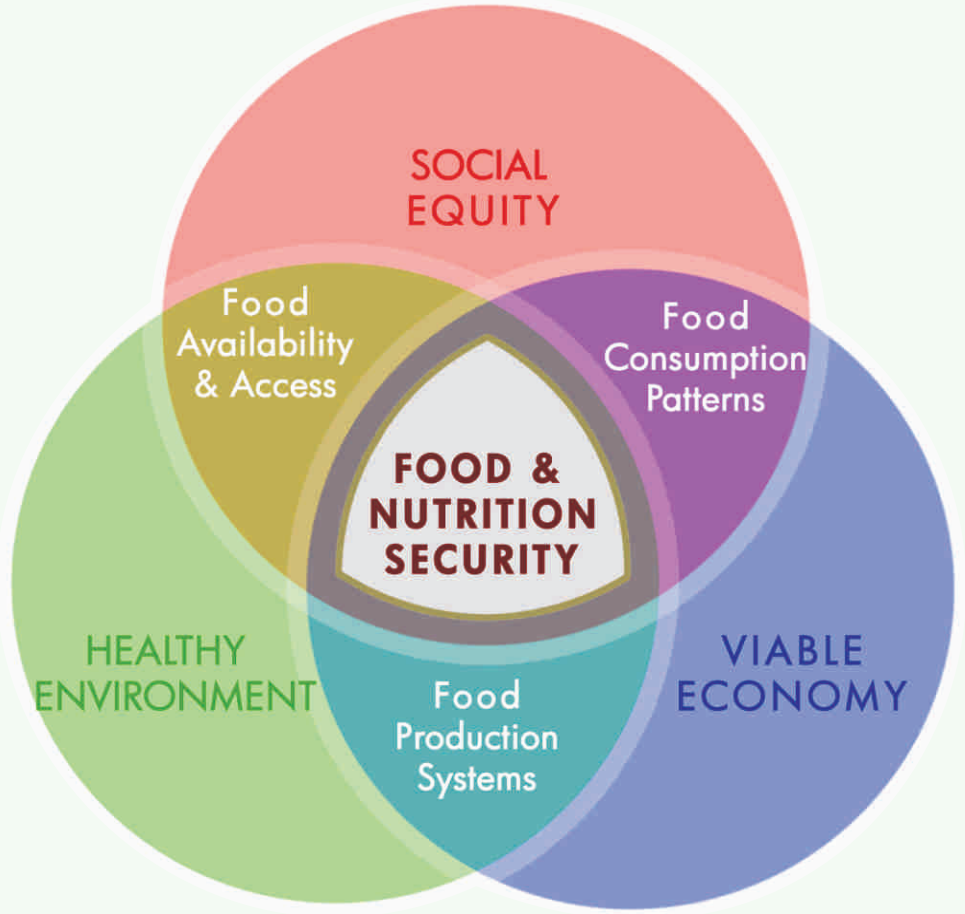
INDIAN NATIONAL ASSOCIATION

SECURING FOOD FOR ALL

The Critical Need for Coherence in Policies and Action



A Report to the Club of Rome
Indian National Association

GLOBAL CONFERENCE ORGANISED BY

THE CLUB OF ROME | INDIAN NATIONAL ASSOCIATION

SECURING FOOD FOR ALL
CRITICAL NEED FOR COHERENCE IN POLICIES AND ACTION

OCTOBER 30 - 31, 2014

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… to answer the primal questions from Asha*'s perspective …

"ARE YOU NOT ASHAMED?"

The challenge before us today:
What can we do for an equitable food and nutrition security regime in India

** Asha means hope … and acting on a proper answer to Asha's questions today is our best hope for an inclusive, better tomorrow*

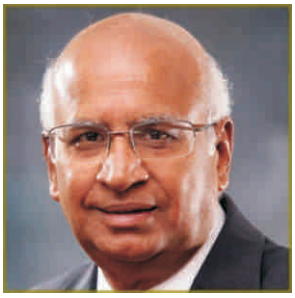
FOREWORD

Dear Colleagues,

The 3rd Annual Meeting of The Indian National Association for the Club of Rome (CoR—India), titled "***Securing Food for All****: The Critical Need for Coherence in Policies and Action*", was held at The TAJMAHAL Hotel, New Delhi, October 30-31, 2014. The purpose of the conference was to help establish coherence in food security policies. The program presented an opportunity for open exchange among diverse stakeholders, to provide knowledge and practical tools to think globally, act locally, build better relationships, and find commonalities. While this conference also provided the right platform for ***food and nutrition security*** (***FNS***) professionals to come together, it also provided them with an opportunity to lead the way in ensuring scientific integrity, relevance and transparency of communications.

CoR—India has always recognized the importance of systematic thinking, coherence and sustainable national futures to its mission: to act as a global catalyst for change. In addition, this conference gave us the opportunity to examine FNS issues that will shape the future for managing the ever increasing amount of knowledge and data available. It is the need of the hour to share this information with the Government, Private industry, Academic researchers and NGOs that represent a variety of interests, with the ultimate objective of being able to provide improved food and nutrition security for the masses. A major goal of the conference was to publish credible documentation that would deliver output-oriented recommendations.

We hope this publication will help us achieve our goal.



S. Ramadorai
Chairman, CoR—India

Ranjit Barthakur
Secretary General, CoR—India

Message from the former President, Club of Rome

Already within the first fifteen years of the new Millennium, humankind finds itself confronted by an explosion of crises. Some of them diminish human wellbeing, others threaten our institutions, social systems and perhaps even our civilizations -- and still others endanger the very processes of nature that support life on Earth.

More than a billion people in our world live in extreme poverty and another two billion people are more or less outside the global economy – a situation we might call the poverty crisis. They, and others, need hundreds of millions of additional jobs that are not being created – the unemployment crisis, a crisis of exclusion and denial of access to the most basic of human needs.

The breakdown of our financial systems is causing a global economic crisis. And the changes in climate, the accelerating extinction of species and the rapid depletion of our natural resources are leading to a massive environmental crisis.

The growth of human populations and the decline of land productivity are now leading rapidly to what could be the most disruptive crisis for civilization in the coming decades, *a breakdown of food security on a large scale*.

Many of these seemingly separate crises are, in fact, driven by the same sets of root causes: narrow and short-term economic goals, reinforced by gross undervaluation of natural capital, driven by individualistic values that assume that the resource base is infinite and the capacity of nature to absorb wastes is unlimited. Furthermore, our systems of governance at the global, national or local levels are not adequate for managing our capital – human, social, natural, physical or economic in a manner that is sustainable even for time horizons measured in decades, let alone milennia.

Likewise, the changes need to save civilization and life on Earth must be systemically designed to address these root causes together; anything less cannot produce a lasting solution to these deeply-set, seemingly intractable crises.

The Club of Rome firmly believes that humanity deserves a better future and such a future is possible, provided we understand the systemic issues that have led to the present and devise holistic solutions for the generations that will follow us.

This report documents the preceedings, proceedings and postceedings of discussions on how to achieve coherence among the different policies that affect the production, access and stability of food and nutrition systems to ensure a secure future for humanity on this set of issues.

Ashok Khosla
Chairman, Development Alternatives
Co-President, Club of Rome (2005-2012)

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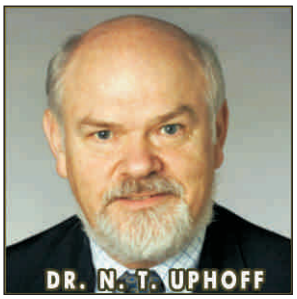
He who has bread may have troubles,
He who lacks it has only one.
Old Byzantine proverb

List of Annexes:

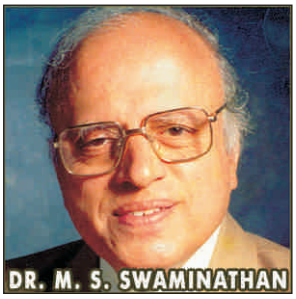
INTRODUCTION

This publication reflects the proceedings of the 2014 Annual Conference of The Indian National Association for THE CLUB OF ROME – "**SECURING FOOD FOR ALL** – *The Critical Need for Coherence in Policies and Action*", held at New Delhi, October 30-31, 2014, to consider and identify specific policies and actions that can be proposed to government, business, civil society, academic institutions & the media for implementing in their respective domains.

Many conferences take place every year on the subject of "Food and Nutrition Security", focused primarily on the 'grow more food' paradigm. This one convened by the Club of Rome - India (CoR-India) offered a valuable opportunity to probe the fundamental, root causes across disciplines and sectors, and find solutions that can be translated into policies in officialdom and action on the ground to enable the country to eliminate hunger, malnutrition and indeed all forms of poverty within a very short time.



We are extremely fortunate that the **Conference**, as it will be referred to henceforth, was graced by international and national thought leaders, who shared their wisdom and knowledge freely with the participants. **Dr. N. T. Uphoff**, *Professor, Government & International Agriculture*, *Cornell University*, lucidly explained the benefits of System of Crop Intensifications and principles of agro-ecology, in which we can make the microbes in the soil work for us by re-'biologising' agriculture and increasing agricultural productivity. **Dr. M. S. Swaminathan**, *Chairman, National Commission on Farmers* explained the new social and technological innovations for the new '*Green Revolution*', emphasizing "Family Farming" and bio-fortification for achieving 'Zero Hunger'. **Dr. Ashok Khosla**, *former President, Club of Rome and Chairman, Development Alternatives*, used simplified but powerful graphical interfaces to explain, among other topics, the essence of the '*debate needed today*' for policy coherence, revolving around the three E's: (a) social **equity**; (b) healthy **environment** and (c) viable **economy**.



Preceding the Conference, we evaluated several factors for FNS for all, focusing on the coherence —or lack of it—in policies and actions in India that could and should be done differently. Achieving food for all, as Professor Uphoff has commented, will require some sort of paradigm enlargement and shifting, as a casual '*business as usual*' approach will leave us with no possibility of achieving the overarching goals of food security for all, cutting hunger by half and eliminating malnourishment, especially for children, by 2020. Meanwhile, the huge 'gorilla' in the room is of course the unmitigated growth of population in India, which is galloping ahead and is projected to exceed China's as early as 2030. Unmitigated population growth has wiped out the socio-technical benefits of almost quintupling of India's food grain production growth over the last 60 years. Even Bangladesh has recently experienced a steeper decline in the crude birth rate, which is a reliable indicator of the stability of a nation's socio-economic and environmental progress. This failure to mitigate population

growth in India—in terms of conceptualization, design and implementation of coherent policies—alone suggests the incompleteness of our socio-economic and environmental achievements over the past 67 years, since independence.

With FAO and Dr. Amartya Sen's theories on poverty gaining credence, the notion of 'access' to food is moving centre stage in the discourse on food and nutrition security (FNS). We are now obliged to move far beyond the productionist paradigms of yesteryear to address the FNS concerns of today and this was a recurrent theme during the Conference, which has been captured here, as well. To improve access to food, we need to reprogram sustainability initiatives in a wide range of climate change, land and water restoration, food storage and distribution, women's empowerment, livelihoods creation, child development programs and various other 'sustainable development' initiatives. These are all issues that also highlight the scenario of 'offshooting', predicted by the seminal book 'Limits to Growth', and published by the Club of Rome in 1972.

The growing scarcities of land, water and other natural resources and the sudden contraction in several indicators since 2007/2008 are factors of concern not only for FNS, but also for the overwhelming issues of population growth, climate change, peak 'many things'—all compounded by an increasing evidence of policy incoherence, not only in India but globally, as well. If we fail to mitigate any and all of these concerns, a sudden catastrophic outcome cannot be ruled out, regionally, nationally or even globally.

As the problems of access to food become complex and multi-dimensional, conference participants made it abundantly clear that that the key to success for change management is the ability, not only to innovate and '*think-outside-of-the-box*' to formulate solutions, but also to identify change agents with inter-disciplinary skills who can bring in new ideas, methods and field work experience, to make these changes happen and remain sustainable.

However, we have to also recognize that people like '*Asha*', smallholder farmers and others who are going hungry NOW because of our failure to understand and work within our limits to growth, cannot wait while we address the imbalances in our social, environmental, capital and human resources, at our own leisurely pace. If the food riots since the 2007 global meltdown are any indication, which are reminiscent of the hungry crowds that sparked the French Revolution in 1789, history and common sense tell us that a functioning food system is an indispensable pillar of a stable economy and a society capable of reproducing itself.

We need not only better and faster solutions, but we need to see them implemented on the ground almost on a 'yesterday' basis, if we are to avoid massive and sudden dislocations in our society. To make this possible—to secure food for all—there is a critical need for coherence in policies and actions, which is the central focus of the Conference.

During the conference, many inputs were received from the participants, which made us all the richer for it. We hope this publication will contribute to the generation of more fruitful ideas. Thank you in advance for your inputs.

S. Mukherjee PhD, MBA
Chief Conference Rapporteur, November 2014.

PART 1: GLOBAL CONFERENCE HIGHLIGHTS

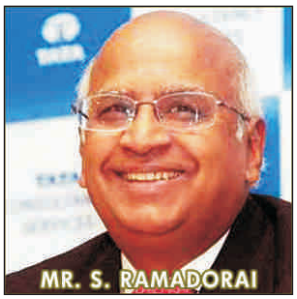
The sessions of the Global Conference were fortunate to have the active involvement of world renowned thought leaders, environmentalists, grassroots implementers and industry opinion leaders who discussed and helped to identify the kinds of existing or proposed policies that have countervailing or counterproductive implications (particularly those that are counter-intuitive and not widely recognized) on food and nutrition security.

The inputs we received from the unusually rich discussion will give us a strong basis for producing outputs that identify concrete policy recommendations that will ensure sustainable improvement in all aspects of food security, from availability issues through access and utilization to stability, and help us formulate strategies not just to raise agricultural productivity but also remove all the other impediments to improving the nutrition of all citizens of our nation, now and in the future.

Summary of the Opening Plenary Session

Mr. Ranjit Barthakur, Mr. S. Ramadorai, Dr. N. T. Uphoff, Shri T Nanda Kumar, Dr. Ashok Khosla, Shri A. K. Seth and Dr. M. S. Swaminathan—in that chronological order—delivered their ideas at the Plenary opening session, which set the tone for the conference. We shall briefly describe the contents of their speeches, as transcripts, PPT presentations and movie records will be archived on the CoR—India website for online and open access.

Mr. Ranjit Barthakur, Secretary General , Indian National Association for the Club of Rome and Chairman, Amalgamated Plantations Private Limited (formerly Tata Tea) kicked off the proceedings by giving a short introduction of the speakers in the first session. He explained that the basic purpose of the conference is to help establish coherence in food security policies, and a major goal of the conference would be to produce documentation that would deliver output-oriented recommendations. Referring to the classic 1972 Club of Rome publication “Limits to Growth” (Annex-1), he hoped that the coming ‘*evergreen revolution*’ in India would provide secure, affordable and nutritious food by 2047. He hoped this conference would address the entire value chain of food, encourage ideas for growth, affordability and delivery systems, and not degenerate into a conference of pulses, as we also need to cover issues such as water security, horticulture, fisheries. He ended by saying that there are 4 areas on which we need to focus on, namely: (a) research and development; (b) convert higher education institutions into universities of food security; (c) that will produce the nation’s food technocrats; and finally (d) the evergreen revolution is all about sustainability.



Mr. S. Ramadorai, Chairman, Indian National Association for the Club of Rome and NSDC & NSDA, referred to the "*Roti, Kapada, Makaan*" doctrine as the three basic needs of mankind, food being an extremely important factor and therefore 'shrinking resources' for producing food are one of the most relevant issues. He decried that (a) India stands at the 69th position for food security; (b) 50th among leading countries for hunger, certainly something not to be proud of; (c) the Global Hunger Index is 50; and (d) biofuel caused 75% increase in food prices. Some of the issues that he hoped the Conference would address are: is food a human right or a

market commodity; should food be available to all or its distribution depends on purchasing power; how do we ensure that policies do not conflict with each other. He noted that, as the population continues to grow, factors re-quired for crop production are declining.

Dr. Norman T. Uphoff, Professor, Government & International Agriculture, Cornell University, explained the benefits of the System of Rice Intensification (SRI) and principles of agro-ecology, in which we can make the microbes in the soil work for us by re-'biologising' agriculture and thereby increasing agricultural productivity. SRI changes in crop and water management procedures in Bihar, Odisha, Jharkhand, Tamil Nadu and many tribal farmers all over India have produced higher yields with plant phenotypes having more resistance to pests and climate hazards, thanks to better root systems and more biodiversity in soil systems. Achieving food for all, he said, will require some sort of paradigm enlargement and shifting to reduce dependence on synthetic inputs and mobilize endogenous biological processes and potentials. In spite of being dogged by negative factors, Indian farmers and scientists have shown that they can think out-of-box as India is now the world leader in use of SRI concepts and in adapting them to many other crops, wheat, ragi, sugarcane, mustard and all the grams. Its leadership in agriculture could help bring food security around the world. *Please refer to Annex-2 for a scholarly review of SRI and comments on the conference by Professor Uphoff and to Annex-3 for a draft minute from MoS (S&T) for promoting SRI*.

Dr. Ashok Khosla, former President, Club of Rome and Chairman, Development Alternatives, began by saying that for around 1 billion people, Malthus' Law is a living reality. He displayed the blueprint and articulated the ethos for the conference, which has provided the framework of the present document as well. He made an impressionable presentation which pitched complex ideas using simplified but powerful graphical interfaces, such as using the image of an 800kg gorilla, morphed into an image of thousands of people bustling on the streets of India, to drive home the issue of population growth as the 'gorilla in the room' which untethered will leave any FNS policy in tatters. In a similar vein, he explained the impact of the adverse ecological footprints, followed by a corporate boot running roughshod over powerless common people, who cannot counter the enormous power of those actors who subvert policies with their economic clout to destroy soils, water and natural resources over the long run, for earning undue profits in the short-term. With 3-D graphics to visualize the impact of various agricultural approaches, he explained that the 'debate needed today' for policy coherence revolves around the three E's: (a) social *equity*; (b) healthy *environment* and (c) viable *economy*. He closed his presentation by identifying this list of ambitions: (1) Policies that promote FNS; (2) Changes needed to promote greater Coherence; and (3) Innovations for greater FNS and policies appropriate for these. *Please refer to Annex-4 for Dr. Khosla's food security paper for CoR-India, Oct 2014*.

In his speech as *Guest of Honor*, **Shri A. K. Seth** (IAS), Cabinet Secretary, Government of India, explained that India has moved from food deficit nation to food exporter within the last two decades. Combating hunger does not only mean providing two square meals every day, but also includes issues like affordable access to food and nutrition, which India is trying to increase by encouraging the use of appropriate technologies in the agriculture sector. Above all, he stated that national considerations must be supreme in all food and agriculture matters, including trade-related issues.

Finally, *Guest of Honor*, **Dr. M. S. Swaminathan**, Chairman, National

Commission on Farmers explained that the '**Green Revolution**' that made huge waves in India and elsewhere in the 1970s has been fading for a number of socio-technical reasons. However, new social and technological innovations have been formulated globally as well as in India, over the past two decades, or more. In his article entitled 'Zero Hunger' which was circulated at the Conference, he says the Green Revolution led to growth and distribution of high-yielding cereals, which provided more calories but was woefully deficient in proteins and micronutrients. In contrast, "Family Farming" with an emphasis on bio-fortification, such as the '*superfood*' Moringa, offers an effective and economic solution to making sure that each person has access to nutritious food. He concludes by saying "…With an estimated 8 billion mouths to feed by 2025, we must think much more precisely about the best solutions for reaching zero hunger." *Please refer to Annex-5 for Dr. Swaminathan's presentation at the conference*.

Launch of "WATER" by Balipara Foundation

The book entitled "Reflections on Managing **Water**: Earth's Greatest Natural Resource", published by Balipara Foundation, was introduced at the end of the Plenary Session, by Mr. Ranjit Barthakur and Dr. Indira Khurana, Joint Editors and launched by the plenary session members present, Mr. S. Ramadorai, Prof. N. T. Uphoff, Shri T. Nanda Kumar, Dr. Ashok Khosla, Shri A. K. Seth and Dr. M. S. Swaminathan.

Mr. Ranjit Barthakur first explained why it is necessary to reflect anew on the subject of managing water, our greatest natural resource in today's debate on food and nutrition security. He emphasized that the aim of the compilation is to promote "*disruptive thinking and innovation that revolutionizes thinking and action in the water sector*", which would set the tone for an informed debate, leading to appropriate action. He then went on to describe the crucial nexus between water and the food value chain, as water is possibly the most important element in the food and nutrition security debate. He called on Dr. Indira Khurana to present the contents of the book in greater detail to the participants present at the Conference. She explained that India—the largest groundwater extractor in the world—will need to produce double the 2000 levels of water utilization in the near future. She thanked Mr. Barthakur for reaching out to a global audience, and getting them to share their views on the book, which not only explains the big scenario but also offers solutions, recommendations and a compendium of lessons learned from global and national examples. *Please refer to Annex-6 for a brief review of the book "Water"*.

Summary of the 'Think Global, Act Local' Sessions

The general theme of the presentations embraced the concept of 'Think Global, Act Local'. In order to preserve the essence of the large and diverse messages delivered by the speakers at the conference, uncluttered by repetitious comments and other distractions, it is felt that a consolidated synopsis of the ideas presented at each session of the conference would be more useful, than a detailed recollection of each presentation, as compiled below:

SESSION 2: Systems, Interlinkages & Policy Coherence

- Grain production growing reasonably well, except pulses and oilseeds
- Food and nutrition security implies not just grains and pulses, but also vegetables, fruit, meat and milk products
- Rural-urban continuum - unprecedented growth of large villages and small and medium towns call for off-farm employment that impact processing and delivery

- Policy coherence is critically important and must start at the district level
- Wastage of food, food grains and crops in transit and storage is unacceptable
- Agricultural growth needs leveraging of innovative technologies
- Crop insurance is growing in importance but is unavailable and expensive at present

SESSION 3: Scientific & Technical Issues

- India's global influence is growing rapidly, and with it, its responsibility for leadership
- Need science to counteract decelerating 'Green revolution', climate change, population growth, decreasing soil fertility and diminishing land and water resources
- Energy needs are increasing but output is falling; need higher efficiency
- Almost half of worlds' population will live in high water stress areas by 2030
- Family farms and smallholder based farm growth have led to poverty reduction
- Nutrition-linked MDGs are lagging – under-nourishment, child & maternal mortality; we have now realized that micronutrients are as important as calories

SESSION 4-A: Economic and Social Issues

- Supporting a population 70% urban must become possible by eliminating urban 'food deserts'
- Adverse impacts of malnourishment are worse than the total impact of TB, AIDS and all other ailments combined
- Talking about food security is not enough; we need nutritional security and reduction in the burden of malnourishment
- Need for inter-sectoral and trans-sectoral strategies to combat malnutrition
- Children grow up stunted and mothers malnourished, which affects their productivity; gender inequality leads to unequal food access
- Current production system produces food for the market but not for agricultural people
- Public Distribution System (PDS) first centralizes the collection of food, then decentralizes its distribution—this results in gross energy inefficiency, spoilage and corruption

SESSION 4-B: Global & National Politics for Coherence in Food Policy

- Need multidisciplinary approach for policy coherence; e.g., agriculture related to energy, water...
- Global corporate interests, with help from governments, are aggressively promoting genetically modified crops (GMC)
- We have to be extremely cautious about all matters related to GMCs
- There is need to analyze the impact of GMCs in each area with more investment needed in distribution mechanisms to the district level
- Small farmers who produce food for others, cannot feed or take care of their own needs
- Food security is a public good like health or education and cannot be treated as another commodity and left to the market economy

SESSION 5: Fundamentals of Food Policy & Politics/Environment & Resources

- Importance of soil health: otherwise neither soil nor food will have nutrients
- Innovations like Sustainable Rice Intensification (SRI) and related post-harvest agri-process technologies have several benefits: a. Higher productivity, b. Women's empowerment: they are becoming self assured, c. Farmers get food security for the whole year
- SRI and the broader System of Crop Intensification should be integrated with FNS
- Currently, government subsidies are skewed toward big farmers and big businesses
- India's agricultural research base is in desperate shape: inadequate investment in R&D

- The farmer is the only entrepreneur who sells in retail and buys in wholesale

SESSION 6: State and Local Politics for Coherence in Food Policy

- All policy issues have political overtones, taking care of interested parties
- Young people leaving farming is a major impediment to future farm production
- FCI handles only rice and wheat; horticulture products in the Northeast languish
- MGNREGA can be designed to provide win-win outcomes; for example, a Rs.40 Lakhs project for desilting yielded ~Rs 10 Crores worth of contingent benefits to farmers from water recharge and productivity increases; communities living in chronic hunger are now getting 3 square meals/day

SESSION 7: Open Discussion

- Pattern of consumption needs to be reviewed for proper nourishment
- Need for simplifying processes for certification for exporting organic farm products
- Intended beneficiaries almost never get the subsidies in totality meant for them
- Subsidies do not create assets, but produce more liabilities, leads to unemployment and increases taxation problems for intended beneficiaries
- In India, there are five ministries that look after water; coherence among them is necessary for convergence in policies that ensure availability of better quality of water.
- There is a need for an indicator-based poverty line

SESSION 8: Policy Barriers to Scaling Up Proven Alternatives

- Lack of implementation, more than laws and institutions is the big barrier
- Benefits of SRI, an alternative method system; crops show healthy resistance to pests, resilience to drought and climatic stresses, conserve water, mobilize nutrients and micro-nutrients from soil
- Major constraint is lack of access to markets and policy designed to stop innovations
- Existing policies give subsidy on power, but many areas have no electric power to get benefit
- Mindsets of the government workers posted in agricultural areas needs to be changed
- Need to be more sensitive and empathetic towards the needs of tribal communities
- Lack of provision of loans for standing crops

SESSION 9: Leaders on the Fundamentals of a Food-secure Future

- From being a food deficit country India is now a food self-sufficient country
- India will overtake China as the most populous country by 2045, if not before
- Climate change was not a major issue till the 1990s
- Biotechnology and transgenics are unlikely to provide food security and excessive de-pendence on them will be counter-productive
- Farmers must be involved in decision- and policy-making

Feedback Form

A “Feedback Form” was circulated at the conference, to capture the sense of conference participants and elicit their comments. A large number of these, duly filled in and providing a treasure trove of information on the conference topics and logistics support, were received at the end of the conference. This information has been woven into the following pages.

PART 2: THE GLOBAL SCENARIO

For around 1 billion people all over the world, Malthus' Law is a living reality. We have made a RAPID transition from a virtually empty 'Holocene' situation in the 1800s to a more-than-full 'Anthropocene' world these days, where there are deep pockets of poverty and food insecurity mainly in Africa, Asia and South America, shown in the Hunger Map below:

Progress has been made in the developing world since 1970, mainly in East and Southeast Asia, with the numbers and percentage of food-insecure people falling from 959 million to 780 million, i.e. from 37% to 17%, respectively. There was a slight increase in South Asia. The picture would be worse if not for the spectacular progress made in China with agro-ecological systems; between 1991 and 1998, the number of food-insecure people in China declined by 76 million, whereas it increased by 40 million in other developing countries.

With business as usual there is no possibility of achieving Food and Nutrition Security (FNS) globally for all by 2020, as the goal of cutting hunger in half will only be reached by 2050 and (a) the numbers of malnourished children will decline by only 20% by 2020; and (b) food-insecure people will decline from780 to only 675 million by 2015.

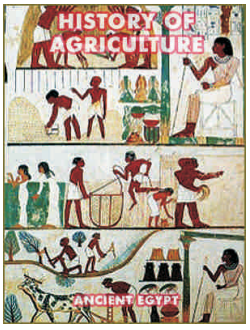
In this Conference, the focus of FNS is on **children**—and by extension, **women**—as one-third of pre-school children in developing countries are mal-nourished, which:

- Impairs their mental and physical development
- Compromises their future health, productivity, and food security
- Undermines economic growth and social justice

We must recognize that **Food Security** and **Environmental Sustainability** are both key policy goals eve-rywhere today, and adequately address **Food Insecurity**, **Malnutrition** and **Unsustainable Resource Management**.

Why is the knowledge of history important

During the Conference, several participants voiced support for' **local knowledge**', which is a recurrent theme for FNS as it is the product of transformation of human civilization over the past 10,000 years, when Stone Age humans increasingly shifted from hunting and gathering, which required little labor, to dependence on cultivated crops and domesticated animals for their subsistence. The wisdom and lessons of 'local knowledge' had been



forcefully suppressed, such as during the 'indigo' and 'opium' famines in the early years of British occupation in India, and other Anthropogenic hazards promoted by corporate greed, in recent times—greatly worsening the peoples' FNS status.

Independent food policy matters

More than 5 million hungry people died during the 1941 Bengal Famine, as colonial food policy was in British hands, a global power. In 2014, independent India stopped the US and WTO from dictating food policy.

History matters in the formulation of coherent agricultural policies. Once we understand how a particular policy emerged and was formulated, we can better understand it, improve it or make it more coherent with other related policies.

Evolution of Food & Nutrition Security Concepts

In the 1970's, food security was mostly concerned with a '*productionist*' approach to increasing national and global food supplies. In the mid-1980s, a paradigm shift took place when it was seen that adequate food availability at the national level did not automatically translate into food security at the individual and household levels. Food insecurity occurred in situations where food was available but not accessible, because of an erosion to people's entitlement to food. By the late 1980's, socio-economic information of stakeholders was considered necessary to analyze food insecurity, emphasizing(a) food availability at the national and regional level; and (b) stable and sustainable access to food at the local level. *Food systems and factors that influence food supply and a household's access to that supply over time became the focus of interest*. In the 1990s, the focus shifted from food to nutritional security, emphasising food, health and mother &child care[1].

Food entitlements of households derive from their own production, income, gathering of wild foods, community support, assets, migration. Hence, a number of socio-economic variables influence a household's access to food.

The present 'food systems' approach

The current heightened debate on FNS is focused on typical systemic issues including: how will climate change affect food supplies; how will food price spikes affect the poor; and *how will the growing food demand be met without further undermining the natural resource base upon which our food security depends?* Food security is now viewed to be a condition whereby: ***"all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life***" (FAO, 2012). This FAO definition puts the notion of '**access**' to food centre stage. It also integrates the notions of food availability and food utilization, moving far beyond the productionist paradigm.

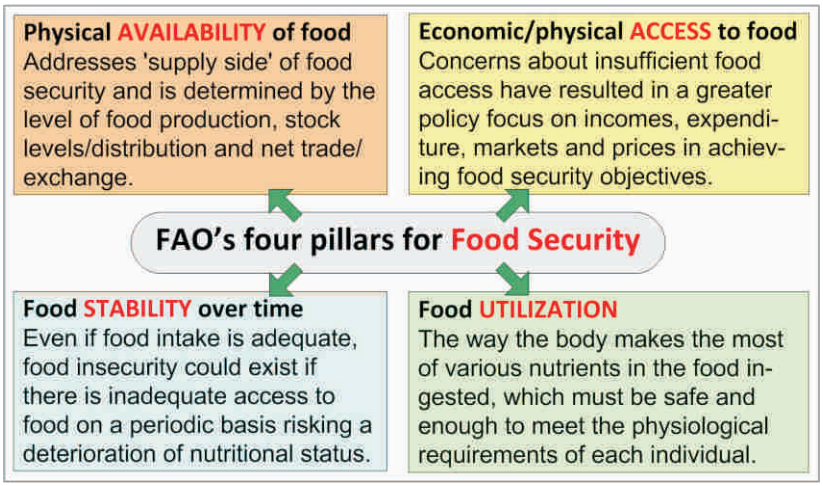
The FAO reference to 'sufficiency' implies ensuring 'not too little'; however, its other implication of 'not too much' is growing in importance, given the rising obesity epidemic, which raises another policy issue: how can over-consumption by increasing numbers of affluent people be moderated? Apart from the health costs of obesity, there are also major environmental concerns related to supplying this incremental food, in addition to the baseline increase due to population growth.

[1] The **International Fund for Agricultural Development** (**IFAD**) describes **Household Food Security** (**HFS**) as "the capacity of households to procure a stable and sustainable basket of adequate food". Operationally, it implies: (i) measures to enhance and stabilize household access to and availability of food across seasons and transitory shortages; (ii) activities that would sustain food supply in the long term; and (iii) constant attention to the adequacy of food while complying with nutrient and safety requirements, and cultural preferences. Two systemic processes that determine nutritional security are: (a) Access to resources for food for different households, which relates to the path from production or income to procurement of food; (b) The extent to which the food obtained is subsequently ingested and transformed into satisfactory levels of nutrition.

Understanding the Food and Nutrition Security Debate

FAO's four dimensions of food security

The present view of food security is about having access to affordable, safe and nutritious food, today and tomorrow. The WHO states that there are three pillars that determine food security: *food availability, food access and food use*. To this the FAO adds a fourth pillar: *the stability of the first three dimensions of food security over time*. Conventional thinking, as codified by the 2009 World Summit on Food Security, divides the *problematique* of food security into four broad sets of issues depicted in the figure above.



To combat food insecurity, China and India leveraged the "Green Revolution"—a series of advances in plant breeding, irrigation and agricultural technology that led to a doubling of cereal crop production between 1970 and 2010—and reduce hunger rates from 70% to 15% within a generation.

Food insecurity

We now face a 'second food insecurity challenge' from two types of food insecurity:

	CHRONIC FOOD INSECURITY	TRANSITORY FOOD SECURITY
is ...	long term or persistent	short term or temporary
occurs when ...	people are unable to meet their minimum food requirements over a sustained period of time.	there is a sudden drop in the ability to produce or access enough food to maintain a good nutritional status
results from ...	extended periods of poverty, lack of assets and inadequate access to productive or financial resources	short-term shocks &fluctuations in food availability and food access, including year-to-year variations in domestic food production, food prices and householfd incomes.
can be overcome with ...	typical long-term development measures also used to address poverty, such as education or access to productive resources, such as credit; they may also need more direct access to food to enable them to raise their productive capacity.	transitory food insecurity is relatively unpredictable and can emerge suddenly; this makes planning and programing more difficult and requires different capacities and types of intervention, including early warning capacity and safety net programs

Transitory food insecurity arises from a complex and interactive set of factors including poverty, micronutrient deficiency, disease, conflict, poor governance and volatile prices. Anaemia and malnutrition, caused by a lack of dietary iron and micronutrients, can permanently damage children's cognitive development and performance, eventually impeding a developing country's growth.

There is a third type called ***seasonal food insecurity***, which falls between chronic and transitory food insecurity and occurs when there is a *cyclical pattern of fluctuations*, such as climate, cropping patterns, work opportunities (labour demand) and disease. It is usually *predictable, of limited duration and follows a sequence of known events*.

The Severity of Food Insecurity

To understand the extent of food deprivation, we need to understand the intensity or severity of the problem(s), in addition to their duration, leading to the overall food security and nutrition status of the community. This knowledge will influence the nature, extent and urgency of the assistance needed by affected population groups. Examples of 'scales' or 'phases' to 'grade' or 'classify' food security include:

- **The severity of undernourishment** refers to the proportion of the population whose dietary energy consumption is less than a pre-determined, country specific threshold, and is measured in terms of the number of kilocalories required to conduct sedentary or light activities; it indicates the extent to which dietary energy consumption falls below the pre-determined threshold
- The **Integrated Food Security Phase Classification** (IPC), which is based on a range of livelihood needs, as shown on the right:

IPC Phase Classification	Indicators
Generally food secure	- Crude Mortality Rate - Malnutrition prevalence - Food Access / Availability - Dietary Diversity - Water Access/Availability - Coping strategies - Livelihood Assets
Chronically food insecure	
Acute food & livelihood crisis	
Humanitarian emergency	
Famine / catastrophe	

See www.ipcinfo.org for more information

Vulnerability

Vulnerability reflects the dynamic nature of food security and is defined in terms of three critical dimensions:

(a) vulnerability to an outcome
(b) from a variety of risk factors
(c) because of an inability to manage those risks.

Vulnerability analysis suggests two principal intervention options:

- Reduce degree of exposure to the hazard;
- Increase the ability to cope.

A person can be vulnerable to hunger even if she is not actually hungry at a given point in time. By accounting for vulnerability, food security policies and programs broaden their efforts from addressing current constraints to food consumption, to include actions that also address future threats to food security.

Hunger, Malnutrition and Poverty

It is important to understand how these three concepts are related to food insecurity, before we can addressing the critical needs for policy coherence (*see box below*).

Arguably, a strategy for attacking poverty in conjunction with policies to ensure food security is the best hope of swiftly reducing mass poverty and hunger. However, recent studies show that economic and agricultural growth alone is not sufficient to enable people to escape problems of chronic poverty of food security. What is needed is a combination of:

- Income growth supported by direct nutrition interventions;
- Significant economic investments in irrigation & road infrastructure;
- Information and knowledge-based services

Hunger is an uncomfortable or painful sensation caused by insufficient food energy consumption. Scientifically, hunger is defined as food deprivation. All hungry people are food insecure, but not all food insecure people are hungry, as there are other causes of food insecurity, including those due to poor intake of micro-nutrients. Malnutrition results from deficiencies &excesses or imbalances in the consumption of macro- and/or micronutrients (see Note below). Malnutrition may be an outcome of food insecurity, or it may relate to non-food factors, such as: (a) inadequate care practices for children; (b) insufficient health services; and (c) an unhealthy environment.

Poverty is a cause of hunger, while the lack of adequate and proper nutrition itself is an underlying cause of poverty. A current and widely used definition of poverty is: "Poverty encompasses different dimensions of deprivation that relate to human capabilities including consumption and food security, health, education, rights, voice, security, dignity and decent work."

for regeneration (e.g. 'TARA*haat*' and 'Infoladies' in India);
- Investments in health, water & education, which is key for agriculture-based poverty exits, and for diversification beyond agriculture.

Note: **Macronutrients** are energy-providing chemical substances consumed by organisms in large quantities. The three macronutrients in nutrition are carbohydrates, lipids or fat, and proteins. **Micronutrients**, are comprised of vitamins and minerals which are required in small quantities to ensure normal metabolism, growth and physical well-being.

Disasters make the poor even poorer

The decline in GDP due to large-scale disasters, which increase the depth and extent of poverty in affected developing countries especially, is often accompanied with loss of employment and income opportunities in the affected sectors. The need to replace damaged infrastructure also means that governments have to divert resources from longer-term development objectives, compromising efforts to reduce poverty and food security.

When emergencies occur, households often resort to selling their assets, such as livestock and other holdings, to meet their emergency food needs. In extreme circumstances, people migrate in search of relief and employment. Poor households that incur injury and disability are hit harder, affecting their ability to work, their main asset. The disruption of livelihood systems, with severe and repeated crop failure results in further pauperization of households and communities.

Besides the (a) relatively visible direct impacts such as destroying housing and washing away crops, and (b) indirect economic impacts putting people out of work, the 1998 floods in Bangladesh, for example, had also impacted:
- Families reliant on wage labor, specifically agricultural labor;
- The poor were more severely affected because they owned fewer assets that could be used to cover expenditure needs during the disaster, and had a harder time recovering to pre-disaster level;
- The poor who lost income opportunities due to the flood were heavily reliant on borrowing (principally from money-lenders) to cover basic needs after the flood;
- Food security for the poor, who were reliant on purchases to cover food needs, worsened after the flood due to difficulty in buying food (lack of disposable income and higher prices) rather than a lack of food (particularly rice) on the market;
- Health conditions (disease incidence and malnutrition) worsened after the flood. In worst affected areas the percentage of households affected by illness of the main earner rose from 10% prior to the flood to 38% in October 1998, and only returned to normal levels six months later.

Coherent policies to mitigate FNS in natural disasters, especially in developing countries, include:
- Continued emergency assistance to reduce human suffering in the immediate aftermath of disasters, that are not unobtainable behind a web of government corruption;
- Stepping up financial and technical assistance to help them implement their long-term disaster mitigation strategies within the framework of sustainable development;
- Strengthen the local food growing capacity to: (a) tackle the impact of disasters and rehabilitate their agricultural sectors by helping small farmers resume normal farming activities by providing inputs and equipments, (b) help them design short and long-term disaster mitigation and management strategies integrated with their agricultural and overall economic and social development plans.

As has been reported many times, it is not that India lacks laws or governance procedures. If law makers and law givers are unaccountable, then there can be little no hope for progress. Here are two stories that The Statesman ran on September 6, 1998, on the devastating Malda Floods, that reminds us of Marie Antoinette of "… *let them eat cakes*" fame, and its aftermath:

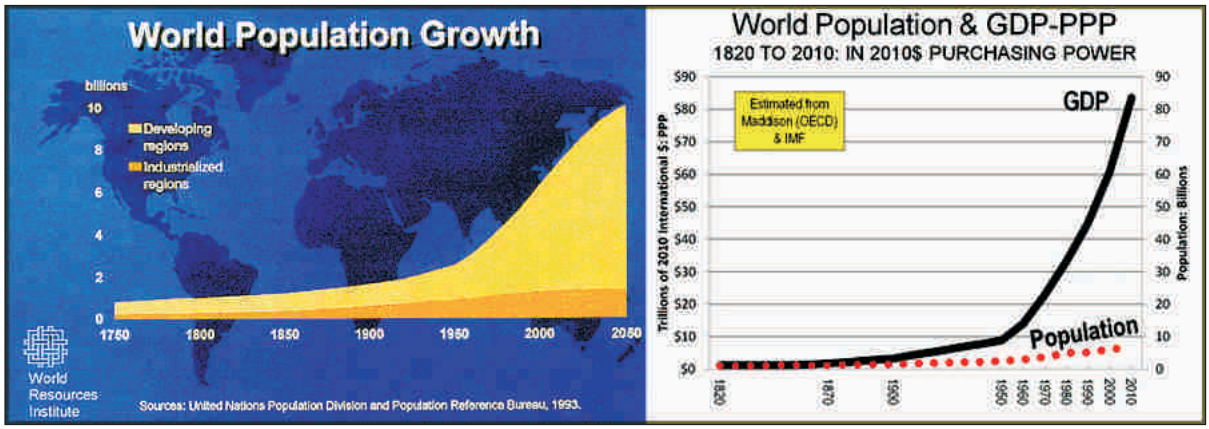
1. "***MINISTERS, STOP WASTING FUEL, HAND US THE MONEY: Now Murshidabad explodes in anger***" on the front page: "Stop burning fuel and hand over the money to us - so we can at least survive," shouted Piyarul Islam at a Lalgola village … as the ministers' convoy whizzed past another village, people thronging the roadside shouted in anger at the vanishing cars. At Fazilpur, however, some villagers attempted to tell the ministers about their troubles. Safikul Islam had begun saying: "What even if you (ministers) send us relief material? We do not get anything. The Panchayat Pradhan and his cronies grab it all ..." But his voice trailed off as he caught the red eyes of cadres …

   [http://www.sankalpacmfs.org/sankalpa/stop/s4flood98.html#contributions11]

2. "***Hotel food, not flood, on central observers' minds***": The Statesman, dated September 6, 1998; page 2. The Central team that came here to see first hand how people were suffering in the flood, got a taste of the human misery soon enough. They found the food and the arrangements at Malda town's most expensive hotel intolerable. The state government had rolled out the red carpet for observers who were to recommend the quantity of aid from the National Calamity Relief Fund … but it was not the flood victims suffering that seemed uppermost in the guests' minds. "*Why isn't the air conditioner working*?" a team member was heard asking the hotel manager. As the hotel was supplying electricity in phases through a generator, which could hardly take the load of working the fans, there was no question of running the even more power-guzzling air-conditioners. The team wasn't happy with the eggs-toast-and-coffee breakfast either. They grudgingly ate the food and left on their helicopter tour to "assess the damage caused by the floods." Tired after the survey, the team seemed none too happy to climb the stairs to the top floor of the hotel, whose ground floor was flooded. The ration on power meant that the lift couldn't be run. As the hapless hotel staff ran helter-skelter to provide the best hospitality—under express orders from the state government—the official guests had them flummoxed with a fresh order: the pakoras they had served were not good enough. ***They wanted prawn balls***!

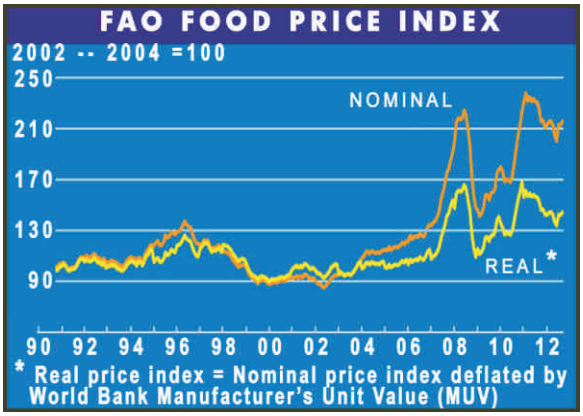
   [http://www.sankalpacmfs.org/sankalpa/stop/s4flood98.html#contributions13]

Population and GDP Growth



The world's population growth is '*the gorilla in the room*' when we debate global **food and nutrition security** (**FNS**), as all the good work that is done by the farmers, scientists, change agents and governments to combat global hunger, is erased in one stroke by the overpowering population growth statistics, especially for developing economies including India, where much of the poverty exists and need for food and nutrition security is acutely felt.

Given the non-linear nature of both—the rapidly rising demand curve (growing populations, changing diets, etc) and the steeply declining supply curve (natural and financial capital, etc.)—a sudden catastrophic outcome cannot be ruled out, nationally, regionally or even globally. Food prices have already reached heights never seen before, both in India and elsewhere and the past decade has seen more than its share of social turmoil and political upheavals on this count, shown in the chart for FAO's World Food Prices, right:



Mortality decline aids economic growth, which leads to an increase in the standard of living. As people live longer, they tend to think more about the future and are more likely to take risks and innovate. There is evidence in developing economies that mortality decline:

- Has the tendency to raise educational attainment and savings rates, and thus to increase investment in both physical and human capital.
- Is accompanied by health gains that in turn enhance people's economic productivity; healthier workers are likely to be more productive.

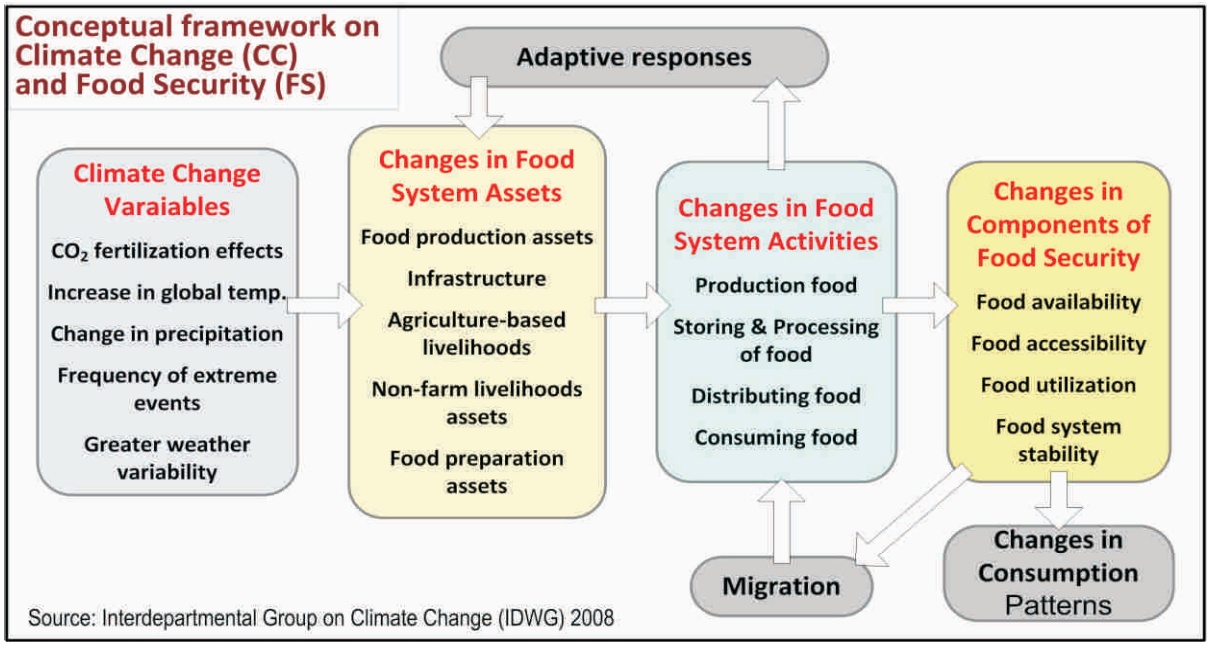
Climate change impact

Most countries are highly dependent on weather, fossil energy and other non-renewable inputs. Scientific evidence shows that '*Climate change*' (CC) is already with us, as past emissions of GHGs are already affecting the earth's climate. Changes in temperature and rainfall and increases in frequency of extreme events have long-term implications for future food security. *If future weather patterns fluctuate, as they have in the past, or if replacements for depleting fossil energy reserves are not found in time, most countries worldwide will almost certainly experience a serious shortfall in food production*. While the 'Developing World' already contends with chronic food problems, FAO estimates that about 820 million people in developing countries are food insecure. CC therefore represents yet another challenge to food and nutrition security that must be carefully addressed.

