Exploiting the Power of Science, Transforming the SAT

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ICRISAT
Science with a human face

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EXPLOITING THE POWER OF SCIENCE, TRANSFORMING THE SAT

This is an anthology of appreciative and interpretive essays on the theory & practice of science by the International Crops Research Institute for the Semi-Arid Tropics. All are original essays published online in American Chronicle as well as the author's blogs; collected, revised and edited into this present volume.

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for the Semi-Arid Tropics
Patancheru 502 324, Andhra Pradesh, India

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The beans revolution. Jack and the new hen that lays golden eggs.

YES, this is the story of another hen that lays golden eggs. Call me Old Jack and this is full of new beans talk – from the unknown to the revolutionary ICPH 2671. It's the legume called the pigeonpea, and this story is from problem to promise, from peas to Rupees. Under the hands of science wizards, this pea has been transformed into a modern-day horn of plenty, if I may mix my metaphor. This is good news first for the farmers of India who grow pigeonpea in 3.5 million hectares, which is almost the total size of 4 million hectares planted to rice in the Philippines (irri.org). Size matters; size is relative.

The pigeonpea is a crop of a rainbow of colors. It is hardy and widely adaptable, growing well in cold or hot climates, acidic or alkaline sites, dry or irrigated fields, fertile or infertile soils (Frances Michaels, greenharvest.com.au); it is planted in many parts of Africa, Asia and Latin America (encyclopedia.farlex.com).

I don't know, but in the Philippines, an unknown lady bought ₱20 worth (about 45 cents) half a bowl of beans, and brought the beans to the house (also unknown), and found out nobody had 'the foggiest clue what to do with the beans,' says author unknown (marketmanila.com).

Beans unknown! I'm surprised. I am a Filipino and proud to say so; this is the Philippines, a great country that even a great many educated Filipinos themselves talk much about in impeccable English or fluent Spanish or articulate Filipino but don't understand, don't love – a tropical Garden of Eden where many an Adam and Eve go after many species of useful plants, where you can find many villagers going beans and many citizens going bananas. I love it!

On second thought, I hardly know those beans myself. I don't remember growing them, harvesting them, handling them, even eating them; not surprising, as I'm a farmer's son who didn't have a bean to spend on them. I grew up in the eastern part of Pangasinan in Central Luzon where those unknown beans were, well, unknown.

If the crop be unknown, it means the beans don't mean anything to the cultivating life of the farmer, to the life of his family, to his wallet or to his wife's purse. In fact, this bean is relatively unknown in the Philippines, but I understand it is the second most important legume crop in India. And now, you ask, based in Manila, Philippines, why am I writing about India? It's a great country, and it's where the beans in my story come from, Sweet Pea.

Jump to Hawaii. From the College of Tropical Agriculture and Human Resources (CTAHR) of the University of Hawaii at Manoa, I learn that the unknown bean is botanically and completely called *Cajanus cajan* (L.) Millsp. (van der Maesen), *Cajanus cajan* van der Maesen for short. If I remember my taxonomy right, *Cajanus* is the name of the genus, *cajan* is the name of the species; *(L.)* means *Linnaeus*, the first botanist to give the crop a botanical name and published his description of it – he called it *Cytisus cajan*; Millsp. is the abbreviation of the family name of the botanist *Millspaugh* who corrected Linnaeus' original botanical name; and *van der Maesen* is the one who corrected both botanists after poring over the literature and examining inch by inch a sample of the plant itself to describe it, roots and all. From the database of the Food and Agriculture Organization (FAO), the botanical name is *Cajanus cajan* (L.) Millsp., and there is no mention of van der Maesen at all. Oh, anytime give me the study of the taxonomy of words, not beans.

Predictably, some people have the patience to find out more, more than just counting beans. I know – I watched Juan V Pancho, the internationally respected Filipino plant taxonomist, at work at the University of the Philippines Los Baños (UPLB) in the late 60s and early 70s. Doing so, he discovered some unknown species. He has moved on to the other side of life, but I can imagine him still poring over old books, old journals, old labels and new specimens, looking for the unknown. Unpredictably, I myself go on looking for the unknown in known or predictable stories. Such as this modern Jack & the beans talk.

The name 'pigeonpea' probably originated in the United States, where it was found that the pigeons loved it. Among its other common names I like are red gram, Angola pea, Congo pea, *dahl* (India). In Tagalog it's *kadios*, in Ilocano *kardis*. Philippine folklore has it that the pigeonpea is useful in medical therapy: an infusion of leaves is good for cough, diarrhoea and abdominal pains. Tender leaves are chewed for stomatitis and spongy gums; pulped leaves are used for sores. In Peru, the leaves make good medicine as infusion for anaemia, hepatitis, diabetes, urinary infections and yellow fever (Leslie Taylor, rain-tree.com).

The Indians of India love it more than anyone else. The crop is grown in that country in 3.58 M ha, while in Myanmar it is grown only in 0.56 M ha, in China 0.15 M ha, and in Malawi 123 M ha. Green seeds are consumed fresh as green vegetable; the crushed dry seeds make good feed for poultry and livestock; and the green leaves make good fodder for cattle. The Filipinos are still studying the matter.

Among other things, pigeonpea is drought-tolerant, meaning it can grow well even on dry grounds. I saw that myself when Department of Agriculture consultant Santiago Obien took me to his Bugnay farm in Ilocos Norte in Northern Luzon in March last year. The water well was empty and gray; the pigeonpeas were full and green.

Thinking of the plants under water stress, how could I explain the bean's survival? Of the fittest it must be. In fact, it more than survives: it thrives. This hasn't been mentioned in press releases or I haven't read it in the emails but, you know, I have the curiosity of a cat. So, summoning the knowledge I gained from reading literature on my own and from my bright professors and their boring lectures during my overstaying student presence at the College of Agriculture of the UPLB in the 1960s – I had only one explanation in mind, a hypothesis as it were: Pigeonpea has deep roots. I was sure, but I wasn't an expert in these things. I didn't know a bean about drought tolerance.

Googling, it took me about an hour to find support to my little hypothesis, and I found it in the website of the CTAHR. There, I am told pigeonpea has 'an extremely deep-rooting taproot' and the rest of the roots are thin and reach down to 2 m. There, I imagine those roots soak up the capillary water

rising from the underground water. Water goes up naturally. If you ask me about capillary action, I will tell you it is the opposite of the law that says, 'Water seeks its own level.' Water goes down naturally. That's what I know. (Incidentally, the CTAHR acknowledges that the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has conducted 'extensive research and breeding with pigeonpea.') From another source, about the roots of ICPH 2671 and the other wonder peas from ICRISAT: These hybrids produce 30% higher root mass than other pigeonpea varieties. This is important in water-starved soils, which we have plenty of in Asia, Africa, America and Australia – more of the pea roots bring up more of the nutrients from more of the deeper soils.

Historically, cultivation of pigeonpea dates back to 3,000 years and originated either in Asia (absoluteastronomy.com) or Africa (Jacki Passmore, cited in food.oregonstate.edu). In Indian cuisine, it's a favourite *dhal* (dry, dehulled, split seed for cooking). It also makes excellent pea soup.

So now, for the first time in history, here's a revolution you can devour, children.

Mother to this one, ICRISAT names it the Pigeonpea Green Revolution, with the new seeds capable of producing 3-4 tons of peas per hectare, at least two times the yield of old varieties in farmers' fields. 'Pigeonpea Green Revolution' also alludes to the first Green Revolution brought about by high-yielding varieties of wheat and rice that changed the economies of the world. The new Green Revolution is based on legumes that are a major source of protein in the developing countries. Because of this extraordinary pigeonpea, former

International Rice Research Institute (IRRI) Director General MS Swaminathan, a widely acclaimed and world-awarded Indian scientist and leader who is currently Chair of the Indian National Commission on Farmers, has predicted that the technological breakthrough 'will create a Second Green Revolution' in India, and then the rest of the world. On his part, ICRISAT Director General William Dar is 'confident that the revolution we started in India with hybrid pigeonpea will soon spread to different parts of the world.' I agree with that prediction; I share that confidence.

ICRISAT had announced the breakthrough boldly, knowing that 'Extensive research by reputed organizations across the world in the past 50 years could not succeed in increasing productivity of pigeonpea,' Dar is quoted by the *Times of India* as saying (July 2008, epaper.timesofindia.com). Remember, it took ICRISAT a total of 35 long years to achieve that scientific advance. I imagine that, like the Red Queen and Alice in Wonderland, those ICRISAT scientists had been running faster than scientists in other lands just to stay in place – first.

Dar attributed the pigeonpea hybrid success to public-private partnership, prominently with the Indian Council of Agricultural Research (ICAR), Acharya NG Ranga Agricultural University (ANGRAU), and a private seed company. 'I welcome more of such partnerships.' I myself will attribute it also to the discovery by van der Maesen of the wild relative of pigeonpea in the forests of Central India, which had the desirable qualities the scientists were looking for in a pea. Conservation-minded, I welcome such forests.

Resistance to diseases and a massive root system were among two qualities transferred from the wild variety to the cultivated pigeonpea. Those transfers were achieved via a technological breakthrough that had something to do with the breeding technique. After a total of 35 long years of trying, ICRISAT breeders finally succeeded in creating a pigeonpea hybrid using what is called a cytoplasmic male sterile (CMS) method, an innovation in the breeding of legumes. It is a complex process, and all I can say is that the CMS technique prevents self-fertilization (inbreeding) and allows cross-fertilization (hybridization), in this case the cultivated pigeonpea crossed with a wild relative, *Cajanus cajanifolius*. In inbreeding, as happens in most crops, the years of cultivation bring a continuing deterioration of yield, among other things; in hybridization, the performance is always high because the seeds are always of new genetic materials and always superior, the hybrid vigor always max. The pea soup is always thick.

I am the one who calls it The Beans Revolution. Beans, because there are a number of these new varieties of the pigeonpea, three of them being Asha, Laxmi, and ICPH 2671, the last being the first commercial pigeonpea hybrid in the world. Revolution, because as the election of Barack Obama, the first African-American President, is a radical change in the history of the

United States of America, so is the current and impending intrusion of the pigeonpea into the thinking and farming systems of Asia, Africa, America, and Australia. If Obama has shown outstanding performance as a presidential campaigner under challenging social circumstances, this new pigeonpea has shown outstanding performance as a productive crop under challenging site conditions. Obama is more than just a new US President – he represents change in many spheres of American life, including abroad, as we can imagine. This pigeonpea is more than just a new crop – it touches on many areas of agriculture, including conservation of natural resources, as we shall see.

In the dry tropics such as India, pigeonpea was a desirable crop in poor soils. It had no problem with lack of water or lack of fertilizer; it was the scientists themselves who had problems with pigeonpea. They could not advise the farmers to grow it because there were many problems with it. The crop was too weak for insect pests and diseases. It also was too leafy for the farmer's good. It also grew too slowly for the farmer's comfort. It also yielded too little for the farmer's security.

The plant breeders said, 'Needs improvement.' That is why scientists of ICRISAT had been trying to develop a variety of pigeonpea that was quite different from the old. With extreme difficulty. Their kind of science they could handle, but the length of time they could hardly manage. In contrast to genetic engineering, conventional plant breeding is slow-motion photography – with Mother Nature handling all the camera work.

In 1974, two years after ICRISAT was set up in India, the Institute's plant scientists started intense improvement work on pigeonpea with full support for R&D by ICAR, and it was only more than three decades later when they achieved the breakthrough. The generation of the world's first commercial pigeonpea hybrid through CMS was announced in 2005; such a feat was achieved with a seed company as private-sector partner.

In 1997, a new pigeonpea hybrid was tested in China; it didn't take root. One of the new pigeonpeas, ICPH 7035, is now taking roots in Southern China. Pigeonpea is currently grown in 150,000 ha in Gungxi and Yunnan provinces (icrisat.org). The Yuanmou Pigeonpea Farmers' Association in Yunnan Province is now growing it for seeds for sale in the country and possibly nearby Myanmar. The Research Institute of Resource Insects, along with the directorates of forestry and science & technology, is leading the Chinese effort in introducing two hybrids, ICPH 2671 and ICPH 3381, which I suppose are like peas in a pod. ICRISAT is promoting hybrid pigeonpea next in Brazil, Tanzania, Malawi and the Philippines.

In 2005, after 35 years of hard science, ICRISAT scientists, led by KB Saxena, ICRISAT's Principal Breeder of pigeonpea, succeeded in developing the breeding process for the commercialization of the pea that is:

- A fast grower
- Not bushy
- Not susceptible to major pests and diseases
- Not sensitive to length of days
- Resistant to waterlogging and salinity
- A high yielder
- A natural mulcher of soils – it produces much biomass and drops off all its leaves at the time of harvest.

ICPH 2671 can be harvested in 170-180 days. It is highly resistant to Fusarium wilt and sterility mosaic, two major diseases of this pea. With sterility mosaic, a farmer's loss can be devastating: 100%. With the hybrid, 10-12 kg of seeds to a hectare is all that is necessary for planting. It yields up to 4,000 kg, which is 5 times more than that of the best non-hybrids, considering an average of 800 kg – all in all, a quantum leap. With the ICRISAT breakthrough, pigeonpea becomes the world's first crop that yields much, needs little. Jack climbs the beanstalk and finds the hen that eats so few grains and lays so many golden eggs.

The beans are highly nutritious, containing up to 28% protein, ten times more fat, five times more Vitamin A, and three times more Vitamin C than ordinary peas (encyclopedia.farlex.com). Birgit Bradtke (tropicalpermaculture.com) has a personal list of the good things about pigeonpea:

- Beans ground into flour make good food
- The peas make nutritious animal feed or fodder
- Flowers attract bees that pollinate plants
- Plants can be pruned often for mulch
- Peas enrich the soil with nutrients
- Pea hedges make good windbreaks
- The plants make good green manure
- The stems make good firewood
- Peas make good living trellises for climbers
- Pigeonpeas grow just about anywhere.

Pigeonpeas also make excellent nurse plants for corn (MCT, plantpath.cornell.edu). With their deep and massive roots, pigeonpeas are now being mainly grown for soil buildup in 150,000 ha of hilly slopes of Southern China; with their relatively fast growth and strong root systems, the peas stop soil erosion and otherwise regenerate degraded sites with plant nutrients coming from deep below the soil surface. Since it's a perennial, it can be grown and remains there for several years from one planting, covering the soil and minimizing erosion, according to Zong Xuxiao of the Chinese Academy of Agricultural Sciences (CAAS) in Beijing. The Chinese know something we don't. Also in China, they are now producing foods and drinks from the seeds.

Since hybrid seeds are expensive, in India, the MS Swaminathan Foundation is now empowering women to grow the hybrid pigeonpeas and produce seeds in such a manner that small farmers can afford them. This is no small matter as India produces 85% of the world's pigeonpea beans.

News from Australia is that a hybrid pigeonpea has the potential to produce 8 tons of beans to a hectare (ac iar.gov.au), max. Even with the current 4 tons, already that's a max of eggs. In the Philippines, that's a max of Pesos. So there you have it; ICPH 2671 is the first modern hen that lays the golden eggs in this version of Old Jack & the new beans talk. Fifty-seven hybrid cultivars of pigeonpea have been released in Asia, Africa, Australia and the USA. That means Jack's hen today is commercial and now selling in a market near you.

(Published on 26 January 2009)

2

Designer crops. My Intel Core i7 sanger sequencing in Manila.

DESIGNER jeans, Designer water. US President Barack Obama is a designer's dream; he is business cool. One of these days, he will mind the business of global warming, and the related business of Sanger sequencing, and I expect him afterwards to say, 'I want my designer crop, and I want it now!' It takes brains. This is a true story of brains, sequencings, genomes, made-to-order crops. One brain is logical (it's sequential); another brain is computational (it's also logical); still another brain is neither (it's creative, that's all). To promote science to promote society, we have need of all three of them. The first brain I associate with plant geneticists – they feel filled; the second brain I associate with computer experts – they feel content; the third brain I associate with people like me – I feel great!

The good news is that sorghum's genome has been completely, successfully sequenced; this science coup has been achieved by an international team led by Andrew Paterson, Director of the Plant Genome Mapping Lab, a joint unit of the University of Georgia and Franklin College of Arts & Sciences. It is now reported in the 29 January 2009 issue of *Nature*, a science journal with an international reputation for quality of content. Quality is in the details. The bad news is that neither quality nor science is exciting news to many.

Should I, a science writer, be excited? Those scientists who reported their success don't appear to be excited themselves; look at the uninspiring title of their *Nature* paper: 'The *Sorghum bicolor* genome and the diversification of grasses.' My genome is my total DNA sequence, if I understand things right; and no, my own genome doesn't excite me at all. Paterson is not communicating; it's all Greek, it's all grass to me.

But I'm excited about another genome sequencing – mine, leading to my own designer crop of course. To address everybody's business: global warming.

Now, look at the DNA building blocks below for a species I shall not identify at the moment. If you can come up with the genome sequence of this '!%1236AAA' DNA set – all the letters of the alphabet are there – then you can design a supercrop that is perfect for the 21st century – amidst problem crops, problem soils, problem local weather, including problem political climates. Since the 1880s, they have had crop circles in England; this is the modern crop circle I have in mind:

! % 1 2 3 6 A A A A A A A A A A A A A A A A A A A A B C C C C C C C D D D
D D D D D D D D D E E E E E E E E E E E E E E E E E E E E E E E E E E E E E E
E E E E E E E E E E E E E E E E E F F F F F F F F F F F F G G G G G G G G G G G
G G G G H H H H H H H H H H I I I I I I I I I I I I I I I I I I J K L L L L L L L L L L L L L
L L L L M M M N N N N N N N N N N N N N N N N N O O O O O O O O O O O
O O O O O O O O O O O O O O P P P P Q R R R R R R R R R R R R R R R R R R
R R R R R R R R R R R S S S S S S S S S S S S S S S S S S S S S S S T T T T T
T T T T T T T T T T T T T T T T T T U U U U U U U W W W W W W W W W W
X Y Y Y Y Y Z Z

Can you read my mind? Of course not. That's the point.

'!%1236AAA' is a designer brainteaser. You can't read between the lines – the lines themselves don't tell you anything, except that they are strings of letters all derived from the English alphabet. Do you realize Paterson & Co couldn't have sequenced the sorghum genome with superfast computers without the slow English alphabet?

Now you're getting a good idea how (almost) impossible it is to sequence anybody's genome: human being, mungo bean, grain or sweet sorghum. It takes human brains and computer brains to sort things out superfast, to read the instructions for life (DNA) and, even with all that, it takes years. It took

Paterson & Co three years to assemble and annotate the genome of sorghum (phytozome.com). And that was fast.

'!%1236AAA' is a designer complexity. You can't decipher it. What you have seen is only one set of codes, and it is made up of 317 letters and other characters of the English language – anyway, I challenge you to make sense of it, to read the message of a crop.

That alphabet soup is my creative reaction to the critical news that the genome of sorghum has been completely sequenced (see 'Scientists publish complete genetic blueprint of key biofuels crop'; David Gilbert, 29 January 2009, innovations-report.de). Not only have Paterson and his scientists published the sequence but they have analyzed the complete genome of sorghum; the scientists belong to the Joint Genome Institute (JGI) of the US Department of Energy and several partner institutions (chinaview.cn).

There are two varieties of sorghum; grain sorghum is grown for the grain, sweet sorghum for the sugar. Sweet sorghum is my favorite crop. 'Sorghum's importance is enormous,' says Paterson, leader of the genome team. That's sweet.

But I'm not sure I'm clear what genome sequencing is all about. The Human Genome Project website tells me that genome or DNA sequencing is the process of determining the exact order of the chemical building blocks (called nucleotides or bases) in the order of the many As, Cs, Gs and Ts that make up an organism's DNA; the human genome has 3,000,000,000 of these genetic letters (GNN, genomenewsnetwork.org). A genome is a set of all the genes a species has in its chromosomes. The human genome has 50,000 to 100,000 genes (cccoe.net); the sorghum genome has 30,000 genes, typical of grasses (Dan Rokhsar, Xinhua as cited). As Gilbert puts it, genome sequencing is 'a highly challenging computational problem.' The numbers awe me, not excite.

In other words, now they can read the DNA of sorghum as if it were a book, as in fact, scientists call DNA the 'book of life'. DNA reading must be boring!

That's why I thought of a virtual designer challenge. And so, as I will show you in just a moment, you can read my '!%1236AAA' sorghum conundrum as if it were marquee, scrolling screen messages in plain English, no words high-faluting.

Wait, whom do we owe the successful DNA sequencing of sorghum? These people, all 45 of them listed as co-authors of the *Nature* paper; the long list shows how exhaustingly detailed and terribly difficult the job was that it needed all their brains:

Andrew H Paterson, John E Bowers, Remy Bruggmann, Inna Dubchak, Jane Grimwood, Heidrun Gundlach, Georg Haberer, Uffe Hellsten, Therese Mitros, Alexander Poliakov, Jeremy Schmutz, Manuel Spannagl, Haibao Tang, Xiyin

Wang, Thomas Wicker, Arvind K Bharti, Jarrod Chapman, F Alex Feltus, Udo Gowik, Igor V Grigoriev, Eric Lyons, Christopher A Maher, Mihaela Martis, Apurva Narechania, Robert P Otillar, Bryan W Penning, Asaf A Salamov, Yu Wang, Lifang Zhang, Nicholas C Carpita, Michael Freeling, Alan R Gingle, C Thomas Hash, Beat Keller, Patricia Klein, Stephen Kresovich, Maureen C McCann, Ray Ming, Daniel G Peterson, Mehboob-ur-Rahman, Doreen Ware, Peter Westhoff, Klaus FX Mayer, Joachim Messing, and Daniel S Rokhsar.

So they have sequenced the DNA of sorghum; why is that important? Red Orbit says (28 January 2009, redorbit.com):

The researchers are hopeful that the results might lead to ways of creating even more drought-tolerant types while providing a blueprint for developing, through breeding or genetic engineering, improved forms of other crops such as corn.

They owe their huge accomplishment to the genius of Frederic Sanger who first thought of sequencing the genome about 25 years ago; to give due honor, today, the art and science of sequencing DNA is known as Sanger sequencing (Edmund Pillsbury, bioinfo.mbb.yale.edu).

ICRISAT based in India, is 1 of 21 institutions that participated in the Sanger sequencing of the sorghum genome. Not surprisingly, it has positively and strongly reacted to the news. Director General and Team Captain of ICRISAT William Dar tells me that, from the point of view of ICRISAT, the Sanger sequencing is 'a monumental development which will impact on and enhance our breeding of sorghum varieties adapted to changing climate, abiotic and biotic stresses.' That is to say, ICRISAT is going to come out with sorghums that grow well considering global warming and, among other things,

considering pests, diseases, soil nutrient deficiencies, waterlogging, and drought. Especially drought. Knowledge on the DNA sequences 'will speed up development of resilient sorghum varieties.'

With 34,496 gene models of sorghum having been inventoried, Dar says, this opens to great possibilities in breeding. For instance, once some sorghum genes have been predicted or identified for drought tolerance, these genes can be used in genetic engineering to develop drought tolerance even in maize, a species related to sorghum, as well as in other cereals, such as rice. If you can't fight them, tame them. Design crops that can best stand drought. Designer maize. Designer rice.

How about improving sorghum itself? Designer sorghum. 'Identification and understanding of genes involved in C4 pathways should be useful in manipulating fuel production of sorghum,' Dar says. 'Fuel' here refers to 'biofuel' or ethanol from either or both sorghum grains and stalks. Also, ICRISAT is looking into the possibility of breeding other sorghum varieties with high content of cellulose as an alternative source of renewable fuel for cars, buses, trucks, tractors, including airplanes.

Already, sorghum has many vitamins (ACP, fao.org). Don't forget, Dar says, that the sorghum grain has high levels of iron (>70 ppm) and zinc (>50 ppm). Once they have identified candidate genes, they can be genetically manipulated to increase iron and zinc contents in sorghum and other cereals to help reduce malnutrition worldwide. From A to Zinc.

There's more where it comes from. Paterson himself says that the wild relatives of sorghum can survive with even less water and resist even more pests and diseases, and the genes for these can be transferred to the cultivated sorghum. Designer sorghum. With genetic engineering, hopefully now you can pester all those pests.

Now I go back to my '!%1236AAA' puzzler. Since this genius hardly understands the concept of Sanger sequencing himself, I thought of trying to explain it to myself by coming up with a metaphor. Yes, '!%1236AAA' is a metaphor. I'm coming up with a virtual sequencing.

Since '!%1236AAA' is composed of single letters and other characters that by themselves are unreadable except if they are linguistically related one way or the other so that they become understandable, and since combinations of characters and letters are processed best by the modern personal computer, I decided to turn to the mechanical brain, the central processor of the PC. And just in time, too. The news of the Sanger sequencing of sorghum appeared on 29 January, and I just happened to have brought home my new PC. Now I have 'the fastest processor on Earth' – an Intel Core i7 920 @ 2.67 GHz 2.66 GHz with 3 GB RAM Transcend DDR3-133 running on a licensed Windows

Vista. It was designed for speed maniacs like me. When sequencing genome, processing speed is of the essence.

I am told the Intel Core i7 has the Nehalem processor, 'the most sophisticated ever built, with new technologies that boost performance on demand and maximize data throughput' (Intel, source cited). I'm sure the Sanger sequencers understand that. Expect performance to the max. Here's the PC when you need it most. With the sorghum genome known in proper DNA sequence, we can expect breeding performance to the max. Here's the DNA when you need it fast.

The J Craig Venture Institute calls the genome 'a jigsaw puzzle' (GNN, genomenewsnetwork.org). It is, because you have to fit the exact pieces together, and there is only one solution. But since the sorghum genome contains 30,000 genes, how on earth can you find the proper Sanger sequence when you can't really see anything? To help myself understand, I programmed our Core i7 to read this alphabet soup as I have already told you:

! % 1 2 3 6 A A A A A A A A A A A A A A A A A A A A B C C C C C C D D D
D D D D D D D D D E E E E E E E E E E E E E E E E E E E E E E E E E E E E E E
E E E E E E E E E E E E E E E E E F F F F F F F F F F F F G G G G G G G G G G G
G G G G H H H H H H H H H H I I I I I I I I I I I I I I I I I I J K L L L L L L L L L L L L L
L L L L M M M N N N N N N N N N N N N N N N N N O O O O O O O O O O O
O O O O O O O O O O O O O O P P P P Q R R R R R R R R R R R R R R R R R R
R R R R R R R R R R R S S S S S S S S S S S S S S S S S S S S S S S T T T T T
T T T T T T T T T T T T T T T T T T U U U U U U U W W W W W W W W W W
X Y Y Y Y Y Z Z

You cannot imagine the number of possible combinations among those 317 characters, each one representing a gene. To get an idea, if I used all numbers instead of mostly letters, I can get this possible total sequences (combinations) out of

numbers 1 to 29:
8,841,761,993,739,700,000,000,000,000,000
numbers 1 to 39:
20,397,882,081,197,000,000,000,000,000,000,000,000,000,000,000
numbers 1 to 49:
608,281,864,034,270,000,000,000,000,000,000,000,000,000,000,000,000,000,000,00
0,000,000 (48 zeros after 270).

I'm using *Calculate* in Word 2003 to compute for the total number of combinations; at *1 to 50*, Word 2003 tells me, '!Number Too Large To Format.'

All this I'm sure is a miniscule effort compared to the Sanger sequencing of sorghum, but you and I get the idea.

As if to test its computing power, the very first assignment I give to our Core i7 is to read the undisclosed messages from the sequence of codes that begins with '!%1236AAA.' Does it compute?

Look at what it has come out with in deciphering the genetic blocks of my favorite crop – read it as marquee, endlessly moving messages repeating themselves:

SWEETER THAN SUGAR 16-23% BRIX NEEDS MUCH LESS WATER GROWS IN THE DRYLANDS OF THE WORLD TOLERATES WATERLOGGING TOLERATES HEAT TOLERATES ACID SOILS TOLERATES SALINE SOILS GOOD FOR JAGGERY NO FERTILIZER NECESSARY FOOD FEED FODDER FERTILIZER FUEL FENCE PULP FOR PAPER CLEAN FUEL WITH HIGHER OCTANE RATING NO NEED TO MODIFY ENGINE GROWS QUICK GROWS ANYWHERE SWEET SORGHUM IS GREAT!

Now then, with all that knowledge, you can design the perfect climate crop of the 21st century with these desirable characters:

Sweeter than sugar – 16-23% Brix
Needs much less water – grows in the drylands of the world
Tolerates waterlogging
Tolerates heat
Tolerates acid soils
Tolerates saline soils
Good for jaggery
No fertilizer necessary
Food, feed, fodder, fertilizer, fuel, fence, pulp for paper
Clean fuel with higher octane rating
No need to modify engine
Grows quick
Grows anywhere!

And of course, in the end you will learn that in fact, we already have that ultimate designer crop: sweet sorghum. Nature has designed it to be excellent to address public concerns about climatic change as well as private concerns about poor farmers and poor soils.

In other words, I didn't do any Sanger sequencing at all. I couldn't recognize a DNA code to save my life. What I really did was come up first of all with the list of the winning ways of sweet sorghum, and then with Word 2003 I separated all the characters individually and sorted them to make what I call the '!%1236AAA' genomic building blocks. The true story of my Core i7 just happens to be a perfect decoy to tell this true story of a genome.

So now I can tell you about C4 pathways. Rice is a C3, sorghum is a C4; where sorghum goes is the C4 pathway. A C3 plant is so-called because the first stable product it makes in photosynthesis is a 3-carbon compound; a C4

plant makes a 4-carbon compound first, then goes on its way to manufacture food for itself and man, much more than a C3 plant does. That's Nature. C3 plants require cooler and wetter climates; C4 plants thrive in hotter, drier environments (answers.com). Like some people you know, rice goes on demanding more resources, while sweet sorghum goes on demanding less and producing more. Rice gets my 3 stars; sweet sorghum gets my 4 stars – no crop is perfect, 5 stars.

C4 crops are hardy and stress-resistant; with knowledge in genome sequence applied in plant breeding/biotechnology, our scientists 'could spur 21st century crops' (29 January, Brandon Keim, greenbio.checkbiotech.org). Red Orbit quotes Joachim Messing, a Rutgers University plant geneticist, one of the authors of the *Nature* paper, sharing his mind-bending experience with C4 crop sorghum in southeastern Africa:

You should have seen the maize growing there, how poorly it did, and then see sorghum just across from it standing tall and green and resistant to disease and drought.

'Drought is the major environmental factor constraining crop production globally,' says Andrew Borrell & Co (cropscience.org.au). Other than sorghum, the crops know the plaint of Samuel Taylor Coleridge's *Ancient Mariner*: 'Water, water every where/Nor any drop to drink!' But you have a survivor crop, sweet sorghum. You know why? One reason is that sorghum roots go down beyond 2 meters (Ian Broad & Graeme Hammer, cropscience.org.au), tapping the underground water rising up by capillary action. Not only that – sorghum roots are massive (National Research Council, 1996, books.nap.edu). Here is Mother Nature's intelligence at work: Water seeks its own level – it goes up, up; and the sorghum root knows which side of the soil is wetter – it goes down, down.

In this world, there is a limit to chemical fertilizers and pesticides. Perfect for sorghum, that resilient, tolerant, superior species scientists prefer to call *Sorghum bicolor*. I believed that sweet sorghum is the Complete Climate Change Crop, the C4 of C4 species. With this designer crop, we can design a Green Future for Mother Earth.

Even the independent-thinking Chinese know much about sorghum. They tell us the grains produce as much ethanol per bushel as corn and yet it needs one-third less water. The stalks grow fast, from 8 to 15 feet in one season. ICRISAT knows: sorghum grows well on marginal soils where other crops will stunt or worse, shrivel and shrink (news.xinhuanet.com). It's a 'failsafe' crop too (springerlink.com). And it's a perennial, so it can be ratooned; thus, there is no need for replanting and disturbing the soil after every harvest, thus preventing soil erosion and conserving soil water.

Today, American corn needs twice more water to grow than American sorghum. So, to approximate the projected excellent performance of American sorghum in the primary role of producing more ethanol more efficiently than American corn, which US President George W Bush had insisted as the main source of ethanol for American cars, some American plant breeders are going to transfer the genes of drought-tolerance from sorghum to corn, so that maize will 'over-express the genes' and become drought-tolerant, and eventually become the ultimate corn that it can be. Designer corn. And they will transfer the genes to other sources of biofuel to produce out of those grasses their designer crops: American sugarcane (designer sugar), European Miscanthus (designer grass), American switchgrass (designer switch). This is physical transfer of traits from one crop to another; it is an exception to Mendel's law of heredity that traits can only be inherited, not acquired. Laws are made to be broken.

It takes brains, yes; it also takes years. In the meantime, I'll take the road more travelled – I'll take the designer crop of designer crops that is here and now: sweet sorghum. In the midst of news of droughts in Africa, Asia, Australia and the Americas, now you know why I have sweet dreams.

(Published on 1 February 2009)

3

The bean revolution 2. Waging wars with women.

US President Barack Obama's is a revolution of change we can believe in. I am more interested in a revolution of change we can participate in. Then I can more or less believe. So, we must wage a revolution with understanding for the Beans Revolution to succeed. So we must learn from the past.

How did the Green Revolution happen? They made it happen. In the Philippines, I know from personal observation in Laguna (Southern Philippines) where I stayed and worked, and in Pangasinan where I was born and grew up, and from the papers. It was a revolution of rice expectations. They called it *Masagana 99* (Bountiful 99), in reference to the target harvest of 99 sacks of palay or unmilled rice from each hectare.

