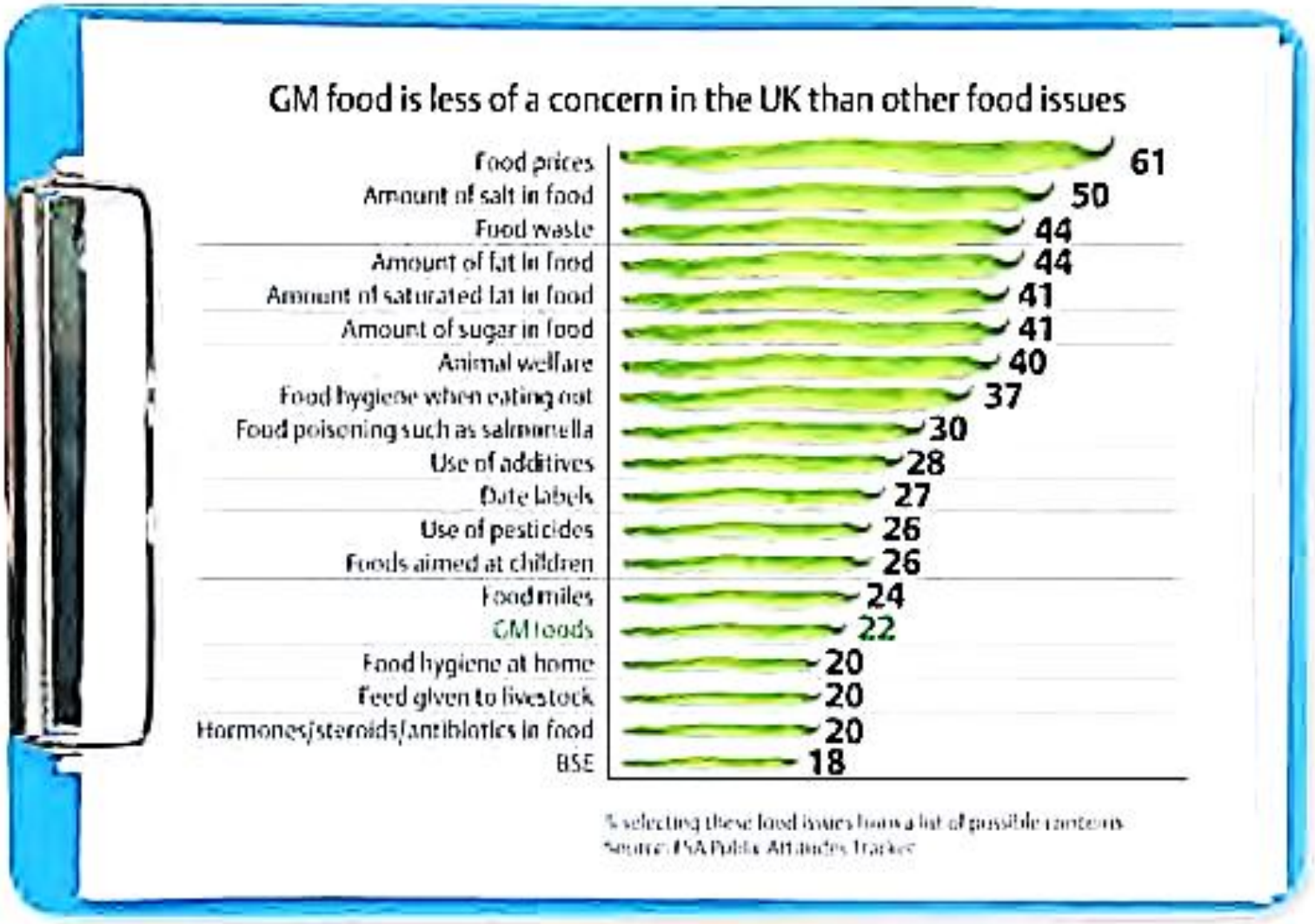
Total cotton production (in thousands of metric tons), 1950–2010