Whereas all four dimensions of food security—availability, access, utilization and stability — are likely to be affected by CC, so far, the focus has been on the first factor, food availability. By 2020, yields from rain fed agriculture in some countries could reduce by 50%, while the area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid areas, are expected to decrease. By 2050, crop yields could decrease by 30% in South Asia, whereas freshwater availability in South and South-East Asia, particularly in large river basins, could decrease, adversely affecting more than a billion people, with implications for food processing and safety.

In Asia, where endemic morbidity and mortality due to diarrhea are primarily associated with floods, increase in CC-induced coastal water temperature rise would increase the incidence of cholera, particularly in South Asia, with implications for efficient food utilization. Deterioration in coastal conditions, in small islands as well, for example, through erosion of beaches and coral bleaching, is expected to adversely affect local resources (e.g., fisheries) and reduce the value and livelihoods income streams from tourism—impacting FNS. For small islands in particular, sea-level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support food distribution and the livelihood of island communities.

Impact of climate change (CC) on policy

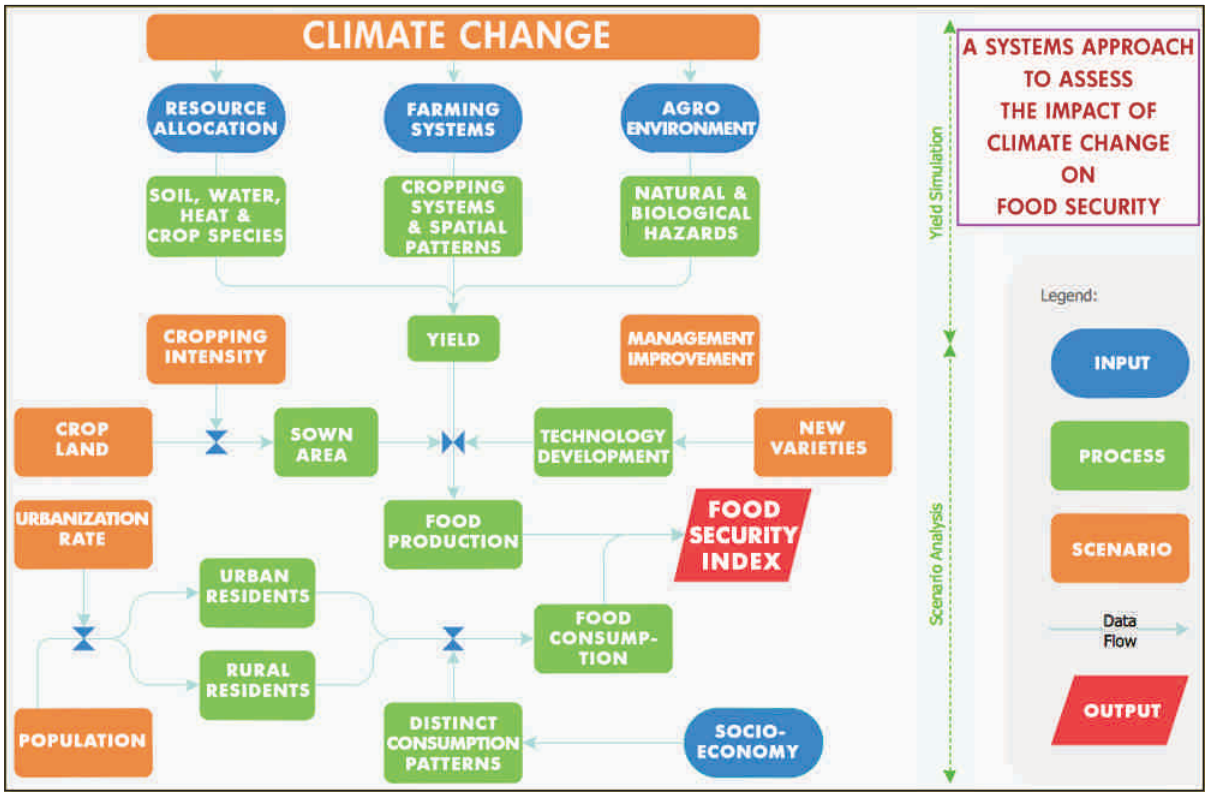


A conceptual framework on Climate Change (CC) and Food Security (FS) is shown above:

Some of the key questions for analyzing the impact of CC on FNS are:

- How does CC affect access to food at the household level?
- How does household vulnerability to food insecurity evolve as a result of CC?
- How will vulnerability to FNS be distributed as a result of CC?
- What policy instruments are needed to increase the resilience of vulnerable groups to deal with the impact of CC on FNS?
- How do we improve the design and targeting of policy responses to address the impacts of CC on vulnerable groups?

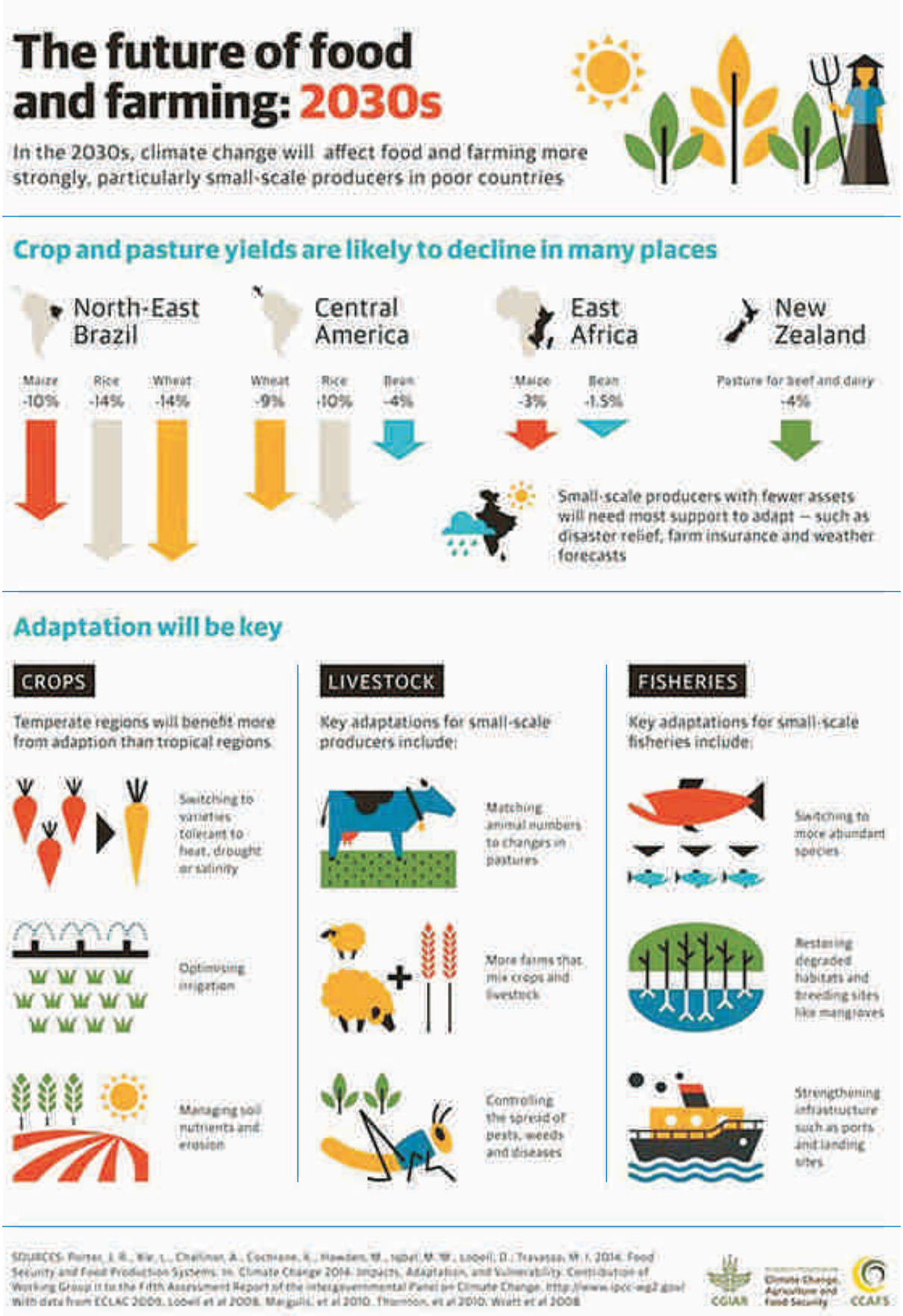
A **systems approach** to assess the impact of climate change on food security, with respect to the three primary inputs of (a) *Resource allocation*; (b) *Farming/food production systems*; and (c) *Agro-environment*, is schematically shown in the flowchart below:



Empirically, two ways of responding to climate change in order to ensure food security are:

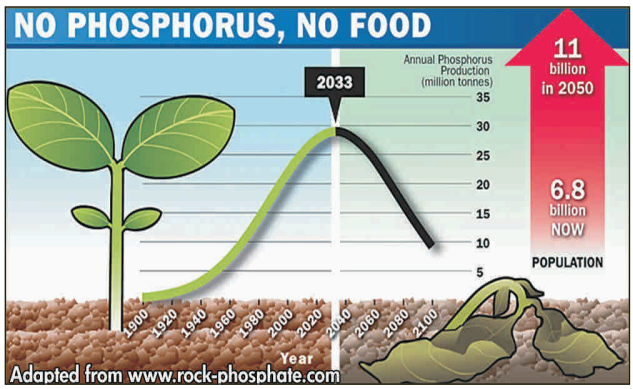
- Reduce, through mitigation measures, the sources (emission abatement) or enhance the sinks (sequestration) of GHGs; mitigation measures are essential, as GHG emissions from the food and agriculture sector contribute over 30% of the current annual total.
- Adapt to the changes, particularly in addressing near-term impacts, through:
  - Autonomous adaptation which may be insufficient given the projected magnitude of future changes in climate; and
  - Planned adaptation measures, involving multi-sectoral response strategies, involving individual citizens and national governments aimed at altering the adaptive capacity of the agricultural systems.

An 'infographic' on a possible scenario of the future of food farming, affected by CC, in the 2030s is shown on the next page:


The future of food and farming: 2030s
In the 2030s, climate change will affect food and farming more strongly, particularly small-scale producers in poor countries
Crop and pasture yields are likely to decline in many places
North-East Brazil
Maize -10%
Rice -14%
Wheat -14%
Central America
Wheat -9%
Rice -10%
Bean -4%
East Africa
Maize -3%
Bean -1.5%
New Zealand
Pasture for beef and dairy -4%
Small-scale producers with fewer assets will need most support to adapt – such as disaster relief, farm insurance and weather forecasts
Adaptation will be key
CROPS
Temperate regions will benefit more from adaption than tropical regions
Switching to varieties tolerant to heat, drought or salinity
Optimising irrigation
Managing soil nutrients and erosion
LIVESTOCK
Key adaptations for small-scale producers include:
Matching animal numbers to changes in pastures
More farms that mix crops and livestock
Controlling the spread of pests, weeds and diseases
FISHERIES
Key adaptations for small-scale fisheries include:
Switching to more abundant species
Restoring degraded habitats and breeding sites like mangroves
Strengthening infrastructure such as ports and landing sites
SOURCES: Porter, J. R., Xie, L., Challinor, A., Cochrane, K., Howden, M., Iqbal, M. M., Lobell, D., Travasso, M. I. 2014: Food Security and Food Production Systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. http://www.ipcc-wg2.gov/
With data from ECLAC 2009, Lobell et al 2008, Margulis et al 2010, Thornton, et al 2010, Wiatt et al 2008
CGIAR
Climate Change, Agriculture and Food Security
CCAFS

Agriculture after peak 'many things'

Globally, we will be struck by not only '**peak oil**', but by '**peak many things**' within the next 20 years, such as phosphorus, food production, topsoil, fish, water supplies, uranium and rare earths. There is widespread evidence of soil erosion resulting in losses greatly in excess of 50 million tons of soil per hectare per year, losses that may be five or more times the natural rate of soil formation (FAO). Meanwhile modern agriculture, instead of converting free solar energy into metabolizable energy as in the past, has been transforming non-renewable fossil energy into metabolizable energy for relatively cheap production of food to feed a growing population. However, as 'peak oil' has kicked in already and oil extraction from the earth begins to decline, agriculture may find itself dependent upon a series of scarce and expensive resources.



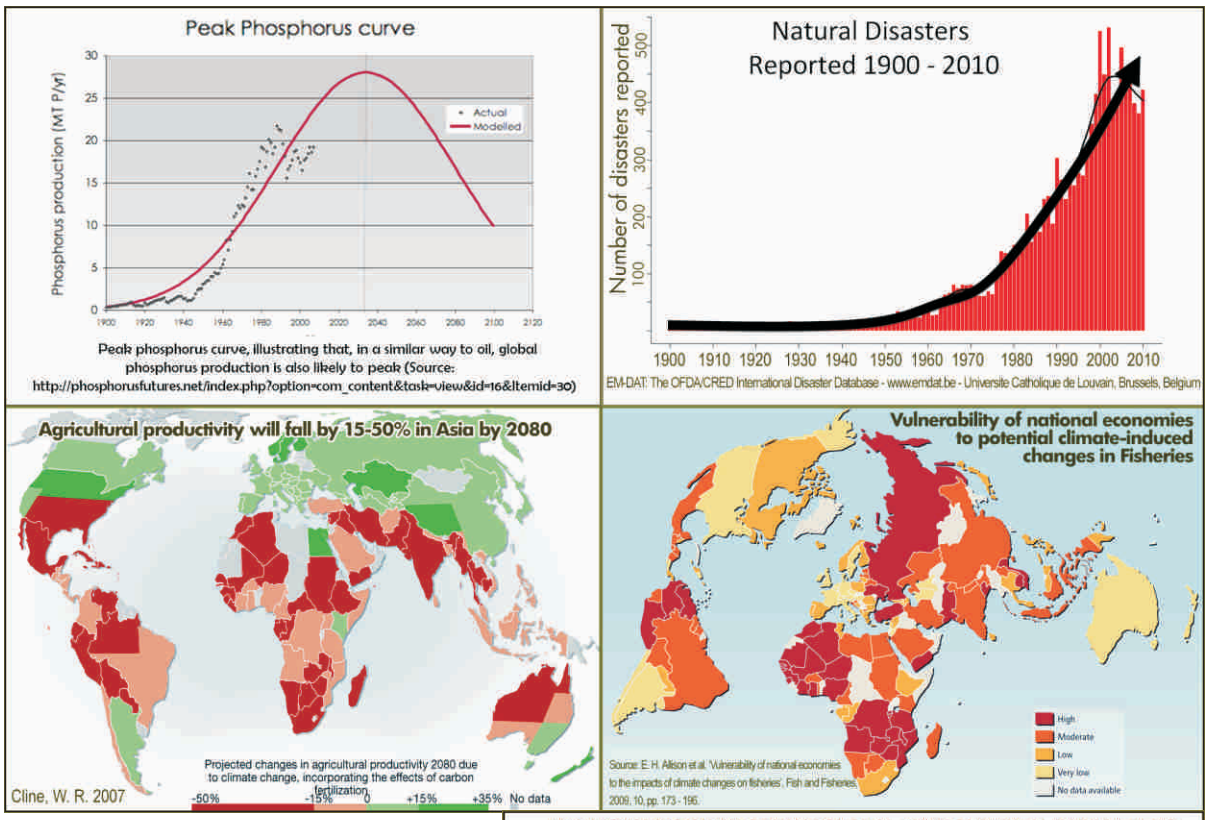
Even more worrisome than 'peak oil' is 'peak phosphorus', which is estimated around 2050[2]. In the past, farmers fertilized their fields with animal and natural waste, which has the nitrogen, phosphorus and potassium for soil regeneration, and would rotate crops to leave fields to fallow for a season, for the land to recover. Without phosphorus (P), a non-renewable resource, plants cannot grow and food production would cease. For instance, to make DNA, we need P, which we get by eating plants and animals that have drawn P through their roots or eaten by the latter. Now, however, modern intensive farming, irrigation and pesticides quickly use up phosphorus, which leads to phosphorus limitation. Hence, signs of volatility have recently appeared in phosphorus markets, and may already be contributing to higher food prices. *We are approaching a threshold where world agricultural requirements may begin to outpace available supplies of phosphorus*.

Hence, *climate change and peaking phenomena* of resources will impact the FNS debate in several ways, such as:

- Beginning with species extinction, which will lead to loss of biodiversity
- Rising oceans, with concomitant loss of coastal agricultural lands
- Natural disasters, which have been rising almost exponentially since 1970s
- Agricultural productivity may fall by 15-50% in Asia by 2080
- Vulnerability of national economies to fisheries

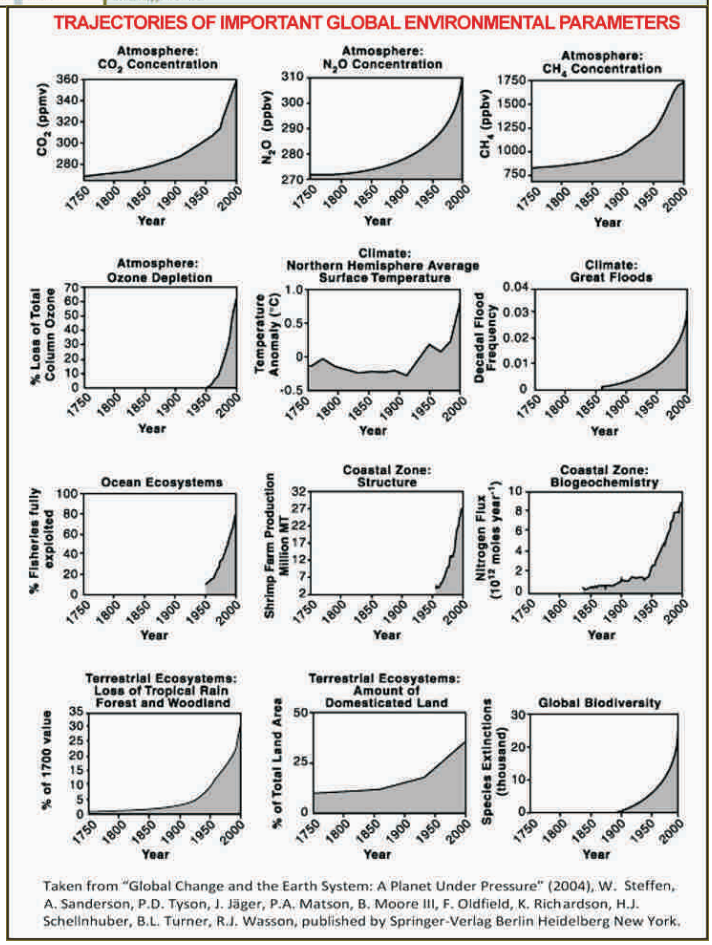
The infographic collage on the next page captures the dynamics of some of these events:

[2] When the global population reaches its peak of nine billion around the same time—2050—humanity needs to generate 50% more power, access 30% more fresh water and grow 50% more food and significantly reduce GHG emissions. With peak phosphorus occurring at the same time, FNS would be greatly stressed.



The trajectories of a host of other important global environmental parameters are briefly collated in the summary image on the right.

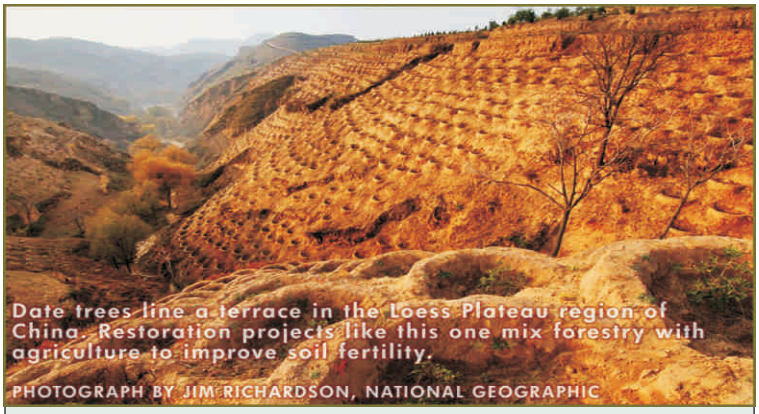
This information conjures the image of an almost exponential growth in almost all of the parameters in the near term, say 2010 to 2020, and then, a sudden collapse, as in the image of the 'peak phosphorus' shown in the top left on this page?



Joining the Food and Nutrition Security Debate

Land and soil

As demand for food production increases, smart land policies, not 'land grabbing'[3], can relieve the pressure on the land cultivated by farmers and used by communities to ensure their livelihoods, promote shared growth and increase food security.


Date trees line a terrace in the Loess Plateau region of China. Restoration projects like this one mix forestry with agriculture to improve soil fertility.
PHOTOGRAPH BY JIM RICHARDSON, NATIONAL GEOGRAPHIC

Soil conservation promotes water conservation, as healthier soils retain more water and prevents eutrophication, which oc-curs when wind blows thinned topsoil off fields and onto large bodies of water, where the excess nutrients hasten plant growth and algae bloom, sucking up oxygen in the water and killing fish and other marine fauna, creating 'dead zones'.

Soil is alive. Chemical fertilizers replace only three or four nutrients, whereas the complex soil system is crawling with microbes and bugs, which nourish the soil and help cycle nutrients in exchange for plant sugars. This is a brand-new science for understanding microbial connections in soil community dynamics. Over the past 30 years, there has been a big shift in understanding microbial connections and the community dynamics under the ground, which is the hidden half of nature.

Soil, like oil, is a finite resource. Historically, misusing soil has led to the collapse of ancient civilizations engendered conflicts in the modern world. Poor farming practices deplete soil nutrients faster than they are able to form, leading to loss of soil fertility and degraded lands. Good soil usage helps prevent droughts and eutrophication. The restoration of soil health requires integrating ecology and old-fashioned "soil husbandry" techniques with new technology and practices, such as integrating crop production with native vegetation and livestock.

Another solution for soil conservation is terrace farming, where farmers create several levels of farms to shore up the steep slope of a hillside, on which they can grow crops. On a straight, steep slope, water would tumble down the hillside, carrying crops and much-needed soil with it, letting nothing grow. With a terrace, the flat areas stop the water from flowing freely down the hillside. In this way, the lower terraces are not eroded and, also, the higher terraces get enough water.

Water, Energy and Food Security Nexus

The **water-energy-food** (**WEF**) security **nexus** revolves around the issues: What (a) **socio-economic, socio-institutional and socio-cultural reforms**; (b) **socio-technical innovations** and (c) **climate change induced environmental concerns** are equitably addressed to sustain livelihoods and grow

[3] The term 'land grab' refers to the purchase or lease of vast tracts of land by wealthier, food-insecure nations and private investors from mostly poor, developing countries in order to produce crops for export.

more healthy food in local and regional areas, in order to ensure that the four pillars of food security, namely, availability, access, utilization and stability, are strengthened, if not maintained. This sustainable development focus is relevant to especially the farming communities in both the developed and developing country economies, as both are threatened by disruptions in the WEF nexus.[4]

Food security is related to the nexus between water and energy, as (a) socio-economic development depends on the sustainable provision and use of these two resources; and (b) while water and energy are required for irrigation, energy is vital for water access, and water is critical for energy production. While water scarcity in the region increases, food price hikes and food access become grave concerns for many. A balance is crucial for the nexus.

Water scarcity = excess of water demand over available supply

Developing countries can learn from success stories in other countries to improve management and the use of rain fed, irrigated and groundwater systems through an innovative approach that includes:

- The creation of a broad consensus on the water reform agenda among all involved stakeholders.
- The acknowledgement of farmers' role in prompting a shift in the way water resources are used and managed.
- The involvement of the private sector as the actual manager of the food value chain and the supplier of the latest available technologies.
- The establishment of partnerships which are action-oriented and results-based.
- The development of tools to concretely measure results and collect evidence to support policy-making and decision-making processes.

Water

The first element in this balance[5] is 'water'. One liter of water is required to produce about one calorie of food, which means that we "eat" more water than drinking. Water affects every stage of food supply chains, from raw material to consumer, and could become the biggest threat to global food security.

Unconstrained water use has grown globally to a rate more than twice the rate of population increase in the 20th century. Water scarcity is therefore one of the most urgent food security issues facing many countries of the world. Fresh water availability in the Near East and North Africa (NENA) regions is expected to drop by 50 percent by the year 2050, according to FAO.

[4] Nexus means 'binding together', a connected group or series; also the core or center of a situation. Water security, energy security and food security are inextricably linked. Actions in one area will impact in one or both of the others. The nexus approach applies at all levels of society; from local competition over access to water for irrigation or livestock, to global connections between policy on bio-fuels, food & water security. Sometimes the synergies lead to improvements in another. Often, the trade-offs are negative; e.g.: increased use of fertilizers to enhance food production lead to higher energy use and GHG emissions, and pollution of surface and underground water. Such trade-offs are often poorly understood, unanticipated or overlooked.

[5] A water balance is governed by conservation of mass, and the rate of water entering a specified domain is equal to the rate of water leaving the same domain with any differences resulting in changes in storage. The linkages between surface water, groundwater, soil moisture content and the process of evapotranspiration are of critical importance, and still inadequately reflected in many water management plans.

Energy and the circular WEF Nexus

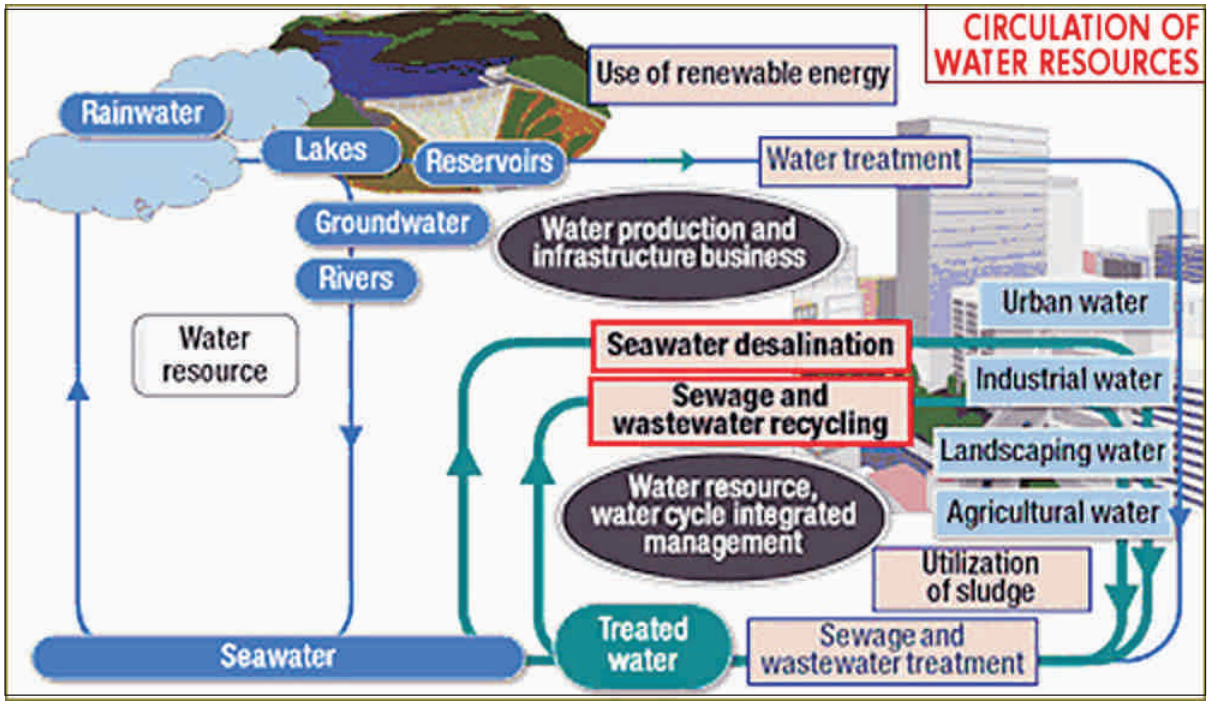
A nexus approach towards multi-functional agricultural policy can help countries to use and re-use resources more efficiently, reduce the impacts of critical technologies, and create synergies between resource sectors. There is also great potential to reduce pressure on existing resources by the recycling and cascading use of resources; for example wastewater from cities can be used to generate energy and be re-used in agriculture.

Modern agriculture also depends heavily on the second element, '**energy**', by way of use of fossil fuels to grow food, meet logistical costs for wheat & rice traditionally and now vegetables and packaging, and fertilizer production. The ***joined-up WEF nexus approach*** can result in increased efficiency, for example by turning waste outputs from food production into useful inputs to energy generation—creating a "circular economy".

In conjunction with long-term scientific land management and soil restoration techniques, the framework for food systems that were discussed in the Conference and documented in this Report, reflect sustainable and equitable long-term solutions for the WEF security nexus.

Sustainable Water Management Systems

The figure above shows how water resources, used as drinking water, come from rainwater and melted snow that is stored in a dam or lake. Water is taken from a river flowing out of this water source, and is then treated. After water has been used for a variety of applications, it is treated as

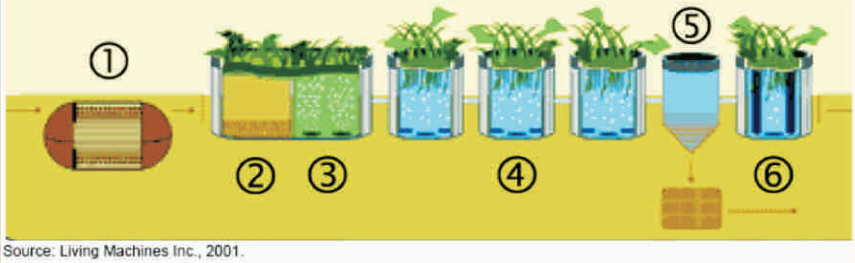


sewage or wastewater, returned to the river, and finally turned back into seawater. Water in the ocean then evaporates and turns into clouds, which then return the water to the surface of the earth as rain, thereby circulating water resources.

Whenever people talk about water management, the discussion inevitably revolves around expensive western technologies, often costing hundreds of Crores of Rupees to install, and requiring thousands of kilowatts to operate. The maintenance costs are high, and plant breakdowns are

expensive to fix, besides the dangers of unavailability during down times.

Our water management policies instead should be to develop strategies for living more lightly on the planet, and foster the emergence of a lasting planetary culture, which will fit nicely into our sustainability debate. For example, the 'Living Machines' that Dr. John Todd has perfected over the past several decades, which require less than one-hundredth the amount of electric energy, and cost less than a tenth of unsustainable systems, to operate.



Source: Living Machines Inc., 2001.

FIGURE 1 THE COMPONENTS OF THE LIVING MACHINE®: (1) ANAEROBIC REACTOR, (2) ANOXIC REACTOR, (3) CLOSED AEROBIC REACTOR, (4) OPEN AEROBIC REACTORS, (5) CLARIFIER, AND (6) "ECOLOGICAL FLUID BED"

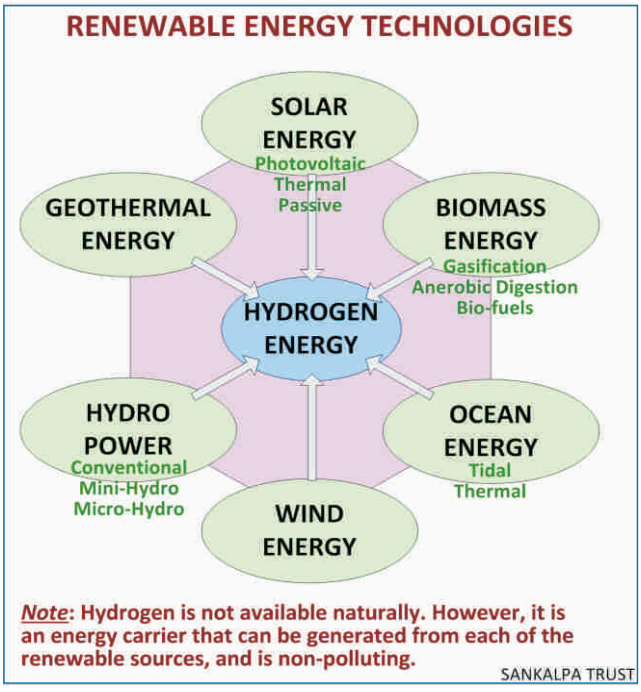
Sustainable Renewable Energy Systems

In the food chain, energy is required to produce and distribute water and food: to pump water from groundwater or surface water sources, to power tractors and irrigation machinery, and to process and transport agricultural goods. Energy security, which is defined as uninterrupted availability and supply of energy at affordable prices, is necessary for socio-economic growth and the wellbeing of the population—hence crucial for FNS.

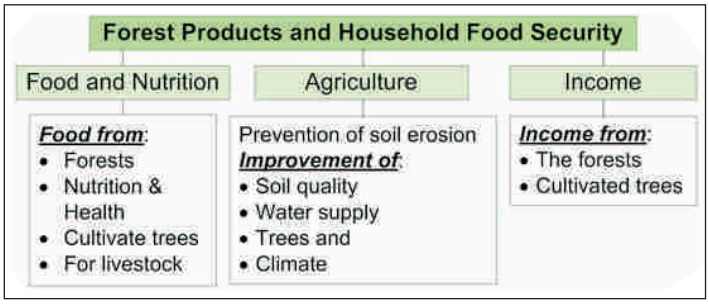
Scales of economy would suggest that centralized energy conversion processes would be more economical than decentralized strategies, especially in urban scenarios. However, centralized strategies also have their share of socio-cultural and socio-technical problems.

Distributed energy, which is renewable energy that is generated at or near the site that the energy is used, avoids the extra costs associated with massive centralized schemes for:

- The need for extensive and expensive high voltage transmission lines, the bane of centralized power generation schemes
- Collection and harvesting of input resources, and
- Emissions clean-up costs.

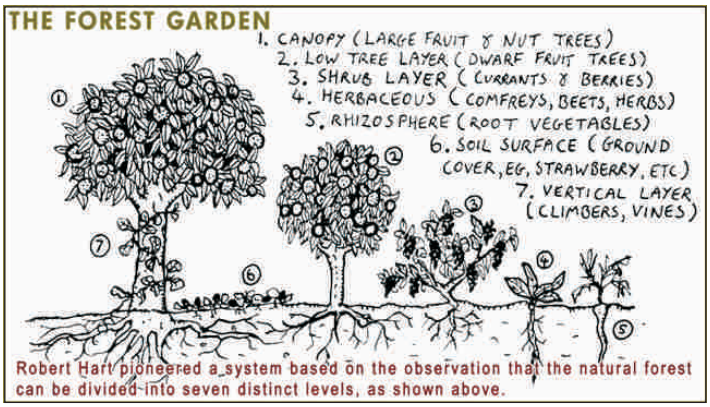


Forests for FNS



Forests, trees and agro-forestry systems contribute to food and nutrition security, which is poorly reflected in national development and FNS strategies. As a result, forests are often ignored in policy decisions related to FNS.

Natural forests are critical for the survival of forest-dwellers, including many indigenous peoples, and they help deliver clean water to agricultural lands by protecting catchments. The ecosystem services provided by forests include creation of soil, treatment and regulation of water flows, enhancing biogeochemical cycles such as Nitrogen, Carbon, Phosphorous and minerals, and as habitats for pollinators are also extremely important, sometimes even more than the tangible outputs.



Farmers increase food security by retaining trees and non-timber forest products (NTFPs)[6] on agricultural land, by encouraging natural regeneration and by planting trees and other forest plants, as NTFPs contribute significantly to household food security by enabling gathering, collection and sale of leaves and medicinal herbs, food vendoring, rearing of goat, sales of palm wine, fruits and nuts, fuelwood and honey; others include snail keeping, goat, sheep, rabbit and poultry rearing, food processing, crafts and basket weaving, trapping, catching and processing of meat. Therefore, the forest reserve areas should be made more accessible to the rural household and laws governing forest reserved areas be reviewed and made flexible so that rural populace in can benefit from such coherent policies. There is a need for forest policy to include the production of NTFPs and local agro-forestry schemes should be developed within national forests to allow for the production of bush meats, rattan, bamboo, traditional medicines, honey and other forest food.

Robert Hart, pioneer of forest gardening in temperate zones, describes Keralan 'home gardens':

From the agro-forestry point of view, perhaps the world's most advanced country is the Indian state of Kerala, which boasts no fewer than three and a half million forest gardens...As an example of the extraordinary intensivity of cultivation of some forest gardens, one plot of only 0.12 hectares (0.30 acres) was found by a study group to have twenty-three young coconut palms, twelve cloves, fifty-six bananas, and forty-nine pineapples, with thirty pepper vines trained up its trees. In addition, the small holder grew fodder for his house-cow.

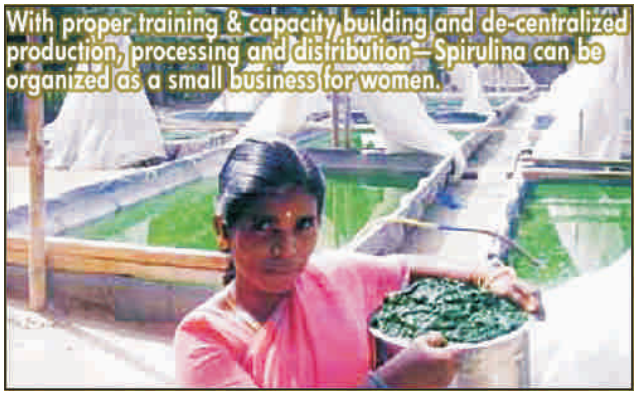
[6] FAO (1992) defined NTFPs as "non-wood forest products which include all goods of biological origin, as well as services derived from forest or any land under similar use, and exclude wood in all its forms". NTFPs refer to all the resources/products (other than industrial round wood and derived sawn timber, wood chips, wood based panels and pulp), that may be extracted from forest ecosystem and are utilised within the household or are marketed or have social, cultural or religious significance (FAO, 1990). These include plants and plant materials used for food, fuel, storage and fodder, medicine, cottage and wrapping materials, biochemicals, as well as animals, birds, reptiles and fishes, for food and feather.

Other linkages for food and nutrition security of the rural poor

Malnutrition and productivity status

Micronutrient malnutrition, especially vitamin A, iodine and iron deficiency/disorders/anaemia, is a serious public health problem in South Asia, affecting millions of people. Of the four methodsused to reduce micronutrient malnutrition,diet diversification, food fortification, medicinal supplementsand disease control, the first two are food based. Many micronutrient programmes rely too heavily onhealth interventions and do not fully exploit the potential of food-based actions.

Spirulina 'Super Food', a photosynthetic microalgae, which reproduces rapidly, has a high protein content of about 65% and rare essential lipids, as well as numerous minerals and vitamins (excepting Vitamin C), is also devoid of a cellulose wall; hence spirulina is easy to digest raw or in dried form.



About 20 million children under 5 years of age and pregnant and breast-feeding women are the principal victims of malnutrition. Malnutrition has numerous harmful consequences in young children especially: increased risk of mortality, lowered immune defenses, slower motor development, and decreased cognitive and learning capacities in school.

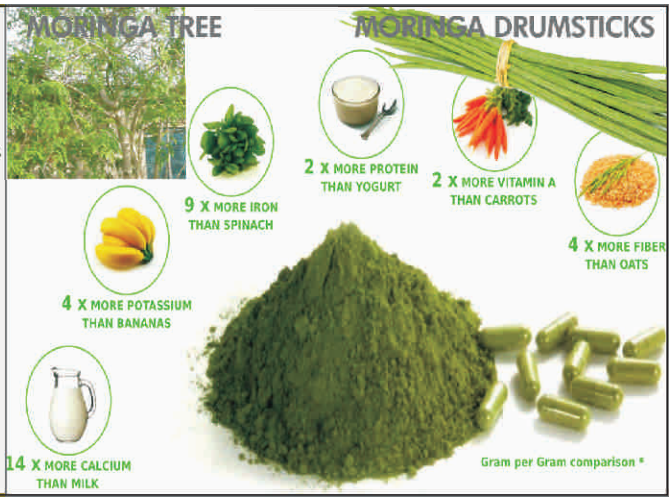
Spirulina Nutritional Composition:

General Analysis:		
Protein	65%	
Lipids (fats)	5%	
Carbohydrates	18%	
Minerals (Ash)	7%	
Moisture	5%	
Vitamins (per 10 grams/ % Daily Value*)		
Vitamin A	23000 IU	460%
Beta Carotene	14 mg	460%
Vitamin C	0 mg	0%
Vitamin D	1200 IU	300%
Vitamin K	200 mcg	250%
B I Thiamine	0.35 mg	23%
B2 Riboflavin	0.40 mg	23%
Vitamin B 12	20 mcg	330%
Minerals (per 10 grams/ % Daily Value*)		
Iron	15 mg	80%
Calcium	70 mg	7%
Magnesium	40 mg	10%
Selenium	10 mcg	14%

**recommended daily dosage*

The other Superfood is Moringa.

The ayurvedic medicine includes a natural antibiotic, an aid in childbirth, treatment of liver disorders, and called '**Mother's Best Friend**'. The Moringa oleifera tree has been identified as the vegetable with the **highest nutritional value** among many types of food species studied. Easy to cultivate and resistant to drought, the Moringa tree produces abundant leaves with a high concentration of proteins, vitamins, and minerals: *100 grams of fresh Moringa tree leaves provide the same amount of protein as an egg, as much iron as a steak, as much Vitamin C as an orange, and as much calcium as a glass of milk.*



Spirulina **'*Super Food*'** is effective in the treatment of chronic malnutrition, as numerous nutritional tests proves the bioavailability of its micronutrients and its health potential It presents clinically significant anti-viral and immuno-stimulating effects in people infected by HIV and demonstrates nutritional efficiency in terms of weight gain even in HIV-infected malnourished people. Scientific studies on the nutritional and therapeutic advantages of spirulina are multiplying and support its expansion, as:

- It is a local, autonomous and sustainable solution: spirulina can be produced, processed and distributed locally by local women, thus creating revenue and sustainable livelihoods for their empowerment;
- Just 1 to 3 grams of spirulina per day for 4 to 6 weeks are enough to rehabilitate a malnourished child.
- Has a high yield of 5 to 6 grams/day/m2 of dry product, and requires very little:
  - Space relative to the amount of protein produced (15, 20 and 250 times less than sugar cane, soy bean and rice, respectively).
  - Water (3, 5 and 40 times less than soy bean, maize and beef, respectively).

Spirulina has been rated G.R.A.S. (Generally Recognized As Safe) by the US Food and Drug Administration, and China has declared it a national food. Meanwhile, the spirulina genome has been entirely sequenced and registered in July 2009 by Antenna Technologies (India), two private Swiss companies–Biorigin AS and Fasteris–and Haute École Spécialisée Hepia of Geneva. By registering the spirulina genome with GenBank, they made it public and freely accessible to all potential users and thus prevented it from being patented. ***Any person can therefore legally leverage spirulina for its socio-economic, nutrition and health benefits***.

The recognition of the virtues of **Spirulina** and **Moringa** as '***Super Foods***' have been limited in India, due to the glaring lack of political will and coherent policy needed to conduct large-scale clinical tests and their large-scale production & distribution, and also a lack of awareness with policy makers, social workers and the general public, which needs to be addressed.

Capacity to access and adopt new technologies

Discrimination against women, for example, can result in women's lack of access to credit, in turn limiting their ability to purchase inputs. The end result is that overall productivity is lower than it could be under the circumstance. Where women have a major responsibility to produce food crops, these linkages are important food security considerations.

Smallholder farmers are generally resource poor, have low level or no formal education, use traditional methods of production and are often averse to adopt new technologies, initially, However, with adequate capacity building and training to improve the stakeholder's knowledge and skills for adoption of the appropriate technologies—through the use of (a) workshops; (b) participatory research and extension services; (c) support in infrastructure building, demonstrations, and on-site trainings that focus on "learning-by-doing"—such as a '*Digital Badging*' program, which does not require any formal prior education for certification—even smallholder farmers are fairly quick to learn, willing to adopt new and appropriate technologies that benefit them and also to invest in acquiring them.

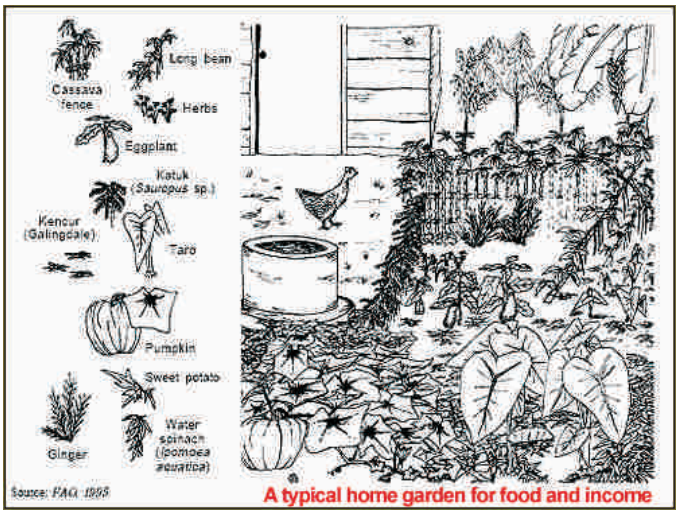
A '**badge**' is a symbol of an accomplishment, skill, quality or interest and is used to set goals, motivate behaviors, represent achievements and communicate success in many contexts. A '**digital badge**' system is an online record of achievements, within each level of competency, categorized at various levels of competencies, starting at the lowest 'Beginner' to the highest 'Master' levels. The digital badging skills development paradigm meets the growing needs of especially the youth to improve their lifelong professional, academic and personal endeavors.

The benefits and efficacy of participatory approaches and bottom-up capacity building programs have been demonstrated in numerous case studies. However, the policy for implementation and action, just as in the case for spirulina noted above, does not take the last mile linkages into account, and interventions remain top-down and ineffective, resulting in unrealized potential for new and appropriate technologies, such as tools, inputs, storage, new varieties of seeds, labor-saving technologies, etc. despite the best efforts of everyone.

The remedy for this is to listen to and involve the stakeholders themselves in developing policy, as they are the ones who know how to make things work for them.

The rural household livelihood security concept

To achieve FNS, rural households must have physical and economic access to a sufficient quantity, quality and variety of foods, and adequate food supplies available year-round at national and community levels. Household providers and care-agents must have the time, knowledge and motivation to ensure that nutritional needs of all household members are met.



A typical home garden for food and income

Achieving these objectives requires coherent policies to enable the combined efforts of diverse people working in agriculture, health, education and other sectors at the international, national, regional and local levels, to accelerate development of the agriculture sector and associated food systems. Coordinated development of local food and agricultural resources will provide multiple benefits, including expansion and diversification of food supplies, and generation of employment and livelihoods opportunities in the production, processing and marketing of food. Coherent policies will facilitate the creation of the community and national wealth needed for investments in health, education, social services and infrastructure.

The equitable participation of stakeholders in decision-making is necessary for their ability to not only enhance their household food and nutritional status, but

An important **institutional linkage** and **policy imperative** for FNS would be to ensure thatkey (*a*) *environmental issues* are effectively captured within the socio-economic, socio-cultural and socio-technical frameworks, and (*b*) *social equity issues* are properly addressed when implementing the economic and environmental interventions. The focus areas for highlighting policy incoherencies—thereby formulating coherent policies for FNS and poverty alleviation goals—would be based on research and capacity building programs to:

- Explore the links between food and nutrition security, poverty, environmental and ecosystem challenges;
- Develop methodologies for economic/market-based and non-market instruments that address efficiency, equity and distributive processes;
- Integrate ecological and environmental policies within FNS Strategies at appropriate levels.
- Develop socio-economic and ecosystem-dependent indicators that can be used by policy-makers to make decisions and design programs.

also to develop the:

- Ways and means to raise incomes of rural families
- Capacity of food-based strategies to prevent and control micronutrient deficiencies, especially in children, pregnant and lactating mothers
- Strategies for home gardening, which helps to diversify diets and provide a source of income to poor households.
- Methods for educating the public, especially young people, about nutrition.

Protected areas, ecosystem services and food production

Humanity needs healthy ecosystems that function effectively to produce the various benefits that nature delivers to all species, including 'ecosystem services' for humans.

Protected areas and the genes, species, and ecosystems that they support, provide multiple benefits to food production and can contribute to the need fordecoupling the destruction of ecosystems from human well-being. Hence, the '*protected area*' agencies should adopt policies that support the continued delivery of ecosystem services that provide support to food production, including, for example, controlled access to plant genetic resources found within a protected area and support for sustainable forms of agriculture (such as agro-forestry), within the categories of protected areas, that allow such land use.

