Session 5
Approaches to Improve Food and Nutritional Security – Part 1
Chair: Prof Julian Wiseman

GLOBAL FOOD SECURITY FORUM

'Meeting Nutritional Needs'

7 - 8 July, 2014

Putrajaya Marriott Hotel, Malaysia

CONTENTS

Foods for healthy futures

Robert Gibson

THE UNIVERSITY OF ADELAIDE AUSTRALIA

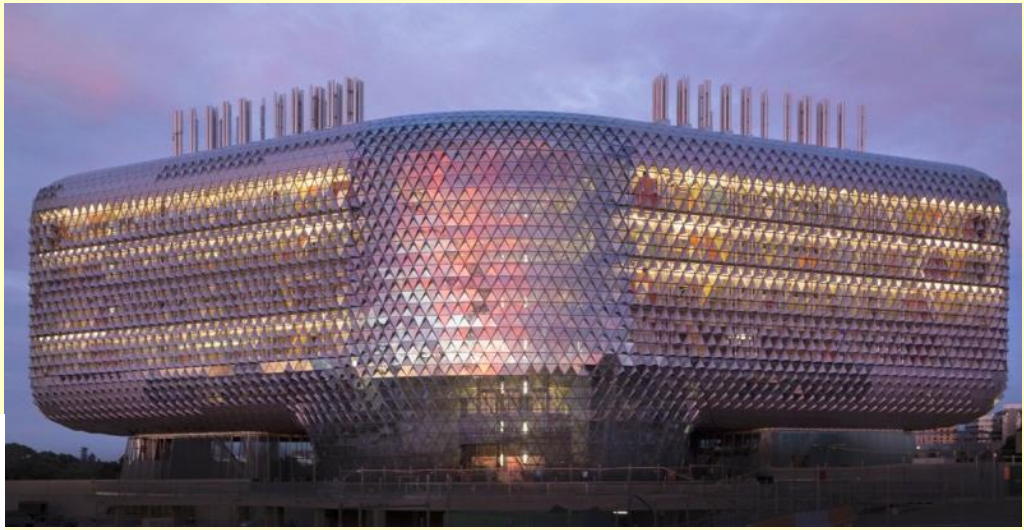
FOOD*PLUS*

THE UNIVERSITY OF ADELAIDE AUSTRALIA

A Joint Venture between the University of Adelaide and the Women's and Children's Health Research Institute

A partner in SAHMRI

Women's and Children's Health Research Institute

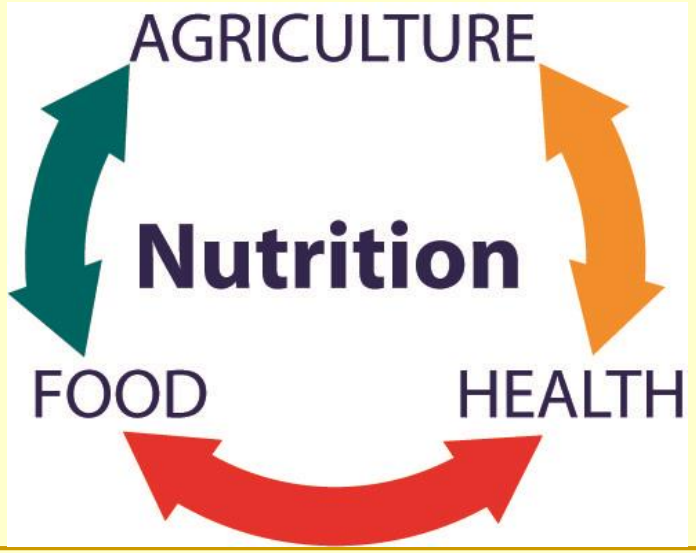


SAHMRI South Australian Health & Medical Research Institute

Partnerships in New Zealand and Singapore

What is FOODplus?

- Acts as a bridge between agriculture and health through improving the nutrient content of foods
- Primary focus on nutrition in the perinatal period
- Nutrients of interest: Iron, Iodine, Omega 3 LCPUFA



Basic Nutrition

Lipid Biochemistry

Grains and Health

Healthy Meats

Fuels from Food Waste

Food Chain Economics

Waite Analytical Services

Applied/clinical nutrition

Growth and Obesity

Food Allergy

Nutrition and Inflamatory Diseases

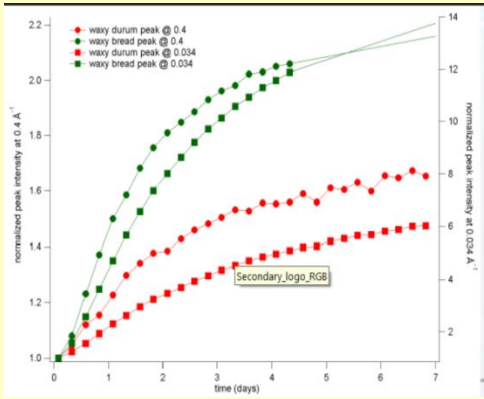
Nutrient Gene Interaction

Pregnancy Nutrition

Early Life Nutrition

Healthier baked goods

- Scientist: Colin Jenner
- Waxy durum wheat
  - 20% in regular flour can make good pastry with 50% of the usual fat
  - Extends shelf life of bread
- High amylose wheat
  - Around 60% amylose (low GI)
  - makes excellent breakfast cereal (weetbix type)



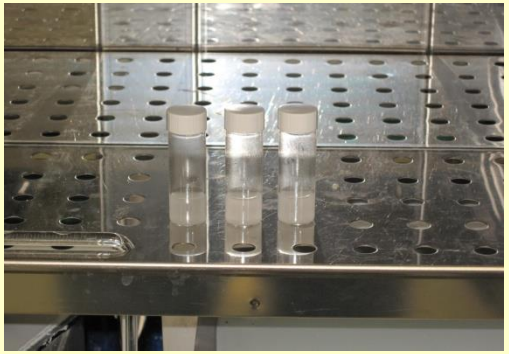
Healthier noodles

- Scientist: Darryl Mares
- High Lutein wheat:
  - Double yellow colour of other noodle wheats (42 vs 24)
  - Asian noodles without colour additives
  - Improved nutritional value (15ug/g lutein)

Omega 3 fats in the diet

New dried blood spot test

Blood allowed to dry



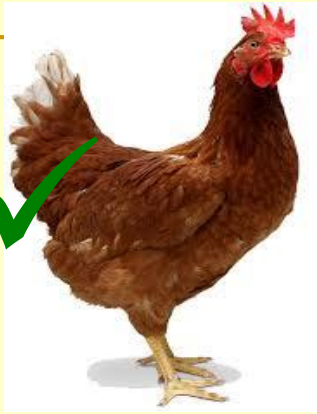
Trans-esterified to FAME

1-2 drops of blood (25-50 µl) onto chromatography paper

Total time less than traditional –
No, extraction, TLC separation;
Perhaps can be speeded up through shorter methylation times, and GC running times

LCPUFA stable for at least 2 months at room temperature

THE PATHWAY



18:2n-6 (LA)
18:3n-6 (ALA)

Δ6 Desaturase

18:3n-6
18:4n-3

24:4n-6
24:5n-3

Elongase

24:5n-6
24:6n-3

√

Elongase

22:5n-6 (DPAn-6)
22:6n-3 (DHA)

20:3n-6
20:4n-3

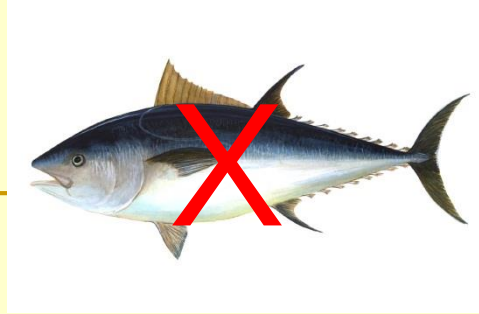
Beta oxidation

22:4n-6
22:5n-3 (DPAn-3)

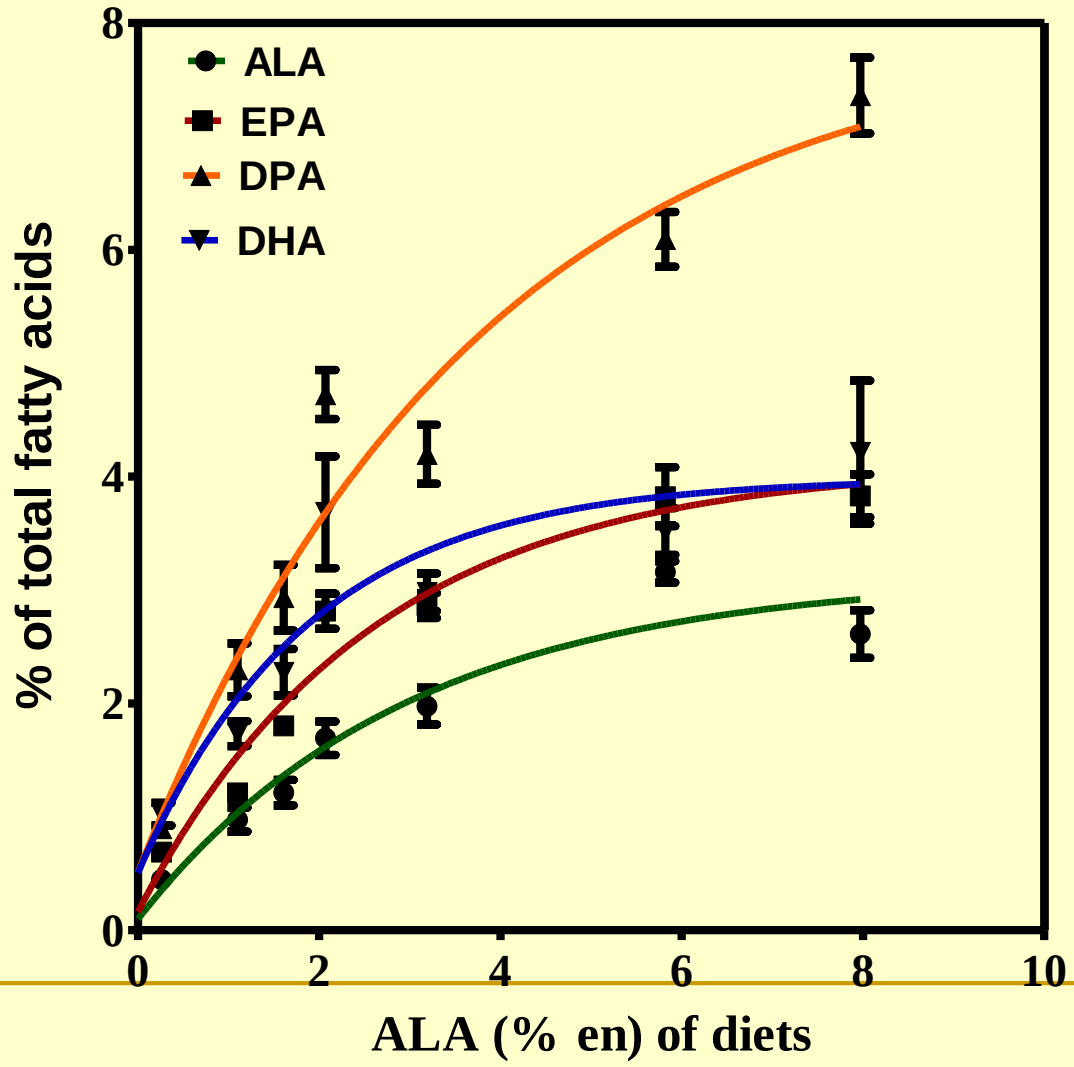
Δ5 Desaturase

Elongase

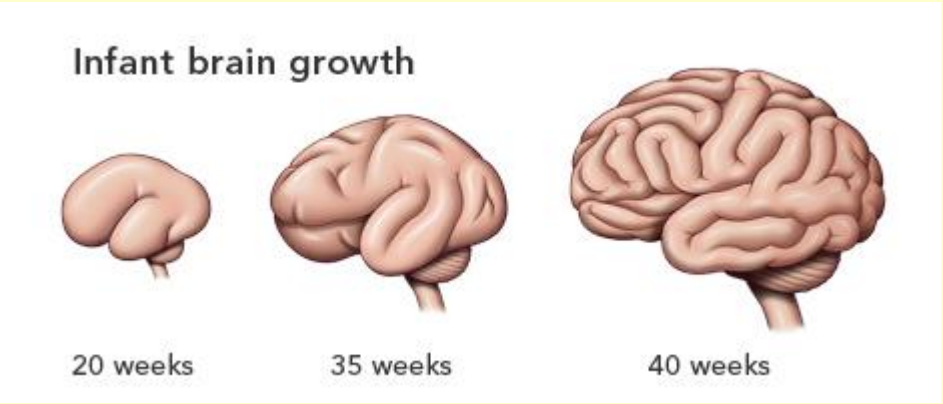
20:4n-6 (AA)
20:5n-3 (EPA)