From where I sat in those Masagana 70s, the contributors to the Green Revolution were:

- Other countries (loans to Philippine government)
- Government (policy)
- Research agencies (high-yielding varieties of rice)
- Credit facilities (supervised credit to farmers)
- Chemical companies (fertilizers and pesticides)
- Non-government organizations (advocacy)
- Businessmen (marketing)
- Farmers and their families (production)
- Mass media (success stories).

Now that I have listed them all down, it occurs to me that the borrowings ('loans' and 'supervised credit') provided the key stimulus for the Green Revolution to occur with the concurrence of everyone. You cannot wage a revolution without funds, without another country to support you, even if you have the vanguard leader and warriors, policy support from government and vocal support from the rich.

We are in the Philippines, a country of contrasts and contradictions. *Inquirer* columnist Solita Collas-Monsod says no, the credit part of Masagana 99 was unnecessary; 'apparently did not contribute that much' (citing Manny Esguerra's thesis, 1981, UP Los Baños); and no, it was profit and not credit that impelled the farmers to plant the new rice varieties (citing Orly Sacay & Co's study, 1985) ('Masagana 99 redux,' 03 June 2008, opinion.inquirer.net). The rices came mostly from, the International Rice Research Institute. Well, as far as I can tell, Solita, Manny and Orly are both right and wrong. They are correct if you consider only the not-so-small farmers who have access to resources anyway, Masagana 99 or not, and there were many of them, and that included my own father. They are wrong if you consider the really small farmers, including the landless, who number legion – if you don't give them a friendly loan, they turn to any of three borrower-friendly, underground sources of credit: the friendly usurers who demand 5-6 (for every 5, you pay back 6 every single day), the friendly suppliers of fertilizers and pesticides who demand exorbitant prices for items on credit, and the friendly traders who demand buying the harvest after threshing and paying at their dictated price. Let us give credit to whom credit is due! Friends in need, friends indeed?

Anyway, credit proved to be dangerous to Masagana 99, even if I failed to see it. I was 30 something, young and arduous and already a public nonconformist, but I didn't see anything wrong with Masagana 99; I didn't see that loans would wreak havoc on the Philippine economy. In fact, it wasn't the loaning that was the problem; it was the borrowers not paying back what they owed the government, too many and too much. The Masagana farmers numbered 500,000 (country-studies.com); if each Masagana farmer borrowed $100, the total loans would have been $50 million, by my computation roughly the equivalent of $1.5 billion today.

That is to say, the Filipino farmers greatly failed the Green Revolution themselves. They failed to contribute what was asked of them: Pay their debts. 'Loan repayments ... had gone down to 35%,' Robert Flint Chandler reported in 1979 (Rice in the tropics, Los Baños: International Rice Research Institute, p128); that was the IRRI Director General speaking. In other words, 65 out of 100 farmers did default. 'The fault, dear Brutus, lies not in our stars but in ourselves, that we are underlings' – Julius Caesar, Act 1 Scene II.

And now we have the Beans Revolution before us. I cannot imagine except that it too will need loans to farmers – but this time, we have to be careful to identify the borrowers who are most likely to return what they have borrowed. And I have just found what Muhammad Yunus of Bangladesh accidentally found out 30 years ago, while the Green Revolution was raging in the Philippines:

The women make the best borrowers.

How did I find out what Yunus had already discovered? Not able to sleep, I was reading avidly an old copy of *The New Yorker* dated 30 October 2006 that I bought for a song at a garage sale last year, 2008, and had reached 'Millions for millions,' the long essay on micro-credit or micro-finance by Connie Bruck, pages 62-73; at about midnight, I had an epiphany:

In the revolution that Muhammad Yunus had accidentally waged in Bangladesh, the Grameen Bank, the people's bank, and for which he had won the Nobel Peace Prize in 2006, 100% credit goes to the women.

Okay, 96% of the credit that year. They call it micro-credit – because of its gargantuan success, it doesn't look micro to me; it's macro. It's a huge thing. Grameen Bank is the biggest thing since the *Titanic*. Grameen is banking for the poor; the poor number in the billions.

It's a major thing. In its website, Grameen Bank says (grameen-info.org):

Yunus' long-term vision is to eliminate poverty in the world. That vision can not be realized by means of micro-credit alone. But Muhammad Yunus and Grameen Bank have shown that, in the continuing efforts to achieve it, micro-credit must play a major part.

As of December 2008, Grameen Bank had 7.67 million borrowers with 2,539 branches covering more than 99% of the total villages in Bangladesh, 97% of the borrowers being women (GB website).

In 2006, 96% of the Grameen borrowers were women, in 2008, they constituted 97%. I didn't have eyes on them before, but women definitely are an irresistible force for good. This is not Women's Liberation – this is Women's Revolution; this is not Women's Lib – this is Family Life. The Grameen women are not fighting for Equal Rights; they are fighting for Equal Lives.

Grameen Bank's positive impact on its poor and formerly poor borrowers has been documented in many independent studies carried out by external agencies including the World Bank, the International Food Research Institute (IFPRI), and the Bangladesh Institute of Development Studies (BIDS).

I believe without having to see those reports of the World Bank, IFPRI and BIDS. Blessed are those that have not seen and yet have believed. You have to have faith.

And that is why I changed the second half of the title of this essay, from 'How to wage a war of understanding' to 'Waging wars with women.' From looking, if belatedly, I realize that the women are more important than the men when it comes to development, when it comes to family indeed.

Against the advice of banks and government,Yunus carried on giving out 'micro-loans,' and in 1983 formed the Grameen Bank, meaning 'village bank,' founded on principles of trust and solidarity.

I would revise that to say, 'founded on principles of womanly trust and solidarity.' Borrowers form groups of five of their own kind; the groups are federated into centers, and the centers link with Grameen Bank. With visible Yunus, who went ahead and formed the Grameen Bank against the advice of experts, the women are the unseen secret of the success of Grameen as a credit option. I see therefore:

The Beans Revolution will have to be waged by women!

Now, the problem we have is how to wage this war with understanding so that success is assured. We want to achieve more than what the Green Revolution did, which were higher yields and higher incomes for farmers, as well as higher net profits for millers and middlemen. The total progress of a country must be not only economic but also environmental stability. You cannot use the soil and abuse it. You cannot have your cake and eat it too. We are stewards and stewardesses of Earth; handle with care.

To be sure, the Beans Revolution cannot be waged by its initiators alone, partners and ICRISAT, headed by now-world-recognized Team Captain & Director General of ICRISAT William Dar.

So, is a revolution a change we can believe in? That depends on its objectives. Is the Beans Revolution a change the poor farmers can believe in? Only if the farmers take part in it in a meaningful way – and only if the rest of society become active participants in the drama of development.

Let us learn from the Green Revolution of the 20th century to be able to wage successfully the Beans Revolution of the 21st century.

The targets of the Green Revolution were the rice farmers. That meant the male farmers, as most farmers were male. That proved to be the oversight. The male of species was deadlier than the female when they had to pay back – 65 out of 100 farmers would not.

Now, who are the targets of the Beans Revolution? You're mistaken if your answer is 'Farmers.' Everyone is a target of this revolution, or any revolution for that matter. You're also mistaken if you say the targets are the 'Stakeholders' – I don't want to use the idea of stakeholder because that term emphasizes a personal stake, a self-interest; it does not give proper emphasis on teamwork, on cooperation. Remember: Your stake is as good as mine.

Change targets to wagers; change stakeholders to contributors. The Green Revolution was waged; the Beans Revolution must be waged. And remember: You can't wage a war based on personal interests – the interest of one must coincide with the interests of the others.

So, in my mind, all of them, these are the wager-contributors to the Beans Revolution:

(1) *Revolutionary investors*
Do you differentiate capitalists from investors? I don't. Neither does Bill Gates and his radical idea of creative capitalism. The focus of Grameen is the have-nots – are they willing and able to become entrepreneurs? The focus of

creative capitalism is the haves – are they willing to invest in those who have nothing so that they may be able to help themselves? The creative capitalists don't say there is no market – they create the market. And they may or may not get back profit, but most likely only recognition from government and the gratitude of the poor. Truly, that is sharing. Creative capitalism is sharing.

(2) *Rebel village bankers*
Borrowing, if you will pardon the expression, from the example of Muhammad Yunus' Nobel Prize-winning Grameen Bank, we need to build Grameen people out of bankers out there in the villages. We must not forget the Grameen basics: groups of five, small loans, no collateral, close supervision of credit, peer pressure, transparency, planning and management.

(3) *Women borrowers & managers*
Should I say, 'Be careful with farmers because they are mendicants?' I'm referring mostly to the male farmers. Truth to tell, if you offer me something that's mine for a song, I'll sing for it. So far, in my 33 years of experience with many an R&D project, 99 times out of 100, it's a dole out, a gift, a carrot stick for the farmer to be part of the project. In the Philippines, we have cultivated the mendicant attitude not only of farmers but most of all the urban poor. The poor deserve our compassion; they don't deserve our disrespect by treating them as children to appease by giving out lollipops.

The farmers must be made aware that, for instance, a loan is a loan, not a giveaway; that Government is the people – we pay taxes. If we don't pay taxes, we have no reason to complain about bad government.

And let the borrowers be only women; let them hold the purse strings so that they can manage their farm enterprises, not to mention deal with their husbands with some clout. No, I'm not talking of equal rights – only equal opportunities.

(4) *Scientists & seed producers*
These are the new vanguards of modern agriculture. They are necessary for producing certified seeds, hybrid seeds; these seeds are necessary if we want to harvest the most from the modern varieties. Therefore, also necessary are investors in modern methods, not the least of which is the search for such techniques. We need further R&D.

Otherwise, have you heard of farmer varieties? The farmers are good seed producers themselves, good developers of new varieties, selecting out the best performers from their own planned or accidental hybrids. I have seen it myself. When I stopped after high school in 1957, I helped my father a little in the growing of rice. I remember Lakay Disiong going ahead of the reapers and harvesting out the standouts, the best-looking panicles in the field; these would yield the seeds for the next crop. I don't remember if I asked him why; he is gone, but now I know. Do that every year and you have your own farmer's variety.

(5) ***Local government units***
To provide the policy support near or within the villages. LGUs cannot simply sit and watch the wagers of war go by and cheer them on – they themselves must contribute to the overall effort. New local laws may need to be passed or the old ones need to be amended to encourage the warriors in the Beans Revolution. The local educational system may need improvement so that families, mothers especially, do not have to worry about their children attending good schools. The local health services may also need strong LGU support.

(6) ***Non-government organizations***
NGOs must play some of the major roles in the Beans Revolution. They can initiate village projects with women in the forefront such as village banks, cooperatives, including handling and storage of raw or processed farm products, and eventually marketing. They can arbitrate in disputes. They can help create markets here and abroad.

(7) ***Civil society***
Not simply to denounce corruption here and there, not simply to agitate for government reforms now, but to advocate and practice stewardship and not profligacy with resources now. It is easy to criticize and do nothing – except vociferate and point your finger. I admire and applaud the loud pushers of entrepreneurship.

(8) ***Church officials***
To provide the social anchor on the highest ideal of morality. Accusation is not one of their options; assistance is. Let them be as doctors to the sick. Let them emulate Jesus, the Preacher's Preacher, the Doer's Doer. Let them recall what happened in Levi's house with Jesus and the Pharisees (Mark 2: 17 NRSV):

'Why does he eat with tax collectors and sinners?' When Jesus heard this, he said to them, 'Those who are well have no need of a physician, but those who are sick. I have come to call not the righteous but the sinners.'

(9) *Academicians*
They must teach students to take the revolutionary way, to become leaders of the people who must wage the revolution themselves on themselves – in peace, not in war. As an alumnus of the University of the Philippines, I'm thinking of the academicians, especially those who practice academic freedom by mouthing it, and not only at the University of the Philippines – when will you stop saying you love your country and start doing it? Our national hero, Jose Rizal, sacrificed his whole life for his country – can you not sacrifice a few years of yours?

(10) *Media people*
They must wage a war of words and ideas, images and illustrations of the revolution from the very beginning. As it goes, let them communicate a revolution of rising expectations, but let them not forget that it must be a revolution of rising participation first. Let them always remember that the media people themselves are not a people apart – a part they are, 'a piece of the continent, a part of the main' (John Donne).

Now, do you ask who of the wagers of the revolution are the most important group? They are all equal, but the women are more equal than the others. I can imagine a phalanx of 300 modern Spartan women, not one woman compromising the phalanx, improving on Author Frank Miller's graphic novel and Director Zack Snyder's graphic film, the Hollywood box-office hit 300 (Wikipedia).

And remember, a revolution is not a single season; it is a generation. We have had it all wrong in the Philippines: People Power 1986 was only the beginning, not the end. People Power we did it again in 2001, but we never improved on the beginning.

Remember too: Science will not solve all the problems of the world – the world will have to help itself. 'It's political will,' says Vicente 'Sonny' Domingo, a farmer-leader, from the same town and province as Team Captain William Dar of ICRISAT; like William, Sonny is one who theorizes and practices, he talks big and does big. And no, he is not afraid to make mistakes.

Political will applies to all of us, applies to me. Since I'm in Manila, and I prefer freelance and blogging, I can imagine being involved in a media vehicle I like to call the iVASAT, that is, the Information-Rich Virtual Advocate for Science in the Semi-Arid Tropics. The germ of the idea already exists within ICRISAT and it's called VASAT, the Virtual Academy for the Semi-Arid Tropics. VASAT is a fusion of experience and expertise; iVASAT will be an information translator of experience and expertise.

Waging the Beans Revolution, we will just have to transport and transform the VASAT idea from India not to create demands but suit the needs of the peoples of the drylands of Asia, Africa, Australia, America – virtually. When it comes to data, I myself don't relish the idea of riding airplanes, buses, jeepneys, tricycles; rather, I relish the idea of the Internet, where information can travel as data travels, fast, where a remote location is not a problem but an opportunity.

Personally, I will not forget the Green Revolution, so I will insist that the Beans Revolution be a Women's Revolution, not Women's Liberation; that it be Women's Rev and not Women's Lib; that it be less about gender equality and more about gender sanity; that it be less about human rights and more about family rights.

The Beans Revolution would be a revolution with understanding. This one would be a revolution of change I can participate in. If you are a woman, why don't you? If you are a man, are you insanely jealous that the woman is the more significant half of it all?

(Published on 8 February 2009)

4

New coffee in Kenya. In Emali, women show who's the better half.

I male, have come to realize that the female is the better half of the human race, whether in America or Asia. At home in Manila, at 69, I can't win any argument with my wife, and I'm the genius around here. Elsewhere, it's time the men are told to their face about giving credit to whom credit is due. In Africa, while women produce 80% of the food, FAO says, it's the men who get the loans because they have the title deeds for collateral (Zoe Alsop, 23 November 2008, womensenews.org). You need collateral to get a loan; that's the credit policy imposed by the domineering male of the species, right?

Credit access is power, or control of power. While the males hold on to power, in the meantime, three man-made phenomena are spreading in Africa as elsewhere: HIV/AIDS, hunger, poverty.

What can we do? Employ medicine, supply food aid, apply microfinance. Especially microfinance. Talk to the women, form solidarity groups – talk to the wives. Because, 'Husbands have the attitude,' says Hannah Wamaitha of Butere, Kenya, 'that women are like slaves'. The men are the modern slave owners. Masters of the realm.

The men have to be emancipated from their master mentality. And in that, they can learn from the women who have grabbed power from the men, the women who have emancipated themselves – the Grameen women of Muhammad Yunus, Bangladesh.

Let us now visit other brave women in a tiny village in southern Kenya. In 2005, tiny Emali was devastated by HIV, AIDS and drought (ChildFund, childfund.org.nz). ChildFund New Zealand Programmes Coordinator Sarah Walker visited Emali in 2007 and reported:

Life is a constant struggle for people in Emali living with HIV and AIDS. Medicine helps keep parents well enough to care for their children and earn a living, but getting the medicine requires a monthly 160-km round trip to the nearest hospital. Then there is the dreadful stigma of being 'cursed' with HIV and AIDS. It was inspiring, then, to meet a group of women who had banded together to support each other.

Sarah said, 'The personal story that touched me the most was from a woman named Josephine who told me she absolutely hated herself for contracting HIV and felt she had failed her children.'

In all of Kenya, the World Bank reports that the total prevalence of HIV/AIDS of total population among ages 15-49 is 6%. In all of Africa, more than 27 M Africans have died, 12 M orphaned by AIDS, while 25 M live with HIV (web.worldbank.org).

'Contracting HIV.' Sarah's 'Josephine' is not a real name, but the process is real: you contract HIV by sexual contact with an infected person. It takes two to tango. No contact, no contract.

I remember the World Wide Fund (WWF) slogan for stopping the illegal trade of endangered wildlife species like elephants and tigers; that was years ago: 'When the buying stops, the killing will too.' Buyer, beware! Borrowing from that, in the case of promiscuity, 'When the buying stops, the selling will too.'

And in Emali, Kenya, amidst poverty, drought and that sad HIV/AIDS scene, a science agency has proven that the female is the stronger sex. Let me tell you the Emali story of ICRISAT, of the crop called pigeonpea, and of the women who made the difference. Vive la difference!

PAN Germany OISAT says pigeonpea is 'difficult to cultivate' (oisat.org). That is because in the past the available varieties were susceptible to pests and diseases. That is why Team ICRISAT, led by Director General William Dar, introduced new varieties in the village of Emali in the Makeuni District of Kenya in 2003 through field days held at the Kenya Agricultural Research Institute (KARI), in Kiboko. Where in the world is Kiboko? If you are interested in an African safari, Kiboko is where you find the lions and the elephants. The hotels are there; that means modern facilities are there, including information communication technologies. You need modern communication if you want to do modern research. Not to mention product marketing.

Whom the gods wish to employ, first they make female. What happened was that the women of Emali, near Kiboko, turned out to be more enterprising farmers than the men; they took the lead in growing the new ICRISAT pigeonpea varieties. Enterprising means you are willing to take some risks; why is it that more of the women took the risk and less of the men? It must have been that more of the women thought more of the food while more of the men thought more of the risk. The weaker stomach takes the lesser risk.

And so it was that farmer Jane Mulinge, a mother of eight children, sold over 1 ton of vegetable pigeonpea during 2007 at a price of 20-30 Ksh/kg. She now plans to expand production from 4 acres to 6 acres in the next season. The winners never quit.

And farmer Priscilla Mutie, another innovator and single mother in the community, planted five acres during 2007 and sold over 1.5 tons of fresh pigeonpea from March 2007 at 25-30 Ksh/kg. Her increased income helps support a family of eight, including orphan children. Priscilla also maintains a village shop where she sells supplies to 'fellow farmers who have not mastered the art of growing high-value crops'. She plans to double her farm area to 10 acres. When interviewed on her mobile phone, she said, 'I assure you that I won't plant maize again.' Maize is not drought-resistant. 'I have proudly learned that one bag of pigeonpea can buy two bags of maize.' Maize is not a high-value crop where it performs poorly. The lady knows whereof she speaks.

The women farmers of Emali, Kenya, were so successful that they began referring to pigeonpea as 'our dryland coffee!' Perhaps that was in reference to the observation that pigeonpea is as valuable as coffee in commerce – equivalent to saying, 'This is our new coffee!' – knowing that pigeonpea thrives in drylands whereas coffee does not. The Emali women also began to call pigeonpea 'our beef,' in reference to the high protein content (20-23%). Also, pigeonpea is rich in phosphorus and richer in potassium. Animal, vegetable, mineral – pigeonpea is all of the above. What a crop!

Pigeonpea is food for the gods if ever they get hungry – the crop is ready for harvest precisely in times when food reserves are low. For the people, this

makes it a saving crop in times of need. For the producers, it's like off-season growing of a food crop.

Even better, the women of Emali found that the immature pigeonpea makes good fresh vegetable that is popular in the domestic market. Because of the high demand, green peas are now sold at prices almost twice that of dry peas.

With pigeonpea, the poor farmers in drought-prone areas are gaining where they had been losing with maize as their main crop for a long time, with their maize failing in 3 years out of 5, in which case the families had to rely on drought-resistant pigeonpea, now considered a 'lifesaver' and 'guarantor of livelihoods.'

The export potential for pigeonpea is big. India alone imports 254,000 tons of pigeonpea every year and Africa currently supplies only about 5% of this demand. This is not to mention Europe and the Americas as markets.

Aside from developing new, outstanding pigeonpea varieties, ICRISAT and partners have been at work on generating institutional innovations to help African farmers. Thus, collaboration has been sought with private and public sector groups to help with processing and marketing of the farm produce. This has resulted in reduced costs of marketing, spurring further commercialization of pigeonpea.

I have already called it The Beans Revolution. In Kenya, this Revolution was 'ignited through an ICRISAT-led consortium that brought together parties

like TechnoServe, CRS, KARI and private sector processors and exporters'. This stimulated seed production for commercialization and the creation of agro-dealer networks for distribution and marketing. The producer marketing groups (PMGs), encouraged seed production, distribution and marketing, as well as managed to increase local producer prices by 20-25% in Nairobi and Mombassa after linking with wholesalers. This has been happening in places where corn has traditionally been the main crop, which had failed because of prolonged drought. No wonder the drought-resistant pigeonpea is now considered a 'lifesaver' and 'guarantor of livelihoods' in these parts.

Before those new seeds, the potential of pigeonpea as a cash crop for African farmers could not be fully exploited because of the low yield since the crop was susceptible to pests and diseases, and the beans were too small for the taste of the market; since the produce did not meet market requirements, the commercial possibilities remained just that, possibilities.

Since 1999, ICRISAT had been trying to develop new pigeonpeas from those locally adapted cultivars by crossing with internationally available high-yielding varieties. The best performers were then distributed to local farmers and scientists in Kenya and Tanzania. After further selection, the top varieties were planted in demonstration plots. From these plots, high-quality seeds were obtained and scientists helped farmers produce more and better seeds. So, the ones from ICRISAT planted by Sarah Mawewu, Priscilla Mutie and Jane Mulinge of Emali, Kenya had large seeds, were cream-colored and resistant to Fusarium wilt.

The initial results surprised everyone, with yields up to 4 tons per hectare (afrol.com). There is more where it came from; 57 cultivars have been developed and released by ICRISAT to Asia (38), Africa (13), Australia (3) and the USA (3).

Elsewhere in East Africa, in Tanzania, new varieties are also becoming popular. In Babati district, already famous for quality pigeonpea – some 60% of farmers are now planting the new pigeonpeas, and this crop alone now contributes to more than 50% of the cash income of small farmers. This has in turn spurred a huge demand for improved seeds; to take advantage of that, local agro-dealers have contracted farmers to grow high-quality seeds with the support of the extension system in training and organizing the pea growers.

With new varieties available and with the produce now attractive to the market have come ICRISAT's idea referred to as PMGs, further encouraging commercial production of pigeonpea. The PMGs allow small farmers to benefit from collective action.

The PMGs are a concept being pioneered across Africa and Asia by ICRISAT. 'PMGs are owned and run by the farmers or jointly with private sector

partners,' says ICRISAT Director General William Dar, 'often with assistance from NGOs, research partners, government agencies and others.' ICRISAT has been working with partners in Kenya since 2003 supporting 10 PMGs. Data shows that PMGs have increased farmer incomes by 23% in Kenya.

Via the PMGs, the successful commercialization of pigeonpea in Kenya has encouraged farmers to own valuable assets such as land and livestock for more production, and mobile phones for communication. Several farmers have bought milking cows and bullocks. The improved local economy has also increased school enrolment as families can now afford to send more children to school. Higher incomes also allow families to buy better-quality food and adequately meet other basic needs to improve the quality of their lives.

Encouraging as it is, the economic story of ICRISAT-linked pigeonpea in Kenya is just beginning. For the PMGs 'to fully reach their potential,' says Dar, 'supportive steps are urgently needed in areas such as legal status, crop insurance, credit access, infrastructure, management skills, and market intelligence-gathering capabilities.'

Another interpretation to the reference by Emali women of pigeonpea as their 'dryland coffee' is that they see one crop as already about as valuable as the other, or can be made to be. 'Coffee from Kenya is well known for its intense flavor, full body, and pleasant aroma' (Wikipedia). That is all in the growing and handling of it. The scientists and farmers of pigeonpea in Kenya can learn from the growers and handlers of coffee in Kenya, who have mastered their operations.

Consider that there is superlative praise for Kenyan coffee (sweetmarias.com):

Kenya is the East African powerhouse of the coffee world. Both in the cup, and the way they run their trade, everything is topnotch. The best Kenyan coffees are not sold simply as generic AA or AB. They are specific auction lots sold to the highest bidder, and heated competition drives the prices up. Their research and development is unparalleled. Their quality control is meticulous, and many thousands of small farmers are highly educated in their agricultural practice – and rewarded – for top-level coffee.

The product itself, the way the coffee people run their trade, conduct their R&D, practice their quality control, employ good agricultural practices: Behind people, this is science at its best. I can imagine ICRISAT scientists and partners as well as the Kenyan female farmers and their advocates longing for the day when the industry of Kenyan pigeonpea has finally reached the local level of that of Kenyan coffee, and they can all say:

'Today, Kenya. Tomorrow, the world!'

(Published on 26 February 2009)

5

India is ICRISAT.
Thinking outside the box of science.

THEY were Rated O by the World Bank for the years 2006 and 2007, among 15 international agricultural research centers supported by the CGIAR. Doing their best, doing their science. I'm referring to ICRISAT. Team ICRISAT is what they have formed of themselves; partners are what they have sought for with other offices and institutions in India to serve the poor farmers in the SAT, semi-arid tropics. If they can do it in India, they can do it anywhere. While I'm confining it to India, this is a story of those collaborations.

For anyone to have an idea how steeped into the fabric of Indian science ICRISAT is, one would only have to look at the Institute's allies, Indians only, that total a formidable 180, including farmer groups, regional governments and mass media.

Indians only. 180 partners? You better believe it!

Note that I included mass media as ICRISAT's fellow workers in science. Media can ignore you and you can ignore me, part of media, but you can't ignore media. Both the theory and practice of science need the endorsement of media.

'The medium is the message,' media thinker Marshall McLuhan says. That is to say, some media are meant for some audiences and not for others. I prefer to publish my essays on the virtual paper called the Internet because my target readers are the computer literate who (should) know what they want, or want to know what they need to know more about at the click of a mouse. And early on I came across and chose ICRISAT as my model science agency to write about because I was intrigued that ICRISAT could squeeze water from stone, could achieve so much from so little, could transform its own decreasing performance to one increasing in quantity and quality. Team ICRISAT was doing something right!

When I started my online science writing in February 2006 at *American Chronicle,* I didn't know either William from Adam or Dar from Doe, but after I interviewed him in Manila and read some publications, I saw how William Dar had refreshed a fading Institute on one hand and how on the other hand Team ICRISAT combined their minds and hearts to begin to deliver on the promises of their science as they worked on five mandate crops, each of which needs improvement in its genes: chickpea, peanut (groundnut), pearl millet, pigeonpea, and sorghum. It takes a leader.

In 2002, on the 3rd year of Dar's captainship, ICRISAT had already begun to think outside the box: one, outside the field to consider 'the full chain of events that begins with planting and concludes with eating – from tillage to table;' two, outside traditional research 'to embrace and assimilate the concerns of stakeholders outside our traditional research parameters'; and three, in 2003, outside the usual Leader-Followers to hug the concept of Team. *Thinking outside the box is not rejecting the box; it is relating the box to the world around it.*

So, while resource-challenged, the underachievers became achievers. Because the crops were themselves resource-challenged, needing to grow on poor soils with little or no moisture, Team ICRISAT and partners went to work so that by 2004, they had already produced, for instance, sorghum hybrids with yields higher than those of the best local varieties by an average of 38%, grown on those same poor soils. *Ambaari, rendement, rendimiento, ani* –

yield is a word that farmers understand very well in any language and with any crop.

As I read more on ICRISAT, I was struck with the thought that if William Dar could succeed with staff working on impoverished soils in India, he could succeed anywhere. After all, he is a Filipino, he who is more than a survivor. I reflected on the science applied to crops and soils of the Philippines, and came to the conclusion that ICRISAT's success had been based not only on intelligent genetic and natural resource management but more so with astute management of these other necessary resources: human, financial, and institutional. Your science must work not only with crops and soils but more so with society, structures and systems.

Years earlier, in the ICRISAT annual report for 2001, on his 1st year as Director General, William Dar said:

ICRISAT works over a vast geographical area, a broad research agenda, and with a dizzying array of partners. Sometimes the complexity can seem overwhelming. To help tie it all together for you, we try to present it (the ICRISAT story) from a different perspective each year.

By shifting paradigms, ICRISAT has made itself creative, productive. Internalizing, I myself try to present the ICRISAT story from a different point of view in each succeeding essay. Variety is the spice of life, of science, of writing.

This time, my story is that of the intellectual, information-based, knowledge-driven relationship between India and ICRISAT. 180 partners! When I began the list, I was thinking of a long list of 50; I was pleasantly surprised to reach beyond 100 – the list tells me there is so much faith of the Indians in their science as well as in ICRISAT as a partner in research and development. My compliments to the Chief!

I can only give compliments; the news this March is that the Governing Board of ICRISAT through its Chair Stein Bie has just given its formal offer of a 3rd term starting 2010 to William Dar, the Institute's Director General appointed in 2000 and reappointed in 2005. My triple compliments to the Chief!

The modern history of India and its relationship with ICRISAT has shown how state and science can work toward making value-adding matches. The Indians' emphasis on the science of agriculture is at least 60 years old. About science, their beloved Pandit Jawaharlal Nehru had said in 1937, 'Science is the spirit of the age and the dominating factor of the modern world. Even more than the present, the future belongs to science and to those who make friends with science and seek its help for the advancement of humanity'. Nehru had graduated from Cambridge University, and had drunk from its wellspring of advanced knowledge and research. Nehru became the first Prime Minister of India in 1947 and served in that position until 1964. About agriculture, Nehru said in 1963, 'Agriculture is far more important than any industry'. I take it that Nehru was trying to say that science applied to agriculture must be for the advancement not simply of agriculture but of the people. Today I see that in India with ICRISAT.

Modern India was born in 1947, with Nehru nurturing her growth under the climate change of Independence from British Imperialism. ICRISAT was born in India in 1972 under the climate change of nurturing international Agricultural Science. ICRISAT was the very first international research institute created under the aegis of the CGIAR and supported by the World Bank. India was chosen as the location of the main campus of ICRISAT for two major reasons: it had the widest areas of drylands in its Deccan plateau, and it had a strong national research capability. Problems awaited solutions from ICRISAT working with local allies.

Today, India is known for the hybrid vigor of her science, and my list of 180 collaborators tells me ICRISAT has contributed a good part of that in the broad field of agriculture. After setting up headquarters near Hyderabad in southern India in 1972, ICRISAT had quickly initiated partnerships with the National Agricultural Research System (NARS) and the universities of India. Naturally, the host country had understandably been the most immediate and largest recipient of the impact of ICRISAT's application of science for the poor.

The year 2000 was to become a watershed in the history of ICRISAT when Dar became its Director General. Before that, ICRISAT had been moribund. Dar

injected fresh blood into the system with the team spirit and his can-do kind of management.

Two years later, in December 2001, winner of the World Food Prize 1987 and Father of the Indian Green Revolution MS Swaminathan told the audience at the Annual Day function at ICRISAT in its headquarters in Patancheru, India:

We are entering an exciting phase of science, but it must be Science with a Human Face. India needs science that will increase not only the country's Gross National Product, but also its Gross National Happiness!

In that quote, we have two original thinkers: 'Science with a Human Face' is Dar's while 'Gross National Happiness' is Swaminathan's. Neither is facetious.

Swaminathan was one of the founding fathers of ICRISAT in 1972, when as Director General of the Indian Council on Agricultural Research, he joined with the other two legs of the 'ICRISAT Tripod,' C Fred Bentley of Canada, who served as the Institute's first Chair of the Governing Board; Ralph W Cummings, immediate past Director General of the International Rice Research Institute, based at Los Baños in Laguna in the Philippines, who served as founding Director. ICRISAT was the 5th member to join the global research network currently composed of 15 international agricultural research centers under the CGIAR.

In that same occasion in 2001, Bentley said he was glad about the continuing excellence of research at ICRISAT, and urged the staff to continue to work on behalf of the poor farmers of the semi-arid tropics. Reflecting on the Green Revolution, Swaminathan stressed that adequate support was necessary for agricultural research, especially on the so-called 'orphan crops' of the dry tropics. 'Otherwise orphans will remain orphans. We need to increase crop productivity sustainably. To import food is to import unemployment.' Orphan crops are important locally, not globally – they add value to farmers' lives; the exporters can take care of themselves.

ICRISAT's overall partnership in science with the whole of India has been growing stronger in recent years, and the funding support from formal and non-formal sources in that country has been increasing for the Institute. Here are some specifics on improvements on the status quo arising from such a partnership:

Zero pesticide use. With partners, ICRISAT has developed a strategy to minimize crop loss to peanut stem necrosis disease. Thus, employing principles of integrated pest management, Indian farmers of pigeonpea and peanut have reduced pesticide use by up to 100%!

World's first sorghum ethanol. With the private company Rusni Distilleries and with funding support from the Department of Science and Technology (DST), Government of India, in June 2007 ICRISAT was able to announce

the world's first commercially successful project for producing ethanol from sweet sorghum, with small farmers of India supplying the feedstock.