The flow of benefits, within national protected area system plans, should be included by Government agencies, such as:

- Ministries of agriculture, fisheries, and water, to give greater attention to developing positive relationships with protected areas; &
- Finance ministry recognize the public goods benefits that protected areas provide to food production, and give sufficient budgets to enable them to continue provision of ecosystem services.

Institutional and policy frameworks

A lack of food security in a village may stem from:

- Environmental factors (e.g. drought) and economic problems (e.g. a lack of wage labor opportunities), institutional problems (e.g. inadequate extension training on food conservation methods) and social problems (e.g. discrimination against women).
- Not only crop and animal production problems at the household or community level, but also from barriers to district-level markets, as well as national pricing policies and international terms of trade

We will now expand on what was said previously, *that agricultural and economic growth alone cannot ensure food security*; what is believed to be needed is a combination of:

(a) *Income growth supported by direct nutrition interventions*:

The issue of sustainable livelihoods is discussed in page 62. The provision of 'safety nets', which are measures taken to enhance direct access of the rural poor and hungry to food, including income transfers for those chronically unable to work, because of age or handicaps…and for

those temporarily affected by natural disasters or economic recession, include:

- Targeted direct feeding programs, such as the school mid-day meal scheme (MMS); feeding of expectant, nursing mothers and children under five, through primary health centers
- Food-for-work programs, such as MNREGA, provide essential food security and livelihoods support to households, while also developing useful infrastructure such as small-scale irrigation, rural roads, buildings for rural health centers and schools.
- Income-transfer programs, in cash or in kind, including subsidized rations and other targeted measures for poor households.

(b) *Significant economic investments in irrigation, road infrastructure, health and water*:

Infrastructure is a key factor to FNS and poverty exits, especially when conceived, designed, developed and implemented with participatory inputs from village beneficiaries, supported by a strong regional planning policy. Participatory development is likely to make infrastructure investments, such as roads, health and water services, more locally relevant.

(c) *Information and knowledge-based services*:

As a result of the Government's typically top down and non-participatory agricultural extension services, which are largely unimaginative and ineffective, the chronic poor—who have inadequate social capital and poor access to information and knowledge-based services—are unable to exit from poverty and hunger, as they lack information on, for example, job opportunities, on input and output markets, or on new and remunerative farming techniques.

Issues for the need of coherent policies for information, knowledge-services and education are:

- Studies show that education systems and programs frequently fail the chronic poor, particularly in remote and tribal regions, where accessibility and affordability are key issues;
- This brings into focus the policy implications for enabling a larger role for private and civil society organizations to augment the government's conventional educational and extension services.
- Providing wider access to mobile phone services, in conjunction with investments in infrastructure and education, may enable robust ICT rural programs.
- Focus on information sources and their impacts, *not technology*, with respect to more powerful and accessible sources of economic information.

(d) *Investments in health, water & education*:

Education is especially important for rural poverty exits, through the ability to:

1. Increase productivity within agriculture;
2. Successfully diversify into non-farm activities, which can increase investments in agricultural production; and
3. Coordinate 'continuous improvement' programs and promote 'change management'.

The Global Window of Opportunities

Food is a basic human need. *Advances in science and technology innovations have profound impacts on the production, processing, storage, distribution and consumption of food and have contributed to a massive increase in the food and nutrition available to people globally*. Collective food security governance is a societal necessity, and failure to do so inevitably leads to social unrest. The riots in capital cities around the world in late 2007 are reminiscent of the hungry crowds that sparked the French Revolution in 1789. History and common sense tell us that a functioning food system is an indispensable pillar of a stable economy and a society capable of reproducing itself.

Professor Uphoff had made the imperative need for a change in thinking amply and eloquently clear in his 2002 publication, an edited excerpt of which is reproduced below:

Uphoff, N. (ed.). 2002. "Agroecological innovations: Increasing food production with participatory development". Earthscan Publ., Sterling, VA.

The world's food supply needs to rise significantly, yet both arable land and water supplies per capita are decreasing. Not only are modern agricultural methods beyond the reach of those suffering the greatest food insecurity, but they are also ecologically damaging, relying heavily upon fossil energy and chemical inputs that adversely affect soil structure and functioning and the soil biota.

This volume offers a collection of diverse, innovative approaches to agricultural development across Asia, Africa and Latin America. The various agroecological approaches, exemplified in 12 case studies, are reliant more upon greater knowledge, skill and labor input than on increased capital expenditures and use of agrochemicals. They are shown to increase yield substantially, sometimes doubling or even tripling output. The volume presents concepts and operational means for reorienting agricultural efforts towards these more environmentally friendly and socially desirable approaches for the developed as well as developing world.

Alternative kinds of agriculture are often not new. Frequently they draw on traditional 'local' knowledge and practices, although they are increasingly supported by scientific explanations. With appropriate development and application, we find that they can offer opportunities to increase food production not just by increments but sometimes by multiples. The case studies show how new and better combinations of plant, soil, water and nutrient management practices, often combined with livestock and/or fish in intensified farming systems and protected by integrated pest management (IPM), are achieving production increases that do not undercut the natural resource bases for future production.

These approaches function under a wide variety of conditions, and even in environments that are quite adverse. The crops grown in the cases reported include main staples such as rice, maize, beans and potatoes. Some of the reports from researchers at international agricultural research centres show similar increases in production of wheat and casava utilizing practices like those considered here. The universe of experience presented here is not one of particular technologies for selected crops, but rather one applying various principles that can capitalize more fully on existing genetic potentials.

A good example of agroecological approaches was reported from Yunnan province in China by Zhu et al (2000). There, crop losses were reduced and yields were raised by inter-cropping rice varieties that are susceptible to blast disease with varieties that are not susceptible. By varying management practices to capitalize on natural disease resistance -- at first on all rice fields in five townships in 1998 and then in ten townships in 1999 -- blast disease was reduced by 94% compared with homogeneous rice varieties grown in monoculture. The yield from the otherwise-susceptible rice varieties was raised by 89 per cent. Reduction in disease was so successful that after two years, farmers no longer needed to use fungicidal sprays, and in 2000, the method was being used on 40,000 ha.

The issue of governance of food security in a globalized world is very complex. It involves multiple layers of decision-making and the need for coherent policies. It is no coincidence that agriculture has been the stumbling block of WTO negotiations. The capacity of single households to ensure an adequate supply of food for its members is affected by developments from local to global. Decisions that affect the food security of the population of a country will involve and alert many social forces: the state, businesses, and civil society.

Now is the time to make the effort to reform the global governance of food. Over the past three years, a series of interrelated crises has unmasked the systemic flaws in the current world food system and highlighted its tendency to reward a small club of privileged economic actors and their political allies. These very crises have opened up the political opportunity to fundamentally reform the world governance of food security. *The time is right to make a substantial and substantive change*.

Comment received from Prof. Mark Swilling:

Food security for all will depend on the transformation of the global food system which is now dominated by a few power global corporations who deliver food that is unhealthy and in a way that destroy the ecosystems that sustain our food systems …We need to recognize that 'land restoration' is not simply about finding the right technical instruments to restore soils, but also the right institutional configurations, incentives and innovation processes that can counter the enormous power of those actors who invest in solutions that over the long run will destroy the soils. **I would therefore phrase this nexus issue as follows**: ***what socio-institutional reforms and socio-technical innovations will be required to accelerate land restoration in ways that result in the improvement of rural livelihoods and increased supplies of healthy food into local and regional food systems?*** This formulation is relevant to farming communities in both developed and developing country economies because both do not benefit from the global food system as it is presently constituted.

Climate change, energy, and land issues

Climate change and the energy crisis indicates that a food system based on the intensive use of petrol products and chemicals is unsustainable. According to recent UNEP publications the conventional agriculture model that is strongly subsidised by both the European Common Agricultural Policy and the US Farm Bill accounts for 14% of the total annual greenhouse gas emissions. This is mostly due to use of nitrogen fertilisers derived from rarefying petrol. Yet, UNEP maintains, the agricultural sector could become carbon neutral by2030 and produce enough food for a growing population, if localised, agro-ecologic systems that can reduce emissions were widely adopted. In addition, the globalized distribution of food is dependent on discounting the energy cost of transporting food around the world. This rapine "land-grabbing" is converting large tracts of land to the production of crops that are processed into agri-fuels or food and exported to rich countries. In the process, local producers and pastoralists are frequently expelled. This situation has to be amended.

Freehold title is the most secure, and encourages the adoption of new technologies. A common way in which freehold title is linked to increased productivity is through using land as collateral against loans. Land held under customary tenure is 'dead capital' and tenure reform can therefore reduce poverty if it creates 'capital' out of land.

Poverty reduction by access to land

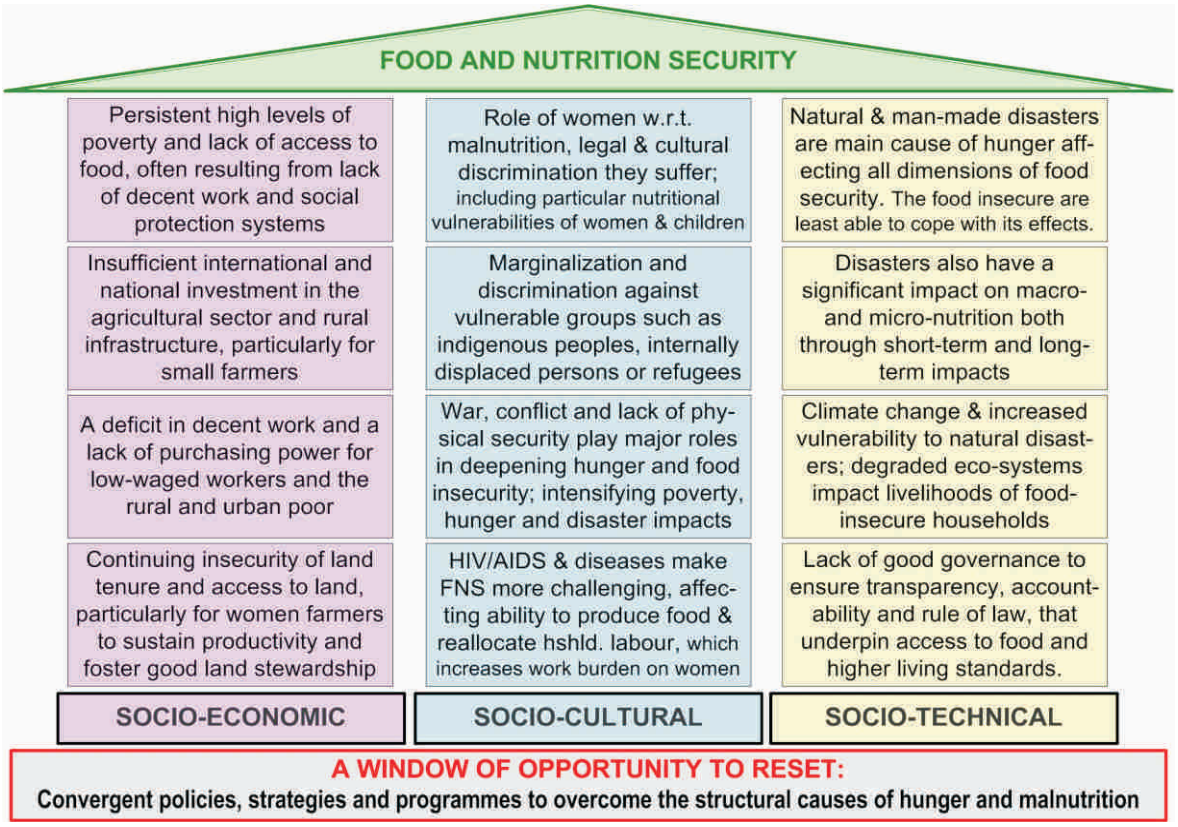
The terms on which land is accessed influences the nature and extent to which agriculture contributes to poverty reduction. Enhanced access of the poor to productive land through land reform scan promotes poverty reduction, by increasing the security of the poor people's tenure

Access to productive land reduces poverty by:

- Giving households a sense of belonging, self worth and risk-taking abilities for growth;
- Enables poor households to produce food; &
- Participate in local & commodity markets.

Secure access to land promotes increased productivity, better resource management decisions, and minimizes local conflicts over land. Changes in assets such as improving access to land, livestock, enhanced village level infrastructure including irrigation and access to more dynamic markets close to urban areas aid the poor from exiting poverty and hunger.

of land. The land reforms ushered in West Bengal by the Marxist government in the late 1970s through to the end of the millennium is one of the most visible example of the direct involvement of state institutions—in addition to non-state and private sector actors—to promote the interests of the poor.



Obtaining a better understanding of the hungry

Systematic analysis of the socio-economic, socio-cultural and socio-technical factors of the structural causes of food insecurity and malnutrition lets us identify and prioritize challenges affecting the realization of food and nutrition security and the right to adequate food for all people at all levels. There is a window of opportunity to overcome the structural causes of hunger and malnutrition, which calls for renewed efforts to define convergent policies, strategies and programmes, as depicted in the schematic below.

Price volatility of food

After food prices peaked in 2008 and again in 2011, it is evident that price volatility will rule in the future, and constitute a source of social unrest throughout the world, as the food riots in Mozambique in September 2010 demonstrated. Current regulatory mechanisms against financial speculation on food commodities are unsatisfactory if not non-existent. In the past, policy interventions on price volatility have largely

Episodes of large, unexpected price upswings are a major threat to food security in developing countries, especially for the poor who may spend 70% of their income on food. The lack of dietary diversification aggravates the problem, as price increases in one staple cannot easily be compensated by switching to other foods.

failed, being short term, limited to the micro level (such as targeted consumer subsidies and safety net programs), or have even been countervailing, eg: export restrictions which compounded uncertainty and undermined trade.

Instead of engaging in isolated measures, better coherence and coordination in policy responses are needed. We need to explore or reinforce measures to protect the most vulnerable, including through emergency food reserves to mitigate price volatility by providing poor people direct access to food. In the long run, their vulnerability can be lowered by a combination of raising agricultural productivity, improving access and promoting dietary diversification, for e.g. Spirulina and Moringa for combating malnutrition.

Good governance, human rights and development

The outcome and interconnection between these three attributes proclaim that every human person and all peoples '*are entitled to participate in, contribute to, and enjoy economic, social, cultural and political development*'. Meanwhile, governments are increasingly becoming committed to promote democracy, strengthen the rule of law and respect internationally recognized human rights and fundamental freedoms.

Rule of law: Human rights-sensitive good governance initiatives—that include advocacy for legal reform, public awareness-raising on the national and international legal framework, and capacity-building or reform of institutions—reform legislation and assist institutions ranging from penal systems to courts and parliaments, in order to better implement that legislation.

Anti-Corruption: Good governance efforts to fight corruption rely on principles such as accountability, transparency and participation to shape anti-corruption measures; includes establishing institutions such as anti-corruption commissions, creating mechanisms of information sharing, and monitoring governments' use of public funds and implementation of policies.

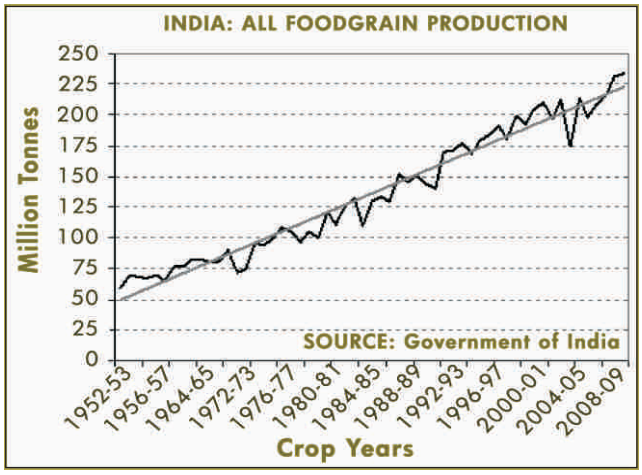
Good governance facilitates an enabling environment that is conducive to the enjoyment of human rights, such as the right to education, health and food while promoting growth and sustainable human development—all of which promote the advancement of food security. Good governance reform initiatives may include participatory mechanisms of accountability, transparency and culturally sensitive policy tools to ensure that services are accessible and acceptable to all.

PART 3: THE FUNDAMENTAL ISSUES IN INDIA

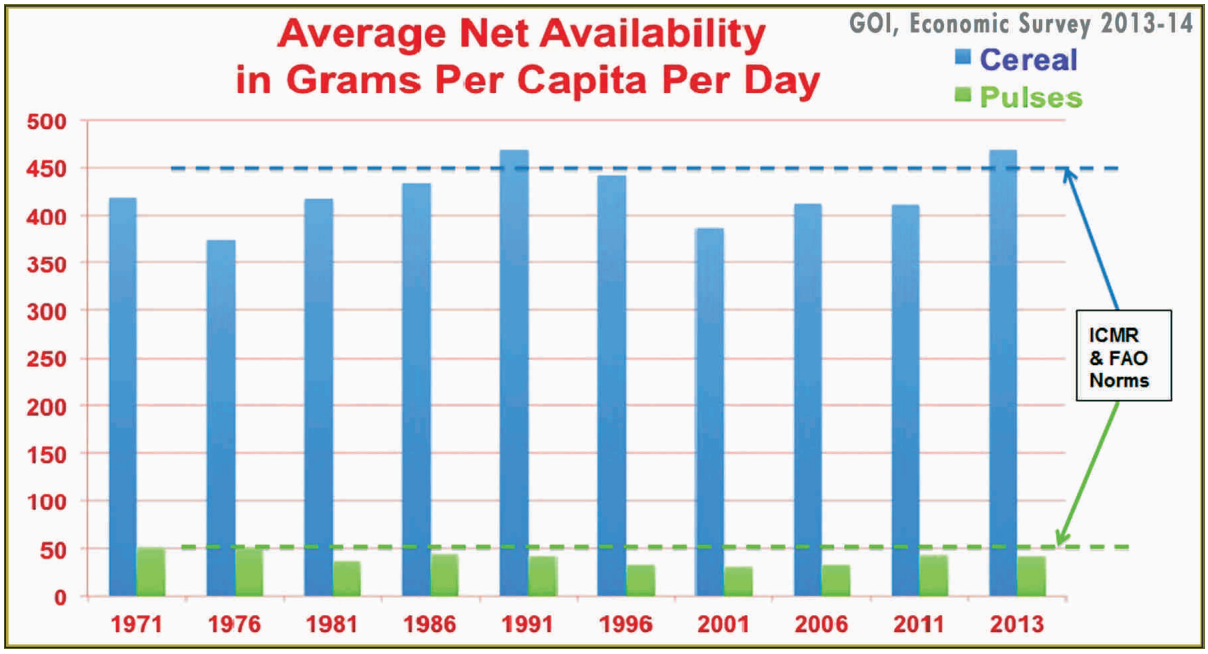
Among the many important goals that India must now pursue, perhaps none is of higher priority than ensuring secure access to food by every one of its citizens, ***now and for the future****.*

India's food grain production growth over the last 60 years has almost quintupled.

Total food production in India today, together with what the nation can afford to import, are said to be more or less sufficient to give every person – child, woman or man – the minimum calories and protein needed for being reasonably healthy and free from hunger. However, experience has shown that economic growth does not translate automatically into a reduction of poverty or hunger.



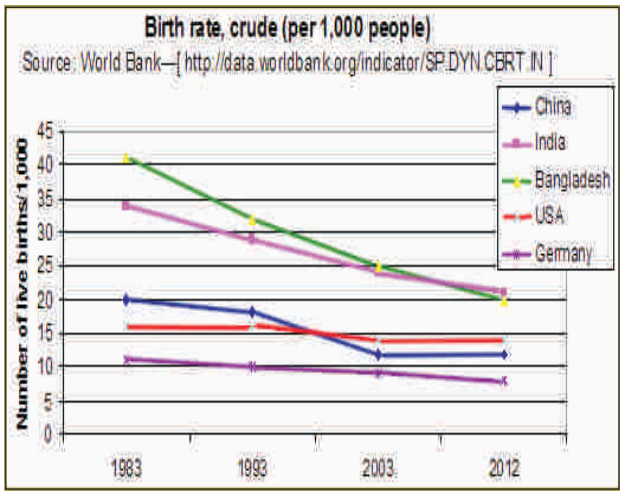
While meat and fish, dairy products, edible oils, vegetables and fruit contribute to the diet and health of those who can afford them, the primary sources of protein and calories, the main nutritional requirements, for a majority of Indians are grains and pulses. According to this year's Economic Survey of the Government of India, the average net amount of cereals and pulses available per capita per day has, over the decades, been:



It is now obvious that from the time of independence, significant portions of our people have not been able to meet their daily requirements of either protein or calories. At no point, including today, has availability of cereals or pulses nationwide been enough to meet the minimum nutritional need. Since this chart is based on the nationwide average, it is obvious that for the large numbers below that average, the bars shown are much shorter and the gaps much larger.

The Population Issue

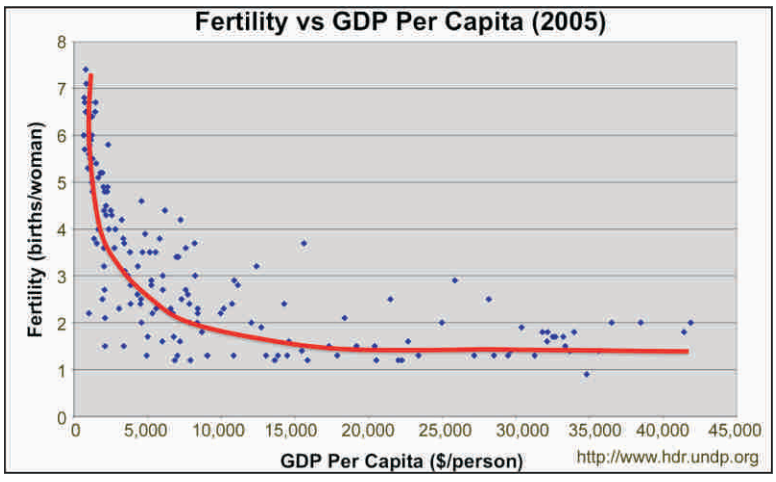
However, the population continues to grow—by more than 15 million each year—and the natural resources – our soils, water, energy and the other factors – essential for crop production continue to decline. Poor people in developing economies, such as India, depend on manual labor to feed their families and bring income into the home. Extra hands are always helpful. People tend to have more children in poorer countries because disease and malnutrition cause their offspring to die early. Also, poor people with less education have more children because of ignorance, lack of birth control, and high mortality rates. The chart below of the trajectory of crude birth rate per 1,000 people puts India at the top of this select group of five countries.



Even Bangladesh has recently experienced a steeper decline in the crude birth rate, which is a reliable indicator of the stability of a nation's socio-economic and environmental progress. After all, as people become more educated and more affluent, their need for pro-creation is lessened. They can depend on themselves for wealth. They do not need children to provide for them in their golden years. Also, they enjoy pursuing higher intellectual pursuits.

An idea: (a) If having many children is a guarantee for survival for the poor, perhaps we can control population growth if we truly empower women with the skills and education to get a job, so that they do not need to give birth to many children. (b) It would appear that Bangladesh is doing better than India in socio-economics to control the growth of its population.

Population growth rates are endogenous variables in the development process, not exogenous ones as they have been treated for far too long. The 'Fertility vs. GDP/capita' chart on the right explains in a more scientific manner, why we have a growing population who are poor, hungry and marginalized. History, including our own in various parts of the country, particularly the Southern states, has shown that poor, hungry and marginalized people tend to have high fertility but as soon as their life prospects improve, they start to desire smaller families. In other words, improved per capita nutrition leads to lower population growth, which in turn leads to further improvement in per capita nutrition. It is a self-reinforcing cycle that has been achieved in parts of India but not yet nationally.



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India has made great strides in empowering women and socio-economic development, but the results suggest that India has to do more to *effectively* empower women, provide more *livelihoods* options for its people, put more vigor into *skills development* programs, and a good start would be to *proscribe child labor*, which will not only make the young people joining the workforce in the future more educated and more productive, but also put more money into the pockets of able-bodied men, who are presently crowded out of the employment market by bonded, child labor—a win-win situation for all except child abusers.

Hence, the gorilla in the room for the FNS debate is the unmitigated growth of population in India, which has wiped out the hard-earned socio-technical benefits of almost quintupling India's food-grain production growth over the last 60 years, and cause several hundred million people in India to remain hungry and malnourished. Estimates vary from around 100 million (GOI) to more than 300 million (FAO, WFP, World Bank, OXFAM, and others). Whatever the precise figure, the loss to the nation of the resulting damage to the physical and mental capabilities of our fellow citizens is, by any standards, astronomical. Our much vaunted "*demographic dividend*" (which refers to a period – usually 20 to 30 years – when fertility rates fall due to significant reductions in child and infant mortality rates) comes complete nonsense – a heavy "demographic liability" – in the light of the legacy we are leaving for the next generation to inherit, of vast numbers of under-proteinized, unskilled and consequently unemployable people.

The Traditional Processes for Achieving FNS

The Green Revolution

The Green Revolution, spreading over the period from1967/68 to 1977/78, changed India's status from a food-deficient country to one of the world's leading agricultural nations.

Historical & methodical perspective

Until 1967 the government largely concentrated on expanding the farming areas. As the population was growing at a much faster rate than food production, this crisis called for an immediate and drastic action to increase yield. The action came in the form of the '*Green Revolution*', which is a general term that is applied to successful agricultural experiments in many developing countries, India being one of the most successful.

Food security has been one of the main items on free India's agenda, ever since the Bengal Famine, the world's worst recorded food disaster in British-ruled India 1943, killed an estimated four to six million people, who died of hunger. Indian economist Amartya Sen has established that while food shortage was a contributor to the problem, a more potent factor was the result of hysteria related to World War II, which made food supply a low priority for the British rulers. This awareness led, on one hand, to the Green Revolution in India and, on the other, to legislative measures to ensure that businessmen would never again be able to hoard food for reasons of profit.

The three basic elements in the method of the Green Revolution were[7]:

- Continuing expansion of farming areas, through the expansion of cultivable land;
- Double-cropping in existing farmlands, instead of the traditional one-season-per-year practice prevalent as there is only one rainy season annually. Water for the second phase came from huge dams/irrigation projects and also simple irrigation techniques.
- Using seeds with improved genetics was the scientific aspect of the Green Revolution. The Indian Council for Agricultural Research (ICAR), developed new strains of high yield variety seeds, mainly wheat and rice and also millet and corn.

Benefits and shortcomings

The Green Revolution (GR) resulted in a record grain output of 131 million tonnes in 1978/79, establishing India as one of the world's largest agricultural producers. Yield per unit of farmland improved by more than 30% between 1947 and 1979. The crop area under high yielding varieties of wheat and rice grew considerably during the GR, which also created jobs not only for agricultural workers but also for industrial workers by the creation of related facilities such as factories and hydroelectric power stations.

However, the GR concept of high yield value seeds has remained confined to food-grains only, and not to all kinds of agricultural produce, or even to regions. The states of Punjab and Haryana showed the best results followed by the eastern plains of the River Ganges in West Bengal. The

[7] With a focus on: (a) integrating governance into all reports; (b) solutions for sustaining land and livelihoods, and (c) exploring the extent to which sustainability depends on the nexus with other issues, such as: energy and water—the research question is: "***What socio-institutional reforms and socio-technical innovations will be required to accelerate and sustain land restoration in ways that result in the sustained improvement of rural livelihoods and increased supplies of healthy food into local and regional food systems, and how will these reforms and innovations be applied in the context of rapidly changing availability of energy and water for agriculture?***"

results were less impressive in other parts of India. GR has also created adverse environmental and human health impacts, through the increasing use of agrochemical-based pest and weed control. Increase in the area under irrigation has also led to rise in the salinity of the water table. Although high yielding varieties had their plus points, it has led to significant genetic erosion.

The Blue Revolution

India's "Blue Revolution" is similar to the reforms that catalyzed its Green Revolution focused on resource productivity to feed the Indian population in the 1960s, and refers to India's focus on aquaculture and water reform policy changes for items such as fish farming and drinking water. The availability of drinkable water and sustainable fish farming are policy issues which lead to a sustainable lifestyle and availability of resources for Indian people.

Fish convert more of their feed into body mass than terrestrial animals. For instance, the production of 1 kg of beef (resp. pork and fish) protein requires 61 kg (resp. 38 kg and 13 kg) of grain. Moreover, aquatic animal production systems also have a lower carbon footprint per kilogram of output compared with other terrestrial animal production systems. Nitrogen and phosphorous emissions from aquaculture production systems are much lower compared to beef and pork production systems though they are slightly higher than those of poultry.

Fish is crucial for FNS policies and strategies

Despite the widening of the definition of food security to include dietary patterns and their influence on nutrition, fish, fisheries and aquaculture are often sidelined in FNS debates, which are still geared mainly towards food access and availability with a focus on staple foods. Especially In developing countries, fish from small-scale fisheries represents one, if not the principal, animal-source food for fishing populations, supplying both high-quality protein and essential micronutrients.

Three attributes of fish for FNS are the: (a) protein and nutrient content of fish as food; (b) role of fisheries and aquaculture as sources of income and livelihoods; and (c) relative efficiency of fish to produce/transform proteins. The schematic below shows how the different pathways are linked together to deliver FNS—directly through the availability of nutrient-rich food, both at the household and at local, state and national market levels—indirectly through trading of fish and generation of revenues, at household or

Some of the policy implications of fish are:

(a) Promote policies for small-scale production and procurement of fish through a food security and nutrition lens for local markets, e.g. for school meals:

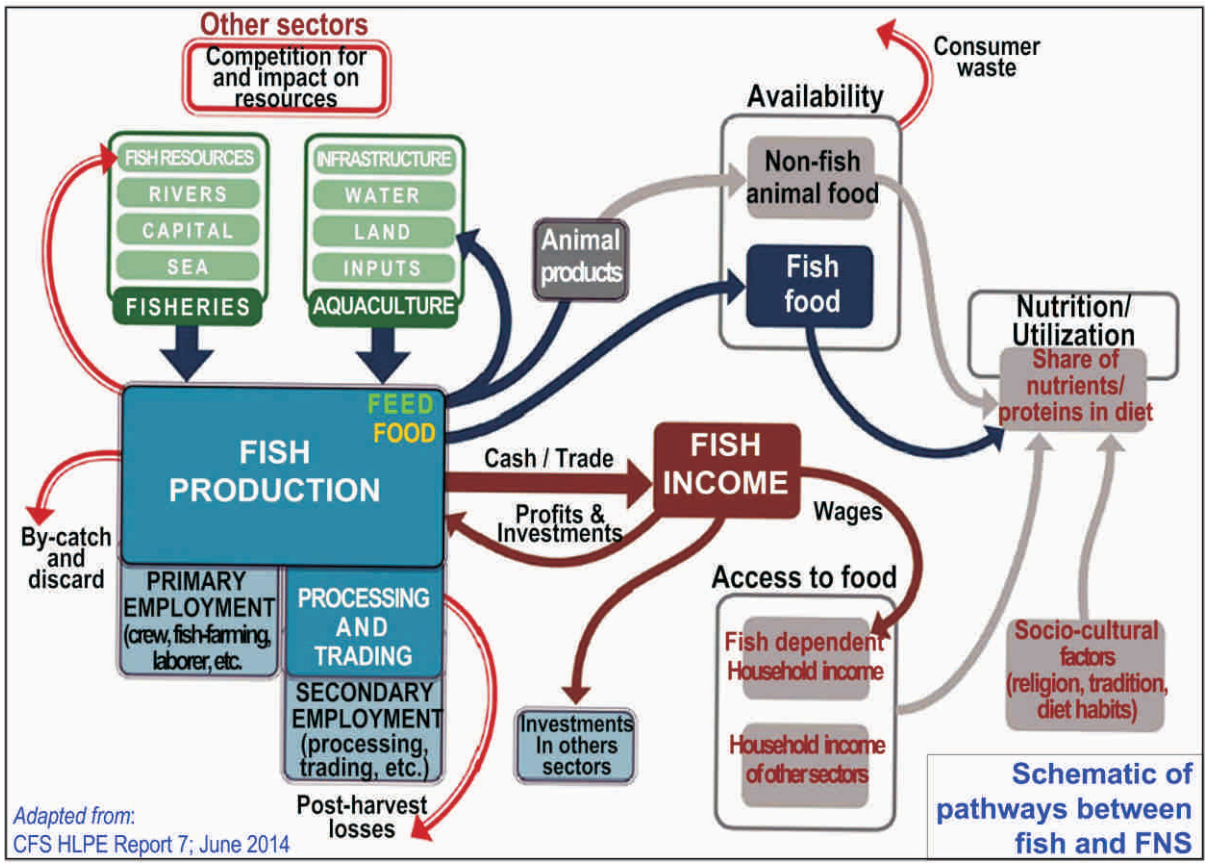
- Include fish in nutritional programs and interventions aimed at tackling micronutrient deficiencies, especially among children & women.
- Capacity building to negotiate better terms
- Eliminate subsidies that encourage harmful over-fishing and discarding practices
- Improve livelihoods and economic possibilities of fishing community residents.
- Conduct studies to better understand the pathways between fish, gender and the nutritional status of individuals and households.
- Review fisheries' practices and options for resources and ecosystem sustainability.

(b) Recognize contribution of small-scale fisheries to food security and nutrition, for the design and implementation of all national and international policies and programs related to fisheries.

(c) Support self-organized, local professional organizations and cooperatives, which strongly contribute and foster the integration of small-scale operators into markets.

national levels, including income for fishing crew/food & fish processing members, along the four dimensions of food security:

- *Availability*: Production and use of fish as human food but also for animal feed, especially in the context of a growing demand for fish.
- *Access* to food, as fish and activities in the 'fish-chain' represent positive effects to generate livelihoods, income and wealth—from household, local, state to national levels.
- *Utilization*: Contribution of fish to good nutrition
- *Stability*: from the combination of availability and access at macro-level – and of access, availability and utilization at the micro/household level..



Some pathways combine their effects towards food security and nutrition as, for example, in poor communities where fish is at the same time a source of nutrition and a source of income. Other pathways, however, imply trade-offs.

In addition to being used directly as human food, fish also contributes indirectly to human nutrition when it is used as a source of feed (fishmeal) for aquaculture and poultry/livestock feeds.[8]

[8] In 2012, 21.7 million tonnes of fish – essentially small pelagic fish species such as anchovy, herring, mackerel and sardine – were destined feed use, of which 75 percent (16.3 million tonnes) was reduced to fishmeal and fish oil to feed carnivorous and omnivorous farmed fish and crustacean species such as salmon, trout, tuna, shrimp and tilapia, as well as poultry and other livestock. In 2010, 73 percent of the total world fishmeal was used to feed farmed fish, followed by pigs (20 percent) and poultry (5 percent) (Shepherd and Jackson, 2013). *Report by The High Level Panel of Experts (HLPE) on Food Security and Nutrition--June 2014*

The White Revolution

Shri Lal Bahadur Shastri, Prime Minister of India, visited Anand on 31st October 1964 to inaugurate the Cattle Feed Factory of Amul at Kanjari, and ignited India's dairy development program, the 'White Revolution' – popularly known as 'Operation Flood', an emotive term coined by its Champion, Dr. Verghese Kurien, who passed away on September 9, 2012.

Milk production in India increased from 17 million tonnes in 1950-51 to 140 million tonnes in 2013-14. From being a recipient of massive material support from the World Food Program and European Community in the 1960s, India has rapidly positioned itself as the world's largest producer of milk (FAO).

This is certainly the trappings of a model that can be adopted for other food producing scenarios, such as the current 'Blue Revolution' or even the renewed "Green Revolution – Mark 2", with methodologies like SRI, Agroecological and soil-less agricultural technologies in the vanguard leading the charge.

In a country like India, beset with its aversion to applauding native talent until foreigners start clapping, and very few success stories in the science of management in the class of the 'White Revolution'—which has made India ranked *numero uno* in the world in milk production, the rarest of rare distinctions, it was a bit surprising that there were not many references made at the Conference—beyond chest thumping—to discuss the techno-commercial, socio-economic and policy merits of the 'White Revolution' *of* India, made possible *by* an Indian, and *for* the people of India … and how we could apply the democratic and indigenous lessons learnt to replicate this successful model for other food projects in India, as well, such as SRI and agroecological technologies. After all, nothing succeeds like success. It is not the technological or scientific brilliance of SRI or agro-ecology, that can make "Green Revolution – *Mark 2*" successful—it will be the successful understanding of the '***soft technologies***' and the socio-technical layout at the grassroots, that can make these new technologies successful … just as the way the venerable and Late Dr. Verghese Kurien understood, in 1964, how to make 'Operation Flood' a success. To iterate: *The cardinal principle on which the operation worked was that the entire value chain — from procurement to marketing — should be the sole and exclusive domain of the farmer, with the small, marginal, and landless farmers getting greater importance.*

The **Kaira District Co-operative Milk Producers' Union** was organized in 1946 and handled only 250 liters of milk per day. The Amul website now reports 378 village milk producers' co-operative societies, having about 65,000 farmers as members, with about 125,000 adult buffaloes of the Surti Breed. Apart from the technical efficiency of its processing units, the union's most striking achievement has been in the socio-economic field. By establishing a steady and remunerative market for the milk that is produced throughout the year, the farmers have an incentive to adopt scientific practices of animal husbandry to produce more milk with lower cost of production and thereby to further increase their income.

The policy argument against international food aid is that the benign face of surplus disposal benefits special interests in donor countries while it disrupts farming in recipient countries. *Operation Flood* is an exception to this rule, as India's '*White Revolution*' was successful beyond belief due to the creation of a small farmer-controlled network of dairy cooperatives. The strategy was to '*monetise*' the aid, invest the profits from the monetised commodities into capital-intensive but essential infrastructure in the form of National Milk Grid System (NMGS). This *holistic* and *multifaceted strategy* paid off, as market supplies were unaffected and yet the dairy farmers got the right prices, and the necessary infrastructure was established and streamlined to match the growing urban demand. **The cardinal principle on which the operation worked was that the entire value chain — from procurement to marketing — should be the sole and exclusive domain of the farmer, with the small, marginal, and landless farmersgetting greater importance**.

Family & Small-scale Farming

Family and small-scale farming are deeply linked to food security, as small farmers carefully manage their lands to sustain a remarkably high level of productivity, despite having less access to productive resources such as agricultural inputs and support. Family farming (a) preserves traditional food products, while contributing to a balanced diet and safeguarding the world's agro-biodiversity and the sustainable use of natural resources; (b) are the custodians of a finely adapted understanding of local ecologies and land capabilities, sustaining productivity on often marginal lands, through complex and innovative land management techniques; and (c) represents an opportunity to boost local economies, especially when combined with specific policies aimed at social protection and well-being of communities.

To empower family farmers eradicate hunger and ensure food security, an enabling policy environment is necessary, including greater recognition of their multiple contributions, and acknowledgment and reflection of these in national dialogues and policies—starting with articulating national definitions of family farming, and collecting data on the agricultural sector that recognizes and organizes farmers' contributions systematically. Successful development of family farming requires access to: agro-ecological conditions and territorial characteristics; markets; land and natural resources; technology and extension services; finance; demographic, economic and socio-cultural conditions and availability of specialized education, among others. Targeted agricultural, environmental and social policy interventions in support of family farmers are necessary in order to make tangible changes and sustainable improvements.

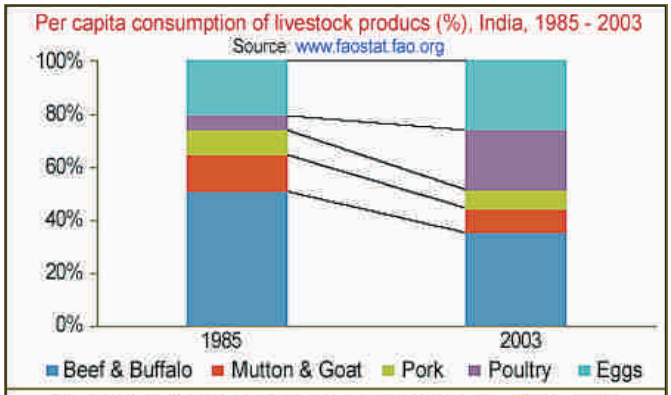
Animal Husbandry & Poultry

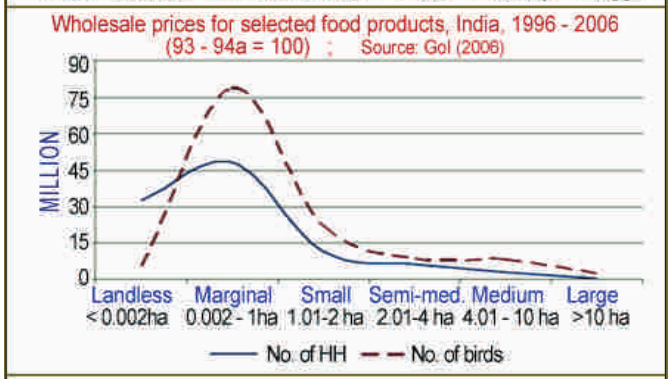
Livestock is vital to the economies of developing countries, like India. Animals are a source of food security, especially protein for human diets, income, livelihoods and even foreign exchange earnings.

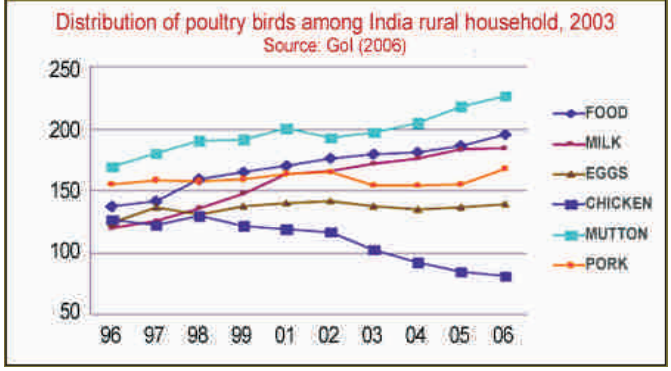
Within the livestock sector, poultry has been the fastest growing sub-sector: between 1985 and 2005 poultry meat and egg production grew by about 12 and 5% per year, compared to an annual growth rate of 1.5 to 2.0% for beef, milk and mutton and lamb.

Although the ownership of few poultry birds does not contribute substantially to rural livelihoods, it does provide a mechanism to improve nutrition, particularly for children.

Current experience in rural India suggests that small-scale rural poultry farmers,



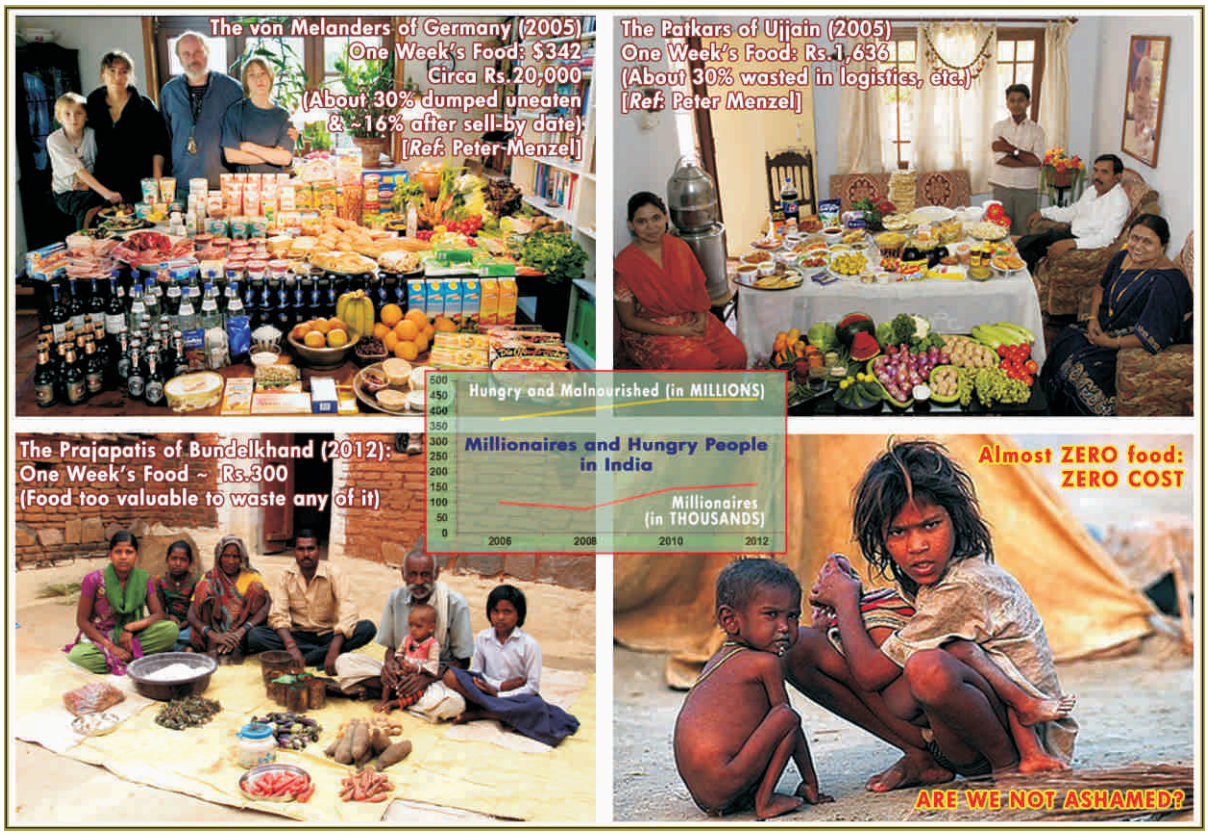




keeping on average a few hundred birds, can be as efficient in production as large commercial integrators, and more efficient than the latter in supplying rural areas with low priced poultry products.

The Hunger Gap

The problem is that we are 6.7 billion people on earth today. If we divide our resources – food, drinking water and energy, per person – we get a "personal quota." If everyone was to live with say, a Nigerian quota, there would be resources enough for about 18 billion people.



But if we all live with a German or USA quota, there is only room for, say, 1.5 billion. As long as there is uneven distribution of the earth's resources, there will be migrations, wars and misery for ALL.

Yesterday's 'Silver Bullets'

For six decades, one-third of our people, a population now larger than that of Europe, have provided living proof of Thomas Robert Malthus' contention that hunger is a natural outcome of unregulated economic and demographic growth. As a nation, we have not been able to outrun Malthus' nightmare, despite the fact that some of us are well fed as anyone, anywhere, at any time. What breed of horse must we now find to jump ahead in the race between food availability and mouths to feed? It is clearly unlikely to be the one we have today, where the bulk of the nation's food and nutrition vehicle is driven by an unholy mix of contradictory and mutually excluding ideologies. Pulling in one direction is crony market capitalism for which the overriding goal is to maximize profits, if necessary with influence, money and shoddy business practices. Pulling in the opposite direction is a simplistic dogma-bound socialism for which the overriding goal is to maximize election

votes by promising populist (but not necessarily implementable) 'schemes', easily subverted by inefficiency and corruption. The glue that keeps the opposing interests together is a system of patronage cultivated over the decades that enables the few to benefit hugely at the expense of the many. Examples abound, such as those of tribal lands and protected natural areas being handed over for a pittance to private companies and free power and diesel being given to a large number of farmers and special interest groups.

The scores of conferences that regularly take place to discuss India's food security present us with shopping lists of the kinds of change needed – mechanization of farms, improved seeds, regionally appropriate crops, improved incomes to farmers, particularly the women, etc. Few deal with the underlying barriers to solving the problem at the scale needed.

From a socio-cultural and socio-economic perspective, we need to change our ways of thinking to usher in a "sustainability revolution", for example, to acquire the taste for alternative foods with high protein and micronutrient content—such as seaweed and spirulina—where women are empowered, children laugh and play in schools, men folk live a life of dignity. Mothers and fathers protect their families and the nation from harm. That is one kind of revolution for India that will bring parity with OECD nations on manageable birthrates. The rest will take care of themselves.

History has shown that any other kind of revolution always lead to abuses … Do we want, one day, to live in peace on this earth? Perhaps in ten years. Perhaps in a hundred years? But we must start planning the future today! Why wait until tomorrow?

That was effectively the subtle message of 'The Limits of Growth' from the Club of Rome in 1972, as it is today.

Given (a) the growing threats of climate change, biodiversity loss and massive desertification, and (b) conventional thinking, as codified by the 2009 World Summit on Food Security, which divides the *problematique* of food and nutrition security into four broad sets of issues discussed previously—the hunger gap could rapidly get worse in the coming decades, unless we change direction on many fronts.

