

Frankenfood or good stuff? Micronutrient rich staple crops for Asia.

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In course of the Green Revolution, new crop varieties are developed in Asia, and GM crops are gradually released in large Asian countries such as China and India. Although many of these developments are intended to be pro-poor and environmentally friendly, they are fiercely refused by environmental organisations. The discourses do take the shape of development narratives, simplified glorifications of a past of harmony with nature, threatened by modernisation, cruel scientists and corporate businesses. But some of the criticism may also be seen in the light of the reactionary elements of hindutwa. The development of micro-nutrient dense staple crops rich in iron and zinc is an example of attempts to develop crops that aim at improving the nutrition of the poor, and hence make up for some of the problems of the first generations of Green Revolution crops. This strategy, also referred to as bio-fortification is applied by the CGIAR programme Strategies for Improving Availability of Micronutrients, headed by IFPRI, and is discussed in the paper. It is suggested that its reception among leading GR opponents may be just as the first generations of GR crops.

Agricultural development discourses and development narratives.

Since the onset of the Green Revolution (GR) in Asia, technological development in agriculture has become an arena of heated discourses. Raising a few pointed arguments on GR in nearly any academic or political setting will provide you with interesting discussions until late hours. The arguments take many directions, from technocratic views focusing narrowly on yields and caloric balances, over social equity issues and employment effects to perceived environmental impacts and nutritional changes. Among the most frequently quoted critics are the eco-feminist Vandana Shiva and her organisation RFSTE. Her criticism is applying any available argument against the GR, as presented in *'The violence of the Green Revolution'* Shiva (1991). As stated by ironically be Borchgrevink (2002), the criticism is not constrained to the evils of the GR, but includes that it is not available to more farmers. Over the last decade, a major focus of Shiva and RFSTE has been patents, intellectual property rights etc., all related to a perceived conflict between small farmers' interests and multinational bio-tech and seed companies and their exploitative behaviour.

Some of the criticism against the GR takes the shape of a *development narrative*. This concept was coined by Roe (1991) in a powerful article which has become central in much of the environment-and-development nexus literature. A development narrative is a normative causal explanation, simplifying the message, and leading to a proposed action. It does often take the shape of a beginning, a middle, and an end.

The beginning may refer to a past where people were living in harmony with nature. The middle is a dramatic change which often is induced by external forces, but it may also be population growth or internal political factors. The middle contains a simplified causal explanation of a perceived environmental or developmental disaster. The end is the proposed solution which is based on the simplified explanation, and which therefore is similarly simplified. The narrative is strongly political although it may not appear to be so. And it may often be seen as the way a complex message from academic analysis is distorted in media and transformed into politics and to policy. Development narratives live their own life in the development business where governmental and non-governmental organisations alike have become dependent on their maintenance. Local people will often have the role as victims who

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are in need of external assistance to get out of their peril, but may also be villains who need to have their minds enlightened and actions controlled.

One classical example of a development narrative relates to the perceived Himalayan land degradation disaster which has been treated by Thompson and Warburton (1985) and Ives and Messerly (1989). In this case, the narrative suggested that the Himalayas in a harmonic past – probably around the 1950's – were covered by a dense forest. Then, population growth and division of land holdings on a general scale led to deforestation on a massive scale, and the projections from the mid-seventies had it that Himalaya, given the existing rate of deforestation, would be bald as a coon and eroded around year 2000. The programmatic solutions to the narrative would then be population control and tree planting programmes, in addition to strict bans or control on use of forest products. The two publications above have become classic in their deconstruction of the Himalayan land degradation myth, proving that it was basically wrong, ill-founded or at least far too generalised for a major region like the one in question.

When I did field work in Arun Valley in eastern Nepal in November 1999, it was pretty clear that chopping down the last trees in two months would be a cumbersome task. In contrast, the local farmers were complaining over the monkey problems in their mandarin groves caused by the *increase* in tree cover which had taken place over the last decades. Similar narratives have been built around the perceived desertification of the Sahel zone in Africa and many other cases.

To be fair, the stating that an explanation takes the shape of a narrative does not mean that it is completely without content, and some of the really positive changes in development-and-environment have been caused by a blunt call for protest. Some of the questions around the Green Revolution raised by the opponents have been acknowledged by its defenders.