Increasing Omega 3 levels in chiken meat - sustainably



DHA in the Brain in early life



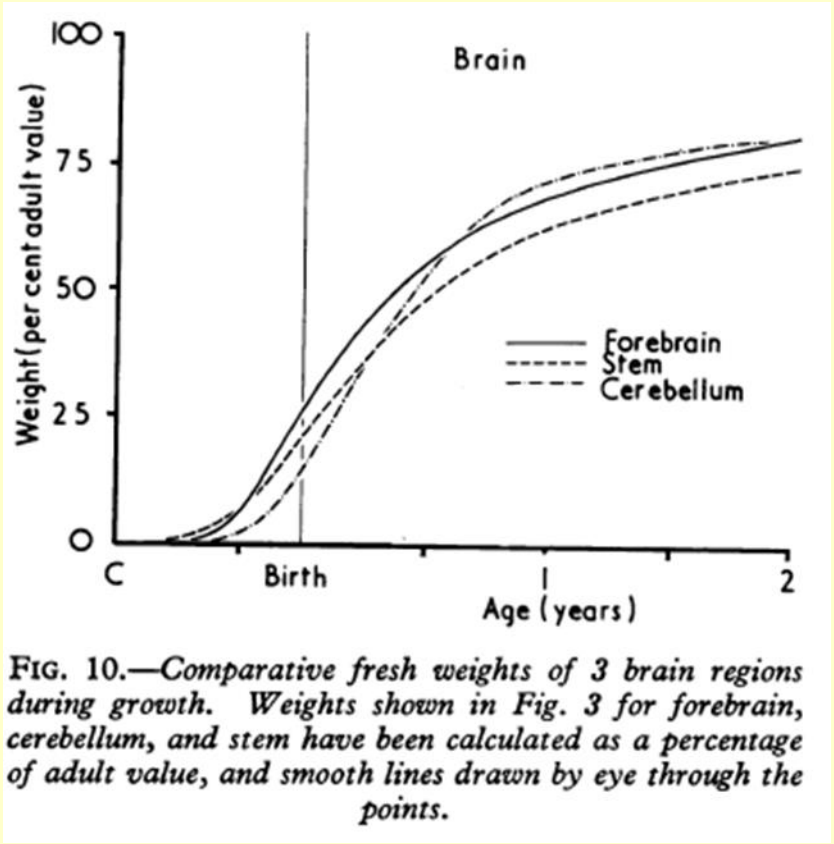


FIG. 10.—*Comparative fresh weights of 3 brain regions during growth. Weights shown in Fig. 3 for forebrain, cerebellum, and stem have been calculated as a percentage of adult value, and smooth lines drawn by eye through the points.*

Dobbing & Sands, 1973

Omega 3 DHA in pregnancy

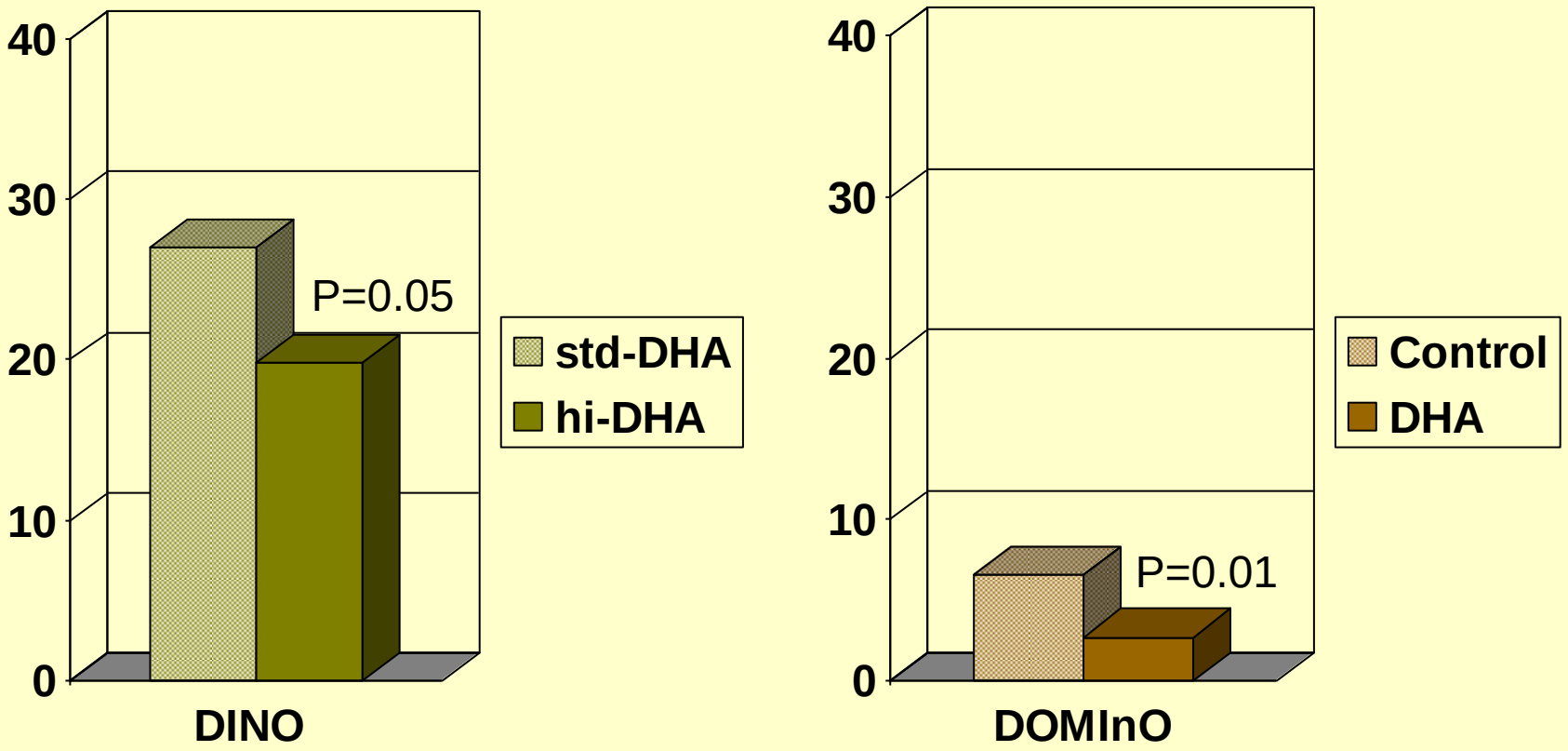
Last trimester of pregnancy is the period of most rapid DHA accumulation into the brain and nervous system

Can omega 3 fats improve cognition/metal development of term infants?

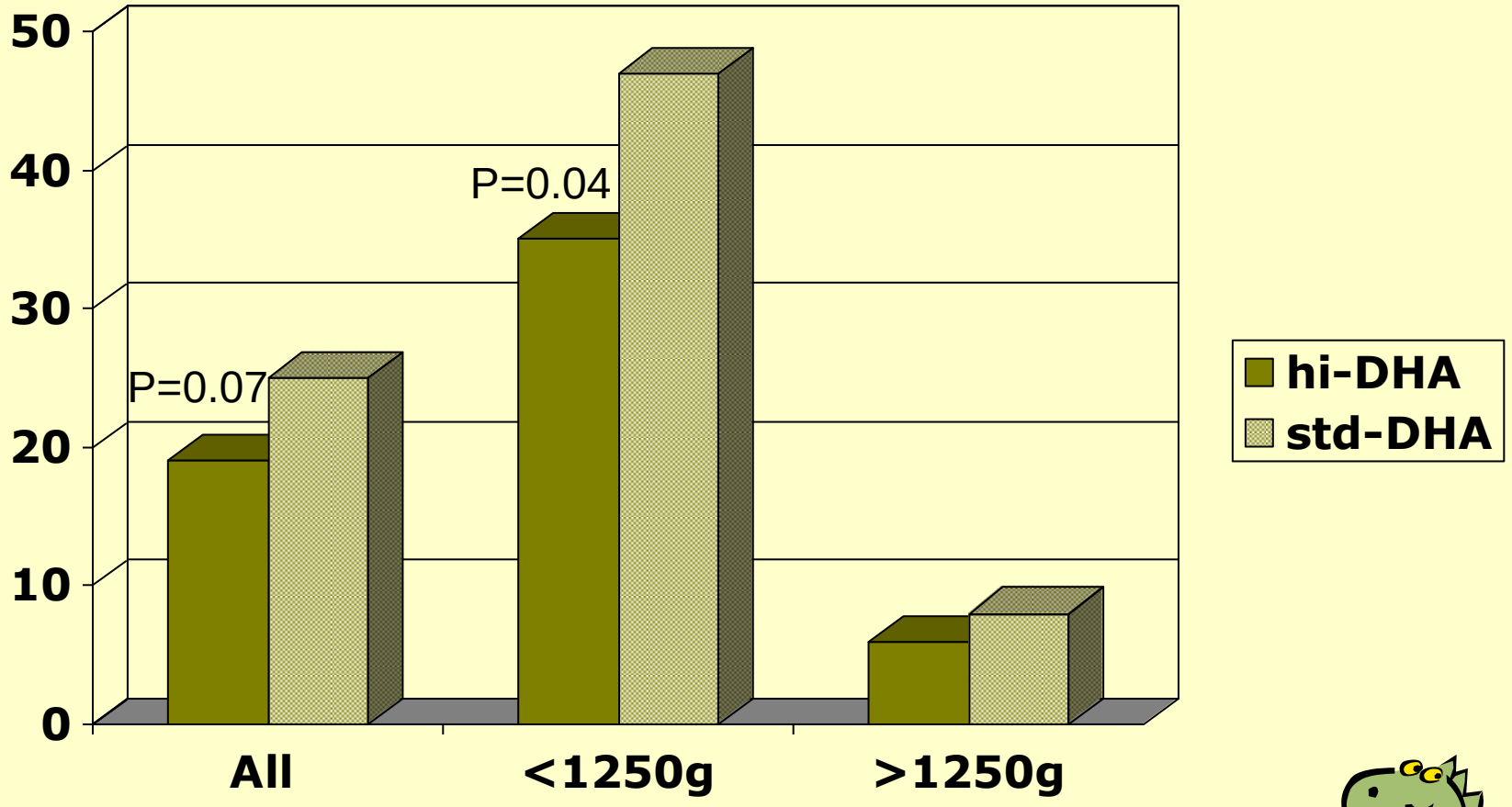
Preterm Infants

- Missing maternal nutrients in the last trimester – born too early
- Calculations suggest that preterm infants need more DHA than in Western breast milk and formula
- Tested increasing the level DHA in breast milk and formula