Even so, what has emerged so far from the clamor for solutions is a prime example of the clichéd '*kitchen sink*' approach to yesterday's debates mainly focusing of course, on positive measures to enhance food availability, for example by raising agricultural productivity and other means shown as the '***Silver Bullets***' in the figure below:

This approach has only resulted in countless proposals, initiatives and goals that are loosely connected at best, and that are often plagued by internal inconsistencies. The frequent succession of governments—each with different ideologies—have left the state of the Indian Republic's food and

nutrition agenda in tatters. The pendulum swings, from the left-wing socialist give-away schemes to the right-wing capital-intensive export-oriented profit-hungry programmes, have left the farm economy in a daze. Rampant corruption continued, of course, through all regimes. Parties at neither extreme of the political spectrum, nor in between, have the answer needed, but some have insights that can help India's citizens and communities to become truly secure in terms of food and nutrition. On the production front, it is clear that the future of India will need a mix of large and small farms and the choice of technology must be such as to maximize both the productivity of land and water and the earnings of farmers and their labor. On the distribution and consumption front, stable, affordable prices maintained by a judiciously regulated market based on carefully designed policies can enable universal access to food in the shortest possible time.

This means that a new, simple and sustainability-oriented approach is needed, which must now become the central subject of debate in our country. Considering that food and nutrition security is one of the most important goals for the future health of the nation, we believe our national debate will require several key changes in our general approach and order of business, in order to develop a food security policy framework, which will carry us forward to at least 2050, if not all the way through to the next century.

All farming alters, and sometimes damages, the environment

Modern Agriculture from Yesterday's Debate

Modern solutions for agriculture embrace the entire spectrum, from one extreme, the industrialized version of 'Modern Agriculture', a term which is generally used to describe the majority of production practices employed globally by large farmers and corporations … and on the other, organic, smallholder and artisanal farmers who leverage agroecological templates for sustainable farming.[9] The need for coherence in policies is therefore acute.

Intensive Monoculture Crops

Intensive Monocultures enabled agricultural productivity and crop yields to be increased for a while, but they represent fragile ecosystems, associated with an increase in diseases and pests, which lead farmers to use even more pesticide. As there is no longer crop rotation, the absence of legumes, which would normally absorb nitrogen from the air and fix it in the soil, requires the use more fertilizers in intensive agriculture; if there is too much mineral nitrogen, insects and pests develop, requiring the use of more pesticides—a vicious cycle.

Monocultures are based on 'high-yield' varieties, with considerable use of chemical additives—mainly pesticides, fertilisers, enriching agents, and substances used to improve the physical and chemical properties of the soil, plus a high level of mechanisation. The large-scale use of pesticides—such as herbicides (to combat weeds), fungicides (to combat fungi), insecticides (to combat insect pests) and other chemicals to exterminate rodents, snails and slugs—are all necessary to protect monoculture crops from destruction.

Impact on health: Amongst the particularly harmful pesticides are the organochlorides, which are made of molecules that are foreign to biological processes and they leave residues in nature, acting on the hormonal system as endocrine disrupters. Even though they have been banned for about thirty years, they still have an impact today because of their ability to persist in the environment and in the human body. DDT (dichloro-diphenyl-trichloroethane) is one of these: it was renowned not merely for its efficacy but also for its toxicity and its persistence in the environment. Such chemical additives have a real impact on the health of:

- *Farmers*, the group most at risk, as repeated exposure can cause poisoning, skin diseases, respiratory disorders, sterility, cancers, asthma and damage to the nervous or reproductive systems; in developing countries, many farmers do not have adequate protective measures; they may mix pesticides with their bare hands; or they may use defective equipment or they may even store pesticides and chemicals alongside food
- *Consumers*, because of the persistence of pesticides in many products and edible plants. Effects on health may be immediate or may only emerge after many years' exposure.

[9] Natural, manmade or agricultural ecosystems are characterized by aspects such as nutrient cycling, population regulation, energy flows and a dynamic equilibrium. The difference between natural and agricultural ecosystems depends mainly on the intensity of human manipulations—as a result of social and economic pressures—and characterized by the intensity of management or intervention, and the level of disturbance vis-à-vis the (natural) equilibrium. This increasing intensity of management is clearly visible in technical innovations in agriculture, often invented under the economic pressure to become more efficient, or simply to be profitable. These innovations often require a uniformity (in crops, soil and resource management) by which the agro-ecosystem moves further and further away from the natural system. [AGROMISA (Netherlands)]

Impact on the environment and on biodiversity:

- Depletion of organic matter in soil and problems with erosion in certain cases, in instances of poor agricultural practices such as 'over-deep' ploughing, substitution of organic with synthetic fertilizers and use of monoculture crops;
- Pollution of soil, water and air, as pesticides leach into the soil and ground water table; between half and three-quarters evaporate into the air and returns as rain and wind, often thousands of kilometers from the origin, even to the Arctic where they are trapped;
- Similarly, synthetic fertilizers are soluble in water; they pollute not only surface and underground water but the entire food chain, as insects feed on plants containing pesticides, birds eat these insects and predators then feed on the birds and so on;
- Deterioration in ecosystems due to eutrophication, an increase in nutrients;
- Loss of biodiversity, homogenization of landscapes (cutting down of hedges, trees, drying-up of ponds, filling-in ditches, etc.), reduction in biodiversity in crops due to the use of hybrid or GMO varieties;
- Reduction in pollinators such as bees, butterflies, beetles, wasps and others; according to the FAO agricultural production and ecosystems diversity are threatened by fragmentation of their habitat, use of pesticides and the introduction of exotic species;
- Pesticides are also responsible for the appearance of "super strains" of weeds or parasites that are becoming immune to chemical products.

A green revolution in developing countries?

Poor peasant farmers have not participated in this system because of its high cost. However, rich farmers in developing countries, such as Punjab in India, who embraced intensive monoculture systems since 1965, have started an active green revolution that initially saw a real increase in their harvests but, very soon, a large number of disadvantages emerged:

- Seeds for the new crops, in particular for hybrid strains, have to be bought recurring every year if they are to retain their productivity;
- This system of agriculture requires a much higher consumption of scarce water supplies;
- Diversity gives way to monocultures which are more fragile systems in the event of poor harvests or the presence of pests;
- Application of fertilizers brings about modifications in the soil, and pests multiply (because they are not being controlled naturally by the micro-organisms in the soil), resulting in the application of pesticides;
- Pesticides in turn impoverish the soil by increasing its toxicity so that they destroy even more of the soil's micro-organisms, which progressively results in the loss of organic matter and soil erosion. Hence, the farmers add more fertilizer in a vicious circle.

Thus the agricultural revolution has, for the rich farmers, been synonymous with additional costs, loss of organic matter in the soil, disappearance of farmyard animals, reduction in agricultural biodiversity and, finally, a reduction in productivity, and this poses problems for sustainable development, for the economy and for ecology. Many farmers have run into debt and unable to repay loans as a result of uncertain harvests, have lost their savings, their lands and sometimes even their lives. Around 46 farmers commit suicide each day, on average. Or nearly one every half-hour since 2001.

Genetically Modified (GM) Crops

Genetic modification (GM) is a relatively recent development which allows specific genes to be identified, isolated, copied and inserted into other plants and animals with a high level of specificity. Genetically Modified Organisms (GMOs) are plants or animals that have been genetically engineered with DNA from bacteria, viruses or other plants and animals. These experimental combinations of genes from different species cannot occur in nature or in traditional crossbreeding.

Transnational Corporations (TNCs), such as Monsanto, Cargill, Carrefour, Archer Daniels Midland, Nestlé and Syngenta, control virtually all commercial GMOs, which are engineered to withstand direct application of herbicide. The biotech industry has conducted safety evaluation tests, based on systematic approaches for combining different test methods to assess the safety of foods derived from a specific GM crop, concluding that foods and feeds derived from genetically modified crops are as safe and nutritious as those derived from traditional crops. TNCs are helping to meet the world's food demand by plugging the huge technological gap between farmers in developed countries and those in developing countries. For example, in Sub-Saharan Africa and Asia—the two areas where populations are growing the fastest—most farmers still work without access to the best agronomic practices and technologies, including more advanced seeds. This is due in part to barriers to entry, such as government regulations, lack of infrastructure and training.

However, a common complaint against the biotech industry is that, despite promises, none of the GMO traits currently on the market offer increased yield, drought tolerance, enhanced nutrition, or any other consumer benefit, on a sustained basis. Meanwhile, there is a growing body of evidence connecting GMOs with health problems, environmental damage and violation of farmers' and consumers' rights. CSOs, such as La Via Campesina, have been at the forefront promoting agro-ecology concepts on the one hand, and violent opposition to TNCs, who they claim are trying to consolidate their control over markets for food and agriculture, while (a)contributing to climate change and other environmental crises by promoting an unsustainable model of industrial agriculture that is toxic to human health; (b) exacerbating poverty and economic recession, worldwide, by expelling small farmers and peasants from their lands; (c) reducing employment opportunities in rural areas, and (d) swelling urban slums with unemployed families. They also claim that in the face of global economic recession, the industries for seed biotechnology and agro-fuels are expanding while hunger, poverty and environmental obliteration are on the rise. Thus, an offensive against TNCs should be a priority for all CSOs, which should instead envision a world in which billions of peasants on small and medium-sized farms will produce healthy food, preserve biodiversity, protect water aquifers, sequester carbon and revitalize rural economies.

From a socio-technical and scientific point of view, it would therefore be desirable to continue with scientific research for improving crop yields with biotechnology, and at the same time continue with stringent and robust tests to determine the overall safety of GMO crops on one hand, and the social implications of control of markets, on the other.

The issues of social equity and fairness have to be kept in the forefront, while developing policy on GMOs.

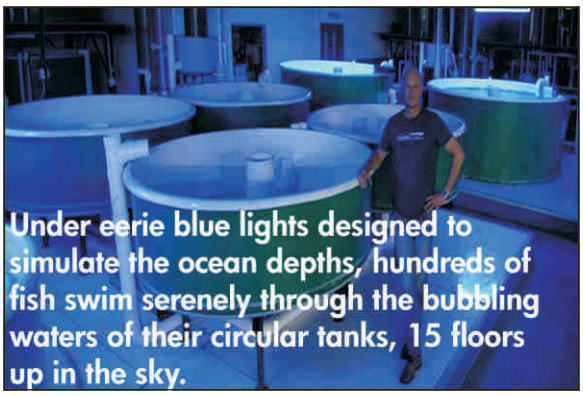
Give a man a fish and you feed him for a day,
teach the man how to grow that fish and you feed him for life
- Ancient Chinese Proverb 500 B.C.

Marine and Intensive Aquaculture

Modern marine aquaculture, if it is done well, could safeguard marine resources for future generations while producing most of the world's marine produce to alleviate poverty and food shortages in some of the world's poorest countries. It has arrived at a time when environmental knowledge and concern has rarely been higher. Whereas the 'Green Revolution' had the luxury of being able to pollute and alter the landscape first and worry about the consequences later, not so the 'Blue Revolution', represented by modern aquaculture.

For example, shrimp and salmon aquaculture, which have shown double-digit growth in the past decade, present particularly worrying environmental challenges. In developing countries, shrimp aquaculture is exceptionally destructive to mangrove forests and local eco-systems, which are essential for healthy populations of many wild fish. Widespread in the developed world, salmon is fed on wild fish caught in the ocean, which will aggravate the pressure on the marine environment and on the world's supply of fish.

The global challenge for marine aquaculture will be to regulate it prudently and efficiently, not just in the rich world but in developing economies and eventually farther out to sea, too. Catching wild fish has long since passed the point of sustainability, as catches are speedily declining. If governments end subsidies, the reduced fish farming could regenerate fish stocks, in part.


Under eerie blue lights designed to simulate the ocean depths, hundreds of fish swim serenely through the bubbling waters of their circular tanks, 15 floors up in the sky.

Intensive aquaculture relies on technology to control diseases and reduce stress and mortality rates of fish, raised in artificial tanks at very high densities, by controlling water quality, temperature levels, oxygen levels, stocking densities and feed rates. Due to the complete control of these factors, intensive aquaculture produces high yields throughout the year, but with a very high start up and labor cost. Modern versions include recirculating systems, which can further raise stocking densities and productivity at higher cost. Hence, only rich countries have developed this line into a profitable business. For example, Mr. Lloyd Moskalik (see image above) has a fish farm in a skyscraper at Hong Kong, with 11 plastic tanks in total, holding a combined 80,000 liters of salt water. He sells two tonnes of fish to wholesalers each week, getting as much as $100 per kilogram!

Modern aquaculture in developing economies, such as India, also relates to the rapid increase of fish production in inland small ponds and water bodies. The technology has also been applied to treat sewage waste, where the treated water is used for agriculture.

PART 4: THE DEBATE NEEDED TODAY

AND ITS UNDERLYING PREMISES FOR TOMORROW

We now need to be more explicit and transparent in prioritizing, or ranking, our broad policy objectives. Setting different agendas on multiple platforms – fading Five-Year Plans, sputtering MGNREGA implementation, the new avatar of Swatch Bharat, and countless other crowd-pleasing political initiatives – is a recipe for confusion and potential conflict.

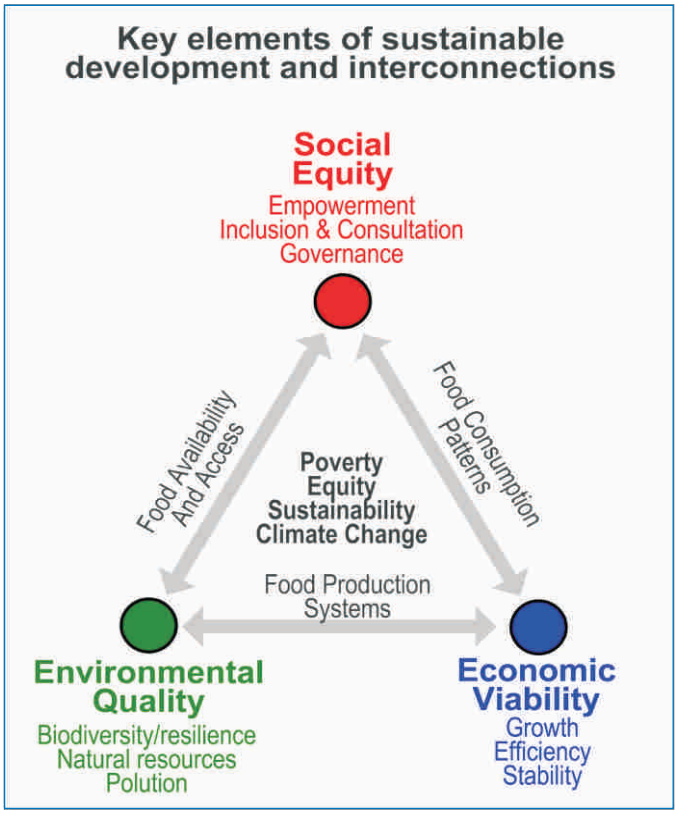
Targets, which smack of the legacy of a state-directed economy – a legacy that runs counter to the current national emphasis on caring for the poor and the "common person", as well as the primary role of markets for economic growth, should in general be downplayed, if not eliminated entirely. Instead of setting production targets that satisfy the needs of policymakers and moneymasters, while leaving the common person hungry, we should instead focus on policies that target 'Zero Poverty' or 'Zero Hunger', which are easily measurable, visibly verifiable and, as Brazil has shown in the past decade, eminently achievable.

Needless to say, no activity that involves production and consumption can be scaled up to reach everywhere or everyone unless it is economically viable. So, reasonable profits and efficient markets are essential for universal food and nutrition security as they are for all other basic needs. But profit and markets, though necessary, are not sufficient. They, alone, do not guarantee food security for all, either today or in the future. For the poor and marginalized today, additional measures are needed to ensure universal and reliable access to nutrition. And for our children and grandchildren tomorrow, the productivity of the environmental resource base has to be protected and enhanced to ensure they can continue to get the nutrition they will require.

Thus, any sustainable food and nutrition policy and governance that will be effective *today*, must:

First, pay attention to ALL THREE dimensions of sustainability: ***Social Equity***, ***Environmental Quality*** and ***Economic Viability***, as shown in the schematic on the right;

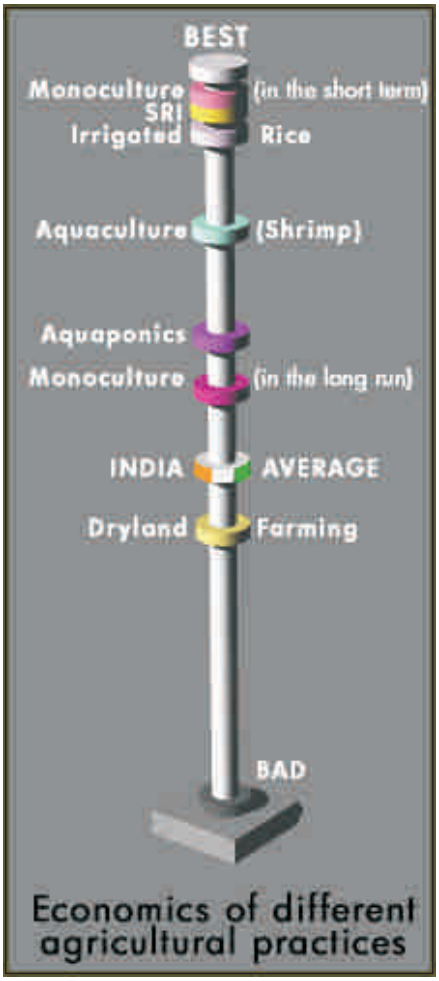
Then focus on the mantra of '***Access to Food***' in order to mitigate the challenges of poverty, equity, sustainability and climate change on the debate for food and nutrition security, today.



Beyond the 'Productionist' Doctrine

A. Issues of Economic Viability

The first commitment is to the efficiency, prioritization and scaling up of food production, which means that the mix of the factors of production – land, labor, capital (and others such as knowledge, technology, infrastructure, market linkages, etc) – in the agricultural practices and the mix of crops produced has to be optimized for each social, economic, resource and geo-climatic context. Given the changes occurring in climate, ecosystem productivity, resource prices, and transportation costs the issues of trade and comparative advantage also have to be examined anew. This visualization of the **economics** of different agricultural practices, with subjective estimates for the economic rating of each method, rather than any attempt at numerical precision, is indicated by the placement of rings on the uni-dimensional vertical axis, with the best practice at the top and so on down, is shown in the diagram on the right[10].



Apart from concerns such as the nation's strategic imperatives and security of food supplies, which have played some part in food-related decision-making in India and other countries, there are several emerging factors including climate change, spread of plant and animal diseases, extinction of cultivars and genetically important varieties, etc that need to be considered in the choice of food strategies. Since few sectors have benefited as much from research and innovation as agriculture, the investment choices made can also hugely impact the relative importance of different crops to the ***economy***.

Implication: Since food security depends on the mix of foods in the market and the relative prices, and the choice of technology determines not just what is produced but who gets the income, it is clear that the investments made in infrastructure, irrigation, seed availability, research and innovation for different crops has a large impact on the outcomes.

B. Issues of Social Equity

The second issue is the commitment society must make to universality, fairness and social justice in spatial or class terms—in the here and now. It assumes that adequate food and nourishment is the right of every citizen, urban or rural, rich or poor, powerful or marginalized. Recent political upheavals in different parts of the world, including ours, resulting from food scarcity or

[10] Monoculture (in the short term and) and SRI are indicated at the top, followed by other agricultural practices. However, there is a second ring for 'Monoculture', but this time qualified as (in the long term); this implies that although 'Monoculture' practice had a top billing in the short term (actually around 1965, when it was first introduced), this approach lost a lot of value with poorer yields and environmental damage (around) 1990s)

unaffordability demonstrate that equity is a central component not just of liberal, participative democracies but, more importantly, of the very sustainability of these. Equity means that the poor, women, tribal people and other marginalized segments of society have access to adequate food of the type they like. It also means that farmers; marginal, small and large, receive a fair price for their produce and are not misled, nor pressured to produce food crops or use practices that may compromise their land productivity and production decisions in the medium to long term. This issue necessarily focuses on the imperative participatory approach for sustainable policy development, in order to have truly bottom-up decision making processes for designing, developing and implementing coherent policies.

We do not have to worry about policy incoherence, if the people are truly involved in deciding their own food and nutrition security.

Implication: It is essential to create strong, viable and resilient communities, which can ensure the health and nourishment of their members by enabling them to access and fulfill their basic needs.

C. Issues of a Healthy Environment

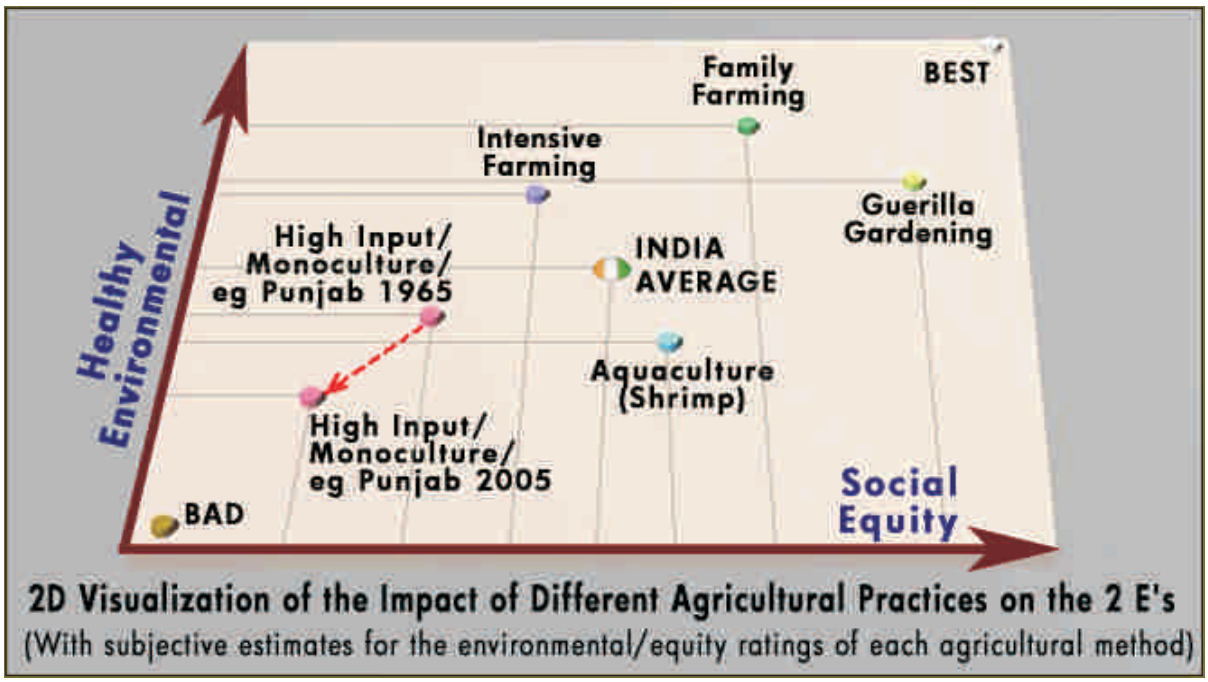
The third commitment is to inter-generational equity and the responsibility we have for our legacy to the future, a factor that requires vastly extending our time horizons. While most past decisions on economic development, including agriculture and food, have been made to deal with immediate problems, on the basis of narrowly-conceived and short-term considerations, we have to recognize the deep and intrinsic trade-offs involved in the technologies and policies we choose, and the impacts these will have on future generations. *We have to mitigate the impacts on food security of over-irrigation, water-logging and salinity, water scarcity, mineral fertilizers and intensive livestock production*. Recent declines in crop productivity in places such as Punjab and increases in food imports in countries such as China, often within a few decades of introducing high yield cropping, demonstrate that the health of the environment and its resource base is a critical factor in sustainability. Environmental health means that the productivity of the land and soils is maximized and pollution, contamination and erosion are minimized.

Implication: Due to contamination of the environment, there is wide concern over the safety of food, with increasing potential of food borne diseases. We must therefore ensure that the methods of producing food and the institutional frameworks for delivering it do not compromise the productivity of our soils, water or other resources, now or for future generations.

The 2 E's—***Equity*** and ***Environment***—are closely related, but different methods aiming at food security involve different mixes of these and influence them in different ways. To show this diagrammatically (with subjective estimates for the environmental/equity ratings of each agricultural method, rather than any attempt at numerical precision), various food production approaches are plotted in the chart in the next page, with the 'best' appearing at the top right corner, and the 'bad' one near the origin, as expected.

On the basis of these three underlying aggregates—***social equity***, ***healthy environment*** and ***viable economy***—we can proceed to determine how best to identify the object oriented attributes of the FNS debate needed today, by analyzing the following patterns of activities:

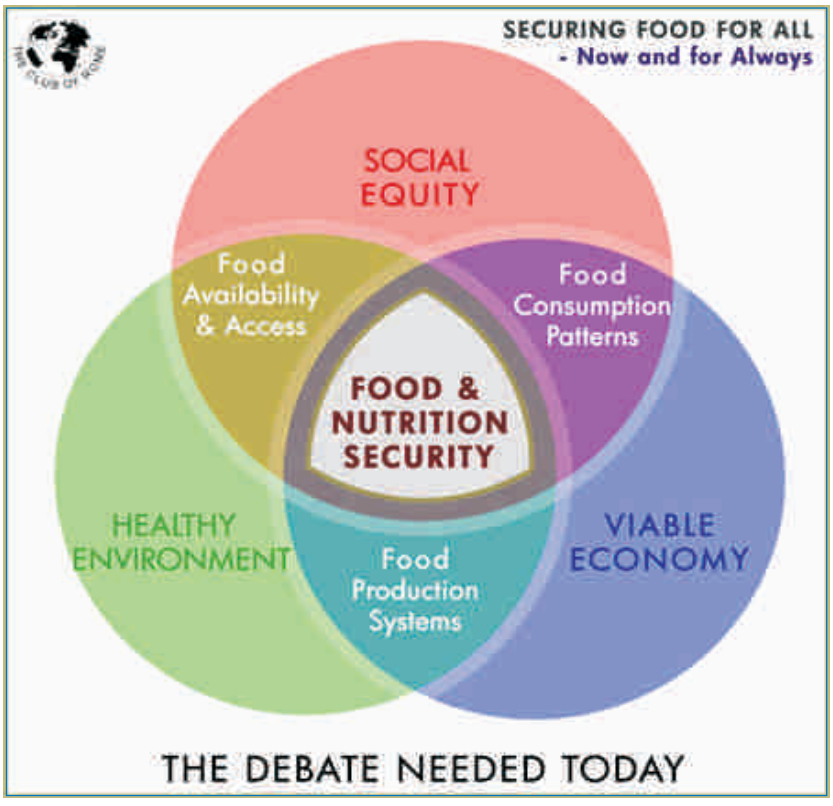
- Food availability and access
- Food consumption patterns
- Food production systems



2D Visualization of the Impact of Different Agricultural Practices on the 2 E's
(With subjective estimates for the environmental/equity ratings of each agricultural method)

As in the footnote in the case of the uni-dimensional visualization, the agricultural practice denoted by 'High Input /Monoculture e.g. Punjab 1965' regresses to the second position, indicated as 'High Input/Mono-culture e.g. Punjab 2005', nearer to the origin, indicating loss of position in terms of both, 'Social Equity' and 'Healthy Environment'.

Hence, **the debate needed today**—is depicted in the Venn diagram below, which exemplifies the Club of Rome's commitment to systems-based analysis.



The set of values that fall within the conjunction of these three activities—marked in the gray trihedron with dark borders—will constitute the set of activities that will provide food and nutrition security for all—now and for always. That is our goal. The immediate challenge will be to determine what these activities will be, and then to develop a unique and convergent set of coherent policies that will enable human society to achieve the outcomes from these activities.

These three patterns will be discussed in greater depth in the following pages.

India's achievements since independence are unquestionably remarkable. It has made massive progress not only in industrialization and infrastructure and information technology and science and education, but specifically in agriculture – doubling, for example, both grain and milk production in a little over two decades, successes that are quite unprecedented. Yet, we do find a significant portion of our country in the Malthusian trap mentioned above.

The types of policies needed to jump out of this Malthusian trap now need to be critically designed, to enable the market to deliver adequate nutrition to all citizens efficiently and sustainably. It is unlikely that this will be possible with only incremental changes to existing technologies, institutions and decision systems. Going on tinkering and fine-tuning a set up that has demonstrably not been able to produce the desirable results for six and a half decades is no more sane than Albert Einstein's madman who does the same thing over and over again, expecting different results. With a new government in charge and with few commit-ments to past decisions, the time has come to redesign the policy process itself and start with de novo as-sumptions, a kind of "zero-based policy" approach, starting from first principles on issues such as innovation, technology, economics of agriculture and food and others, adopting of course, those that are recognized to have worked well.

Patterns of Activities for Today's Debate on FNS

The Conference has yielded a great deal of information on the nexus between food and nutrition security on the one hand and a host of key human development factors, which include water, energy, climate change, livelihoods creation, land restoration, food storage and distribution, appropriate technology, and so on. It was revealed that recently:

(a) The concept of food security may require a stronger focus on nutrition outcomes, &

(b) The tendency for a paradigm shift that can best be described as emanating from a sector-specific approach to a multi-sector systems approach, with focus on nutrition outcomes, can be observed.

But, again, the Silver Bullets plus these new approaches and technologies are not sufficient. Even if all, or most, of these interventions were to be implemented, it is still unlikely that the hunger and malnutrition problem would be fully solved. This is because there are other political, economic and social barriers, not usually dealt with in the current discourse, that undermine the impacts of such well-intentioned policies and actions.

1. Food availability and access

The '*productionist*' agenda of viewing the crucial subjects of food availability and access through the tinted glasses of the 'grow more food' campaign is giving way to a big frontier encompassing a whole new multi-dimensional approach, for improving the food and nutrition situation through innovation – based on a judicious combination of the latest science and traditional knowledge: innovation that can scale up and become a part of mainstream praxis. Some of these innovative ideas that were articulated at the Conference include:

India is the worlds leading producer of milk, its second-largest producer of fruit and vegetables, and also produces a significant amount of meat and poultry. GoI spends Rs. 750 billion a year, about 1 per cent of GDP in 2011, on the food distribution system.

"Only 10–11% of the fruits and vegetables produced use cold storage. There is a deficit of 90%. Storage capacity needs to increase 40 per cent to avoid wastage. The wastage of fruits and vegetables occurs more in the southern and western regions of India due to the tropical and humid climate."

Director, National Horticulture Board.

The problem of food waste in India

Indian agriculture contributes 14% of the country's GDP. Despite high food production and an extensive distribution network, India cannot feed its own people, principally due to high wastage and low processing capability.

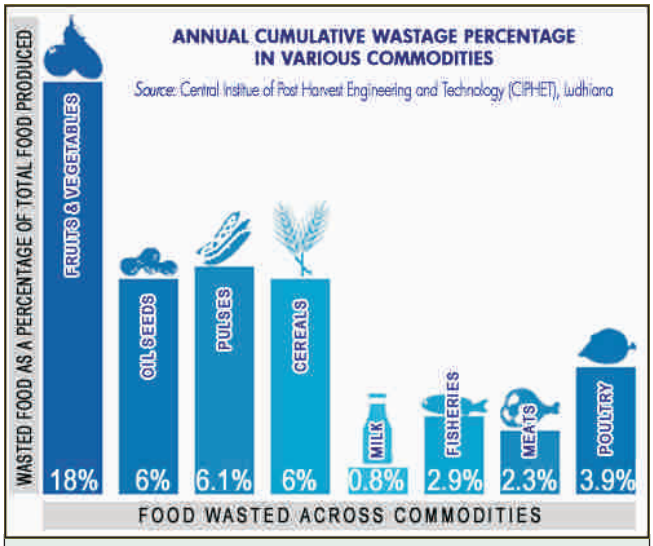
According to the Central Institute of Post Harvest Engineering and Technology (CIPHET), India wastes about 18% of its fruits and vegetables, worth Rs.133 billion annually, more than any other food, because of the lack of cold storage facilities. The cold chain segment has huge opportunities for growth, given the market potential in the country. But developing an efficient cold chain logistics system with the latest technologies and capacity is highly capital intensive for large-scale, industrial food processing centers. The infographic on the next page reveals an interesting fact, that only 0.8% of 'Milk' as a commodity is wasted, compared to 18% for fruits and vegetables.

Case study of milk in India

Compared to fruit and vegetables, the supply chain management, including its cold chain

component, is better organized for India's milk dairy industry, leading to substantially lesser wastage of milk, although milk is the most fragile food item in this collection of commodities, and most likely to perish first if mishandled.

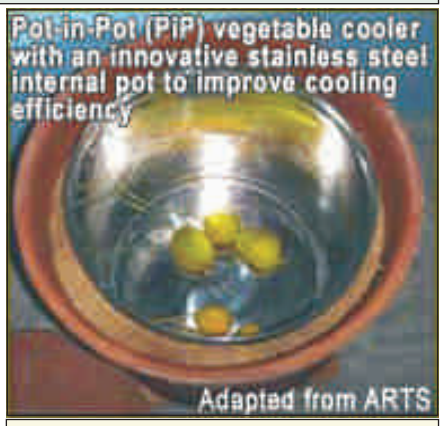
This happy situation can be attributed to the success of the Amul dairy cooperative India (see discussion on 'White Revolution'), which operates on the cardinal principle that the entire value chain — from procurement to marketing — should be the sole and exclusive domain of the farmer, with the small, marginal, and landless farmers getting greater importance. This is participatory management at its best. The case can be made that these stakeholders—small farmers—are so committed to the idea of their business, that they will not allow milk to perish, as they understand the milk value chain better than other types of farmers, and can internalize the impact of spoilage on their own bottom-line and business.



Amul cooperative dairies collect milk from farmers at technologically advanced collection centers after testing it for milk fat content. The milk is then transferred to chilling centers or bulk cooling units where it is cooled to 4°C. It is then transported in insulated tankers to processing plants where it is processed and then sent to distribution centers for packaging.

'Pot-in-Pot' vegetable coolers for storage

The motivation for the inexpensive 'Pot-in-Pot' (PiP) Absorption-type Refrigeration System shown right is lack of electricity in villages and poor people cannot afford refrigerators. The PiP consists of two pots of different diameters—an inner aluminum/stainless steel pot placed inside a larger earthenware pot. The space between the two is filled with wet sand. By virtue of thermodynamics, evaporation automatically causes a drop in temperature of up to 7oC measured in prototypes at up to 90% humidity—cooling the inner container, destroying harmful microorganisms and preserving perishable foods for several days, thereby avoiding spoilage, distress sales and getting remunerative prices for vegetables.



While the debate over the excessive cost of electrically powered cold storage plants is becoming endless, food produced by the small farmer still has to travel long distances to reach their markets. It is essential that coherent policies for alternative cold storage facilities, such as PiPs and BGBCSs, are made available to small farmers for cold storage of fruits and vegetables at every point of their journey from the farm to dining tables.

Biomass gasification based cold storage system

Conventional cold storage units are powered by compression cycle refrigeration, which use grid-connected power or GHG-emitting fuels as sources of energy, and environmentally harmful working fluids (such as CFCs). Biomass thermal energy based vapor absorption refrigeration that use heat energy from solar, biomass and waste heat and environmentally friendly working fluids, is an ideal alternative for rural cold storage applications.

Food processing industry in India

The malaise and low efficiency of food processing in India is caused by the same problems that beset other food systems—except milk—namely:

- Lack of skilled operators and outdated technology due to small scale/low capacity units
- Incoherent policies favor small scale investments without adequate training and ownership; large processors cannot attain economies of scale, also due to high cost of finance.

> The panacea to all our problems, it seems, would be to study what was done in the case of the 'White Revolution or 'Operation Flood', and apply the same participatory approach to solve all our problems by getting out of the way of people at the grassroots, and instead help and motivate them to take charge of their lives and destiny.

Land restoration

One of the more important and widely recognized needs for availability and access to nutrition is for regenerating the production of pulses and oilseeds. According to the Ministry of Agriculture, India has gone within two decades from being self-sufficient in these crops to becoming a net importer of Rs.50,000 Crores (US$ 8,300 million) worth of produce annually. The data on All-India temporal changes in the area share of cereals and pulses indicate a regression, whilst all other categories register increases.

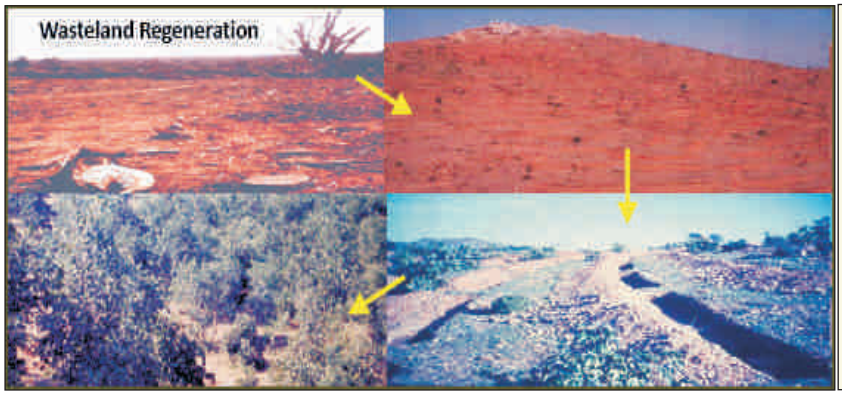
All-India temporal change (%) in the area share of main crop and crop groups, 1991 to 2008

Crop	Area (million hectares)	
	TE 1991*	TE 2008
Cereals	103.68 (56.53)	99.01 (51.74)
Pulses	23.74 (12.94)	22.77 (11.90)
Oil seeds	24.2 (13.24)	26.97 (14.09)
Fruits	3.09 (1.68)	5.54 (2.89)
Vegetables	5.17 (2.82)	7.48 (3.91)
Spices	2.26 (1.23)	2.47 (1.29)
Gross cropped area	183.42 (100.00)	191.36 (100.00)

Figures within parentheses are share in gross cropped area.
*For fruits, vegetables and spices data pertain to triennium ending (TE) 1993.

P. S. Brahmanand, *et al*

Reversing this unhealthy trend will need many initiatives, including improved varieties, seed availability and reviving age-old land-and-water management systems that can provide huge gains in productivity for pulses and oilseeds on dry or degraded lands.



> Coherent policies are needed for governing im-proved pasture manage-ment and integrated agro forestry systems that com-bine crops, grazing lands and trees in ecologically sustainable ways are effec-tive in conserving the envi-ronment and mitigating climate change, while providing more diversified and secure livelihoods for inhabitants.

Severely degraded land requires landscape rehabilitation and erosion control which is difficult from an economic perspective. However, the work of many civil society organizations, including Development Alternatives, has (a) demonstrated the enormous potential for growing these crops and much of the knowledge is available to be further built upon; and (b) reported considerable success in rehabilitating landscape function by promoting the rebuilding of restored patches.

Sustainable livelihoods and purchasing power

We know that access to food is a key requirement of FNS, and that to improve access to food in a robust way; we need to strengthen and multiply the pathways to the people's entitlement to food through the institutionalization of 'purchasing power'. Food-for-work programs, such as MGNREGA, are one-dimensional and not as robust as creating sustainable livelihoods[11], which empower people at multiple levels, multi-dimensionally.

Nexus of primary education and FNS

As in the case of landscape rehabilitation and erosion control, the work of many civil society organizations, including Development Alternatives and *Tarahaat*, have demonstrated that '*Education*'—and more specifically '***primary education***', or the lack of it—is the central problem, around which revolve a wide range of attributes that promote the creation of sustainable livelihoods. Illiteracy is an indicator of human insecurity, which engenders food insecurity and endangers food security. According to Professor Amartya Sen, primary education advances human security by enhancing political participation, economic opportunity and human capabilities. Education also generates self-confidence, reduces fear, enables risk-taking and supports an orientation towards the future.

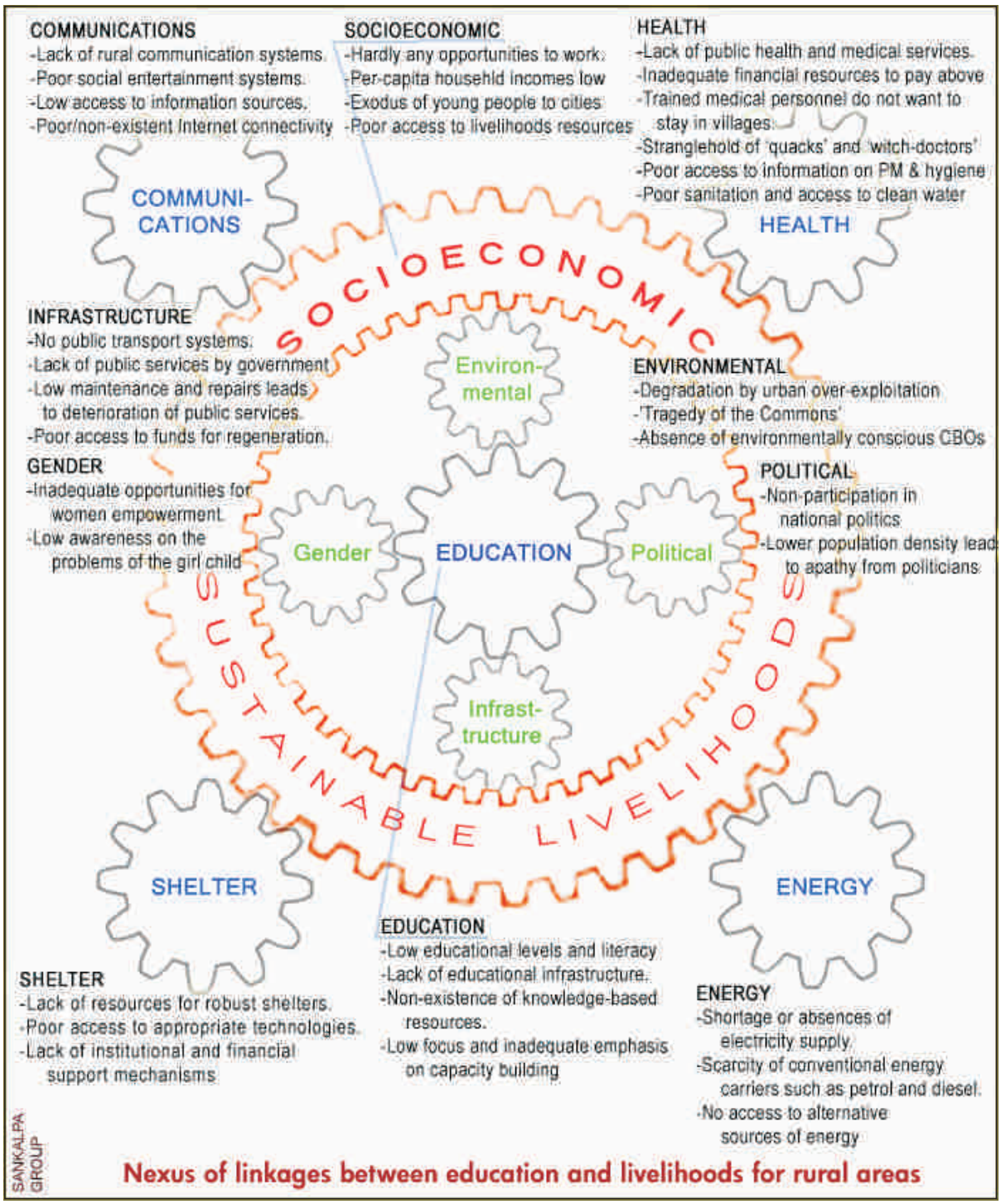
> Professor Amartya Sen believes that no economic development is possible without compulsory universal education. He writes: "The remarkable neglect of elementary education in India is all the more striking given the widespread recognition, in the contemporary world, of the importance of basic education for economic development. Somehow the educational aspects of economic development have continued to be out of the main focus in our country".

Good education endows people with better coping capabilities to grapple with crises and attain human security. There are multiple linkages between human/food security and education, which:

- Provides greater employment security;
- Enables people to exercise their rights;
- Empowers the underdog, especially women; and finally,
- Can socialize children towards tolerance and respect among diverse communities.

Hence, education and training is intricately linked with any discussion on the creation of sustainable livelihoods, and this nexus extends in a wide web of linkages, which will vary in spatial terms as well as in program content. One such mechanical description of the geared linkages of social attributes for rural areas is depicted in the schematic shown in the next page—where the-elephant-in-the-room is the 'socio-economic' gear, which represents the overarching goal of creating '***Sustainable Livelihoods***', and with '***Education***' at the focal center, as the motive power that turns the other gears, comprising: communications, health, shelter, energy, environmental, gender, political & Infrastructure.

[11] Sustainable Livelihood is a job that gives a decent income, gives some status in society and some dignity and meaning in life. It also conserves and, if possible, regenerates the environment. It provides opportunities for people to work right in their own community instead of having to migrate to the slums of a big city. And the purchasing power and lifestyle provided by such a livelihood would be at least comparable to that of a factory worker in an urban area, where the wages have to be much higher than in the village to compensate workers for higher costs of living. Adapted from a lecture by Dr. Ashok Khosla at the UN, New York, 30th April 2001.



Nexus of linkages between education and livelihoods for rural areas

The above schematic highlights the difficulty of making coherent policy decisions in a nexus of linkages, as policy actions in one attribute can have positive or negative implications on each other—and each of these have to weighed accordingly. The analysis of these coherencies can be done when these attributes are arranged in a ***matrix of dependencies***, and all sorts of analytical tools—please see Reference #18 for a brief study on one such technique, known as the state variable approach—can be employed to test the reaction of the mathematical model to varying stimuli. A chart, indicating the strength of the relationships between the nine attributes for '***Sustainable Livelihoods***' shown above, is shown at the top of the next page.

Meanwhile, the summary of a pragmatic case study for the object of improving livelihoods and nutrition throughout the bean value chain in East Africa, is shown in the box below the chart.

	Attributes of Sustainable Livelihoods	Principle relationships among attributes								
		1	2	3	4	5	6	7	8	9
1	Education						xxx	High		
2	Communications	xxx					xx	Medium		
3	Health	xxx	xxx				x	Low		
4	Shelter	xxx	x	xxx						
5	Energy	xxx	xx	xx	xx					
6	Environmental	xxx	xxx	xx	xx	xxx				
7	Gender	xxx	xx	xx	x	xx	xx			
8	Political	xxx	xxx	xxx	xx	xxx	xxx	xxx		
9	Infrastructure	xxx	x	xxx	xx	xx	xx	x	xxx	

Note : With subjective assessment for the strength of the relationships between each attribute, rather than any attempt at precision, to stimulate debate.

This approach of decomposing nexus linkages into a matrix of relationships may be adopted for analyzing a host of other nexuses, including WEF, the most famous one of them all.

Improving livelihoods and nutrition throughout the bean value chain

Women and men in East Africa typically cultivate small farms with variable soil fertility and erratic rainfall. They have limited access to high-quality seeds, advanced production and post-harvest technologies, credit, extension or training, all of which could help to improve yields and production and reduce post-harvest losses. Typically, even if these farmers could increase production, they are not well-linked to domestic and regional markets.

In Rwanda and Uganda, a partnership involving universities, research institutions and NGOs is addressing key points in the value chain for common beans. The goal is to improve food and nutrition security by improving production, linking producers to the market and increasing consumption of more nutritious foods. To improve bean yields and bean quality, the project focuses on improving management practices and technologies. In addition to improved production practices, this includes better techniques for harvesting, drying and storing beans.

To increase the nutritional value and appeal of the beans, researchers developed improved processing procedures (de-hulling, soaking, milling, fermentation, germination and extrusion). The digestibility and nutritional value of the beans was enhanced by reducing phytates and polyphenols that limit iron uptake. To increase consumption, the project developed bean-based, protein-rich composite flours for use in cooking and baking as well as a special weaning porridge. Additional research aims to produce and market a variety of bean-flour-based snacks.