As an example, Conway (1997) is strongly agitating for a strengthened, 'doubly green' revolution which is aimed at improving environmental sustainability as well as addressing social equity, participation and other issues in a 'partnership' model with peasant farmers. And the purpose of the bio-fortification programme to be discussed later in this paper, is precisely to develop crops that are more nutritious than the first generation GR crops, and better suited to the mineral deficiencies that are typically found in the soils of the Asian farmers.

And, it might as well be argued that the GR itself has been based on a development narrative: The past was glorious, but wrecked by population growth, the answer is to give a new seed to the peasants.

Global discourses on GM crops.

The introduction of Genetically Modified (GM) crops in Asia has added a new dimension in the discourses over agricultural development. GM technology has been warmly embraced by some politicians and scientists, and fiercely resisted by some NGO's.

The heated debates over GM crops have similar characteristics as the GR debates, and some of the points are the same. A useful treatise of the GM discourses has been presented by Winston (2003), outlining the cultural contexts of different stakeholders in the GM discourses.

The discourses on GM crops can largely be attributed to grand regions. The development of the crops has been dominated by USA-led multinational firms, although also European companies have been in the forefront, and have been merged into still larger companies. According to Winston (2003), the entry of GM crops have followed long term trends in modernisation of US agriculture, as well as a massive influence of corporate businesses on the private farms. The resistance against GM food from the US consumers has been relatively limited, although environmental groups, organic farmers and consumer groups have been and still are engaged. Even at White House level, GM crops have been strongly promoted as one of the most important strategies to alleviate food security problems in the 3rd World.

In Europe, the resistance has been much more pronounced, and comprises an imbroglio of arguments which include risk of new allergenic plants, pest resistance, spread of genes to wild species, increased use of specific herbicides, but also fear of dominance from multinational companies. The discourses have been raised to a general level of public distrust in the regulatory system concerning food safety, amplified (and even confused with) outbreaks of BSE, Kreutzfeld-Jacobs disease and foot-and-mouth disease. It has become a cultural issue which even is linked to landscape protection (Winston, *ibid.*). Although some US politicians and WTO bureaucrats see the resistance as an attempt to conceal a technical trade barrier, it must be realised that a major part of the EU consumers simply don't want to have GM foods stuffed down their throats.

Asia has become a new battlefield concerning GM crops. China is the second largest nation in the World after US in terms of number of released GM varieties. The country claims to follow strict environmental procedures before the release, but has done less in terms of consumer safety (Clarke 2002). In Thailand, a pragmatic view is applied where GM crops can be tolerated with the exception of rice, the country being the largest exporter of this crop.

In India, the Government decided in 1999 to use and promote GM crops, after intense debate and struggle. The background was, however, not only the result of positivist science or pressure from seed producers like Monsanto, but also because Indian farmers had been steeling seeds of Bt Cotton and planting it illegally (Jayaraman 1999). This highlights one potential environmental issue: *if* development of pest resistance to the inserted Bt toxin is an issue, it may be effectively controlled by Insect Resistance Management programmes (IRM) in US (Winston 2003), whereas it is impossible to control in India.

Vandana Shiva and her organisation RFSTE reject the promotion of high-vitamin A 'Golden Rice' on the grounds that traditionally grown leafy green vegetables and fruits that can be grown in any backyard which potentially provide hundreds of times more vitamin A than the GM rice (Shiva 2000).

Svarstad (2002) has provided a useful application of the *narrative* concept for analysing discourses concerning bio-prospecting, bio-diversity conservation and bio-piracy. She shows how what she refers to as a *bio-prospecting win-win discourse* aims at presenting the use of genetic resources as a value-free, technological benefit to bio-prospectors as well as local poor. The *bio-piracy discourse* is presenting the multinational, medical companies as villains who exploit the local poor by stealing their genetic resources, and later selling it back earning fortunes through a system of patents.

The arguments held by RFSTE contain the same division into villains and victims as the Hanne Svarstads' bio-piracy narrative. It is linking the 'Golden Rice' to evils which include

the Rockefeller Foundation, the Green Revolution, loss of biodiversity, globalisation and unfounded claims of risk known from other GM crops. '*It has yet to be established that genetically engineered rice is not a Frankenfood*' (Shiva, Ibid.), using one of the many nicknames for GM foods which successfully has been introduced by the GM critics (Winston 2003).