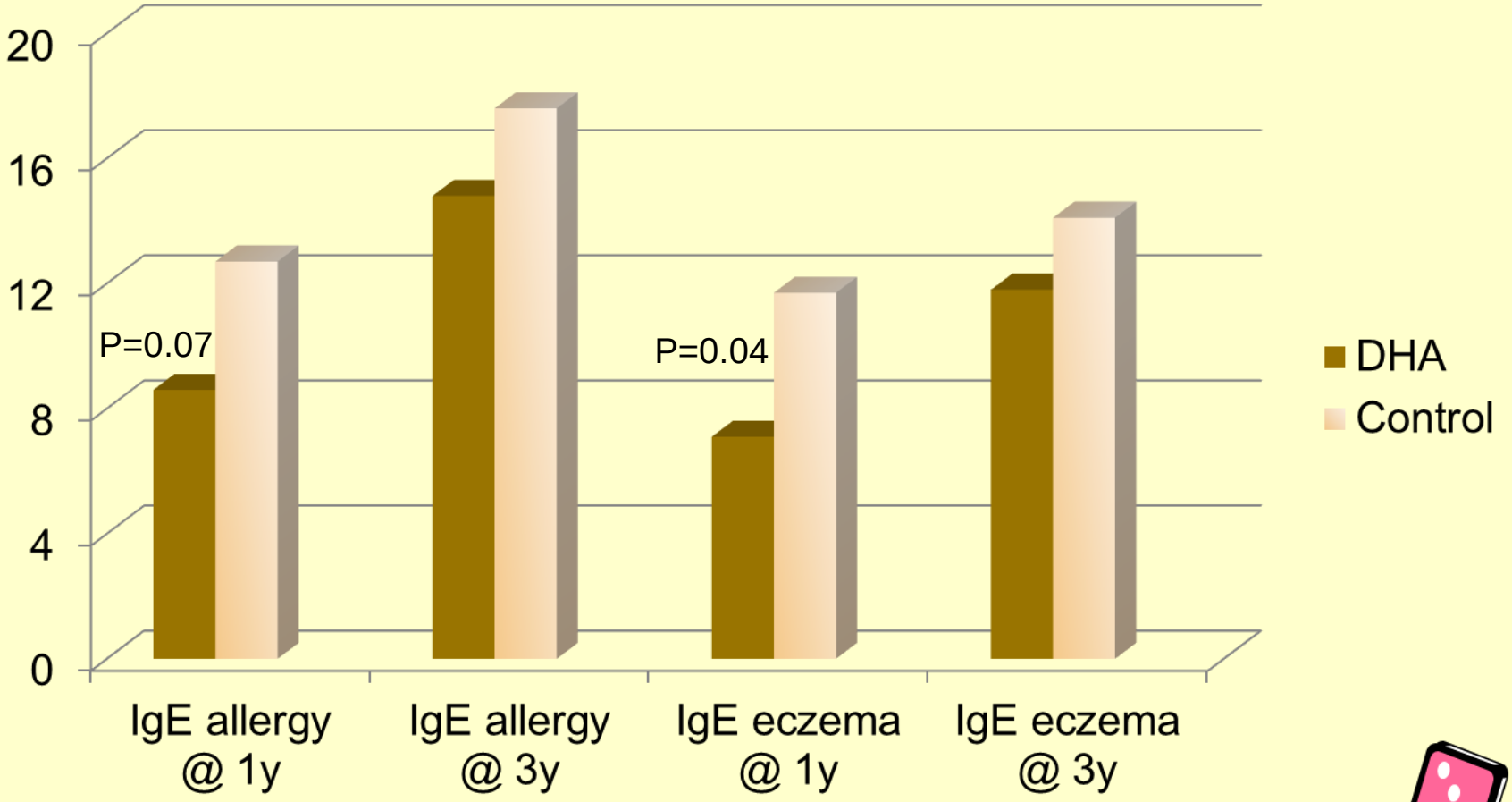
Percentage with DQ < 85 (mild cognitive delay)



Percentage of infants requiring oxygen at 36 weeks



% of children with IgE mediated allergies (n=706 with high hereditary risk)



Palmer et al, BMJ 2012;344:e184
Palmer et al, Allergy 2013;68:1370-6

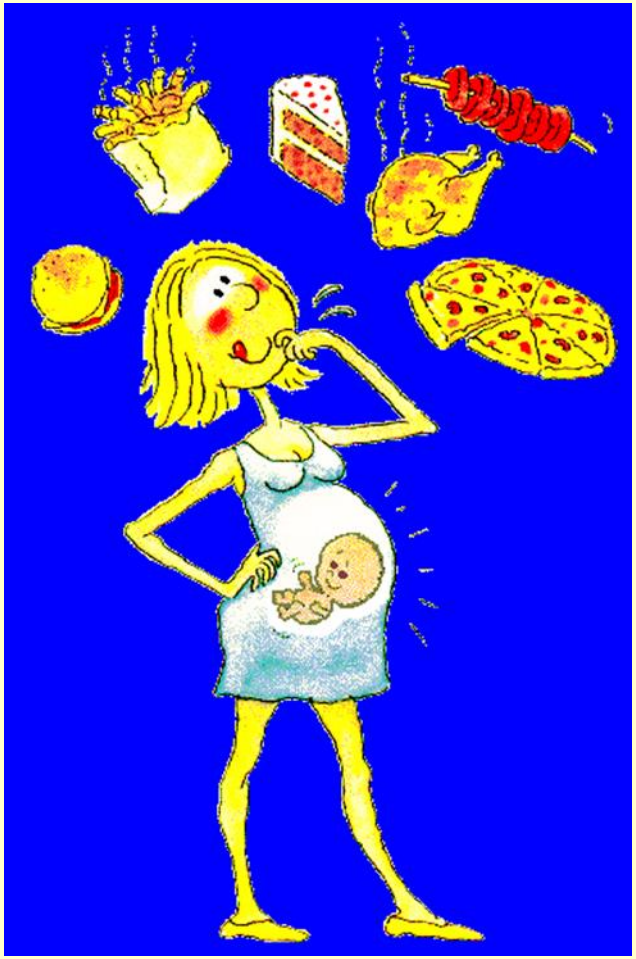
Updated Systematic Review of effect of DHA on gestation

Variable	Cochrane review 2006	Updated Cochrane review (unpublished)
Mean Difference in Gestation Length (d)	**2.5 (95% CI 1.0 to 4.1) 1621 women, 3 trials**	**2.0 (95% CI 1.1 to 3.0) 4289 women, 5 trials**
Relative Risk of Preterm Birth (<37 w)	0.92 (95% CI 0.79 to 1.07) 1916 women, 5 trials	0.92 (95% CI 0.80 to 1.04) 5586 women, 8 trials
Relative Risk of Early Preterm Birth (< 34 w)	**0.69 (95% CI 0.49 to 0.99) 860 women, 2 trials**	**0.60 (95% CI 0.44 to 0.81) 3560 women, 4 trials**

No effect in Mexico study (400mg DHA)

Pregnancy: What are good infant outcomes?

- Term birth
- Baby is not too small and not too big
- Mother remains free of postnatal depression
- Baby develops well
- Baby has a robust immune system (few infections and few allergies)



The CNRC/FoodPlus Team

Women's & Children's Health Research Institute Inc

FOOD*plus* Research Centre

Research excellence linking sustainable agriculture, food and nutrition to improve human health.

www.adelaide.edu.au/foodplus

Life Impact | The University of Adelaide

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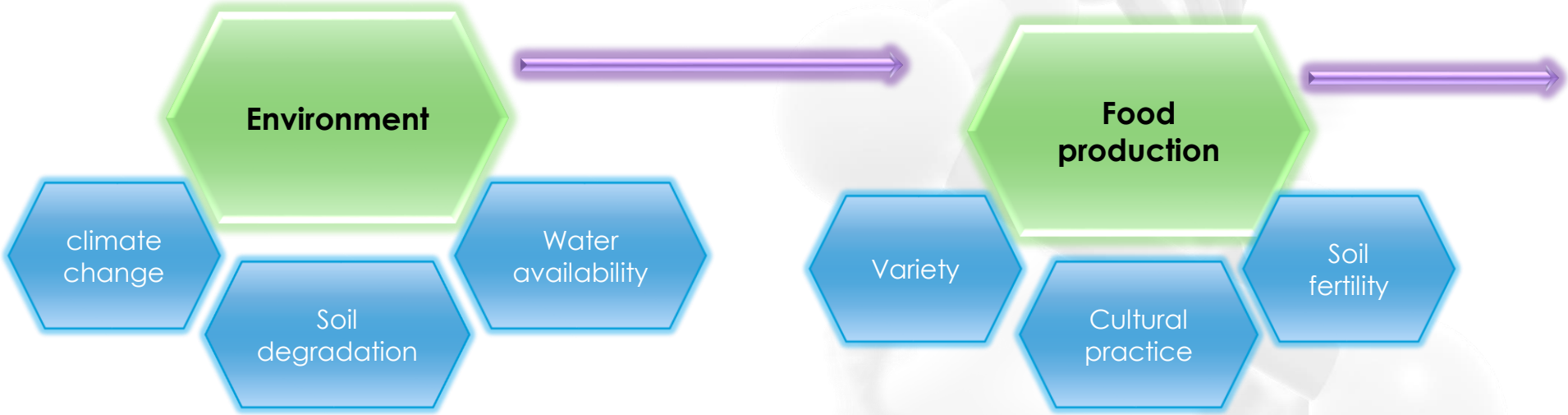
Nutrigenomics: An approach to achieve food and nutritional security