Rebirth of a crop. ICRISAT's Maruti pigeonpea has revived the crop in central India, especially in Andhra Pradesh, Karnataka and Maharashtra. That is because ICRISAT-bred Maruti is resistant to the deadly wilt disease, which has devastated previous plantings. Thus, the farmers of Karnataka have begun referring to the ICRISAT cultivar as 'a blessing and a miracle'.

Upheaval with a crop. From ICRISAT has come short-duration Fusarium-wilt resistant-*kabuli* chickpea varieties such as Swetha and KAK 2, and *desi* varieties Kranthi and JG 11 – taken together, these have triggered some sort of a chickpea revolution in Andhra Pradesh. The record: a 6-fold increase in area (to 360,000 ha) and a 20-fold increase in production (to 580,000 tons) from 1990 to 2006.

Improved pigeonpea. In the drylands of India, ICRISAT's recent research breakthroughs achieved in partnership with the public and private sectors have the potential for both higher yields and better linkages of farmers with industries and markets. For instance, the hybrid pigeonpea ICPH 2671, because of its greater tolerance to drought and higher root mass, is expected to increase crop productivity by more than 30%.

Increased incomes. ICRISAT projects have been strengthened by collaboration with the Indian Government, state governments and the network of agricultural universities. Over the years, 142 improved varieties of sorghum, pearl millet, chickpea, pigeonpea and groundnut developed by ICRISAT have been released in India, raising production and incomes of small farmers substantially.

Increased support. Dar notes that 'it is a measure of the increase of confidence and trust that the funding supports from formal and non-formal sources in India for ICRISAT have been increasing in the recent years.' Specifically, the latest available data shows that the support from the Government of India increased from US$ 400,000 in 2005 to US$ 1.4 million in 2006, and was expected to rise to US$ 2.3 million in 2007. There had also been similar increases in contributions from state governments, foundations and trusts, and private sector companies, increasing the total funding package

from India from US$ 1.3 million in 2005 to US$ 2.8 million in 2006, and an estimated US$ 4 million in 2007.

Improved harvests in drylands. Applying lessons learned from the Institute's Adarsha project, the work of ICRISAT scientists and partners in 10 nucleus and 40 satellite watershed projects has resulted in 30 to 120% increases in harvests of various crops.

Increased pearl millet. With ICAR collaboration, ICRISAT has released over 70 pearl millet hybrids cultivated in about 4.5 million hectares (about 50% of the area under pearl millet in the country), contributing to cultivar diversity and increasing the crop's national productivity.

Increased chickpea. Today, ICRISAT chickpeas form about 37% of India's chickpea breeder seeds. Between 1993 and 2002, the area planted to chickpea increased 5 times and the yields 13 times. In Andhra Pradesh alone, ICRISAT chickpea farmers were earning $60 more per hectare than those who planted the local variety. In Maharashtra, farmers enjoyed added net incomes of 89%.

Increased milk from groundnut. In the Ananthapur district of Andhra Pradesh, the ICRISAT dual-purpose groundnut ICGV 91114 has proven to be more resistant to disease and drought than the local varieties. Also, this variety has higher yields (pods and fodder) and dairy animals fed with the haulms have been observed to yield 10% more milk.

Improved crop improvement. In 2000, 10 Indian companies and ICRISAT developed the Hybrid Parents Research Consortia. The members grew to 30 in 2004. In 2008, a biotechnology center was approved for funding at $6.25 M for five years (2008-2013), a joint project with the Department of Biotechnology of the Indian Ministry of Science & Technology. This will provide a platform for transgenic research in crop improvement and build synergies among institutions. Transferring genes from one organism to another, more popularly known as genetic engineering, is resorted to when problems cannot be solved through conventional breeding.

Empowered partners. Part of ICRISAT's goal is to empower its science partners by enhancing their skills, including how to prioritize and implement interventions and predict trends. Once partners learn to empower themselves, they can be relied upon to teach the farmers how to empower themselves too, a necessary step toward local development.

Improved science Q&A. The Virtual Academy for the Semi-Arid Tropics was set up in late 2003 in India. This is a virtual coalition facilitated by ICRISAT for information, communication and capacity-building. Volunteers help operate the setup, which for instance has reduced the time for answers to reach askers of questions six times shorter, to 20 hours. Collaborators in VASAT in India include the Indira Gandhi National Open University (IGNOU), Central

Research Institute for Dryland Agriculture (CRIDA), and the National Institute of Agricultural Extension Management (MANAGE) of India.

Improved communication of science. ICRISAT signed a memorandum of agreement with the Asian Media Information and Communication Centre of India to conduct a series of media workshops on reporting biotechnology. To improve knowledge sharing in its practice of science, ICRISAT has also been encouraging and working closely with people in the print, electronic and Web-based media.

Open access to research results. In collaboration with the Food and Agriculture Organization of the United Nations, ICRISAT launched through a workshop 'an initiative to promote open-access information sources in agricultural sciences and technology in India'. The workshop was participated in by representatives of ICAR, MANAGE, Indian Institute of Science (IISc), MS Swaminathan Research Foundation (MSSRF), Indian Statistical Institute(ISI) and National Informatics Centre (NIC). Two pilot repositories were to be set up, one in Delhi with support from ICAR, and another in Hyderabad with support from ICRISAT and MANAGE.

Improved agricultural extension. ICRISAT is collaborating with TelNet, Telecommunications and Computer Networking Group of the Indian Institute of Technology, to set up a system for gathering and sharing information on weather to provide advisory to dryland farmers. More than that, the information kiosk will provide ICT services in three areas: for rural development, open and distance learning, and further agricultural research.

Improved business incubation. ICRISAT's Agri-Business Incubator (ABI) aims at helping develop technologies to become commercial successes through public-private partnerships. Recently, ABI won the Asian Association of Business Incubation Award for 2008. ABI is part of ICRISAT's Agri-Biotech Park. Since 2003, ICRISAT has been promoting the Park at the Patancheru campus jointly with the Genome Valley of the Government of Andhra Pradesh. The Park is designed to attract world-class biotech companies, corporations and foundations to establish units and commercialize their technologies from there.

Now then, for all those achievements mentioned above and many others not included, can Team ICRISAT afford to relax? In fact, their work has barely begun. For millions more in the drylands of India, not to mention the drylands of the rest of Asia, Africa, Australia and the Americas, poverty remains.

Progress begins once the challenge is recognized. The story of ICRISAT so far tells me that the power of technology to transform the world needs the power of men to transform their own selves from working separately to working together. For public-private, science-societal progressive partnerships in India and the rest of the world, the huge challenge of development remains.

(Published on 16 March 2009)

6

Power in numbers.
Science with human faces.

IN art, movies are numbers and faces. In science, generations are also numbers and faces. You can choose which to show. I choose both. *Shelter* is a movie now shooting by Nala Films of Los Angeles in California, with a budget of $22 M, and yes, they want that 'Inbred Look' (David M Brown, 26 February 2008, pittsburghlive.com). Because it's a supernatural horror thriller, and yes, it's a story about real people in the mountains who have been inbreeding generations after generations, Nala Films is looking for people with a different kind of look, such as an albino girl and deformed people to depict those West Virginia mountain folk.

With people, inbred is weird. I'll call that the Shelter Effect. Given generations, among people the Shelter Effect produces not only decadence but a social monstrosity. In the movies, visuals with inhuman faces may produce a box office hit, like Dr Frankenstein's monster – but we're not in the movies, are we?

With luck, terror in movies makes waves; with luck, error in science makes you waver, and then you go on with a new idea and a new resolve. The Inbred Look is the ultimate dream of Nala Films; they think the ones that look worst will look best to moviegoers. It's been done before. Quite the opposite, the Hybrid Crop is the ultimate dream of breeders; they know heterosis or hybrid vigor will bring out excellent offspring, plant or animal. With continued inbreeding, with related parents, you get badder and badder offspring, as the Nala movie would show; with continued crossbreeding or hybridization, with unrelated parents, you get better and better progeny. In history, why do royal bloodlines run out? It's due to inbreeding, or inter-family marriages; they want the family blood to remain pure, and that's exactly why it runs into family trouble.

Inbreeding is the mating together of blood-related animals or gene-related plants. In people, that would be mother & son, father & daughter, sibling & sibling, half-sibling & half-sibling, cousin & cousin, aunt & nephew, niece & uncle and grandparent & grandchild. Because of the limited gene pool from continuous inbreeding, the deleterious genes become widespread and the breed loses vigor. Denis J Murphy says that that is known as 'inbreeding depression' marked by poor performance such as lower growth rate or lower disease resistance, or higher death rate. The Shelter Effect. Not unlike a car runs out of gas, a breed runs out of vigor; to make the same car run again, you buy gas; to make the breed thrive again, you cross it with another, and then you get a new and better breed. There's power in driving a car; there's more power in breeding. Nice work if you can get it!

You do have to be careful. And so a marriage between cousins, as well as any other marriage between close relatives, is against the law; it's inbreeding, and as seen in cattle, all consequences of inbreeding are undesirable. It's obeying the laws of love that makes the world go round, along with obeying the laws of genetics.

And, while in theory you can, in fact, no, you can't get rid of inbreeding, or shouldn't. You need lines resulting from inbreeding for crossbreeding – that is, in crops, whether plant or animal. You just have to watch out for the Shelter Effect.

Is cloning inbreeding? Like stem cutting in plants, cloning is asexual; cloning is multiplying the exact same genetic materials. It is not inbreeding, but the results are the same: a multiplication of the same substance, not unlike Jesus' multiplication of the five loaves of bread to feed 5,000 hungry mouths in the

New Testament (Mark 6: 41-44). I don't know about cloning, but a miracle is nice if you can get it!

In inbreeding, there is the production of sameness; in crossbreeding, there is the production of unlikeness. In inbreeding, if you keep planting the seeds of your previous crop over the years, there is a danger that all the recessive traits will crop up. There is a loss of hardiness and vitality; it is not surprising that rare genetic diseases become more common among inbred crop populations.

From cuttings of an old plant, you get new plants along with the old genes; from seeds of self-pollinated crops, you get the same. From crosses of parent plants from different lines, you get new plants plus new gene combinations that result in character traits that are usually desirable, like much higher yield along with much lower fertilizer cost. Inbreeding perpetuates its own kind; crossbreeding perpetuates hybrid vigor.

Hybrids give you hybrid vigor, the ultimate dream of breeders, plant or animal. If plants, they give you quantum leaps of yield so high that you will jump for joy; if animals, they give you quantum leaps of meat, milk or eggs so much you will jump through hoops.

Another way of saying that is this: Hybrid vigor gives you higher returns on your crop investment, all things being equal. With the same inputs, the higher the output, the higher the net.

That's science, that's knowledge. Now, today knowledge has a way of multiplying itself either by printed word or mouth or electronic file. And knowledge, known by publicly funded institutes of science, like ICRISAT, is similarly known by private seed companies. Is that good or bad? It can be better.

In India in the 1990s, even as scientists of ICRISAT were aware of hybrid vigor, scientists of private companies in India themselves were aware of it and, thinking business, started developing their own science around their own new and improved crops (CLL Gowda et al, 2004, cropscience.org.au). Since the private companies were closer to the seed pushers (merchants) and users (farmers), this led to the decline of funding in ICRISAT and other research centers of the CGIAR, which forced significant budget cuts all over CGIAR. Business was minding its own business, not thinking out of the box. Error. Science was making a similar mistake. Two wrongs don't make a right.

You can't do much science without much funding and without much enthusiasm. In those years, ICRISAT urgently needed new ideas and a new resolve.

In 2000, with William Dar as the young and new Director General of ICRISAT, the Institute woke up from its stupor and, thinking out of the box, among other things, saw that the private companies could be enticed to become allies in funding if first they became partners in research. Collaborators all, in a consortium. Thus were born the Hybrid Parents Research Consortia for sorghum and pearl millet that year at ICRISAT. At that time, the consortium model was a novel idea within the CGIAR system. This was the first broad-based public-private partnership in the history of that system. If you can't fight them, join them. This is science with many human faces reflecting work in harmony with one another.

Other CGIAR centers have since been adopting the ICRISAT consortium model in their R&D operations. They know a good thing when they see one.

Here is a list of specific ICRISAT consortia. There is a Sweet Sorghum Ethanol Research Consortium, with Tata Chemicals and Praj Industries of India as two of the newest members. There is the Pearl Millet Hybrid Parents Research Consortium that has 35 members. There is the Chickpea Genomics Consortium on Drought Tolerance. There is the Africa Biofortified Sorghum Project, a consortium of 7 African and 2 American institutions. One of the latest is the consortium for the project of the Government of India called 'Sweet Sorghum Ethanol Value Chain Development' with 7 partners.

Outside of the CGIAR system, MS Swaminathan, has recommended an ICRISAT-model consortium approach in watershed management for dryland districts throughout his country. A local innovation with a global application.

They all have seen the power in the consortium:

- There's power in numbers. It's called synergy
- You have a knowledge base of resource persons working together
- It's a one-stop shop for clients, not to mention members
- There are education & training opportunities
- You enjoy economies of scale
- There's access to resources otherwise unavailable; and
- You participate in a focused project with a clear-cut objective – by itself, a definite benefit.

It works of course if you have teamwork, and that requires a Team Captain.

I'm coming to that. Another novel idea was put into practice by Dar early in his first term as Director General; he launched Team ICRISAT as a movement within the Institute in early 2002. With Dar as Team Captain, this resulted in 'staff morale greatly boosted'. That was the first thing that the Team spirit made happen; I'm sure it did much more than that. What subsequently happened at ICRISAT proves to me that if you have a great Team Captain, you will have a great Team.

One time, in a lull during a seminar in the Philippines, I asked Dar what gave him the idea of Team ICRISAT, and he said he had borrowed the concept from sports, from Team Philippines (basketball). Today, when I think of Team ICRISAT, I think basketball and I think consortium, that is, public institutions and private companies working towards producing new and improved crops collaborating as a team with a common goal. Team Chickpea, Team Groundnut, Team Pearl Millet, Team Pigeonpea, Team Sorghum – each should make a great Team to produce scores of new and improved crops.

You can't have new crops without hybrid parents, and you can't have hybrid parents without HPR, hybrid parents research. In 2000, for pearl millet, the consortium for HPR emerged as 'the most appropriate among partnership models'. Team ICRISAT discovered the power in public-private collaboration in science.

The HPR consortium was to follow two guidelines: (1) It shall address the core research agenda of ICRISAT. (2) All products of HPR shall remain in the public domain as International Public Goods (IPGs).

As of 2001, the ICRISAT hybrid pigeonpea, the world's first hybrid of any food legume crops, had been developed through partnership in HPR. Out of this, a hybrid cultivar called ICPH 2671 was launched in July 2008, that is, made available commercially.

The consortium model broadened the concept of public-private sector partnership, and gave birth to the Agri-Science Park (ASP@ICRISAT), which is

the hub of the wheel of public-private partnerships for the development and commercialization of technologies such as hybrid seeds of pearl millet and sweet sorghum. The consortium tactic has emerged as a successful method of generating funds as well as promoting development and marketing of technologies for the poor in the semi-arid tropics of Africa and Asia. This is the dream of those interested in technology transferred to the people.

Not resting on its laurels, ICRISAT's search for partnerships is 'proactive'. Seek and you shall find. The partnership involves joint identification of priorities and joint investments for research in key areas. As of the latest data made available by ICRISAT, there are now 50 private seed company partners with financial contributions under 5-year renewable agreements.

As a result, ICRISAT is now a center of excellence for research and development for hybrid parents in three crops – sorghum, pearl millet, pigeonpea; it is now a supplier of high-quality parents necessary for hybrid development, testing and release in Asia. These are what I like to call parents-in-waiting.

So now you have a good idea why ICRISAT has been into hybrid parents research. It's within the wide area of crop improvement. To have an idea how Team ICRISAT does it, let us look at its efforts in breeding and selection for sorghum seed parents for the last 31 years, in three phases:

- *1st phase* 1978-1988 – emphasis on crop grain yield and food quality matching local crop seasons and sites.
- *2nd phase* 1989-1998 – emphasis on crop resistance to pests, diseases and drought.
- *3rd phase* 1999-today – emphasis on farmer-preferred grain characteristics such as white, large and lustrous grains from cultivars that are adapted to postrainy season growing conditions.

The phasing indicates that in solo or partnership research, you start with the problems of local farmers and end up with the choices of local farmers. Which gives me an idea; to generate an entirely different marketing theory, we can look at it as a demand-supply chain, not simply a supply chain. In ICRISAT's actual sorghum work, the first two phases are supply push; the third and final phase is demand pull. In marketing as in science, the pull is greater than the push. (As in: Gravitation is greater than 1 billion physicists praising Isaac Newton.) That is to say, in the production and marketing of crop-related knowledge, or technology, the farmers are always right because they are always the customers.

As a direct product of the ICRISAT consortia, many partner local private seed companies in India have now grown into global businesses. In turn, the partnership has enabled ICRISAT to develop breeding lines and hybrid parents, as well as enabled country NARS, in Africa and Asia to diversify

the genetic base of their local hybrid programs. That means better genetic materials for better crops. The more diverse the parents-in-waiting, the greater the hybrid vigor of the offspring.

Meanwhile, the challenges remain and there are two of them: inside the consortium, that is, value-adding relationships with partners, and outside the consortium, challenges arising from changing farming systems, changing farmer preferences, as well as changing consumer preferences.

Now, let me remind you, you can't have hybrids without inbreds. Hybrids and inbreds co-exist. Thus, when a hurricane destroyed the maize seeds stored by farmers and the national seed bank in Honduras, the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT) sent to Honduras half a ton of maize seeds of both hybrids and inbreds that had high yields, were highly adapted to the country, and tolerant to stress such as that brought about by drought or pest. CIMMYT and ICRISAT both belong to the CGIAR system.

Currently, with respect to Africa and ICRISAT-derived inbred-line cultivars, ICRISAT cultivar Macia is being grown in 30% of the area planted to sorghum in Eritrea, Kenya, Mozambique, Namibia, Tanzania and Zimbabwe. Cultivar Gadam el Hamam is being adopted by farmers in Kenya, and Pato is being adopted by farmers in Tanzania. Phofu, which adapts to late-season drought due to early maturity and stays green, has been adopted by 21% of farmers in Botswana. Cultivar S35, also called ICVS 111, enjoys 10 to 15% adoption in Nigeria and Ghana, and ICVS 400 is popular in Nigeria. The extra-early cultivar

CSM 63 is accepted by farmers in West and Central Africa. Seven new lines in the Guinea race of sorghum have been released by ICRISAT in Mali. This race is grown by many, including farmers in other countries in West Africa. Today, half of India's 8.5 M ha planted to sorghum is growing hybrids. Of the 50 commercial hybrids in the market, about 30 are from ICRISAT parents or lines. Nearly 50% of India's 10 M ha planted to pearl millet is growing at least 84 hybrids, at least 60 of these based on ICRISAT parents or lines.

All those are products of the consortium model.

ICRISAT has been promoting the consortium model in places other than in India. In Asia, for one, ICRISAT has signed agreements with five private companies in the Philippines to form a sweet sorghum consortium for ethanol production. In Africa, ICRISAT has been exploring the formation of consortia in Uganda, Nigeria, Mozambique and South Africa.

The Institute recently launched a consortium for self-pollinated chickpea and groundnut to share new breeding lines and varieties with partners, eventually so that farmers can have access to the seeds of improved cultivars for higher yields and incomes. Yields they can appreciate, incomes they can enjoy.

'Power is the capacity to bring about change,' they say; 'as measured by results,' I say. Now then, if I may summarize the power in consortia, it's simply this: It's not 'I alone can' but rather, 'Together, we can.' Theory must translate into practice. Easy to say, hard to do, which makes the ICRISAT consortium breakthrough story all the more remarkable.

And so the story of the power in the ICRISAT consortia continues. I want to point out that while it did not invent the concept, ICRISAT has marvelously tapped the power in consortia to create science with human faces.

(Published on 5 April 2009)

7

The drylands. Crops under stress, scientists under pressure.

HOT. A few years ago, it wasn't this hot. The wind hits my face as if I'm walking out there hatless on the concrete road under the noonday sun. This is the 3rd week of April, in Asingan, in the Philippines. My hometown is lucky. There's water in the irrigation canals for the ricefields and there's the flowing Chico River parallel to the houses. You can complain of the lack of a cool breeze but not the lack of water for plants and animals. If I dig, I know the soil is moist. I am not the man with the hoe. The man with the hoe is elsewhere.

In the hot and dry parts of my country, under more adverse conditions, either crops grow or they don't. Pity the farmers of the drylands who can't be reached by irrigation canals, can't afford to pump water from the underground, or can't be served by modern knowledge on dryland agriculture in the Philippines because no one has gathered the ingredients to make a recipe. Where is the technology dissemination team when you need it most?

No, I haven't heard of dryland agriculture coming to town in one year and one week since I attended the 'National Dryland Agriculture RDE Conference' held 17-18 April 2008 in the Oxford Hotel in Pampanga, Central Luzon, Philippines. The conference was co-sponsored by Department of Agriculture-Bureau of Agricultural Research (DA-BAR), Philippines, led by Director Nicomedes P Eleazar, and ICRISAT, led by Director General William Dar. This was thinking globally (drylands of the tropics), acting locally (drylands of the Philippines).

The Dryland Conference had the theme 'Energizing research, development and extension for sustainable dryland agriculture in the Philippines.' A year has passed and the ship for dryland science has remained high and dry. We must have failed to tap the energy available and accessible at that time.

Today, 25 April 2009, I'm looking at the handouts in that dryland conference, having numbered them at exactly 240 pages of 8.5 x 11 inches of single-sided printouts, with about 160 pages of single-spaced text; the Dryland Papers I shall refer to them here. This thick 1.5-inch handout reminds me that lots of paperwork is how government-funded research begins in the Philippines. You can imagine how long the paper trail is, and how much time it takes to go from here back to here. I'm speaking from 34 years of experience working in and out of the national agricultural research system in my country. We really must learn to conserve paper.

One of the offshoots of the conference is a proposed Executive Order (EO) establishing, Philippine Dryland Research Institute (PhilDRI). The EO must have reached President Gloria Macapagal-Arroyo sometime late 2007 or early 2008. Did she give it a thought, or has it been buried under tons of bureaucratic details? We really must do something about Philippine bureaucracy.

Personally, I'm thinking of charter change along with climate change. In both cases, we need to decrease social energy toward self-destruction; in one, we need to increase social energy for construction.

Meanwhile, climate change waits for no man, believer or not; the farmers can't stay around and wait for dryland agriculture to visit them in their parched fields; and, as always, the yields of their crops leave much to be desired.

The drylands wait, scorched and scarcely populated with survivor species, unable to shrug off the dust of time. The dryland man is whom I see in the eyes of poet Edwin Markham, looking at 'The Man with the Hoe' (1899), which

he was moved to write after seeing Jean-Francois Millet's painting 'L'homme a la houe':

Bowed by the weight of the centuries he leans
Upon his hoe and gazes on the ground,
The emptiness of ages in his face
And on his back the burden of the world.
Who made him dead to rapture and despair,
A thing that grieves not and that never hopes,
Stolid and stunned, a brother to the ox?

When I think of the man with the hoe, I think of this modern Gordian knot for scientists to untie: The Dryland Challenge is to grow two blades of grass where none grew before – in the dusty fields, in the parched lands, on the thirsty ground cracking up to half a foot down.

I know I too am a brother to the ox, but unlike the man with the hoe, I know I grieve not; I never stoop to despair; I never stop to hope. In fact, the man with the hoe, whether painting or poem, reminds us, says Hattie Erminie Rives, that 'the misery and unhappiness of this life come not from outward circumstances, but from inward conditions and struggles' (query.nytimes.com). Pogo says, 'I have seen the enemy, and it is us.'

When I think of the man with the hoe, I also think of my father. A farmer almost all his years, my father lived to be more than 90, built strong, but he died many years before I heard anyone whisper about global warming and local rising of temperature, so he was never bothered by visits of a scorching wind and a drying breeze. Today, I roam the world of knowledge to the ends of the Internet while yesterday, my father roamed only our village of Sanchez, but the climate knows no boundaries and the weather is no respecter of person. I have more problems than he ever had.

I also think encyclopaedic and fast-backward. And so I also know that we have more solutions than my father ever had in his farming. I remember, before we transplanted the seedlings of eggplant and tomato – yes, we always planted them side-by-side patch to patch – he made us pound on many a *bingkol* (stone-hard, dry, chunks of soil that came up when he plowed the parched field) with a long wood or bamboo stick, all over our *bangkag* (dryland farm) on the other side of the Chico River. It would take us 2 or 3 days to pound down something like 1000 square meters – that's recall; I can't check my measurements; that farm is gone now, ravaged by the river, but that's another story – and then we would carry, pail by pail, water from the river half a kilometer away, to quench the thirst of the soil first and the seedling next, even if it is under the noonday sun. I'm talking of the 1950s, when I was in high school, perhaps even to the 1960s, when I attended college. It would be summer; I now wonder why we always had to wait for the soil to dry up before we planted those vegetables – my father was waiting for me to help,

when classes were over? Actually, he had no choice; there were only old or non-improved (*oni*) varieties of vegetables; there was no rainy-season tomato at that time, no rainy-season eggplant. My father knew only to suit his crop with the climate, not change his crop.

Today we have new or improved (*noi*) varieties of legume and grain crops for the drylands from India, courtesy of ICRISAT, based in Hyderabad in Andhra Pradesh. We have *noi* species of rice for the drylands from IRRI. What are we waiting for!?

The man with the hoe waits to know.

I glance again at the thick Dryland Papers and I know we know enough for dryland agriculture. We know about multiple cropping, about green manuring, about cover-cropping, about relay cropping, about organic farming, about trap crops, about handpicking worms, about harvesting rain ... so, I ask: 'Where are the entrepreneurs where you need them most? Where roam the risk-takers? In rice, in biofuel crops, in cash crops, in fruits ... in the Ilocos and other drylands?'

The Dryland Challenge is to go where irrigation water cannot. And where groundwater is for drinking.

I like to think the Dryland Challenge is not only to GMA to issue the EO for PhilDRI but more so to local governments to encourage and support local farmers who would like to try planting *noi* varieties such as sweet sorghum, pigeonpea, groundnut, chickpea, rice and corn during the rainless months. In the pursuit of democratic progress, government is supposed to rush in where the risk-averse fear to tread; policy and financial supports for *noi* varieties are necessary in case the trials fail. Investigations must be carried out not only in aid of special legislation but also in aid of social entrepreneurship.

All over Asia, drought-related research remains underfunded, according to Director General Robert S Zeigler of IRRI. Notwithstanding, the lack of a center of research, development and extension for dryland agriculture in the Philippines, the lack of financial support by government should not be the excuse for non-action in applying theory and coming up with practice. The pressure is on the scientists to produce. Creative science is dependent less on funding and more on creative minds.

The man with the hoe waits for the man of science.

In the meantime, for dryland agriculture, we don't have to wait 3 years. We can learn now from ICRISAT scientists. Among their technologies, we can use these immediately:

(1) Controlled fertilizing (microdosing). 'Microdosing permits small farmers to get good impact by adding affordable quantities of fertilizer to the fields,' Dar says. The right quantity at the right time at the right spot: the same

hole where the seed goes. Interestingly, in southern Africa, farmers use an empty beer cap to measure out the dose; in western Africa, farmers use a 3-finger pinch. Choose your dose. How much can you reduce fertilizer cost? By as much as 80%. What about the yield? Higher, up to 120% for pearl millet and sorghum.

(2) Controlled drip irrigation. An African Market Garden (AMG) is a small plot intensively cultivated and bucket-irrigated in Sub-Saharan Africa. AMGs involve high-value crops. ICRISAT reports that an AMG pays for itself in the very first year, and that when date palms are included, the profit advantage is 30 times. Between 2003 and 2007, about 2,000 AMG units were introduced in 8 West African countries.

(3) Pigeonpea to prevent soil erosion (groundcover). The Chinese farmers are geniuses when it comes to recognizing a plant's virtue where others see none: They are now planting pigeonpea in about 150,000 ha on the rolling hills of southern China – planting more to conserve the soil and less to harvest the beans. The ICRISAT hybrids are perfect for soil conservation because they grow faster and bigger and have stronger root systems, more able to hold the soil particles together. Not only that, they are resistant to drought and diseases.

(4) Drought- (and disease-) resistant varieties of chickpea, groundnut, pearl millet, pigeonpea, sorghum). Ask ICRISAT and they would have quite a few varieties you can try in your country. As an example, ICRISAT's dry-season chickpea grows well with only one-third of the irrigation water for wheat in India; not only that, it needs no nitrogen fertilizer – and yet yields a much higher profit for the grower. That could be you.

(5) Improved cropping systems. ICRISAT has found in Vietnam that if you add watermelon to maize after maize, along with water harvesting, your net income multiplies 300%; with a watermelon-mungbean-soybean system, you add 70%.

(6) ICRISAT Kothapally watershed model. This is now being replicated in many countries, including China, Thailand and Vietnam. It started with the villagers of water-stressed Kothapally in Andhra Pradesh at first not cooperating with ICRISAT and partners when they brought soil and water management technologies there, among others water-harvesting and 'drought-proofing' structures and measures such as check dams, percolation tanks, increasing vegetation, vegetative barriers, contour bunding, gully control structures, and landform treatments. Then the villagers noticed water returning to Kothapally and saw that it was good.

(7) Working credit scheme (warrantage). In western Africa, 'the farmers are effectively linked with the markets,' Dar says. Farmer associations have been either formed or strengthened, with warehouses built for grain storage. When the prices are low, the grains stay in the warehouses; meanwhile, the farmers get a credit of 80% of the grain price of their stored harvest, which they use for AMG. When the prices of grains improve, the farmers sell and pay their loans. This arrangement is shooting two birds with one stone: storage and credit. You have to give credit to the farmers – and ICRISAT.

And what are the NGOs, non-government organizations doing? To the NGOs, is the man with the hoe only a painting, only a poem?

A frightful scenario is that a drought brings zero harvest, as has happened in Mindanao. In the Philippines, in 2007 alone, the loss in rice from drought in more than 17,000 ha was ₱1 billion ($20 million). In India, in the state of Assam, tea production went down 12,000-15,000 tons less tea in the first quarter of 2009 than in the same period in 2008 because of drought. In California, 3 years of drought has forced farmers to fallow their fields, lay off thousands of farm workers. In China, they have declared a 'Level 1' (highest) emergency as drought grips central and northern China, 'a severe drought rarely seen in history,' according to the *People's Daily*. The end is not near!

The Dryland Challenge. Climate change is going to make it worse – until we learn to make it better. The man with the hoe waits.

(Published on 27 April 2009)

8

Sweet revolution 2009.
SSI gives birth to neo-agriculture.

SWEET LOVE C12H22O11, Sweet Ignore C7H5NO3S. Quite simply, I like my sugar naturally sweet, not artificially saccharine. I like it harvested from the field rather than from the lab; I like it cultured on soil rather than cultured on Petri dishes or whatever. I want to be in the US, the home of the brave and the land of the free. But I don't want to be sugar-free.

I'm in the Philippines; I am a farmer's son; I am part of the island – I prefer the natural to the man-made. Today, I want to talk nicely about sweetness. Grown by mild-mannered chemists in immaculate facilities, $C_7H_5NO_3S$, Saccharin is sweet; grown by tough-talking farmers on uneven farms with hard methods, $C_{12}H_{22}O_{11}$, sugar is sweet and delectable:

These high wild hills and rough uneven ways
Draw out our miles and make them wearisome;
But yet your fair discourse hath been as sugar
Making the hard way sweet and delectable.

William Shakespeare, Richard II, Act 2, Scene III.

If the long and winding road leads to sugar, it's fine with me. To me, a Philippine author, nobody beats the British Shakespeare as nothing beats the natural sugar from sugarcane.

That would be muscovado. In the late 1940s to early 1950s, as a boy in shorts going to grade school in the village of Sanchez in the sleepy town of Asingan, I had muscovado in my pocket somewhere to bring out as snack. Were we poor? Not really, but I have always been a sweet tooth; I loved the brown color and the God-given sweetness.

Asingan never had a sugarcane plantation, but we always had muscovado. It must have come from Tarlac, from the Central Azucarera De Tarlac, the sugar refinery of the Cojuangcos. I preferred the light one 'with a warm honey color and creamy fudge flavor'. Today, raw sugar, muscovado is considered a health food. Not surprisingly, it has all the natural vitamins & minerals in sugarcane juice. I love it!

Raw sugar is a major export of the Philippines. For 2009, the country will supply 13% of the total volume the US is importing for the year (March 2009, agriculture-ph.com). How sweet!

We Filipinos are good in raising Cain, that's for sure. If you didn't know, you have not been reading the papers. Now, are we Filipinos good in raising cane?

Definitely not! That's why I'm writing this long essay. But we are good producers of sugar. In crop year 2002-2003, total sugar production in the country increased by 32.6% compared to 1998-1999 largely due to higher sugar recovery by 22%; the increase can also be attributed to 'favorable climatic conditions, adoption of high-yielding varieties, improved cultural practices, increased farm inputs, and better milling facilities' (Asia Pulse, August 2003, goliath.ecnext.com). I tried hard but I couldn't gets data on local recovery rate for 2007 or 2008.)

The problem there is that 'favorable climatic conditions' don't apply anymore; cultural practices need to be much improved still – and farm inputs need to be

decreased. Our technical knowledge needs to change for the better, and not only in making things clear to the layman.