Likewise, a high-protein GM potato is rejected. The list of arguments is as follows (RFSTE 2003):

The potato is *not traditional* to Indian cooking whereas the *traditional* amaranth (which with reference to Sanskrit means 'eternal') is higher in protein as well as minerals. Likewise, '*our*' pulses are also very rich in protein. Hence, the protein rich potato is claimed to lead to malnutrition among poor children, compared to *if* they were given traditional, nutritious food. As the crop has not yet been legally cleared for commercial cultivation, it is still pending in court. The idea of feeding GM food to poor, Indian children is ascribed to outside forces in the shape of international relief organisations (the 'environmentalists' managed to force back two shiploads of corn soya blend famine relief due to GM content), organisations which are *force feeding* the children, in addition to the Department of Biotechnology (DBT) which also is seeking to force feed children and use them as *Guinea pigs*. Furthermore, a temporary price fall on potatoes is linking suicides among potato farmers to the World Bank, WTO and trade liberalisation. Finally, the new agricultural policy has promoted a shift from food grains to more perishable vegetables, making farmers more vulnerable to market fluctuations. (Emphasis added).

No explanations are given why the Latin American origin crop amaranth is more traditionally Indian than the potato.

The argumentation serves as a narrative based on a wholesale rejection of the imbroglio of modernism and outside attempts to dominance which is also found in European criticism of GM foods, agricultural modernisation, patent rights of greedy transnational seed companies and all these issues.² But the RFSTE stance also clearly contains a glorification of traditionalism which easily can be linked to Meera Nanda's outline of the reactionary contents in Hindu nationalism (Nanda 2003). It is applying us-and-them dichotomies, it is nationalist and backward looking.

Bio-fortification of staple crops with micronutrients.

The role of micronutrients such as vitamin A, iodine, iron and zinc in human nutrition has over the last decade turned into a change of paradigms in nutrition research and policy. Their physiological impacts are complex, relating to many bodily functions, but essential to an extent equivalent to the 'traditional' protein-energy-malnutrition (PEM). Not least the impact of zinc deficiency on immune system defects is of interest in South Asia where as much as 95 % of the population is at risk of deficiency, due to poverty and rice-pulse diets (Brown & Wuehler 2000).

² In terms of patents and the questions relating to multinational companies, it is noteworthy one of the favourite targets of Vandana Shiva, the multinational corporation Monsanto, has decided to release the Golden Rice from all the patent rights that were taken during its development, in order to make it freely available to poor farmers (Winston 2003: 219), based on proposals from the scientists who were developing the technology.

Strategies to improve micronutrient balances in humans differ from element to element. Fortification with iodine of salt is common because salt is a good *food vector* for this element. In some countries, fortification of wheat flour with iron is an option, and for instance in Thailand, zinc and iron enriched noodles are being marketed. With regards to zinc supplies to the poorer parts of the population in South Asia, no existing food vector is presently obvious. This is because of the no major foods are circulated and processed through the market system. Supplementation, using concentrates etc. to vulnerable groups may be expensive and difficult to implement.

For these and other reasons, the international agricultural research centres under CGIAR have started a project of *bio-fortification*, which is aiming at improving the human nutrition through breeding of micronutrient dense staple crops. Descriptions of the programmes have been presented by e.g. Graham & Welch (1996) and Bouis et al. (1999). The project is coordinated by the CGIAR institute International Food Policy Research Institute IFPRI in Washington, basically because staff from this institution took the original initiative. The actual breeding programmes have been disseminated to the CGIAR institutes like IRRI, CIMMYT and CIP. The research is supported by national development agencies and NGO's, with notable contributions from DANIDA, USAID and ACAIR, and indirectly by the Melilla & Bill Gates Foundation through various NGO's. In addition, public universities as well as multinational biotechnical companies are involved in related research.

There are three main strategies that are looked into:

- 1) Increasing micronutrient density in the edible part of the grain.
- 2) Reducing the content of anti-nutrients (notably the phytic acid is a natural constituent of seeds, especially pulses)
- 3) Increasing content of enhancers (like ascorbic acid and some amino acids)

Presently, the main efforts appear to go into the first strategy. It has been established that micronutrient efficiency to a large extent is genetically controlled, and screening of existing varieties have shown that breeding for increased density is feasible (Graham & Welch 1996). The arguments for following this strategy are not only linked to human nutrition, but also to overall productivity. A study from the Philippines showed that a selected, zinc-efficient cultivar produced 4.4 t/ha compared to the farmers' varieties yielding 1.8 t/ha on zinc deficient soils (Neue et al. 1990). In addition, the micronutrient efficient varieties will also tend to have more disease resistance and drought resistance than other varieties.