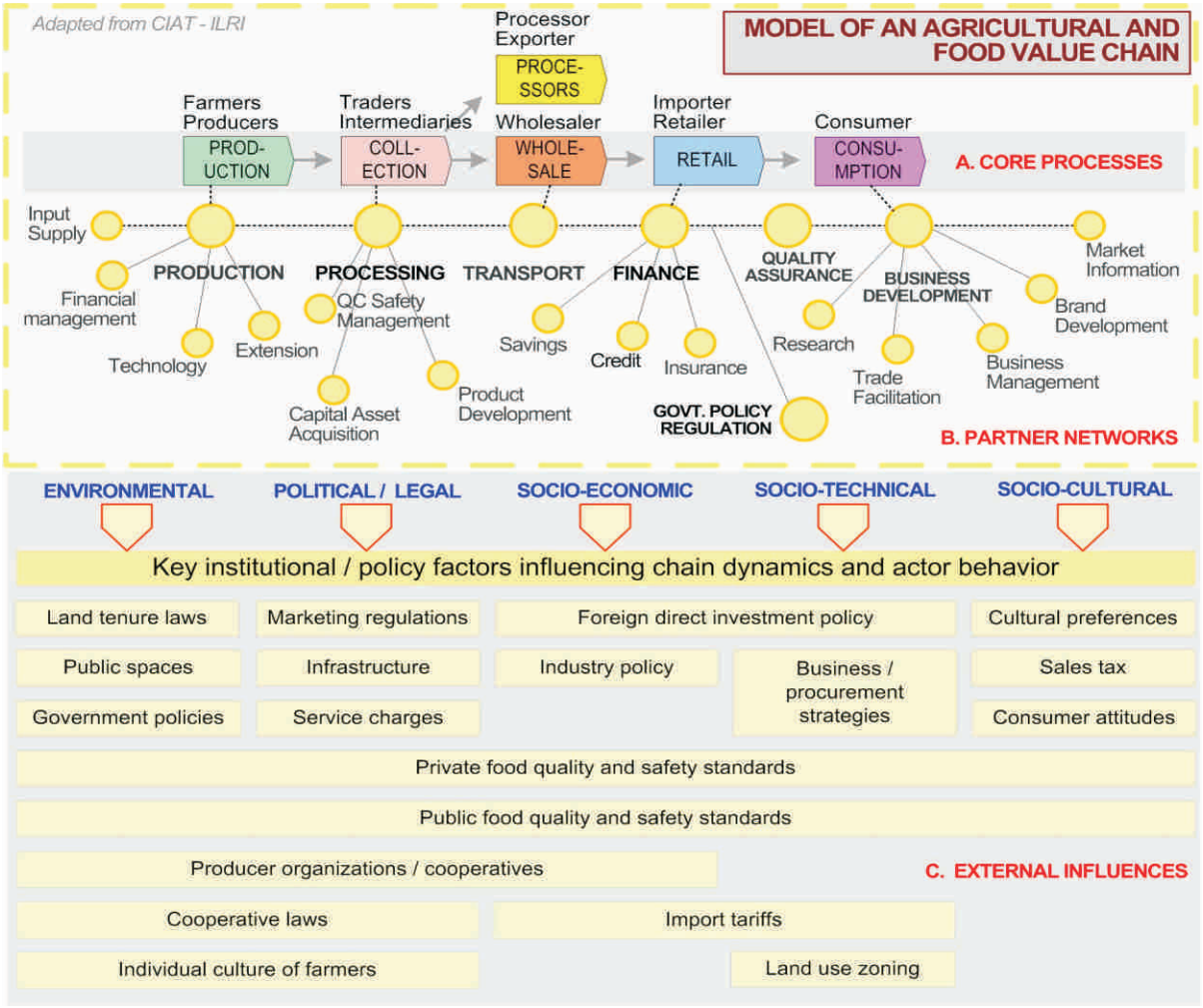
Extension materials were developed to increase knowledge about bean production and utilization. Materials cover the basics of feeding children aged 6–59 months, methods of preparing beans that reduce cooking time and enhance nutrient bio-availability, as well as how to prepare bean-based composite flour and use it in making porridges, cakes, biscuits and bread.

Source: Contributed by Robert Mazur, Professor of Sociology and Associate Director for Sodoeconomic Development, Center for Sustainable Rural Livelihoods, Iowa State University, United States of America.

2. Food consumption patterns

A food supply chain or food system refers to the processes that describe how food from a farm ends up on dining tables. The major processes include production, collection or harvesting, processing, distribution (wholesale and retail), consumption and disposal.

The food we eat reaches us via food supply chains through which food moves systematically in domino-like motion from producers to consumers while the money consumers pay for food goes to people who work at various stages along the food supply chain in the reverse direction. A typical schematic model of an agricultural and food value chain is shown below:



Each link in the food supply chain affects the availability, affordability, diversity and nutritional quality of foods. How foods are handled throughout a chain influences their nutritional content and prices as well as the ease with which consumers can access them. This, in turn, shapes consumer choices, dietary patterns and nutritional outcomes, as in the 10Ps of food value chain management shown next.

For example, proper household storage can preserve nutrients; food processors can use more nutritious inputs or can fortify foods during processing; logistics firms can employ nutrient-preserving techniques for storage and transport; and retailers can provide a more diverse range of foods consistently throughout the year. At every link in the chain, better technologies and management practices can preserve nutrients, reduce food losses and waste, and enhance efficiency and lower prices for nutritious foods.

A typical representation of the 10Ps of food chain management is shown below:

The 10Ps of Food Value Chain Management

1. PEOPLE: Invest in Human Relations, Resources and Empathy

- Ensure that people have physical, social and economic access to sufficient, safe, and nutritious food to meet their dietary needs & food preferences for an active & healthy life
- Make a firm commitment to '*put the last first*' – not merely as a moral or ethical obligation but as a social, environmental and economic sustainability imperative in the interest of all
- Traditional & modern food value chains play complementary roles to provide consumers in urban and rural areas with available, accessible, diverse and nutritious foods
- Involve girls as well as boys in learning how to leverage food chain activities
- Institutionalize participatory management and development systems for all

2. PLANNING

- Improve access to affordable & nutritious food, especially for nursing women & children
- Ensure availability of healthy, safe and low-cost quality food for all
- Fight "hidden hunger" & chronic FNS
- Build 'good governance' into food chain design

3. PROCESS

- Food processors must use more nutritious inputs or fortify foods during processing with key micro-nutrients such as Vitamins A and D, Iodine, Iron and Zinc
- Micronutrient fortification of staple foods is generally inexpensive & cost-effective.
- Develop systems thinking in food chain process development

4. PERFORMANCE

Improve the nutritional performance by:

- Enhancing the availability and accessibility of a wide diversity of foods
- Reduce post-harvest nutrient losses and improve the nutritional quality of foods through fortification and reformulation.

5. PRODUCT

Food supply chains must innovate and improve:

- Nutritional performance throughout the supply chain
- Efficiency, reducing nutrient waste and losses, and
- Enhance the nutritional quality of foods.

6. PRICING

- Prices should 'fully reflect' all information available
- Efficient futures markets could reduce price and output instability resulting from production, marketing, and storage of food
- Differences in cost structure allow traditional retailers to develop flexible pricing strategies for different locations and different socioeconomic groups.

7. PROMOTION

- Job and income generation schemes
- Promote ecosystem services such as forests, watersheds, coastal zones, mountains/ glaciers, grasslands +, through appropriate laws and community based institutions
- Promote foods of low energy intensity

8. PLACE

- Modern food value chains have more efficient distribution chains, with better year-round availability of a wide variety of foods
- Improve soil and environmental factors
- Through appropriate technology choices, mitigate climate change concerns and reduce GHG emissions

9. PACKAGING

Packaging has four aims:

- Ensure food safety & quality
- Determine what to offer, also value-added services
- How to convey the value of your product or services
- How to match customer needs, and minimize costs of customization.

10. POSITIONING

Positioning has three aims:

- Claiming a distinctive niche in the marketplace
- Making your food distinctive from the others
- Supporting your overall marketing and business objectives.

The Food Systems Approach

As we will see in the next section on 'Food Production Systems', there are a number of ways to improve the efficient and sustainable use of natural resources in food systems and to simultaneously reduce the environmental impacts of food supply chains or food systems[12], while at the same time improving the outcomes for food and nutritional security.

A food systems approach is an effective way to model the pressing issues around natural resources and food security and to identify the opportunities to address these issues. To overcome the shortcomings in the present productionist, sector- and/or issue-based approaches, while simultaneously addressing the critical need for coherence in policies and actions for our overarching goal of 'Securing Food For All'—the model can be tweaked to consider integrated options at the global, national and local levels, in order to identify and act on these opportunities.

It has to be accepted that the challenges are immense, and no simple or linear solutions are proposed. The food systems approach yields an integrated analysis of the full set of 'food chain' activities and their outcomes, for FNS and for beneficial use of natural resources. It also permits the recognition of a wide range of views inherent in the mix of multiple actors in the food system, such as balancing the interests of people who are committed to intensive agriculture, with their protagonists, such as organic farmers.

Conceptual framework of food systems and natural resources

The conceptual framework of the food system approach, presented in the next page, explicitly considers the position and interests of actors—such as input suppliers, farmers and fisher folk, food companies, supermarketers, retailers and consumers—all of whom stem from specific institutional and social context The latter has been further stratified vertically, as socio-economic, socio-cultural and socio-technical blocks, in order to more effectively capture the 'voice' of the people involved in this complex process.

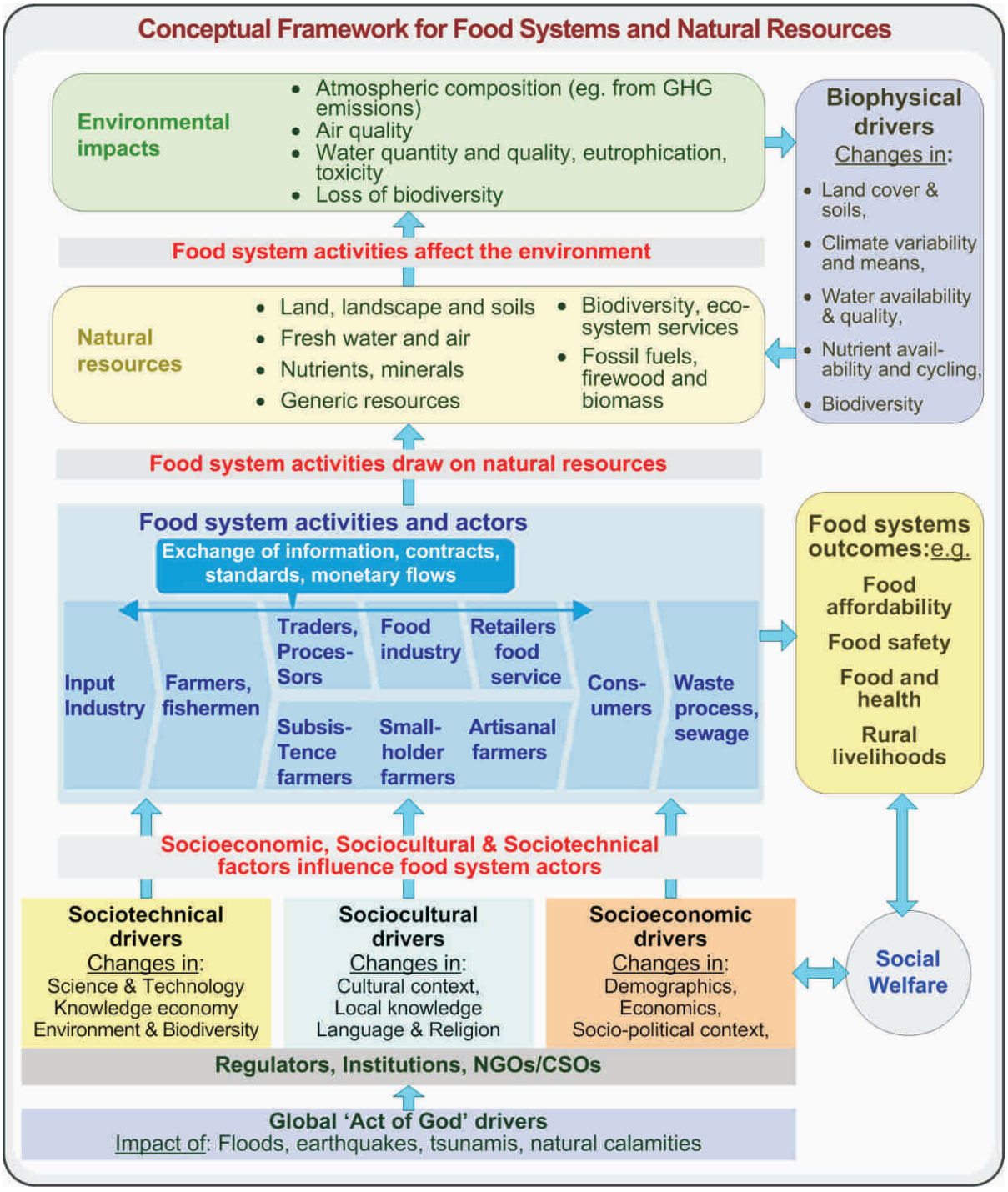
Furthermore, food systems are very diverse. In 'modern' food systems, powerful downstream actors such as food companies and chain stores determine production, consumption and food system patterns and outcomes. For example, dietary choices are actively influenced by food companies, retailers, chain restaurants and outlets, through national and local advertising, supermarket chains, marketing and pricing strategies. The dietary choices on offer—such as MacDonald's and Pepsi/ Coke—affect both natural resources use as well as human health. More 'traditional' food systems, mainly found in developing economies like India, are experiencing rapid changes, such as consolidation in the processing industry and 'supermarketization' of retail food. Increasing awareness of these processes and understanding their impacts on resource use will help to move food systems in a more sustainable direction.

A food systems approach to natural resource use

As an outcome of the Conference, evaluation offeedback and research on FNS strategies for securing food all, we present a concept of a food systems approach that integrates:

[12] A food supply chain or food system refers to the processes that describe how food from a farm ends up on dining tables, and beyond—including the input of germplasm and agrochemicals, production, harvesting, storing, handling & processing, packaging, distributing and retailing, to consuming and disposing of food.

- The full set of activities and actors—including the socio-economic, socio-cultural and socio-technical environments in which they operate—in the 'food chain'
- The outcomes of these activities for food security.



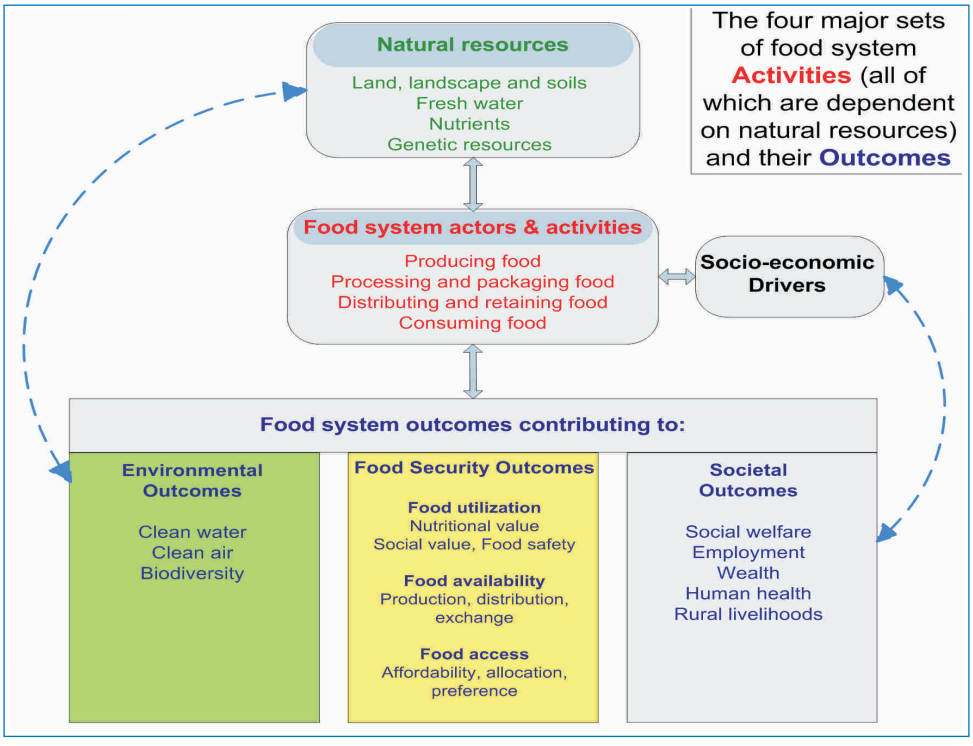
The new food systems concept helps us to understand and model the numerous two-way interactions between food systems and natural resources, which is important as the food system activities, from producing to consuming food, are currently (a) significantly degrading our natural

resources, including biodiversity, upon which our food security depends, and (b) contribute significantly to climate change. It is obvious that these inter-related problems will be exacerbated unless more effective and efficient food systems are developed and implemented, globally. This is urgent not only because we will globally add about a further 1 billion people within a decade, mainly in 'food desert' cities where food insecurity is already a challenge for many, but also because we already have at least two billion who are under-nourished because of our past mistakes. The food systems approach also permits inventorying the benefits for a range of 'actors' who take the initiative to adopt a food systems approach for natural resource management. [there is an 'official' number of 'hungry' in the world, and it is currently about 900 million; probably an underestimated, by saying 2 billion invites distracting argument and looks like an exaggeration; precision on 'under-nutrition' is harder argue about]

The emergence of new 'food system' concepts

Dr. Uphoff makes the important point deviating from the thrust of the arguments made here—building on the emerging agro-ecologically-supported methods and experience of growing food, that costs of production (per kg of food produced) are reduced by adopting scientific principles, such as SCI and SRI—that it should, with wide enough adoption, make it possible to make food more accessible in terms of price.

As we transcend the 'productionist' paradigm—which is doubtless important as we still have to produce more food, but in more environmentally benign ways, by leveraging innovations, such as 'climate smart agriculture'—the central policy issue remains access to food, which is largely determined by the affordability of food. This, in turn, is a function of the amount of disposable income a person has to spend on food, and its price. The former is related to livelihood policies, whereas the price is a function of the 'food system', which relates all the food system activities—such as growing, harvesting, processing, packaging, transporting, marketing, consuming, and disposing of food and food-related items—to the outcomes of these activities not only for food security and other socioeconomic issues, but also on the environment.



This food systems approach (see figure above, which is typical of systems thinking) allows the ***modeling*** of policies for:

a) The food chain activities to be linked to their social and environmental context, which impacts and affects policies for:
   - Social and environmental welfare; and
   - Food chain activities—taking the feedback and two-way linkages into account.

b) Modeling the policies that control the behavior and actions of the actors in each section of the food chain, as they have their own interests and affect each other's behavior.

In summary, the present food system concept is a combination of the activities ("what we do") and the outcomes of these activities ("what we get").

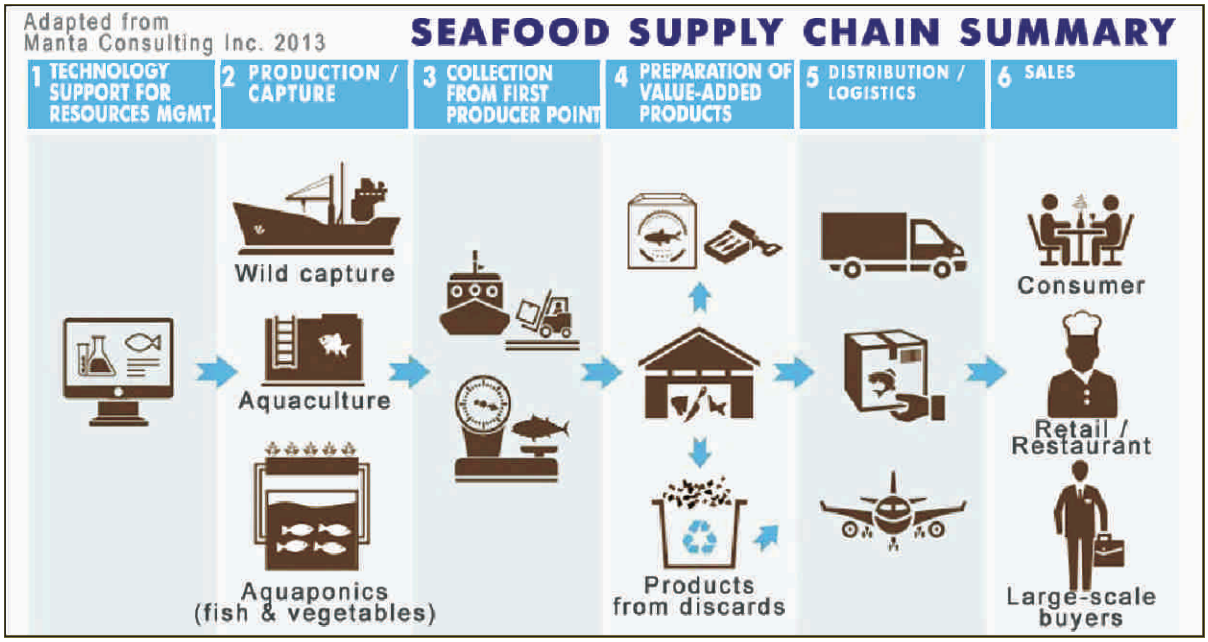
The 'combined' food system approach defines the full set of activities (not just the production aspects) and links these to a notion of food security 'unpacked' into its varied elements a la the FAO definition of food security.

As all the activities have interactions with natural resources, this approach allows a more thorough analysis of ***developing new and coherent policies and the links between food security and natural resources*** *on the one hand, and* ***revamping the existing set of countervailing and incoherent policies****.*

Seafood supply chain management

As a case study for seafood, the following infographic presents the salient points for the seafood supply chain, numbered over six vertical categories.

It should be noted that the consumption of exotic sea 'superfoods', such as seaweed and sea cucumbers, is very popular in many parts of the world, especially in Japan and China and other parts of the western world—but severely limited in India.



This is a socio-cultural trend that should be reversed in India, for the greater good of all. Eating of sea super-foods can quickly reverse the chronic malnutrition and food insecurity situation in coastal scenarios, such as the Sunderbans in West Bengal, which has the highest proportion of malnutritioned children in the State.

3. Food production systems for today's debate

System of Crop Intensification[13]

A sustainable intensification approach integrates research from multiple disciplines and combines a scientific understanding of agro-ecological systems with local knowledge[14] in order to produce more and better quality food, stimulate economic growth, and build resilience in the face of climate change, while using less seeds, water and land and relying less on fertilizers and agrochemical inputs. We shall explore several case studies to determine the specific needs for policy coherence, by analyzing the approach known as the *System of Crop Intensification* (SCI), and the *System of Rice Intensification* (SRI) in particular. The three main principles that govern this 'climate-smart agricultural approach', which first originated in the 1980s in Madagascar to benefit farmers with small landholdings, are:

(a) Build resilience by sustainably boosting agricultural yields and household incomes through different and better resource management (productivity);

(b) Support the transition to agricultural systems that are better suited to deal with climate-change stresses (adaptation); and

(c) Reduce greenhouse gas emissions from agricultural activities and their influence on land-use conversion (mitigation)[15].

Although SRI methods may be implemented successfully in very different cultures and climates, the pattern is the same: farmers are able to produce more rice using less water, seeds, agrochemical inputs, synthetic fertilizers, pesticides, herbicides, and often with less labor (once the methods are mastered). The net effect is to improve household incomes and food security, while reducing the negative environmental impacts of rice production, thus making food production more resilient. These methods are producing similar effects also with other crops such as wheat, ragi, sugarcane, mustard, and various legumes (grams).

Current practices for growing rice, or any other crop for that matter, mostly promote genetic uniformity, which makes crops more vulnerable to pests and diseases. They are also water- and energy-intensive. More than 60% of India's available water is used for single-crop paddy cultivation. Heavily fertilized and continuously flooded rice fields produce greenhouse gases that contribute to global warming, while misuse and overuse of inorganic fertilizers and agrochemicals results in soil degradation and water pollution. As growing rice is labor-intensive, women generally bear the major burden of work along with their other household and child-rearing tasks.

Following the dramatic increases in rice production achieved with Green Revolution technologies during the 1970s and 1980s, there has been a slowdown in the yield gains in many countries

[13] The contents of this section on sustainable intensification approaches are largely based on comments and inputs received from Professor Norman T. Uphoff (please refer to Annex-2 for a scholarly review of SRI by him) and Dr. Biksham Gujja.

[14] The importance and usefulness of reviving local knowledge—and the concomitant need for policy coherence to promote this trend—cannot be overstated. Research has revealed that most of the basic principles and practices of what is now known as 'sustainable intensification' existed in India a century ago, and farmers were aware of these practices to increase their yields well before the Green Revolution. Documents and training manuals in local languages, dating to 1911, which explain methods similar to SRI and with details of yields and other pertinent information, have been have been translated and published by the National Consortium of SRI.
http://www.wassan.org/sri/documents/SRI_Newsletter_April_May_2009_No_6.pdf

[15] See comment from Professor Mark Swilling on page 41.

including India, with additional synthetic fertilizer inputs encountering diminishing returns. SRI therefore represents an unprecedented opportunity for developing economies to enable households to be more productive, secure, and self-reliant, while buffering and even reversing the trends that contribute to climate change. This is a win-win-win situation for rural households, countries, and the planet. (See Annex-3)

Climate change adds to this challenge: Farmers will increasingly face unfamiliar and unpredictable conditions, such as heat stress, changing seasonal rainfall patterns, infestations by diseases and pests spreading into new areas, and sea-level rise leading to saltwater intrusion into aquifers and coastal agricultural lands. Melting of mountain glaciers causes flooding and erosion in the near-term, while depleting water reserves in the long-term. Many communities are also experiencing more frequent severe-weather events, such as droughts and floods. Ultimately, climate change puts the sustainability of agricultural development and food security at risk and aggravates hunger and poverty, particularly where farming conditions are marginal and social safety nets are weak.

Organic farming

There is no such thing as waste in natural systems

Organic farming is by definition: "*A system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives, etc) and to the maximum extent feasible relies upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives, and biological systems of nutrient mobilization and plant protection*". It aims at cultivating the land and raising crops in ways that keep the soil alive and in good health by use of organic wastes, such as crop, animal farm and aquatic wastes, and bio-fertilizers with beneficial microbes. These release nutrients to crops for increased sustainable production, in an eco-friendly pollution-free environment.

With the increase in population and the realization that the 'Green Revolution' with its high input use has not only plateaued but has diminishing returns, organic farming would help not only to stabilize agricultural production, but to increase it further in a sustainable manner. This is not the kind of stereotyped farming widely considered as regressive, but very modern methods of farming drawing on scientifically-established principles and on new knowledge and practices that complement and make more productive many older, time-tested methods of agriculture.

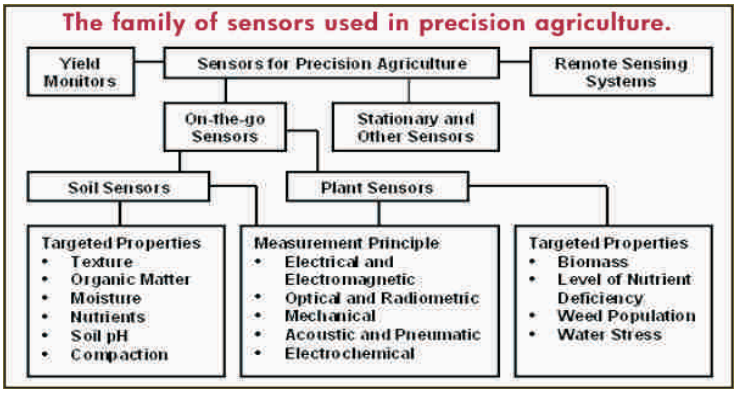
The key characteristics of organic farming include:

- Protecting the long-term fertility of soils by maintaining beneficial organic matter levels, encouraging soil biological activity, and careful mechanical intervention.

- Providing crop nutrients indirectly by using relatively insoluble nutrient sources which are made available over time to the plant by the action of soil micro-organisms. This can be considered as 'feeding the soil, so that the soil can feed the plant' rather than just 'feeding the plant' with short-run fixes that do not build up long-term soil system capacities.
- Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures. Most soils have large reserves of 'unavailable' nutrients that can be tapped through biological activity.
- Weed, disease and pest control relying primarily on crop rotations, natural predators, biodiversity, organic manuring, resistant varieties, and limited (preferably minimal) thermal, biological and chemical interventions.
- The extensive management of livestock, paying full regard to their evolutionary adaptations, behavioral needs, and animal welfare issues with respect to nutrition, housing, health, breeding and rearing.
- Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats. This has many benefits for agriculture, the most evident (and endangered) being the huge services of many species of pollinators.

Precision farming (PF)

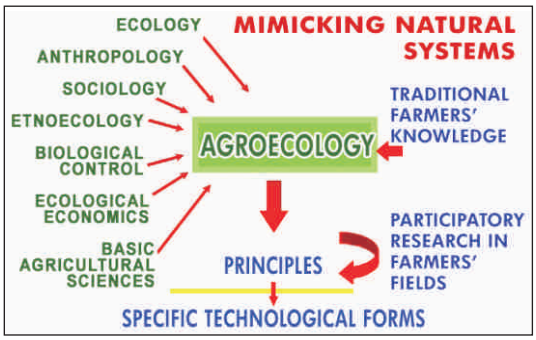
Precision farming is a systems approach to managing soils and crops to reduce decision uncertainty through better understanding and management of spatial and temporal variability. Success of precision farming is linked to the increased knowledge that a farmer needs of his natural resources in the field, including a better understanding of soil types, hydrology, microclimates and PF technologies, such as GPS and aerial photography.



High costs and knowledge demand, unavailability of many services, and uncertain benefits preclude widespread use of PF in developing countries. Also, the information utilized is primarily chemical and physical, so much current PF is concerned with biology only in output terms, not in terms of inputs to production.

The need for spatial and biological information is actually greater in developing countries, principally because of stronger imperative for change and lack of conventional support. A large body of spatial information exists in the developing world, much of it freely available. The policy incoherence challenge lies in overcoming issues of scale and uncertainty, and finding meaningful ways of delivering this information to farmers. There is also need to integrate soil biological factors and dynamics into analyses and interventions. First examples of this have emerged for fruit, tea and oil palm plantations. The much reduced cost of labour may in fact enable developing countries to obtain spatial knowledge at a lower cost than in developed countries, if coherent policies to promote PF can be institutionalized.

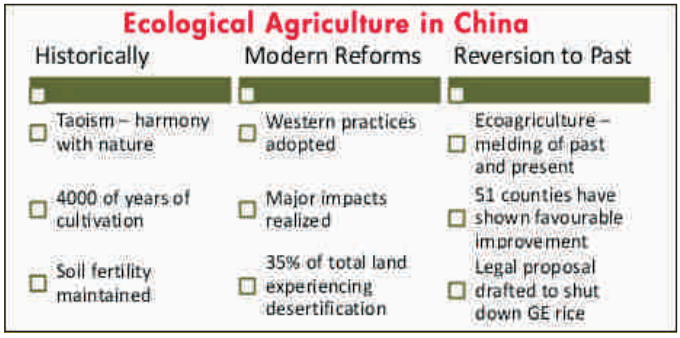
Agro-ecology approaches



Agro-ecology is the holistic study of agro-ecosystems[16], which means different things to different people. There is no single way to define or practice agro-ecology, but the concept unifies different groups of scientists, practitioners in the food system, and social movements. It became an interdisciplinary method of research to understand the:

- Ecological relationships and processes, so that agro-ecosystems can be managed to improve production and to produce more sustainably, with fewer negative environmental or social impacts and fewer external inputs; and
- Relation between science and society, emphasizing the interrelatedness of all agro-ecosystem components and the complex dynamics of ecological processes.

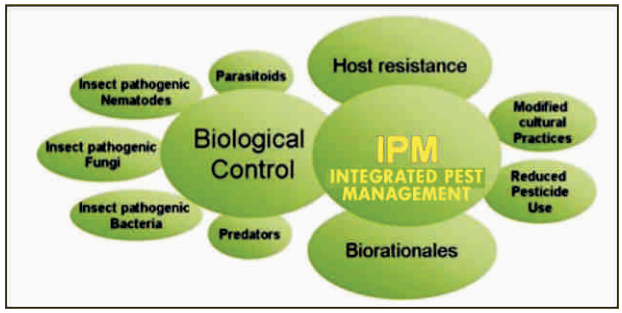
As a scientific discipline, agro-ecology *questions* the dominant (a) agronomic model based on the intensive use of external inputs; and (b) ecological model that separates the protection of biodiversity from the production of food. Thus it develops a new role for farmers as stewards of the landscape and biodiversity.



As a social movement, agro-ecology opposes the globalized effects of (a) the industrialization of agriculture: and (b) '*supermarketized*' economies that de-couple productive and ecological constraints. As an alternative, this social movement explores other ways of growing and distributing/marketing food, based on producer and consumer autonomy and on the prudent use of resources rather than trying to maximize consumption.

The design of such systems[17] is based on the application of the following ecological principles:

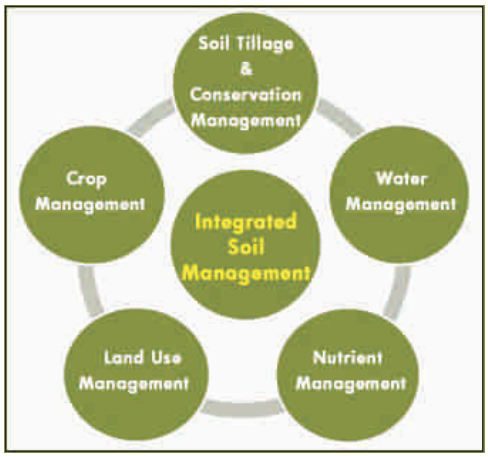
- Enhance recycling of biomass, optimize nutrient availability and balance nutrient flows;
- Secure favorable soil conditions by managing organic matter & soil biotic activity;



[16] A sustainable agro-ecosystem is environmentally sound, economically viable, socially just and meets the needs of the present without compromising the ability of future generations to meet their own needs.

[17] Systems thinking is a "*habit of mind*" and practice rooted in model making, which serve as useful descriptions, abstractions, and simplifications of important parts of reality, but are not the same as reality itself. ***Smart*** systems thinking can diagnose complex problems and deliver smart solutions with multiple benefits for both the planet and its people. Among these solutions that impact FNS: (a) a drive for universal access to electricity and clean water & air can lead the poor out of poverty, while saving lives and fighting climate change; and (b) a global push on education could deliver more brains fit to tackle technological challenges and embrace solutions for sustainable governance, better and healthier lives, empower women, leading to a smaller populations.

- Minimizing losses in the flows of solar radiation, air, and water by way of microclimate management, water harvesting, and soil management through increased soil cover;
- Species and genetic diversification of the agro-ecosystem across time and over space.
- Enhance beneficial biological interactions and synergisms among agro-biodiversity components, thus resulting in the promotion of key ecological processes and services.



The ultimate goal of agroecological design is to integrate components so that overall biological efficiency is improved; biodiversity is preserved; and the agro-ecosystem productivity and its self-sustaining capacity is maintained. The goal is to design a quilt of agro-ecosystems within a landscape unit, each mimicking the structure and function of natural ecosystems. From a management perspective, the agroecological objective is to provide a balanced environment, sustained yields, biologically-mediated soil fertility, and natural pest regulation—Integrated Pest Management (IPM)—through the design of diversified agro-ecosystems and the use of low-input technologies capitalizing on new knowledge and skills.

Agro-ecologists are now recognizing that intercropping, agro-forestry and other diversification methods mimic natural ecological processes, and that the sustainability of complex agro-ecosystems resides in the ecological models they follow. By designing farming systems that mimic nature, optimal use can be made of sunlight, soil nutrients, and rainfall.

Conservation Agriculture (CA)

CA is a concept for resource-saving agricultural crop production that is based on enhancing natural biological processes above and below the ground. Interventions such as mechanical soil tillage are reduced to an absolute minimum, and the use of external inputs such as agrochemicals and nutrients of mineral or organic origin are applied at an optimum level and in a way and quantity that does not interfere with, or disrupt, the biological processes. CA is characterized by three principles which are linked to each other, namely:

- Continuous minimum mechanical soil disturbance.
- Permanent organic soil cover.
- Diversified crop rotations for annual crops or plant associations for perennial crops.

Promoting and adopting CA management systems can help meet the complex goal of sustainably producing more food from less land through more efficient use of natural resources and with minimal impact on the environment in order to meet growing population demands.

Learning from Israel & China for production of micronutrients

Israeli experience of producing higher value-added micro-algae products, such as Dunaliella and Nannochloropsis, commercially using flue-gas desulpharisation (FGD), membrane technology and gas transfer from power stations, is quite extensive.

It is reported that the Israelis have transferred their technology to China, who have built the first major plant for producing higher value-added micro-algae products at Penglai (near Beijing) in 2011, spread over a 10 Hectare area, and at a cost of about US$10 millions (including a technology transfer fee of about US$3 millions). The production capacity is 700 tons per year (at the production rate of 20 grams/m2/day). Accordingly, micro-algae cultivation is transforming CO_2 and sunlight into fuel, food and animal feed products.

This approach should also be replicated in India. The National Thermal Power Corporation (NTPC) has power plants near the sea, which can be targeted for this kind of production strategies for micro-algae. It is reported that the flue-gases contribute to higher productivity, compared to use of pure CO_2.

Across China: Agricultural modernization reduces rural poverty

YAN' AN, Shaanxi, Feb. 25 (Xinhua)—Miao Yuchun, a farmer from Zichang County in northwest China's Loess Plateau, never imagined he would have a life of financial stability. The 33-year-old man was forced to drop out of high school due to poverty, and a botched attempt at growing tomatoes left him penniless, driving him to look for work in the city. However, Miao could not forget his farming roots, even when he was doing well in the city.

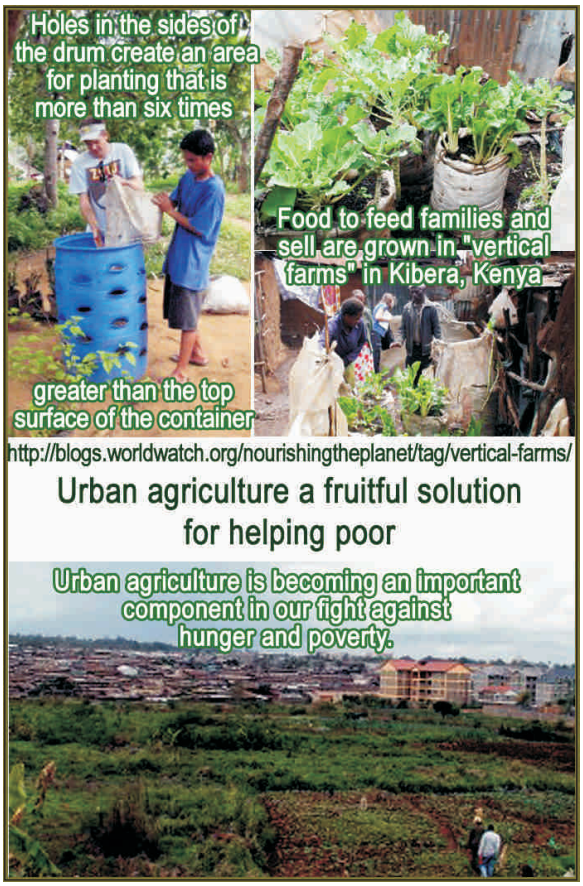
Three years ago, inspired by organic soilless cultivation, he returned to his hometown to grow strawberries. He enrolled on technical training programs organized by the local government, consulted with experienced farmers, and explored ways of improving his crops so they could meet "green product" standards. Miao's organic farm last year earned him 500,000 yuan (about 81,460 U.S. dollars) and he employed 15 people.

The government is encouraging more farmers to follow Miao's path out of poverty through agricultural modernization, helping farmers change to either industrial, intensive farming or organic, sustainable agriculture. Top policymakers have called for more efforts to modernize agriculture, boost farmers' consumption and spur rural investment. In response, the central government earlier this month, pledged to develop agriculture with a balanced emphasis on quality and quantity rather than high output, which comes at the cost of resource depletion. It also promised to boost policies that would benefit farmers, deepen rural reforms and strengthen the rule of law in rural issues.

The Communist Party of China's (CPC) flagship magazine "Qiushi" last Monday published an article by Premier Li Keqiang that advocated agricultural modernization. Li wrote that agricultural modernization could stabilize economic growth and promote structural transformation. Tian Guangping, a sweet potato farmer in Ganguyi Town, Yan'an City, could benefit from the push. With techniques passed through generations and soil particularly suited to sweet potatoes, Tian made 90,000 yuan last year from a half hectare plot of rented land. However, Tian has big dreams. The government in his town plans to launch a 24-hectare organic sweet potato farm. He hopes to be involved in the project so his sweet potatoes can be labeled "green products", as the domestic market is preoccupied with food safety concerns.

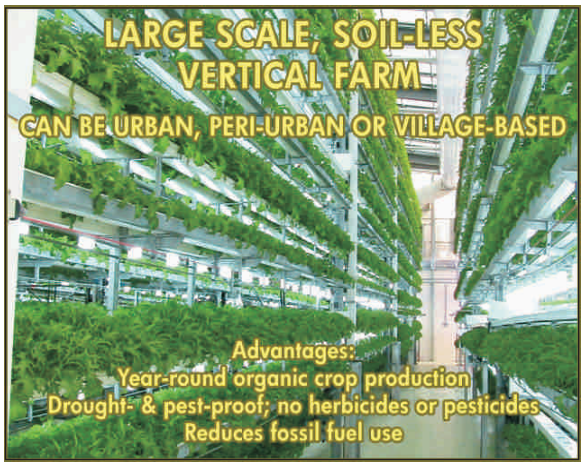
Unconventional modern solutions for urban agriculture

Without proven alternatives on food security—their crucial use, strategies and complex management schemes—the world is unprepared to cope with food or climate emergencies.



It is projected that between 50% - 70% of people will live in urban and peri-urban areas by 2050. Going by current thinking and policies—principally those handed down from yesterday's 'Four Pillar' doctrine and other similar approaches—this implies that massive quantities of food will need to be transported from food-growing hubs in the rural areas to the food-consumption centers in urban/peri-urban areas and large rural towns—to prevent them from becoming '*food deserts*', defined as urban neighborhoods and rural towns without ready access to fresh, healthy, and affordable food. At least from an energy point of view, this approach is unsustainable. And this looming catastrophe is not even a part of policy debates in India today.

One such approach is a commitment to create local sustainable economies around small-holder and urban artisanal farmers, with democracy based upon self-governing principles. Again, there is no established policy in place that encourages the creation of either smallholder urban farmers, or local sustainable economies. Without a serious effort by government to address the issue of '*food deserts*' in urban and peri-urban areas, we could slide into chronic imbalances in social and environmental problems. Failures in this realm could be the first to land humanity in sudden catastrophic outcomes, as food riots, climate change, and other social and environmental imbalances lead to societal collapse.



As a critical response to food insecurity in urban cities, environmental stress, climate change, and social inequity, we need 'out-of-the-box' thinking for modern and effective solutions to the problems of growing and distribution of food—in both urban and rural environments—which will meet the goals of Sustainable Livelihoods and Development.

The *possible solutions*: Arable land is being depleted at the same time that the need for nutritious food is increasing. What if solutions to this crisis could be found so that fish and vegetables could be

grown using one-tenth of present water and land resources, with negligible carbon footprint as compared to current, soil-based agricultural practices? And what if these solutions take advantage of unused and/or abandoned, built-up environments in the cities themselves, and result in multiple ways of using and occupying the space? This is not as fantastic as it sounds.

Aquaponics

Aquaponics is an *eco-friendly, efficient and effective alternative* to traditional farming, which is becoming recognized as neither safe nor economically/environmentally sustainable, due to excessive use of chemicals and depletion of natural resources, both land and water. Conceptually, Aquaponics is a paradigm *shift* in the way that fish and vegetables are traditionally grown, transported to the markets and points of purchase, and consumed.

In Aquaponics systems, the nutrient-rich water from growing fish in a *re-circulating* and *soil-less* system provides a source of natural fertilizer for the growth of plants, *organically*. Plants absorb the nutrients and bio-purify the water that the fish live in. The growth of useful bacteria in this '*bio-mimicry*' system promotes the proliferation of natural microbial processes which allow the fish and plants to grow in a natural and symbiotic relationship. The advantages of Aquaponics are:

Water Reuse: Aquaponics systems are completely contained systems that reuse most of the water from the fish holding tanks. Fish wastes are removed, and the water is recycled back to the tanks. Water loss during waste removal/evaporation is typically 1-1.5% of the total volume of water.

Space and Production Efficiency: The productivity is higher than in conventional aquaculture, while allowing for optimal year-round growth. Market-sized fish can be produced in 9 months compared to 15-18 months in conventional fish farms, *using about one-tenth the land and water resources needed in traditional farming*.

Bio-security: Aquaponics fish farms, which are fully closed and controlled and operate without any inputs of chemicals, drugs or antibiotics, are bio-secure—as diseases and parasites cannot get into the system, and wastes have no adverse effects on the environment.

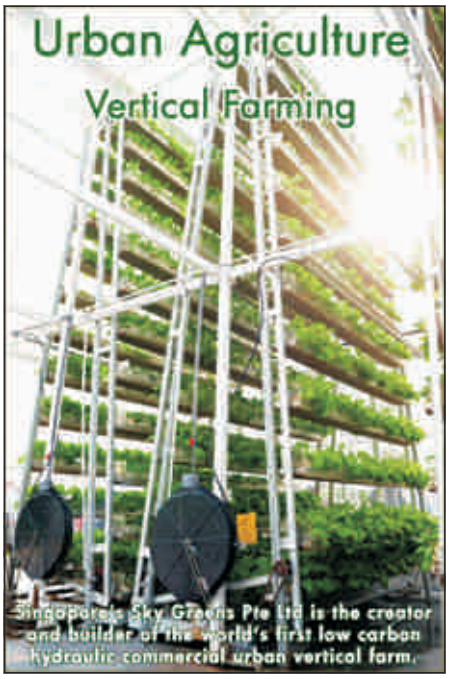
Hydroponics

Hydroponics is a technology for growing plants in nutrient solutions (water containing fertilizers), with or without the use of an artificial medium (sand, gravel, vermiculite, rockwool, perlite, peat moss, coir or sawdust) to provide the mechanical support for the plants. Liquid hydroponic systems have no other supporting medium for the plant roots: aggregate systems have a solid medium of support. Hydroponic systems are further categorized as either open (i.e., once the nutrient solution is delivered to the plant roots, it is not reused) or closed (i.e., surplus solution is recovered, replenished, and recycled).

In combination with greenhouses, it is capital-intensive technology that is also highly productive, conservative of water and land, and protective of the environment. For most of its employees,

hydroponic culture requires only basic agriculture skills. Since regulating the aerial and root environment is a major concern in such agricultural systems, production takes place inside enclosures designed to control air and root temperatures, light, water, plant nutrition, and adverse climate.

There are many types of controlled environment agriculture (CEA)/hydroponic systems, in which each component is of equal importance, whether it be the structural design, the environmental control, or the growing system. Not every system is cost-effective in every location. All too often, importance is given to only one or two of the key components, but the system can fail due to lack of attention to any one of the components. If improper attention is given to the greenhouse structure and its environment, no hydroponic system will prove economically viable. While hydroponic and CEA are not synonymous, CEA usually accompanies hydroponics. Their potentials and problems are inextricable.



Urban agriculture and vertical farms

A global trend in the food and nutrition security (FNS) debate is the shift to an urbanized world, which was 3% in the 1800s, rising to 15% in 1900, to 30% in 1950 and onward to 45% in the new millennium, expected to be an estimated whopping 70%-75% by 2050! Demand for FNS coming from cities, which have major pockets of 'food deserts' at present, will require transporting roughly 70%-75% of the nation's food production from rural to urban centers. This is unsustainable from the logistics, infrastructure and energy requirements, and will require coherent policy formulations.

Many OECD countries, including nearby Singapore and Qatar, as well as private facilities in New York, London, Berlin and other major western cities, are experimenting with **Urban Agriculture** (**UA**) based on massive **Vertical Farms** (**VF**), powered by Hydroponics and Aquaponics systems, as well as traditional soil-based systems. New ideas to turn cities from 'food deserts' to 'food farms' are underway in OECD countries, but not in developing economies.

Vertical (Skyscraper) Farming is an ambitious idea attributed to Professor Dickson Despommier, Columbia University. His idea for temperate climates requiring green houses, envisages building a glass skyscraper made up of many

Advantages of Vertical Farming (VF)

- Year-round crop production; 1 indoor acre = 4-6 outdoor acres or more, depending upon the crop;
- No weather-related crop failures due to droughts, floods, pests;
- Grown organically, with no herbicides or pesticides;
- Eliminates agricultural runoff by recycling gray water;
- Adds energy back to the grid via methane generation from composting of non-edible parts of plants;
- Reduces fossil fuel use (no tractors, plows or trucks)

With Aquaponics and/or Hydroponics and a controlled interior climate, VF can grow nearly any kind of food, anywhere, year round, shielded from weather and seasonal extremes. Yields are claimed to be 15-20 times greater than conventional, soil-based farming. These innovative developments bring the farm to the city, where the people live, and if implemented on a large scale, could go a long way toward improving food security in cities.

floors of fields and orchards. Inside, the temperature, humidity, airflow, lighting, and nutrients would be controlled to create the optimum conditions for plant growth. A conveyer belt would rotate/ move crops on vertically-stacked trays around the windows to ensure an even amount of natural light. Unfortunately, plants farthest from the windows would receive less sunlight and grow more slowly. Thus additional light needs to be provided artificially to prevent uneven crop growth, and the energy required for this lighting will significantly increase food production costs.

Developing countries in equatorial and sunny climates, such as India, however, are blessed with a favorable climate for growing fish and vegetables naturally, without the need for such expensive climate and light control arrangements.

Edible landscapes and 'guerilla gardening'

Where our food comes from is becoming more and more critical to our health and well-being. Growing food on our own land is a healthy, economical, therapeutic and satisfying endeavor. Edible plants in our landscape give a return on investment that is both smart and delicious.