We Filipinos learned to produce sugar in Luzon for export in the 1830s (Michael S Billig, 2003, cited in World Sugar History Newsletter July 2004). Today, some 170 years later, the way we grow sugarcane leaves much to be desired.

Actually, the world over, most sugarcane farmers have much to learn about raising cane. We need a Sweet Revolution in sugarcane farming in response to the realities of climate change (global warming / global cooling), inefficient practices (like too much fertilizer), and dwindling resources (like the water table going down – our water deposits are overdrawn).

For sugarcane farmers in the dry tropics, who can they turn to, to learn to grow sugarcane much, much better? The Brazilians are the biggest sugarcane producers in the world, but Brazil doesn't have the drylands that we have. In the 2007-2008 season, total sugarcane production was estimated highest in Brazil at 491 M tons, followed by India at 348 M tons (commodityonline.com). So maybe we should go to India and learn from the Indians. After all, in history, sugar was first squeezed out of cane grown in that country. Except, the latest news is that in contrast to the Philippines, last year India had a decline in recovery rate, which is the amount of sugar you get out of sugarcane (13 May 2009, commodityonline.com).

Consider: The above production figures in reality are estimates, and yield estimates change during the year as the weather changes; after all, in agriculture, harvests are only as good as the weather allows. So, expect that for any growing season, any country's sugarcane yield estimates will be revised at least four times: early in the year, before harvest, harvest time, then afterwards.

In agriculture as in flying, the weather is a risk. That is to say, your field as well as your flight is only as good as your weather. And why is that? Don't ask me anything more about flying, as I have a natural fear of it; but I have a natural liking of farming, and as far as I can tell, the telling effect of the weather is felt by plants via the water in the soil. Water is that important.

Mark Twain did say, 'Everybody talks about the weather, but nobody does anything about it.' In this age of Climate Change, I say we need to and indeed we can modify the weather, if we simply modify the water in the soil: how much is in it and how much the plants are taking out and transpiring from it. We need to practice out-of-the-box water management.

I did say we should go to India and learn. You know, we learn from mistakes, preferably those of others, preferably big. In this case, India is the biggest sugar producer in the world - and they must make big mistakes there. In fact, in 510 BC Emperor Darius of Persia invaded India and found 'the reed which gives honey without bees' (quoted by ANN in sucrose.com). Now then, the Indians have been raising cane for more than 2,500 years; their huge mistake is that they have been profligate with their resources when it comes to the growing of sugarcane: too much water for the canes in the field, for one thing.

And that's one of the modern Indian lessons we can learn on campus at ICRISAT at Patancheru. As far as I know, they are very serious when they say, 'We need to explore every possible approach to reduce the water input to all crops, particularly those which excessively depend on scarce resources.' That's ICRISAT Director General William Dar speaking. In other words, he is telling us we have to save on water, and so do our crops. I know him personally to be a non-traditional and out-of-the-box manager-thinker, looking for, in his own words, 'approaches wherein the resource inputs are low and yields are high.' The mantra of the CGIAR is 'Doing More with Less' – and ICRISAT is part of the CGIAR. Plow in less, harvest more – that kind of farming is contrary to textbook economics, isn't it? As well as textbook agriculture.

Going-against-the-grain-of accepted practices was very much in the minds of the experts when they worked out the joint project Sustainable Sugarcane Initiative (SSI). I'm referring to the World Wide Fund for Nature and ICRISAT. The Team Leader for the SSI project is Biksham Gujja of ICRISAT – he has been a Special Project Scientist for WWF based at the ICRISAT headquarters in Patancheru, India since 2005.

In this unusual age of climate change, I do not find it strange that the panda is talking to the plant. Based in Switzerland, the current top panda of WWF is President Chief Emeka Anyaoku of Nigeria; based in India, the current top crop of ICRISAT is Director General William Dar of the Philippines – these tropical minds were thinking of, if vaguely, if I may borrow from the science of fisheries, the concept of optimum sustainable yield (OSY). OSY is where you decrease the cost in general – in the case of SSI, water, fertilizer and seed in particular – and yet you do not decrease the yield – you only maintain it. SSI does OSY one better; it so happens that in SSI, while you decrease the costs, you increase the yield. Plow in less, harvest more – SSI is sugarcane agriculture at its best.

The ICRISAT-WWF partnership is a revelation. The WWF has a mandate of protecting ecosystems; considering that, 'ICRISAT is collaborating with WWF to understand and integrate the ecological concerns of agriculture,' Dar says. 'This partnership is unique, and we are looking forward to many more practical results on the ground.' Not just theories but practices.

And so, on March 2009, the ICRISAT-WWF project came up with a training manual with the long title, Sustainable Sugarcane Initiative (SSI): Improving sugarcane cultivation In India, freely downloadable from panda.org.

About the training manual, Project Leader Gujja says that 'the inspiration for putting this package together is from the successful approach of System of Rice Intensification (SRI),' which has been proven to need less water and yet to yield more. And do you know who invented SRI? It was Fr Henri De Laulanie SJ who spent 34 years of his life working with the Malagasy rice farmers in Madagascar (ANN, ciifad.cornell.edu). He came up with the idea of SRI in 1983. In 1990, Fr De Laulanie, along with some Malagasy colleagues set up a non-government organization, the Association Tefy Saina, to help improve lives in Madagascar. 'Tefy Saina' means, in Malagasy, 'to improve the mind.' Cornell International Institute for Food, Agriculture and Development, is now working with Tefy Saina.

From SRI to SSI. The SSI approach has been tested by farmers in different climatic zones of India: Punjab, Uttar Pradesh, Andhra Pradesh, Karnataka and Orissa. With very encouraging results, Gujja says he expects that the SSI practice will replace farmer's practice in sugarcane within 5 years. I expect the same for the Philippines.

In fact, SSI is the new economics of agriculture – neo-agriculture I shall call it from here on, because it's new and because I believe the concepts are applicable with other crops. This is the Sweet Revolution of 2009 I refer to in the title to this essay.

Call it SSI or call it neo-agriculture, it has been shown to work in practice, not simply in theory. One Indian farmer, PK Singh, in Uttar Pradesh found that cane yields went up to 100 tons to a hectare as against a 'normal' yield of 30 tons. That's an increase in yield of more than three times.

From the training manual, the first recommendation that caught my eye is that on water. If you follow neo-agriculture, all things being equal, your input will be up to 80% less water for irrigation and your output will be up to 50% more cane for sugar. The new economics of agriculture, Why didn't pre-climate change agriculturists think of that?! They couldn't have because they were not thinking out of the box. Now, neo-agriculturists, as well as neo-economists perforce must think of water used in production, not as a dependent but an independent variable, something that can be to the highest degree manipulated, controlled, varied or changed. This is water before the bridge.

The ICRISAT-WWF sugarcane scientists may have been thinking more of Indian sugarcane farmers than those in other lands, but that was natural. They had enough problems in India already! Neo-agriculture will have greater impact in India than the Philippines, simply because in the Land of the Maharajas, there are 36 million sugarcane farmers, and that number is more than the entire population of Canada, estimated at 32 million in 2006, 35 million in 2021 (sustreport.org). This is not to mention the multiplier effect in India on another 50 million who depend on employment generated by the 571 sugar factories and industries using sugar.

It is true that we have only 56,000 Filipino sugarcane farmers (Katharine Adraneda, 2007, newsflash.org), but even then, all of them too have to practice neo-agriculture for cane starting right now. Filipinos, neo-farmers of sugarcane? That would be sweet music to my ears.

For starters, here are some techniques prescribed for SSI/neo-agriculture for sugarcane (mostly from the SSI training manual):

(1) Raise single-budded setts in nursery. Grow the setts in trays filled with coconut coir. Being hygroscopic, the coir absorbs water 8-9 times its own weight, then slowly releases the precious liquid to the feeding roots of the

setts. Also, nursery-raised settlings are excellent for filling up missing hills at anytime – the nursery settlings are of the same age as the ones growing in the field. They will mature at the same time.

(2) Transplant young settlings (25-35 days old). By then, the settlings are old enough and vigorous to withstand the shock of transplanting. Irrigate the field a day or two before transplanting. Being well-developed, transplanted setts can compete with the weeds better. Transplanting can increase cane yield by 85% (Yukio Ishimine et al, 1994, University of the Ryukus, ms1. agsearch.agropedia.affrc.go.jp).

(3) Space widely (5 x 2 feet) in the main field. Rather than at 1.5 x 2.5 ft, plant at 5 x 2 ft. This will result in two times more millable canes because the setts produce more tillers. It also reduces the number of setts needed from 16,000 3-budded setts to 4,000 single-budded setts to an acre.

(4) Apply a trash mulch. Apply sugarcane trash within 3 days of planting. Mulching is the best practice in controlling weeds. Trash mulch can also increase yield and decrease energy cost.

(5) Avoid flooding. Do alternate furrow irrigation to minimize water loss, or employ a drip irrigation system. Drip irrigation is where you get 80% savings on water.

(6) Go organic. Gradually switch from inorganic to organic manures and bio-fertilizers. These are natural materials and do not pose any danger to the crop or soil. Organic methods help directly reduce the carbon footprint of

sugarcane farming by reducing use of farm chemicals that require fossil fuels that emit carbon dioxide in their production. Organic methods also help build soil, not only add to its fertility.

(7) Do bio-control of pests. Instead of applying pesticides, learn to apply biological methods of minimizing pest damage to your crop. An example of beneficial insects? Lady bugs are predators of aphids, mites, scale insects and caterpillars.

(8) Intercrop. You can intercrop wheat, potato, cowpea, French bean, chickpea, watermelon and many other crops with sugarcane with your wider spacing between rows and hills. Aside from the extra income, the intercrops will help control weed growth because of the combined denser canopy of the crops, depriving the weeds of sunlight.

(9) Ratoon. Harvest the plant crop when weather conditions are conducive for stubble growth. Cut the canes close to the ground level.

So, Neo-agriculture is not only saving on water but also saving on fertilizer, saving on seed, saving on cost, saving on time – and saving against pollution of the soil, water and air. This is a paradigm shift in thinking agriculture. I can imagine that neo-agriculture is also good for other high-value crops like hybrid rice, fancy rice, tropical fruits, vegetables, flowers, whatever. This is a change in climate in understanding agriculture. Biksham Gujja imagines SSI will replace farmer's practice in 5 years in India. Beyond SSI, I am already imagining Sweet Revolution! 2009.

(Published on 29 May 2009)

9

Rescue by Indian women. When drought persists, consult your doctor.

CNN carried the frightening news of 'India's farmers cursed with severe drought' (edition.cnn.com). 'Climate Change is real,' says Dr William Dar, Director General of ICRISAT, which is based in the drylands of India and, therefore, in the thick of the climatic challenge. Dar is a Doctor of Horticulture, his postgraduate degree from the University of the Philippines (at) Los Baños, in that little university town south of Manila. He should know what he's talking about. The drought is true, the curse is not. But it could become true if the farmers don't do what they have to do, the Indian government doesn't cooperate, and doctor scientists stay in their ivory towers. Climate Change waits for no man.

Whether in India or Zimbabwe, this time, while delayed monsoons as well as below-normal rainfall are not entirely new, there is a need for knowledge-based best efforts to mitigate the effects of drought. When in doubt, ask the scientists. Based on information provided by Dr Dar, I can see there are two things that have to be done. One is to cope; the other is to plan and, having planned, to act accordingly.

Coping

The immediate concerns of Indian farmers have to be addressed as they come. An ICRISAT-led project is providing a working model for other similarly stressed villages not only in India but in all drylands of Africa and Asia. A group of women of Adarsha at Addakal, Mahbubnagar district in Andhra Pradesh, India, are showing how villagers can survive with the drought. The Adarsha women are helping run ICRISAT's Virtual Academy for the Semi-Arid Tropics, which is expert- and Internet-based. The dryland farmers relay their concerns directly to the Adarsha ladies; with a little processing of the information, the ladies relay the need for knowledge or assistance to the doctors/experts of science via information & communication technology (ICT), including a satellite dish for video-conferencing when necessary or desirable. This is ICT technology truly in the service of the people in the hands of the people themselves, with a little help from their friends, the doctors of science. The women of Adarsha, may their tribe increase!

Planning and acting

Beyond coping, Dr Dar proposes a four-pronged science-based strategy not only to combat the drought but more so to improve the harvests from crops. I translate the strategy as follows, that farmers should:

(1) ***Replace crops endangered by drought.***

With the delay of monsoon rains, farmers may not be able to grow their crops of choice. Instead, Dar says, 'they should grow other shorter-duration crops.' These are the ones you can harvest sooner rather than later, avoiding the drought that will come later. That is because these crops become harvestable before the soil moisture gets depleted if the growing season lasts longer.

(2) ***Grow drought-tolerant crops and season-adapted crops.***

ICRISAT and partners from the Indian Council for Agricultural Research and state universities have developed and released several varieties of sorghum, pearl millet, chickpea, pigeonpea and groundnut that not only decrease the effects of the drought but also increase yields over those of traditional varieties. The doctors of academe are not only good in science; they are also good in technology.

(3) ***Practice conservation agriculture.***

'Water scarcity,' Dr Dar says, 'is indeed the most critical constraint of dryland agriculture.' That is to say, anything you do that helps you to conserve water is good for your farming. Such as preventing land degradation – when you do not protect your soil from erosion, your field gets deprived of organic matter, for instance, and hence cannot store much water. Vermi-composting may be an option. Likewise, it is a must to harvest the excess water during the rainy season, for later irrigation as the need arises.

(4) ***Communities must learn to help themselves.***

With more appropriate policies translated into more funded projects, national and local institutions, public or private, must help empower communities in support of dryland agriculture, which has been neglected long enough. There is need for low-cost credit, market linkages, more roads and bridges, more value added to farm produce, more support services than ever before. There is also need for more farming options such as crop and livestock raising models, and multiple cropping as a hedge against failure in a single crop.

Traditional agriculture has always been a gamble with the monsoons; since the weather is not what the weatherman predicts but what Mother Nature dictates, that is why agriculture may be the riskiest venture there is. That is why, Dr Dar suggests, 'India should start investing for the long-term stability and sustainability of the farming sector, particularly in dryland agriculture.' If you gamble with the monsoons, you lose. If you plan ahead and act accordingly, you win.

(Published on 15 June 2009)

10

Reinventing plows. In Zimbabwe, farmers are not always right.

ZIMBABWE! the last country in my list. Today, to the Christians, the Republic of Zimbabwe is a colossal, colonial challenge to faith and works and science. Yet, despite everything, they have to give honor to God, the origin of their life; they have to give honor to men, the origin of their everything else – and they have to work the soil, the origin of their food.

You give your soul to God; you give your best smile to men – and you give your best science to the soil. Can you do that? You have to. Even as you have done it to the worst of your brethren, you have done it unto your God. Even as you have done it to the worst of the soils, you have done it for your own good.

I don't understand the disheartening civil performance in Zimbabwe, but I do understand the depressing soil performance in that country: over-grazed, over-cultivated, lacking in irrigation, lacking in fertility, lacking in crop diversity. A farmer's son, I am an agriculturist by training, a writer by choice, a landless farmer at heart. At UPCA, we were taught in the old agriculture what to do – sow seeds on bed, plow, harrow, transplant, furrow, irrigate. And we were taught in the new agriculture what more to do – fertilize, spray against weeds & insects & diseases.

Now I'm in Manila; I have the whole world via the Internet as my library. I thank God for the Internet. If you tell me Zimbabwe is suffering, among other things, from desertification, land degradation, declining soil productivity, infertile soils, low organic matter content, poor water-holding capacity of sites – I know where you're coming from. You too are describing my country, the Philippines.

If you neglect the land, it will become a desert; if you abuse the soil, it will deteriorate; if you starve the soil, you will get a sick crop; if you don't build the soil, it will not keep the water for your crops; if you don't return to the soil what you take from it, it will repay you in kind.

Water is almost everything to the farmers, especially in the drylands of Africa and Asia. Without science, they depend mostly on the rain and, so, the behavior of the rain determines the behavior of their yields: erratic.

Not exactly in those words, but I've been thinking those thoughts and been reading for years on alternative agriculture. Thus I was excited when I read ICRISAT's Happenings about Walter Mupangwa of ICRISAT Bulawayo being awarded November 2008 a PhD by the University of Free State at South Africa for his thesis work on water and nitrogen management in farmers' fields in Zimbabwe. It's not as daunting as it looks. His study covers small farmers within three growing seasons, from 2005 to 2008, comparing on-sight (farmers' fields) and on-station (experimental areas) the outputs of plowing, planting basin and ripper systems in the dry soils of Zimbabwe. I was familiar with plowing of course, but it was the first time I encountered the basin and the ripper. I wanted to know more.

I had forgotten. In the book *ICRISAT at 35: Triumphant journey with the poor in the drylands,* it is reported that ICRISAT is working with NGO partners in Zimbabwe on a conservation agriculture (CA) package for small farmers, supported by the Department for International Development (DfID), UK. The

key component of the package is the planting basin; this is described as a small pit that is 15 cm across and 15 cm deep, where the rainwater collects, the seed is planted, the N fertilizer is applied and manure likewise. Crop rotation is also practiced. I had read that and forgotten.

I surfed the Internet and found that basins and rippers are parts of conservation agriculture. Why haven't I learned of CA in the Philippines? I also learned that CA was successfully introduced in Zimbabwe in 2004 by a task force led by the FAO Emergency Office in that country, indicating that relief and development can go hand in hand (S Twomlow, JC Urolov, M Jenrich & B Oldrieve, 2008, ejournal.icrisat.org). I understand that, because under relief conditions, you must think of the minimum, not necessarily the optimum, certainly not the maximum. Under extremely scarce farm resources, the better economists will hardly teach you to save, while the better agronomists and horticulturists will teach you to conserve. In this essay, I will talk about save and conserve.

Let me concentrate on Mupangwa's thesis work on comparing three tillage systems: plowing, planting basin and ripper. The first is conventional – you have seen a field plowed, you have seen them all. The last two are minimum-tillage techniques, not well-known. Let me describe them briefly.

Planting furrows (plowing system). This is the conventional system and should be familiar to most people in the tropics: in plowing, you create furrows for planting. In his study, Mupangwa compares the effects of single plowing and double plowing.

Planting basins (basin system). To make the planting basins, the farmer digs out the soil with a hoe, and the resulting hole turns into a basin for catching and holding rainwater; later, the basin is the site for planting and fertilizing. The problem is that in southern Africa, hoeing is difficult because the soil is hard, very hard. To encourage the farmers, the UN's World Food Programme (WFP) provides food assistance while the farmers create the basins on their fields.

Planting lines (ripper system). To make the planting lines (my term), pulled by a pair of ox, the plow-like ripper with its single tine opens a very narrow furrow in every pass. The idea that the tool 'rips the soil' is apt because the field is rock-hard. As with the planting basin, ripping is done before the rains come in order to harvest the rainwater. In Zambia in the mid-1990s, researchers of the Golden Valley Agricultural Research Trust (GART) introduced the Magoye Ripper to farmers, which it claims to be 'a Zambian original'.

We might call double plowing maximum tillage and ripper plowing minimum tillage. The moldboard plow is designed to open up the land and turn over a wide path of soil with each passing, disturbing the whole field. In contrast,

with the ripper, the rest of the field is not disturbed, soil and vegetation included. The ripper is essentially a soil chisel, and can be attached to an off-the-shelf plow frame. Thus, from where I sit, whoever invented the ripper literally reinvented the plow.

How does the ripper improve on the plow? It is claimed that John Deere 'invented a better plow' in 1837, but tell that to the farmers of Zambia and Zimbabwe! The ripper is for planting; since much of the field is not disturbed, whatever water is there is retained with the vegetation; the undisturbed vegetation covers the field and the soil underneath it does not run off with the rainwater. The vegetation also builds organic matter, especially if you apply a vegetative mulch. The plow is for disturbing the soil structure, disrupting soil buildup, preventing organic matter accumulation, and opening up the site for the soil water to evaporate. We need all the water we can save!

The ripper is a revolution in thinking such as it is. Now, will other farmers in other lands adopt the ripper and abandon the plow? I should think so, because the ripper is not too new; it is itself an adaptation of the plow, which has long been an accepted technology to the farmers all over the world. The plow was invented in China in 3 BC.

CA is a method of farming that minimizes soil disturbance, applies more precise timing for planting, and utilizes crop residue to retain moisture and enrich the soil. In Mupangwa's study, the crop residue is used as mulch, which among other things, not only supplies water to crops all the time, but also enriches the soil, reduces soil runoff and evaporation of water from the field. The mulch is a natural collector and conserver of rainwater.

The results of Mupangwa's study include the following:

- Planting basins reduce soil water runoff, basins cropped or uncropped.
- Cowpea yields decrease with delayed planting.

- Sorghum yields decrease with the planting basin due to rodent attack at crop establishment.
- Sorghum and cowpea can be grown well on planting basins at 0.9 m x 0.6 m.
- Regardless of tillage system, nitrogen fertilizer increases maize yields.
- Mulching increases maize grain yield significantly.
- Double plowing gives the highest yields to farmers.

Giving them the highest yields, as expected Mupangwa reports that his study farmers rank double plowing as the most appropriate tillage system for them given local Zimbabwe conditions. Mupangwa himself cites SJ Twomlow & PMC Bruneau (2000) as reporting that studies in Botswana and Zimbabwe 'have demonstrated that double spring plowing can increase crop yields in a wide range of soil types under semi-arid conditions.' Double plowing is good for almost any kind of soil. Be that as it may, note that the farmers are, it seems to me, using yield as the single most or the only important factor in deciding whether to call a technology appropriate or not.

The farmers are not always right!

Mupangwa says that long-term (69-year) simulation modeling reveals that crop failures can be expected in the use of either basin or plowing systems 'due largely to uneven distribution of rain events during the growing season.' Translation: You can't rely on the rain because the weather is unpredictable. Implication: Harvesting and storing the rainwater is critical to the growing of crops. Another lesson I learned from ICRISAT.

On that matter, aside from ICRISAT's holistic watershed approach for a whole village to harvest rain, mulching for a farmer's field can be used. In his study, Mupangwa finds that mulching maize, cowpea and sorghum fields improves the soil water supply and increases yield even in a season with below-average rainfall. I can explain it. The mulch becomes humus (organic matter), and in turn the humus, being spongy, increases the water-holding capacity of the soil. If there is no rain, the soil gets its water from the humus itself; as well, the humus absorbs capillary water rising through the layers of soil. Thus, all things being equal, water being life to the crop, with a mulch applied, one can expect much better yields. Bare soils, and therefore hungry and thirsty, can only give bare yields.

Mupangwa's study is based on the grand concept of conservation agriculture; that is looking at it from the point of view of scientists. I believe in conservation agriculture; I'm just looking at the term itself. And having been learning from ICRISAT science in the last two years since February 2007, I want now to look at it from the point of view of the farmers and call it Saving Agriculture, and it comprises the following:

(1) Saving the soil. Soil erosion is stopped or reduced by minimum tillage. 'We're losing 400 million tons of soil every year,' says James Breen, an agronomist of the FAO (IRIN as cited). I say if you're losing soil, you're losing food – you're losing the nutrients that can become cereal, vegetable, nut or fruit.

(2) Saving on fertilizer, 1. Fertilizer is applied as ICRISAT microdose, 1 bottle cap of fertilizer to a planting basin. No over-fertilization, hardly any fertilizer leached to the underground.

(3) Saving on fertilizer, 2. Mulch applied turns into organic matter rich in plant nutrients. Crop rotation with a legume enriches the soil with nitrogen.

(4) Saving on water. Rainwater is harvested by the planting basin, also absorbed by the undisturbed soil. In the Adarsha approach, as mentioned above, the rainwater is saved so that a whole watershed is rehabilitated and the underground water is replenished.

(5) Saving on weed control. Crop residue is applied as mulch, an excellent technique for weed control. Planting a cover crop is also effective against weeds.

(6) Saving on pest control. Planting on time, that is, simultaneously with other farmers or fields, prevents a specific crop from becoming the feeding and, therefore, the breeding ground for pests. Planting trap crops is another option to save on pest control. These techniques minimize the use of pesticides that are expensive.

(7) Saving on cost of sad experience. Since inter-cropping is a hedge against a single crop failure, multiple cropping is a multiple hedge.

Saving agriculture is saving on farm labor, no. Not the conservation agriculture I'm thinking of. 'Labor-intensive' is a term to describe conservation agriculture, as there is a need to do all these manually: prepare planting basins with a hoe, rip the field with planting lines, mulch field with crop residue, apply fertilizer, and plant the seeds. At any rate, small farming is always labor-intensive. Thus, I might say CA in the Philippines is perfect, as our President Gloria Macapagal Arroyo currently is encouraging job creation – the more brains and brawns employed, the better for the economy.

Saving agriculture is not reinventing conservation agriculture; it is only calling for a paradigm shift in thinking about climate change globally and acting on agriculture locally. From Australia to Zimbabwe, the small farmers will understand.

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11

Climate change agriculture in China. A watershed in collaboration.

BEIJING, CHINA – A radical kind of crop-cultivator-center-country corporate connection for climate change is being built and its first network can be found in China, of all places. The collaboration has been institutionalized by China and the CGIAR. On 4 August 2009, they inaugurated in Beijing a facility called the Center for Excellence in Dryland Agriculture (CEDA).

This joint undertaking has been triggered by the imperative challenge of global warming and the risks that modern agriculture must face, especially in the drylands. Now therefore, I shall call what CEDA seeks climate change agriculture. Is China reinventing agriculture then? China is not new to innovations in farming; after all, it invented the plow.

So, they are making modern history in China; it just happens that its capital Beijing is an excellent choice as site. 'Beijing is the miniature of Chinese history and present actuality,' says ANN. 'Beijing is an archaic city with 3,000 years' brilliant civilization, but simultaneously is also a city that glows with beauty and youth.' It is a city that harbors the old while it welcomes the new.

CEDA is a collaboration of the Chinese Academy of Agricultural Sciences (CAAS, founded 1957, based in Beijing, China) on one hand and on the other, two centers of CGIAR: the International Center for Agricultural Research in the Dry Areas (ICARDA, founded in 1975, based in Aleppo, Syria), and ICRISAT. The old must catch up with the new. In climate change, there's the common threat; in union, there's the common strength.

CEDA was jointly inaugurated by ICARDA Director General Mahmoud Solh, CAAS Vice-President Huajun Tang, and ICRISAT Director General William Dar. CEDA is a fulfillment of a Memorandum of Understanding signed by Tang, Solh, and Dar in Maputo, Mozambique during the Annual General Meeting of CGIAR in December 2008 to establish CEDA. Present during the inauguration were delegations from ICRISAT (including Peter Ninnes and Suhas Wani), ICARDA (Kamil Shideed and Weicheng Wu), and high-level officials from CAAS, including Director General Mei Xurong of the Institute of Environment and Sustainable Development in Agriculture (IEDA). On 3 August 2009, the ICRISAT and ICARDA delegations were received at CAAS and they held detailed discussions with CAAS VP Huajun Tang and colleagues Gong Xifeng, Feng Dongxin and Liu Yukun of the Division of Bilateral Cooperation.

ICRISAT DG William Dar gave a presentation titled 'Poverty, water scarcity and climate change: Opportunities and challenges in dryland agriculture.' You have to help the poor farmers, the poor crops, the poor soil, the poor environment. Institutionally, ICRISAT has come up with the Adarsha prototype, a watershed model that harvests water from the rain, improves village incomes, and at the same time protects the surroundings from degradation. Learning from the Adarsha model, the Lucheba watershed at Guiang shows the transformation of the commune via crop diversification, planting more vegetables and using less water. The Lucheba farmers have also learned to do collective marketing via a vegetable growers' association. As a result the average income per capita has multiplied three times that in 2003. Climate change is a challenge, not a constraint.

On his part, CAAS VP Tang pointed to the growing Chinese economy, the growing water scarcity, and the growing need for food security, a basic

necessity for any country, developed or developing. Gong focused on ICRISAT's collaborative work in watershed management in the provinces of Yunan and Guizaou, as well as with the crops pigeonpea and peanut. Xurong emphasized the value of the drylands, those sites that receive little rainfall, and which support 80% of the world's rural poor. About 40% of the Earth's surface is drylands: arid, semi-arid, and dry sub-humid areas (Philip Dobie, 2001, undp.org). According to Dobie, it is important to note that drylands of the world contain both rural and urban populations. The climate is no respecter of persons.

Under the CEDA collaborative scheme, three priority fields have been identified: (1) further improving climate change-ready crops, (2) increasing water use efficiency, and (3) enhancing crop-livestock systems. I think all that calls for crops more resistant to warm weather as well as to water-starved soils, for better tillage and culture methods that conserve water in the soil and cut cost on fertilizer, and for mixed crop-animal farming systems appropriate to the poor. Otherwise, we will always have the poor with us, and climate change.

If viewed in the proper perspective, constraints are not obstacles; rather, they are opportunities to correctly define the problem and propose solutions or options for action. When developed, community watersheds, Dar said in his presentation, address the problems of the scarcity of water, lack of income, and poor environmental protection. In that sense, whole villages, whole towns and whole cities can be considered watersheds and treated with conservation of resources in mind: water, soil, air, as well as people.

In the first Steering Committee meeting of CEDA, it was agreed that capacity-building, institutional innovations as well as policy initiatives will receive adequate attention. Research area coordinators from CAAS, ICARDA and ICRISAT will develop R&D proposals under the CEDA umbrella. As a component basis for decision, a status report on present and past collaborative R&D in agriculture in China will be prepared by December this year.

The inauguration of CEDA was celebrated in a dinner sponsored by ICARDA and ICRISAT for senior CAAS members, including CAAS President Zhai Huqu. There was also a visit to the advanced biotech labs of CAAS, as well its well-equipped genebank that can hold 450,000 germplasm accessions. CAAS is China's national agricultural research organization; with 38 research institutes located in 17 provinces, it employs about 10,000 people.

DDG Yao Xiangjun of the Chinese Ministry of Agriculture sought ideas from the participants to strengthen collaboration between the Ministry and CGIAR Centers. On his part, ICRISAT DG Dar, along with acknowledging that 'the tripartite collaboration marks a new milestone in the relationship with CAAS, Ministry of Agriculture and other research institutions in China to

address issues of water scarcity, climate change and achieving food security,' reminded everyone of the need to allocate more funds for CEDA. History tells us that lip service will get us nowhere.

A delegation from the Millet Research Institute of the Zhangjiakou Academy of Agricultural Sciences led by Institute Director Zhao Zhihai drove 300 km and sought a meeting with ICRISAT to explore possibilities for collaboration on millet, one of the mandate crops of ICRISAT. The ICRISAT delegation also met Guandong Academy of Agricultural Sciences (GAAS) President Zuo Yi Liu, Director Sun Qiu of the International Agricultural Development Research Institute (IADRI) and other officials. The GAAS and ICRISAT teams discussed collaboration on sorghum and peanut, two other mandate crops of ICRISAT.

From where I sit, I see that ICRISAT is both reactive and proactive when it comes to appreciating the concerns of dryland areas, especially with the advent of climate change, as well as to defining the problems and seeking solutions or options for actions that are positive and constructive. ICRISAT has come a long way from its moribund status in 2000, when DG William Dar took over the reins. A Filipino from among the poor in Santa Maria, Ilocos Sur in northern Philippines, he had his job cut out for him. The Institute was then plagued by declining morale and beset by decreasing finances amid lacklustre R&D performance. With heart and mind in the right places, Dar planted the seeds and has since been nurturing Team ICRISAT. The institute has since won an unprecedented two Outstanding ratings (for the years 2006 and 2007) from the World Bank, which supports CGIAR, and Dar has made a historic first in the history of international agricultural centers: He was appointed this year for his 3rd term as Director General of ICRISAT.

(Published on 13 August 2009)

12

Adapting to climate change. ICRISAT policy recommendations for the developing world.

WHILE economic growth and development are priorities in all countries, the needs in developing and least-developed countries are on a different scale altogether from those in the developed world. Developing countries are constrained by their particular vulnerability to the impacts of climate variability.

The poor in these countries are also at higher risks to both current and future climate-change impacts, given their high dependence on agriculture, strong reliance on ecosystem services, rapid growth and concentration of human and livestock populations and relatively poor health services. In fact, about 99% of the casualties due to the vagaries of climate take place in the developing world.

As a result of global warming, the type, frequency and intensity of extreme events, such as tropical cyclones, floods, droughts and heavy precipitation events are expected to rise even with relatively small, average temperature increases. New climate studies project that extreme heat waves are very likely to become common in the tropics and subtropics by century's end. Add to this gloomy scenario the insufficient capacity to adapt to future climate change impacts, inadequate infrastructure, meager household income and savings, and the limited supporting public services, and you have a veritable time bomb in the offing.

Climate change goes against the grain

Climate change is already inevitable, but in the absence of robust adaptation strategies, it will almost certainly exacerbate food insecurity. Millions of people in countries that already have food security problems will have to give up traditional crops and agricultural methods as they experience changes in the nature of the seasons, for which, over time, they have developed coping strategies that have enabled them to survive. Given the fact that two billion people already live in the driest parts of the globe, where climate change is projected to reduce yields even further, the challenge of putting enough food in nine billion mouths by 2050 is daunting!

And what does it imply for about 1.5 billion people, nearly 60% of developing nations' workforce, who are engaged in agriculture? Since agriculture constitutes a much larger fraction of GDP in developing countries, even a small percentage of loss in agricultural productivity could snowball into a larger proportionate income loss in a developing country than in an industrial one.