The anti-nutrients issue is emphasised by some of the bio-technological companies who are producing animal fodder. One strategy is to increase the content of heat resistant phytase enzymes in order to break down the phytic acid content and make the uptake of the released phosphate more effective. This has the dual aspect of increasing utilisation of fodder as well as reducing losses of phosphate to the environment, which is an important issue in industrialised agriculture. However, reducing phytic acid content in the grain is viewed sceptically among several researchers, because it may affect seed vigour, and because phytic acid is also playing a positive role in human nutrition.

Increasing the content of uptake-enhancing components may have dual nutritive benefits, as the enhancing component itself may be nutritionally beneficial, as in the case of vitamin C or

lysine. However, the increased nutritive value alone is unlikely to make the cultivars adapted by the farmers who will always wish to see a production benefit as well. The experiences with high-lysine maize for industrialised agriculture have not been very successful although the improved amino acid balance is supposed to provide some production benefits in animal production.

The adaptation of crop varieties - other 'local' or exotic, is depending on a long range of local factors. The physical environment - soils, pests, diseases, frost, hail or drought -, the storage qualities, size, colour, odour and other qualities of the grain, will all be taken into consideration by the farmer when choosing a variety.

Although the breeding programmes aim at tackling a multitude of such problems, by for instance addressing resistance against a number of pests in each variety (Conway 1997), there appears to be some conflict between these ideals and the reductionist traditions in the plant breeding communities. For instance, probably the majority of Asian farmers are facing double or triple micronutrient deficiencies, but the present bio-fortification programmes are aimed at one nutrient only. The result may be that zinc-efficient, but boron-susceptible wheat cultivars are released to the farmers, but without success as boron deficiency is extremely widespread in Asia.

The bio-fortification programmes may however overcome some of the questions without problems. There is no reason why efficient crops should differ in organoleptic qualities compared to other cultivars, except that the zinc-efficient gene in rice appears to be linked to aromatic varieties which rather must be seen as an advantage. One of the characteristics of micronutrient efficient varieties is that the rooting system often is larger than that of other varieties, providing more drought resistance. And the vigour of the plant itself will add to resistance against pest and diseases, in addition to compete better with weeds. No change in diets or cooking habits is required. So, all in all, breeding for micro-nutrient dense crops is likely to be one of the most cost-effective than any alternative in order to improve the nutritive balance of the poor in Asia (Bouis et al. 1999).

Finally: is bio-fortification based on GM? No. In fact the major part of the research is based on conventional breeding methods. Gene technology is used to *identify* genes for micronutrient efficiency, but the selection of varieties carrying these traits *may* be done conventionally. The medium-term objectives of the CGIAR programme does, however, also contain the development of GM lines (IFPRI 2002), and research into bio-fortifying GM varieties is taking place (Holm et al. 2002). But the question is not emphasised strongly by the researchers, perhaps for tactical reasons.

Discussion and conclusion.

If we assume that the GR was based on a development narrative, the bio-fortification programme can be said to build on a deconstruction of the narrative which is taking into consideration the complexity of the environment where the peasants live, as well as a NPK fertiliser narrative and a calorie narrative. Although it may look like a new development narrative ('give them another seed'), it is based on sophisticated knowledge of plant/soil interactions as well as food system considerations and social and economic analyses (see e.g. Graham & Welch 1996 and Bouis et al. (1999).

How the results of the bio-fortification initiatives will be received in the long run is difficult to foresee. If new varieties developed do not live up to some or all of the farmers' wishes in

terms of resistance to local pests, climate and mineral imbalances or organoleptic qualities, the answer is simple, they will add to the long range of CGIAR partner institution crop releases which were not such a good idea anyway. If they are a success in terms of production, they may become an important part of the 'doubly', 'truly' or 'secondary' GR which has been called for by many authors: more sustainable, more stable and even higher yields, more nutritious food.