PROCESS V/S SAFETY

- Different agenda for different stakeholder
- Consumer wants safety of food while environmental activist looking for protection of environment
- Scientist looking for development of technology which is workable, solution oriented, safe for food and environment
- Process is important for developer and regulators
- Very few consumer are interested to know the process of making a product
- Most of the consumer in case of food ,interested in safety, quality, nutrition and taste

ISSUE IS WHERE IS THE CONFLICT


Concern about GM foods has gradually declined over time
50
45
40
35
30
25
20
15
10
5
0
43
40
35
40
32
33
28
28
26
19
22
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
% selecting GM as a food issue of concern from a given list
Source: FSA Public Attitudes Tracker


GM food is less of a concern in the UK than other food issues
Food prices 61
Amount of salt in food 50
Food waste 44
Amount of fat in food 44
Amount of saturated fat in food 41
Amount of sugar in food 41
Animal welfare 40
Food hygiene when eating out 37
Food poisoning such as salmonella 30
Use of additives 28
Date labels 27
Use of pesticides 26
Foods aimed at children 26
Food miles 24
GM foods 22
Food hygiene at home 20
Feed given to livestock 20
Hormones/steroids/antibiotics in food 20
BSE 18

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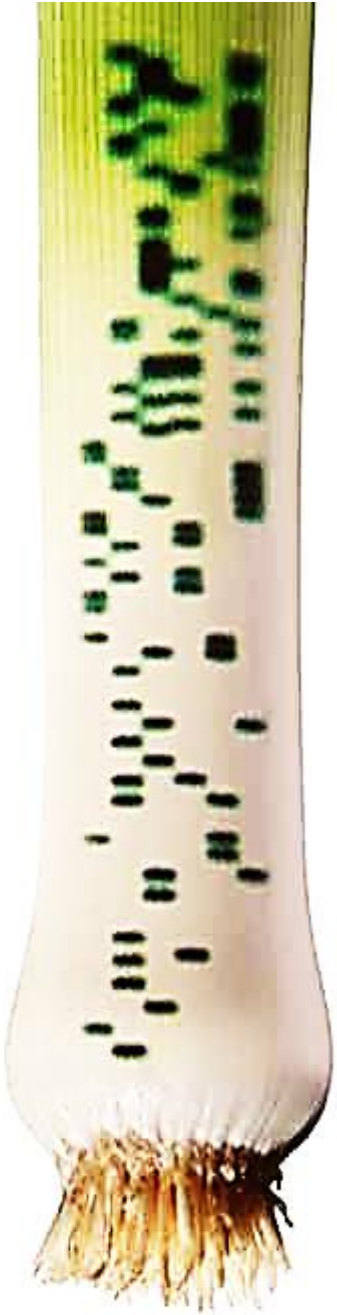
FILLING BELLY V/S NUTRITIOUS FOOD