Climate change also threatens poverty reduction efforts because poor people depend directly on already fragile ecosystems for their well-being. They also lack the resources to adequately defend themselves or to adapt rapidly to changing circumstances, and more importantly, their voices are not sufficiently heard in international discussions, particularly in climate change negotiations. Environmental effects such as desertification and rising sea levels triggered by climate change can lead to increased conflicts for resources, which in turn can displace people. The World Bank estimates that sea level rising by a single meter would displace 56 million people in 84 developing countries!

Food insecurity is a gnawing concern among smallholders and the poor in developing countries. Unhindered climate change has the potential to negatively impact developing countries' prospects for sustainable development. As the rural poor across the developing world feel the pressure of climate change, high food prices and environmental and energy crises, it is now clear that new knowledge and technical and policy solutions have never been more necessary – and critical.

Technical solutions

Climate change being a threat multiplier, adaptation and mitigation strategies need to be urgently integrated into national and regional development programs. Developing countries need to participate in a globally integrated approach to this problem. Policies on adaptation include changes in land use and timing of farming operations, adaptive plant breeding and crop husbandry technologies, irrigation infrastructure, water storage and water management. Mitigation measures may include better forecasting tools and early warning systems, improved crop and livestock management practices including improved input use efficiencies (such as ICRISAT's microdosing), crop systems diversification and improved water management.

Policy solutions

More investments in agricultural research and infrastructure. Considering the role of agriculture in the social and economic progress of developing countries, and the vulnerability of agricultural systems to the impacts of climate change, a renewed agenda for agricultural research, more aggressive investments in and better management of agricultural research and knowledge can make significant improvements in food security goals. A progressive policy environment should also include more investment in infrastructure and education and research that improves understanding and predictions of the interactions between climate change and agriculture.

Water management. Almost 95% of the developing countries' water withdrawals are used to irrigate farmlands. Therefore, water policy to make more efficient use of water for agriculture is crucial. This involves understanding water flows and water quality, improved rainwater harvesting and water storage and diversification of irrigation techniques. Such considerations will need to be framed in the context of rapidly expanding populations that are predicted to exacerbate inter-sectoral competition for abstracted water supplies. Robust irrigation infrastructure may be necessary to cope with climate change risks in the short to medium term. Maintenance of existing infrastructure too deserves early attention.

Land-use practices. Land-use policies to encourage diversification and natural resource management, including protection of biodiversity, are critical. Erosion control and soil conservation measures, agroforestry and forestry techniques, forest fire management and better town planning are some steps that can be initiated to blunt the impacts of climate change. Reducing and sequestering terrestrial greenhouse gas (GHG) emissions are possible by enriching soil carbon, farming with perennials, engaging in climate-friendly livestock production, protecting the natural habitat and restoring degraded watersheds and rangelands.

Weather and climate services. The role of weather and climate services and products in developing adaptation solutions is crucial. Stock-taking of available climate information in developing countries to ascertain where the systematic observation needs are most pressing; collaboration between national and international providers of climate information and users in all sectors and generating awareness among different user communities of the usefulness of such information are essential. Climate-change assessment tools are needed that are more geographically precise, that are more useful for agricultural policy and program review and scenario assessment, and that more explicitly incorporate the biophysical constraints that affect agricultural productivity. Packaging all that data for its effective use and rescuing historical meteorological data are equally important. In this respect, the National Meteorological Services in the developing world must be encouraged and enabled to become fully integrated into research and development initiatives.

Engagement of the private sector. Policies that encourage holistic approaches including the engagement of the private sector should feature in any national and international approaches to address climate change and facilitate the transition to a low-carbon economy. The private sector can invest in clean new technologies and develop innovative market mechanisms to combat climate change, particularly the dangers from GHG emissions.

Capacity-building and collective action. Policies that enhance the effectiveness of rural institutions at the local, national and international levels will be a central concern as they seek to speed up the pace of agricultural

adaptation. Unless steps are taken to initiate and strengthen cooperation among academic and research institutions, regional and international organizations, and NGOs to provide opportunities for strengthening institutions, dealing with climate change impacts may be cumbersome. Involving local communities, education on climate change and raising public awareness are key to combating climate change.

Economic diversification. Economic diversification to increase the economic resilience of and to reduce reliance on vulnerable resources is crucial. Reducing dependence on climate-sensitive resources is an important adaptation strategy that must be promoted. Improved food security through crop diversification, developing local food banks for people and livestock, and improving local food preservation need to be encouraged.

Database of adaptation options. Given the diversity of agro-ecological zones and their inherent problems, it is also essential to assemble, document and disseminate a comprehensive and action-oriented database of adaptation options of different farming and livelihood systems and agro-ecological zones.

Access to credit and crop insurance. Since farmers are often constrained by access to credit, policies that enable better access to credit (micro-finance) and agricultural inputs in order to intensify integrated production systems need attention. Catastrophic or weather-risk insurance and index insurance (insurance linked to a particular index such as rainfall, humidity, or crop yields rather than actual loss), can be used as new climate risk management tools in developing countries.

Gender diversity. While underscoring the vulnerability of poor women to climate change, policies that cater to the rural poor and recognize the important role of women in agricultural production should be acknowledged. By virtue of the valuable knowledge in water, forest and biodiversity management that women have acquired over the years, and their important role in supporting households and communities to mitigate and adapt to climate change, their contribution to the identification of appropriate adaptation and disaster mitigation processes could be very useful. Women's environmental resources, knowledge and practices can be key elements in climate change processes.

Contributing to value chains. Policies that contribute to value chains in the agricultural sector and smallholder farmer participation in these value chains are fundamental to efforts to deal with climate change.

The CET opportunity. The emerging market for carbon emissions trading (CET) offers new opportunities for farmers to benefit from land uses that sequester carbon. Policies that encourage and enhance participation in carbon emission trading schemes must be put in place.

ICRISAT's role

The International Crops Research Institute for the Semi-Arid Tropics serves the poor of the semi-arid tropics in Asia and sub-Saharan Africa (SSA). It recognizes that vulnerable rural communities need to adapt to climate change, beginning with enhancing their ability to cope better with the rainfall variability associated with current climates.

To help farmers in sub-Saharan Africa cope better with climate variability, ICRISAT currently facilitates a NEPAD-endorsed consortium for 15 national, regional and international partners titled 'Investing in rainfed farming systems of sub-Saharan Africa: Evaluating the agricultural implications of current climatic variability and planning for future climate change.' ICRISAT is currently partnering with meteorological services, CGIAR centers and climate science specialists in several projects pertaining to climate risk management in Asia and Africa. There are currently 10 such projects taking place in SSA.

ICRISAT has developed and continues to develop tools and technologies enabling the resource poor to improve livelihoods. It uses sophisticated techniques of predicting and forecasting monsoons in the context of climate change; enables collective action and rural institutions for agriculture and natural resource management; upscales and outscales its community watershed management model; rehabilitates degraded lands and diversifies livelihood systems for landless and vulnerable groups and initiates government support for water saving options.

Climate-ready crops. ICRISAT already has on hand crops that are adapted to high soil and air temperatures; knowledge and understanding of flowering maturities; information on genetic variation for water use efficiency; short duration varieties that escape terminal drought and high-yielding and disease-resistant varieties. For instance, we have developed short-duration chickpea cultivars ICCV 2 (Shweta), ICCC 37 (Kranti) and KAK 2 and short-duration groundnut cultivar ICGV 91114 that escape terminal drought. We recently developed a super-early pigeonpea line that flowers in 32 days and matures in about 65-70 days.

We have integrated shrubs and trees into traditional annual cropping systems to help reduce the impacts of winds and to protect soils from erosion.

ICRISAT has developed crop varieties that resist pests and pathogens, such as downy mildew-resistant pearl millet hybrid HHB 67-Improved in India; wilt-resistant, high-yielding pigeonpea ICEAP 00040 in Tanzania, Malawi and Mozambique and rosette-resistant groundnuts in Uganda, to name a few.

Guiding our crop adaptation work are tools such as INSTAT and GENSTAT, MARKSIM and APSIM/DSAT that analyze climate data and produce high-quality information and products tailored for agricultural applications and to quantify the relationships between climate, crop, soil and water resources.

Since ICRISAT's mandate crops are already more adapted to heat and high soil temperatures, our breeding strategy factors these harsh and dry conditions while developing improved varieties. What we need to better understand is the physiological mechanism underlying heat tolerance; we also need to identify wider gene pools to develop crops with wider adaptability; and develop more effective screening techniques of germplasm for desired traits. ICRISAT's gene bank holds more than 119,000 accessions from 144 countries that will help safeguard and exploit genetic diversity in order to enhance adaptation.

Biofuel production. ICRISAT is also responding to the challenges by exploiting the potential of 'pro-poor' opportunities for biofuel production. Its BioPower initiative encourages more investments in bio-energy crops and systems to provide a major impetus for sustainable development; empowering the dryland poor to benefit rather than be marginalized, so that farmers can better cope with stresses, climate change or otherwise. The current activities include developing higher-yielding sweet sorghum varieties for food, fuel, feed and fodder; pilot-scaling pro-poor commercial startup company partnerships in sweet sorghum bioethanol production and research-to-development alliances for pro-poor Jatropha plantation development for biodiesel.

To summarize, if developing countries are to contribute meaningfully to efforts toward adaptation and mitigation of climate change impacts, they will need the strengthened capacity that comes with development. A conducive

and comprehensive policy environment that enhances opportunities for smallholders given the climate change scenario, needs to encompass all levels – farm, basin, regional, national and global. It must include adaptation and mitigation strategies, more investment in agricultural research and extension, rural infrastructure, and access to markets for small farmers, among other things. The bottom line is to ensure that they develop resilient ecosystems, resilient crops, resilient livestock and resilient communities.

(Published on 10 September 2009)

13

Sweet BBC?
Growing crops; raising hell.

PATANCHERU, India – On 10 September 2009, the BBC interviewed William Dar, Director General of the ICRISAT; the subject was rose-colored glasses, that is to say, looking at the bright side of things. Inevitably, the subject was Rusni – with ICRISAT's sweet sorghum seeds, Rusni Distilleries established 3 years ago in Andhra Pradesh the world's first commercial sweet-sorghum distillery for ethanol.

Now I'm glad the BBC is documenting biofuels. A very revealing BBC editorial last year reported on the giant leap of Europe's mankind to convert plants into biofuels, meaning bioethanol and biodiesel. A great leap backward. 'Recent reports have warned of rising food prices and rainforest destruction from increased biofuel production' (Roger Harrabin, 'EU rethinks biofuels guidelines,' news.bbc.co.uk). The Europeans are learning the lesson that if you are growing a biofuel crop, you may also be raising hell.

Earlier, BBC reported what Achim Steiner of the UN Environment Programme said the critics were worried about biofuel production in 2007, pointing to 'the destruction of Indonesia's peat swamps as an example of biofuel folly' (15 November, entangledstates.org). The 'massive subsidies to promote American corn production for ethanol,' according to William Laurance (Smithsonian Tropical Research Institute, Panama), has encouraged the growing of soybeans in Brazil, where large areas of grasslands are being cleared and converted to soybean farms (news.mongabay.com). And why is that? The huge US subsidies for biofuel have elevated prices of biofuels (not to mention foods and feeds) all over the world, so everyone wants a bite of the gigantic pie. This has been your Bush's Biofuel Folly.

That is a little background as to why the BBC went to India and specifically asked Dar about his Institute's research on sweet sorghum as well as its advantages over other biofuel crops used for producing ethanol, the preferred gasoline additive for energy-conscious countries like the US A and India, where ICRISAT is based.

Like I said, you can't talk about biofuel and what ICRISAT has been doing with sweet sorghum without mentioning Rusni. Sweet sorghum is a favorite subject of mine – so, thank you, BBC. That has been so since I learned about Dar and ICRISAT and their sweet sorghum initiative.

I call sweet sorghum a multiplier crop, and enumerate the reasons:

(1) *It multiplies the planted fields* – This crop grows anywhere, including the marginal lands, infertile, heat-challenged.

(2) *It multiplies the farmers* – More farmers can afford to grow sweet sorghum since it doesn't ask for fertilizers and pesticides, these two being the bulk of the cost of farming these days.

(3) *It multiplies the carbon gas-guzzlers* – This crop quaffs more of carbon dioxide, a pollutant, per unit space than other crops. To produce more organic matter, it needs more carbon dioxide to process with sunlight; you've heard of it – it's called photosynthesis.

(4) *It multiplies the consumers* – It has multiple uses and, therefore, products: food, feed, fuel, fertilizer, fodder, and fence.

(5) *It multiplies the water* – It grows with little water, no need for irrigation, so a little water goes a long, long way.

As a matter of fact, Dar of ICRISAT told the BBC that sweet sorghum lorded over other ethanol crops such as corn (which the Americans prefer) and sugarcane (which the Brazilians favor) for several reasons (restated below, in my terms):

(1) Sweet sorghum is *soil-friendly*. Dar said sweet sorghum had the ability to thrive in soils where there is little water (that is, drought is no object), or soils that are saline ('salty') or alkaline ('sweet'), where corn and sugarcane would languish.

(2) Sweet sorghum is *water-friendly*. This crop grows in waterlogged soils of the world where corn and sugarcane could not. Yes, it can grow in both drylands and wetlands.

(3) Sweet sorghum is *ethanol-friendly*. It produces more (equivalent) ethanol a day than sugarcane.

(4) Sweet sorghum is *farmer-friendly*. Where sugarcane takes a year to grow to maturity, sweet sorghum needs only 4 months. So, a producer can grow 3 crops a year. Translation: While the sugarcane grower has been yearning the whole year through, the sweet sorghum farmer has been earning all the time.

(5) Sweet sorghum is *a miser's hope*. Where sugarcane is profligate with water, this crop is niggardly with this valuable element. Sugarcane: 'Water, water everywhere!' Sweet Sorghum: 'Just one drop to drink, please.'

(6) Sweet sorghum is *a bean-counter's dream*. This crop costs less to grow that it's a budget officer's dream come true.

(7) Sweet sorghum is *an extensionist's fantasy*. Dar says that because of this crop's many advantages over sugarcane, the willingness of small farmers to adopt sweet sorghum as a choice crop is high. I say sweet sorghum brings to life the idea that Ernest F Schumacher made famous in the 1970s: 'Small is beautiful.'

Not only that; as I pointed out on 15 October 2007, sugar is sweet, but sweet sorghum is sweeter. 'Sweeter' means you get more sugar per unit of volume.

Meanwhile, in Manila, in pursuit of a book I'm writing for the UP Los Baños Alumni Association on successful graduates of the College of Agriculture to celebrate the College's centenary this year, I was talking to Emil Q Javier, once Chancellor of UP Los Baños, once President of the University of the Philippines (UP) System, once Secretary of Science – under President Ferdinand E Marcos. And since when I interview people, it's more a conversation than a Q&A session, the talk drifted to William Dar, whom he knows, and of course about ICRISAT and, of course, about sweet-stalked sorghum. Among other things, Javier was pointing out the need for contiguous or near-enough areas of thousands of hectares to supply

economically sweet sorghum stalks for an ethanol distillery plant for a year-round operation. Let's leave that problem to the managers.

Javier also had an idea that made sense if you considered the sugar plantations as given: There are marginal areas in those plantations, unproductive soils, so why not populate them with sweet sorghum instead? You then get maximum results from minimum resources.

On my part, where a capitalist cannot put up an ethanol distillery for lack of economic supply of sweet sorghum stalks, and where farmers cannot get inside sugarcane plantations, I like to think of jaggery, that which farm families can produce in a village-scale sweet sorghum industry, and the many cottage products they can produce from that unrefined sugar. (In the Philippines, jaggery is *panutsa* in Tagalog, *sinakob* in Ilocano.) Having read Schumacher in the 70s or 80s, I prefer to think small.

In contrast, the Americans prefer to think big, like shooting for the Planet Mars; and when they ignore something, it's huge, like the United Nations. In 2007, I had called sweet sorghum sweet-sounding names: 'Discovery Sorghum' and 'The Great Climate Crop'. That was a great discovery to me. That was also the time I discovered that the Americans had ignored *Sorghum bicolor* (sweet sorghum) as their source of ethanol, preferring *Zea mays* (corn), even as they had ignored the Kyoto Protocol (what's that?), even as they had refused to pass a Biofuels Act (had they even considered it?). They had been ignoring one of their own kind, Al Gore, because he was talking about an inconvenient truth: that man was a major cause of global warming.

The Nobel Prize Committee agreed and gave Al Gore and the UN Intergovernmental Panel on Climate Change (IPCC) jointly the 2007 Nobel Peace Prize (msnbc.msn.com). The Nobel citation read in part:

His strong commitment, reflected in political activity, lectures, films and books, has strengthened the struggle against climate change. He is probably the single individual who has done most to create greater worldwide understanding of the measures that need to be adopted.

On one hand, the Nobel Prize created huge political waves all over the world by acknowledging what Al Gore referred to as 'a true planetary emergency.' On the other, the use of American corn mainly for ethanol has created huge economic waves of woe for Filipinos, not to mention the food processors and meat producers in the US and elsewhere. Since much American corn goes today to ethanol, the supply has shifted direction, and this has jacked up the price of American corn that, quite frankly, hilarious it isn't anymore. Nobody's laughing. We Filipinos are fond of imported goods; we even import American corn to feed our imported poultry and imported livestock. We have to unlearn our expensive taste. Then we can laugh better.

The Americans have to unlearn their expensive thinking of themselves. They think that growing sweet sorghum is an extravagant waste of time and resources. Case in point: On 20 March 2006, the Americans in OK (Oklahoma State U) had considered sweet sorghum for ethanol production, then discouraged themselves, concluding that sweet sorghum was 'economically

unfeasible' since the juice could not be stored and therefore had to be processed immediately, and the harvest season for the crop was only a few months (reported by David Page, redorbit.com). They had Internet access, but they probably weren't paying attention to what was going on elsewhere, such as in India, such as at the campus of ICRISAT, where since 1980 research on sweet sorghum has been ongoing.

Where there is a will, there is a won't – so, the OK researchers failed to consider that you could stagger the planting of the crop so that you have feedstock the whole year round. You have quite a few of 'a few months' throughout the year, right? In the case of sweet sorghum, you have three sets of 4 months to grow the grains and stalks of this sweet crop. No, don't forget: When you grow sweet sorghum for ethanol, the grains are extra income, whether they become food for the table, feed for the birds, or feedstock for ethanol.

I realize the Indians know better; as I mentioned earlier, with Filipino William Dar as Team Captain of ICRISAT, Indian AR Palaniswamy as the entrepreneur of Rusni has established in Andhra Pradesh, India an ethanol distillery plant fed through a sweet sorghum supply network. You can't ignore the small farmers. And since the Rusni technology is multi-feedstock, it accepts sweet sorghum grains as well as sugarcane for producing ethanol. You can't ignore the big farmers. No downtime. The Rusni ethanol plant showed success in 2007; the OK Americans had quit on sweet sorghum a year too early, in 2006.

Going back to the clear and present danger of damaging forestlands arising from growing biofuel crops, this is the connection I see: In the Philippines, if you plant *Jatropha curcas* (jatropha) for biodiesel in non-agricultural lands, meaning in logged-over areas, you are borrowing from Peter to pay Paul – you are in fact embarking on a short-term journey of changing forestlands into farmlands, that is to say transforming chainsaws into plowshares – and begging for a long-term disaster. You are solving a problem by creating another. You're OK if you don't clear forestlands to plant sweet sorghum or jatropha. I think this is a lesson that to learn we don't have to go to university. Or India.

Personally, while not convinced with jatropha and not converted to sugarcane, while climate change stalks you and me, I prefer to be sweet-stalked by sweet sorghum.

(Published on 13 September 2009)

14

Drylands Dar.
The man with a thousand shifts.

HYDERABAD – India! Land of the tiger. Land of mystery. Land of ancient wisdom. We are in the City of Pearls, in the State of Andhra Pradesh in India. And about 25 km from here is Patancheru, where we find ICRISAT, the leading institute for the drylands of the tropics, and Team ICRISAT and their leader, Director General William Dollente Dar.

Dar will be in Buenos Aires from 21 September to 2 October attending the First Global Scientific Conference Supporting UN Efforts to Curb Desertification, with top scientists and policy advocates to discuss what the world can do about the drylands and climate change. 'Buenos Aires' means 'good airs,' but this time, my essay is not so much about a bone-dry global desertification conference as it is a fresh breath of creative writing in science. This time, I write for the writers; I unfold a tale as I report the news for the news reporters as well as the news readers. There are no boring news, only boring journalists; there are no boring stories, only boring storytellers.

In that Buenos Aires conference, they will need to make countless paradigm shifts. 'Desertification is the cancer of the earth,' says Argentine geographer Elena Abraham. A deadly metaphor. It means there is no cure for this disease. If it's cancer, they should not be talking about a 10-year strategy and plan to monitor land degradation, fight desertification – and demand more funding to do both. 'We have to install a culture of monitoring,' says Abraham. Madam, I think what we need is a culture of caring, because as your science colleague Octavio Perez Pardo says, 'it is the global environmental problem that draws the least funds.'

Desertification is solvable. Don't talk about cancer to William Dar, or you will learn from him. What we all need is a climate change from critical thinking to creative thinking. And we'll get it. There in Buenos Aires right now goes the man with a thousand paradigm shifts. Without him and those many shifts, there would not have been a gigantic climate change within the CGIAR. Because, among the CGIAR centers, without him, ICRISAT might still be on a dry rut, if not deep into its own degradation process towards desertification of its soul and spirit.

Looking back now, the man was destined for ICRISAT. 'The high destiny of the individual is,' says Albert Einstein, 'to serve rather than to rule.' So ICRISAT now has a servant-leader, William Dar, servant-leader for the poor and heat-oppressed.

Before Dar, the institute itself had been poor. In 2000, the finances of ICRISAT had been going down for years; the morale of the staff had been declining since they do not know when; the international standing of the institute was down to a dangerous level – comes in a man from the backyards of Santa Maria in Ilocos Sur in northeastern Philippines. What will happen now? A big question.

Who was he anyway? Dar's story is worth telling and retelling. He is a genuine Ilocano (GI); we GIs are known as the Wandering Jews of Asia, which means we can make a geographical shift as fast as you can say 'Santa Maria!' That explains the modern Filipino diaspora known as the Overseas Filipino Workers (OFWs). He is the first GI I know who has made as many intellectual shifts as

there are islands in his native country, the Philippines. He is my Man of a 1000 Paradigm Shifts.

Watch my list grow:

Paradigm shift #1

Still on the mountains of Benguet on the MSAC campus where he was teaching, he decided he was more interested with growing plants than with growing boys and girls. So he took his Master of Science in Agronomy in the same school and graduated in 1976. He was going to watch the fields from hereon, no longer to watch the classrooms. He wanted to manage the nature of plant crops, not the nature of the crops of teenagers.

On climate change, the nature of plant crops is that they are great contributors/harvesters of greenhouse gases. Shift your thinking to the soil also. You cannot ignore the role of agricultural land use in reducing greenhouse gas emissions.

Paradigm shift #2

He decided to go down to the lowlands and aim higher, reach for a doctoral degree at the College of Agriculture of the University of the Philippines Los Baños. I know the folks at UP Los Baños, many of whom are high hats. He probably knew what I knew, and took the risk; he graduated from UP Los Baños with a PhD in Horticulture in 1980. If you finish from UP Los Baños, you must be worth your grades in black ink.

A key topic during the conference is 'Understanding desertification and land degradation trends.'

Paradigm shift #3

All the while, he was with the MSAC, which grew up with him into the Benguet State University (BSU). He led a Ford Foundation-funded project to upgrade the University's research facilities and abilities, and the farmers' production skills. No matter what the scholarly, proud academics say, the State University exists for the farmers, who pay taxes for it.

'We need to view drylands as the front lines in our global effort to help the rural poor cope with climate change,' says William Dar. Science should not be only pro-poor; it should be of, by and for the poor.

Paradigm shift #4

At BSU, he became Coordinator of the Highland Agricultural Research Center in 1979; he stayed until 1987. A major undertaking of his was the Cordillera Integrated Agricultural Development Program, a joint project of BSU and the Provincial Government of Benguet. He learned to shift attention to the local government units as partners in development.

'Farmers in these (dry) areas already face harsh and variable weather and limited resources,' says Mahmoud Solh, Director General of ICARDA, the major partner of ICRISAT in the conference. These partners should be partners with the farmers too.

Paradigm shift #5

He did the packaging of research and development project proposals. He initiated the formation of the BSU Development Foundation, which implemented several projects. A foundation like that at the very least cuts through government red tape and saves researchers not only time but money. Red tape degrades government services.

Degraded drylands cease to perform key 'environmental services' such as carbon sequestration. With plant crops, these soils store organic carbon, and that is so much less carbon going up the atmosphere and threatening us with climate change.

Paradigm shift #6

In 1987, he became Director of the Philippine Department of Agriculture's Bureau of Agricultural Research. He had to hone his skills in interagency coordination, policies and politics, and linkages with funding institutions and agencies in the Philippines and abroad. He had to oversee the whole Department's R&D programs and projects, to make the DA-BAR an efficient and effective coordinator of research in the various DA bureaus, units and attached agencies.

So far, the main barrier to progress in combating desertification is lack of standardized, science-based methods for monitoring and evaluating land degradation and, indirectly, soil development, if any. You cannot coordinate research if you cannot monitor properly, if you focus more on symptoms rather than on underlying causes.

Paradigm shift #7

He laid the groundwork for resource generation to augment BAR's limited budget. He successfully sourced funds from international donors, creating a Project Packaging Section, in charge of generating proposals for funding. He started the DA's research allocation system and strengthened the BAR's research analysis.

To prove climate change, what the Intergovernmental Panel on Climate Change, did was to marshal massive scientific evidence on the causes and consequences of climate change. Figures don't lie; the experts do figures.

Paradigm shift #7

In 1994, he became the Executive Director of the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD). Immediately, he laid out for PCARRD a 7-point agenda and set out to implement it: (1) continuously rationalize the National Agriculture, Resources Research and Development Network of the Philippines; (2) strengthen partnerships with the private sector, non-governmental

organizations, state universities and colleges, government units, Congress of the Philippines (which approves/disapproves budgets); (3) strengthen regional R&D consortia; (4) pursue balanced institution-building; (5) initiate more effective management of research and priority-setting for a focused R&D program; (6) increase R&D investments from government and other sources; and (7) enhance linkages and expand networks with international research institutions.

At the Buenos Aires conference, they are bringing to the attention of everyone state-of-the-art approaches such as advanced modeling, mapping, high-resolution remote sensing.

At PCARRD, Dar introduced an innovation, the Farmer-Scientist Bureau, in which outstanding farmers taught their local counterparts to become more productive and profitable.

The Buenos Aires conference cannot ignore community participation – development must be not only for the people but more so by the people.

Paradigm shift #8

In July 1998, he became Philippine Secretary of Agriculture. He laid the groundwork for the implementation of the Agriculture and Fisheries Modernization Act (AFMA, Republic Act 8435), leading to the transformation of the agriculture and fisheries sectors from a resource-based to a science & technology-based sector, and fought for continued increase in budget allocation for R&D. He initiated and conceptualized the Agrikulturang

Makamasa (Agriculture for the People), the national program for rural development that operationalized the AFMA, resulting in the El-Niño-ravaged agriculture sector registering an unprecedented growth of 12% in 1999!

'To be effective,' says Mark Winslow of ICRISAT, 'these approaches must be connected with government decision-making.' The head must be connected to the body.

Paradigm shift #9

In January 2000, he became Director General of ICRISAT. He began by mapping out ICRISAT's vision and research strategy in 2001 as well as expanding partnerships with regional, sub-regional and national organizations in Asia and Sub-Saharan Africa. Out came 'Science with a human face,' the mantra that implies that the leader is the servant of the people.

ICARDA scientists are working closely with rural communities in North Africa and Central and West Asia to integrate water management and conservation agriculture to improve productivity of farmers in the dry areas.

Paradigm shift #10

In ICRISAT, he conceived and formalized the concept of Team ICRISAT with him as Team Captain, who serves the team. The leadership and teamwork had been so successful, it gave the following results: (1) increased the budget from outside sources; (2) increased the morale of staff; and (3) improved the quantity and quality of accomplishments of staff.

'Science and technology hold the key to coping with the desertification-climate change nexus,' says Dar. 'With the right combination of holistic policies and sustained global action, path-breaking science can help curb desertification and land degradation, improving the livelihoods of millions of poor people in drylands.'

Science, policy and action in combination are necessary not only to prevent the desertification and degradation of an international research institute but more so to make it perform extremely well. Indeed, in 2006 and 2007, ICRISAT was rated Outstanding in overall institutional performance by the World Bank.

Ten professional paradigm shifts in 36 years. This meant that the previous other nine paradigm shifts had been but preparations for excellent work at ICRISAT in Patancheru, Andhra Pradesh, India.

And preparations for excellent work at Buenos Aires, Argentina this week.

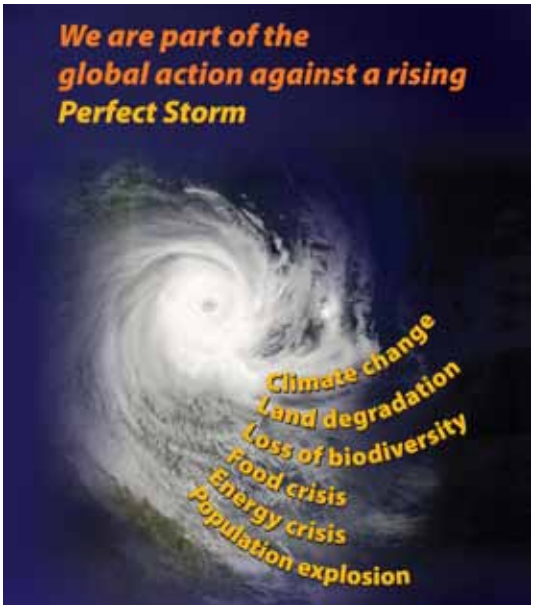
William Dar likes to be referred to as Servant-Leader. In the religious sense, a servant-leader is one who is in theory the leader of the group and in practice the servant of all – that is to say, he serves the people to the best of his abilities without expecting any reward except his joy in knowing he is serving the public good. His journey from being an unheralded teacher in high school

in the boondocks to being a much-honored team leader of an international research agency in a country not his own are the hallmarks of the new Filipino, the international servant-leader. May his tribe increase!

(Published on 21 September 2009)

15

Perfect storm. Will UN stir up political will?



BUENOS AIRES – While some 200 scientists from all over the world meet in this city, it is time to ask The Scientific Question of the Millennium: Science can inform the people, but can Science inform the politicians? The historical answer is: No. Al Gore showed us that such is An Inconvenient Truth about us, people. We primates don't want to know, or, we don't want to know more. So, like Al Gore, the scientists or their advocates will also have to embark on a project and persevere to create Primate Change for Climate Change.

Givens: On one hand, in many constitutions of the countries of the United Nations, there is a distinct separation of Church and State; this is internationally observed. On the other hand, there is a fragile separation of Science and State, and this is universally not recognized. If the connection between scientific knowledge and state policy is flimsy, how can science ever inform the people of the options for better lives, especially given the global challenge of climate change?

We all are vulnerable to climate change – as in, the waters rise, the economy goes down. I imagine that's why the Director General of ICRISAT, William Dar, calls it 'a perfect storm':

The world is facing a ´perfect storm,´with a number of huge problems converging around land issues. At the center of this storm are the poor, who depend on the land for survival – yet, they are unable to fight off the massive storm clouds that are abuilding.

Dar includes in his idea of his perfect storm the rise and fall of temperatures, continual visits of droughts and storms, as well as escalating population pressure and poverty – all resulting in harsher suffering. As an indicator, land degradation is progressing at the rate of 1% a year.

Dar happens to be the Chair of the Committee on Science and Technology (CST) of the United Nations Convention to Combat Desertification (UNCCD). The CST is the convenor of the Buenos Aires scientific conference. The CST conference was organized by ICRISAT and four other international research institutes under the Drylands Science for Development Consortium in collaboration with the UNCCD. The Consortium is made up of five leading desertification organizations catalyzed by ICRISAT: European DesertNet (based in Spain), Institute for the Environment and Sustainability (Italy), International Center for Agricultural Research in the Dry Areas (Syria), International Network on Water, Environment and Health (Canada), and ICRISAT (India). Representing ICRISAT at the CST meeting were Mark Winslow and Suhas Wani. This was Dar's final session as Chair of CST; his 2-year term was a watershed in that he led in overhauling the CST to jibe with the revised UNCCD strategy, and this has been highly appreciated by UNCCD leaders as well as the CST members themselves. He is a Team Captain par excellence.

The CST scientists know that the poor in the drylands of Asia and Africa are the most vulnerable, as they cannot afford the rich's response to global warming: more air-conditioned planes, more air-conditioned hotels, more air-conditioned offices, more air-conditioned cars. Meanwhile, the drylands get drier, the arid soils get warmer, the wastelands deteriorate further – Mother Earth groans and Atlas shrugs.

The policymakers, that is, the lawmakers of the land, as well as the managers in national and local offices public and private are vulnerable to climate

change – but they are invulnerable to policy change when challenged by science. The scientists know that, but they have to try again. This time in the good airs of Buenos Aires, summoned by the UN, they are not talking but the way I understand it, the world's scientists have previously agreed that you cannot convince the policymakers of climate change, or even just to look at any of its signs or symptoms, if you don't have the hard facts resulting from actual monitoring and evaluation (M&E), which in turn is actually monitored and evaluated as it proceeds. Ideally, scientists do their thing, and the world watches.

