When maize withers and rice shrivels, people in many parts of the world depend on sorghum. Apart from eating the grain, farmers can make beer and use the stalks to build houses and fences, as well as produce animal feed and medicine.They have nurtured and adapted sorghum for 5,000 years, and it has spread along trade routes from its origin in Ethiopia. GRAIN reports on Ethiopian wheat and sorghum farmers who recovered from famine and on Indian farmers who came through the Green Revolution to restore their food sovereignty. Their stories contrast starkly with biotechnologists' plans to turn yet another food crop into an export commodity.

Sorghum

a crop to feed the world or to profit the industry?

GRAIN

Great millet, or "Jowar", as sorghum is called in India, is the country's third most important grain.[1] In the Medak District of Andhra Pradesh, the poorest and most marginalised members of the communities manage not only to achieve food security but also to assert food sovereignty, with sorghum and millet as the cornerstones of their strategy. These farmers are marginalised in two important ways: they are women and they are dalit, the lowest caste in India. In addition, they grow their food on the Deccan Plateau, in some of the poorest soils and driest areas of India; this exacerbates their marginalisation. They achieve independence and food security by applying one basic principle: local control over seeds and food. The movement is based on a few practical pillars: recovery of traditional seeds, productivity without ecological compromise, nutritious food and feed, productivity, food security, independence from government handouts, increased household diversity, and the empowering of women.

The people of Andhra Pradesh went through the painful experience of the Green Revolution. During the 1960's the Indian government and international scientists pushed the communities into growing new rice and wheat varieties and provided credit for farmers so that they could afford the fertilisers and pesticides. This approach devalued traditional crops by promoting so-called high-yielding varieties of rice, and in this way also devalued the traditional food culture.

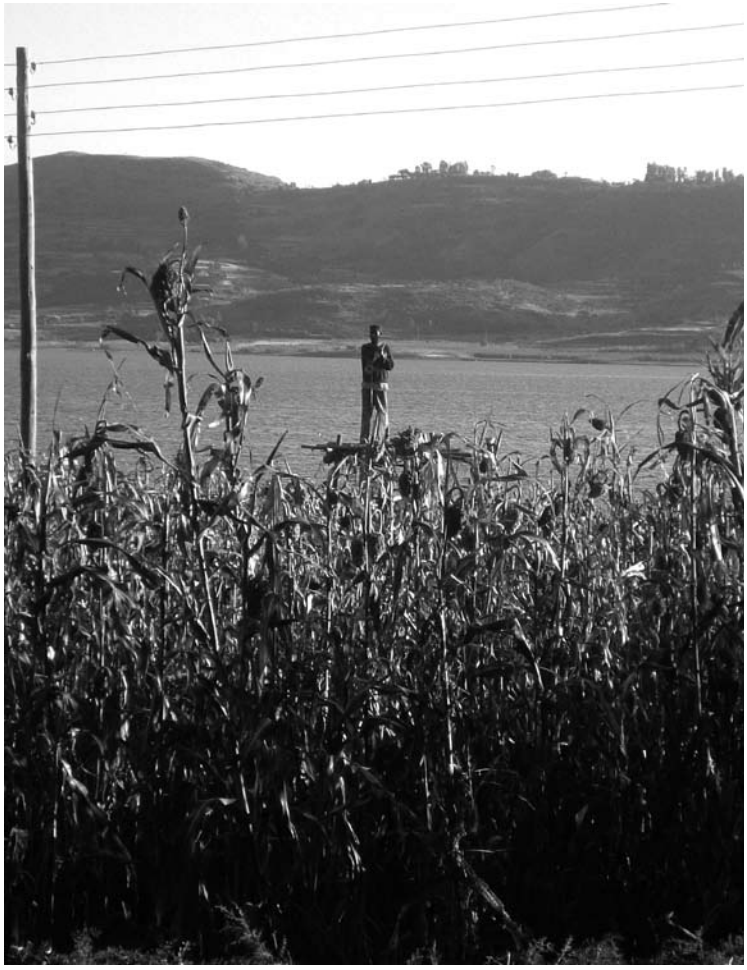
It was the failure of this top-down approach and the terrible poverty and suffering that it caused that spurred the NGO the Deccan Development Society (DDS) to work with the local communities in the recuperation of their seeds and the food culture it supports. They regenerated depleted soils and encouraged crop diversity, thus improving nutrition and eliminating extreme poverty and malnutrition. Every year, an annual biodiversity festival is held in the region to celebrate their wealth. In the words of one of the women, Anjamma from Gangwar Village, "…today we are

