



9th ICABR

Golden Rice – the Partitioning of Influence

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Scientific progress with Golden Rice – SGR1

US 2004 open field trial of several events

- SGR1 grain expressed 4 - 8 $\mu\text{g} / \text{g}$ (5x PoC work)
- no abnormal taste
- will test retention of carotenoids under different storage conditions
- will test effect of cooking on carotenoids



SGR1 now with rice breeders in India and Philippines

**Genetically Modified Rice Adoption:
Impact for Welfare and Poverty Aleviation.**

K Anderson, LA Jackson, CP Nielsen.

World Bank Policy Research Working Paper
3380, August 2004

The paper uses the 'global economy-wide computable general equilibrium model' to analyse the potential economic effects of adopting first and second generation GMO crops in Asia.

,The results suggest that farm productivity gains could be dwarfed by the welfare gains resulting from the potential health-enhancing attributes of Golden Rice'.

➤ Projected gains from Golden Rice adoption by developing Asia would amount to \$ 15.2 billion per year globally.

➤ Enhanced productivity of Asian unskilled labor in \$ billion:
China 7.209; India 2.528; Other S+SE Asia 4.140.

➤ Export losses due to import ban from Europe are > 0.5%!

Scientific progress with Golden Rice – SGR2

- 37 μg /g carotenoid – 20x PoC (actually up to 80 μg /g in individual grains = 50x PoC work)
- very high levels of β -carotene (~95%)
- donated by Syngenta for humanitarian uses



Syngenta FTE's used 2000-2005 for Golden Rice Research & Event Creations

| | SGR1 | SGR2 | Total |
|---------------|----------|-----------|-----------|
| Japan | 3 | 0 | 3 |
| UK | 3 | 12 | 15 |
| USA | 0 | 5 | 5 |
| TOTAL: | 6 | 17 | 23 |

Share of Energy Intake for rural Bangladesh – 80% from rice with no carotenoid

SHARE OF *ENERGY INTAKE* FOR RURAL BANGLADESH

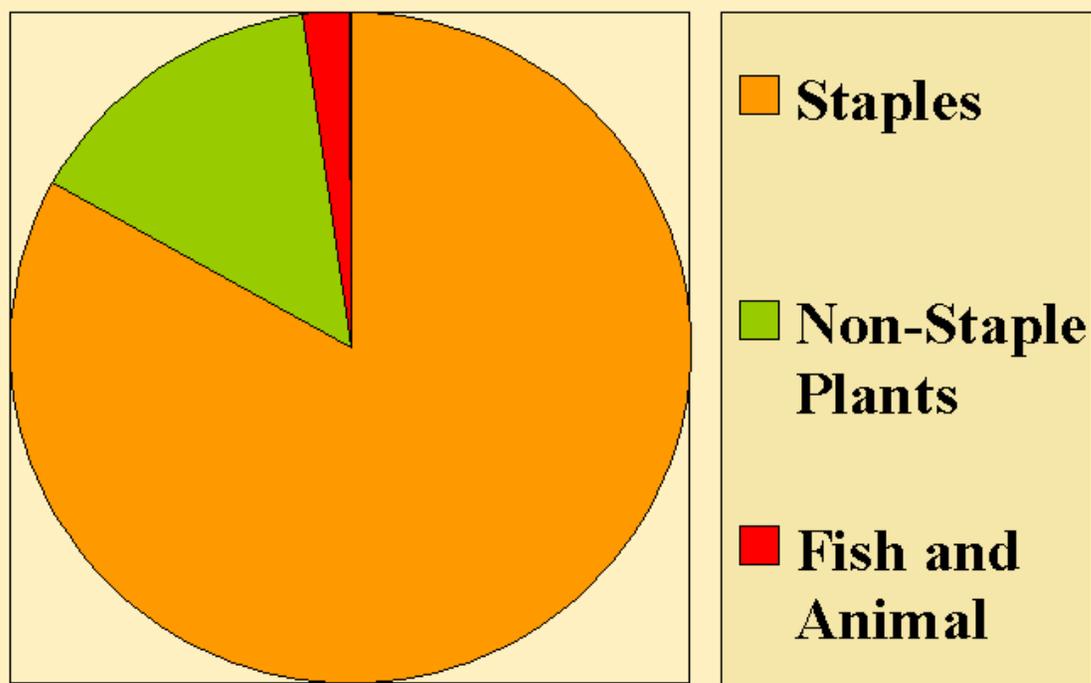


Figure 1: The importance of rice in the diet in rural Bangladesh. White rice has no pro-vitamin A.
(From Bhargava, A., H. Bouis & N. Schrimshaw. 2001)

SGR2 is expected to contribute significantly to VAD alleviation:

Bouis (pers. com.) has calculated the contribution of SGR2, (after making allowances for various factors such as losses in cooking and bioavailability effects), to satisfying pro-Vitamin A requirements of adults and children in Bangladesh. (Figure 2)

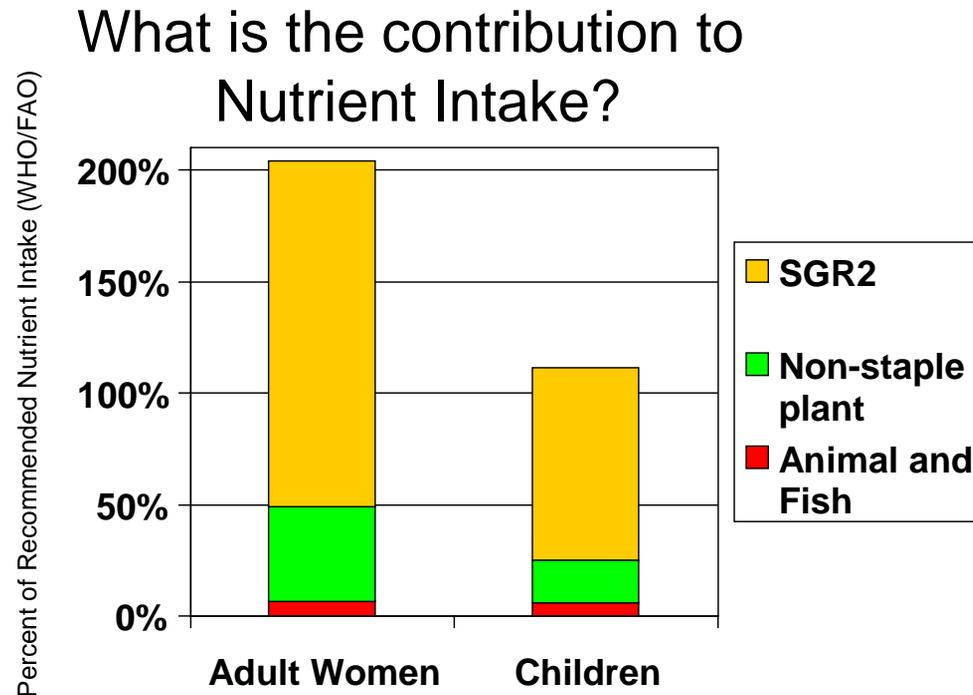


Figure 2: The contribution to daily pro-Vitamin A requirement of adult women & children in rural Bangladesh from Animal & Fish sources, non-staple plants and SGR2 GoldenRice.

(H Bouis, 2005, unpublished.)

Cost-effective and sustained production of nutritious food.

The potential of one GoldenRice seed:

1 seed > 1 plant > 1 000 seeds / 20 g

> 1 000 000 seeds / 20 kg

> 1 000 000 000 seeds / 20 t

> 1 000 000 000 000 seeds / 20 000 t

In two
years

Each seed has the potential, to produce in two years food for 100' 000 poor. And it carries the technology, to reduce vitamin A-malnutrition in a cost-effective, sustained manner.

All a farmer needs to benefit from this technology is one seed. He neither needs additional agrochemicals or pesticides, nor novel farming system or seed. He uses part of his harvest for the next sowing. There are no new dependencies. The technology is free for farmers with a yearly income of < \$ 10'000

Sustainable Agriculture

The only sustainable agriculture is intensive agriculture

Current technologies are reaching the limit of their ability to provide paradigm shifting improvements to quality and quantity of food production.

This includes use of:

- Traditional seed breeding
- Fertilizer
- Crop Protection chemicals
- Irrigation

Transgenic, and other genome based technologies allow crop improvements which are otherwise unobtainable

Applications of genome based technology are not capital intensive:

- Highly appropriate for developing country invention and use
- Capacity building needed, best provided by experience

Genetic modification allows new solutions:

For 10,000 years traditional agriculture has selected desirable traits in crops used for food

For the last 100 years seed breeding has been a business
Biology limits what can be achieved through conventional breeding

Modern molecular biological understanding increases the rate of traditional breeding success in tracking towards desirable traits.

However, transgenic technology is currently the only way of achieving certain desirable characteristics, eg :

- Introgression of traits from plants adapted to incompatible climates, flowering times etc
- Completing biosynthetic pathway to pro-Vitamin A in rice endosperm

Risk: Benefit of GMO's

Intensive global observation, by vociferous opponents, of very significant usage

- **No** substantiated risks from GMO's

Many real benefits have been described, eg:

- African Bt cotton
- China with Bt Rice

Continuing growth of GM crops underlines the utility of the technology

- Six million developing country farmers
- Within 10 years there is more area cultivated with GM crops, than after >5000 years with “organic” agriculture

Until farmers can grow Golden Rice.....