I look at the Buenos Aires scientific conference as a parallel approach to the work of the Nobel Prize-winning Intergovernmental Panel on Climate Change on postulating about climate change. The IPCC had gathered data, organized them into data sets, processed and analyzed them, and came out with the conclusion that climate change was 'unequivocal' (see the highlights of the IPCC report 'Warming Of The Climate System Is Unequivocal,' UN Chronicle Online Edition, un.org). Our warm physical explorations, exploitations, experimentations are warming Mother Earth.

What the IPCC did was enough to win the Nobel Prize for Peace, but not enough to convince the policymakers of the world (not to mention the grant givers, and George W Bush) – that indeed there is global warming. Your science is good, but we need cause; we need the unmistakable signs of the times to cause us to act.

So we begin with the poor of the Earth. The poor families. The poor soils. Especially the lands that right now are suffering desertification, degradation and drought. What happens to them? What do you mean desertification? What do you mean land degradation? What do you mean drought?

In other words, there remain the doubts of policymakers. You have to quantify the doubts so that they become certainties. Simplifying, that's what

the Buenos Aires scientists met and talked about. In the end, they agreed essentially on the who, what, where, when, why and how to measure desertification, the final stage in the process of land degradation, that which is exacerbated by drought.

The CST scientists meeting agreed to 'make use of knowledge-management approaches' to monitor and measure desertification in its various stages. But what in Earth's name does a 'knowledge-management approach' do? With a bit of luck, just launched is Google Earth's Climate Changer (my term); here is part of the Google Earth announcement:

In collaboration with the Danish government and others, we are launching a series of Google Earth layers and tours to allow you to explore the potential impacts of climate change on our planet and the solutions for managing it. Working with data from the Intergovernmental Panel on Climate Change, we show on Google Earth the range of expected temperature and precipitation changes under different global emissions scenarios that could occur throughout the century.

If you haven't, just download and install Google Earth, and already you have a good idea what is a 'knowledge-management approach' the CST scientists are talking about. The climate changer makes use of Google Earth to show you Before and After scenarios using IPCC data. Click the mouse and you are looking at the climate changing!

Notwithstanding all that, about the 'IPCC data' as basis for knowledge – if I were a policymaker, I would say, 'ay, there's the rub,' as Shakespeare's Hamlet did say; you can't convince me of climate change if all you have are mostly presumptions and propositions, given that they are computerized, created as 3D and shown in Google Earth or even in IMAX. What the CST scientists want to do next is gather post-IPCC data, that is to say, Data Over Time (DOT), later to show in a time series, that Climate Change is costing us that much and must be mitigated, and how. I say, DOT's the spirit!

Based on the Buenos Aires discussions, the CST scientists are advising the UN, through the UNCCD, to set up a scientific advisory, one, 'to facilitate the coordination and dissemination of new knowledge,' and two, to set up 'clear channels for its advice in decision-making.' That is to say, the scientists want the policymakers to listen to them before they decide on what actions to take. Aside from that, the scientists want the UN to 'make use of a networking body so that (scientific) results can be accessed, shared and used with greater ease.'

If I may use my metaphor again, what the CST scientists want done is gather data and information that can be transformed and used with tools like Google Earth's Climate Changer, which anyone can download at anytime, and is absolutely free.

All that has to do with some critical thinking. When we get to know all that the CST scientists are asking to be known, what then? Then the policymakers will do their critical thinking. What if the policymakers don't agree with the scientists? Then we will see science trying to stir up the political will. Then we will have another perfect storm, the scientists asserting that they are perfectly right while the policymakers remain perfectly unmoved. And both sides might forget that it is not working with knowledge that is the most important; ultimately, it is working with people.

Science is critical thinking. The problem is using critical thinking from beginning to end. Before and after critical thinking, we have to do some creative thinking, which is not the realm of science. You cannot move the policymakers by science alone. Al Gore knows that; he began thinking about An Inconvenient Truth via creative thinking in serendipity, then he resorted to critical thinking, using logic to convince his audience. That's why it took him 30 years to get our attention! I don't think we have the luxury of waiting for another genius for another 30 years.

MANILA – The havoc wrought by the tropical storm Ketsana (local name, Ondoy) in the Philippines is a sign of the coming times. The weather bureau PAGASA said the rainfall recorded Saturday in Manila alone is the capital city's highest amount of rain since 1967: 410 mm of rain in 9 hours, exceeding the average rainfall of 391 mm and the 1957 record of 331 mm. Nilo Prisco of PAGASA said, 'We can attribute this to climate change'. About 280,000 people were distressed by Ketsana, not to mention death and destruction as thousands spent the night on the roofs of nearly submerged houses in Manila and suburbs like Marikina, where the flood was roof high. There were landslide victims and fishermen who drowned. The runway of the international airport in Manila was closed as it was flooded. That was more than a month's rain in less than a day. PAGASA Director Nathaniel Cruz

said, 'This is related to climate change and could be a manifestation of things to come'. 'We were all totally caught unprepared,' Chair of the Philippine National Red Cross and Senator Richard Gordon said. 'This was supposed to be a small typhoon.' The good Senator has not been paying attention to Al Gore either. The government declared a state of calamity in Metro Manila and 25 provinces.

Will such bad news stir the political will of policymakers towards sympathy with the demands of science? Let's see what my President Gloria Macapagal-Arroyo will do after this. But I doubt that climate change will be acknowledged officially and acted upon with firm resolve. How about people who have declared their intentions of running for President in next year's election: Noynoy Aquino, Manny Villar, Bro Eddie, Bro Mike, Gibo Teodoro? I doubt it too. The death and devastation speak for themselves, but the connection between those and climate change is not obvious. Logic will not save the day. For instance, the river squatters do not see that their hovels and their daily throwaways are clogging the waterways – they only see that they are entitled to survive and they will break the law of common sense to do it, while politicians patronize them for their votes. Logic works for the good of the politicians, not for the good of the people.

I worked as a copywriter 35 years ago; at the Pacifica Publicity Bureau in the City of Makati, we learned that to market your product, your best come-on is atmosphere (virtual), not logic (real). Nothing has changed much. Ultimately, you convince by logic, but you don't begin with it. You don't stir political will by logic. The genius of Philippine President Ferdinand E Marcos showed you can stir it with a slogan ('This nation shall be great again!'), followed by political will. The uncertain genius of Benigno 'Noynoy' Aquino III who would-be-President, himself the son of assassinated would-be-President Benigno 'Ninoy' Aquino Jr, is trying to stir it with the colors of Benigno (red and yellow); the slogan is meaningless, 'Ituloy ang laban' ('Carry on the fight' for what?), and I don't see political will. Manny Villar is portraying himself as the man from rags to riches; that is the politics of the poor. Good luck! 'The true sign of intelligence is not knowledge but imagination' – Albert Einstein. I can imagine that.

(Published on 27 September 2009)

16

Servant-leader William Dar. Can't follow, can't lead.

LOS BAÑOS, LAGUNA - Today, 9 October 2009, the University of the Philippines is honoring William Dar as '2009 Outstanding UPLB Alumnus' and all I can say is, 'What took you so long?' 100 years. This is the 100th year of the founding of the UP College of Agriculture (UPCA), the mother of the University of the Philippines Los Baños. Better late than never.

Never have I anticipated some award for somebody, except for myself. Dar, another Ilocano from Danuman West, Ilocos Sur, is a class all by himself. Alone. Without a doubt, without equal. This is the story of a Pinoy Servant-Leader who has come a long way, and his leadership is a hard act to follow. Do you follow? If you can't follow, you can't lead. You can only follow by un-becoming yourself first. He calls it transformational leadership; I call it good.

We go back to the year 2000; the place was the campus of ICRISAT in India. As the new Director General of ICRISAT, Filipino science manager William Dar was in a quandary. He knew ICRISAT was down with a disease or two, and if he could not restore that body to health, that body would get rid of him. Where he could not make history, history would unmake him.

There was the burden of leadership. There was the annoyance of finance. There was the stress of staff morale. There was the fatigue of science. Leadership was fading; finances were contracting; morale was declining; and the management of the science was disappointing. The campus was desolate. Where had all the flowers gone?

Notwithstanding, the dreamer in Dar was undaunted. He had always been an innovator and unafraid to take calculated risks, from small to state-sized. He had been Secretary of Agriculture of his country, the Philippines. In his watch, 1998-1999, he initiated a national program to carry out the provisions of the Agriculture and Fisheries Modernization Act and, even with the visit of El Niño, the agriculture sector registered an unprecedented growth of 12% in 1999! As if to show that if you have more in law, you can have more in life.

At PCARRD, he initiated the successful Magsasaka-Siyentista (Farmer-Scientist) Program and set up the Farmers' Information & Technology Services. Coming from a poor farming family, William Dar had always been pro-poor.

He had been Director of the Bureau of Agricultural Research (BAR). As the first head of BAR, he guided the Bureau on what policies to adopt and what actions to take to manage the R&D programs and projects of the Department of Agriculture. As it turned out, this was good training for directing the science efforts of a large organization; he was starting to become, as it were, ICRISAT-ready.

He had been Professor and Vice President of his BS and MS alma mater, Benguet State University. He steered the development of the Cordillera Integrated Agricultural Development Program, a joint project of the BSU and the Provincial Government of Benguet. With a Ford Foundation grant, he upgraded the BSU research capability and manpower and conducted farmers' trainings. He packaged R&D proposals, set up professorial chairs, and formed the BSU Development Foundation for implementing projects. Working with local government and with foreign funding, as well as implementing projects through third parties, he was indeed becoming ICRISAT-ready.

He had been a recipient of the prestigious Ten Outstanding Young Men (TOYM) Award of the Philippine Jaycees. He had received the Achievement Award for Research Management from the Crop Science Society of the Philippines and the Outstanding Science Administrator Award from the Department of Science and Technology. He had received a great many other awards, as if to make him feel that indeed, his accomplishments were less for himself and more for others. He was indeed ICRISAT-ready.

And here he was. So, back to 2000, back to the question: How do you solve a problem like ICRISAT? You have everything to gain and nothing to lose. Now, where should he start? Paradigm shift. He started with himself.

He was at the top, so he needed to go down. He started with being a Servant-Leader. This is not a species that those management geniuses like Peter Kotler or John Maxwell or Peter Drucker writes about, not the kind that Barack Obama's hero Rick Warren talks about, assuming that each of these geniuses knows something we don't.

He likes to call himself a Servant-Leader. I believe the single secret of the genius of William Dar as Captain of Team ICRISAT is indeed the theory and practice of servant-leadership. Now, who is a servant-leader? The originator of the concept of Servant Leadership, Robert K Greenleaf, said in his essay 'The Servant as Leader' published in 1970 (greenleaf.org): 'The servant-leader is servant first' and leader next, not the other way around. And how do you differentiate a leader-first from a servant-first? Greenleaf said:

The difference manifests itself in the care taken by the servant-first to make sure that other people's highest priority needs are being served. The best test, and difficult to administer, is: Do those served grow as persons? Do they,

while being served, become healthier, wiser, freer, more autonomous, more likely themselves to become servants? And what is the effect on the least privileged in society?

Without being in that campus in any of all the last 10 years, I surmise that that is exactly what happened in the case of ICRISAT as the institution and William Dar as Servant-Leader.

To explain by example. We were at the Hotel Intercontinental in the City of Makati, where I would interview Dar for a book to be published by the UPLB Alumni Association this year. Hmm, intercontinental - by definition, 'having the capability to travel from one continent to another' - he and his wife Betty had just planed in from India. William Dollente Dar is the intercontinental servant-leader, as it turns out.

Betty, of course, had always been the Servant behind the Servant-Leader. She was telling me about her husband's rites of passage at ICRISAT. One quiet day, he noticed that the path from the campus gate to the main building was populated with trash, that is to say, nobody had been cleaning the premises. An international, multi-million-dollar facility and nobody was cleaning the surroundings! What else were the staff not doing?! That was an indication of how the ICRISAT situation had deteriorated. Time to get mad? Time to get the adrenalin going – theirs. What the new Director General did was talk to the Head of General Services and politely asked that the proper cleaning be done. Nice work if you can get it! He didn't.

One week passed, and the litter was still there – and so were the lazybones. Two weeks, same story. The new DG didn't complain and didn't go see the head of General Services and didn't lecture him on civil disobedience; instead, he went to see the Head of Security, and politely asked that the premises be cleaned. 'Yes, Sir!' It pays to be nice, firm but nice. The Security Boys went about cleaning the premises and the ICRISAT staff started to ask questions, and realized that they had a new DG who meant pleasure and business. The two go together, not always in that sequence. The Head of Security explained the situation and said he was doing it because he had been asked by the new DG. Logical, right? The boys at General Services took notice. And so did everyone else. You establish authority not so much by asserting it as by insinuating it.

'Don't get mad - get even!' No. rather, 'If you can't solve a problem, change the problem.' To me, what William Dar did is an example of servant-leadership, where the leader humbles himself. The incident is also a great example of the flexible, adaptable mind of William Dar.

Another example has to do with Dar as he asserts leadership – twice, and differently. He had been warned by insiders about trusting someone enough to make him one of his trusted main players, but he was convinced that he

was right and went ahead and hired the fellow anyway. It later turned out that they were right and he was wrong – when he realized that, he gathered information and, when he had enough to hang the fellow by the neck, he gave two choices: one, the fellow got to leave with a clean record, and two, the fellow got fired. The fellow got the message.

Servant-leadership is neither for the ego-tripper nor the weak-kneed.

2000. That year he began to take control. He asserted his leadership – by serving his staff. First, he saw that the ICRISAT staff needed not only to be reassured of their worth as human beings but of their worth as servants of the people. As the institute was based in India, land of the gods, this Filipino gave the staff a mantra with a contrast: 'Science with a human face,' that is to say, 'to meet real human needs.' The harvest is plenty, and the workers are worthy – if they work at it. Science for the poor, that is, the marginalized, the disadvantaged, not to mention the hungry.

Dar saw ICRISAT as 'bridge, broker and catalyst'. ICRISAT had generated more than enough technologies since 1972, when it was founded; with those, 2000 was time now to bridge, broker and catalyze farm productivity and reduce poverty in the semi-arid tropics, if possible in a magnitude never seen before. By creating win-win technology transfers, public-private-farmer partnerships, empowering the poor, once-impersonal science was going to put on a happy face. In time and in Dar's hands, science would become, somehow, a public commodity, accessible to the poor.

Dar declared in 2000 that now the science of ICRISAT would help reduce poverty, reduce malnutrition, and reduce environmental degradation. The institute would help increase incomes even given marginal soils, help improve human health with fruits and roots of crops that grow with minimal demands on the cultivators, and at the same time help restore the balance of nature, as much as those were possible.

And in 2001, for ICRISAT to translate 'Science with a human face' from words to foods, from theory to practice, he initiated a paradigm-shifting 'Grey-to-Green Revolution.' A dream as huge as Africa and as wide as Asia. We must make the deserts bloom; we must make the drylands green. With science, we must help the poor farmers of Asia and Africa turn a barren field into barrels-full of peas, sorghum, pearl millets and peanuts. With 'science with a human face,' we don't have to ask the humans to smile - they will. And then with a great team to play, we can turn all those who play R&D games into winners all.

And so Team ICRISAT went on and turned its negative finances into positive, not to mention turned in also some surplus.

And Team ICRISAT went on and turned its low morale into high energy.

And Team ICRISAT went on and turned its R&D from disconnected to disciplined and dedicated.

It was the Team that did it, where everyone was a servant working for the common good. The best servant-leader has a team whose members are themselves servant-leaders of those below them in rank. The Captain inspires the Team with his example. And so, as Greenleaf says it should be, the servant-leader helps them grow as persons; while they serve and are being served, they become healthier, wiser, freer, more autonomous, more likely to become servants. And more likely to serve the poor, as they should.

And as a team, ICRISAT had gone on and won the King Baudouin Award five times, three times during William Dar's watch, since 2000. The award is given once every two years; it is the highest award within CGIAR. And ICRISAT had been rated Superior two times and Outstanding two times among the CGIAR centers. William Dar and ICRISAT are both hard acts to follow. A great Team deserves a great Captain.

How did William Dar and Team ICRISAT come this far? Already, it's a long story, and I want to start in India in 1972, the year of birth of the Institute, and at the same time in the Philippines in 1953, the year of birth of the one who eventually became its historic renaissance leader. Two countries that have more in common than they think.

Dar was born on 10 April 1953 in Danuman West in northern Philippines, a poor boy in his pockets but a bright boy in his classes. Even as a kid, he already saw that to earn a college education was his only way out of poverty, and he never lost sight of that goal. Once you hitch your wagon to a star, don't let go.

He changed course (if you will pardon the pun), and took up his MS in Agronomy, also at MSAC (today, Benguet State University). Changing course again, he challenged himself by taking up a PhD in Horticulture and attended many an intensely competitive, terror-filled classes at the University of the Philippines (UP) Los Baños, and received his doctorate in 1980. He needed

that. UP was incomparable. Truth to tell, he knew that if you're not UP, you're DOWN.

This year, he is the UP Los Baños Outstanding Alumnus for 2009. This is another milestone for the scholar in William Dollente Dar. 2009 is most historical, as it is the centenary of the University of the Philippines College of Agriculture (UPCA). From a Cow College, UPCA transformed itself into UP Los Baños in 1972; UPCA is celebrating and being honored for its legacy, and so is Dar for his accomplishments not only locally but more so internationally. And not for personal glory but for the country, and the drylands of the world. An international servant-leader.

The dimensions of his achievements for an international institute and, consequently for the CGIAR, and consequently for himself, is unmatched in the history of the alumni of UP Los Baños. Because of his consistent and outstanding performance in a major role as Director General of ICRISAT, inadvertently he had raised the standards of CGIAR excellence even higher. And the ICRISAT Board of Trustees rewarded him with not only 2 but 3 terms. When the Ilocano is good? He is the best!

He is a Team Captain par excellence that the geniuses of UP Los Baños would be hard put to emulate. There is no Team UPLB as far as I can tell, and I know they need that – or I've been around too long.

He had received the high-status 2009 Outstanding Professional of the Year in Agriculture award from the Professional Regulation Commission. Dar is difficult to appreciate by UP geniuses because he is not UP-loquacious. I'm a UP Los Baños graduate myself, like Dar with a BS in AgEd, but my first impressions of him was that he was your average guy. And herein lies a short story, and it's mine. I was very proud of myself when, a long, long time ago, I applied for a writer position and William Dar did interview me when he was Director of the Bureau of Agricultural Research, BAR – but, horrors, he did not hire me! On hindsight, did he sense that I was not a team player? No, I wasn't. Even today, you can ask me to do anything, including the impossible, and as long as it has something to do with words and I can use the personal computer to produce it, I will bring about the miracle, and in a matter of hours if you want. But don't ask me to work in a team.

About 20 years after I wasn't hired by William Dar, I published in the American Chronicle an article on Santiago Rigonan Obien (SRO), himself an outstanding head of office, Director of the Philippine Rice Research Institute (PhilRice), the one that he almost singlehandedly made world-renown, that he started from scratch with. I called SRO the Wizard of Rice, and he liked it. After that, SRO had a strange request: 'Isuratmo man met ni Willie Dar.' Please write too about William Dar. Strange because I didn't know Dar from Adam and, yes, I thought he was ordinary, but I didn't tell SRO that. I only said, since I didn't know him, I'd like to interview him. And so we met at the Dars' house in

Quezon City, and I asked some innocent questions – after all, I was innocent as far as Dar and ICRISAT were concerned – and he showed me published reports and books. While browsing, I was shocked to realize that I had misjudged the man. And so I was inspired to write about him and his team.

The rest, as they say, is history. It's great to write about great stuff. ICRISAT has since published among others, two books authored by me: Team ICRISAT Champions the Poor (2007) and THE SMART REVOLUTION: ICRISAT Partners in Research for Development (2009), both collections of my essays published in my blogs and American Chronicle. Two books to give credit to whom credit is due.

Today, I rather think that the titles of those two books can summarize what the staff of ICRISAT took it upon themselves to do, and how they did it. With the leadership of William Dar. Remember, they're a team.

In 2002, William Dar emphasized 'the centrality of partnerships and the need to maintain scientific excellence'. There were the needs to promote the adoption of new crop varieties, to strengthen extension services, strengthen private sector marketing channels for farmers, and to encourage transparency in the bureaucracy. The Adarsha watershed model came out of this via a multi-disciplinary, multi-institutional consortium approach.

In 2003, Dar told Team ICRISAT:

There is very little we do, or hope to do, that does not involve partnerships. Partnerships are the keystones of success in agricultural research.

Dar learned that lesson long ago, in the boondocks. The lesson on partnerships is one that UP Los Baños has been trying to learn year after year for the last 100 years, the same which has been logjammed with the continuing emphasis on disciplines. There is synergy in partnerships; there is only statistics in discipline-based projects. Team ICRISAT should know.

You can see how William Dar's mind works just examining the titles of the annual reports of ICRISAT from 2001 to 2008:

2001 AR, Grey to Green Revolution
2002 AR, Research for Impact
2003 AR, Building a Strong ICRISAT
2004 AR, Sowing Seeds of Success
2005 AR, Germinating Seeds of Success
2006 AR, Nurturing Seeds of Success
2007 AR, New Horizons of Scientific Excellence
2008 AR, Innovations for a Changing World

Starting with revolutionizing agriculture and ending with changing the world even as it changes us – somehow, all that acknowledges the fact that the only constant thing in the world is change.

The annual report titles indicate the point of convergence for the specific year under review. This is the workings of the mind of a Servant-Leader planning as a leader first and as a servant second. Whether the succession of institutional centers of action was written down or merely existed in his head is unimportant – it's nice to know that as a team you have been doing great over the years.

And so 2007 was the year Al Gore and the IPCC won the Nobel Prize for Peace, the year that suddenly 'Climate Change' became the talk of the town and not only of the town crier named Al Gore. He was no longer the boy who cried wolf and, to change metaphor, he was no longer a voice crying in the wilderness. And so, the years 2007 ('New Horizons of Scientific Excellence') and 2008 ('Innovations for a Changing World') had been spent by Team ICRISAT challenging itself to come up with more high-tech advances to help low-tech farmers in the lowlands and drylands of Africa and Asia.

ICRISAT Champions the Poor is the title of my first ICRISAT book; not that the Institute wants the poor to be always with us, but for the drylands poor to be always presented with options out of African poverty and out of Asian scarcity.

Good, but how? Here are some of the hows generated so far by ICRISAT for the poor farmers of Africa and Asia:

(1) Give them crops that are misers in fertilizer. Crops that grow with a pinch of fertilizer and yield pails-full. With the ICRISAT microdose technique, a little fertilizer goes a long, long way.

(2) Rebuild the watershed. Revive water harvesting. ICRISAT has developed the Adarsha Watershed model that many countries have since adopted or adapted.

(3) Breed them crops that give even more with even littler water. ICRISAT chickpea is drought-resistant, and the farmers of India have taken advantage of that.

(4) Sweeten the crop and marketing arrangements. ICRISAT encouraged Rusni Distillery to build the world's first sweet sorghum-based ethanol plant that now buys feedstock from farmers.

(5) Ration out the water. ICRISAT has the small-scale irrigation model called African Margin Garden and it's out in Africa. The AMG is a package based on low-pressure drip irrigation, requiring just $60 to outfit an 80 square meter area, and pays for itself in the first year: date palm, papaya, table grapes, figs, citrus, pomegranate and vegetables.

(6) Build up the soil. With ICRISAT pigeonpea hybrids, the Chinese have been building hillsides into rich, non-erodible soils. Advice for the harshest of environments such as acidic soils: Plant pearl millet, then when it's about half-size, knock it down and incorporate it with the soil, thus creating a

soil-protecting mulch. You grow your next major crop of, say, soybeans, through the mulch. With the slow-rotting mulch, you have not only a soil protector but also slow-release fertilizers – plant nutrients coming from the decaying organic matter.

(7) Distribute seeds through the women. Do not give away seeds, because you are bypassing the traditional traders. Instead, provide breeder seeds and let the women sell them on consignment.

(8) Don't change the soil - Change the crop. What do you do when the soil, drained of water, becomes hard as rock? Plant it early with a crop like chickpea that can penetrate as deep as 1 meter into the hardpan – and that you can harvest before the soil hardens after the rainy season. Chickpea can be grown in areas where nothing grew before.

(9) Don't leave the desert dry. Do the Desert Margins Program, which covers fertilizer microdosing, community-run credit plans.

(10) Put up a Sahelian Ecofarm. This is an integrated land-use system that incorporates high-value multi-purpose crops with soil and water conservation – fuelwood, forage, cash, plant nutrients, biomass for mulch and protection from wind erosion: trees, hedges, grass and annual crops. The Garden of Eden on Earth.

2003. Village seed banks for groundnut (peanut) in Mali, Niger, Nigeria and Senegal were initiated, with 45 locations for trial plantings. From these, varieties were selected for their higher yields as well as resistance to the devastating groundnut rosette disease.

2004. ICRISAT is the first CGIAR center to tap significantly the resources of private seed companies for public research on hybrid crop parents' development.

2005. ICRISAT scientists are studying how climate change can be understood, measured and therefore predicted, for use in determining policy, defining research, and minimizing the risks in agriculture.

2006. ICRISAT R&D is shown to pay off in dramatic fashion. The Voice of America reported in June 2006 that in Kenya, the ICRISAT pigeonpea 'demonstrated its superiority during a severe drought – several families we visited survived solely on pigeonpea as it was the only crop that made it in the fields.' Survivor Africa.

2007. ICRISAT reports successful commercialization of pigeonpea by dryland farmers of Kenya, Tanzania, Malawi and Mozambique, from production to output marketing and utilization. In northern Tanzania, contract farmers grow high-quality seeds and these are marketed through producer marketing groups, so that small farmers enjoy economy-size collective action.

2008. ICRISAT dreams up a 'Hypothesis of Hope,' whereby through computer modeling of crops, weather and soils, climate changes have been simulated. For instance, it has been tentatively predicted that climate change will have a negative impact on crop production more by way of higher temperatures and less by way of changes in rainfall. If confirmed, this will call for more varieties of crops that can withstand more severe droughts.

But wait a minute: Is all that part of servant-leadership? All that is product of servant-leadership.

And no, you can't survive if you are unable to shift perspective from being a servant first to being a leader first. From thinking critically to thinking creatively. From always forgetting to remember the least of your brethren.

Whoever wishes to become great among you must be your servant, and whoever wishes to be first among you must be slave of all. - Mark 10: 43-44 (NRSV)

Our 2009 UPLB Outstanding Alumnus is a man of many firsts:

(1) Secretary of Agriculture, the first alumnus of UP Los Baños ever to become one.

(2) First Filipino and Asian to be Director of an institute of the CGIAR

(3) First Filipino and Asian Chair, Alliance Executive of the Alliance of CGIAR Centers

(4) First Filipino and Asian Chair, Committee on Science and Technology, United Nations Convention to Combat Desertification – In his 2 years as Chair, he succeeded 'in injecting the spirit of science into policy and decision-making for combating desertification.'

(5) He already has been appointed for his 3rd term as Director General, to serve from January 2010 to December 2014.

Do you follow so far? These are very hard facts to swallow. His is a very hard act to follow.

The letter from UPLB Alumni Association President Sim Cuyson informing him of the award was very curt, and I quote more than 50% of it:

We are pleased to advise that you have been selected as 2009 Outstanding UPLB Alumnus Awardee for your role in transforming ICRISAT into a responsive institute and global center for scientific excellence in agriculture for the semi-arid tropics.

That is putting it too mildly.

I have always heard William Dar himself say he is a servant-leader. Servant-leadership is less about rising to the top of the ladder and more about service above self. It is less about excellence and more about relevance. It is less about charity and more about character-building. It is less about being the star and more about building a team. Up there, if you can go down, you can be above all. If you can be a good and faithful servant, you can be a good and faithful leader.

Yes, as he puts it himself, 'he belongs to the new generation of Filipinos who are proud of their country and have a dream for its future.' We should all be proud of our country and be dreamers like William Dar!

(Published on 10 October 2009)

17

Farmer green Bill Gates.
Listen you capitalist laggards.

DES MOINES, IOWA - Nouveau Riche Farmer Green Bill Gates on Thursday, 15 October, called on the wealthy people and the rich countries of the world to invest more millions on the millions of poor farmers of Africa, Asia and America.

He isn't talking, but I'm sure it's his latest application of his own innovative idea he calls Creative Capitalism. I've been using Microsoft applications since I can remember 'Alpha' (Word 1); I've been following up his career and software for better or for worse. If I know Bill Gates from his Microsoft days, he's trying to program it as the industry standard.

Putting his money where his mouth is, Bill Gates gets 5 stars from me, a critic of capitalism - and Microsoft. He announced that the Bill & Melinda Gates Foundation was granting a total of $120 million to 9 pro-poor farmer green groups, according to the news, about his 'call for united action to support world's poorest farmers' (ANN, 15 October, reuters.com):

$15 million, Alliance for a Green Revolution in Africa: The AGRA policy program

$10 million, American Institutes for Research (AIR): Farmer voice radio

$4.7 million, Grameen Foundation: Building a network of community knowledge workers

$18 million, International Crops Research Institute for the Semi-Arid Tropics: Harnessing Opportunities for Productivity Enhancement (HOPE) of Sorghum and Millets

$21.25 million, International Potato Center: Sweet Potato Action for Security and Health in Africa (SASHA)

$10.4 million, New Partnership for Africa's Development (NEPAD) and Michigan State University (MSU): African Biosafety Network of Expertise (ABNE)

$12 million, Partnership for Child Development (PCD): Home-grown school feeding

$9.7 million, Professional Assistance for Development Action (PRADAN): Developing farm-based livelihoods in endemically poor regions of India

$19 million, Wageningen University: Putting nitrogen fixation to work for small-holder farmers in Africa (NforAfrica).

Yes, I'm sure the poor farmers would be pleased. The news was on Bill Gates speaking his mind at the World Food Prize Symposium (ANN, 15 October, allafrica.com). Thinking locally and acting globally, new farmer Bill Gates urged governments, donors, researchers, farmer groups, environmentalists and others to set aside ideologies and unite to help farms boost their yields and farmers increase their incomes so that they can rise above hunger and poverty. The farmers are the ones who feed the world, so why should they remain poor?

Actually, Bill Gates' memo to the rich to help the poor farmers is an old note, not a new message at all. What is new is that he insists that the efforts be:

(a) Farmer-guided;

(b) Locally adapted; and

(c) Economically viable and environmentally sustainable.

Farmer knows best. This is also called the bottom-to-top approach, in contradistinction to the top-to-bottom approach of many an expert. The expert knows more, the farmer knows better!

I didn't know Bill Gates is a farmer at heart, a green farmer at that. Speaking at the World Food Prize Symposium in Des Moines 15 October, held in honor of the 2009 World Food Prize winner Gebisa Ejeta, the Ethiopian scientist who bred a sorghum resistant to drought and the *Striga* weed, Bill Gates not only said we know-it-all experts have to listen to the illiterate farmers; he also said we have to help those farmers grow their crops on poor soils, get their harvests to the market, and get a fair price for their produce. I say it may help to consider that for producers and creators, a fair price is a human right.

'Melinda and I believe that helping the poorest smallholder farmers grow more crops and get them to market is the world's single most powerful lever for reducing hunger and poverty,' Bill Gates said. If we don't help the farmers enough, in broad daylight we can always watch the display of market forces – the bulls and the elephants degrading the harvests and depressing the incomes of the already poor farmers.

I see that the Foundation has a new vision for the better seeds, trainings, market accesses, policies that favor poor farmers. Hence the $120.05 million total grants for higher-yielding sorghum and millet; higher Vitamin A sweet potato; higher-value policies for poor farmers; higher levels of access of knowledge by farmers through the radio and cell phone; higher nutrition for school children; higher vigilance by governments on biotechnologies; higher women's participation in managing land and water in their villages. The $120.05 million is part of a total of $1.4 billion that the foundation has committed to the higher application of the science of agriculture.

Bill Gates remembered the Green Revolution, he did say it succeeded in increasing food and at the same time in increasing the use of fertilizers and irrigation to the levels of abuse. What happened was that the soils were depleted of their wealth of nutrients; the crops became more susceptible to pests, diseases and drought; and farmers became wasteful of water as long as they had it in abundance. On top of all that, the Green Revolution did not help the farmers tap favorable markets to sell their harvests. We experts

taught the farmers how to farm but not how to compute!

'The next Green Revolution has to be greener than the first,' Bill Gates said. 'It must be guided by small-holder farmers, adapted to local circumstances, and sustainable for the economy and the environment.'

The poor farmers who? The World Bank says that would be about 750 million people who depend on farming for their (bare) living.

Bill Gates noted that the G20 group of developed countries recently made a 3-year, $22-billion pledge to help solve global hunger by supporting the poor farmers of the world. That's to the G20's credit. Your credit is good, but we need cash. 'It's a great thing that donor nations are focusing on this issue,' Bill Gates said, 'but we need them to spell out clearly what the $22 billion means – how much is old money, how much is new, how soon can they spend it, and when will they do more?'

'When will they do more?' In short, Bill Gates was telling the G20 group of nations that for the millions of poor farmers, $22 billion is only good for peanuts. And only for now.