1 All data and quotes in this section are from www.ddsindia.com and from personal communications with PV Satheesh of DDS.

able to bring back the lost seeds. What we have is being disseminated, and we are able to exchange seeds, sell excess seeds, and use the money for future purchases of seed material." Many farmers in India have not been as fortunate as these women: it is estimated that every year thousands drink pesticides and end their life to escape from the debt trap in which they and their families have been caught as a result of failed crops.

Traditional farming systems, such as the ones that the DDS promotes, also allow for the use of wild foods and the cultivation of a variety of greens, pulses and other grains that complement sorghum, giving a nutritionally complete diet. Susheelamma from Raipally village in Andhra Pradesh says: "If we use many crops, our health and our children's health will be good; because even if a few crops fail we would still have others to stay well-nourished. The soil also will get enriched with a variety of replenishments from different crops." Others have reported in depth about the value and extensive use of uncultivated foods in traditional diets.[2]

The farmers of Andhra Pradesh are very clear about what is important to them. To quote one of them: "Today, if I look back, I can sense a sea-change in my life. And what is so exhilarating about it is the feeling of control that we are experiencing. Earlier, we were like drift-logs being swept here and there by external forces. We had to work for others on lands alien to us. We did not feel that anything belonged to us. We were just being used. But now, thanks to the Sangham [community coming together], we are shaping our life in a way that we have chosen on our own."



Chasing birds in a sorghum field, Ethiopia

The Ethiopian food crisis

Ethiopia brings to mind images of starving children, and these very same images are extensively used by the genetic engineering (GE) industry to justify why Africa needs to embrace genetically modified organisms (GMOs), including GM sorghum. The severe drought and famine of the 1980s left many destitute and dying. At the time, food aid poured into the country. At the beginning of the 1990s, soon after the military government was ousted, the IMF and World Bank moved in to help Ethiopia to deal with foreign debt, and they enforced their usual programmes of structural adjustment and privatisation.[3] Campaigns were organised to get farmers to use chemical fertilisers and high-yielding varieties through subsidised fertilisers and credit schemes. Pioneer Hi-Bred International, then the world's major seed company, assisted in "reforming" the informal seed exchange system, with the establishment of a seed industry in which the Ethiopian Seed Enterprise (ESE) supplied seeds replacing farmers' varieties.

USAID "donated" fertilisers in exchange for reforms in the fertiliser and seed markets. But in 1998 the farmers were hit by a double whammy: the US government withdrew subsidies on chemical fertilisers, and the price went up; at the same time, the world maize price dropped.[4] When drought struck in 2002, farmers were heavily indebted and had to withdraw from the fertiliser schemes. The government had to request food aid for more than 14 million people.

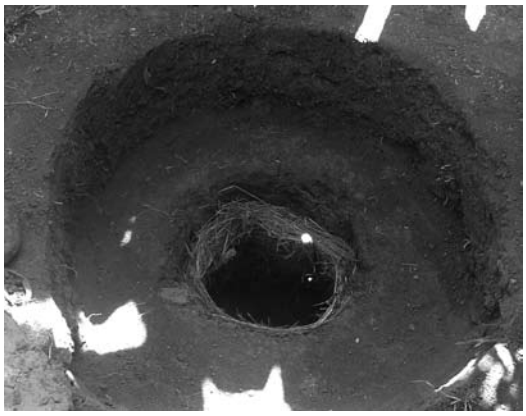
This crisis enabled US agrochemical companies to exploit the situation and to further replace local seed systems with hybrid seeds, to import fertilisers and to dump surplus GM food from the US as food aid. It is clear that the crisis was not caused by drought alone, and this example is a good illustration of how Green Revolution initiatives, combined with structural adjustment programmes, have created the conditions for famine all over Africa.[5]