Indu Bala Jaganath (PhD)
MARDI

GLOBAL FOOD SECURITY FORUM 2014: MEETING GLOBAL NUTRITION NEEDS.
6-8 july 2014

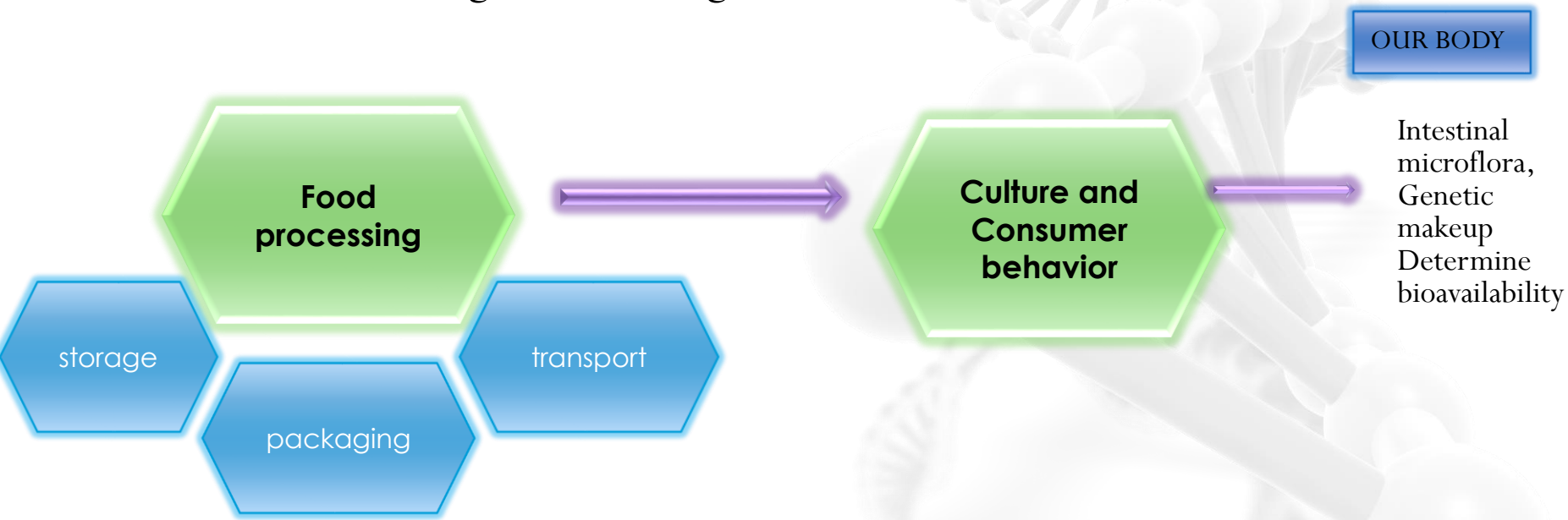
Nutritional Security

Nutritional security: Along the whole agricultural value chain



Nutritional Security

Along the whole agricultural value chain

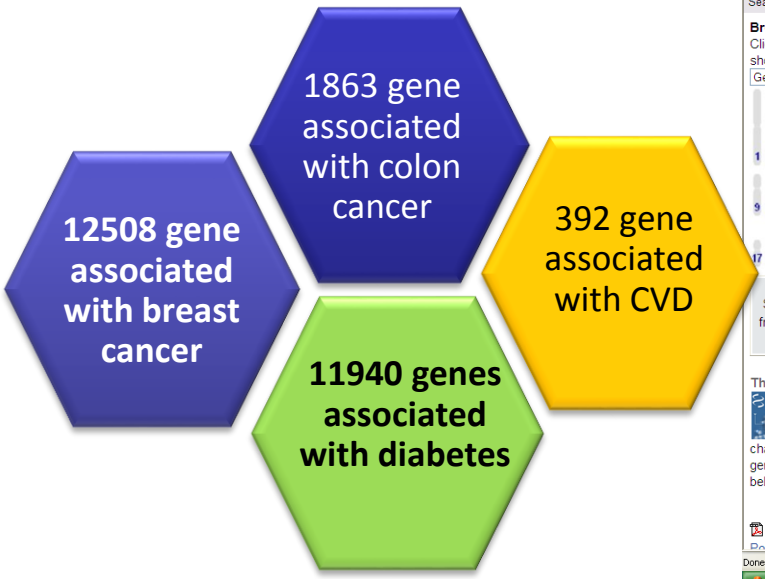


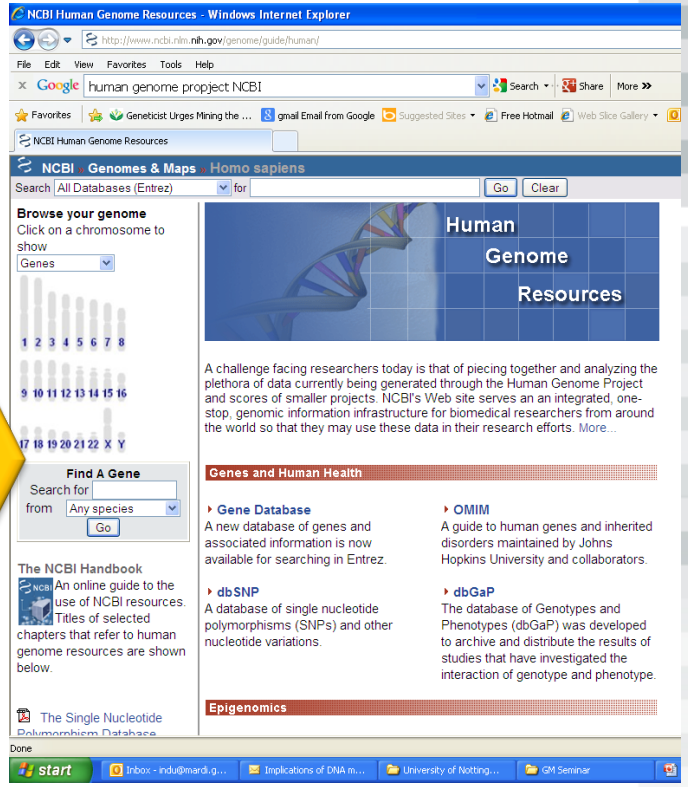
Age of Bioscience

Driven by vast informatics, new tools and technologies

Human genome sequenced in 2003
20,500 genes in human beings(3.3 billion base pairs)

Genes annotated for diseases





Database mining : Data used to expedite biological knowledge discovery

NUTRIGENOMICS – interaction of genes with the diet

Study of how dietary compounds in foods have the ability to turn on and off certain genes that are responsible for the prevention or onset of diseases

TECHNOOGY BEHIND NUTRIGENOMICS

Plant extracts / Food

- Hundreds of nutrients – that act synergistically
- Multiple targets
- Affects multiple cellular pathway
- Multiple gene expression

→ Challenge of understanding polygenic diet-related diseases.

→ Address at genome-scale i.e it is more holistic

EVOLVING TRENDS OF NUTRITIONAL SCIENCE

Evolution of nutritional research

Nourishing

Traditionally, nutrition research has dealt with providing nutrients to **nourish** populations

Safe and healthy food

Nutrition : reduce risk of diseases or allergic reaction i.e we are going for **Healthy & Safe Food**

-anti-oxidant properties

- reductionist approach

Epidemiology studies

Era of bioscience

Interaction of nutrients with genes.

Holoistic view- synergistic effects of nutrients acting at multiple cellular targets (mode of action)

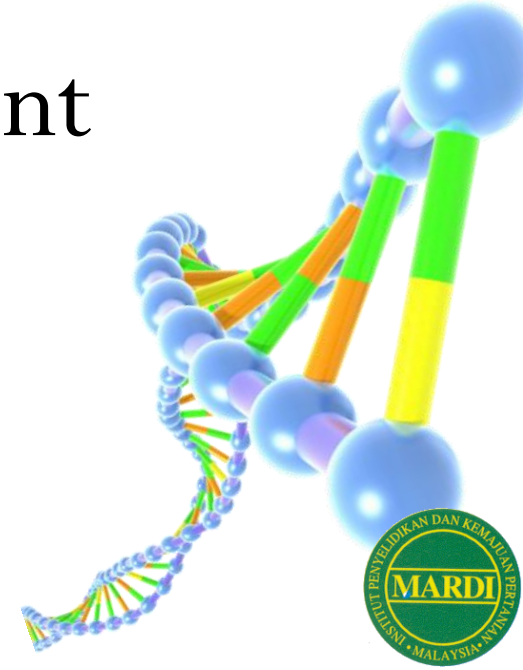
Generation of efficacious and novel formulations

Quantum Leap

Personalized nutrition (depending on the genetic make up of the individual

NUTRIGENOMICS @ Biotechnology Research Centre,

Malaysian Agricultural Research and Development Institute



Nutrigenomics –multi-disciplinary

Metabolomics

Toxicology

Transcriptomics & Proteomics

Bioassay

Nano-formulation and delivery

Bioinformatics & Chemoinformatics

Pre-clinical studies

Product development

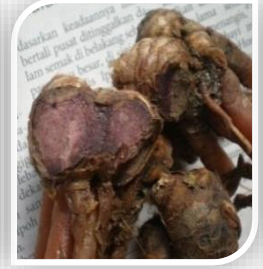
Core area

Efficient production

Supporting area

Centella

Bacopa



Black ginger

Curcuma

Phyllanthus

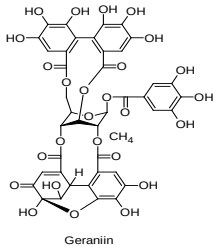
Gynura

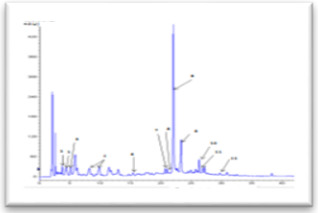
Pitaya

METABOLOMICS APPROACH

HPLC, FLASH CHROMATOGRAPHY, GCMS AND LCMS-MS

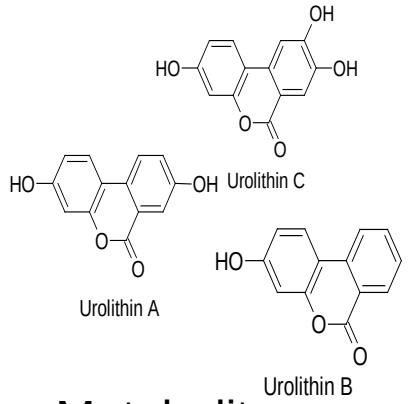
Chemical fingerprint and markers – for standardization (> 4)





IN-VIVO STUDIES – ANIMAL MODEL

Effect on genes related to diseases



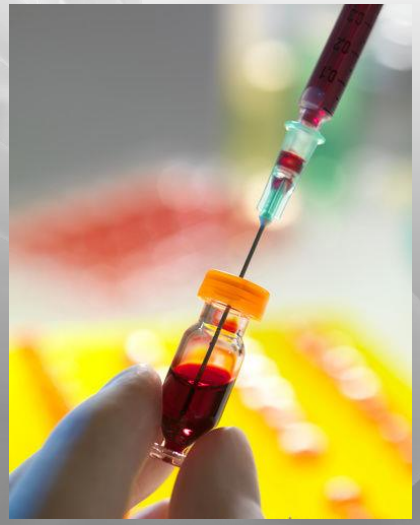
Metabolites

Formulation1

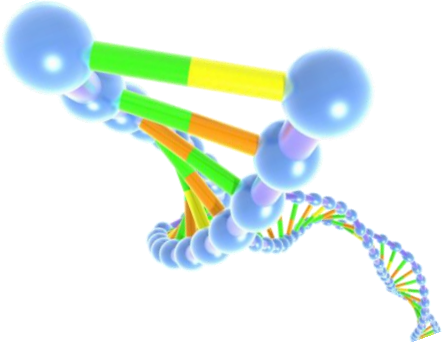
Formulation 3

Formulation 2

Fed with different formulation



Tissue / blood



B. Transcriptomics

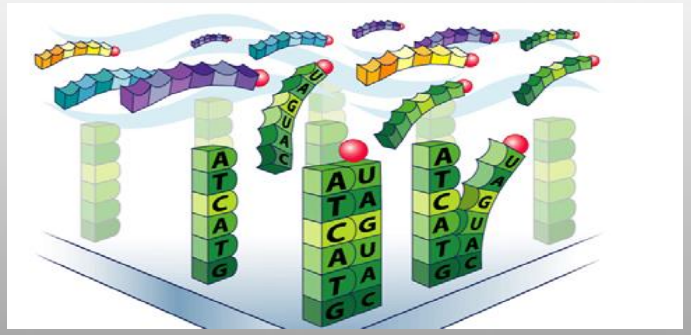
Effect of dietary components on gene expression