Bill Gates noted that there are on one hand those who argue for higher productivity without sustainability, and on the other hand those who argue for sustainability without higher productivity. About the ideological wedge (never mind the mixed metaphor), he said:

It's a false choice, and it's dangerous for the field. It blocks important advances. It breeds hostility among people who need to work together. And it makes it hard to launch a comprehensive program to help poor farmers. The fact is, we need both productivity and sustainability – and there is no reason we can't have both.

Bill Gates has turned out to be a better farmer than many a great graduate of high-prestige universities of agriculture around the world, including the UPLB where I graduated. And we are talking here of a computer nerd who is a Harvard high school dropout!

He wants strong policy support systems for agriculture from governments. For both poor household and national food security. You can't think of the country without thinking of the poor household.

He wants new crops that can withstand drought and flooding, so that the poor farmers can hope to adapt to climate change. If you can't change the farmer, change his crop.

He wants expanded markets for the poor farmers' produce. You have to teach the farmer marketing, but not make him attend college, if it were the likes of Harvard.

He wants the World Food Programme to buy more food from poor farmers for the WFP to stack up for food aid; in fact, the WFP had already bought 17,000 metric tons of food from them. If the rich won't help the poor, help the poor do what they can!

He wants new knowledge broadcast and impact the lives of small farmers. Science is more for the people, and less for scientists.

He wants the cell phone to be a device for reaching and teaching farmers. To make sure farmers can't escape from new knowledge wherever they are.

He wants for farmers more HOPE: harnessing opportunities for productivity enhancement. Hope must spring eternal from the human breast. Higher yields, lower costs, higher incomes – hopefully from the thirsty drylands of Africa and Asia.

He wants sweet potato farmers to live sweeter lives than they have ever tasted. Sweeter than sweet potato.

He wants biotechnology with limits to growth. 'No rules, no borders, no limits' cannot apply to biotechnology. Old-gold conventional breeding has an exalted place among the jewels of high-tech hybridization.

He wants the poor farmers and their children to get enough food and adequate education. (Harvard did grant him a degree, and he values that.)

He wants legumes to enrich the soil as well as enrich the lives of small farmers, to happen like shelling peas.

He wants the women to learn better how to farm, to teach, to sell. So that anything the men can do, the women can do better.

He is thinking like millions of the rich aren't thinking.

He wants more for more. I hope that as he throws 12,005,000,000 more coins into The Fountain of More Knowledge, his wish is our command.

Bill Gates would be pleased.

(Published on 16 October 2009)

18

Small is big.
Have fertilizer, will drink Coke.

LIMPOPO, SOUTH AFRICA – We are with the staff of ICRISAT and LPDA who are demonstrating to the women farmers in this province of this African country the 5 Ws and 1 H (who, what, where, when, why and how) of a revolutionary way of applying chemical fertilizer: Buy a small pack, buy Coke and use the bottle cap. They needed to do all that.

Limpopo is rich in its tourism but poor in its soils. South Africa is, of course, not new to radicalism, as it is home to Nelson Mandela, the revolutionary who won the Nobel Prize for Peace in 1993. Today, we are looking at science revolutionaries in peace.

A revolution is not a dinner party, Chairman Mao once said. It's true for science too. Where people don't wear shoes at all, it doesn't mean that you can easily sell a pair; you still have to convince them that they need one. Where farmers know their soils are infertile as in South Africa, that doesn't mean they will buy your sales pitch about fertilizers; you still have to show them that it's a good thing and that they can afford it. These Limpopo farmers are learning their necessary lessons about the Coca-Cola bottle cap fertilizer.

This fertilizer revolution first happened not in South Africa actually but in one of the least developed countries in the world, the West African nation of Niger, about 5,600 km away. With this Institute, the technology was developed and tested by the University of Hohenheim (Germany), the International Fertilizer Development Center (IFDC); the National Agricultural Research Institute of Niger; and the FAO; and with several non-governmental organizations not named, all working together. The team that came up with the radical technique was based at ICRISAT's West and Central Africa regional hub, the ICRISAT Sahelian Centre located 40 km east of Niamey, Niger.

The revolution is called microdosing (or micro-dosing), which is the application of a bottle cap of fertilizer to every hill in a row. No more, no less.

'I'm not sure why,' said Andre Bationo, a soil scientist working with IFDC and ICRISAT, 'but farmers tend to favor the Coca-Cola caps over other brands' (icrisat.org). (And in the Philippines, we don't know either why in the countryside Filipinos invariably call any soft drink 'Cokes' - plural, yes. 'Do you have Cokes?' 'Which Cokes would you like: Pepsi, Cosmos, Sprite, or Coca-Cola?') The reason may be practical: 'They deliver the fertilizer in precisely the right amount, about 6 grams per individual group of plants.' They're applying phosphorus, the key limiting nutrient in Niger. That comes to about 4 kilograms of P to a hectare. In Europe and North America, farmers usually apply 3 to 6 times that amount.

The Nigerian crop was millet, the world's most drought-tolerant cereal crop, according to ICRISAT. In exceedingly dry Niger, millet stands between survival and starvation. According to the World Bank (cited by ICRISAT), millet yields in Niger have gone down 3% every year since the mid-1980s. With P microdosing, the yields have jumped 50 to 100%. I note that where they give the soil about 25% less, they get from the soil about 75% more. The Nigerian team had come up with one of the minor miracles in science.

One implication of the results is that the 4 kg of P applied to a hectare is the point of increasing returns of millet in Africa, while the 12 to 24 kg of P were

the points of diminishing returns. The team of scientists had to have their economics right before they could help the illiterate farmers.

Another implication is that the amount of water to apply should be only a miserly volume of water for the crop to use up all the stingy amount of P fertilizer. That's a huge relief to Niger where the drought was so serious that in September 2000, we are told, President Mahamadou Tandja delayed a parliamentary meeting and asked his ministers to go to the mosque and pray for rain.

ICRISAT tells us 2001 was actually the 3rd consecutive year that the Coca-Cola method worked its wonders. The microdose apparently made the millet mature earlier, and thus escape the drought, and thus increased the yield.

At Limpopo, for 2 years, extension officers of the province, along with experts of ICRISAT and the Limpopo Agricultural Strategic Team, had been selling the idea of microdosing to the local farmers (SATrends, October 2009). But they were not buying until a new twist was added to Coke-capping the fertilizer: Instead of being sold as 50-kg bags, the fertilizer was now sold as 10-kg packs. It didn't only look, it was affordable.

For the record, in 2006, SASOL Nitro, a Limpopo fertilizer maker, had begun offering those packs, and the farmers bought the idea, with the following reasons, as revealed in a survey: (a) the 10-kg pack was inviting as it was only 1/5 investment compared to the 50-kg bag, and (b) the packs were easier to carry and transport home than the bags.

What happened after that, according to ICRISAT, is that sale of fertilizer at the Progress Milling outlets in Limpopo increased from 15 tons in 1999-2003 to 96 tons in 2005-2006 to 140 tons in 2006-2007. In 4 years, that's an increase in volume sales to about 10 times. And the yields of those who bought the fertilizer packs increased by at least 25%.

For the creation of the Coca-Cola fertilizer phenomenon in Niger, ICRISAT credits public-private partnership, describing it as 'an environment where all the players succeed in achieving mutual objectives.' A win-win-win situation.

Personally, I see it as another instance towards the fulfillment of the vision of Creative Capitalism of Bill Gates of Microsoft:

(Creative capitalism is) an approach where governments, businesses and nonprofits work together to stretch the reach of market forces so that more people can make a profit, or gain recognition, doing work that eases the world's inequities.

If we all worked for the poor in that sense, the poor we will not always have with us.

(Published on 31 October 2009)

19

Climate citizens.
FAO's hunger and paradigm shifts.

TODAY, 11 November 2009, is the beginning of Climate Citizenship (my term). For all that, even in the midst of world hunger, in all innocence or guilt, we all need to make a paradigm shift or two.

The FAO has launched an online anti-hunger campaign (fao.org). Director General Jacques Diouf of FAO announces his personal concern and declares he is going on a 24-hour hunger strike and calling on a global 24-hour hunger strike against worldwide hunger. The FAO is holding a 3-day world summit on food security 16-18 November 2009 in Rome; almost at the same time, 16-19 November 2009, in Manila, a world conference on rice genetics will be held, led by the International Rice Research Institute, IRRI. More genetics to feed more of the hungry. Well, I wish the FAO and IRRI luck. They will need more than a 24-hour hunger strike, more than even a 3-day conference of world leaders and science experts, but my wish is all I can command.

"Eradicating hunger is no pipe dream," Diouf says. "The battle against hunger can be won" (quoted by Ariel David, boston.com). Of course! That's why I want more than just to eradicate hunger. And IRRI can breed us a dream crop: Golden Rice, with Vitamin A. Certainly! But I want more than just dream the possible. There is no challenge in that. I want to dream the impossible!

Pay attention now: My mind tells me that any strike for or against hunger is calling attention to hunger. Creative thinking gives me this paradigm shift, and so I'm calling on the capitalists to invest more wisely than just invest in hunger, and my double-bladed advice is:

(1) You want to invest in hunger? Please don't!

Because you have better use of your TIME: time, intellect, money & means, and energies (including biofuels). To spend TIME eradicating hunger is investing in hunger. You are assuming that hunger is a given, that it should always be there. The hungry we have always with us because we think so poorly of them, those of us who think not on an empty stomach but on an empty head.

You know why you are fixated on hunger? You're too logical, left-brain-right-brain thinking. You are too focused, I mean, you're paying too much attention to the same things you have heard so many times before. You are thinking critically, not creatively. You are not looking at the problem with a bird's-eye view. The birds always have a better view of things: they can see forward and backward, including cause and effect. If birds can think, they must be doing what Edward de Bono prescribes: lateral thinking. Surely, you are more intelligent than a dog that practices vertical thinking: He digs exactly the same hole but deeper and deeper? He doesn't know enough to explore the horizon and dig more holes to find more bones. So, explore the horizon for better bones, bonehead!

No Sir, hunger is not the problem; rather, hunger is the symptom. You don't try and eradicate the symptom, because that's palliative, like getting rid of the headache when you have a mouth infection. Eradicate is also too negative, too strong a treatment. To think more creatively now, don't think hunger; instead, think food. ICRISAT does.

You know why the poor we will always have with us? Because we think of the poor – we don't think of the rich. We invest on the poor, when we should invest on the rich!

Instead, why not deal on the positive and invest in the opposite of hunger, which is abundance? So:

(2) Instead, invest in the opposite: Plenty.

Considering the capitalist world in its long-standing incarnation, that's an impossible dream. But listen to Microsoft's Bill Gates espouse and expand on creative capitalism.

Paradigm shift He didn't ask the capitalists to save the poor; instead, he asked them to serve the poor. Very practical-minded sort of guy. A genius. That's starting not from the perspective of the poor but from the rich. When it comes to knowledge diffusion or technology dissemination, creative capitalism is the only capitalist tool I love and would like to take advantage of!

"Creative capitalism," explain Tracy Williams, Michael Deich & Josh Daniel, "starts from a fundamentally different premise – working with the incentives faced by business to find common ground between their interests and those of the poor". Since it's hardly ever explored and yet it promises salvation, this has to be sacred ground!

So, as a businessman, how do you invest on the idea of poor being rich? Simple. Let's take the farmers of the tropics, especially those in the dryland areas; for instance, if you help the farmers:

(a) Produce more? You will buy & sell more.

(b) Create more with less? For a bank, this multiplies resources.

(c) Do more conservation agriculture? Then they can save more of US. The farmers feed us in the Philippines, but we don't treat them like they do in the United States: with enough love, and with more subsidy.

For all that, we have more climates to change; here are a few more:

- (Hypo)critical attitudes
- Lack of political will
- Pandemic mendicancy
- First-World liberalism (meaning licentious)
- Third-World journalism (meaning third-rate).

If you are in the art & science & business of agriculture, can you improve on the example of ICRISAT? You can make the paradigm shift and help change:

(1) ***The climate of water management.*** Global climate change means the coming of more droughts in the tropics in the future. So, breed those crops

that can tough it out with the long, hot summers. ICRISAT has bred varieties of water-miser pearl millet, sorghum, pigeonpea, peanut, and chickpea.

(2) ***The climate of fertilizer application.*** Since people tend to apply more fertilizers than they should, to get them to use the recommended amounts is already an achievement. But you also know that chemical fertilizers contribute to global warming, so when you prescribe microdosing – the technology of ICRISAT – to me you are prescribing climate citizenship. It's a patriotic thing.

(3) ***The climate of credit control.*** They call it warrantage, and the FAO and ICRISAT and partners initiated it in West Africa. Also called inventory credit, it's an old idea whose time has come again.

Warrantage is a credit system in which farmers stock their produce at harvest when prices are low with a local entrepreneur, and receive cash on credit. Together, they sell the produce about 4 months later when prices are much higher, and achieve up to 40% (higher) profitability. The system allows farmers to raise cash to buy farm inputs including fertilizers and improved seeds (for the next cropping).

(4) ***The climate of science at work.*** In 2006, from Medak District, Andhra Pradesh in India, ICRISAT and Rusni Distilleries reported success in their joint attempt to produce commercial quantities of bioethanol using the patented extraction technology of Rusni and the sweet sorghum breed of ICRISAT. The bioethanol plant, costing US$ 7 million, now benefits 3,000 Medak farmers directly, not to mention the multiplier effect of the value added by bioethanol to sweet sorghum.

(5) ***The climate of empowerment working.*** You haven't heard of empowerment through technology. At the village of Umra in Maharashtra State in India, ICRISAT has touched off a second non-violent Indian revolution. I didn't see it like this a year or two ago but now I say this is a flowering of ICRISAT's mantra, Science with a human face. At Umra, the ICRISAT groundnut (peanut) production package has improved yields, incomes – and, if unexpectedly, social relations. This is India surprising even the Indians! One thing had led to another: Better science led to better crops that led to higher yields that led to higher incomes that led to higher demand for labor that led to higher in-migration of labor that led to higher wages that led to better working conditions. Ah! And the balance of political power shifted – the landowning households (mostly upper caste) "consciously began improving relations with the labor community, and for the first time a lambada (tribal) became deputy head of Umra's village government," Cynthia Bantilan reports. And more marriages and family ties with those outside Umra. You must know India, the land of the caste system, a revolution waiting to happen. So now it has begun to happen, thanks also to ICRISAT.

But leave hunger alone, please. Hunger is mine!

This time, my hunger is different. I hunger for the sharing of Filipino leaders who want to change the political climate of my country:

Share with me, Noynoy Aquino, what you have that the other would-be candidates for President don't? So far, you have demonstrated popularity – of the Aquino name.

Share with me, Manny Villar, how can you propagate entrepreneurship? So far you have demonstrated your entrepreneurship.

Share with me, Gibo Teodoro, how can you cultivate scholarship with soldiership (and vice versa) at the same time? So far you have demonstrated yours.

Share with me, Chiz Escudero, how can you convince the youth to act like they are the hope of the fatherland? Because they are, unless you show them otherwise.

And I hunger for the mass media in the Philippines, including the blogging community, to stop flaunting press freedom and start changing their message from bad to good.

I hunger for the sharing of the newspapers who want to change everything:

Share with me, *Philippine Daily Inquirer,* how can you contribute to national development aside from cutting down people to the quick or to the size you want? So far, you have demonstrated editorial pride.

Share with me, *Philippine Star*, how can you develop the power of the printed word to convince Filipinos to contribute to the benefit of their country instead of to her misery? So far, you have demonstrated being #2.

Share with me, *Manila Bulletin*, how can you excite us when you write about exciting news in agriculture in a boring manner? So far, you have demonstrated the journalistic prose of 50 years ago.

It's time for climate change in the mass media, my other impossible dream:

Stop the shaming and start the sharing!
Or as our international singing sensation Charice puts it in another context, and with a smile: "Share, share."

(Published on 15 November 2009)

20

ICRISAT can do it!
Reduce $10 billion pest losses.

PATANCHERU, INDIA - In the wake of huge crop losses of over $10 billion worldwide due to insect pests, ICRISAT calls for a critical look into the "insecticide treadmill" to save crops and the environment.

Coinciding with the 29th Annual Meeting of the Academy of Environmental Biology, ICRISAT is organizing a symposium on Biosafety and environmental impact of genetically modified organisms and conventional technologies for pest management, on 20 and 21 November at the ICRISAT campus. Over 100 eminent scientists from the Indian Council of Agricultural Research, Council of Scientific & Industrial Research, and the Department of Biotechnology will take part in this symposium.

Stressing the need to reduce pest-induced losses, William D Dar, Director General of ICRISAT says, "The world needs to develop innovative techniques to address the most complex challenge to global food production. My reference here is the US$10 billion annual losses caused by insect pests, which are expected to change in unpredictable ways due to intensification of agriculture and climate change."

Dar further said that crop production is constantly threatened by insect pests, which prevent poor farmers from earning better. As a result of overdependence on insecticides, an 'insecticide treadmill' situation has arisen due to the poor choice of insecticides, poor application equipment, and pest resistance to insecticides. Apart from huge economic costs, indirect costs such as the deleterious effects of pesticides on the environment and human health are becoming increasingly severe all over the world, calling for appropriate technologies and guidelines for their judicious application.

According to Dar, the outcomes of the symposium will be useful to researchers, research planners and regulatory agencies for developing environment-friendly strategies for pest management. Significant progress has been made over the past three decades in the production and deployment of transgenic crops resistant to insects in several countries. In India, the introduction of Bt cotton has more than doubled production in the last five years.

Genetic engineering is an environment-friendly method that has resulted in a drastic reduction in pesticide sprays and increased crop production. Along with this, transgenic crops have been subjected to a rigorous assessment of their bio-safety to human beings and the environment. Therefore, the need of the hour is to compare the protocols used for assessing the efficacy, biosafety and environmental impact of various pest management technologies to make informed decisions on pest management.

Hari Sharma, Principal Entomologist at ICRISAT and the President of International Congress of Entomology says, "ICRISAT has been in the forefront of developing environment-friendly technologies for pest control through the use of insect-resistant varieties derived through conventional methods. ICRISAT is also involved in evaluating the potential of transgenic crops for pest management, and assessing their biosafety to the non-target organisms in the environment."

(Published on 20 November 2009)

21

Public science center. Climate change ICRISAT and public-private partners.

IF you ask me for a world-class climate-change institution that is both proactive and reactive, I will point to you ICRISAT, which is based in Patancheru, Andhra Pradesh, India. Among other things, climate change is bringing the world huger droughts, so we need more and more drought-resistant crops. You can look to ICRISAT for some of those. I already did.

Years before the awareness-raising Nobel Prize for Peace joint win of the IPCC and Al Gore, ICRISAT was the first of the 15 centers under the CGIAR to initiate partnerships with the public and private sectors to come up with public goods for the poor farmers of the semi-arid tropics of Asia and Africa. This happened under the insightful leadership of now much-honored Director General William Dar.

And by climate-change institution I mean a center that pushes the cutting-edge frontier of science even further by coming out with climate-sensitive, high-yielding new or improved varieties of such crops as chickpea, peanut, pearl millet, pigeonpea, sorghum – and partnering with the public and private sectors in carrying out collaborative science for the people, especially those of the semi-arid tropics of Asia and Africa. To paraphrase ICRISAT itself, this is working out a common science with a human face. In the face of climate change.

Ever innovative, ICRISAT announced on 17 November 2009 that it is expanding the facilities of its highly successful Agri-Science Park and is constructing a complex of new pilot plants, new laboratories and new training facilities. The ASP was established six years ago in December 2003, as the agro-biotech park of the Genome Valley initiative of the Government of Andhra Pradesh.

The ICRISAT Director said during the cornerstone-laying that day that the new complex will become a core division of ICRISAT and will be given a new name. Nobody's asking for my opinion, but I'm giving it anyway: I suggest the name "Public Science Center" that would take on the friendly acronym PSci (pronounced p-sigh).

In any case, the name I have in mind possesses the 4 Cs of Communication, being clear, concise, coherent, comprehensive and, more than that, it is convenient. Whatever, to explain the ICRISAT concept of the ASP, by way of my invented name, I am very glad to point out to you that the name itself, those three words "Public Science Center" as a whole describes quite succinctly what it is all about: that it is open to the public for collaborative work, that science is the way around here, that it is a dedicated place.

Public – The facilities are offered for collaboration to the public, and the products and services that are the expected outputs are for the good of the public. The word also suggests partnership and collaboration: "open to the public," open to all interested groups.

Science – This is the primary instrument for generation of those public goods. "Science" is taken to refer to both knowledge and tool, to software and hardware, to process and technology.

Center – This suggests the idea of a one-stop shop, a place for everything.

As I was saying before, ASP is the means by which ICRISAT easifies (my coinage) with its partners the process from generating a product (or service) up to commercializing it, including fashioning out the new or improved technology that is necessary to come up with the product. Partnerships make up another intelligent approach to respond to climate change, in that it reduces energies needed compared to going solo.

The ASP begins the work not only with ICRISAT's own innovations (such as a new hybrid crop) but also innovations from its partners in science. Incubation of innovation.

Convinced of the worthiness of the concept, the Government of India in general and the Andhra Pradesh Government in particular have been collaborating with ICRISAT and providing millions of dollars in the form of grants to ICRISAT.

As of April 2009, the ASP has the following components:

Ag-Biotech Innovation Center (AIC). This enables companies to set up their own R&D facilities within the ASP and operate in collaboration with ICRISAT. The joint work is through a Collaborative Research Agreement with ICRISAT. Eight major agri-biotech companies have established their R&D setups here.

Agri-Business Incubator (ABI). This helps entrepreneurs proceed from business conceptualization to implementation, with support ranging from business mentorship, technical support, business consultancy, and facilitation services.

The ABI has been the most successful component of the ASP, as it has helped incubate at least 20 technologies and enterprises.

Worth special mention as a great success of the ABI is that ICRISAT, Rusni Distilleries and sweet sorghum farmers have established the world's first commercial distillery using sweet sorghum as a feedstock in the village of Mohammed Shapur in Andhra Pradesh. Through a Rusni-patented technology, the distillery can produce 40 kL of ethanol a day, demonstrating to the world that ethanol from sweet sorghum is a sustainable proposition: technically feasible, economically viable, socially acceptable, and environment friendly. It is a decentralized model, starting with the farmers (stalk producers), on to farmer groups and micro-entrepreneurs (juice extractors) to distilleries (ethanol processors). The model includes links with credit and input agencies. The links I think are why it's called a value chain.

And I know about incubation. When I was in high school more than 50 years ago, we had a small poultry setup, about 100 birds of Rhode Island Red and White Leghorns that we had to raise with commercial feeds. After the first batch, we raised our own flock by incubating our own eggs, so I learned from my brother-in-law how to use the incubator, how to candle eggs, how often to turn over the eggs, and how to tell the fertile from the infertile. Imagine how delightful it is to watch an egg crack itself from the inside and then out comes a wet, tiny, helpless being. With the warmth of a brooder, from the incubator the chick begins to learn about the outside world. An egg is hatched; an egg becomes a life. An incubator assists in the miracle of life.

ICRISAT's metaphor of incubation is apt because in ABI, you bring your own eggs and they will help you hatch them in the ASP. From personal experience, I know that not all eggs are fertile, and the infertile must be taken out of the incubator. I can imagine that in the case of the ABI, some ideas are taken out – that is, found either not technically feasible, not economically viable, not socially acceptable, or not environmentally friendly. In other instances, instead of throwing out concepts of a new product, they improve on it: embellish it, modify it, add to it or subtract from it and so on. That is to say, the ABI is more than an incubator; it is a creative force in itself.

So I'm not surprised that the Government of India honored the ABI with the Best Technology Incubator Award in 2005. Last year, ABI received from the Asian Association of Business Incubation the AABI Award. This year, the ASP received the Maryland India Business Roundtable (MIBRT) Award on 19 November, "for outstanding service in promoting science and technology research." It happens to the best.

Hybrid Parents Seed Research Consortium (HPSRC). The concept is to improve access by poor farmers of much better seeds through public-private partnerships with ICRISAT. Currently, there are 40 seed companies that are members of the consortium. The improved crops available are sorghum,

pearl millet and pigeonpea. Today, 80% of hybrid millet and sorghum varieties available in the market have ICRISAT parental lines.

Bioproducts Research Consortium (BPRC). The consortium is dedicated to the mass production of biological pesticides to supplement or replace chemical pesticides. There are currently 11 private companies supporting research for more environment-friendly methods of pest control. You cannot be climate-friendly if you're not environment-friendly. The magnitude of the target is staggering, in that each year worldwide 3 billion kilos of chemical pesticides are applied at the cost of US $40 billion plus.

NutriPlus Knowledge Center (NutriPlus). This is a platform of innovation in food processing, with focus on cereals, legumes, fruits, vegetables, as well as medicinal and aromatic plants. The expected outputs are fortified foods, flavors and fragrances, functional foods, functional beverages, food additives and colors, bio-actives and enzymes, post-harvest management and bio-products. Phase I implementation is in program through the UNIDO South-South Cooperation Office. "Through the NutriPlus Knowledge Center," Dar says, 'we want to strengthen enterprise in the food processing industry, which will in turn link with the poor farmers of the drylands to improve their livelihoods." The collaboration is inside and outside India; in January 2008, ICRISAT and the Crop and Food Research, one of the Crown Research institutes of New Zealand, signed a memorandum of understanding, to help develop NutriPlus. Nandan Biomatrix is also involved in NutriPlus.

SAT Eco-Venture (ICRISAT campus). ICRISAT has entered into an MoU with the Andhra Pradesh Tourism Department, along with the World Wide Fund, to develop the whole area as an agricultural as well as an environmental education system. (The WWF is already a partner in the Ag-Biotech Innovation Center; in fact, ICRISAT and the WWF have come up with the Sustainable Sugarcane Initiative.) The tranquil countryside landscape of the campus comprising lakes, natural habitats, forest and cultural heritage buildings are being preserved to form an eco-tourism park.

Still as part of the SAT Eco-Venture, with the Suri Sehgal Foundation, ICRISAT has just inaugurated a 16-ha, newly excavated lake at the black saline part of the site. Today, the campus serves as a demonstration and training platform for visiting academics, farmers and visitors, as well as a model for watershed management. With public-private partnerships, ICRISAT expects to replicate this model in other semi-arid tropic areas.

That is not to forget to mention that all components of the ASP are now functioning as Strategic Business Units, meaning the ASP is now self-sustaining: AIC, ABI, HPRC, BRC, NutriPlus, and SAT Eco-Venture. The ASP has proven its value as an enterprise in itself. The proof of concept is the living proof.

And the ASP has the following facilities: a Food Safety Laboratory, Genetic Transformation and Applied Genomics Laboratory, Bioinformatics and Computational Genomics Facility, regular and P2 containment greenhouses, and world-class facilities for communicating and computing. This is all hardware waiting for software, including intellectual inputs.

The ASP is now being extended to sub-Saharan Africa. On 8 September 2009, ICRISAT signed an MoU with the Ministry of Science and Technology of Vietnam, to help set up ASP-like science parks. Imitation is the most sincere form of flattery.

For the record, before and after the ASP, ICRISAT and partners released in 77 countries more than 600 improved crop varieties and hybrids between 1976 and 2007. The first in the history of the CGIAR, the ASP is meant to intensify innovative public-private partnerships in value chains. The value chain is the distributor of benefits; the challenge lies in searching for shared values.

Some other ASP-related happenings and occasions worth mentioning are the following:

Nandan Biomatrix Ltd has set up a facility within the ASP that is dedicated to research in the processing of herbal formulations from Aloe vera, Safed musli (*Chlorophytum borivilianum*) etc. Nandan also has an MoU with ICRISAT for collaboration in developing wastelands through the raising of biofuel plantations of Jatropha, Pongamia and other species.

The GTZ-ICRISAT Initiative is designed to assist small farmers within 50 km of a biodiesel plant site in the scientific cultivation of oilseed-bearing trees like Jatropha and Pongamia, up to and including oil extraction and marketing, through training, technology support and field demonstrations.

With the Sir Dorabjee Tata Trust, ICRISAT has been working to scale up watershed development in the districts of Guna in Madhya Pradesh and Boondi in Rajasthan. The Guna partnership has developed new soybean varieties along with new cropping systems, as well as enhanced market links, including information diffusion.

The TVS Agri-Sciences Research Institute has been working with ICRISAT on a natural resource management project in the village of Eruvadi in the district of Tirunelveli in Tamil Nadu.

With Philipps University of Marburg, Germany, ICRISAT has signed an MoU to carry out collaborative work in food science and food safety, including the production of neutraceuticals and development of rapid detection techniques for food bio-actives and contaminants.

Public and private seed companies have been producing large quantities of the new pigeonpea ICPH 2671, the world's first commercially available hybrid of this species. It is an ICRISAT breeding achievement that broke the natural yield barrier of the crop. Dar says that with 40% higher yields than the best current varieties, "ICPH 2671 is truly the magic pea." The other magical quality of ICRISAT's pigeonpea is that because of its strong root system, among other things, it is being successfully used to control soil erosion in China, where this crop is being grown in about 150,000 hectares on the hilly slopes. In fact, I understand it was the Chinese who discovered this unique use of ICPH 2671. It takes a modern variety to show that even in a traditional society like China, the people know what is good for them.

There's more. Bioseed Research Ltd is developing transgenic cotton. Seedworks Ltd is developing transgenic vegetables. Sessler Tom and Hyglass are developing a fermentor and some agricultural implements.

All that goes to show that the ASP allows the pursuit of institutional happiness.

Meanwhile, ICRISAT has launched a Center of Excellence in Genomics in partnership with the Department of Biotechnology of the Government of India. Avesthagen is a partner in this one, being interested in GMO/food safety testing.

All in all, the ASP is a major feature of ICRISAT's vision and strategy up to 2015. Team Captain of ICRISAT William Dar has said:

We strongly believe that collaborative arrangements and strategic alliances are the ways of winning organizations. Our collaborations are geared towards

helping mobilize cutting-edge science and technology for the well-being of the poor in the semi-arid tropics of Asia and sub-Saharan Africa. (The ASP) will be the premier public-private partnership platform for this purpose in the dry tropics.

With this, I believe I have shown you that it already is.

(Published on 26 November 2009)

22

Designer crop.
SSI sugarcane and Copenhagen calls.

HYDERABAD – All roads lead to Copenhagen this week but, Robert Frost-like, I have decided to take the road less travelled by, because I want to make a difference. So, from India, I'd like to offer one crop as model for all Copenhagen crops from now on: For all crops must from today relate to the best of Copenhagen, or else remain anti-climate change action.

Copenhagen! You have heard from 64 aggie scientists and leaders their plea, "Food security and climate change: Call for commitment and preparation". They are telling you that millions of poor farmers must learn to adapt to the changing climate; scientists must teach them many how-tos; science must help them mitigate much of the adverse impacts; and the Copenhagen Treaty must advocate for them.

Copenhagen! If not the whole of agriculture, I am personally asking you to just consider one input of agriculture, the non-traditional, out-of-the-box Designer crop: SSI sugarcane. Sweet revelation. Sugarcane, with which India is #2 in the world.

This species is not just your ordinary *Saccharum officinarum* but your noble cane, the one that has been called by many other name but is just as sweet:

Arabic *qassab es sukkar*
Bengali *aankha*
Chinese *hong gan zhe*
Danish *suikerror*
Dutch *sukerriet*
Finnish *sukenruoko*
French *canne a sucre*
German *zuckerrohr*
Hebrew *kaneh*
Hindi *sakhara*
Ilocano *unas*
Indonesian *tebu*
Italian *canna da zucchero*
Japanese *satou kibi*
Khmer *ampeu*
Korean *sa t'ang su su*
Laotian *o:yz*
Malay *tebu*
Nepalese *sahacar*
Norwegian *sukkerror*
Portuguese *cana de assucar*
Punjabi *gacnaa*
Russian *trostnik sakhamyi*
Sanskrit *Ikshava*
Spanish *cana de azucar*
Swedish *sukkerror*
Sundanese *tiwu*

Tagalog *tubo*

Tamil *kaarumbu*

Thai *oi*

Urdu *gannaa*

Vietnamese *cay mia*.

Except for the Ilocano entry, which is from me, this list is from the University of Melbourne (plantnames.unimelb.edu.au).

Sugar from sugarcane is honey without the sting. SSI Sugarcane, I did call it, a discovery name. Despite a long tradition and a large area planted to the crop (4 million hectares), India's sugarcane average productivity has remained low. So we find this old, tired crop that a team has re-created in India, via the ICRISAT-WWF Project called "Producing more food grain with less water: Promoting farm-based methods to improve water productivity," the one with which they came out with the Sustainable Sugarcane Initiative (SSI). The team members came from ICRISAT and the World Wide Fund, the project based near Hyderabad, at the campus of ICRISAT in Patancheru, Andhra Pradesh. In March this year, the partnership came out with the SSI Training Manual for improving sugarcane cultivation in India, and it's rich, very rich. In fact it's the richest manual for sugarcane that I've seen. And this time, I dare say:

What's good for India is good for the world.

I'm speaking as a not-so-poor farmer's son and proud aggie graduate from the UPCA. UPCA has since graduated to become UP Los Baños, but it no longer has a BS Sugar Tech degree, which is strange because in Laguna itself and nearby Batangas Province, we have sugarcane plantations. It must have been that while UP Los Baños had always been pro-poor, it finally decided that sugarcane was not a poor man's crop. That was poor thinking.

Copenhagen, it's not perfect, but the SSI sugarcane manual coming from India is as bright as can be - eclectic, pioneering, bold and smart in meeting the need for global warming action through the practice of agriculture that answers the needs of farmers.