The political and legal fate of GM crops is presently uncertain although it appears that a domino theory may be applied. There may be differences between the acceptance of cisgenic (gene transfer within the same species) and transgenic (movement of genes between species) approaches, or it may be difficult for the transgenic yellow rice to get consumer acceptance because of the colour.

In India, the double thinking in Hindutwa is intriguing. On the one hand, it is embracing traditionalism in a conservative manner, including traditional medicine. On the other side Hindutwa assumes itself scientifically correct by forecasting molecular physics (Nanda 2003). In this sense, the paradoxical answer may be a *both and*. RFSTE and Vandana Shiva will undoubtedly maintain their crusade against modernism, but at the same time India may join China in overtaking Europe and maybe even US in the field of development of GM crops.

In March this year I asked the Vandana Shivas' organisation RFSTE whether they had any stance on bio-fortification, and if the answer is dependent on whether it is achieved with GM technology, but so far no reply has been returned.

References:

Borchgrevink, A. (2002): Den Grønne Revolusjonen - grønn og revolusjonerende? In: Benjaminsen, T.A. and Svarstad, H.: *Samfunnsperspektiver på miljø og utvikling*. Universitetsforlaget, Oslo.

Brown, K.H. & Wuehler, S.E 2000: *Zinc and human health*. The Micronutrient Initiative, Ottawa.

Bouis, H.E., Graham, R.D. & Welch, R.M. 1999: *The CGIAR micronutrient project: Justification, history, objectives and summary of findings*. Paper presented at a workshop on: *Improving human nutrition through agriculture: The role of international agricultural research*. IRRI, The Phillipines.

Clarke, T. (2003): China leads GM revolution. *Nature Science Update*.
<http://www.nature.com/nsu/020121/020121-13.html>

Conway, G. 1997: *The doubly Green Revolution. Food for all in the 21st. century*. Penguin Books.

Graham, R.D. & Welch, R.M. 1996: *Breeding for staple food crops with high micronutrient density*. IFPRI Working Papers on Agricultural Strategies for Micronutrients, No. 3. IFPRI, Washington D.C.

Holm, P.B., Kristiansen, K.N. & Pedersen, H.B. 2002: Transgenic approaches in commonly consumed cereals to improve iron and zinc content and bioavailability. *Journal of nutrition* 132: 514S-516S.

IFPRI 2002: *Biofortification. Harnessing agricultural technology to improve the health of the poor*. Pamphlet, IFPRI, Washington. Downloadable from www.ifpri.org.

Ives, J.D. & Messerli, B. 1989: *The Himalayan dilemma: reconciling development and conservation*. Routledge, London.

Jayaraman, K.S (1999): India approves use of genetically modified crops, despite critics. *Nature news* **397**, 188.

Nanda, M. (2003): Postmodernism, Hindu nationalism and 'Vedic Science'. *Frontline* Volume 20 - Issue 26, December 20, 2003 - January 02, 2004; <http://www.flonnet.com/fl2026/stories/20040102000607800.htm>

Neue, H.U., Lantin, K.S., Cayton, M.T.C. and Autor, N.U. 1990: Screening of rice for adverse tolerance. In: *Genetic aspects of plant mineral nutrition* (Bassam, N. El, Dambrioth, M and Loughman, B.C. (eds.): 523-531. Kluwer, Dordrecht, the Netherlands.

RFSTE (2003): *GM potato hoax: Future of GM foods rests on lies. Lies about GM potato to solve 3rd world hunger*. RFSTE Press release 11th June 2003.

Roe, E. (1991): Development narratives, or making the best of blueprint development. *World Development* vol. 19, no. 4, pp. 287-300.

Shiva, V. (1991): *The violence of the Green Revolution*. Zed Books.

Shiva, V. (2000): *Vit-A rice a blind approach to blindness control*. RFSTE Press release February 19. 2000.

Svarstad, H. (2002): Analysing conservation-development discourses: The story of a biopiracy narrative. *Forum for Development Studies* no. 1: 63-92. NUPI, Oslo.

Thompson, Michael and Michael Warburton (1985): Uncertainty on a Himalayan Scale. In: *Mountain Research and Development*, Vol. 5, No. 2, 1985, pp. 115-135

Winston, M.L. (2003): *Travels in the genetically modified zone*. Universities Press (India)/Orient Longman.