When we grow our own food, we create a more sustainable world. Meanwhile, large-scale food production has unfortunately become a money-driven business instead of a health-driven business. Non-renewable resources are used to transport food over long distances, causing a third of all man-made emissions, while losing quality, nutrients and freshness in the process. Edible landscapes by artisanal farmers are an answer.

Guerrilla gardening

Forget about the pretty shrubs and flower beds. The new thing is edible parks. '*Guerrilla gardeners*' are planting in vacant, neglected public lands, and everyone is welcome to help in the growth process. Some fruits, vegetables and herbs are used collectively by the gardeners, and the excess is donated to the poor. Some are managed with the concept of food going entirely to the needy. The gardens are maintained by neighborhood groups and non-profits, and the harvested produce is consumed locally. The economically-challenged and hungry people in the community have a standing invitation to participate and take what they need.

This is perhaps an exciting phase in human development, where literally everyone, including even the scientists, experts, policymakers and rapporteurs who have been turning out millions of pages and megabytes of information on how to combat hunger, poverty and FNS, can literally take a spade to the problem, and let humanity turn the corner in the newest food revolution. To own an edible landscape in a personal space or be the guerilla manager of a public eco-park will not only contribute positively to resolving FNS problems through personal initiatives and responsibility, but will contribute to urban greening.

Can India afford to ignore the stark reality of the demographic shift in migration to urban areas? Do we have enough trucks, fuel, roads to transport that much of food between rural food production hubs and urban consumption centers? And can we absorb the GHG emissions or the spoilage? These are questions with very worrisome answers.

Urban Agriculture and Vertical Farming does not necessarily mean that we have to leverage sophisticated, energy guzzling and expensive technologies adopted by OECD countries. As shown in the collage above, to get started, various economical and indigenous approaches have been successfully tried by entrepreneurs in developing economies such as Kenya, Philippines and India, to develop fruitful solutions, which can also help the poor.

Policy Coherence for Food and Nutrition Security

Conference participants highlighted the need for more policy coherence[18] and ecological integration around food and nutrition, livelihoods, water, energy, shelter, health (including sexual reproductive rights) and education, as the best hope to improve economic development. Coherence will ensure socio-economic development while also protecting human health and the environment.

It was recognized that, whereas food security provides an assured supply and access to affordable and adequate food, nutrition security[19] incorporates the consumption, across the life-time, of healthy nutritious diets that are based on international nutrient recommendations and food-based dietary guidelines. For example, nutrition security for infants can only be achieved if their mothers´ eating patterns before, during and after pregnancy ensure appropriate weight gain, exclusive breastfeeding for the first six months and appropriate complementary feeding until two years of age. Optimum growth, development and learning ability of children depend not only on healthy and nutritious diets, but also having access to affordable and quality health care, sanitation, shelter and family care.

Global agricultural policies should facilitate a stable environment that encourages alternative and successful agricultural systems to take root and to grow, such as systems that become: (a) net energy sources, instead of net energy users; (b) low water footprint; (c) highly productive per unit of land area; and (d) improve soils over their initial state. To promote and foster such emerging systems, global agricultural policy should:

- Provide extension of systems that meet at least these four criteria, particularly in:
  - Developing countries where energy, water and food scarcity will first be felt
  - Urban areas, where land scarcity and local food production close to market is needed
- Institute an international grain reserve to avoid price volatility and food scarcity.
- Use alternative sources of energy to reduce use of fossil fuels, and
- Countries to have the right to food sovereignty and set their own food policies.

Food and Agricultural Policy Framework

A food policy provides a basis for the establishment of national food safety objectives and requirements, and guidance for the application to specific sectors of the food continuum—production, processing, storage, transportation and marketing. Agricultural policies describe a set of laws to address domestic agricultural issues and regulate the import of foreign agricultural products. The goal is to achieve specific agricultural outcomes, such as a guaranteed

Large corporations have lobbied to stop reforms that would improve human health and the environment, but hurt their profits. For example, proposals in the USA in 2010 for a voluntary code of conduct for the livestock industry that would have provided incentives for improving standards for health, and environmental regulations, such as the number of animals an area of land can support without long-term damage, were successfully defeated due to large food company pressures.

[18] Policy coherence means different policy communities working together in ways that result in more powerful tools and products for all concerned. It means looking for synergies and complementarities and filling gaps among different policy areas, so as to meet common and shared objectives.

[19] Nutrition security exists when all people at all times consume food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health, education and care." Nutrition insecurity is the opposite of this state.

supply level, price stability, product quality, product selection and land use and employment issues. Agribusiness interests perhaps have the greatest influence over policy making, in the form of lobbying and campaign contributions, followed by consumers, trade lobbies, political action groups and labor unions.

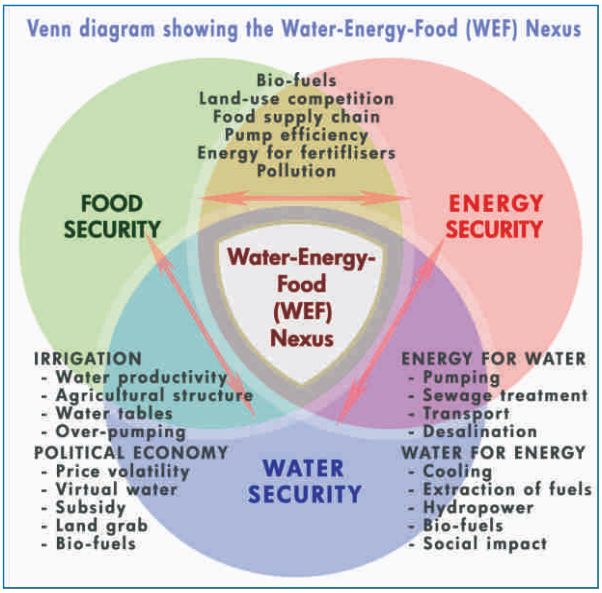
Food and agricultural policies are the set of government decisions and actions relating to domestic agriculture and imports of foreign agricultural products. Governments implement agricultural policies with the goal of achieving a specific outcome in the domestic agricultural product markets and have an important role in establishing framework conditions that complement and encourage responsible private investment. Some overarching themes include risk management and adjustment (including policies related to climate change, food safety and natural disasters), economic stability (including policies related to taxes), natural resources and environmental sustainability (especially water policy), research and development, and market access for domestic commodities (including relations with global organizations and agreements with other countries). Agricultural policy can also touch on food quality, ensuring that the food supply is of a consistent and known quality, food security, ensuring that the food supply meets the population's needs, and conservation. Policy programs can range from financial programs, such as subsidies, to encouraging producers to enroll in voluntary quality assurance programs.

Water, energy and food (WEF) policy nexus

The Water-Energy-Food (WEF) nexus is complex and disturbances in any one sector will have serious implications on the other two. Alternatively, any policy that focuses on only one part of the food-water-energy nexus, without considering its interconnections, risks failure, as the intense competition for resource access can easily provoke internecine conflicts.

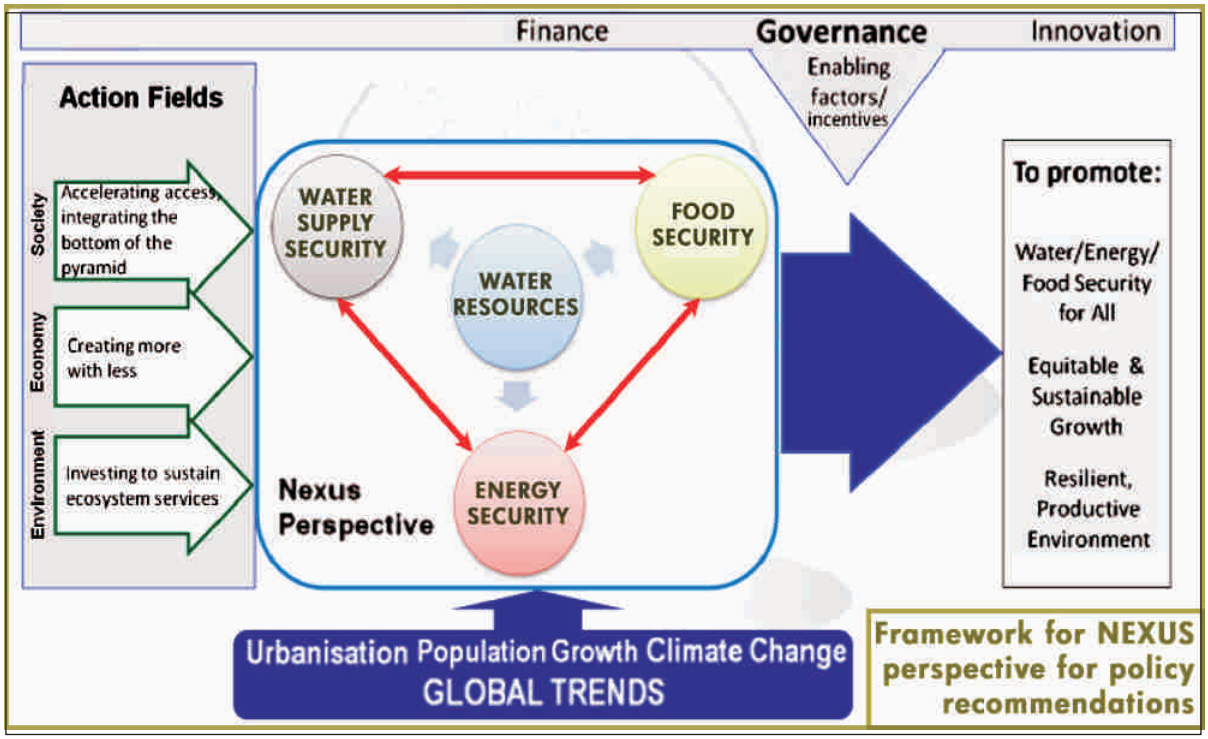
As an example, a framework to help us understand their applicability to, say, land and policy development issues, is discussed next. The current and future challenges in water, energy and food security—individually and across inter-relationships—indicate that the WEF nexus needs to be integrated and addressed in tandem to improve our knowledge of the following:

- The nature of the relationships among the three elements.
- The consequences of their changes and changes in other sectors.
- The implications for policy development and actions for addressing the three securities.



A nexus-oriented approach is needed to address unsustainable patterns of growth and to proactively address the causes, rather than the symptoms, by identifying effective points for intervention in underlying structures and systems. An actionable framework should take a holistic, rather than narrowly sectoral, approach, to reduce unintended consequences and trade-offs, while generating additional systemic benefits. It should also address other elements that are directly dependent on WEF, or mediate between them and human well-being, such as the diversity of natural or cultivated species.

In this context, the BONN2011 NEXUS Conference suggested a framework for policy recommendations shown in the figure below, as an approach that is centred on water supply, energy and food security, all connected to available water resources, as well as the influence of trade, investment and climate policies.



It accounts for global trends including urbanization, population growth and climate change. Using finance, governance and innovations as enabling factors and incentives, the goal is to promote (a) water, energy, food security for all; (b) equitable and sustainable growth; and (c) a resilient, productive environment. This goal could be achieved through action fields and specific measures by accelerating access and integrating the bottom of the pyramid (society), by creating more with less (economy), and by investing to sustain ecosystem services (environment). It also suggests specific measures to support the transition to sustainability, by reducing trade-offs and generating additional benefits that outweigh transaction costs associated with stronger integration across sectors.

Some of the policy areas may include: (a) increasing resource productivity; (b) using waste as a resource in multi-use systems; (c) stimulating development through economic incentives; (d) governance, institutions and policy coherence; (e) benefiting from productive ecosystems; (e) integrated poverty alleviation and green growth; and(f) capacity building and raising awareness.

The WEF nexus extended to 'compost-cum-biogas' toilets

The *Swaatch Bharat* initiative and providing toilets for almost 50% of India's population is an emotive issue—for almost 600 million people defecate in the open fields. Whereas studies conclusively show that soil and water becomes contaminated with open defecation, amongst other grave health issues, perhaps we should recall that the open defecation (OD) practice was once considered useful in much older times, as a source of natural soil fertilizers, when the practice was naturally sustainable. If the natural fertilizers from 600 million open defecators are overnight channeled into ordinary rural toilets and 'lost', what is the impact on the nation's natural soil

fertility? How many artificial fertilizers will we need to buy or import to offset the loss of natural fertilizers?

While nobody is suggesting that we encourage open defecation merely to obtain soil fertility in a dubious way, one object of coherent policy making is to turn weaknesses into strengths and threats into opportunities.[20]

Therefore, the '*weakness*' of loss of natural fertilizers if people stop open defecation, coupled with the '*threat*' of soil and water contamination and health issues with open defecation, could be turned into ***strengths*** and ***opportunities*** for village-based development, if the policy of constructing ordinary toilets was replaced with a policy to construct compost toilets for 600 million people, *which would not only transform the once loathsome waste into valuable compost, which could by itself spawn a whole new industry and rural livelihoods scheme*, but with a few other changes, *could also be the source of biogas for lighting and cooking in villages*. The specious argument that a ***compost-cum-biogas*** toilet is far too expensive is just that: specious—because our knowledge of scales of economy and the learning curve suggests that a *compost-cum-biogas* toilet, made at the scale for 600 million people, would rapidly approach the cost of an ordinary toilet, but provide an infinitely greater '*benefit-to-cost*' ratio, which should be immediately calculated, considering the whole array of contingent benefits and externalities involved with this simple idea .

Policy Coherence and Intersectoral Balance

A good balance in investments, say, between the agricultural sector and industry, or between services and natural resource extraction is critical for the economy to grow in an optimal and sustained manner. A balanced economy is a necessary condition for sustainability, and is possible when there is coherence amongst the policies adopted for different sectors.

The "silver bullets" including the various activities that can help bring supply of food into some balance with the demand for it, are necessary and extremely important.

The many conferences each year that reiterate them testify to the broad recognition of how essential these traditional thrust areas are, particularly in the right combinations. But they are not enough. We now need to address the requirements of today and tomorrow and focus on the coherent policies needed to

Urban agriculture is an important policy debate for India, which is lagging far behind many OECD nations that have embraced this concept, keeping in mind that 50 to 70% of our population will soon live in urban areas, which are *food deserts* at present. Without new food policies, the 'Four Pillar' doctrine of FAO and similar conventional approaches imply that massive quantities of food will need to be transported from rural food growing hubs to urban food consumption centers. From the energy policy point of view, this is unsustainable, considering also that:

- One-third of all food produced in India is spoiled and rendered useless before it reaches the dining table.
- Supply-chain mechanisms lack infrastructure and are impeded by a system of middlemen who delay delivery, force up prices and introduce big frictional losses.
- Conventional agriculture produces about a third of all GHG emissions.

[20] In the 1960s, Prime Minister Mr. Lee Kuan Yew made it official policy in Singapore to plant trees so as to enhance the catchments of water from rainfall. Soon after, he realized that instead of planting just ordinary trees, the nation would profit immensely, from socio-economic and environmental benefits of having more fruits for 'free' and biodiversity expansion, if they planted fruit trees instead. So, the slogan went from "Plant more trees" to "Plant more fruit trees". Just the addition of one word in a policy document was very, literally, fruitful. In a similar vein, 'thinking-out-of-the-box' for planning on compost-cum-biogas toilets could impact the food-water-energy nexus in a major and unimaginably fruitful way.

promote new technological innovations, which will enable humanity to leapfrog over yesterday's obstacles that limit growth.

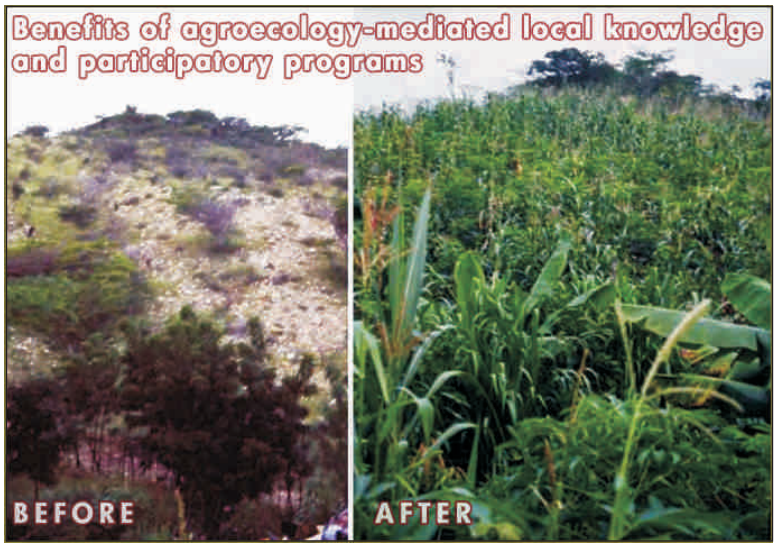
Current examples abound: The astonishing productivity increases made possible by SRI for growing rice, while also scoring high on equity and environmental health. Or, similar gains by Organic Farming that rewrite the equations for quantum leaps in naturally enhancing soil regeneration and food quality with lower carbon and water footprints. Or, Aquaponics, which introduces new possibilities for organic, soil-less agriculture and vertical farming, thereby opening up vast new urban and peri-urban spaces for robust urban agriculture, requiring only one-tenth of water and land resources.

On the other hand, policy incoherence in India's political economy is highlighted by questions, such as: ***why grow rice, a highly water-intensive crop, in Punjab and Haryana which lie in the country's arid zone?*** Diesel and power have been subsidized to the farmer—an important vote-bank—over several decades. Near zero marginal cost power supply remains. Coupled with attractive minimum support prices (MSPs) and policy directives to FCI to procure the bulk of its rice supplies from these two states, an irresistible economic incentive is created for the farmer to grow rice, rather than the alternatives – maize, other grains, pulses, horticulture, that are more suited to the natural ecology of the region. This policy incoherence not only contributes to food insecurity for future generations, but causes air pollution from inappropriate burning of the straw on site, water table falling from less than 10 m to 500 m, while the subsidy on power increases continuously and is met from the state budget.

Research and innovation are urgently needed for improving crop productivity, crop protection from pests, diseases and weeds, sustainable livestock farming and new technologies such as nanotechnologies, genomics, vertical farming and micro-electronics.

New and unfamiliar ideas must be fully supported to allow rigorous testing, even when viewed skeptically by the scientific establishment. The time has come to recognize that, much as in nature, breakthroughs can only occur by nurturing emergent ideas and allowing the fittest to survive and grow.

Hence, the policy coherence debate continues …



Going beyond the food productivity debate

It is becoming clear that the timeworn '*produce more food*' debate to combat the food and nutrition security issue is passé. The debate needed today revolves around a number of bold and innovative approaches, which requires our clichéd ability to '*think out of the box*':

Putting the last first

Central to this must be a firm national commitment to '*putting the last first*', or in Mahatmaji's words, to the *antodaya* – not merely as a moral or ethical obligation but as a social, environmental and economic sustainability imperative in the interest of all.

Measures taken to enhance direct access to food are more likely to benefit the '*antodaya*' if these are embedded in general social safety net programs, which include income transfers for those chronically unable to work—because of age or handicaps—and for those temporarily affected by natural disasters or economic recession. These options include:

- Targeted direct feeding programmes, which include Mid-day Meal Scheme (MDMS)[21] ; feeding of expectant and nursing mothers as well as children under five through primary health centres, soup kitchens and special canteens.
- Food-for-work programmes, such as MGNREGA, which provide support to households while developing useful infrastructure such as small-scale irrigation, rural roads, buildings for rural health centres and schools.
- Income-transfer programmes, which can be in cash or in kind, including subsidized rations and other targeted measures for poor households.

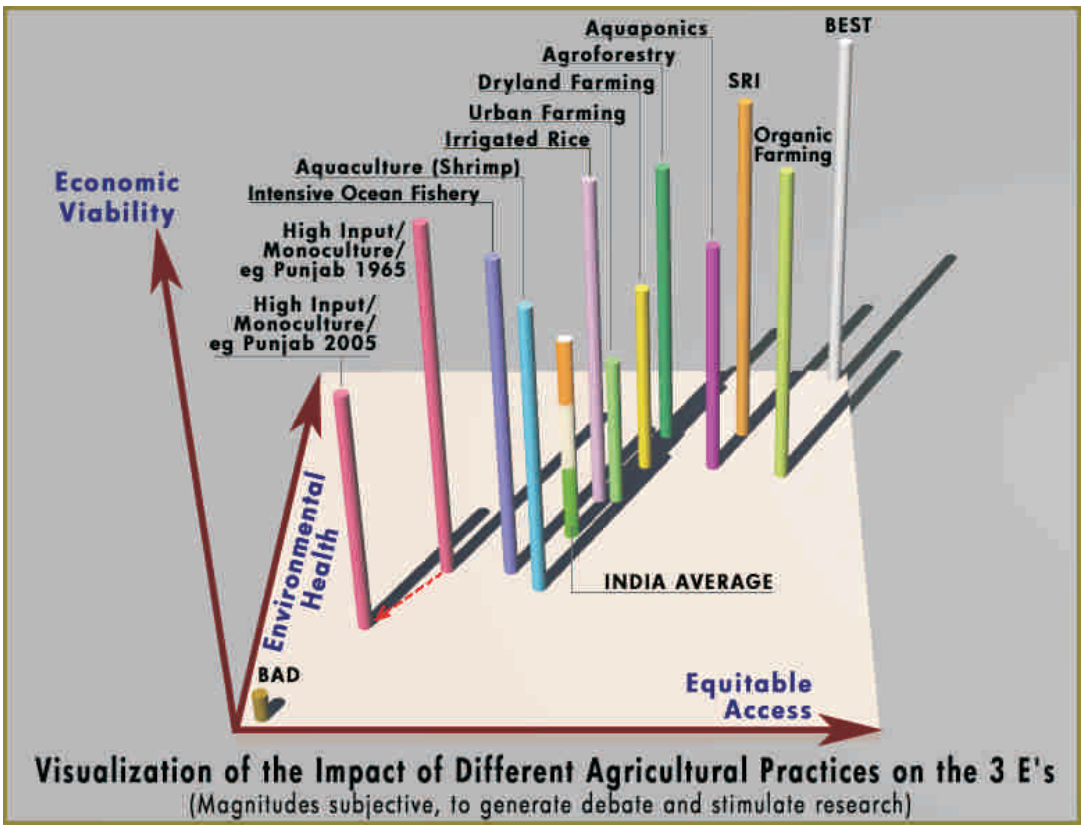
New models for the continuing FNS debate

When reliable and objective data is available on these patterns of activities, we can develop effective models to make reasonably accurate predictions on the effective mix of activities which will enable us to meet our central goal of providing food and nutrition security for all. For example, a 3D visualisation of a number of typical attributes is indicated in the image in the following page, with imputed values that are indicative and open to discussion and change.

This visualization can help decision and policy makers to discern the robust and effective policy initiatives needed to achieve the goal of food and nutrition security for all. It is instructive to note that several of the nascent innovations of SRI, organic farming, dry land regeneration and Aquaponics mentioned previously, are placed at the top right corner, signifying high sustainability credentials.

Based on such representations of the attributes of the 'Food & Nutrition Security' debate, we may use various modeling approaches, to simulate the trajectory of food security outcomes in terms of time and space variations. This would enable researchers to get a handle on the sensitivity of food security to various changes in the economic, social or bio-spheric environment, and provide sensible information for decision and policy makers.

[21] The MDMS, revised and universalized at the primary level from 1 Sept 2004 and extended to the Upper Primary School level from 1 Oct 2007, was intended to cover about 180million children by 2008–09. However, MDMS has systemic problems with financial allocations, abysmal quality of food and widespread corruption. The Sixth Report of the Commissioner appointed by the Supreme Court points out inadequate infrastructure; majority of schools lack a separate kitchen, and teachers having to prepare meals instead of teaching.

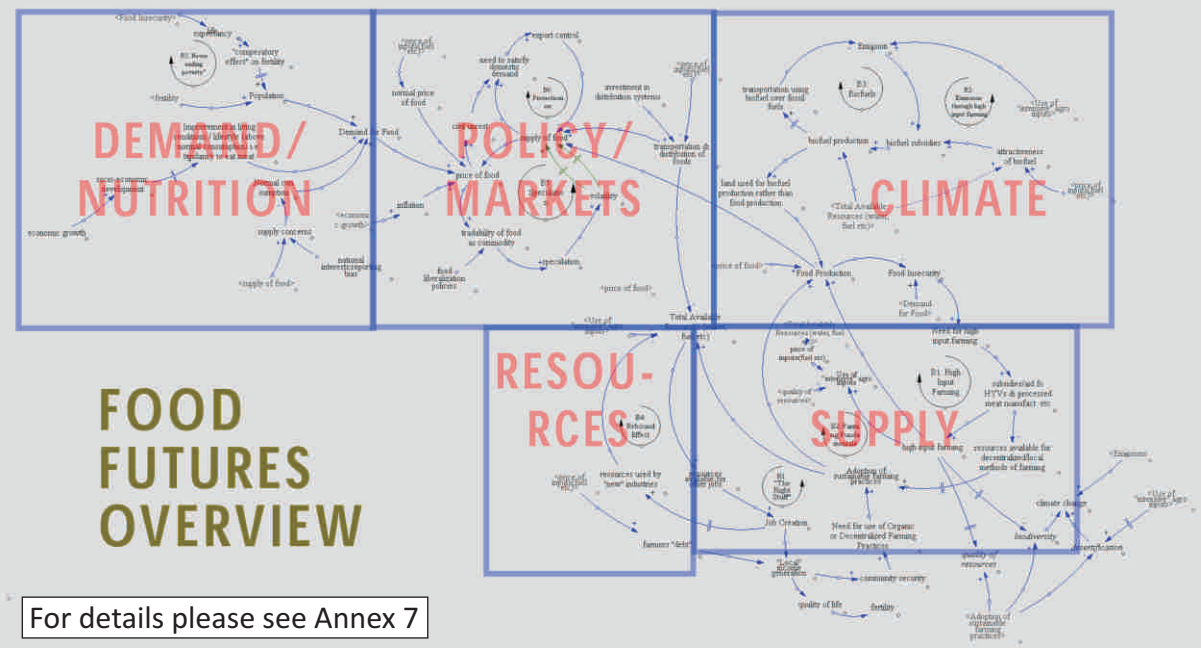


Of particular interest is the impact on '*High input/Monoculture e.g.Punjab 1965*', where it is showing the highest economic value, versus its state in '2005', where its economic value is lamentably lower, and even worse are its impact on the '*Equitable Access*' and '*Environmental Health*' scales. This loss in status is contributed by many of the factors stated in the failure of the first "Green Revolution" model.

The issues are complex, yet amenable to simple, logical analysis, as the chart below, which describes the linkages between the many factors that affect food security. It shows clearly that there is an urgent need for strengthening the databases and inventories of existing policies that impact food and nutrition security. This will aid in leading to the creation of a matrix of attributes, where each coefficient will map the degree of coherence, or the lack of it, between each policy. This dynamic model will help to quantify the extent of policy and regulatory incoherencies, and provide inputs for institutional policy reform that will lead to coherent practices—a goal that needs the widest possible cooperation.

Policies however, are often made with an eye on vote banks and pacifying or benefiting certain constituencies whether the poor masses or the industry – longer term sustainability benefits will need to be linked with or factored in the politics of policy making. This may require identifying the winwins and how to package them for the greatest impact.

We may conclude that identifying the policy issues related to the three fundamental values of sustainability—equity, environment and economy—whether they are intra-sectoral within the food security nexus domain or extra-sectoral, must be carefully made explicit to enable a meaningful public debate.



For details please see Annex 7

While domain experts often have valuable insights (particularly on what has or has not worked in the past), they often tend to have rather conventional, narrow and somewhat restrictive ideas on what should be tried for the future. The need today is for brave and massive innovation – innovation in technologies, institutions, approaches and policies that mutually reinforce each other. And this requires people who can communicate across disciplinary and sectoral borders. **We therefore now need widespread consultation with scientists, academics and practitioners, government officials, businesspersons, civil society groups, and the wider public to give advice of value to governments, corporations and other decision makers on**:

Pricing of various resources (*policies that counteract FNS*)

Policies and actions that grossly distort the pricing of various resources, leading to suboptimal use of these resources and losses to the sector and the national economy include:

- Perverse subsidies – such as for energy, water, fertilizer, transport
- Technology choice – short-term benefits vs. long-term costs
- Inter-state tariff barriers
- Job and income generation schemes
- MGNREGA
- PDS procurement prices
- Land use policies that add to the vulnerability of farmers to minimise risk to crops from natural disasters
- Land use policies to prevent hijacking of fertile farmlands, urban or infrastructure development

Willingness to invest (*changes needed to promote greater coherence*)

Policies that influence, positively or negatively, the willingness, of farmers or businesses to invest in food production and downstream activities such as:

- Security of land ownership and tenure; inheritance laws that promote farm fragmentation
- Improving ecosystem services such as forests, watersheds, coastal zones, mountains and glaciers,

grasslands, etc., through appropriate laws and community based institutions

- Incentives and disincentives for cash crops, bio-fuels, agro-forestry and other changes in products and production systems
- Promotion of mechanization, chemicalization and financialization in agriculture and downstream activities
- Market pricing distortions due to hoarding, exports and other administrative, regulatory or legislative failures
- Minimum support prices for crops desired for food and nutrition security, resilience to climate change and reducing risks from extreme events (e.g., financing shifts to new cropping patterns, diversification and flood protection)

Other policies that affect food security (*innovations for greater FNS*)

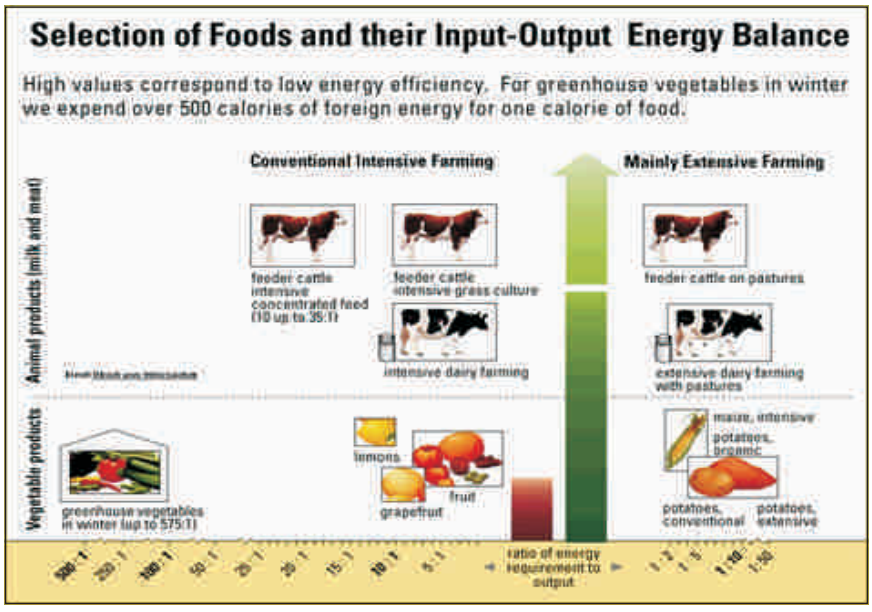
Policies that affect the food security of the population:

- Economic and fiscal policies that maintain or exacerbate economic disparities, and particularly poverty
- Trade policies in all sectors, not just on importing raw materials needed for producing agricultural inputs and for exporting food products (e.g., critical assessment of subsidies for export oriented produce, need for secure access to key foods)
- Energy, environmental and other policies, or the inadequacy thereof, to mitigate or adapt to climate change and its impacts on food security (e.g., biofuels and – or versus – food, extensive agriculture vs. input-intensive agriculture)
- Infrastructure development policies and programmes, especially for irrigation, storage, distribution, etc (e.g. salinisation of soils, spread of diseases)
- Policies and investments in research, especially in areas with clear private benefits such as GMO trials.

In identifying the policy issues that need to be examined and possibly modified, whether they are intrasectoral within the food security nexus domain or extrasectoral, their relationships and commitments to the three fundamental values of sustainability – commitment to equity, environment and economy – must be carefully made explicit to enable a meaningful public debate.

For example, as the chart on the right shows, the energy intensity of the chain of agriculture and food from land to table has, over the past six decades, evolved through several orders of magnitude in energy use.

Simply put, the chart shows that the extensive farming practices employed by the grandmother of today's modern farmer



(represented by the right side of the chart) produced 50 calories of food energy for every calorie of input. Today's modern farmer, who has drifted to the intensive farming and food processing methods depicted on the left side of the chart, produces 1 calorie of food energy for the several hundred calories of inanimate energy he puts in. Within half a century, the farming practices currently attracting policy support now use three orders of magnitude (one thousand times) as much energy than the ones that actually produced much healthier foods at the table for millennia. Even if the energy mix that goes into intensive agriculture shifts from fossil fuels to renewables, this form of food production will still make huge demands for scarce resources such as water and phosphorus and pollution causing inputs such as fertilizers and pesticides. This is a rudimentary example of the conflict between national policies purporting to encourage "modern agriculture and food systems" and those that are intended to conserve increasingly scarce resources such as energy, water and land.

Overarching policy incoherencies that affect FNS

As we approach the end of this report, having surveyed the major burning issues of the FNS debate that we had '*Yesterday*', and the '*Debate that We Need Today*', we come uncomfortably closer to the genesis of our real problems in India. Unless the national and overarching policy incoherencies that affect FNS are swept away in the current avatar of '*Swaatch Bharat*', we may never really mitigate the food and nutritional security conundrum, which afflicts the Indian People. We begin with a note on the **Indian Penal Code**:

India is policed by a draconian, archaic and colonial Police Act of 1861, which was designed after the Indian Mutiny of 1857, to help the then British rulers to literally loot the Indian people. The Head of the District Administration in British India was actually called **The Collector**, as his (no known instance of a woman ICS Officer) main function was to collect the land taxes and district revenues, to transfer to the British (Treasury?). As he was also the Head Magistrate (Judge), he controlled the Police, which helped in the collecting (and perhaps looting, too). Even 153 years later in free India, she is still called '***The Collector***'. That misnomer, in a day and age when we have an effective Indian Revenue Service (IRS) to do the collecting, arguably for the good of native Indians this time,says it all! It is the attitude of the Police administration that is so damaging for good governance. The inequities instituted by the Police in British India—suppressing dissent and free speech, the beatings, custodial injustices and deaths, the lack of grievance redressal, gender inequities and the utter contempt for the *Aam Aadmi*—are only marginally better today than it was during the British Raj. India deserves a better, ***more coherent*** Penal Code!

Good governance relates to political and institutional processes and outcomes that are necessary to achieve the goals of development—and FNS. Good governance is needed amongst others, to have peace, the rule of law, provide tenure of assets and land, tackle technological challenges and embrace solutions for sustainable governance, better and healthier lives, empower women and children and make them safe, leading to a smaller future national population that can feed and nurture itself. That is the essence of the FNS challenge. Not to have leftovers.

As a fundamental requirement of policy coherence, we must have a completely new 21st Century Indian Penal Code—*of the Indian People, by the Indian People and for the Indian People*!

Unfortunately, we have a bigger problem than the IPC, to confound 'Today's FNS Debate'!

In the waning years of the last Millennium, Development Alternatives formed 'People First', the prime objectives being to research the reasons for failure of governance in India, design and advocate institutional reforms required, and evolve a legitimate, non-violent process for realizing them. As Dr. Ashok Khosla, Founder of PF, has said on many (excerpted) occasions:

"No one in the country today, from the top government or corporate leader to the lowliest peasant would deny that "there is something rotten in the State of India". Indeed, that is the primary topic of current conversation in most sections of society … our nation suffers from a long list of ailments, each of which is sufficient to debilitate its entire body politic. Stark poverty, illiteracy and deprivation exist side by side with ostentation and runaway consumption; massive resource destruction and environmental degradation are compounded by narrow self-interest and corruption; endemic social and economic alienation leads increasingly to violence, crime and terrorism. And all these diseases are on the increase, both in their virulence and their spread.

Yet, it is equally obvious that there must be interests opposing any change in the systems that are at the root of these problems – else they would surely have been dealt with by now. If there is a difference between top leaders and lowliest peasants, it lies mainly in their respective stakes in perpetuating the current state of affairs. The solutions require fundamental changes on many fronts. They involve the introduction of alternative technologies, alternative resource management methods – and alternative institutions and policies to enable these changes to take place … The changes needed to challenge the status quo will directly threaten the interests that benefit from the present systems of governance – which includes almost everyone who is relatively well off or in a position of power. The opposition to change is therefore strong and rock solid. It is also smart. It never argues with the desirability of the ends to be achieved, but more cleverly undermines any means or strategies proposed with labels such as "ineffective", "unrealistic" or "utopian".

And the poor, for whose ostensible benefit all the present policies have been put in place, continue to suffer the most …To enable real, substantial change to take place in society, involvement of people and interchange of ideas is essential. ***Creative dialogue and active debate are the anvils on which the broad consensus of a "new" or "third" way must be hammered out … (by) all those who also feel that our children and our country as a whole deserves a future that is more fair and more sustainable****."*

A major thrust of People First was to actually rewrite the Indian Constitution, which has 448 articles; it is doubtful if there is a person on Earth who can claim to have read it all, understood what it says and own the document. Dr. Ashok Khosla also goes on to say:

"Democracy is now universally recognised as the only vehicle for global sustainability … Fundamentally, a democracy is a society in which the people are sovereign. Their decisions are, in all respects, supreme. Logically, therefore, a democracy is one in which the systems of governance reflect the wishes of the common people on how they would like to be governed … With the growing power of information technology, it may soon become possible to measure and elucidate the true consensus with much greater precision but for the present, the rule of the majority with adequate safeguards for those who dissent is widely accepted as a good basis for democratic governance.

Given the choice, the common people would … first retain adequate resources at the local level to handle all local matters such as administration of justice, police, education, healthcare, land, water systems and forests … then devolve the remaining resources to the state and national governments for providing higher-level infrastructure, support to local entities with inadequate resources and coordination through regional planning, but not for interfering in local matters. They would institute effective transparency mechanisms to ensure that the government at each level is directly accountable to them on a day-to-day basis, not to a higher authority. The sustainability of such systems of governance have been demonstrated by the indigenous people of many continents such as North and South America, South Asia and Africa.

Transparency includes the sovereign rights of the people to information, consultation, participation and referendum. In a democracy, people have the right to all public information, except that restricted by society in public interest. Consultation is through public hearings on all projects exceeding, say, 10 meters in height or 1000 square meters in land area. Participation in key decisions is through participatory councils. Referendum is the supreme sovereign right of the people, intrinsic and inherent to democracy, to enable them to take decisions overruling their representatives, including promulgating the legislation and amending or changing the Constitution.

The people would also ensure that the executive, legislature and judiciary at each level are distinct and separate as checks and balances of democracy, and that the elected executive is directly accountable to them and not only via the legislature. Similarly, the people would ensure that the appointment and impeachment of departmental heads at all levels is approved by the concerned legislature, thereby, ensuring that the bureaucracy exercises professional autonomy with accountability to the people.

Derived from simple logic based on the perspective of the common people, the structure described above can, along with certain rights described as fundamental to democracy, be said to be the basic structure of universal democracy. Any other structure will be semi, pseudo or non-democratic. All nations claiming to be democracies can be evaluated on the basis of the above parameters."

Democratic Experience in the West

Britain is often called the mother of democracy. It would perhaps be more accurate to describe Britain as the mother of feudal exploitation of its own people and colonial exploitation of other nations … Basic principles of management dictate that the executive, legislature and judiciary should be distinct and separate as checks and balances of democracy. With a mixed up executive and legislature, the ***Westminster system*** fosters abuse of authority, jockeying for power, horse trading, jumbo cabinets and bribing legislators. Legislators who are expected to be watchdogs become wild dogs of governance. *It is, as such, fundamentally faulty* … Most countries that adopted the Westminster system have suffered serious problems of instability. Much of Africa and South Asia has demonstrated the inability of the parliamentary system to provide the selfless leadership and continuity of policies needed to create vibrant and healthy economies …

Democratic Tradition of India:

Sir Charles Metcalfe, a British Governor General, in his minute recorded in 1830 wrote: "*The village communities of India are little republics, having nearly everything they can want within themselves. They seem to last where nothing else lasts. Dynasty after dynasty tumbles down; revolution succeeds revolution; but the village community remains the same…. This union of village communities, each one forming a separate state in itself, has, I conceive, contributed more than any other cause to the preservation of the peoples of India, through all the revolutions and changes they have suffered. It is in a high degree conducive to their happiness, and enjoyment of a great portion of freedom and independence. I wish, therefore, that the village communities may never be disturbed and I dread everything that has a tendency to break them up*."

But fate willed otherwise. The British abolished the village republics, usurped the forests, and made the villagers tenants of the state or feudal lords!

… In closure of this section on the dire need for correction of policy incoherence, the case can be made for both—pessimism and optimism.

Pessimism: The case can be made that mitigating the problems of policy incoherence is intractable, as reform initiatives are linked to huge and difficult policies as complicated as the Indian Penal Code of 1861, and as if that is not bad enough, if what Dr. Ashok Khosla has said is true, in order to get the level of coherence in policies we need to implement a robust FNS program, we may even have to

first overhaul the Indian Constitution, which has been modeled after the Westminster System—patently described by Tom Paine in 1776 as absurd.[22]

Optimism: The wealth of this nation is not in the minerals under the ground, but in the young women and men who are shaping the destiny of this great and ancient nation. They do not have any allegiance to the follies of our past, and have the ability to develop a bold vision and consciousness for fashioning for themselves a new and modern India, unshackled and unchained. ***What they do need is a platform to come together for this onerous task***.

Carl Sagan once commented on this new emerging consciousness with these words: "*The old appeals to racial, sexual, and religious chauvinism – to rabid nationalist fervor – are beginning not to work. A new consciousness is developing which sees the Earth as a single organism and recognizes that an organism at war with itself is doomed.*"

The success of the homegrown White Revolution should be a pointer to the way forward from this quagmire. Its lessons must be imbibed, because it succeeded at a time when the issue of governmental obstructionism and paralysis were even more palpable than now.

The conclusion is: If the people at the grassroots can be mobilized to enter into an intelligent discussion and mass action—as Mahatma Gandhi and others of his ilk did to win our freedom from the British—then the way to win our freedom from homegrown and foreign despots cannot also be far. And while recognizing that Swami Vivekananda was right to praise western science and logic as a means to an end, we must not be enamored with ***everything*** western, especially post-postmodern. For example, subscribing to the Michael Douglas created character of Gordon Gecko, who made popular beyond belief the ruinous statement: "*Greed is good*"—as it tugs at the most basic and fallible of human instincts—cannot be the lodestar for our youth, as it has been for an entire generation of American '*gold-rush diggers*', who have with their bravado brought the whole world to the brink of economic and spiritual ruin, by pursuing greed as their new God. We can also see this in the tireless efforts of MNCs and their corporate honchos who cannot see beyond their bottom lines—that there are thousands of farmers committing suicide every day, unable to meet their capricious needs, nor to see the ruination of our precious natural resources, playing into the hands of international moneymasters who control shadowy councils on foreign relations for dubious intentions, in this instance, through agriculture and control of availability and access to food.

Implementation of the new concepts

The concepts outlined will be meaningless unless they are implemented and lead to results on the ground. Most of these concepts are well known to government officials, businesses and civil society – but the formulation of policies does not seem to be influenced much by this knowledge. Clearly, there exist considerable barriers to rational policy making.

One of these is, of course turf or territorial issues. *The silos within which ministries work and the bureaucratic instinct to protect that turf from all new-comers is probably the biggest barrier to rational policy making*.

Other barriers include ignorance of the issues, lack of data and attention to research findings,

[22] "… But as the same constitution which gives the Commons a power to check the King by withholding the supplies, gives afterwards the King a power to check the Commons, by empowering him to reject their other bills; it again supposes that the King is wiser than those whom it has already supposed to be wiser than him. A mere absurdity!"; Thomas Paine, Common Sense Pamphlet published in 1776.

inadequate support to research, lack of respect for the views of others (the "Not Invented Here syndrome"), fear of the unfamiliar, narrowly-defined professional or personal self-interest and the other well-known societal or individual frictional processes such as corruption, inefficiency and lack of concern for the national good.

But such barriers have been overcome in various places and at various times, and given the magnitude of the problem in our nation, India has little choice but to make this the place and time when it happens.

It is critical for young leaders, equipped with social media at their disposal, to identify core values and engage with each other on a global platform. There are many challenges ahead for young people but if they are offered education in agriculture, a voice at policy level, and in the media, and are engaged with innovations then the agriculture industry can attract youth again. Keeping food security and family focused agriculture high on the development agenda is crucial in achieving major reductions in poverty and undernourishment, by the following methods:

- Comprehensive Reforms
- Improvement in Investment Climate
- Land Reforms Supported by Sustained Social Protection.

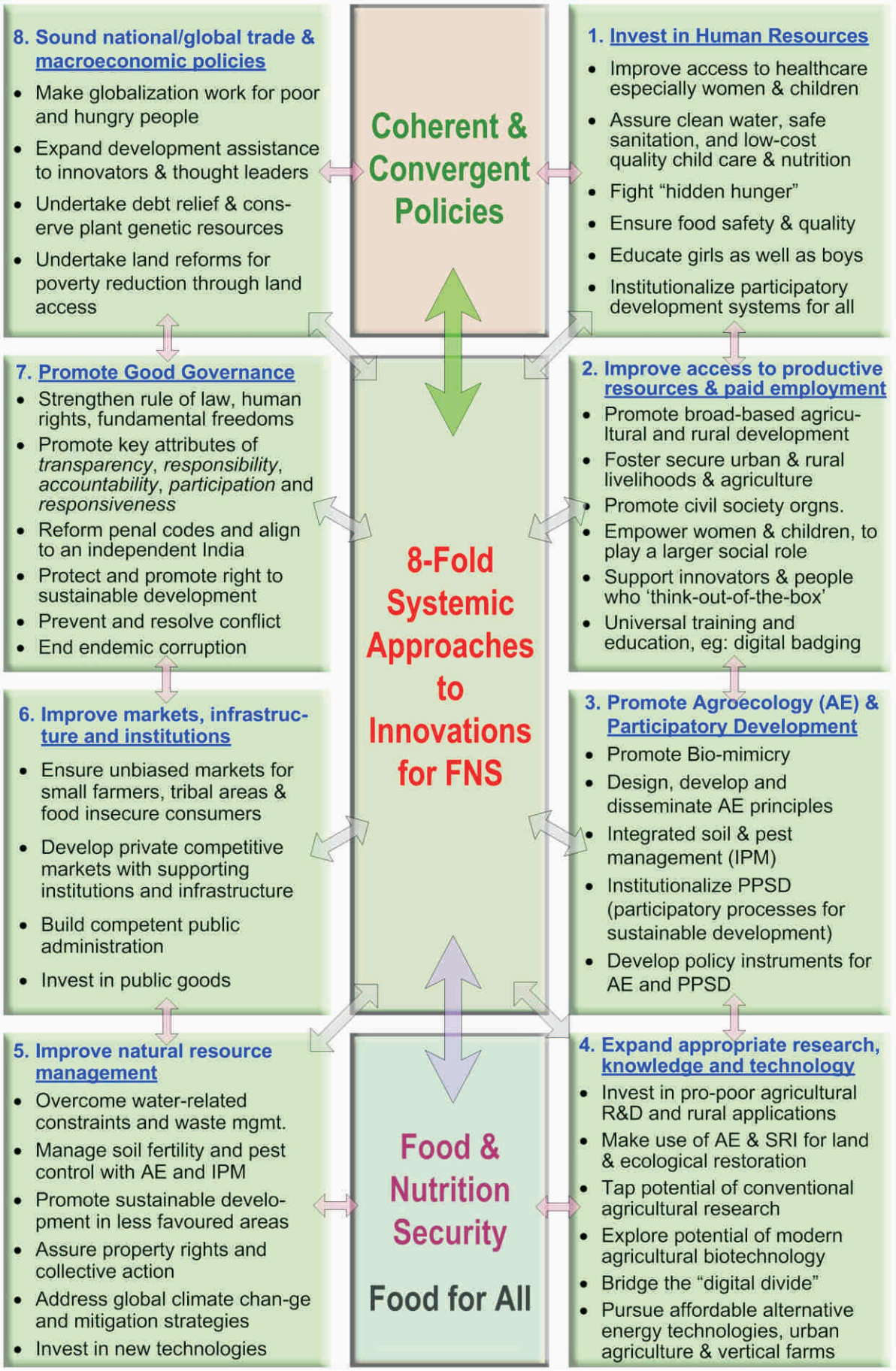
However, these policies should be accompanied by strategic capacity building and knowledge enhancement to enforce practicability at the desired levels.

8-Fold Systemic Approaches to Innovations

A big frontier for improving the food and nutrition situation is, clearly, innovation – based on a judicious combination of the latest science and traditional knowledge: *innovation that can scale up and become a part of mainstream praxis*.