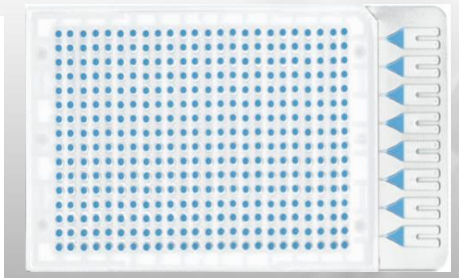
Transcriptomics

RNA

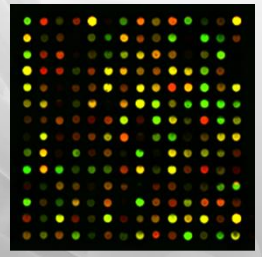
cDNA

Hybridization





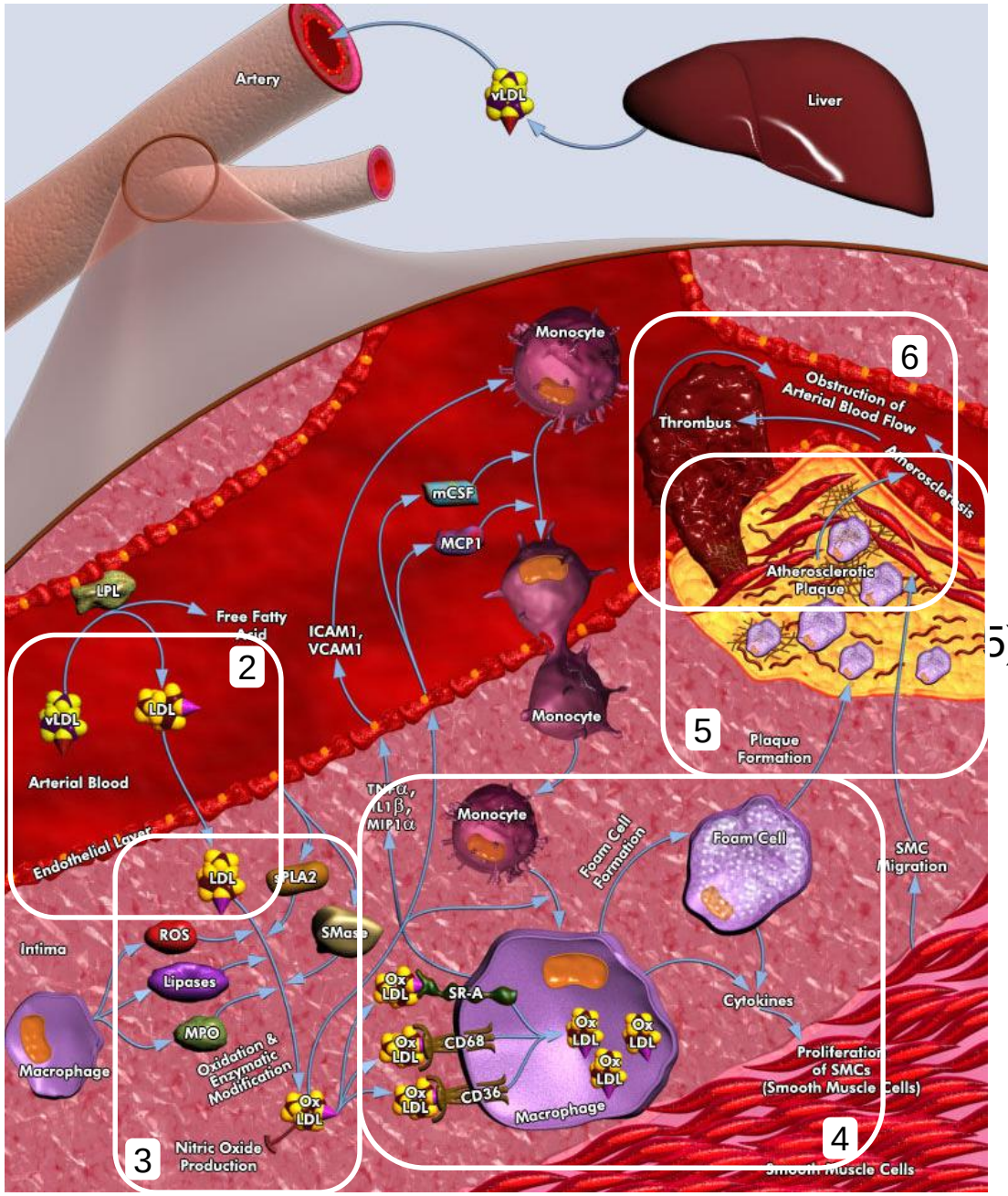
PCRarray gene expression



Microarray gene expression

Data analysis

Progression of atherosclerosis



1) Lipid metabolism

6) Thrombosis

5) Fibrous plaque

2) Lesion initiation

3) Inflammation and adhesion

4) Foam cells formation

Plant cell culture system for production of bioactives

Gynura sp.-root culture

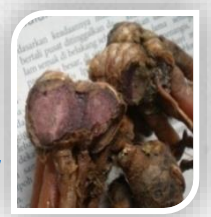
Pitaya - callus

Kaempferia sp regeneration

Curcuma sp- plant stem cells

Vertical farming – home gardens

Anti-obesity
& anti-inflammatory



Anti-diabetic

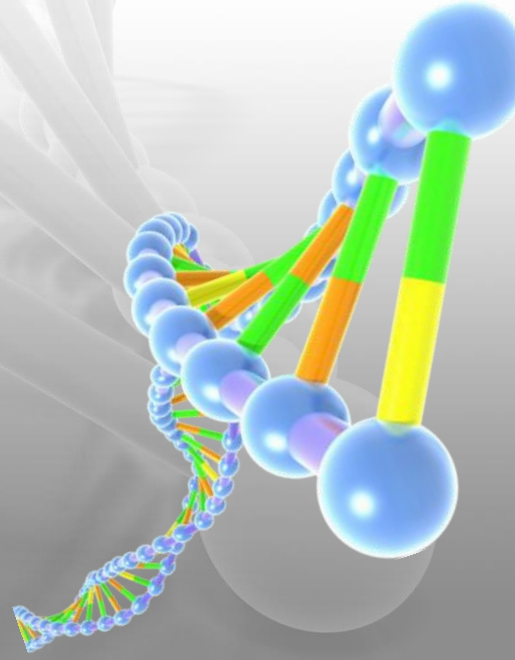
Cognitive

Cognitive

Standardized
ingredients

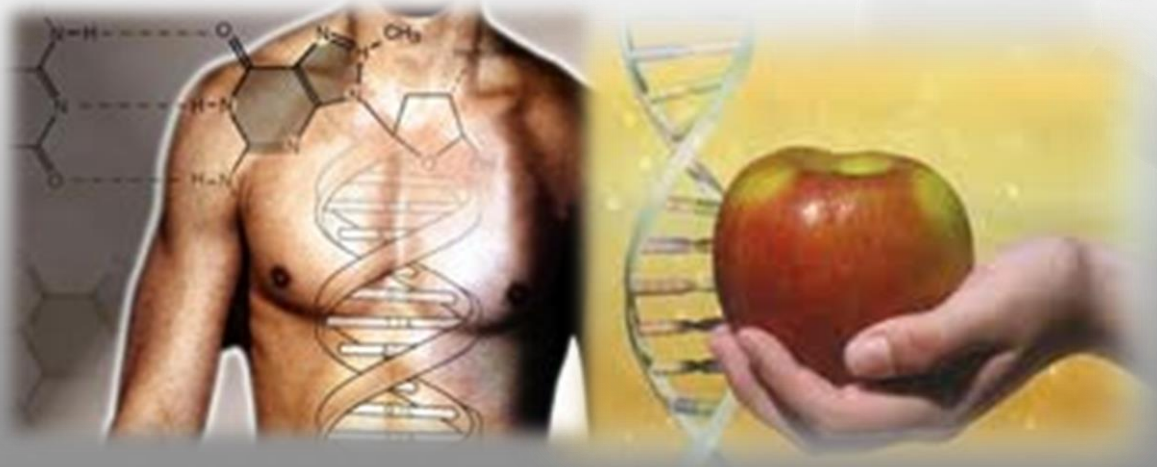
Micronutrients/
beneficial
microbes

FROM NUTRIGENOMICS TO PERSONALISED NUTRITION



Nutrigenomics –the way forward

The ultimate goal of nutrigenomics is the development of foods that can be matched to individual human genotypes in order to benefit the health of those individuals



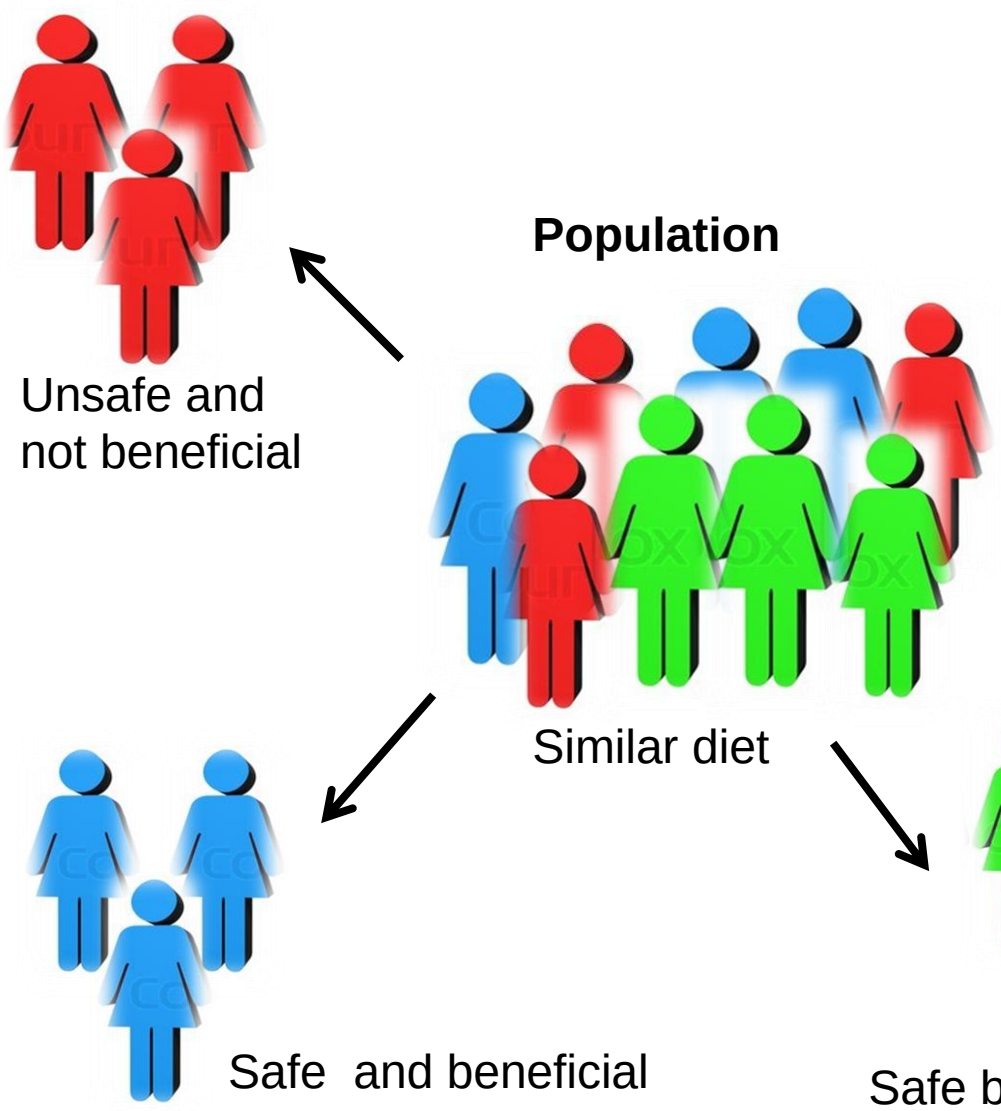
DIVERSITY

It is all because of our DNA

- *Unique in each of us*
- *reflecting our heritage*

- Differences in single nucleotides polymorphism (SNPs)
- Epigenetics : not in the genetic level but at the biochemical level – i.e at the post translation modifications of DNA-binding proteins (e.g., histones and chromatin) and of DNA itself (methylation)

Example : *lactose intolerance - inadequate production of the enzyme lactase in the small intestine due to genetic variation in the lactase gene*



One-size-fits-all diets could be a thing of the past.