2 Ian Scoones, Mary Melnyk and Jules Pretty (eds.), *Hidden Harvest: Wild Foods and Agricultural Systems. A Literature Review and Annotated Bibliography*. London, IIED, 1992. See also: Janet Bell, "The Hidden Harvest", GRAIN, *Seedling*, October 1995. grain.org/seedling/?id=157

3 M. Chossudovsky, "The Real Cause of Famine in Ethiopia – Statistical Data Included", *Ecologist*, September 2000.

4 R. Thurow, "Behind the Famine in Ethiopia: Glut and Aid Policies Gone Bad", *Wall Street Journal*, 1 July 2003.

5 B. Smith, "IMF/World Bank policies pave way for continuing famine in Africa", 5 February 2003.



Traditional storage for seeds

Farmers from north-east Ethiopia, Tigray, Eritrea, and northern Wello were forced to eat their seeds during the severe famine of the 1980s, and so a huge erosion of farmers' varieties and genetic diversity occurred. During the famine, some farmers were more strategic than others and kept seeds underground in seed storage holes known only to one family member.

In response to the crisis, Ethiopian scientists such as Dr Melaku Worede, then Director of the Ethiopian Plant Genetic Resources Centre (later the Ethiopian Biodiversity Institute), in partnership with the Canadian NGO USC Canada, started the Seeds of Survival (SoS) programme in 1989. Dr Melaku had a very different vision from most other plant breeders as he valued farmers' knowledge and their seeds and wanted to work with their resilience and capacity, rather than against it.[6]

His approach combined farmers' knowledge with scientific and government support. Rather than bringing seed from outside, they helped farmers to find seed from other farmers in the region and neighbouring regions. Farmers were given access to 130 varieties that were preserved in the Ethiopian Gene Bank, but in the end only 10 per cent of the recovered seeds came from the Gene Bank, as most were below the viable threshold.[7] About 90 per cent of the recovered seeds came from farmers in the region. Farmers selected what they wanted to use and multiplied the recovered seed. They then spread it among other farmers, as they had always done, and biodiversity increased once again.

Sorghum: a golden harvest in Wello

In November 2006, GRAIN participated in a meeting held in Ethiopia and hosted by USC Canada and the Ethio-Organic Seed Action (EOSA). We visited local sorghum and wheat farmers. Although the situation in the Ethiopian countryside is challenging, the farmers' stories and strong belief in their own knowledge and seeds are heartwarming. When we visited Harbu, in south Wello province, the harvest stood densely as far as the eye could see, with the sorghum's jewel-like white, yellow, red and bronze heads showing off their abundance. This seemed clear evidence that sorghum diversification and better production had improved farmers' livelihoods, and they testified to this. A farmer near Kombolcha told this story: "The new structures [systems of production] are foreign, (but we don't use them as) we have our own system

Wheat and teff, Ethiopia

6 See a description of this work and its impact in M. Worede *et al.*, "Keeping diversity alive: an Ethiopian Perspective", in S. Brush (Ed.), *Genes in the Field. On-Farm Conservation of Crop Diversity*, IDRC/IPGRI/Lewis Publishers, 2000.

7 Dr Melaku Worede, personal communication, November 2006.

It's all in a name: the Ethiopian farmers and their sorghum

As long as communities have a use for crops, they will conserve them. The names farmers in Ethiopia give to sorghum varieties says a lot about the way they use and value them. Ethiopian farmers nurture a huge variety of species and some have very poetic names. A local saying goes: "You do not disregard your relatives or your crops", which shows that crops are considered to be as valuable as relatives, and provide equally strong social ties.