The path to 'Securing Food for ALL' is not only dependant on scientists and technologists who can innovate and work their magic in research laboratories, but will also depend on social scientists, farmers, academicians, media persons, mothers and the children, who can circumscribe the 'hard technology' of our scientists with the 'soft technology' our scientists desperately need, to achieve a grand design.

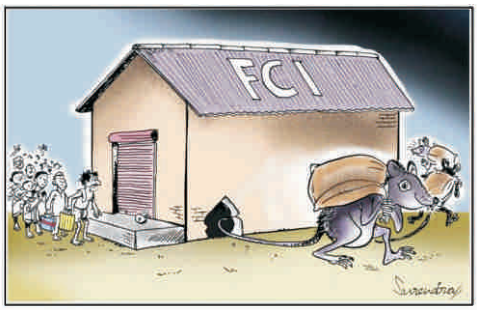
The following chart defines the role of '***Coherent and Convergent Policies***' for an '***8-Fold Systemic Approaches to Innovations***' to achieve ***FNS*** and '***Food for All***':


8. Sound national/global trade & macroeconomic policies
• Make globalization work for poor and hungry people
• Expand development assistance to innovators & thought leaders
• Undertake debt relief & conserve plant genetic resources
• Undertake land reforms for poverty reduction through land access
Coherent & Convergent Policies
1. Invest in Human Resources
• Improve access to healthcare especially women & children
• Assure clean water, safe sanitation, and low-cost quality child care & nutrition
• Fight "hidden hunger"
• Ensure food safety & quality
• Educate girls as well as boys
• Institutionalize participatory development systems for all
7. Promote Good Governance
• Strengthen rule of law, human rights, fundamental freedoms
• Promote key attributes of transparency, responsibility, accountability, participation and responsiveness
• Reform penal codes and align to an independent India
• Protect and promote right to sustainable development
• Prevent and resolve conflict
• End endemic corruption
8-Fold Systemic Approaches to Innovations for FNS
2. Improve access to productive resources & paid employment
• Promote broad-based agricultural and rural development
• Foster secure urban & rural livelihoods & agriculture
• Promote civil society orgns.
• Empower women & children, to play a larger social role
• Support innovators & people who 'think-out-of-the-box'
• Universal training and education, eg: digital badging
6. Improve markets, infrastructure and institutions
• Ensure unbiased markets for small farmers, tribal areas & food insecure consumers
• Develop private competitive markets with supporting institutions and infrastructure
• Build competent public administration
• Invest in public goods
3. Promote Agroecology (AE) & Participatory Development
• Promote Bio-mimicry
• Design, develop and disseminate AE principles
• Integrated soil & pest management (IPM)
• Institutionalize PPSD (participatory processes for sustainable development)
• Develop policy instruments for AE and PPSD
5. Improve natural resource management
• Overcome water-related constraints and waste mgmt.
• Manage soil fertility and pest control with AE and IPM
• Promote sustainable development in less favoured areas
• Assure property rights and collective action
• Address global climate change and mitigation strategies
• Invest in new technologies
Food & Nutrition Security
Food for All
4. Expand appropriate research, knowledge and technology
• Invest in pro-poor agricultural R&D and rural applications
• Make use of AE & SRI for land & ecological restoration
• Tap potential of conventional agricultural research
• Explore potential of modern agricultural biotechnology
• Bridge the "digital divide"
• Pursue affordable alternative energy technologies, urban agriculture & vertical farms

Inconvenient truths about the FNS debate

There was a perceptible undercurrent of unease amongst some participants, that meetings and conferences on food and nutrition security, even such as the present one, miss the forest for the trees. Some questioned: *Are we really serious* about wanting to bring food and nutrition security to the masses, and especially the children who suffer the most from its absence?

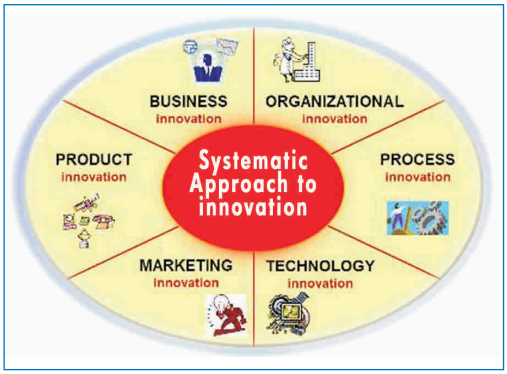
Others asked: Are we focusing on solutions that are impossible to achieve? Some of the imputed sarcasm can be re-stated as follows:



Eliminate hunger by 2020??? (*or even 2050*), when we cannot even empower women to mitigate population growth, prevent child labor, fight off the multinationals, or distribute the food that is already grown without wasting upto 50% of it in poor storage, theft, spoilage, logistics and so on;

Implement clean government and stop corruption (*at any time*), in the face of some of the senior-most members of the three branches of government—the Judiciary, the Executive and the Legislature—being caught with their hands in the till—a*nd then being transferred or allowed to get away without even a slap on the wrist*; even worse, how many even get caught?

Make coherent government policies, in the face of the government's inability even to make its employees come to office in time, other than periodic media exposés of Ministers hauling tardy government employees over the coals in choreographed events, only to slip back to somnolence for the rest of the year;



Create an innovating environment that promotes R&D, when many policy makers are cussed, vindictive and stuck in a groove made in the last century, or perhaps even the previous one, as it relates to understanding the scientific temperament, processes and ways to promote creativity;

Speakers and Representatives of the politicians and bureaucrats in power speak outright lies of high and unattainable visions of the future, often qualifying any new action as '*will be*', and parrot the party-line *ad nauseum*, while denouncing the actions of the previous regime as ill-conceived, etc. etc. etc.

Speakers and Representatives of the politicians and bureaucrats out of power speak outright lies of high and unattainable visions of the future, often qualifying any new action as '*will be*', and parrot the party-line *ad nauseum*, while denouncing the actions of the present regime as ill-conceived, etc. etc. etc.

Speakers often come to the podium with ill-made and uncommunicative presentations, often cut-and-pasted from previous meetings which may or may not have any relevance to the current one, and speak for long intervals of time, without saying anything, at all;

Scientists and Thought Leaders who jockey to access the nation's scarce resource to "do science" and be heard globally, but are caught 'cutting and pasting' from the documents of TNCs for their policy reports, for just a few pieces of silver, or outright plagiarism when writing their articles, and worst of all flaunt their ignorance arrogantly—can we trust them to build a modern India? *… Etc. etc. etc*.

OUR RESPONSE: While anyone who reads newspapers will know that there is an element of truth in all these allegations, the objective of the Conference is not to criticize anyone, as that is a waste of time. The Pareto Principle implies that for every eight such persons who are not doing the right thing, there will be at least two persons who are doing commendable work in the face of daunting challenges and opposition. Let us celebrate these heroes, these change agents with inter-disciplinary skills, who can bring in new ideas, methods and field work experience … in order to make these critical changes happen and then to make sure that they remain sustainable.

The goal of this Conference and Club-of Rome – India is to provide a platform for *champions and change agents* who can '*think-out-of-the-box*', to come forward, speak boldly and act decisively. Today's challenge is 'Securing Food for All'. *Will you join us?*

Let us not look back but boldly go forward … if need be, to completely uncharted places.

CONCLUSIONS

This Conference was billed for key discussions in the areas of:

- Inter-linkages and Policy Coherence,
- Scientific, Economic and Social Issues
- Global & National Politics
- Environment and Resources issues
- State and Local politics affecting food security, and
- Policy barriers for scaling up proven alternatives

Each of these areas have a defined focus, but their boundaries are blurred in the context of the debate on FNS, because of the seemingly endless complications and inter-relatedness of each. For example:

- Creation of sustainable livelihoods, which is central to the entitlements debate on FNS, is held hostage by the intractable gender inequality and governance issues;
- Governance is a key issue in the FNS debate, but the nexus of governance with corruption, nepotism and a large number of socio-political and socio-cultural factors makes it impossible to even start a useful conversation;
- Externally, it is widely reported that the European Union is committed to eradicate poverty in the world, but to succeed its policies need to be fairer and coherent.

The nine sessions, including the plenary opening session, captured the essence of these complications and inter-relatedness of each area listed above, and we have attempted to present its findings in this publication, hopefully in a coherent manner.

The Conference has yielded a great deal of information on the nexus between food and nutrition security and a host of key factors, including water, energy, climate change, livelihoods creation, land restoration, food storage and distribution, appropriate technology, and so on. It was revealed that (a) the concept of food security may require a stronger focus on nutrition outcomes, and (b) a tendency toward a paradigm shift can be observed recently that may be described as emanating from a sector-specific approach to a multi-sector system approach, with focus on nutrition outcomes. Therefore, the present 'linear' concepts of household food and nutrition security are not well-suited to facilitate the complex set of research and actions needed to develop coherent policies, in order to address these nexus issues and to guide holistic actions on promising pathways out of hunger and malnutrition.

The conclusions that we can draw from the Conference are:

1. There was an almost universal consensus that we need to focus on pro-poor enhancement of productivity for better food security, nutrition and the creation of sustainable livelihoods of vulnerable groups in rural and urban areas.
2. Farmers must be involved in decision and policy making.
3. The Conference yielded guarded optimism in our ability to break new ground on technology and innovations that will help us to meet the productionist demand for growing more food to meet the food and nutrition security needs of a growing population globally, as well as in India.

4. There was also a growing consensus and a sense of unease amongst the participants that simply growing more food alone would not help us to achieve the goal of "Securing Food for All"; indeed there is evidence that the problems of access to food are growing because of policy incoherence, whereas there is a general lack of consensus in defining a unified way forward to identify these countervailing policies and how to rectify the situation.

5. It was recognized that micronutrients are as important as calories for children, who continue to grow stunted, while mothers are malnourished in large swathes of the country; this affects their productivity and the cognitive development of especially the children, which it was also pointed out, could jeopardize the "Demography Dividend" that public officials are eyeing greedily; the chimera could even slide into a "Demography Liability", if the vast numbers of young and adolescent people in India fail to get the food and nutrition they need, to pull themselves out of the whirlpool pulling them down into obsolescence, unemployment, hunger, malaise and malfeasance.

6. Several participants drove home the point with examples and illustrations that the main culprit for the sometimes artificial barriers to FNS was due to the lack of implementation of current laws, regulations and policies, rather than shortage of laws and institutions; the obvious suggestion was perhaps that we should collectively hold the feet of these malfeasant officials to the fire, although why it has not been successfully done so far, or how to do it in future was not made clear, unless the large-scale reform of either the IPC or The Constitution, or both, mentioned in this Report could possibly provide the answer to this intractable problem.

7. There were a number of presentations and ideas exchanged on the ways that current legislations and policies—such as MGNREGA—has been benefiting a much wider cross-section of stakeholders and beneficiaries than reported elsewhere, and that researched and well-documented studies of their impact on the ground should be made before tampering and unwittingly damaging them by ill-advised, "AC-Room"-based faulty decisions, arrived at by the fallacies of "Conventional Wisdom" (CW), which was alleged to be the modus operandi of most of our policy- and decision-makers—which in a way provides an answer to the question: why are there so many incoherent policies, anyway?

8. Whereas there were lively discussions and light thrown on the way forward to meet many of the social, technical and managerial issues confronting the issues of FNS, there was unfortunately less clarity on the issue of seeking and suing for policy coherence, which was the main focus of the Conference; this could be attributed to the innate difficulty in getting a handle on the subject of 'coherence', which relates to being clear and understandable, whereas 'policies' are usually just the opposite, encased in legalese that makes them opaque and-like eels-difficult to grab hold of.

9. There was also a muted feeling that our failure to develop coherent policies to address the wide-ranging problems of FNS, in particular, perhaps stems from the problems generally attributed to a state of mind described as "missing the forest for the trees".

10. It was also stated that, whereas policy coherence is critically important, it must start at the district level.

11. The general sense was that global corporate interests, with help from governments, are ruthlessly promoting genetically modified products and organisms, which we have to be

extremely cautious about; there was wide consensus on the need to analyze the impact of GMCs in each area with more investment needed in distribution mechanisms to the district level.

12. The several benefits of innovations such as Sustainable Rice Initiative (SRI) and related post-harvest agri-process technologies were acknowledged; Agroecological concepts were also reviewed fleetingly, and perhaps not given as much importance as the approach deserves in today's natural farming ethos; it was felt that SRI, in particular, should be made an integral part of India's food security policy.

13. A colorful presentation revealed that MGNREGA can be designed to provide win-win outcomes for a wide audience, including farmers; for example, a specially designed Rs.40 Lakh MGNREGA project in Andhra Pradesh for de-silting yielded almost Rs 10 Crores worth of contingent benefits to farmers from water recharge and productivity increases; whereas conventional wisdom dictated that farmer's, as a class, are only on the receiving end of scheme; moreover, entire communities who suffered from chronic hunger in the past are now getting three square meals.

14. There was talk of the 'Rural-Urban Continuum', with unprecedented growth of large villages, small and medium towns, which calls for more off-farm employment that impact processing and delivery; however, there was not much talk of cities as 'food deserts', or discussions of the issue of growing more food in urban areas, which will have 50%-70% of the country's population by 2050.

15. The food-water-energy nexus was often recalled, which led the author to develop the case study for the policy coherence angle of building compost-cum-biogas toilets instead of ordinary toilets, to combat the open defecation problems in India.

16. The poignant point—that small farmers who produce food for others, cannot feed or take care of themselves—led to the sense that food security is a public good like health or education, and cannot be treated as merely another commodity and left to the free-marketers, to be scavenged to death.

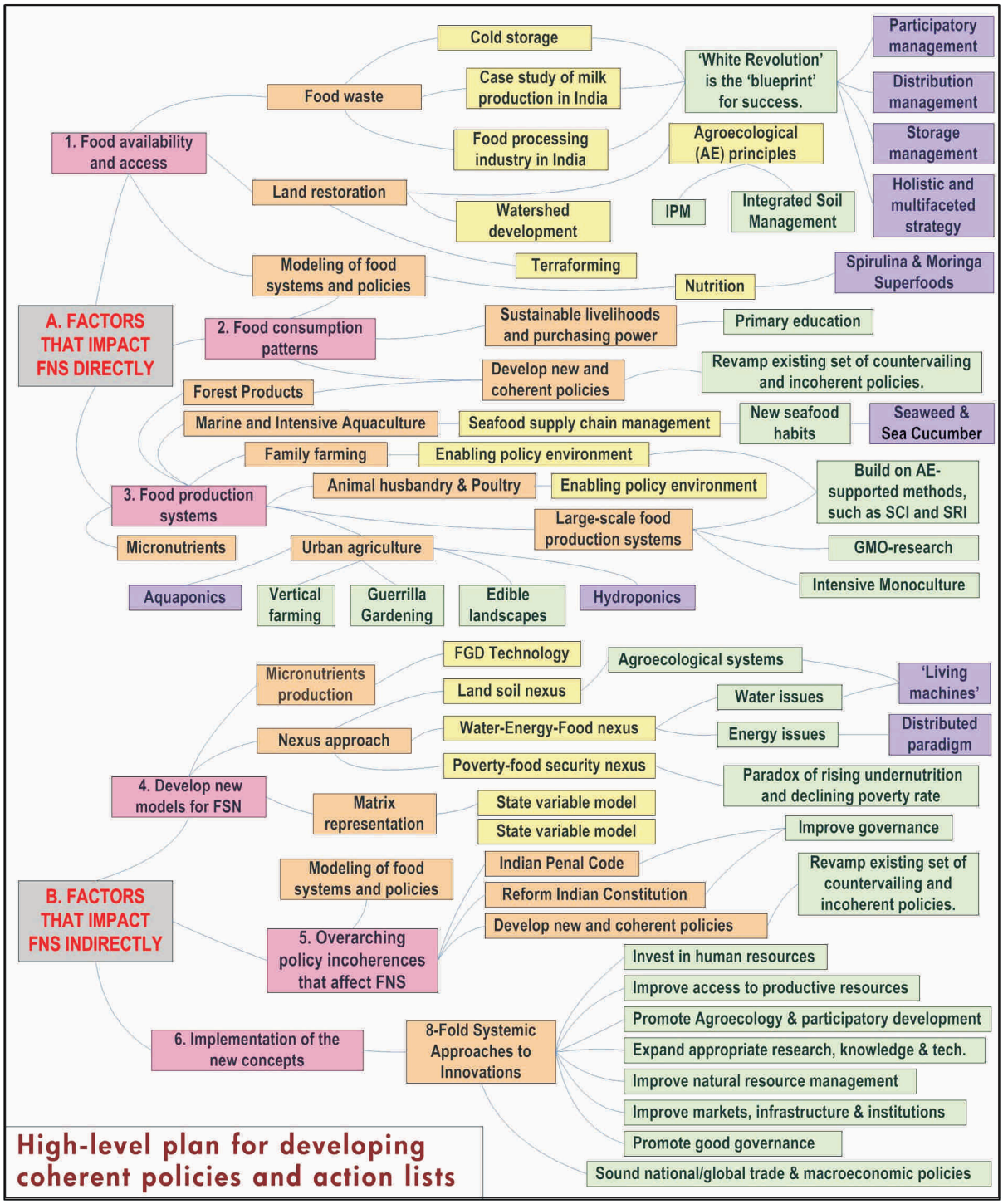
17. It was felt that subsidies do not create assets, but actually produce more liabilities, leading to unemployment, while increasing the taxation problems for intended beneficiaries; moreover, intended beneficiaries almost never get the subsidies meant for them.

18. Coherence and convergence for developing policies for the availability of better quality of water is needed amongst the five or more ministries that are responsible for water-related matters, in India.

19. It was revealed that, as FCI handles only rice and wheat, horticultural producers in the Northeast are languishing from lack of financial support; this is a factor for young people leaving farming, which has become a major social problem with far-reaching consequences, as an impediment to future farm production in the North-East.

20. Biotechnology and transgenics will not provide food security and excessive dependence on them will be counter-productive.

The high-level plan for developing coherent policies and action lists, of compilations emerging from the 'Conclusions', may be summarized in the following diagram:



In closure, we wish to acknowlege that the Prime Minister of India, Shri Narendra Modiji, within the first few weeks of assuming office, issued this clarion call for what he saw as '**The Four Fold Way to Grow**'. This is particularly important in the face of the Club of Rome's predictions on the 'Limits to Growth' on the one hand, and for all of us in the **food and nutrition security** (**FNS**) and **sustainable development** (**SD**) movements, on the other, as each of the revolutions cited on the left of this infographic—*Green, White, Blue and Renewable Energy*—coupled with the development of '*Smart Cities*' and harnessing the '*Demographic Dividend*', are *ALL* high points on the agenda of the Club of Rome - India team, in the coming year.

With this note of optimism, we conclude the present preliminary report on identifying specific policies and actions for advancing today's debates on the food and nutrition security, in the hope that the next round of discussions with government, business, civil society, academic institutions & the media will yield a consensus and advance the cause for implementing coherent policies in their respective domains.

Thank you for your support.

Glossary: *Explanation of terms used*

Asset: A resource having economic value that a micro-entrepreneur owns or controls with the expectation that it will provide future benefit.

Agroecology: The holistic study of agroecosystems, which means different things to different people

Aquaculture: Intensive aquaculture relies on technology to control diseases and reduce stress and mortality rates of fish, raised in artificial tanks at very high densities, by controlling water quality, temperature levels, oxygen levels, stocking densities and feed rates.

Aquaponics: Integration of recirculating aquaculture and hydroponics in one production system; an eco-friendly, efficient and effective alternative to traditional fish and vegetable farming.

Badge: A symbol of an accomplishment, skill, quality or interest.

Biodiversity: The variety of ecosystems and living or-ganisms (species); the totality of genes, species and ecosystems in a region.

Blue Revolution: Aquaculture and water reform policy changes for items such as fish farming and drinking water.

Capacity Building: Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk; in-cludes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.

Coastal Ecosystem: The coastal zone represents transition from terrestrial to marine influences, and vice-versa; comprises not only shoreline ecosystem but also upland watersheds draining into coastal waters & the near shore sub-littoral ecosystems influenced by land-based activities.

Community Center (CC): CCs change the power structures and remove the barriers that prevent people from participating in the issues that affect their lives.

Community Development: Building active and sustain-able communities based on social justice and mutual respect.

Conservation; The management of the present human use of the biosphere, to yield the greatest sustainable benefits while meeting the needs and aspirations of future generations.

Convergence: A representation of common ground between theories or phenomena; cooperation among various NGOs and civil society organizations to deliver the best possible community development services to large, village-based beneficiary communities, using a variety of delivery systems to reach the widest possible audience.

Domain Expert: Or subject matter expert—is a person with special knowledge or skills in a particular area.

Econometrics: A methodology that measures the relation between two or more variables, running statistical analysis of historical data and finding correlation be-tween specific selected variables.

Economic Viability: The efficiency, prioritization and scaling up of food production.

Ecosystem: A community of plants and animals (including humans) interacting with each other and the forces of nature. Balanced ecosystems are stable when con-sidered over the long term.

Environmental Resources: Parts of nature that that humankind considers to be useful or valuable

Food Security: All people, at all times, have physical, social and economic access to sufficient, safe, and nu-tritious food to meet their dietary needs and food preferences for an active and healthy life. (FAO, 2012)

Food Systems Approach: An effective way to model the pressing issues around natural resources and food security and to identify the opportunities to address these issues.

Framework: A set of assumptions, concepts, values, and practices that constitutes a way of viewing reality; the underlying structure.

Genetic Modification (GM): Allows specific genes to be identified, isolated, copied and inserted into other plants and animals with a high level of specificity.

Greenhouse Gas: A gas that traps heat from the sun causing the Earth's atmosphere to warm up (eg carbon dioxide or methane).

Geographic Information System (GIS): A system de-signed to capture, store, manipulate, analyse, manage and present all types of geographical data. In the simplest terms, GIS is the merging of cartography, statistical analysis and computer science technology.

Green Economy: An economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.

Green Investment: An investment that promotes the green economy by reducing carbon emissions and pol-lution, enhancing energy and resource efficiency, pre-venting the loss of biodiversity and ecosystem services, and creating green jobs.

Green Jobs: They are decent jobs that reduce con-sumption of energy and raw materials, limit Green-house gas emissions, minimize waste and pollution, and protect and restore ecosystems.

Grid: The system of transmission cables that is used to transport electricity around the country.

Guerrilla Gardening: Planting in vacant, neglected pub-lic lands, and everyone is welcome to help in the growth process. The economically-challenged and hun-gry people in the community have a standing invitation to participate and take what they need.

Healthy Environment: The inter-generational equity and the responsibility we have for our legacy to the future.

Holistic: Sometimes spelt 'wholistic'—relates to or is concerned with wholes or with complete systems rather than with the analysis of, treatment of, or dissection into parts.

Hub: A focal point around which events revolve; a cen-ter around which other things revolve or from which they radiate.

Human Development: A complex concept of develop-ment, based on the priority of human well-being, and aimed at ensuring and enlarging human choices which lead to equality of opportunities for all people in society and empowerment of people so that they participate in—and benefit from—the development process.

Hydroponics: A technology for growing plants in nutrient solutions.

Indigent: Describes the poor, needy, impoverished and disadvantaged people who live in the villages; they lack food, clothing, and other necessities of life because of poverty.

Information and Communications Technology (ICT): Information technology (IT) or information and com-munication

technology (ICT) is the technology required for information processing. In particular the use of electronic computers and computer software to con-vert, store, protect, process, transmit, and retrieve information from anywhere, anytime.

Institutional Overheads: Fixed costs of running an or-ganization, indirect costs; facilities and administrative costs; infrastructure and service costs.

Livelihoods Skills Development: To mainstream institutional support and capacity building for existing & new civil society organizations i.e. networks and federations of self-help groups (SHGs) in villages, so that they can drive the participatory formation of a replica-ble model of rural livelihood skills training & economic opportunities development.

Maintainability: A measure of the ease with which changes necessitated by new requirements, error cor-rections, new environments & enhancements may be introduced into a product.

Market: A social arrangement that allows buyers and sellers to discover information and carry out a voluntary exchange of goods or services; the location where goods are traded.

Methodology: The underlying body of knowledge for the creation of different types of simulation models. It includes theoretical foundations for the approach, and often encompasses both qualitative and quantitative analyses and instruments.

Microenterprise: A type of small business; a business having 5 or fewer employees; typically have no access to the commercial banking sector; microfinance institutions are their common sources of funding, particularly in the Third World.

Modifiability: The extent to which the object itself fa-cilitates the incorporation of changes, once the nature of the desired change has been determined.

Model: A schematic description of a system, theory, or phenomenon that accounts for its known or inferred properties and may be used for further study of its characteristics; a hypothetical description of a complex entity or process.

Modular: Designed with and composed of standard-ized units or dimensions, as for easy assembly and re-pair or flexible arrangement and use.

Monitoring and Evaluation: A management tool that is built around a formal process for evaluating performance and impact using indicators that help measure progress toward achieving intermediate targets or ultimate goals. Monitoring systems comprise procedural arrangements for data collection, analysis and reporting.

Morality: The quality of being in accord with standards of right or good conduct; a system of ideas of right and wrong conduct.

Nexus: It means 'binding together', a connected group or series; also the core or center of a situation. The nexus approach applies at all levels of society; from local competition over access to water for irrigation or livestock, to global connections between policy on bio-fuels, food & water security.

Non-linear System: A non-linear system is one whose output is not directly proportional to its input.

Optimisation: Simulation that aims at identifying the best solution (with regard to some criteria) from some set of available alternatives.

Organic Farming: A product, its producer, and the farmer must meet stringent organic standards and must be certified by an approved food-certifying agency. Organic foods cannot be grown using synthetic fertilizers, chemicals, or sewage sludge, cannot be genet-ically modified, and cannot be irradiated.

Pattern: A pattern is a model or set of rules which can be used to make or to generate things or parts of a thing, especially if the things that are generated have enough in common for the underlying pattern to be inferred or discerned, in which case the things are said to exhibit the pattern.

Paradigm: A set of assumptions, concepts, values, and practices that constitutes a way of viewing reality for the community that shares them, especially in an intellectual discipline; an example serving as a model or pattern.

Policy: A plan of action adopted by an individual or group.

Public-Private Partnerships (PPPs): A variation of privatization in which elements of a service previously run solely by the public sector are provided through a partnership between the government and one or more social/NGO or private sector organizations. Unlike a full privatization scheme, in which the new venture is ex-pected to function as a private business, the govern-ment continues to participate in some way.

Renewable Energy: The term used to cover those en-ergy flows that occur naturally and repeatedly in the environment and can be harnessed for human benefit. The ultimate sources of most of this energy are the sun, gravity and the earth's rotation".

Reusability: The extent to which a module can be used in multiple applications (IEEE Standard Glossary of Terms)

Risk: The probability of harmful consequences, or ex-pected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions.

Rural: All land areas that are not urban.

Rural Development: Improving the physical, economic and social conditions of people living in the open country side and in coastal areas; a process leading to sustainable improvement in the quality of life of rural people, especially the poor; the process of strengthening the 'liveability' in rural areas according to the quality of life and landscape identity;

Shelter Technologies: The specific methods, materials, and devices used to build structures that provide privacy and protection from danger to rural households, in this instance.

Social Equity: The commitment society must make to universality, fairness and social justice in spatial or class terms-in the here and now.

Socioeconomic Program: A planned, coordinated group of activities and procedures to deliver social and economic impacts on any product or service offering, market intervention or other activity on a rural economy—in this instance—and on the companies, social organizations, NGOs and individuals who are its main economic actors.

Specialization: Allows you to define new kinds of in-formation—new structural types or new domains of information—while reusing as much of existing design and code as possible, and minimizing or eliminating the costs of interchange, migration, and maintenance.

Structure: The way in which something is arranged or organized; the way in which parts are arranged or put together to form a whole.

Sustainable Agriculture: Sustainable agriculture is a way of raising food that is healthy for consumers and animals, does not harm the environment, is humane for workers, respects animals, provides a fair wage to the farmer, and supports and enhances rural communities.

Sustainable Development: Development that meets the needs of the present without

compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of “needs”, in particular the essential needs of the world’s poor, to which overriding priority should be given.

Sustainable Livelihoods: A work opportunity that gives (a) a decent income; (b) some status in society and (c) some dignity and meaning in life; it provides opportunities for people to work in their own community instead of migrating to the slums of a big city.

System Dynamics: A methodology to create descriptive models that focus on the identification of causal relations influencing the creation and evolution of the issues being investigated. Its main pillars are feedback loops, delays and non-linearity through the explicit representation of stocks and flows.

Technology: The scientific method and material used to achieve a commercial or industrial objective; the practical application of science to commerce/industry.

Vocational Training: Training for a particular occupation, business, or profession in industry or agriculture or trade.

Watershed: The land area from which water drains to a given point.

Water Table: In a shallow aquifer, a water table is the depth at which free water is first encountered in a monitoring well.

White Revolution: India’s dairy development program– popularly known as ‘Operation Flood’.

Work Plan: Describes the technical, social, management and other activities to be conducted during the various phases of a project; it is a living document that defines co-operations between project partners to help them reach common goals.

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Annex 1

The Real Message of "Limits to Growth"

Jorgen Randers, Co-author of Limits to Growth and Club of Rome Member

The book entitled "The Limits to Growth", first published in the US in March 1972 is known to many. It has been printed in millions of copies in more than 20 languages. It has been discussed aggressively for decades. Still it is not commonly known what this research report really did say in its 150 illustrated pages.

Many believe that The Limits to Growth forecast the end of the world before the year 2000, using a big mathematical model of the world system to do so. Others believe that Limits to Growth was a neo-Malthusian projection of population collapse in the 21st century, caused by global shortages of natural resources including oil and agricultural land. Others again think that Limits to Growth proved that economic growth cannot continue for ever on a finite planet.

Very few seem to know that Limits to Growth was a scenario analysis of 12 possible futures from 1972 to 2100. And that the main scientific conclusion of the study was that delays in global decision-making could cause the human ecological footprint to overshoot planetary limits before the growth in the human economy slowed. Once in unsustainable territory, human society would be forced to reduce its rate of resource use and its rate of emissions.

This contraction could only happen in two ways. Either through "managed decline" orga-nized by humanity. Or through "collapse" induced by nature or the market. The only thing that could not happen, said Limits to Growth, was for world society to remain forever in unsustainable territory, using more of nature every year than nature produces during that year.

Irrespective of what it really said, "growth will come to an end" was the imprecise summary that stuck with the book. This was unfortunate, because most believed that Limits to Growth spoke about "economic" growth, while it really spoke about growth in "the human ecological footprint". An important distinction, because Limits to Growth opened for endless economic growth (in economic value) as long as that growth is not associated with growing physical impacts (e.g. in resource use or pollution output). Whether "economic growth without growing ecological footprint" is feasible, remains an open question to this day. It is clearly possible in principle, but has not yet been observed in practice.

Limits to Growth did not seek to resolve this question, and the authors were split in their views on whether full decoupling is possible. But they did agree that global society ought to reduce its ecological footprint per unit of consumption, and much more important, start doing so in time to avoid global overshoot. They also agreed that the task would be greatly simplified if human society moved away from its fascination with growth, both in population and economic value.

Annex 1 (Contd.)

Main Conclusions of Limits to Growth (in today's language)

1. The human ecological footprint cannot continue to grow at the rate seen from 1900 to 1972, for more than a hundred years from 1972 because Planet Earth is physically limited and in fact rather small relative to human activity. Humanity cannot – in the long run - use more physical resources and generate more emissions every year than nature is capable of supplying or absorbing in a sustainable manner.

2. It is possible, and even likely, that the human ecological footprint will overshoot the sustainable limits (=the carrying capacity) of Planet Earth because of significant delays in global decision-making. When limits start approaching, society will initially spend time discussing their reality – and continue expanding while debating. It will take time (possibly decades) to observe and agree that current global activity exceeds the long-term carrying capacity, to then pass the necessary legislation and time until activities repair the damage caused during overshoot, and heal the damage caused to ecosystems.

3. Once the global carrying capacity has been overshot, contraction is unavoidable, as the human ecological footprint cannot remain in unsustainable territory for very long. Humanity will have to move back into sustainable territory. Either through "managed decline" to sustainable levels of activity, or through "collapse" to the same levels, caused by the unmitigated work of "nature" or "the market".

4. Overshoot can be avoided through forward-looking global policy. The challenge of overshoot from decision delay is real, but easily solvable if human society decides to act.

5. It is important to act as soon as possible, (at the time of publication in 1972, that was in 1975) in order to achieve a smooth transition to a sustainable world – without having to pass through overshoot and contraction.

Has the message of Limits to Growth stood the test of time?

The real world has followed the business as usual scenario in Limits to Growth. This means that the real world has followed the main trends in that scenario for the first 40 years of the scenario period, which ran from 1970 to 2100.

This does mean that the global population and economy has continued to grow more or less as expected in 1970 (and represented in the model world). This also means that the real world has moved into overshoot, just like the business as usual scenario from Limits to Growth. According to the best estimates of today, the world moved into aggregate overshoot in the middle 1980s. This is most commonly accepted when related to the issue of greenhouse gas emissions, but other dimensions of human activity have also moved into unsustainable territory.

We have not yet had a final resolution of one of the main challenges to the idea of "limits" – namely the idea of the technological fix. Many thoughtful observers oppose the idea that the world is finite

– even in the physical interpretation. They believe instead that technology will be able to remove the planetary limits faster than we approach them. In other words: technological advance will continue to push back limits or increase the carrying capacity of the planet, so to speak expanding the size of the earth in the process. For this group, Limits to Growth will only be proven right once there is a significant collapse, caused by environmental limitations not being solved fast enough.

For global society to continue to move back the limits will require pre-emptive investment in new technology. Society must invest before the problem gets serious. If investments are delayed until after the need is obvious, the solution may come too late, and society will be back in the overshoot and collapse mode.

Annex 2

A scholarly review of SRI and comments on the conference by Dr. Norman Uphof

OPENING SESSION

I appreciate this opportunity to participate in such an important and timely event as this Global Conference on 'Securing Food for All.' My comments will be brief, consistent with a maxim of the System of Rice Intensification (SRI), about which I will say more tomorrow: ***less can produce more***. To help frame the mission of this Conference, I would like to offer just four points. Two of these represent 'bad news' and the other two constitute 'good news.'

(1) DIMINISHING RETURNS: First, the productivity gains in food production deriving from Green Revolution technologies have been decelerating for some years now, reflecting the ubiquitous phenomenon of diminishing returns. In almost all production processes, when we keep increasing inputs without any change in technology, trying to do more and more of the same, the marginal productivity of inputs usually declines over time.

This is becoming evident with the Green Revolution technologies, which beneficially and mercifully hiked the production of wheat and rice around the world, and particularly in India, from the mid-1960s to the mid-1980s. However, globally per-capita production of cereal grains has more or less plateaued since the mid-1980s, and increases in total cereal grain production have slowed since the mid-1990s.

The Green Revolution was based on (a) breeding new varieties to be more responsive to external inputs (chemical fertilizers, water, and agrochemical use) and then on (b) increases in these inputs. This strategy was very successful in its time, but it has been less and less successful over time; and in the words of the American folk song writer Bob Dylan, "the times they are a-changin'."

It is true that with higher cereal prices, more production could be extracted from our fields and farms. But this input-driven strategy is coming with higher and higher economic and environmental costs, both for farmers and for our natural ecosystems, and thus the general public. Moreover, if our production gains are achieved by higher food prices, rather than by increases in factor productivity, food is put out of the economic reach of the poorest sectors of our society, thereby defeating the goal of 'food for all.'

This is not meant as a criticism of the Green Revolution, which has enabled millions of people to live better, more secure lives and to avert predicted impositions of hunger and starvation, particularly in India. However, the question before us is this: what do we do for an encore? More of the same? Some think that biotechnology will deliver our agricultural salvation. But without rejecting this possibility, I would suggest that agroecological approaches offer a new paradigmatic direction that can usefully address this first point and the next one.

Agroecological approaches, including conservation agriculture, the systems of rice and crop intensification, integrated pest management (IPM) and other biologically-based methodologies, can co-exist with permutations of the Green Revolution. There is no good reason why they should be held back by ideas and interests that are linked with the input-dependent, genocentric strategy of agricultural development which is currently favored by most policies and much public opinion.

Achieving food for all, I would like to suggest, will be enhanced by some paradigm enlargement and shifting.

(2) CLIMATE AND OTHER CHANGES: Presently-favored technologies were developed under the economic, social and environmental conditions of the latter half of the 20th century. Thus they are better suited to its opportunities and constraints than to our present and foreseeable situation. Opportunities and constraints are already changing in this new century, and will continue changing in the decades ahead. So what factor proportions and what combinations of factors can *optimize* our agricultural production in the future will need to change in response to our altered circumstances and conditions.

We have become more conscious in recent years of the powerful and dire influences of *climate change*. This is no longer something for the future. Its current effects are already being seen in drought, flooding, temperature shifts and extremes, and associated problems with storm damage and pests and diseases. Agriculture is more vulnerable than most other sectors to the vagaries and hazards of climate.

Further, the luxury of relatively-inexpensive energy from *cheap fossil fuel*, subsidizing mechanized farming, synthetic fertilizer production, and long-distance transport, has been disappearing, as farmers' costs of 'modern inputs' have been rising and will surely continue to rise. The cost-price squeeze on farmers is driving many producers out of the sector, and this trend is likely to continue, with ensuing shortages of agricultural labor and consolidation of production units.

These larger units when profitable succeed more because of their *economies of size* than their *economies of scale*. Market power explains their success more than their intrinsic resource efficiency. In agriculture, in contrast to industry, economies of scale are not as influential as are economies of size. The latter lead to larger and larger units of production that do not make the most productive use of our increasingly scarce resource of fertile agricultural land, although with capital investments they can use water more efficiently. Around the world, we find that the per-hectare output of food is usually higher not on larger units of production, but on smaller ones because they use resources more intensively than extensively. Larger landholdings produce more profit mostly because they are bigger.

With continuing population growth, *arable land per capita* continues to decline, especially as arable land area is lost. By 2050, the amount of arable land per capita is likely to be one-third what it was in 1950. This is partly because of land degradation that is continuing and accelerating, with water and wind erosion, salinization, water-logging and other processes debilitating our soil systems.

These days, water itself is becoming a greater constraint on aggregate agricultural production than is available land. And we see the availability, reliability and quality of water all decreasing in many parts of India and the world. These economic and environmental trends affecting land, water and energy make the sustainability of our present paradigm of agricultural technology less tenable.

Even if the Green Revolution strategy of improved varieties with more water and more external inputs were not encountering diminishing returns, the altered conditions under which these seeds, irrigation and fertilizer are used are making this strategy less productive -- or at least less profitable for all but the largest units of production which substitute capital for the other factors of production. Agriculture remains intrinsically dependent on soil, water and genetic resources, and to a large extent on labor. Thus, this sector confronts limits for a strategy where capital displaces other factors of production.

Annex 2 (Contd.)

(3) SRI: On the positive side, we are seeing now, in more than 50 countries, that the yields of rice, the world's most widespread staple crop and a mainstay in so many Indians' diets, can be greatly increased just by making simple changes in the practices for growing irrigated rice, as well as for rainfed rice production. The System of Rice Intensification (SRI), which I will say more about tomorrow, has now been demonstrated in more than half of the rice-growing districts of India, with yield increases of 20 to 50% and often higher, 50 to 100%, or even more.

By changing the way that plants, soil, water and nutrients are managed, substantial yield increases can be achieved with less seed, less water, less or no chemical fertilizer, and reduced or no agrochemical inputs, and often even with less labor. SRI effects are achieved by starting with much younger seedlings (direct seeding is possible if not transplanting rice); by providing much more spacing between plants so that their roots and canopies have more room to grow; not keeping paddy fields flooded, as this suffocates the plants' roots and soil microbes for lack of oxygen; enhancing the soil's organic matter with compost or other materials; and actively aerating the surface soil with a mechanical weeder.

The resulting rice plants (phenotypes) produced from a given variety (genotype) are not just much more productive, but also more resilient to adverse climatic conditions. While this may sound 'too good to be true,' I and more than 10 million farmers (at least 3.5 million of them in India) can assure you that these impacts and these benefits are real.

Our present Green Revolution technology is one where farmers must increase their purchased, material inputs to produce more output. But their gains in net income are shrinking in recent years as costs of production rise without commensurate increases in yield. SRI management, conversely, decreases these inputs and increases farmers' inputs of knowledge, skill and management; also there is more soil enrichment through compost, crop residues, farmyard manure or other organic materials. Labor inputs may increase initially, but they usually decline as techniques are learned and mastered. With lower costs of production, the economic benefits of higher yield are amplified.

Standard benefit-cost analyses do not apply under such conditions as greater benefit with reduced cost yields a ratio of infinity. There are, of course, some costs, even if farmers' costs decline -- costs for extension, harvesting, storage, etc. But the ratios of total cost to total benefit (many of which are hard to measure, such as protection against the effects of climate change, or micronutrient improvements in the grain) are more favorable than for any innovation that I have ever seen.

(4) SCI: A further development, which should make us more optimistic about the possibility of achieving food for all, at least in terms of supply, is the extension and extrapolation of SRI ideas and practices, with similar results, to **many other crops**: wheat, ragi, sugarcane, mustard, many legumes, and also several vegetables. Many institutional and policy issues need to be addressed beyond having the technical capability of being able to produce sufficient food; but that is the concern of this conference.

These innovations for other crops have been grouped under the rubric of System of Crop Intensification (SCI), or in Bihar, the System of Root Intensification. As the accompanying pictures show, more productive and more climate-resilient phenotypes of most of the major food crops in India can be achieved by making changes in the management of available (not new) resources. The aim is to promote greater root growth in plants and also more abundant, diverse and active 'life in the soil.' This soil biota mobilizes, solubilizes and recycles nutrients as long as the organisms have a

good supply of organic matter (for nutrition), plus optimizing amounts of water and temperatures within an acceptable range.

India has been the world leader in SCI, thanks to imagination and innovation by farmers growing ragi in Jharkhand, wheat in Bihar, sugarcane in Maharashtra and UP, various legumes in Gujarat, Karnataka and UIttarakhand, mustard in Bihar and Odisha, turmeric in Taml Nadu, and even lac in Jharkhand (see fn 3).

This is all part of a process which I would characterize as 're-biologizing agriculture,' mobilizing and benefiting from processes and potentials already available within our existing crop genomes and within the plant-soil microbiome that is only starting to be comprehended. This parallels in significance the human microbiome which we have come to learn is so critical for our own human health and well-being.

Much more scientific work remains to be done on agroecological approaches to agricultural progress. But there is already more than enough published and available knowledge so that the question before us should not be ***whether*** we can achieve 'food for all,' but ***how***? – this global conference's theme.

Two Indian high-yielding varieties displaying more productive, vigorous phenotypes when grown with SRI methods in Andhra Pradesh. On left is a rice plant of Swarna variety (MTU 7029) grown from a single seed. This variety has been considered as 'shy-tillering,' until grown under SRI practices: from young seedlings transplanted with wide spacing and more soil organic matter and aeration. On right is a single rice plant (MTU 1071) with massive root development under SRI management. The white color of roots that there is no degeneration from the hypoxia that is caused by continuous flooding. Pictures courtesy of Dr. A. Satyanarayana, at the time Director of Extension, ANGRAU; and Dr. P.V. Satyanarayana, the rice breeder who developed MTU 1071 at Maruteru Research Station in AP.

Annex 2 (Contd.)

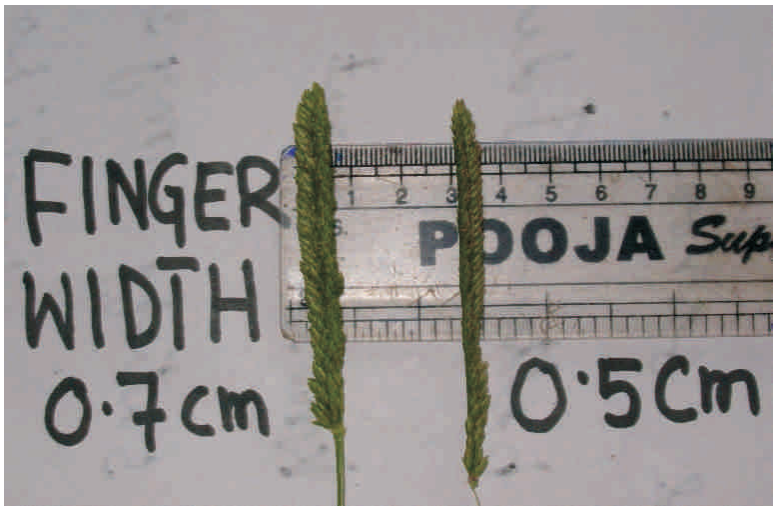
On left, a system of wheat intensification (SWI) field in Chandrapural village, Khagarla district, Bihar .

The wheat crop in the field on right is same age and same variety, but less vigorous and less matured. Courtesy of Dr. Erika Styger, SRI-Rice.

Contrasting finger millet (ragi) plants: on right, local variety with traditional management methods; in center, improved variety (A404) with same management in center; on left, A404 grown with methods that farmers working with PRADAN in Jharkhand state adapted from their SRI experience.

Courtesy of Binju Abraham, PRADAN, Ranchi.

Annex 2 (Contd.)



Phenotypical differences seen between finger millet (ragi) plants grown with adapted SRI methods (on the left) and with usual methods (on the right). Pictures show differences in panicle size (top) and width of 'fingers' (center) and in root systems (bottom). Courtesy of Binju Abraham, PRADAN, Ranchi.

Annex 2 (Contd.)

Sugarcane grown with Sustainable Sugarcane Initiative (SSI) methods adapted from SRI.

Courtesy of Dr. Biksham Gujja, AgSri, Hyderabad.

Annex 2 (Contd.)

Comments from Professor Norman Uphoff for panel discussion on '*Policy Barriers To Scaling Up Proven Alternatives*,' for The Club Of Rome – Indian National Association Global Conference on 'Securing Food For All,' New Delhi, October 30 – 31, 2014

As I suggested in the opening plenary session, I think that the main question before us is not whether India or the world can produce enough to 'secure food for all,' but how we can make this happen? What we have been learning from experience with the System of Rice Intensification (SRI) and its derived System of Crop Intensification (SCI), both well supported by scientific investigation, is that **modifications in crop management** can raise yields and factor productivity, quickly, significantly, and with benefits rather than liabilities for the environment. Because this is a very visual subject, it is helpful for everyone to see how much better phenotypes can be grown from the same genotype, i.e., the same variety, if the conditions under which they are grown are modified; so I have some pictures to share.

What produces 'the SRI effect,' seen similarly with many other crops through SCI, is the **increased root growth**, size and health, coupled with abundance, biodiversity and activity of **beneficial soil organism**. Some of the latter reside in the plants as symbiotic endophytes, enhancing the number and growth of tillers and roots, promoting higher levels of chlorophyll in the leaves and more photosynthesis, reducing senescence, and other growth and productivity promoting changes in plants' morphology and physiology. A URL link to the large literature on SRI research findings was given with my first day's comments; but specific references can and will be provided upon request. There is recent research from IARI which shows significantly higher levels of important nutrients (S, Fe, Mn, Cu, Zn) in the grains of SRI-grown rice plants, so these methods could even help reduce micronutrient malnutrition in India.

We have been learning many things about the effects of these changes in management that mobilize services and benefits from the soil biota; but more still remains to be studied and assessed. The findings so far have been probably ten times more positive than negative. Probably at least 3.5 million farmers are benefiting from these alternative practices across most of the states of India, and many scientists are now hastening to catch up with farmers' practice.

One can reasonably be concerned about the **sustainability** of these benefits. So far, SRI benefits have been seen to increase rather than decrease over time. But let me note that since SRI is not doctrinally 'organic,' only pragmatically 'organic' to the extent that this benefits farmers and the environment, if soil nutrient limitations are encountered, inorganic soil amendments could be provided if needed.

What can and should be done to make this knowledge, these opportunities, more widely known and more available to farmers?

(1) **FUNDING**: As with most innovations, there is ***some need for funding from the government***. But, the good news is that SRI, being more knowledge-intensive than input- and capital-dependent, is quite different from most other innovations in agriculture. Funds are needed for training, for publicity, for cross-visits that enable new farmers to learn from experienced farmers (and also for research, as noted below). But all things considered, SRI/SCI represents **a relatively inexpensive strategy** for raising agricultural production. The ratios of benefit-cost (B:C) with SRI are hard to

Annex 2 (Contd.)

match by any other technology. The equipment needed for SRI crop management is mostly simple and not very expensive, suitable for provision through the private sector, especially if appropriate credit arrangements can be worked out, as discussed below. SRI/SCI has the advantage of using existing resources differently, rather than requiring us to acquire and use large amounts of new resources.