Nutrigenomics = customized diet

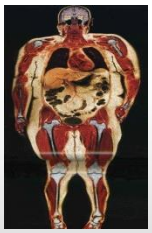
You can do something about your diet but cannot pick your parents

DIET

OR

Can alter the epigenetic state of the genome

Deprogramming or reprogramming of large number of genes

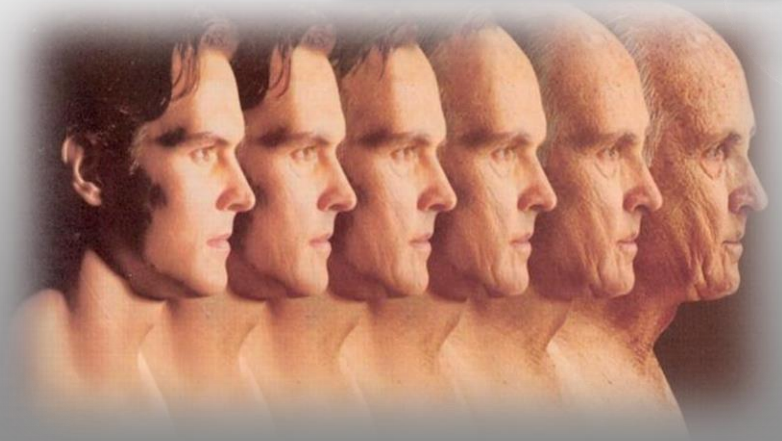


Deprogram : late stage of type 2 diabetes, CVD, neurodegenerative disease and cancer

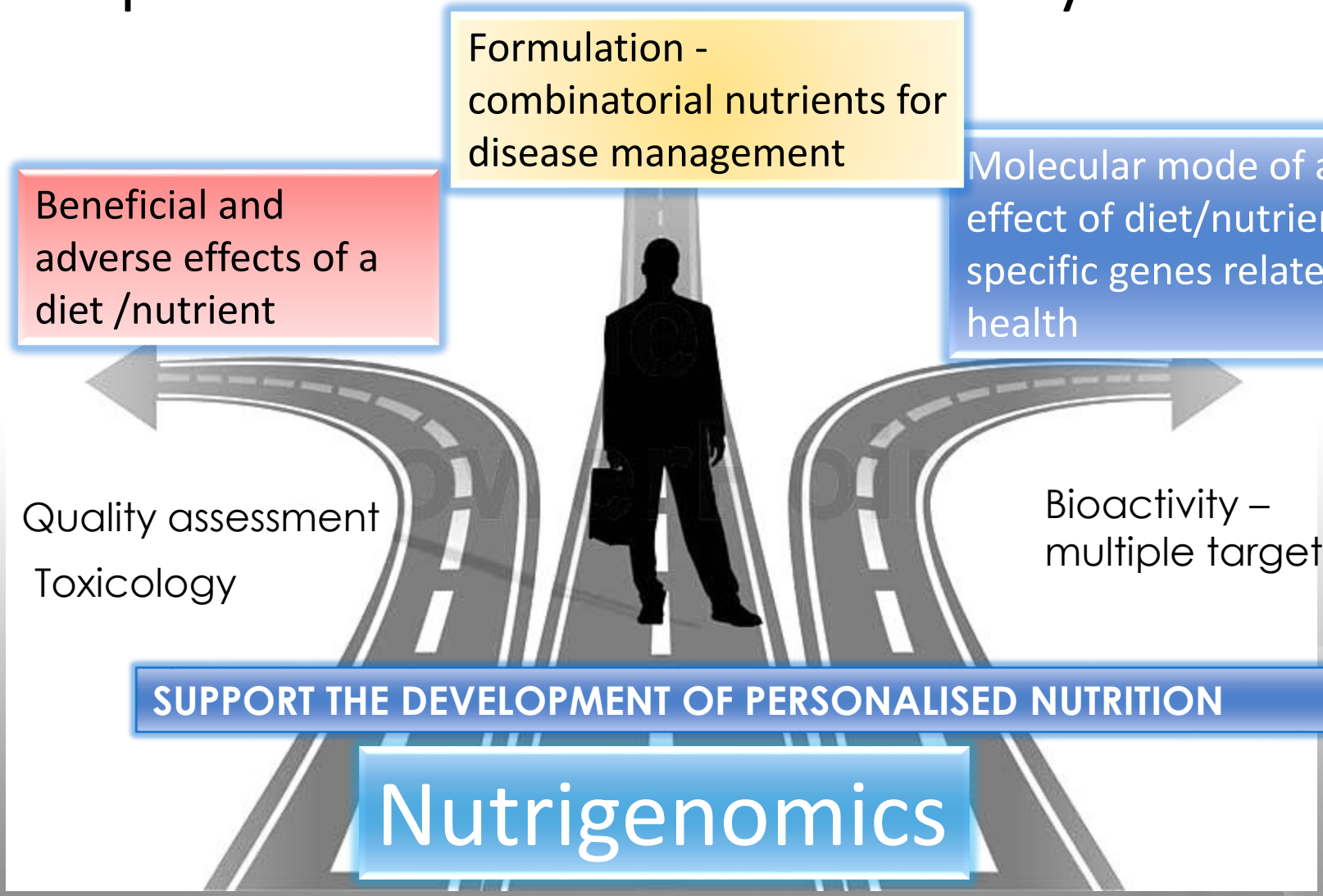
Reprogram : promote and prevent disease

GOOD NUTRITION IS THE CORNERSTONE OF HEALTH AND DISEASE PREVENTATION

Goal: Tailor your diet to slow down aging process, prevent or slow down cardiovascular disease and neurodegenerative disease = safe food



Conclusion : Nutrigenomics –assist in playing an important role in nutritional security



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Lina Rozano
Bioinfomatics

Mohd Waznul Adly
Transcriptomics

Thank you

Sago as an Approach to Food and Nutritional Security

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Japan

Background

Rice, wheat and maize (corn) are the three major crops and the annual total production is ca. 2.26 billion ton (FAOSTAT, 2012) and they are used as staple food for the human beings. In some tropical countries, root and tuber crops, such as cassava, yam, taro and sweet potato are also used for the staple food.

The cereal and root and tuber crops play very important role as the energy supplier for the peoples.

Need to increase the production of staple food crops

- **Anticipated population increase・・・7.2 at present to 9 billion in 2050**
- **Decrease the hunger people・・・842 million people in 2013**
- **Increase the consumption of meat・・・as feeding materials for livestock**
- **Increase of bio-fuel production・・・as producing materials for bio-ethanol**

- **Stable increase of the production of major staple food crops, such as rice, wheat, maize, root and tuber crops**
- **Development of underutilized miscellaneous crops**
  ・・・Starch accumulating palms in the Tropics

Global climate change・・・Global warming, drought, flooding, etc.

Starch accumulating palms

Palms; 2600 species, 200 genera
Palms which accumulate starch in their stems (trunks)

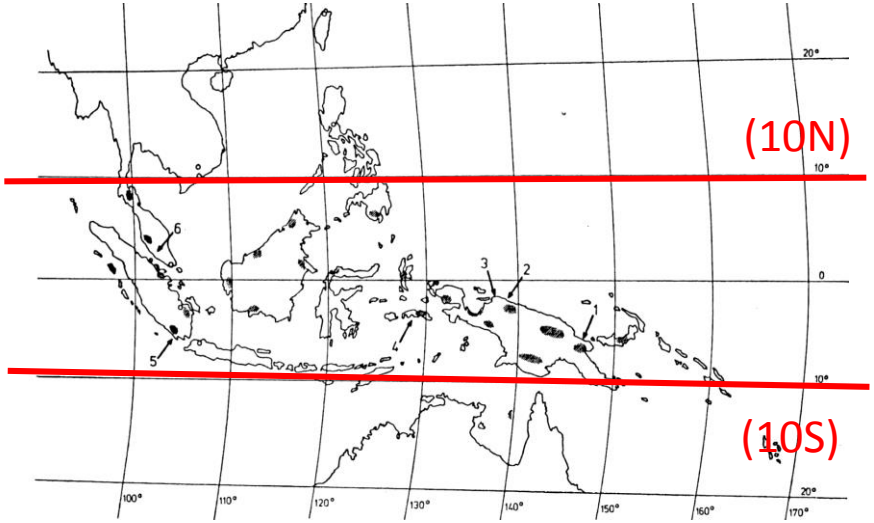
Genus		
	Arenga	*Guilielma*
	**Arecastrum*	**Mauritia*
	Borassus	*Metroxylon*
	Caryota	*Oreodoxa*
	Corypha	*Phoenix*
	Eugeissona	**Roystonea*

* Distributed in New Continent (South America)

Among these genera, starch production is highest in *Metroxylon* .

At harvesting stage:
Total length : 15～25m
Trunk length : 5～15m
Trunk diameter : 30～60cm
Trunk weight : 500～3000kg
Starch percentage : 60～70%

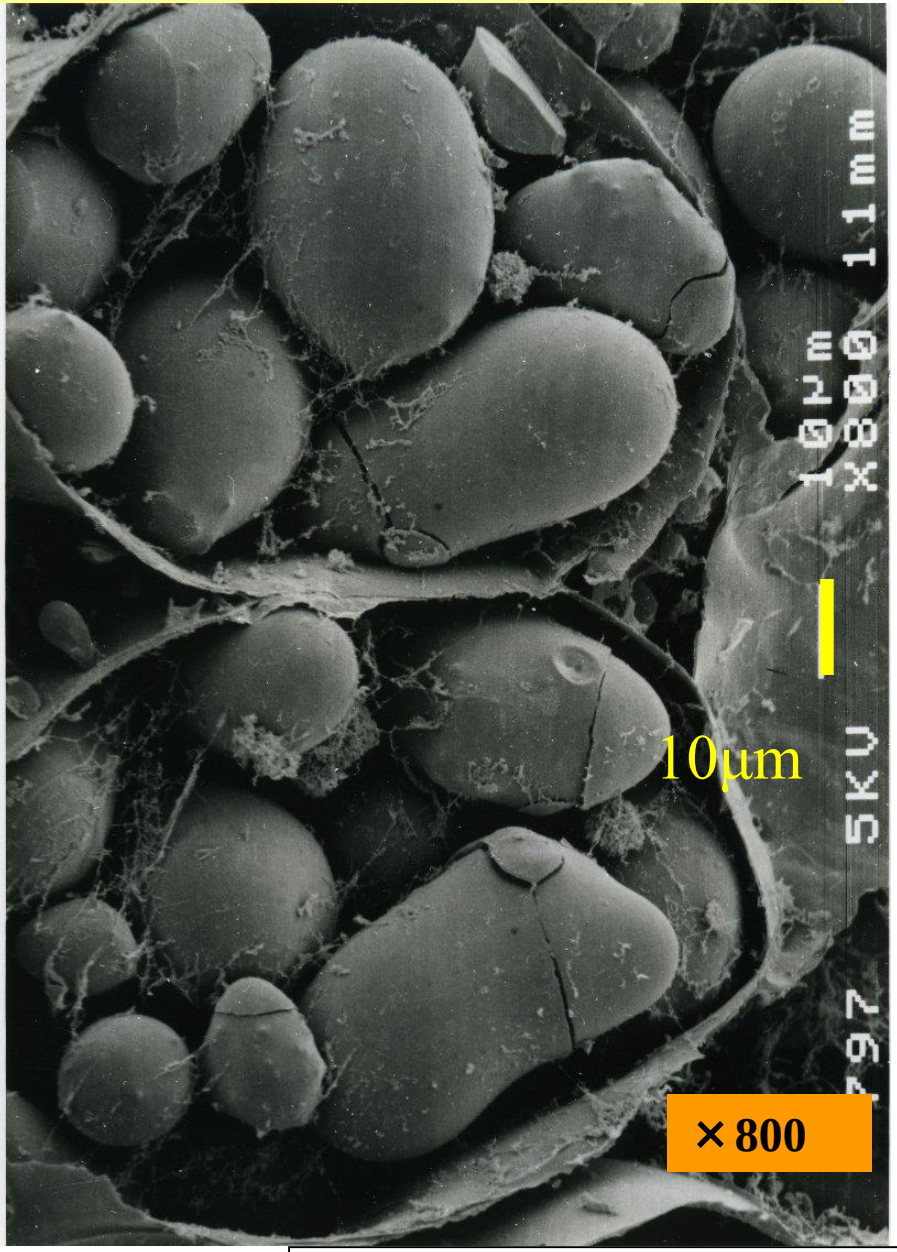
Introduction of sago palm



Sago palm (*Metroxylon sagu* Rottb.) is indigenous to the lowlands of Southeast Asia and Melanesia, located between latitude 10° N and 10° S, up to an altitude of 700 m (Flach 1986).