One farmer, called Said, liked most the "Gorad" variety, because in his experience it has a higher yield (3 tons /ha) than wheat. Gorad describes the shape of the panicle; the same word is used to describe someone with a round head and short nose. Among its many applications, people use it to make injera (bread) and beer, and roast it to eat. Mohamed Yemer, on the other hand, preferred "Wegere", because the head or panicle is compact, making it bird- and insect-resistant, as well as giving it a long shelf life. Ahmed, who grows 7 different varieties, said "Cherekit", meaning "as shiny as the moon", is a quick-maturing, drought- and striga-tolerant variety, was best. However, "Cherekit" is susceptible to weevils and must be used quickly. Amina, whose fields we visited south of Kombolcha, farms 10 varieties on just one hectare. She has sorghum for many different uses, including one which is sweet and good for eating and "Gorag" with its high yield. She mixes the seeds together, saying that she is giving herself a safety net planting in this way, as the seeds have different levels of adaptation. Her yields vary from about 3t/ha in a good season to about 2t/ha in a bad season. She also plants other grains such as maize, barley, finger millet and wheat. Sorghum is popular because it requires less labour than teff or maize and needs fewer inputs.

Other varieties grown by farmers include: "Merabete", a local variety that is striga- resistant; "wetet be gunche" ("milk in my mouth"), which is a variety rich in lysine, used by lactating mothers and as a weaning food; "Ganseber" ("pot-breaker") because it makes such a good beer, sometimes breaking the pot during fermentation; and "Sende lemene" ("why bother with wheat"), because it is as good as wheat for making a local bread. The variety is also high-yielding and has a high market value.

of selection and exchange. I go with my wife to select the seed, and then we hang it over the fire in the smoke. Every Friday, I put the seeds outside. Once they are dry, we put them in a container where there is no humidity. When the time comes to sow, I talk to my wife. If I do not have seed, I get some from my neighbour or a relative." For these farmers the bonds between culture, knowledge and diversity are strongly associated. "On certain days, I look at the sun and the moon and decide what to do with the seeds. Some days we dry the seed, and we use plants and ashes to preserve the seed. Each farmer does not have everything, but at weddings and funerals we can exchange seeds."

This is biodiversity-based farming: farmers decide for themselves how they select seed and what varieties they plant when and where; and then they grow sorghum varieties in a mixed way so as to encourage the continuous exchange of genes and the maintenance of a dynamic system.[8] These farmers also make use of the undergrowth in sorghum fields, especially during the dry season in July and August. There are 7–8 varieties of uncultivated companion plants that they use for food and fodder.

In talking to the Harbu farmers, it becomes clear that seed exchange has many functions, and performs a very important social function, because it affirms interdependency among neighbours and the value of social relationships. They do not sell traditional seeds, but exchange them and keep them for friends and family. These days the farmers along the highway are losing this tradition, because the markets along the road influence them, breaking cultural and ethnic barriers and eroding culture and knowledge. They also noted that the weather and seasons were changing, forcing them to plant at different times from their forefathers.

Sorghum diversity under threat

Ethiopia is the heartland for sorghum worldwide, with hundreds of varieties under cultivation, but genetic erosion is still continuing for a number of reasons. The farmers say that the trend is moving away from their varieties, because the Minister of Agriculture condemns them and, along with the aid agencies, promotes high-yielding varieties. But these varieties, the farmers say, "do not meet the standards we learnt from our mothers", and farmers who resist these pressures do better: "Those that rely on the Minister have lost."[9] The farmers are left vulnerable, they say: sometimes they may have very high yields but at other times they lose everything. Many of the agricultural extension workers who introduced improved sorghum varieties in Ethiopia now acknowledge that they have failed. The reasons

8 Dr Awegechew Teshome in his research came across one farmer who had 24 varieties of sorghum on 1 ha of land. Personal communication, November 2006

9 Harbu farmers, personal communication, November 2006.

Chaletu Degefa, wheat farmer, Ethiopia

they cite include their focus on short plant height, which attracts birds, lower yields and the failure to adapt the varieties to the agro-climatic conditions of the area.[10]

Land ownership is another big problem for these farmers: under the current system they have a contract with government and ownership is not secure. This, together with population pressure leading to decreasing farm sizes, has a huge impact on how land and resources, including biodiversity, are managed.[11] During a meeting with farmers in Harbu, it seemed as if this might be the issue causing them most anxiety.