.....the projects humanitarian aims, and related welfare and economic benefits, can not be delivered.

This is several years away.

The original ICABR 2003 question, still needs to be answered :

“Why has very little public sector progress has been made in delivering GM crops to impoverished farmers in developing countries for local use and sale?”

What are the negative influences on humanitarian GMO project progression?

1. The Convention on Biodiversity

– *particularly its interpretation.*

2. A European governmental philosophy: the ‘precautionary principle’

– *particularly its interpretation.*

3. NGO’s ideological opposition to GM crops

– *and unthinking support for their position*

The CBD

The 1992 Rio Earth Summit, led to three United Nations Conventions, including:

- Convention on Biological Diversity (<http://www.biodiv.org/>)

The CBD (150 country signatories) is dedicated to promoting sustainable development.

*“Conceived as a practical tool,..... the **Convention recognizes** that biological diversity is about more than plants, animals and micro organisms and their ecosystems – it **is about people** and our need for **food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live**”.*

The CBD’s main intent is to benefit people, and peoples living standards.

In association with the CBD, for design of regulatory systems is CPB:

Cartagena Protocol on Biosafety (119 signatory countries).

Intent:

- **both risk and benefit** should be considered in taking decisions relating to biological materials, including GMO's

The UN's current training

- for bioregulatory systems- in ~100 developing countries - is based **only** on **risk** assessment (no consideration of benefit)

(Independently of the intent of the parties to the CBD, and its language, how can risk be assessed without consideration of benefit? Risk is a relative term.)

Cartagena Protocol on Biosafety – high intent

Ratification in Africa and date of entry into force (at 22 February 2005)

| North Africa | West Africa | Central/East Africa | Southern Africa |
|----------------------|---------------------------|-------------------------|---------------------------|
| Algeria (31/11/2004) | Burkina Faso (02/11/2003) | Cameroon (11/09/2003) | Botswana (11/09/2003) |
| Egypt (21/03/2004) | Gambia (07/09/2004) | Djibouti (11/09/2003) | Lesotho (11/09/2003) |
| Tunisia (11/09/2003) | Ghana (11/09/2003) | Ethiopia (07/01/2004) | Mauritius (11/09/2003) |
| | Liberia (11/09/2003) | Kenya (11/09/2003) | Mozambique (11/09/2003) |
| | Mali (11/09/2003) | Madagascar (22/02/2004) | Namibia (11/05/2005) |
| | Niger (29/12/2004) | Rwanda (20/10/2004) | Seychelles (11/08/2004) |
| | Nigeria (13/10/2003) | Tanzania (11/09/2003) | South Africa (12/11/2003) |
| | Senegal (06/01/2004) | Uganda (11/09/2003) | Zambia (25/07/2004) |
| | Togo (30/09/2004) | | |

African Biosafety Status – few functioning systems

Table 1. Status of Biosafety in Africa, 22 February 2005

| Biosafety status | Countries |
|---|--|
| Ratified the BSP and currently developing Biosafety legislation | Algeria, Botswana, Burkina Faso, Cameroon, Djibouti, Egypt, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Mali, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Senegal, Seychelles, South Africa, Togo, Tunisia, Uganda, United Republic of Tanzania, Zambia |
| Noted for slow-progress in developing biosafety legislation | Angola, Burundi, Cape Verde, Cote d'Ivoire, Comoros, DR Congo, Eritrea, Gabon, Guinea, Guinea Bissau, Libya, Mauritania, Sao Tome & Principe, Somalia, Sudan, Sierra Leone |
| Have biosafety guidelines | Tunisia, Morocco, Mauritania, Burkina Faso, Namibia |
| Have draft legislation | Kenya, Namibia, Nigeria, Uganda, Zambia |
| Have legislation, but framework not yet functioning | Cameroon, Malawi, Mauritius |
| Have functioning Biosafety legislation | Egypt, South Africa, Zimbabwe |
| Member of UPOV | South Africa, Kenya |

The European Commission's Precautionary Principle:

"Where action is deemed necessary, measures based on the precautionary principle should be, inter alia:

- **proportional** to the chosen level of protection,
- **non-discriminatory** in their application,
- **consistent** with similar measures already taken,
- **based on** an examination of the **potential benefits and costs of action or lack of action** (including, where appropriate and feasible, an economic cost/benefit analysis),
- **subject to review**, in the light of new scientific data, and
- capable of **assigning responsibility for producing the scientific evidence** necessary for a more comprehensive risk assessment."

However, the Precautionary Principle

is widely represented to mean:

“if there is a risk, however small, don’t take it.”