Sago palm accumulates a lot of starch in its trunk (pith) and has been utilized as a staple food by local people for long time, and in recent years, much attention has been paid to sago palm due to the high starch productivity .

Scanning Electron Micrograph of Sago Starch Granules in Parencymatous Cells of Pith



（Courtesy of Prof. Nitta）

Estimated sago growing area

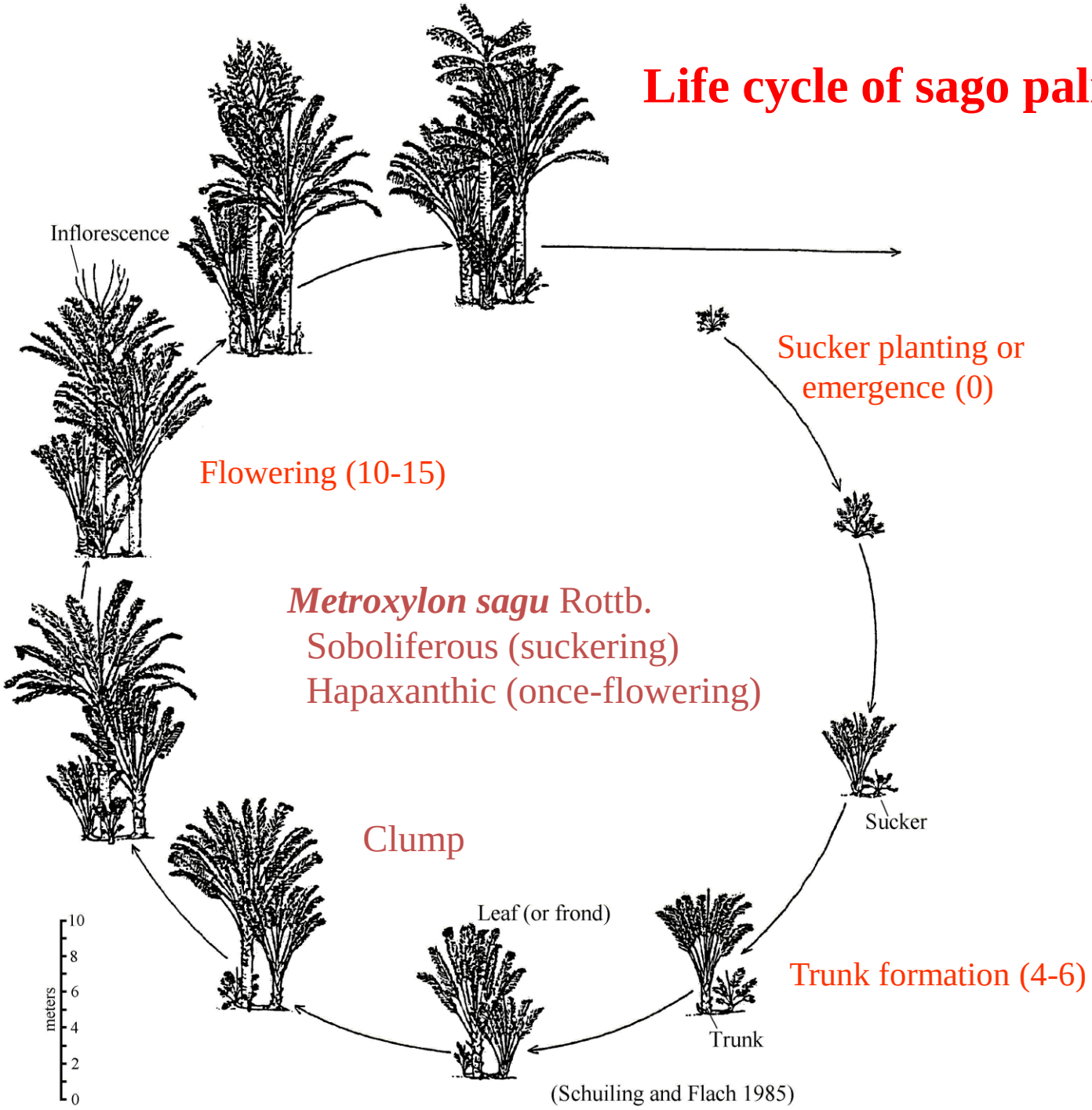
Table Rough estimate of area (ha) covered with good quality sago palm stands

	Wild stands	(Semi-) cultivated stands
Papua New Guinea, total	1,000,000	20,000
Sepik province	500,000	5,000
Gulf province	400,000	5,000
Other provinces	100,000	10,000
Indonesia, total	1,250,000	148,000
Irian Jaya, total	1,200,000	14,000
Bintuni	300,000	2,000
Lake Plain	400,000	—
Southern Irian	350,000	2,000
Other Districts	150,000	10,000
Moluccas	50,000	10,000
Sulawesi	—*	30,000
Kalimantan	—	20,000
Sumatera	—	30,000
Riau Islands	—	20,000
Mentawei Islands	—	10,000
Malaysia, total	—	45,000
Sabah	—	10,000
Sarawak	—	30,000
West Malaysia	—	5,000
Thailand	—	3,000
Philippines	—	3,000
Other countries	—	5,000
Total	2,250,000	224,000

*No wild stands.

(Flach 1977)

Life cycle of sago palm



Metroxylon sagu Rottb.
Soboliferous (suckering)
Hapaxanthic (once-flowering)

Starch productivity of sago palm

Table Comparison of starch yield of sago palm with major cereal and root and tuber crops.

Crop	World average yield[1] (t/ha)	Water content (%)	Starch (%)	Starch yield (t/ha)
Rice	4.41[2] (3.09)[3]	15.5[4]	73.8[4]	2.28
Wheat	3.11	13.0[4]	69.4[4]	2.16
Maize	4.92	14.5[4]	70.6[4]	3.47
Cassava	12.88	70.3[5]	30.0-33.3[6]	3.9-4.3
Sweet Potato	12.75	66.1[4]	15.0-30.0[7]	1.9-3.8
Potato	19.00	75.8[4]	10.0-30.0[8]	1.9-5.7

Sago palm	Starch yield (kg/palm)	No. of harvestable palms (/ha)	Starch yield (t/ha)
Case A	100	30	3.0
		50	5.0
Case B	200	30	6.0
		50	10.0
Case C	300	30	9.0
		50	15.0

1) FAOSTAT (2012). 2) Paddy yield. 3) Brown rice yield (paddy yield x 0.7). 4) Standard tables of food composition in Japan (5th edition) (.2001). 5) Yatsugi (1987). 6) Maeda (1998). 7) Sakai (1999). 8) Umemura (1984). .

Botanical and agronomical characteristics of sago palm

- **High productivity of starch**

  100～500 kg dry starch /palm, 5～15 ton dry starch /ha

- **Starch is accumulated in the pith of trunk for long duration**

  Stable production to the climate changes and meteorological disasters

- **Only one crop which can grow under deep peat soil**

  Peat soil (low pH, less nutrient, high groundwater level):

  20～30 million ha in the Southeast Asia

- **Some salt water tolerance**

  Grow under brackish water

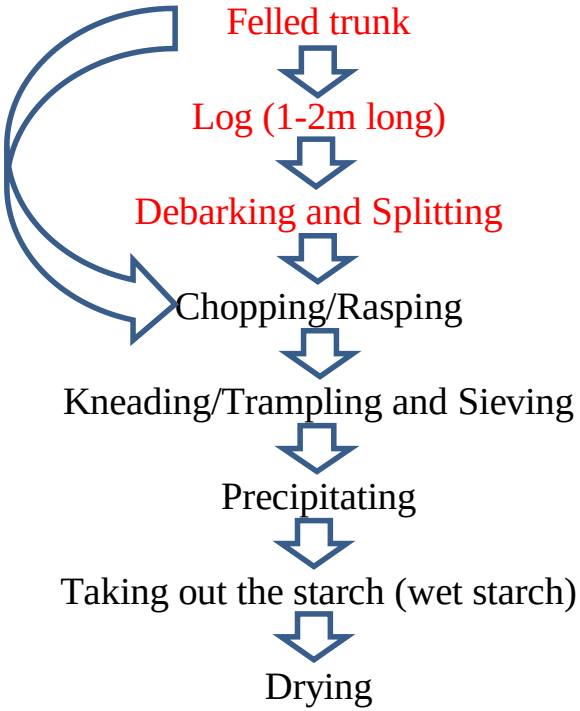
- **Low input and technique for cultivation**

- **Better growth under strong sunshine, higher temperature (>15℃) and humid conditions**

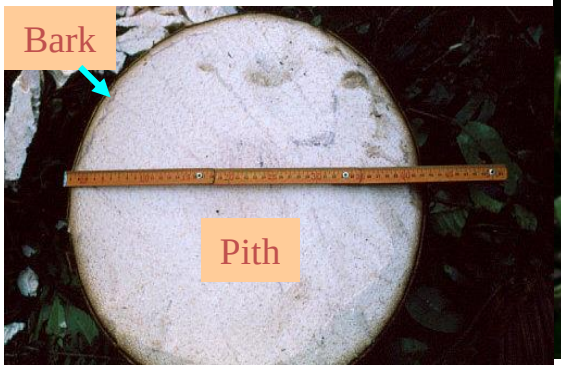
- **Long years from planting to harvesting**

  Need 10～15 years

Starch extraction process



Starch extraction process in sago palm



Starch extraction process

Felled trunk

⇩

Log (1-2m long)

⇩

Debarking and Splitting

⇩

Chopping/Rasping

⇩

Kneading/Trampling and Sieving

⇩

Precipitating

⇩

Taking out the starch (wet starch)