Dr Awegechew Teshome says that it is absolutely critical for farmers to have a range of choices, so that they can make their own decisions. "Heterogeneity is an asset – they need quality not uniformity. They need different materials for different environments. The changes in soil, climate, socio-economic demands are huge, and farmers adapt by growing diversity, and staggering their crops. The biggest threat to genetic erosion and dependency is when farmers do not have their own seeds. It is not sustainable to bring foreign seed in, they will lose their own seed supply, lose independence and eventually no longer farm. Seed is the linchpin of farming."[12]

The "Super Sorghum" Project

Important as sorghum is for the livelihoods of local communities, it has now also become the target of the biotechnology industry, largely because of its genetic potential, but also because it is seen as the perfect crop for a public relations offensive. The industry has won the support of powerful backers. Even before the Bill & Melinda Gates and the Rockefeller Foundations announced in September 2006 that they were funding a new Green Revolution for Africa, they had already put big money into the so-called "African Biofortified Sorghum" (ABS) project, for the development of GE sorghum for Africa.

The ABS is widely known as the "super sorghum" project. It has a long list of collaborators, including the University of Pretoria, South Africa's Agriculture Research Council (ARC) and Council for Scientific and Industrial Research (CSIR), the Forum for Agriculture Research in Africa (FARA) and various universities in the USA. It is led by the "Africa Harvest Biotechnology Foundation International", headed by Florence Wambugu. Wambugu is one of the leading defenders of genetic engineering in Africa. She claims that this is, for once, a wholly "Africa-owned project", but forgets that the technology belongs to Pioneer/Du Pont. She makes a multitude of claims for "super sorghum": it will fight HIV/AIDS, increase farmers' productivity and in the process "mentally empower" farmers.

As the scientific leader of the project, Du Pont Crop Genetics Research (Pioneer) "donated" technology to Africa that was valued (by Du Pont) at US$4.8 million in unclaimed intellectual property rights (IPR) earnings. The material they have supplied include IPR-free GM sorghum, engineered to contain 50 per cent more lysine (an amino acid found in proteins said to be beneficial to human health). The African Agricultural Technology Foundation (AATF) manages the intellectual property and license negotiations between the "collaborators": Pioneer itself, CSIR, and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). This, of course, turns the whole project into a "win–win" situation for Pioneer (which sits on the Board of AATF). But despite the rhetoric, feeding people is not really on the radar of the super sorghum pushers. In the vision of Dr William Dar, the Director General

10 T. Hunduma, "Local Crop Genetic Resource Utilisation and Management in Gindeberet, west-central Ethiopia", thesis submitted to the Norwegian University of Life Sciences, May 2006, p. 49.

11 J. Eberlee, "Long-Term Sustainability of Ethiopian Landraces at Risk", August 2001, http://tinyurl.com/336aug

12 Dr Awegechew Teshome, personal communication, November 2006.

The "super sorghum" pushers keep on pushing

The ABS Consortium wanted to use biotech-friendly South Africa to launch their GM sorghum in Africa and, with the CSIR and ARC on board, applied for a permit to carry out experiments. Even though sorghum is not as important in South Africa as in most of the rest of Africa, the pro-biotech South African government still found the threat of contamination serious enough to reject in June 2006 the application for experimental planting of Pioneer's GM sorghum. The CSIR re-applied on behalf of the ABS Consortium, and South Africa's regulatory body again rejected the application on 30 January 2007. The advocates have indicated that they will not give up and said in the media that they were confident that, by putting continued pressure on the South African government, they would eventually break down its resistance.[1] One would have thought that the propaganda put out by the ABS Consortium could be believed only by the most naive of politicians. But late in February, at an ABS Open Day, the South African Minister of Agriculture, Lulama Xingwana, said that the government would support the ABS project.