I've called the SSI sugarcane growing system neo-agriculture. Today, I want to designate the sugarcane crop grown the SSI way as Designer crop, as I realize that it is a crop that has been designed to save the farmer 7 things:

(1) Water

(2) Seeds

(3) Chemical fertilizer

(4) Invasions by pests

(5) Planting times

(6) Croppings

(7) High cost of learning.

With apologies to Stephen Covey and his bestselling book, "The 7 habits of highly effective people," I will now discuss my own list of habits based on the SSI training manual and using the SSI sugarcane as model crop for Copenhagen:

The 7 habits of highly effective farmers

(1) Saving on water

Deducting the cost of precious drops of water that would otherwise be wasted. Under SSI, you are instructed to scrimp on irrigation by a technique so simple; why didn't you think of it before!? Alternate furrow irrigation – you irrigate every other furrow; by that, you can expect to save 50% on water. Otherwise, sugarcane gobbles water.

(2) Saving on seeds

Deducting the cost and handling of unnecessary materials. Under SSI, you need only to prepare single-budded seeds (setts) and grow them in the nursery, in trays filled with coconut coir, an inexpensive water-holding growing medium. Instead of the usual 16,000, you need only plant 5,000 setts, so you save about 75% on seeds.

(3) Saving on chemical fertilizer

Deducting the cost of greenhouse gas emission arising from the manufacture of fertilizer. Under SSI, you need only to buy inexpensive organic fertilizer, or make your own compost. I like Edward H Faulkner's idea of trash farming with which weeds, crop refuse and green manure are incorporated with the topsoil as organic matter and mulch (David Kupfer, 2001, organicanews.com),

which in fact becomes your compost pile already in place. You can also try what ICRISAT calls microdosing, the three-finger-pinch or beer-cap fertilizer technique, which has been successfully used in Africa, for instance increasing millet yield by 70% on the average. Director General William Dar of ICRISAT tells us microdosing has been successfully tried by now by more than 12,000 farmers in Africa (Burkina Faso, Niger, and Mali) with the assistance of African Development Bank, BMZ/GTZ, CORAF, FAO, TSBF-CIAT, USAID, and the University of Hohenheim/University of Kassel.

(4) Saving on invasions by pests

Deducting the cost of chemical pest control and, therefore, minus greenhouse gas emission. Under SSI, you are instructed not to depend highly on chemical pesticides and weedicides. Instead, you should try biocontrol. For instance, release the Sturmiopsis parasite for early shoot borer control, *Trichogramma chilonis* for internode borers, and *Isotima jaensis* for top borer. Weeds are also pests – trash-mulching will save you the expense and energy necessary for chemical weed control.

(5) Saving on planting times

Deducting the energies for repeated land preparations. Under SSI, you are advised to practice ratooning, or after the plant crop to cut off the stubbles just above ground level, using a sharp blade to make clean cuts and faster work. Other farmers can only do two ratoon crops; following SSI advice, you may be able to do up to six ratoons and expect high yield each time.

(6) Saving on croppings

Deducting the multiple risks of monoculture. Under SSI, you are encouraged to practice intercropping. Since you plant the setts under wider spacing between rows and hills, you can very well intercrop potato, wheat, cowpea, bean, chickpea, green gram, watermelon, and many other crops with sugarcane. The intercrops will also help you control up to 60% of the weeds at the initial stage because the denser canopy deprives the weeds of sunlight, that energy for photosynthesis that all green plants need for growth. And you have the extra incomes from your intercrops.

(7) Saving on high cost of learning

Deducting the costs of mistakes. The SSI manual was produced after extensive research and verification by the ICRISAT-WWF project team and with inputs from well-known sugarcane farmers, experts, institutes, agencies, as well as based on personal experiences of the project staff. They have learned from their own mistakes; with the manual, you already have learned, and you can avoid their nameless mistakes.

Seven times saving! Those are The 7 habits of highly effective farmers. With all that risk reduction and those savings in costs, and with a 50%

higher yield each time, you get what you deserve: a higher net income. SSI sugarcane makes farming a very good investment package, indeed.

So, to avoid raising trouble, in raising cane, cultivate the 7 SSI habits!

So, Copenhagen, tell the farmers to grow the Designer crop, SSI sugarcane – using less chemical fertilizers and more organic matter, using less pesticides and more biocontrol methods, using less water and more water-conserving methods, and using the ratoon crop more than twice. It's good for the environment; it's good for you; it's good for us. In fact, it's excellent.

Copenhagen! Do you dare to ignore agriculture, the mother of industry? I dare you to ignore the designer crop, the mother of many industries. May I remind you that this is the crop that is the main source of sweetness in all tropics and subtropics, grown in 16 million hectares in 80 countries, with Asia as the largest grower followed by Europe (ikisan.com). Out of the Horn of Plenty comes syrup, jaggery, molasses, fodder yeast, yeast for humans, baker's yeast, alpha-amylase, wax, rum, glucose, sorbitol, fuel for engines, liqueur, preservative for fruit and meat, citric acid, ethyl alcohol, lactic acid, oxalic acid, monosodium glutamate, lysine, acetone, polystyrene, polyethylene, even synthetic rubber (pakissan.com); paper, cardboard, mulch, compost, animal feed, fuel for the kitchen; and folk remedies for various complaints: arthritis, bedsores, boils, cancers, colds, cough, diarrhea, dysentery, fever, hiccups, inflammation, laryngitis, opacity, sores, sore throat, tumors and wounds (hort.purdue.edu).

Copenhagen, I offer you the SSI sugarcane as the model climate crop for the world: wallet-conscious on water, stingy on seeds, miser on fertilizer, and yet plentiful in yield and abundant in income. Copenhagen, you must signify reduced energy as input, and SSI sugarcane agriculture can show anyone multiple ways to reduce energy. Those who have eyes, see.

Why sugarcane? It's a crop familiar to all peoples. It's for both the poor and rich farmers. An SSI sugarcane village economy can be characterized thus: Decreasing seeds, water, fertilizer; increasing work opportunities, labor productivity; and multiplying effects of sugar as it goes into numberless products. Vibrant village life.

Copenhagen, I am convinced that as a talking point, an SSI sugarcane system has the appropriate networked focus on sustainability, components all for one, one for all: crop, products, energies, people, and environment. That, Copenhagen, is as bright as you can be, if you're smart enough.

(Published on 9 December 2009)

23

Agriculture calling. Copenhagen.

AT the world leaders' meeting in Copenhagen, it is imperative that governments pledge to adopt up-to-date technologies to boost food production as well as outweigh the negative impacts of climate change. Nothing less is expected of leaders. A clear signal that agriculture urgently needs attention is that India, the second-biggest producer and consumer of rice, may have to import 2 million tons to shore up 2010 supplies.

If this happens, it would be the first time in over two decades that the country imports the grain. Though the government has assured that there is enough stock of rice, it has kept the import option open for subsequent review. Thanks to a severe drought, the summer-sown crop harvest could fall 18 per cent to 69.45 million tons compared with the previous year. The monsoon rainfall this year was 23% below normal — the worst since 1972. Next came floods, which further damaged crops.

In the same way, recent storms in Philippines destroyed 1.3 million tons of rice and the southeast Asian country may have to buy a record 2.45 million tons before the end of the year.

The price of rice

Just the news that both India and the Philippines could import huge quantities has swollen the price of rice. Prices will further jack up should Thailand and Vietnam, the world's largest rice exporters, decide to keep their stocks rather than export them. Pulses in India cost higher every day. Some varieties have crossed the Rs. 100 a kilo mark, putting it out of reach for several Indians.

Last year, food scarcity set off riots from Haiti to Egypt. Fresh unrest looms large over developing nations if food costs shoot up. According to the FAO, food prices in 31 poor countries remain stubbornly high and more than one billion people have to go hungry every day. FAO Director-General Jacques Diouf rightly says that the hunger crisis – affecting one sixth of all of humanity – poses a serious risk for world peace and security.

The demand for food

Keeping pace with a growing world population is not easy for farmers. As demand for food increases, they struggle to extract more crops from each acre of land. Farmers who practice rainfed agriculture in the semi-arid and dry tropics are especially vulnerable as rains here are erratic, soil fertility is poor and crop pests abound. Despite the high risks, rainfed agriculture is practiced on 80% of the world's farm area, and generates almost 70% of the world's staple foods. The drylands are home to more than 2 billion people. Of these, 1.5 billion depend on agriculture for a living with 670 million comprising the poorest of the poor. Sixty five percent of India is semi-arid.

The threat of climate change

Adding to the conundrum is a progressively warming world. Climate change is expected to expand drylands by 11% and this will increase the frequency and severity of droughts across the globe. Unsurprisingly, crop productivity is expected to decline.

Here's my point: Countries in semi-arid tropics need to be in a better position to feed their own people. They need to grow more food for themselves. New policies that push investment into agricultural productivity and increase farmers' access to food markets are essential.

Why? First, food self-sufficiency would prevent undue pressure on the international grain trade. It would check wild fluctuations in global prices and avert panic buying in an already thin market.

Second, do we really want to ignore 670 million poor people who not only earn a living from farming but also have to produce the bulk of food? When agriculture is hit, broader economy-wide impacts may also arise. A case in hand is the Kenyan drought of 1998-1999. According to a recently launched Met Office report commissioned by Barclays, the Kenyan drought caused an overall loss amounting to 16% of GDP, but around 85% of this was incurred through foregone hydropower and falls in industrial production and only 15% due to agriculture.

The help from science

ICRISAT scientists have developed farming systems resilient to shocks, buffering crucial resources like water and nutrients, and adapting crops to warmer temperatures and new pest patterns. Changing crop varieties and efficient irrigation can indeed help mitigate risk in the agriculture sector.

We have proven innovations in crop, soil and water management that farmers could quickly deploy in these times of crises. For example, we can help farmers produce more food with less water. Also, ICRISAT-developed pearl millet hybrids can produce seeds even under very hot temperatures

and improved sorghum lines are capable of giving good yields even in harsh conditions. In the nutrient-starved soils of sub-Saharan Africa, ICRISAT helps increase agricultural productivity with fertilizer microdosing, which ensures that the right quantity of scarce fertilizer is given to the crop at the right time.

Yet another powerful tool is integrated watershed management: building micro-irrigation structures advantageously located in the trail of runoff rainwater that would otherwise have just gone down the drain. This advanced watershed system, a model of which ICRISAT set up in Kothapally village of Ranga Reddy district in Andhra Pradesh, uses modern science tools, including GIS, satellite data, and remote sensing for maximum efficiency. Advanced watershed systems combine training farmers about high-yield seed varieties, different cropping patterns, and other skills including manufacturing green manure.

The agenda

Agriculture and food security should be high on international agenda. The G8 rich countries have promised to increase spending on agricultural development by $20 billion over the next three years. While this is commendable, the amount is still woefully less than the $44 billion that FAO estimates will be needed each year to end malnutrition. Also, rich countries have to match their words with action.

But developing countries also need to get their house in order. A paradigm shift from instating makeshift measures during droughts and floods to long-term agricultural solutions needs to come about. Governments need to increase spend on agri-science research and rural infrastructure including roads. Our farmers need better facilities to make them less dependent on erratic rains. To be exact, they need superior training, technology and marketing opportunities. These will make farming a profitable enterprise for our smallholder farmers.

Agri-entrepreneurs need to be encouraged by helping them tap into a pool of commercial technologies. This would in turn help farmers access innovative and improved farming systems through small and micro-enterprises. Policies could help boost local agricultural production by speeding up irrigation investments, and subsidizing farm implements and high-yield seeds. At state-sponsored workshops farmers can learn how best to protect crops during droughts. Also, improve the linkages between farmers and markets.

To tide over the agrarian crisis, smallholder farmers need to be part of the solution. Access to technology, markets and financial funding will help them not only produce more food but also get profitable returns. Nothing less is expected of farmers.

(Published on 9 December 2009)

24

Creative CGIAR.
Rich out for the poor – Bill Gates.

WASHINGTON DC – Out of Ayn Rand's masterpiece, *Atlas Shrugged* and, intruding into the business meeting of the CGIAR held 7-8 December 2009 at the International Monetary Fund headquarters, he spoke about the poor farmers as a new engine of economic growth. A climate change. The poor we shall not always have with us. A primate change. Katherine Sierra, Chair of the CGIAR, would know that the group will never be the same again.

In essence, Atlas said: "We need the rich creative minds of business working with the poor productive bodies of farmers to design and build a brave new world in the midst of climate change." Audacious, original. The words are mine but the thought is that of the one and only William "Bill" Gates, once CEO of Microsoft. I have been reading his two masterpieces, his Davos speech, "A new approach to capitalism in the 21st century" and his Washington statement at the CGIAR business meeting, "For a sustainable & resilient global agriculture - Bill Gates". I have connected the two declarations together even as they are separated by almost 2 years. The creative force behind Microsoft is now behind the plow.

"Agriculture will play a central role in addressing most challenges that the international community faces today," says Carlos Perez del Castillo, newly appointed Chair of the Consortium Board of the CGIAR.

We must focus on the poor farmers, Bill Gates says, as they are the key to world agriculture. The Harvard dropout is now the aggie scholar. With his creative capitalism, the software is now behind the hardware. In the 1980s, he wanted "a computer on every desk in every home." Microsoft is software. "From a very young age, I thought software was magical," he tells Peter Jennings of ABC (abcnews.go.com). The PC world has been listening, so it has made Microsoft a castle of legends, with 60% of homes in the US now with PCs. As it were, he now wants a magic pot of peas in every poor home. Is the rest of the rich world listening?

I didn't give Bill Gates credit for innovation until he retired from Microsoft and he came up with entirely new software, a novel capitalist tool: creative capitalism. You can't buy it - you have to buy into it. Great! As far as I know, I'm the first and probably the only one saying his Davos speech in January 2008 and his Washington statement in December 2009 are linked in time and meaning much more than Word 2007 is linked to PowerPoint 2007 in the suite called Microsoft Office 2007. There are 2,756 words in the Davos speech and 574 words in the Washington statement, including titles. Assuming that you have read both manuscripts word for word, which I doubt, afterwards you have to read between the lines. That needs practice.

You have to intuit, otherwise, you will miss the capitalist boat. Somebody else has gone ahead and given creative capitalism a run for its money. Says Declan McCullagh, the Chief Political Correspondent of CNET News.com (25 January 2008, news.cnet.com): "Gates misses the point on 'creative capitalism'." He doesn't know what he's talking about? McCullagh says creative capitalism is simply a new name for an old idea: "corporate social responsibility" or "social caring." Well, I have bad news for CNET News.com: As it turns out, McCullagh is the one who doesn't know what he's talking about.

Creative capitalism, as Heidi Benson puts it (sfgate.com), is capitalism being "a driver for social change" and not simply doing corporate good; or, as

Michael Kinsley puts it, "It's using the idea of self-interest turning into the general interest." The corporate good becoming the social good. "Creative capitalism" is a new name for a new idea.

In his opening paragraph in the Davos speech, after saying he is going to make "a big career change" and retire as Chairman of Microsoft, he says, "Also, I'm learning how to give money away." He's a practicing Christian, isn't he? He not only memorizes but also practices the dictum that of those who have more, more are expected of them.

And now, with creative capitalism, we can expect more from those who have less.

Climate change happens years before and creative capitalism happens months before the Wall Street cash crash. Then US President Barack Obama comes out with his bailout plan. I hope it helps. From climate change, there can be no bailout plan; we cannot buy our way out – it would be too late. You can buy carbon credits, even on credit, but you cannot buy time. Now the capitalists that McCullagh is trying to defend have no choice: Do it or else! Climate change leaves them no choice. Bill Gates says, unfortunately "climate change will have the biggest effect on people who have done the least to cause it." And there are billions of them.

On the same day that McCullagh opens his mouth to make Bill Gates' seem little, Michael Kanellos, Editor at Large of CNET News.com, says "On 'creative capitalism,' Gates gets it" (25 January 2008, news.cnet.com). I like Kanellos for being frank. He mentions the rewards of creative capitalism: if not profit,

recognition and enjoyment. It cannot buy you the farm, but it can buy you someone's wolf's ticket. He then quotes a most important part of Bill Gates' Davos speech:

This kind of creative capitalism matches business expertise with needs in the developing world to find markets that are already there, but are untapped. Sometimes market forces fail to make an impact in developing countries not because there's no demand, or even because money is lacking, but because we don't spend enough time studying the needs and requirements of that market.

Business expertise, demand, money, needs, and markets untapped – The business experts fail in or fear to tread on the Third World because they fail to study the resources and requirements of those markets; they only succeed in studying the resources and requirements of their businesses.

"Climate change will have the biggest effect on people who have done the least to cause it," Bill Gates says in Davos. "In particular the billion people who live on less than a dollar a day." So we must harness the power, "the genius of capitalism" so that "it benefits everyone," the poor included. In certain cases, the profit motive will have to give way to the prophet motive. The Protestant Ethic will have to give way to what I shall call and define here as The Christian Ethic: "As you did it to one of the least of my brethren, you did it to me."

Bill Gates says:

I like to call this idea creative capitalism, an approach where governments, businesses, and nonprofits work together to stretch the reach of market forces so that more people can make a profit, or gain recognition, doing work that eases the world's inequities.

Too many words for me; I'd like to summarize creative capitalism in 12 simple words:

Meeting the needs of the poor as market, for business or pleasure.

With the threat of global warming beyond tolerance, what we need is not simple corporate social responsibility. Whether the capitalists like it or not, this is where the genius of capitalism is being tested, in the crucible of climate change. We don't want history to record that Atlas shrugged in 2008 – we may not be able to write that history. The rich cannot ignore the billions of poor even if they don't want to look. I have found the great leveler, and it's called climate change.

In the Washington statement, Bill Gates announces "the Bill & Melinda Gates Foundation's intention to formally join the CGIAR" even before the "programmatic focus, funding arrangements, and membership issues" are discussed. From the world's biggest software company, Bill Gates is buying into the consultative body of the world's biggest partnership for research and

development in agriculture, the CGIAR, comprising a total of 15 centers based in different parts of the world.

Now retired, Bill Gates wants to be where the inaction is. The world has largely ignored its better half; the Wall Street crash signaled that the cash crop is as important as the cash drop, if not more so.

The Bill Gates I know, starting more than 20 years ago from my reading second-hand PC magazines, is the antithesis of John Galt in Ayn Rand's monumental novel *Atlas shrugged*; instead of striking out, Bill Gates wants to apply creative capitalist intelligence onto the twin problems at hand: poverty and climate change. Nobody ever thought of that before. Rich reaching out for the poor to generate more progress and not more poverty, to create a common bounty and not a singular mendicancy. We are all in this together. The poor deserve more, the rich no less.

The CGIAR system may or may not be larger than Microsoft when Bill Gates turned it around on its own axis in 1995 to confront the challenge of the Internet that it had largely ignored previously; consequently, Microsoft captured the Windows- (PC-) based billion-dollar worldwide market, and almost the Internet; and for decades he was the world's richest man. Bill Gates is not only a major survivor; he is a magnificent planner and victor.

Now, the plot thickens!

In its own press release, the news is that the CGIAR Goliath has challenged himself:

To enhance the organization's ability to mobilize science for overcoming poverty and hunger and achieving ecosystem resilience in developing countries. The agreed reforms should help boost funding for priority research areas, simplify organizational structures, reduce transaction costs and give greater emphasis to development results.

Right! Get rid of the heavy armor and get down to brass tacks.

I single out the two most important words in the announcement: "Boost funding." You can't work out external change with an internal budget on a string, except if you're a software genius. On this note, the Bill & Melinda Gates Foundation has committed to the CGIAR some $400 million for the next 5 years, or $80 million a year, which comes down to $1.54 million a week. It can't get any better than that! Bill Gates has indeed learned how to give away money.

And he has thought about how to spend all that money. In the Davos speech and in TIME, he gives examples of real-life, working creative capitalism:

(1) As "a way to bring technology to people who don't have access," Microsoft has donated more than $3 billion in cash and software.

(2) When Microsoft people "show how to use technology to create solutions," they have the greatest impact.

(3) A Dutch company shares the rights to a cholera vaccine in Vietnam and brings down the cost to less than $1 a dose, including delivery and cost of an immunization campaign.

(4) The US FDA gives a priority review for another drug of your company if you develop a new drug for a neglected disease like malaria or TV (Bill Gates, 31 July 2008, time.com).

(5) Another approach is to find ways to create methods for information to serve a wider circle of people.

(6) Governments can create market incentives for business to help the poor improve their lives, by setting policy and disbursing funds.

(7) The Fast Company (a magazine) offers awards for what it calls "social capitalism."

That is all market-driven, Bill Gates says, demand-driven. For people who have been left out of the global economy. Creative capitalism focuses on "what your company does best," so much so that "it takes the brainpower that makes life better for the richest, and dedicates it to improving the lives of everyone else."

Since I am more familiar with ICRISAT than any other CGIAR center, I shall now proceed to look at what this India-based institute under the leadership of Director General William Dar has done in the name of creative capitalism, in fact if not in name:

(1) ***Access.*** ICRISAT has donated to countries like the Philippines seeds of improved crops like sweet sorghum and peanut (groundnut) for location testing and seed production.

(2) ***Solutions.*** With its Adarsha watershed model, ICRISAT is showing the world how old technology can create new solutions to old/new problems of water scarcity.

(3) ***Sharing costs.*** With its Agri-Business Incubator, ICRISAT shares the cost of developing businesses and products with the poor as markets.

(4) ***Neglected area.*** For farmers who can hardly afford fertilizers, ICRISAT has come up with what it calls microdosing: 6 grams per hill, so small they have to measure it with a bottle cap.

(5) ***Knowledge.*** ICRISAT has nurtured its award-winning system of information sharing called Virtual Academy for the Semi-Arid Tropics. The system is actively involved, among others, in information leadership among women volunteers in Addakal, Andhra Pradesh and training in drought preparedness among youth. VASAT is now being modeled in the Philippines (as the Open Academy for Philippine Agriculture) and Afghanistan.

(6) ***Government as ally.*** The national and local governments of India have been quite proactive and reactive in formulating policies as well as in developing, assisting and funding ICRISAT-partnered projects for its target clienteles in the semi-arid tropics.

(7) ***Awards.*** I suggest that through its Agri-Science Park, following Bill Gates' exhortation, ICRISAT begin to encourage innovation by itself offering awards for social capitalism directly addressing the needs of the poor.

Going back to Bill Gates, this is his challenge to the CGIAR's own challenge to itself in partnership "to tackle hunger, poverty and climate change:"

We believe the reform process should lead (the CGIAR) centers back to their comparative advantage and empower them to deliver high-quality research and technological innovations. We believe that region- and country-specific technology adaptation and dissemination activities ought to be led by national partners and that the centers ought to work in close partnership with them.

Thinking globally and thinking locally, to me, these words stand out: comparative advantage, empower, research, technological innovations, adaptation and dissemination. I note ever so gladly that the activities, whatever they are, are "to be led by national partners." Bill Gates proposes, CGIAR disposes. What do the poor want? What do they need? From faraway Manila where I sit thousands of miles away from either India or Washington DC, the leadership of projects will be a bone of contention – or a bone of

contentment – depending on whether the CGIAR will or will not "spend enough time studying the needs and requirements of its market" even as it comes out with any number of innovations.

Having worked within UPLB, the most densely populated PhD universe, I can easily say myself that half the world's scientists are not driven – they push. That effectively eliminates the poor who cannot afford the technology, or cannot articulate their demand for something else entirely. Supply-push vs demand-pull. The pushers have been consistently pushing the supply of their discoveries and not been driven to discover the demand. Is science our salvation or not? This half neglect of science helps explain why it is that while we have always Christ with us, we also always have the poor.

Creative capitalism is out to change that; if inadvertently, Bill Gates is out to reform the CGIAR even as it reforms itself. "The end-result of the reform," he says, "ought to be a CGIAR system that can once again attract 'the best and the brightest' scientists to devote their careers to the cause of improving developing-country agriculture," focused on "the poor producers and consumers across the developing world."

I love it when everything comes together for the good of those who love the poor. This is the climate change I'd like to see enveloping the whole creative CGIAR.

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How I write. TEAM ICRISAT award in my mind.

MANILA – I love what I'm doing so much it isn't work, in case you ask. And so, for the last three years, I have been blithely struggling with technical terms coming out of the steady streamflow of ICRISAT theories and practices in and out of the drylands and wastelands of Asia and Africa, not to mention China, sometimes in a torrential downpour of reports and releases, theories and thoughts.

The creative science and sense from ICRISAT headed by Director General William Dar have been both a challenge and an inspiration for me in my creative thinking and writing. Based in India, ICRISAT has been global in thought and global in action. Excellent!

To end 2009 with my own version of The Big Bang, as you shall be surprised to see towards the end of this essay, I have decided to show you examples of how my mind works when confronted with vague technical terms running one after the other, both modern and ancient, each one of which makes me feel uncomfortable. Notwithstanding, truth to tell, I almost always find my unease the beginning of my creativity. All is well that ends well.

You could get indigestion if you try biting into and swallowing hard science for meal or snack. Not me. With a paradigm shift to fuzzy logic – another excellent approach to creative thinking – you can make science talk sense to the layman or, at least, get him to ask some intelligent questions. Any questions?

Translating the technical to the popular, let us examine the record with some examples below (in italics), all of them from one annual ICRISAT report, and that I shall number, each to which my translation follows. You will probably note that when I'm not so sure of what to say, I beat around the bush. Take #1:

(1) ***Integrated Genetic and Natural Resource Management (IGNRM)***

An ignoramus on IGNRM, I will put it this way, simply as "Resource Management." Management is management, and to me everything is resource, except humans – they are the ones who the manager expects to work on the resources instead of him.

(2) ***Genome sequencing***

I don't understand the term that much either, so if you ask me to discuss it, I will concentrate less on the meaning and more on what happens after genome sequencing. In sweet sorghum for instance, if you know which gene comes before and which after, you may be able to tell the one associated with, say, drought tolerance in a wild sorghum species, and that may be the gene you may want to engineer into the sorghum variety that you are developing for planting in water-stricken farmers' fields. You come up with a GMO, I'm not sure. GMOs have always been a difficult subject for me.

(3) ***Rapid degradation of watershed slopes***

I suppose it simply and literally refers to soil runoff on hills. It can also refer to clear-cutting of forests (following the market mandate), which is a faster process than selective logging (following the legal mandate).

(4) ***The crop's multiple-use and sustainability attributes***

My translation and enumeration: "Pigeonpea has many uses: food (dried peas, flour, and green vegetable), windbreak, fence, fodder for poultry and

livestock. This ICRISAT variety also addresses the need for sustainability in two ways: This pea doesn't need any fertilizer; it can sustain itself and in fact enriches the soil with nitrogen as it is a legume. This pea is an excellent protector of the soil against erosion with its widespread canopy (protecting the soil from the impact of rain) and widespread tiny roots (firmly holding the soil particles in place)."

(5) ***Improving water retention in the field***

Translation: "We are experimenting with multiple cropping and earth check dams. Multiple cropping ensures that the soil is continually covered with vegetation, thus minimizing evaporation of moisture from the soil. Earthen check dams create little reservoirs of water that last into the dry season. Mulching and green manuring are also techniques for retaining soil moisture."

(6) ***The poor have negligible savings, and correspondingly little chance for upward mobility.***

Translation: "The poor don't save and, therefore, they can't invest to earn more. But with some assistance, the poor can be successfully taught to save and be their own entrepreneurs."

(7) ***Fish catches are significantly smaller than they were 10 years ago, and fishermen are forced to spend more time in the water.***

Translation: "The fishermen have been overfishing, that is, harvesting even the young ones and the fertile females; they have also been careless, inadvertently destroying the habitat of commercial species. It's like a bank

account – if you withdraw the interest as well as the principal, your bank earnings will dry up sooner or later."

(8) ***Inexpensive, small earthen dams convert eroded gullies into seasonal reservoirs that recharge depleted wells and make extended-season irrigation and cropping possible.***

Translation: "The dams are inexpensive because they are made of earth and they are small, not massive. In two words, "eroded gullies," the redundancy provides the visual impact of the soils of fields eaten away by running water gathered from the rains. While the earthen dams are not removed after the planting season, they become seasonal reservoirs because they collect water only during the rainy months. Much of the trapped water in those gullies percolates through the gully beds and replenishes the underground water, the same which is tapped by artesian wells. With the recharged underground reservoir, there is water to irrigate crops even beyond the usual, rainy-season cropping."

(9) ***Minimum or no-till relay cropping keeps the soil protected during flash rains, shading the soil to reduce evaporative losses and providing better growth conditions for soil fertility-enhancing organisms.***

Translation: "The least or zero cultivation is a lazy man's dream because he can save on his energy as well as on animal power (cattle) or mechanical energy (tractor big or small) that otherwise would have been spent for plowing and harrowing the field. Since the soil is undisturbed, the canopy of the vegetation growing on it shields the ground from the impact of raindrops, and the thousands of tiny roots hold the soil particles in place. There is little or no soil erosion; there is little or no soil water evaporating into thin air. All these conditions insure that earthworms, bugs, fungi and bacteria do their thing and cause the decay of organic matter (dead plant parts as well as other organisms), and in so doing release substances and compounds that enrich that soil."

(10) ***Diversified and higher-value crops reduce risk, increase farmers' incomes, and provide an incentive for investing more in land improvement and intensification.***

Translation: "Diversified or multiple cropping works at reducing a cultivator's risk of farmer failure by growing several crops at the same time in the same field. If a crop fails, the other crops will save the farmer's skin. Higher-value crops reduce risk in the sense that even in the event of a crop failure, the harvest should earn more than enough to break even because the harvest brings in more cash per unit crop. Once the farmer realizes all that, he will invest more in his farm for soil development by resorting to the least or zero tillage (to save on cost), as well as to the growing of more crop per unit of land (to save on space)."

(11) ***By unleashing the power of women to turn the grey tropics green, ICRISAT and its partners are not only improving the livelihoods of today's generation. They are seeding the Grey to Green Revolution for decades to come.***

That needs no translation, does it? ICRISAT has two mantras that I shall now try to combine into one motto: "(From) Grey to Green Revolution (through) Science with a Human Face."

(12) ***Through generous supplementary assistance from the Dutch Government and the Asian Development Bank, practical applications of these exciting research findings are being rolled out jointly with national and local partners in community watersheds in Ethiopia (Ginchy), India (Kothapally in Andhra Pradesh and Lalatora and Solsinda in Madhya Pradesh States), northeastern Thailand, and northern Vietnam (Thanh Ha watershed in Hoa Binh Province).***

Translation: "We have gotten generous funding from the Dutch Government as well as the Asian Development Bank to support the practical applications of the research findings mentioned above. The findings are transformed into technologies for diffusion, that is, for adoption or adaptation by farmers in the field; this is done by ICRISAT jointly with national and local public and private partners in community watersheds in Ethiopia (Ginchy), India (Kothapally in Andhra Pradesh and Lalatora and Solsinda in Madhya Pradesh States), northeastern Thailand, and northern Vietnam (Thanh Ha watershed in Hoa Binh Province)."

Historically, it was the success of the Adarsha watershed community in Kothapally with their watershed-building enterprise that resulted in the generation and packaging of what I like to call The Adarsha Model and the subsequent introduction of the whole concept and process into Ethiopia, Thailand, Vietnam, in other places in India itself, and elsewhere.

And now, a note on the discovery Adarsha model of countryside development itself. In forestry, the fate of the watershed is effectively controlled by the logging concessionaire who, unfortunately, has little or no interest in the waters stored on the site and which provide headwaters for streams and rivers. In agriculture, as in the case of the Adarsha community, the watershed can be effectively and efficiently controlled by the members of the community itself who have much stake in the maintenance and development of bodies of water above and below ground.

The Adarsha story is quite interesting and illuminating. It was at first a supply-push event (that was, "technology is the answer, and here it is"). Then Team ICRISAT (including partner groups) learned a lesson from the Adarsha people and it became a demand-driven concern (that was, "villagers' needs come first, and it is livelihood"). After those mutual-learning encounters, Adarsha became a thriving community; today, it has become a model for the rest of the world to learn from.

Now then, as far as I can see, with ICRISAT's success in Adarsha, considering climate change and the concomitant severe droughts in many a country and countryside, suddenly the community watershed has become the first and minimum goal and, thereby, the first unit of measurement of successful countryside development. Success is defined as dividing the liabilities and multiplying the benefits among the members of that community. This is a Team ICRISAT accomplishment, with partners; now then, considering other achievements, I believe Team ICRISAT deserves the World Food Prize, which is non-sectarian, or the Right Livelihood Award, which is non-ideological. There should be no drought of awards for significant climate change changers. Success in countryside development should no longer be measured on a project basis but on a community basis, all resources included, from the trees on the hills to the water underground. Team ICRISAT's Adarsha story has forever changed the human face of science in the countryside.

The last paragraph above is the proper ending of this essay, but I wanted to point out how it came about: Serendipity. I didn't plan on it. Horace Walpole tells us in so many words: Serendipity is the phenomenon of a happy thing happening when you're not asking for it. As often happens when I write, there comes a point when out of nowhere I gain an insight from the materials I'm working with – as the lead sentence of that paragraph shows: "Suddenly the community watershed has become the first and minimum goal and, thereby, the first unit of measurement of successful countryside development. Success is defined as dividing the liabilities and multiplying the benefits among the members of that community." The text is mine; the triumph is Team ICRISAT's. May their tribe increase!

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About ICRISAT

ICRISAT
Science with a human face

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 644 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT is supported by the Consultative Group on International Agricultural Research (CGIAR).

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