⇩

Drying

Starch extraction process in sago palm

Chopping the sago pith

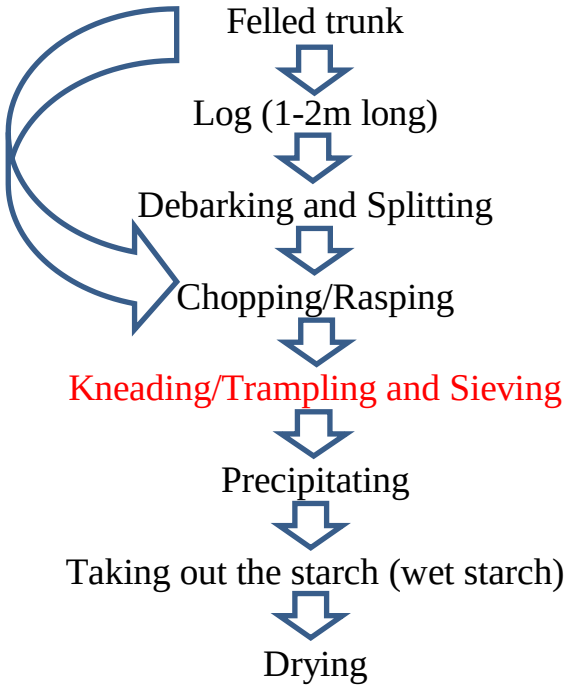
Motor-drive-rasping machine for sago pith

Grating the sago pith

Grater

Cylinder with teeth

Starch extraction process



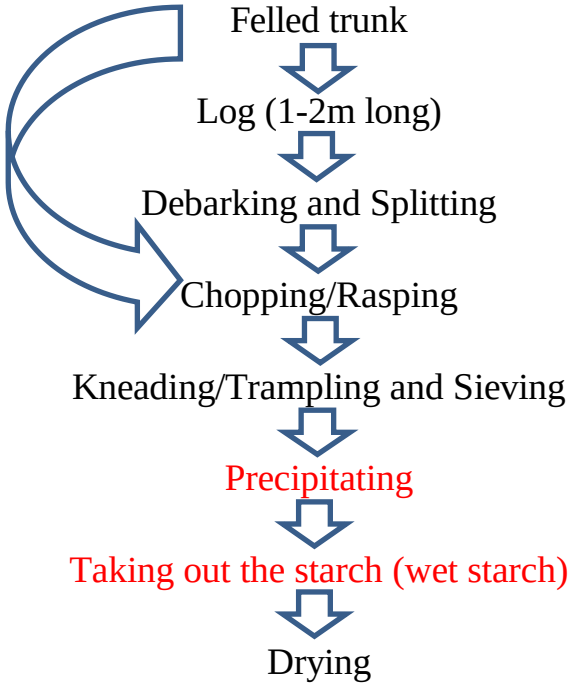
Starch extraction process in sago palm

Starch extraction（Kneading by hands）

Extracted starch solution

Starch extraction（trampling）

Starch extraction process



Sedimentation of sago starch

Collected sago starch（wet sago)

Starch extraction process in sago palm

Starch extraction process of sago palm is very simple and easy.


Sago starch in the Tumang

Nutritious aspect of sago starch

Table Comparison of chemical compositions of sago starch with other crops (/100g)

Composition	Sago starch	Cassava starch	Milled rice
Calorie (Kcal)	349	346	356
Water (g)	13.4	14.2	15.5
Protein (g)	0.1	0.1	6.1
Fat (g)	0.2	0.2	0.9
Carbohydrate (g)	86.1	85.3	77.1
Ash (g)	0.2	0.2	0.4
Na (mg)	7	1	1
K (mg)	1	48	88
Ca (mg)	7	28	5
Mg (mg)	3	5	23
P (mg)	9	6	94
Fe (mg)	1.8	0.3	0.8

Source: Standard tables of food composition in Japan (5th edition) (.2001).

How to utilize the sago starch as food (1)

As staple food

Papeda (Sinonggi): Pour hot water into the mixture of sago starch with water →To be paste→Cut it into small portions→Put the portions into fish, chicken or vegetable soup and eat

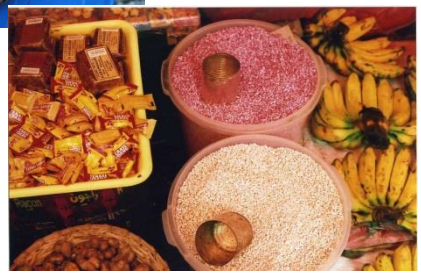
How to utilize the sago starch as food (2)

As staple food

Sinoli: Put oil on hot pan→Spread the sago starch and bake→Put coconut sugar on the baked sago starch→Rolled the baked starch and eat

Lempeng: Pour the starch mixed with water into the unglazed earthenware and baked→Put it (lempeng) into hot coffee or tea and eat

Bubur-sagu: Mixed boiled sago pearls with sugar, milk, chicken and potato and eat



How to utilize the sago starch as food (3)

As noodle

Mie sagu (sago fried noodle)

Sohun (Soun)

As cake

Unbaked sago cake (Ongol-ongol)

Baked sago cake (Bagea sagu)

Sago pearl with honey dew melon juice

Conclusions

Sago palm has the following characteristics;

- Possible growth on the marginal land
- Possible low input and sustainable cultivation
- Tolerable to climate change and meteorological disasters
- High starch productivity
- Simple and easy processing of starch extraction

These characteristics of sago palm suggest that it should be considered as a promising candidate of supplementary food crop (energy supplier) in the humid tropical countries for the food security.


Thank you for your attention!
KOCHI

Approaches Taken in Bangladesh to Assure Food and Nutritional Security for improved livelihoods

PRACTICAL ACTION
Technology challenging poverty

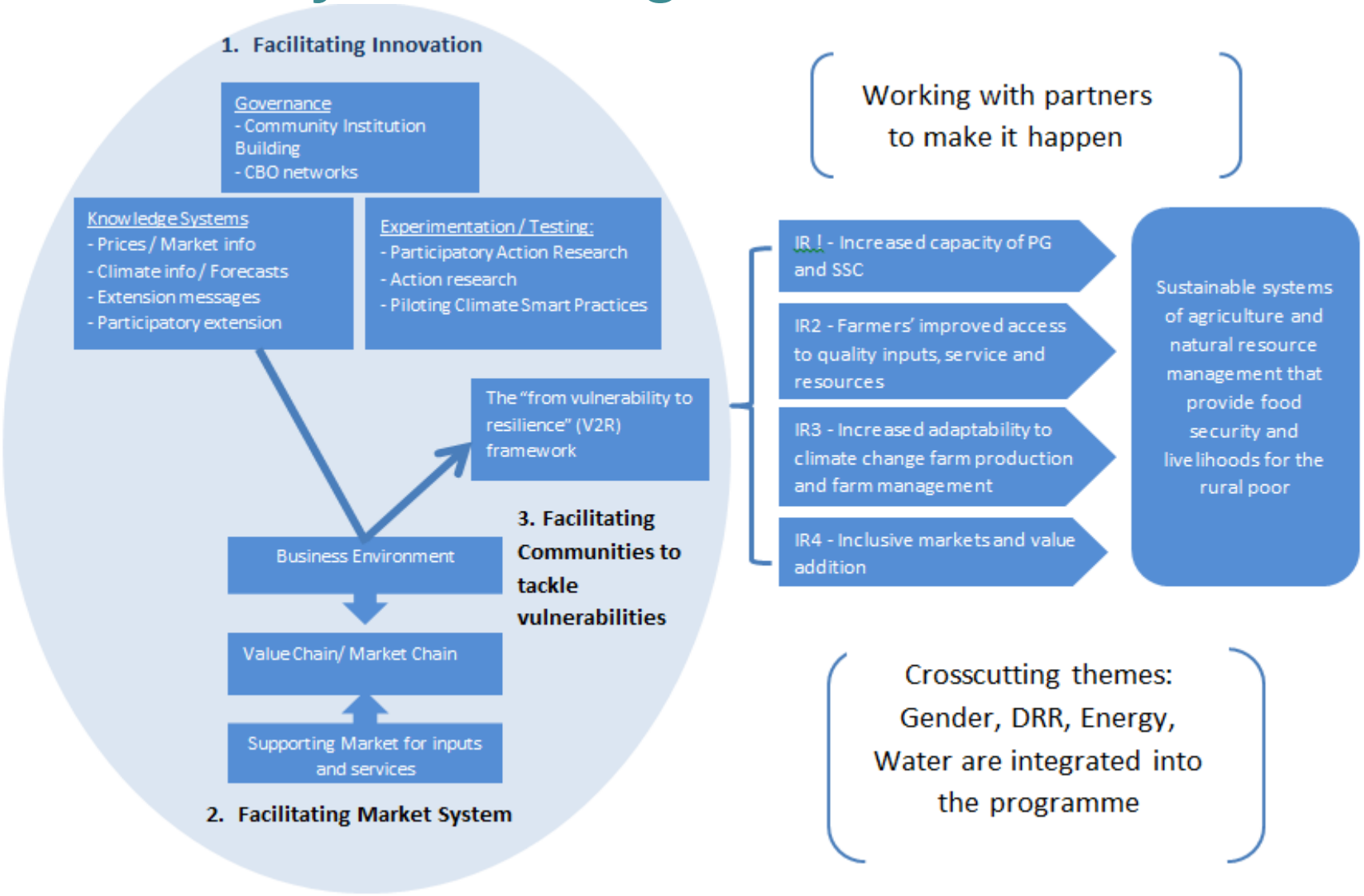
Global Food Security Forum: Meeting Nutritional need, 7-8 July, 2014

Abdur Rob
Head of Food Agriculture and Markets
Practical Action, Bangladesh

Country Context

- Bangladesh is a small but highly populated country with 160 million people, 75% whom live in rural area and depend on agriculture and its labour market.
- Land use - 55.39% is arable land.
- 42.1% remain below poverty line.
- 56 million people (40% of the population) undernourished, fail to meet minimum level of caloric consumption needs of 2122 KCal/ person/ day.

Theory of Change



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Example of an Inclusive Market System in Bangladesh

1.
Landless women, or those farming very small plots of land in difficult areas in Bangladesh find scarce opportunity to increase income. Disconnected from local market systems they struggle to improve their economic situation.

17%

....The contribution of women to overall household income in this case study

2.
Practical Action helped facilitate the creation of 80+ Rural Sales & Service Centres an important institutional innovation in Bangladesh, connecting people to markets

3.
.... Meanwhile, Pabna meat in Dhaka, the 2nd biggest supplier in Bangladesh, start looking for ways to source livestock from producers not usually part of their supply chain

4.

Practical Action and BIF engage the women in beef fattening techniques so they can supply Pabna with the high quality meat they are trying to source. Pabna collect the cattle, and the women are taught hov to use organic techniques: No growth hormones, preventative medicine and organic feed

5.

30%

increase in contribution to household income = more descision making leverage leading to empowerment and increased wellbeing

....Now the largest supplier of meat in Bangladesh is interested, the amount of poor people benefitting from this inclusive market system has potential to increase expodentially

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Example 2: Selected products for small holder adaptation in River Islands, M4C

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Technology challenging poverty

Areas of small holder adaptation:

- Improved inputs and services (seeds, fertilizers, pesticides (both organic and non-organic)
- Production and post harvest technologies and practices
- Systemic change in markets and marketing

Example: Major impediment in transport system affecting the small holders adaptation in River Islands, M4C

Improved transportation of improved agricultural inputs, services and outputs, further supporting farmers with production and post-harvest technologies and practices, M4C.

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Key Takeaways

Use **market and value chain approaches** to leverage private sector investment, build public-private alliances, and enable sustainable livelihoods that are not tied to development assistance.

Enhance household productive assets by facilitating access to improved seeds or animals, and financial services, skills training in effective production strategies and enabling economic strengthening at the household

Build the capacity of Producer Group, Farmers Sales and Service Centre, Local NGOs, community groups, government agencies, private sector extension agents and input suppliers to sustain these services, and provide linkages to financial services and savings mechanisms that reinforce smallholders' abilities to substantially expand their outputs and grow their incomes.

Thank you

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