NGO's Values

.....a moral underpinning based on

- “solidarity and ***compassion for the fate and well being of others:***
- a sense of personal responsibility
- reliance on ones own initiative to ***do the right thing***
- impulse towards altruistic giving and sharing
- ***refusal of*** inequality, violence and ***oppression.***

NGO's are neither governments nor business”

NGO's opposition to GMO's has been called “ideological bigotry”, and is inconsistent with “NGO values”

NGO's, 'Giant multinationals' and GMO's

NGO's form the 8th biggest economy in the world,

- Worth \$1 trillion annually;
- Have spent \$100m opposing GMO's

The largest agribusiness "giant multinational" is >100 times SMALLER

- annual sales \$7.3 billion.
- Spent \$5.0m developing GoldenRice
- Has donated GoldenRice for Humanitarian uses at no cost

"NGO's have been instrumental in directing international attention to the importance of poverty reduction and human rights"

"NGO people prioritize ethical, social and environmental issues and feel a sense of outrage when these values are offended."

The Paradox:

NGO's, by their opposition to GMO's, deny a potentially life-giving technology, GoldenRice, being available to the poor

THE DAILY TELEGRAPH SATURDAY, FEBRUARY 10, 2001

Greenpeace backs down on protests over GM rice trials

BY ROGER HIGHFIELD,
SCIENCE EDITOR, IN LYONS

GREENPEACE backed down from its stand against GM crops yesterday by admitting that it would not oppose field trials of “golden” rice, being developed to combat blindness in the Third World.

Paralysis of Leading Edge Agricultural Research:

Cartagena Protocol: “ assess risk only”

+

Precautionary Principle: “any risk is too much”

(with the mix stirred by NGO opposition)

=

Unworkable regulations

and

Paralysis of Crop Research

(Especially In the Public Sector)

Public GM projects find progression to Products almost impossible.

Cohen,(2005) has described the very broad scope of

- crops,
- traits,
- transformation events and
- developing countries

involved in GM projects by public sector research institutes.

The dearth of public sector product development capacity, regulatory capacity, and product introductions is noted.

The Public Research & Regulation Initiative (PRRI) aims to involve public research sector in international agreements

Phase 1 - 'Raising awareness phase':

consulting the public research community about the need for organised involvement in international agreements & negotiations (2004)

Phase 2 - 'Try out phase':

Involvement of public research scientists in Meetings of the Parties to the Cartagena Biosafety Protocol & the Aarhus Convention (2005)

Phase 3:

a multi year project for structured involvement of the public research sector in relevant international agreements (Cartagena Protocol on Biosafety, Biological Diversity & Aarhus Convention) & their national implementation (2006 onwards)

The 'Copenhagen Consensus':

Panel of economists made cost: benefit comparisons, including

- ethical issues
- humanitarian urgency

To determine global priority of

- many different projects
- from a wide variety of disciplines
- for developing countries.

Micronutrient malnutrition alleviation was ranked # 2 of 17 projects short-listed

28 June 2005 – Bill & Melinda Gates Foundation - Grand Challenge # 9

Announced ~\$30m grants over 5 years to support

- Micronutrient biofortification of staple crops
- For use in developing countries
- For the benefit of impoverished people

Four projects

- All aspire to include pro-vitamin A plus other micronutrients eg Vit E, Iron, Zinc, High protein,
- Product delivery plans were very important in the assessment by Gates

Thank you, Gates Foundation, on behalf of the project teams, and the poor people who will benefit!

Greenpeace on trial under Danish terror law after GMO protest

9 June 2005

Agence France Presse

COPENHAGEN, June 9 (AFP) - ... Greenpeace went on trial in a Copenhagen court on Thursday.... Greenpeace was charged under the new legislation last month following a protest against genetically modified organisms (GMOs)

Golden Rice – the last decade:

Good scientific progress

- Significant increases in carotenoid expressed in rice endosperm
- Micronutrient malnutrition recognised as a major factor in total world malnutrition.

Q What could be responsible for the continuing slow progress of the project?

- Not IPR's
- Political will is important
- Public Private Partnership is useful

A Three *interpretive* influences on society's attitudes to genetically modified crops:

- The Convention on Biological Diversity,
- the Precautionary Principle, and
- some NGO's opposition to GM technology.

The Challenge to ICABR's Economists and Social Scientists, and NGO's:

Determine the societal cost of:

The disproportionate bureaucracy being put in place by governments and intergovernmental departments, to run a 'risk only' regulatory system,

.....yet where any 'risk' is too much....(and no risk has been found to date)

Resulting in 'public good' humanitarian, projects – and private sector projects - being significantly burdened with cost and time delays, or made impossible

And poor people, with no political voice, being denied life benefits, which the intergovernmental conventions were designed to deliver to people.