1 O. Ogodo, "South Africa halts 'super' sorghum study", SciDev.Net, 20 July 2006.

of ICRISAT, what is important is to get the poor communities in the drylands to contribute to a glorious African future based on biofuels.[13]

The Bill and Melinda Gates Foundation have contributed US$16.9 million to the project, as it fits in perfectly with their vision of a new Green Revolution for Africa aimed at breeding new seeds and getting Africa's small farmers to use them.[14]

Undermining sorghum's diversity base

While a very important staple food crop in Africa and Asia, sorghum is also widely grown in Central America, the US and Australia, mainly for animal feed and increasingly for biofuels. The annual global production of sorghum now fluctuates around 60 million tons. The protein in most sorghum varieties is considered inadequate, with a low lysine value, and not very digestible. Traditionally, farmers have known how to deal with this: sorghum is often fermented to make essential nutrients available to the human digestive system. In addition, African farmers have developed their own sorghum varieties, high in lysine, which farmers grow when needed. Moreover, the thousands of sorghum varieties grown all over Africa are locally adapted to agro-ecological zones and cultural uses, and this is just one of the reasons why the uniform approach of the Green Revolution did not and will not work in Africa.

There is also a wide variety of wild relatives of sorghum, some considered weeds and others used by farmers, with which the cultivated crops readily exchange genes, and it is very important for the farmers that these continue to be a future source of genes.[15] In west-central Ethiopia's Gindeberet region alone, six wild varieties of sorghum have been found; three are in the process of being domesticated.[16] In fact, there are wild relatives in most sorghum-growing areas. If these plants are contaminated with GM sorghum, serious and irreversible problems will be caused. For instance, Johnson grass (*Sorghum halepense*), with which sorghum can backcross, is considered one of the world's most noxious weeds.[17] If it is contaminated by the GM variety, it could turn into a super-weed and be extremely difficult to control. Moreover, GM sorghum will almost certainly contaminate farmers' varieties and cause further genetic erosion.[18] Contamination will also transfer the patented genes to farmers' varieties and, as Africa is rushing to implement legislation to protect corporate seed breeders, the corporations will inevitably raise questions about ownership,

The background to all this is that hybrid sorghum has already failed in Africa. In a 4-year on-farm trial in the early 1980s it was demonstrated that, in villages, none of the varieties carefully bred in research trials could outperform local types in any environment.[19] In a 1996 USAID report assessing extension support to sorghum and cowpea research in northern Cameroon, it was shown that the return on investment was extremely low.[20] Moreover, this study did not take into account (as these assessments seldom do), the opportunity cost of developing non-hybrid varieties. Despite the worldwide sorghum breeding done to date, less than 10 per cent of Africa's sorghum area is being planted with improved varieties from research stations.[21] In

13 ICRISAT formed a partnership with Rusni Distilleries in India to distribute hybrid sorghum seed and then buy the stalks from the farmers for biofuel production, *What ICRISAT thinks*, September 2006, http://tinyurl.com/ypw85t

14 GRAIN, "Another Silver Bullet for Africa?", September 2006, grain.org/articles?id=19

15 S. Edwards, "Crops with Wild Relatives Found in Ethiopia", in J.M.M. Engles *et al.* (eds.), *Plant Genetic Resources of Ethiopia*, Cambridge University Press, 1991.

16 T. Hunduma, "Local Crop Genetic Resource Utilisation and Management in Gindeberet, west-central Ethiopia", thesis submitted to the Norwegian University of Life Sciences, May 2006, p. 71.

17 M. Schmidt and G. Bothma, "Risk Assessment for Transgenic Sorghum in Africa: Crop-to-Crop Gene Flow in *Sorghum bicolour* (L.) Moench", *Crop Science* 46, 2006: 790–98.

18 See the objection against the sorghum application by the African Centre for Biosafety, http://www.biosafetyafrica.net.