EGGPLANT

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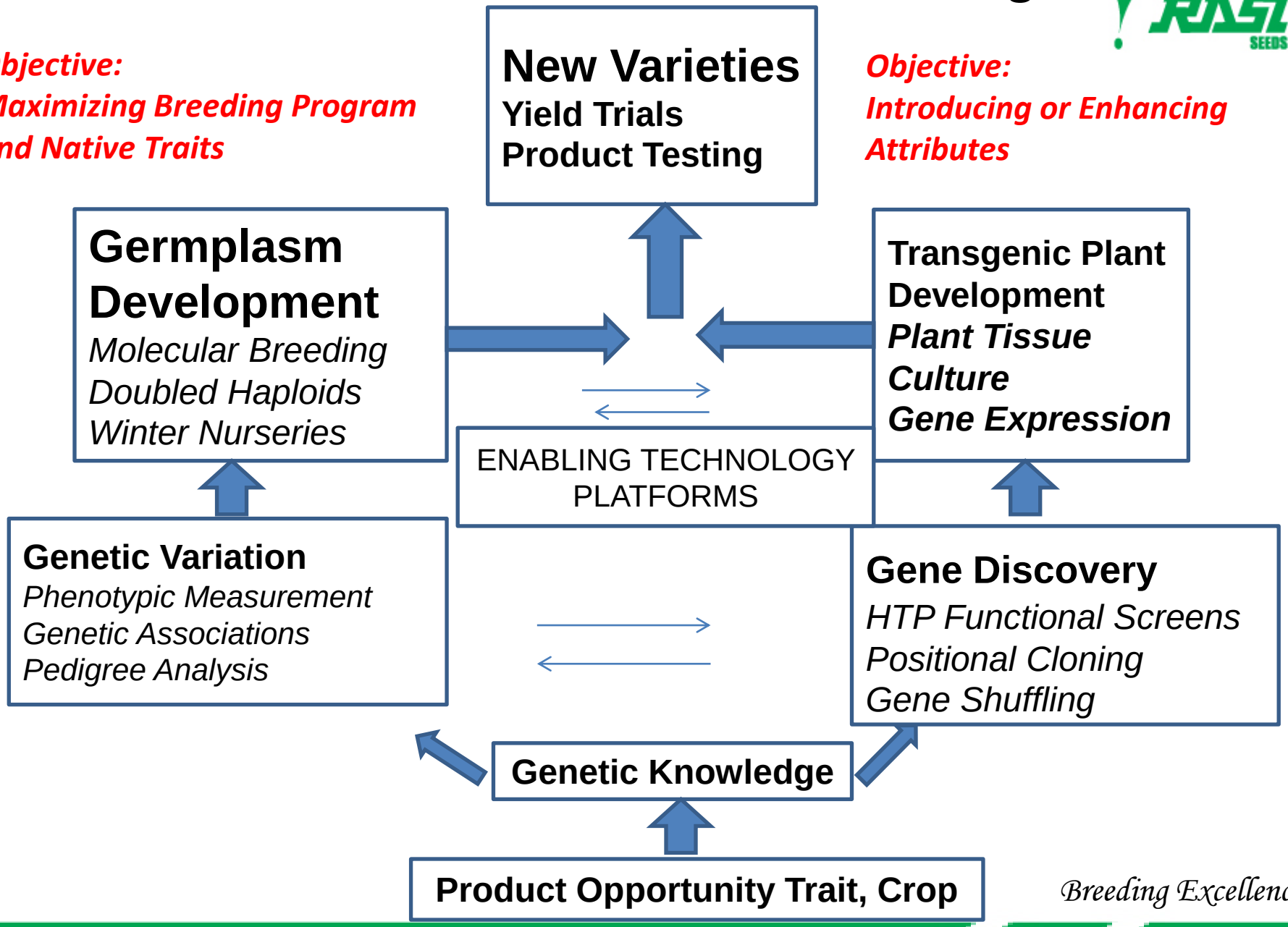
CABBAGE AND CAULIFLOWER DBM

TOMATO- VIRUSES


A New
Approach
to Molecular
Plant
Breeding

The Tools of Modern Plant Breeding



NEXT GENERATION AGRIBUSINESS

- Conventional plant breeding will be fully integrated with technology innovations
- Genomic maps will be available for most of the crops
- Functional genomics will be better explained thru high through put technologies like allele mining and phenomics
- Patent regimes will further encourage the investments
- Technologies innovations will further improve the precision
- Breeding by design will change the whole process of developing new and performing hybrids
- Product development life cycle will be shortened

CONCLUSIONS

FOOD CRISES AND HIGH PRICES WILL GENERATE

INNOVATIONS

Malthusian Theory **say "All human and climate factor will bring dooms day for human species**

Promathesean Theory **says " Whenever there is crises, human ingenuity will bring innovation and these factors are well taken care off**

Future is bright

if

Public Policy, Science and public understanding are addressed and linked

According to recognised Aerotechnical Tests,
the Bumble Bee cannot fly because of the shape and weight
of its body in relation to its total wing area.
The Bumble Bee doesn't know this, so it goes ahead
and flies anyway.