19 S.J. Carr, "Technology for Small-scale Farmers in sub-Saharan Africa", Technical Paper No. 109, World Bank, Washington, D.C., 1989, p. 106, in *Lost Crops of Africa: Volume I: Grains*, Board on Science and Technology for International Development, 1996, p. 149.

20 J.A. Sterns and R.H. Bernsten, "Assessing the impact of cowpea research and extension in northern Cameroon", *International Development Working Paper No. 43*, Michigan State University, 1996, http://tinyurl.com/2rl42c

21 *Lost Crops of Africa: Volume I: Grains*, Board on Science and Technology for International Development, 1996, p. 149.

Finding solutions for self-created problems

Over the last 25 years the CGIAR has spent over 40 per cent of its budget in Africa, but it failed to bring about a Green Revolution. All this money poured into research and extension has not made much difference to farmers in Africa, but the continent has, on the other hand, contributed hugely to crop improvement in the rest of the world. Through public research institutions, genetic material has continued to flow from Africa and India to private seed companies. According to a 1994 RAFI study, sorghum from Ethiopia alone was worth US$12 million a year to US growers, a figure that has undoubtedly increased since then.[1] India's CGIAR Research Centre, ICRISAT, is considered to be the world centre for improving sorghum and holds over 35,000 accessions of sorghum.[2] The USDA also holds a large selection of accessions, and uses them for the benefit of the US sorghum industry. Paradoxically, much research at these institutions focuses on eliminating problems that were in the first case created by hybrid sorghum varieties. For example, two key difficulties – grey mould, which is found in improved varieties that have a short duration or growing season; and sorghum ergot, a very serious disease that is spreading very rapidly – are encountered exclusively in hybrid varieties.[3]

1 RAFI, "The Benefits of Biodiversity", *Occasional Paper Series*, Vol. 1, No. 1, March 1994, http://www.etcgroup.org/upload/publication/490/01/occ_vol1_1.pdf

2 For more information, see CGIAR website, http://www.cgiar.org/impact/research/sorghum.html

3 Pandyopadhyay *et al.*, "Ergot: A new Disease Threat to Sorghum in the Americas and Australia", *Plant Disease* Vol. 82, No. 4, pp. 356–67. See also: "Focus on Crops of the Semi-arid Tropics", *New Agriculturalist* online, http://www.new-ag.info/98-1/focuson.html

these circumstances it makes absolutely no sense to introduce GM sorghum with more risks and even less acceptability.

Sorghum for food or for export?

Sorghum is a critical food crop for millions of Africans and Asians. In Africa sorghum is fermented to make beer, porridge, injera (a kind of bread) and other products, in a process that makes available the much-needed proteins it contains. If sorghum is processed in the right way and cultivated in a mixed farming system, it can form the basis of a varied and balanced diet, where foods complement each other. As Dr Awegechew Teshome pointed out, "The solution to hunger lies within these communities. They must leave the system alone because it works for farmers. There must be a faithful relationship between farmers and scientists, where scientists enhance the knowledge of farmers, and support and empower them to value their own seed."[22]

But sorghum is also becoming an increasingly attractive commodity to the industry. There is now a rush to find alternatives to maize, which cannot grow in marginal conditions. There is the market for animal feed, and now for biofuels. Sorghum is clearly a crop with huge potential for the agro-chemical industry, with a large untapped earning potential.

All over the world we have seen the same pattern of action for creating markets for multinational agrochemical companies: first, the dismantling of government support for farmers and the weakening of local control over biodiversity and land; then, when hardship strikes, the moving in with hybrid seed, fertilisers, and GM seed, often in philanthropic guise. All these initiatives operate on the arrogant assumption that the people behind them know better than farmers and that crops developed in labs are better for farmers than their own varieties. These people refuse to acknowledge that such interventions have failed time after time, and that they have caused untold misery. By refusing to acknowledge and respect the innovations made by farmers over millennia, they devalue traditional crops and cultures in order to strengthen the seed and chemical industry, which sells seeds back to farmers at a premium, and thereby contributes to the devastating erosion of livelihoods.

22 Dr Awegechew Teshome, personal communication, November 2006.