(2) IRRIGATION: One of the key elements of SRI management is **reduced water applications**, not keeping rice paddies continuously flooded. This makes it important to **improve both the hardware of irrigation systems and the software of irrigation management.** Improvement should aim at **providing smaller amounts of water, but providing these reliably**. Because water scarcity is growing, and the value of water is rising, maybe even drastically in the future, it is quite justified for governments to spend money and staff time, buttressed by appropriate policies and administrative guidelines on this. We need in any case to improve irrigation water control because water is becoming such a valuable commodity.

These improvements will enable farmers to consume less water in their agricultural production while increasing food output. As the value and cost of water rise, this will become an ever-more attractive investment. Note also that while good water control is needed to get the very best results from SRI management, control does not need to be perfect or complete for farmers to benefit from using most or all of the recommended practices as best they can. SRI is basically a set of principles rather than certain prescribed practices; water management with SRI aims to optimize water and air (oxygen) in the soil.

(3) WATER HARVESTING: Related to this, because SRI methods can be adapted productively also to **rainfed rice production**, an important government initiative would be to d***evelop water harvesting structures and facilities for upland areas*** not served by irrigation facilities This could be worked into the MGNREGA scheme with little additional cost, and it would be a very productive use of such funding. Creating this kind of permanent, decentralized infrastructure can enhance food security in many ways, enabling farm households to ensure their production of staple grain.

(4) SOIL FERTILITY: Further related to this would be investments in the ***enhancement of soil systems fertility*** through the collection, processing and application of composted vegetative material to soils. Whereas soil organic matter (SOM) should normally be in the range of 2 to 6%, large portions of India's arable soils have less than 1% SOM. Restoring soil organic matter (soil carbon) after centuries and sometimes millennia of cultivation is a huge task, but it does not require much capital, mostly labor and skill, which could be appropriate for MGNREGA-financed activity.

Such investment will become ever more important and productive as climate change creates more drought conditions and exposes crops to more water stress. Organic matter increases the soil's ability to absorb and retain water. It has been found that application of chemical fertilizers will not compensate for inadequate SOM. Their use on SOM-deficient soils does not give positive marginal economic returns until soil carbon reaches a threshold of about 3%. So one reason why nitrogen fertilizer use has had to be subsidized is because without adequate organic matter in the soil, its application is not economic.

(5) IMPLEMENTS: Equipment that is important for SRI success, although not absolutely essential, are soil-aerating mechanical hand weeders that aerate the soil's surface while eliminating weeds. Hand weeding or herbicides can be used with the other SRI practices to control weed, but they do not provide the productivity benefits of active soil aeration. Weeders come with various designs, some

better suited than others for women or men, for heavy vs. light soils, or dealing with serious vs. light weed infestation.

The cost of mechanical weeders varies between $10 and $30, depending on design, quality of materials and construction, and particularly scale of production. As SRI methods have been raising paddy yields in India by 1.9 tons per hectare on average, the additional income from just 1 acre of SRI paddy (with other costs of production usually being reduced) will be 3-4 times the cost of purchasing a weeder, which can be used for a number of seasons. Since farmers are usually cash-constrained at the start of a season or may not yet have much confidence in the new methods, some kind of hire-purchase scheme should be provided, with a small down-payment or deposit at the start of the season, the balance being paid after harvest. This could be government supervised or guaranteed, or operated by merchants or suppliers

(6) MECHANIZATION: Even with high levels of poverty in rural areas, there are often constraints in labor supply, or concerns about the cost of hiring labor these days. Even when household labor is being used, rice field work is hard work, and stressful work. One of the things which would most benefit farmers and facilitate their acceptance of SRI, with its higher productivity and water savings, would be to 'motorize' weeders to make their operation quicker, cheaper and easier. There are already many designs of motorized weeders available, many developed by farmers themselves.

Government agencies have no comparative advantage in such innovation or in producing and selling implements; private-sector entities can be both more efficient and more effective. But government agencies could work with private fabricators and companies to encourage and facilitate the development, publicity, and sale of appropriate mechanical implements. There is also need for other SRI implements such as mechanical transplanters or direct-seeders. If initiative in this area is left to state governments, since agriculture is a state subject, the national government could facilitate exchanges of designs and evaluations thereof. This is an area where private sector initiative should be profitable.

(7) RESEARCH: As noted, there is much scope and need for generating of new knowledge and critical assessment of existing knowledge regarding SRI and SCI. Research institutions and state agricultural universities should rejoice in the long and diverse research agenda which this paradigm shift presents. Most of the research in India to date has been on **whether** SRI methods are effective, and by **how much**. The next generation of questions will focus on the **how** and **why**? There are good reasons for expanding research particularly on the microbiological aspects and dimensions of SRI and SCI.

(8) VARIETAL DEVELOPMENT AND PREFERENCES: That SRI elicits more productive phenotypes from available genotypes does not mean that there is no reason for further work on plant breeding and varietal improvement. That SRI can get **better and fuller expression of crop plants' genetic potentials** does not mean that there should not be further improvement of those potentials. It is unfortunate that SRI's appearance on the scene was met with more hostility and suspicion than curiosity and collegiality from agricultural scientists. Attitudes appear now to be shifting and becoming more friendly, however.

It should be noted that SRI methods can greatly improve the productivity of '**unimproved' varieties**. These, because of their taste and other qualities, are often favored over HYVs and hybrid rice by consumers, who are willing to pay a higher market price for local, traditional or heirloom varieties. With SRI methods, they can produce 4 to 10 tons per hectare, very respectable and remunerative

Annex 2 (Contd.)

yields. If produced by 'organic' practices, there can also be a price premium received for higher quality.

So far, all of the highest SRI yields in India have been with high-yielding varieties or hybrids, so plant breeders should be happy to see their creations giving yields of 15 to 20 tons per hectare of more. The same hybrid varieties when grown with conventional methods produce much less than with SRI. Moreover, because SRI methods reduce drastically the amount of paddy seed needed, the much higher price of hybrid seed presents no barrier to adoption for farmers to use these new methods. However, on the policy front, there is a question whether the government should be actively promoting and even subsidizing the adoption of hybrid varieties, as if this is the only way to achieve higher grain production.

SRI experience shows that HYV and hybrid yields with conventional methods can be surpassed by the alternative management practices using even local varieties. These with SRI management can have advantages of resistance and resilience to the effects of climate change (drought, flooding, storm damage, increased pests and diseases) and can also meet market demand in terms of quantity and quality. A policy implication of this is that there should be a '**level playing field**' with regard to varieties, leaving the choice of seeds and of methods to farmers and ultimately through the market to consumers.

(9) A SPECIFIC PROPOSAL: There is already an extensive body of experience and published literature supporting the statements that I have made, but there is still in some circles a reluctance to accept these new ideas and practices, to move away from the presently-favored Green Revolution paradigm. It need not be abandoned, as is the case with some paradigm shifts; but current thinking should not obstruct the acceptance of new thinking if there is good evidence to support it.

This Club of Rome conference could do everyone a service and advance the goal of 'securing food for all' by getting the Government of India to conduct **a systematic and scientific review** of both experience and evidence with SRI methods -- and not just for rice, but including other crops (SCI) as well. I am sure that the National Consortium for SRI (NCS) would be quite willing to cooperate in such a review if it is a fair and balanced undertaking that proceeds as factually and objectively as possible. The NCS could assist any reviewers to have access to both field experience and published information for getting a full understanding of options and opportunities, problems and limitations.

India has been giving leadership for SRI and SCI for some years now. It could provide **global leadership** for these new, eco-friendly directions for agriculture, appropriate for a climate-changing world, if there is agreement within the scientific community, and with political decision-makers, and of course, from farmers. If what I have reported here is verified for all to see, such an initiative by the Club of Rome INA could serve Indian farmers, consumers and the environment well, contributing to 'securing food for all.'

Trial plots at Al-Mishkab Rice Research Station in Iraq, 2007, comparing effects of SRI (left) with non-SRI (right) management practices for pairs of on-station plots with the same rice varieties. Picture from Dr. Khidhir Hameed, Senior Rice Scientist, MRRS, Najaf.

Annex 2 (Contd.)

Farmer Nagaraju in Amadagur village, Ananatapur district, AP, showing difference in growth between a single SRI rice plant (left) and a conventionally-grown clump of rice plants of the same variety (right). Note particularly the difference in root growth. Picture from a field visit in 2006 by N. Uphoff.

Paddy fields in Sri Lanka with same rice variety, same soil, and same drought, where irrigation had been stopped three weeks earlier. Field on left was grown with usual methods: older seedlings, close spacing, continuous flooding; on right is SRI field: younger and fewer seedlings, wider spacing, no continuous flooding with intermittent water supply before irrigation stopped, active soil aeration (mechanical weeding), and more organic matter provided to the soil. Picture courtesy of Dr. Gamini Batuwitage, at the time Additional Secretary of Agriculture, Colombo.

Paddy fields in East Java, Indonesia after Crawak village has been hit by both a brown planthopper (BPH) pest attack and a tropical storm in 2011. The field on left was planted with a modern variety (Ciherang) and provided with inorganic fertilizer; the SRI field on right has an aromatic traditional variety (Sinantur) managed organically. Because of lodging and 'hopper burn,' the field on the left gave almost no harvest, while the field on the right, with no such damage, produced 800 kg from 1,000 m2 (8 tons/ha). Courtesy of Ms. Miyatty Jannah, the farmer in Crawak, Ngawi district, who managed the SRI field on right.

Annex 3

Following [Draft] Minute of MoS (S&T)

Date: 1 November 2014

"In exercise of powers conferred by Sections 16 (1) and (2) of the Technology Develop-ment Board Act, 1995, I direct:

a. TDB shall make it a priority to fund the adoption, adaptation and extended demonstration in India of the Sustainable Rice Initiative (SRI) of the International Rice Research Institute

b. TDB shall liaise closely with registered farmer's co-operatives and State Agricultur-al Universities already engaged in one or another aspect of SRI.

c. The above programme shall be designed in such a way that each project under the programme, when successfully completed is deemed pre-approved, without further scrutiny by NABARD, for the latter to provide loans to farmers for routine use by them of this technology.

d. As the much-increased higher yields from the adoption of SRI will result in in-creased quantities of post harvest agri-material such as rice-husk and rice-straw, TDB shall identify and fund the development of saleable prototypes of machinery to enable those by-products/residues to be utilised for making profitably -- at at no larger than district-scale -- of construction material -- such as rice-husk particle-boards -- for dwellings, community buildings and similar use

e. TDB shall also include at a subsequent stage in the above programme the adoption and/or adaptation of technologies for the conversion of the waste from such post-harvest processing to be usable as aggregates for local drains, roads and pave-ments.

f. Provide Draft Guidelines for (a), (b) and (c) for my approval within thirty (30) days.

   Draft guidelines for (d) and (e) shall be submitted to me within thirty (30) days of the first project that is approved per above.

g. PM has seen.

- Sd -

[MoS, S&T]

Marked to: Secretary, DST

Copy to: Cabinet Secretary

Additional copies to: Principal Secy to PM; Addnl. Principal Secy to PM; Secretary, DARE.

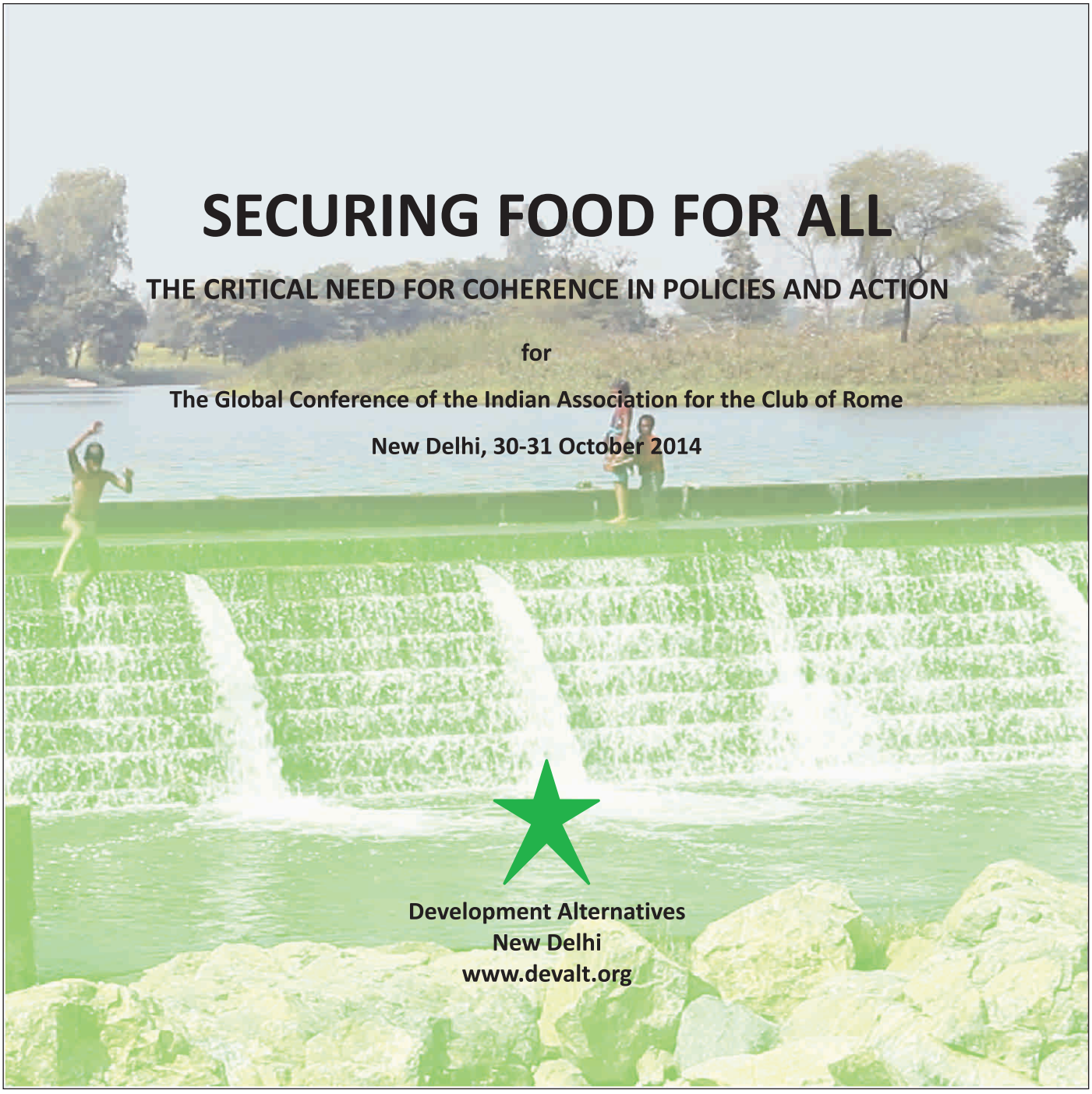
Copy for kind info to Minister for Agriculture and Minister for Rural Development

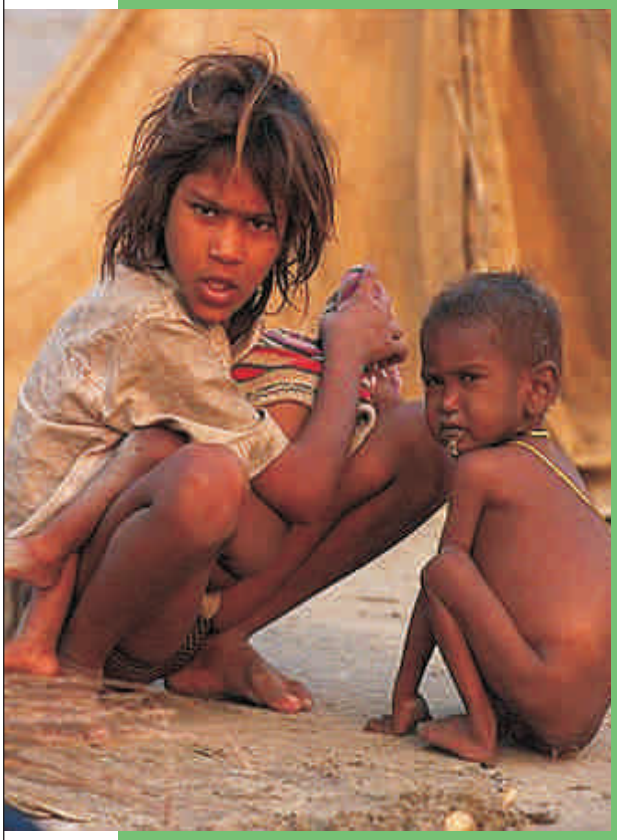
Comment from Dr. Biksham Gujja:

Close to 4 million farmers in India have attempted SRI at least once, and State and Central Governments have spent resources to promote SRI. It is therefore high time to have an independent commission consist-ing of economists, ecologists, social scientists and agronomists to review and suggest measures for further improvement and design programs to upscale SRI interventions. Such a review process will also document the positive experiences as well as some of the shortfalls. The review may also look at similar approaches being tested adapted on other crops.

Annex 4

Dr. Ashok Khosla's FNS paper for CoR-India, Oct 2014





Summary

Six-and-a-half decades after Independence; a half-century after the Green Revolution liberated India from the spectre of starvation, even official statistics estimate that more than a hundred million of our fellow citizens go to sleep each night hungry and malnourished.

A great number of them are children under 5 years of age. These children will grow into being physically and mentally stunted adults; predestined for no fault in their genes to be not only unproductive, but also to be an economic and social burden on their families, communities and on the more fortunate in society.

Our collective duty to eliminate hunger from India is an unarguable moral issue, as it is an indisputable existential imperative and, moreover, an unquestionable matter of simple self-interest.

This booklet explores the design and functions of the institutions of the State, of business and of civil society that are necessary - even if not entirely sufficient -- to serve the ethical, ecological and societal purpose of speedily eliminating hunger and malnutrition from India.

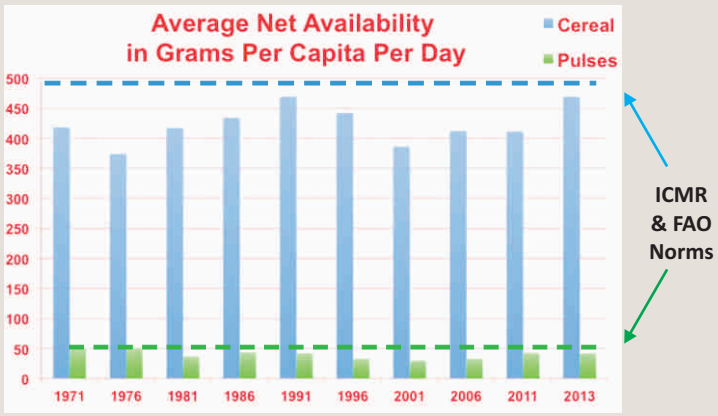
Ashok Khosla
Chairman
Development Alternatives

THE FUNDAMENTAL ISSUES

Among the many important goals that India must now pursue, perhaps none is of higher priority than ensuring secure access to food by every one of its citizens, now and for the future.

If you look at the total food production in India today, together with what the nation can afford to import, is said to be more or less sufficient to give every person – child, woman or man – the minimum calories and protein needed for being reasonably healthy and free from hunger.

Yet, several hundred million people in India remain hungry and malnourished. Estimates vary from around 100 million (GOI) to more than 300 million (FAO, WFP, World Bank, OXFAM, and others). Whatever the precise figure, the loss to the nation of the resulting damage to the physical and mental capabilities of our fellow citizens is, by any standards, astronomical. Our much-vaunted "demographic dividend" becomes complete nonsense – a heavy "demographic liability" – in the light of the legacy we are leaving for the next generation to inherit, of vast numbers of under-proteinised, unskilled and consequently unemployable people.



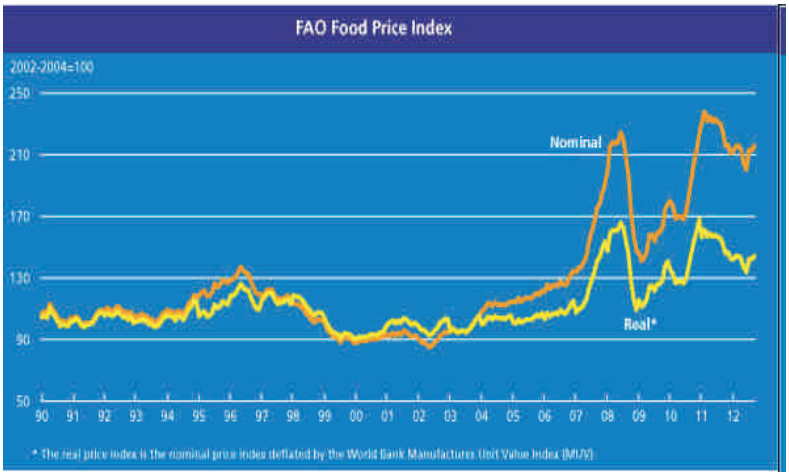
GOI, Economic Survey 2013-14

While meat and fish, dairy products, edible oils, vegetables and fruit contribute to the diet and health of those who can afford them, the primary sources of protein and calories, the main nutritional requirements, for a majority of Indians are grains and pulses. According to the 2013-2014 Economic Survey of the Government of India, the average net amount of cereals and pulses available per capita per day has, over the decades, been lower than the minimum acceptable norms. It is obvious that from

01

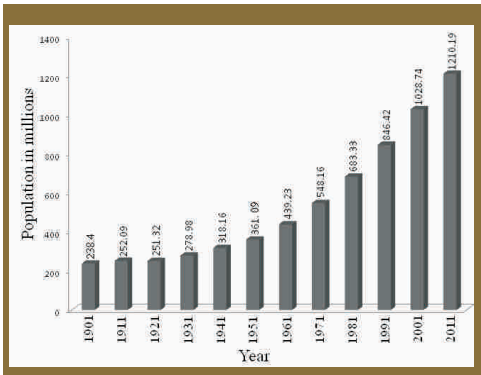
the time of India's independence, significant portions of our people have not been able to meet their daily requirements of either protein or calories. At no point, including today, has availability of cereals or pulses nationwide been enough to meet the minimum nutritional need. Since this chart is based on the nationwide average, it is obvious that for the large numbers below that average, the bars shown are much shorter and the gaps much larger. Moreover, the population continues to grow, and the natural resources – our soils, water, energy and the other factors - essential for crop production continue to decline. Given the non-linear nature of both the rapidly rising demand curve (growing populations, changing diets, etc.) and the steeply declining supply curve (diminishing natural and financial capital, etc.), a sudden catastrophic outcome cannot be ruled out, nationally, regionally or even globally. Food prices have already reached heights never seen before, both in India and elsewhere and the past decade has seen more than its share of social turmoil and political upheavals on this count.

World Food Prices - FAO

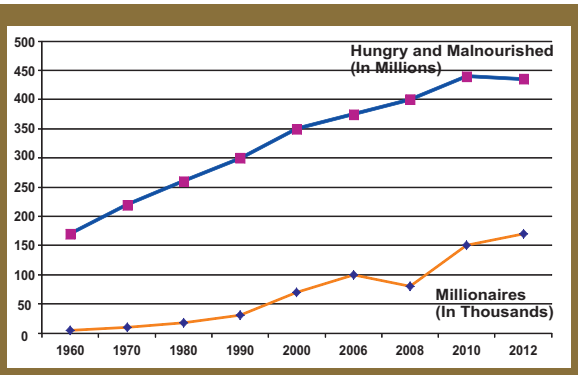


02

For six decades, one-third of our people, a population now larger than that of Europe, have provided living proof of Thomas Robert Malthus' contention that hunger is a natural outcome of unregulated economic and demographic growth. As a nation, we have not been able to outrun Malthus' nightmare, despite the fact that some of us are well fed as anyone, anywhere, at any time. What breed of horse must we now find to jump ahead in the race between food availability and mouths to feed? It is clearly unlikely to be the one we have today, where the bulk of the nation's food and nutrition vehicle is driven by an unholy mix of contradictory and mutually excluding ideologies. Pulling in one direction is crony market capitalism for which the overriding goal is to maximise profits, if necessary with influence, money and shoddy business practices. Pulling in the opposite direction is a simplistic dogma-bound socialism for which the overriding goal is to maximise election votes by promising populist (but not necessarily implementable) 'schemes', easily subverted by inefficiency and corruption. The glue that keeps the opposing interests together is a system of patronage cultivated over the decades that enables the few to benefit hugely at the expense of the many. Examples abound, such as those of tribal lands and protected natural areas being handed over for a pittance to private companies and free power and diesel being given to a large number of farmers and special interest groups.



Census of India



CII, Oxfam

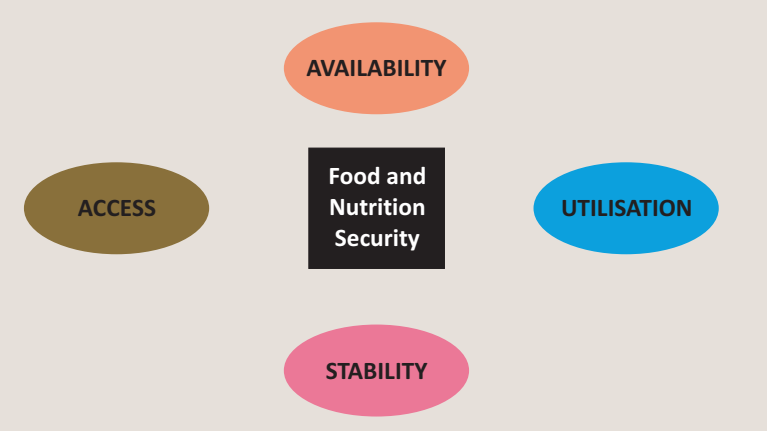
03

Annex 4 (Contd.)

The scores of conferences that regularly take place to discuss India's food security present us with shopping lists of the kinds of change needed – mechanisation of farms, improved seeds, regionally appropriate crops, improved incomes to farmers, particularly the women, etc. Few deal with the underlying barriers to solving the problem at the scale needed.

Given the growing threats of climate change, biodiversity loss and massive desertification, the hunger gap could rapidly get worse in the coming decades unless we change direction on many fronts.

Conventional thinking, as codified by the 2009 World Summit on Food Security, divides the problematique of food and nutrition security into four broad sets of issues:



Even so, what has emerged so far from the clamour for solutions is a prime example of the timeworn "kitchen sink" approach to yesterday's debates mainly focusing of course, on positive measures to enhance food availability, for example by raising agricultural productivity and other means shown as the Silver Bullets in the figure below:

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Annex 4 (Contd.)

This has only resulted in countless proposals, initiatives and goals that are loosely connected at best, and that are often plagued by internal inconsistencies. The frequent succession of governments, each with different ideologies, has left the state of the Indian Republic's food and nutrition agenda in tatters. The pendulum swings, from the left-wing socialist give-away schemes to the right-wing capital-intensive export-oriented profit-hungry programmes, have left the farm economy in a daze. Rampant corruption continued, of course, through all regimes. Parties at neither extreme of the political spectrum, nor in between, have the answer needed, but some have insights that can help India's citizens and communities to become truly secure in terms of food and nutrition. On the production front, it is clear that the future of India will need a mix of large and small farms, producing a diverse regional food mix and choice of technology that maximises both the productivity of land and water and the earnings of farmers and their labour. On the distribution and consumption front, stable, affordable prices maintained by a judiciously regulated market based on carefully designed policies with inbuilt transparency mechanisms could enable universal access to food in the shortest possible time.

This means that a new, simple and sustainability-oriented approach is needed, which must now become the central subject of debate in our country. Considering that food and nutrition security is one of the most important goals for the future health of the nation, we believe our national debate will require several key changes in our general approach and order of business. Only then can we develop a food security policy framework, which is capable of carrying us up to at least 2050, if not all the way through to the next century.

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THE DEBATE NEEDED TODAY
AND ITS UNDERLYING PREMISES FOR TOMORROW

We now need to be more explicit and transparent in prioritising, or ranking, our broad policy objectives. Setting different agendas on multiple platforms – fading Five-Year Plans, sputtering MGNREGA implementation, the new avatar of Swacch Bharat, and countless other crowd-pleasing political initiatives – is a recipe for confusion and potential conflict.

Targets, which smack of the legacy of a state-directed economy – a legacy that runs counter to the current national emphasis on caring for the poor and the "common person", as well as the primary role of markets for economic growth, should in general be downplayed, if not eliminated entirely. Instead of setting production targets that satisfy the needs of policymakers and money-masters, while leaving common people hungry, we should instead focus on policies that target 'Zero Poverty' or 'Zero Hunger', which are easily measurable, visibly verifiable and, as Brazil has shown in the past decade, eminently achievable.

No activity that involves production and consumption can be scaled up to reach everywhere or everyone unless it is economically viable. So, reasonable profits and efficient markets are essential for universal food and nutrition security as they are for all other basic needs. But profit and markets, though necessary, are not sufficient. They alone, do not guarantee food security for all, either today or in the future. For the poor and the marginalised, additional measures are needed to ensure universal and reliable access to nutrition. And for our children and grandchildren tomorrow, the productivity of the environmental resource base has to be protected and enhanced to ensure that they can continue to get the nutrition they will require.

Thus, any sustainable food and nutrition policy and governance must pay attention to ALL THREE dimensions of sustainability, social equity, environmental quality and economic viability:

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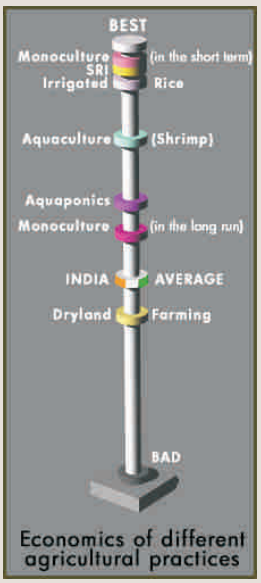
A. Issues of Economic Viability – The first commitment is to the efficiency, prioritisation and scaling up of food production, which means that the mix of the factors of production – land, labour, capital (and others such as knowledge, technology, infrastructure, market linkages, etc.) – in the agricultural practices has to be optimised for each social, economic, resource and geo-climatic context. This applies also to the mix of crops produced. Given the changes occurring in the climate, ecosystem productivity, resource prices, and transportation costs; the issues of trade and comparative advantage also have to be examined anew.



Economics of different agricultural practices

Apart from concerns such as the nation's strategic imperatives and security of food supplies, which have played some part in food-related decision-making in India and other countries, there are several emerging factors including climate change, spread of plant and animal diseases, extinction of cultivars and genetically important varieties, etc., that need to be considered in the choice of food strategies. Since few sectors have benefited as much from research and innovation as agriculture, the investment choices made can also hugely affect the relative importance of different crops to the economy.

Implication: Since food security depends on the mix of foods in the market and the relative prices, and the choice of technology determines not just what is produced but who gets the income, it is clear that the investments made in infrastructure, irrigation, seed availability, research and innovation for different crops have a large impact on the outcomes.

B. Issues of Social Equity – The second issue is the commitment society must make to universality, fairness and social justice in spatial or class terms—in the here and now. It assumes that adequate food and nourishment is the right of every citizen, urban or rural, rich or poor, powerful or marginalised. Recent political upheavals in different parts of the world, including ours, resulting from food scarcity or

Annex 4 (Contd.)

unaffordability demonstrate that equity is a central component not just of liberal, participative democracies but, more importantly, of the very sustainability of these. Equity means that the poor, women, tribal people and other marginalised segments of society have access to adequate food of the type they like. It also means that farmers; marginal, small and large, receive a fair price for their produce and are not misled, nor pressured to produce food crops or use practices that may compromise their land productivity and production decisions in the medium to long term. This issue necessarily focuses on the imperative participatory approach for sustainable policy development, in order to have truly bottom-up decision making processes for designing, developing and implementing coherent policies. We do not have to worry about policy incoherence, if the people are truly involved in deciding their own food and nutrition security.

Implication: It is essential to create strong, viable and resilient communities, which can ensure the health and nourishment of their members by enabling them to access and fulfil their basic needs.

C. Issues of a Healthy Environment – The third commitment is to inter-generational equity and the responsibility we have for our legacy to the future, a factor that requires vastly extending our time horizons. While most past decisions on economic development, including agriculture and food, have been made to deal with immediate problems, on the basis of narrowly-conceived and short-term considerations, we have to recognise the deep and intrinsic trade-offs involved in the technologies and policies we choose, and the impacts these will have on future generations. Recent declines in crop productivity in places such as Punjab and increases in food imports in countries such as China, often within a few decades of introducing high yield cropping, demonstrate that the health of the environment and its resource base is a critical factor in sustainability. Environmental health means that the productivity of the land and soils is maximised and pollution, contamination and erosion are minimised.

Implication: Ensure that the methods of producing food and the institutional frameworks for delivering it do not compromise the productivity of our soils, water or other resources, now or for future generations.

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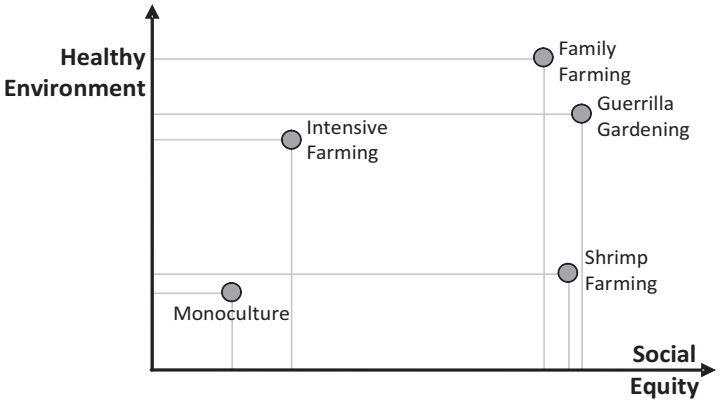
Equity and Environment are closely related, but different methods aiming at food security involve different mixes of these and influence them in different ways. To show this diagrammatically (with subjective estimates for the environmental/equity ratings of each agricultural method, rather than any attempt at numerical precision), various food production approaches are plotted in the chart below:



Each choice has its own requirements of land, water, and ecosystem services and has its own yields of produce per unit land, and especially protein and carbohydrate calories per unit land, people fed per unit land – and these will evolve over time as population dynamics change and resources get depleted.

Policy Coherence and Inter-sectoral Balance

A good balance in investments, say, between the agricultural sector and industry, or between services and natural resource extraction is critical for the economy to grow in an optimal and sustained manner. A balanced economy clearly is a necessary condition for sustainability, and is possible when there is coherence amongst the policies adopted for different sectors.

The "silver bullets" including the various activities that can help bring supply of food into some balance with the demand for it, are necessary and extremely important. The many conferences each year that

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reiterate them testify to the broad recognition of how essential these traditional thrust areas are, particularly in the right combinations. But they are not enough. We now need to address the requirements of today and tomorrow and focus on the coherent policies needed to promote new technological innovations, which will enable humanity to leapfrog over yesterday's obstacles that limit growth. New and unfamiliar technical ideas need to be given full support to allow rigorous testing, even when they are viewed with scepticism by the scientific establishment. The time has come to recognise that, much as in nature, breakthroughs can only occur by nurturing emergent ideas and allowing the fittest to survive and grow.

Current examples abound: the astonishing productivity increases made possible by the System of Crop Intensification (SRI) for growing rice, while scoring high on equity and environmental health. Or, similar gains by Organic Farming that rewrite the equations for quantum leaps in naturally enhancing soil regeneration and food quality with lower carbon and water footprints. Or, Aquaponics, which introduces new possibilities for organic, soil-less agriculture and vertical farming, thereby opening up vast new urban and peri-urban spaces for robust urban agriculture.

Urban agriculture is an important policy debate for India, which is lagging far behind many OECD nations that have embraced this concept, keeping in mind that 50% of our population will soon live in urban areas, which are food deserts at present. Without new food policies, the 'Four Pillar' doctrine of FAO and similar conventional approaches imply that massive quantities of food will need to be transported from rural food growing hubs to urban food consumption centres. From the energy policy point of view, this will become quite unsustainable, considering also that:

- One-third of all food produced in India is spoiled and rendered useless before it reaches the table.
- Supply-chain mechanisms lack infrastructure and are impeded by a system of middlemen who delay delivery, force up prices and introduce big frictional losses.
- Conventional agriculture produces about a third of all GHG emissions.

One of the more important needs, now widely recognised is for regenerating the production of pulses and oil seeds. According to the Ministry of Agriculture, India has gone within two decades from being

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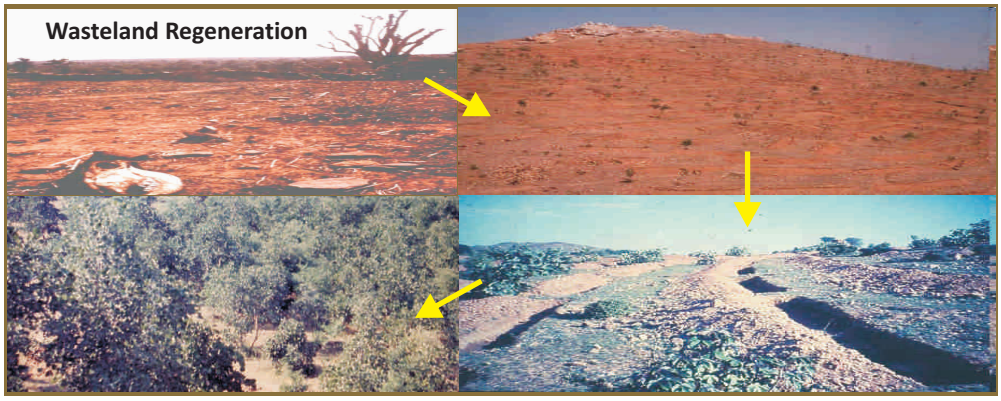
self-sufficient in these crops t to becoming a net importer of INR 50,000 crores (US$ 8,300 million) worth of produce annually. This will need many initiatives, including improved varieties, seed availability and reviving age-old land-and-water management systems that can provide huge gains in productivity for pulses and oilseeds on dry or degraded lands. The work of many civil society organisations, including Development Alternatives, has demonstrated the enormous potential for growing these crops and much of the knowledge is available to be further built upon.



Thus, one big frontier for improving the food and nutrition situation is clearly, innovation – based on a judicious combination of the latest science and traditional knowledge: innovation that can scale up and become a part of mainstream praxis.

But, again, the Silver Bullets plus these new technologies are not sufficient. Even if all, or most, of these interventions were to be implemented, it is still unlikely that the hunger and malnutrition problem would be fully solved. This is because there are other political, economic and social barriers, not usually dealt with in the current discourse, that undermine the impacts of such well-intentioned policies and actions.

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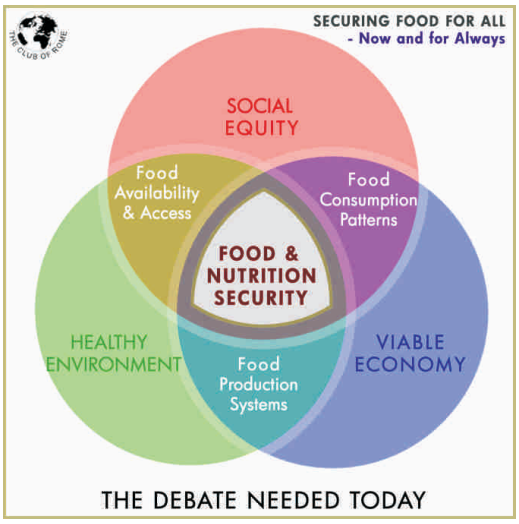
Hence, the debate needed today—is depicted in the following Venn diagram which exemplifies the Club of Rome's commitment to systems-based analysis:



Using these three underlying aggregates—social equity, healthy environment and viable economy—we can proceed to determine how best to identify the object oriented attributes for the following patterns of activities:

- Food availability and access
- Food consumption patterns
- Food production systems

India's achievements since independence are unquestionably remarkable. It has made massive progress not only in industrialisation and infrastructure and information technology and science and

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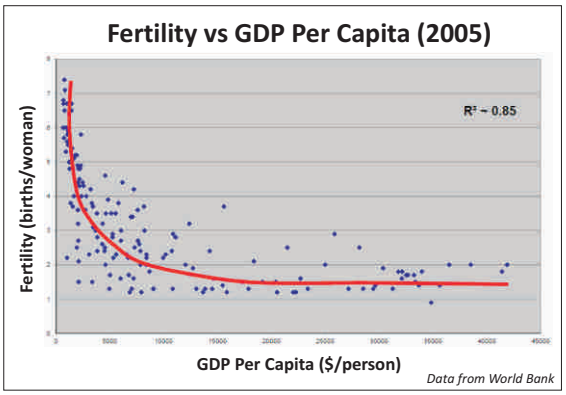
education, but specifically in agriculture – doubling, for example, both grain and milk production in a little over two decades, successes that are quite unprecedented. Yet, we do find a significant portion of our country in the Malthusian trap mentioned above. The normal response is "yes, but we have more people." Which is true, but not a given. Population growth rates are endogenous variables in the development process, not exogenous ones as they have been treated for far too long. We have more people because we have large numbers of people who are poor, hungry and marginalised. History, including our own in various parts of the country, particularly the Southern states, has shown that poor, hungry and marginalised people tend to have high fertility but as soon as their life prospects improve, they start to desire smaller families. In other words, improved per capita nutrition leads to lower population growth, which in turn leads to further improvement in per capita nutrition. It is a self-reinforcing cycle that has been achieved in parts of India but not yet nationally.



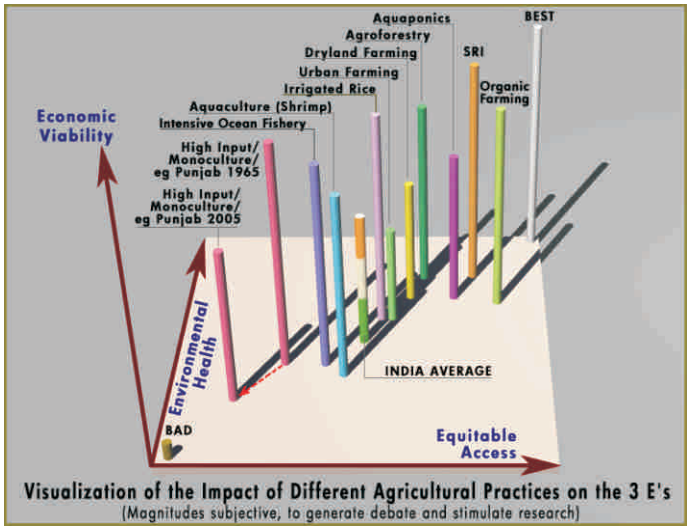
The types of policies needed to jump out of this Malthusian trap now need to be critically designed, to enable the market to deliver adequate nutrition to all citizens efficiently and sustainably. It is unlikely that this will be possible with only incremental changes to existing technologies, institutions and decision systems. Going on tinkering and fine-tuning a set up that has demonstrably not been able to produce or demonstrate the desireable results for six and a half decades is no more saner than Albert Einstein's idea of a madman who does the same thing over and over again, expecting different results. Policy makers have to now recognise that with a new government in charge and with few commitments to past decisions, the time has come to redesign the policy process itself and start with de novo assumptions, a kind of "zero-based policy" approach. This means starting from first principles on issues

Annex 4 (Contd.)

such as innovation, technology, economics of agriculture and food and others, continuing of course, with those that are recognised to have worked well.

Central to this must be a firm national commitment to "putting the last first", or in the Mahatma's words, to "antodaya" – not just as a moral or ethical obligation but as a social, environmental and economic sustainability imperative in the interest of all. Indeed, Gandhi's concepts of sarvodaya and swadeshi are just as important in this light.

When reliable and objective data is available on these patterns of activities, we can develop effective models to make reasonably accurate predictions on the effective mix of activities which will enable us to meet our central goal of providing food and nutrition security for all. For example, a 3D visualisation of a number of typical attributes is indicated in the following image (with imputed values that are indicative and open to discussion and change):



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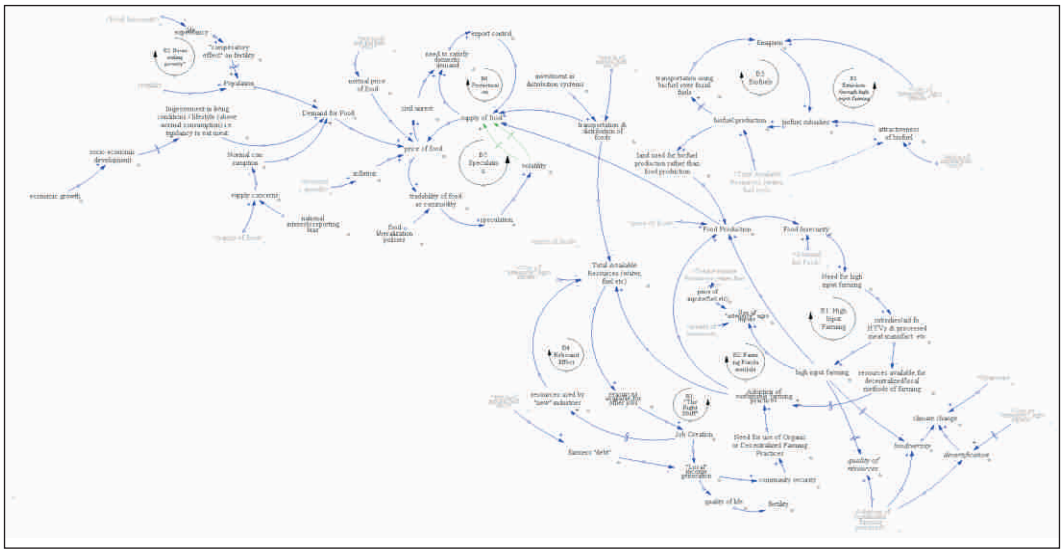
This visualisation can help decision and policy makers to discern the robust and effective policy initiatives needed to achieve the goal of food and nutrition security for all. It is instructive to note that several of the nascent innovations of SRI, organic farming, dry land regeneration and aquaponics mentioned previously, are placed at the top right corner, signifying high sustainability credentials.

Based on such representations of the attributes of the 'Food & Nutrition Security' debate, we may use various modelling approaches, to simulate the trajectory of food security outcomes in terms of time and space variations. This would enable researchers to get a handle on the sensitivity of food security to various changes in the economic, social or biospheric environment, and provide sensible information for decision and policy makers.

The issues are complex, yet amenable to simple, logical analysis, as the chart below, which describes the linkages between the many factors that affect food security, shows clearly:



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There is an urgent need for strengthening the databases and inventories of existing policies that impact food and nutrition security. This will aid in leading to the creation of a matrix of attributes, where each coefficient will map the degree of coherence, or the lack of it, between each policy. This dynamic model will help to quantify the extent of policy and regulatory incoherencies, and provide inputs for institutional policy reform that will lead to coherent practices—a goal that needs the widest possible cooperation. Policies however, are often made with an eye on vote banks and pacifying or benefiting certain constituencies whether the poor masses or the industry – longer term sustainability benefits will need to be linked with or factored in the politics of policy making. This may require identifying the win-wins and how to package them for the greatest impact.

We may conclude that identifying the policy issues related to the three fundamental values of sustainability— equity, environment and economy—whether they are intra-sectoral within the food security nexus domain or extra-sectoral, must be carefully made explicit to enable a meaningful public debate.

While domain experts often have valuable insights (particularly on what has or has not worked in the past), they often tend to have rather conventional, narrow and somewhat restrictive ideas on what should be tried for the future. The need today is for brave and massive innovation – innovation in technologies, institutions, approaches and policies that mutually reinforce each other. And this requires people who can communicate across disciplinary and sectoral borders. **We therefore now need widespread consultation with scientists, academics and practitioners, government officials, businesspersons, civil society groups, and the wider public to give advice of value to governments, corporations and other decision makers on:**

Policies and actions that grossly distort the pricing of various resources, leading to suboptimal use of these resources and losses to the sector and the national economy include:

- Perverse subsidies – such as for energy, water, fertiliser, transport
- Technology choice – short-term benefits vs. long-term costs

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- Inter-state tariff barriers
- Job and income generation schemes
- MGNREGA
- PDS procurement prices
- Land use policies that add to the vulnerability of to minimise risk to crops from to natural disasters
- Land use policies that permit to prevent hijacking of fertile farmlands urban or infrastructure development

Policies that influence, positively or negatively, the willingness, of farmers or businesses to invest in food production and downstream activities such as:

- Security of land ownership and tenure; inheritance laws that promote continual fragmentation of farms
- Improving ecosystem services such as forests, watersheds, coastal zones, mountains and glaciers, grasslands, etc., through appropriate laws and community based institutions
- Incentives and disincentives for cash crops, biofuels, agroforestry and other changes in products and production systems
- Promotion of mechanisation, chemicalisation and financialisation in agriculture and downstream activities
- Market pricing distortions due to hoarding, exports and other administrative, regulatory or legislative failures
- Minimum support prices for crops desired for food and nutrition security, resilience to climate change and reducing risks from extreme events (e.g., financing shifts to new cropping patterns, diversification and flood protection)

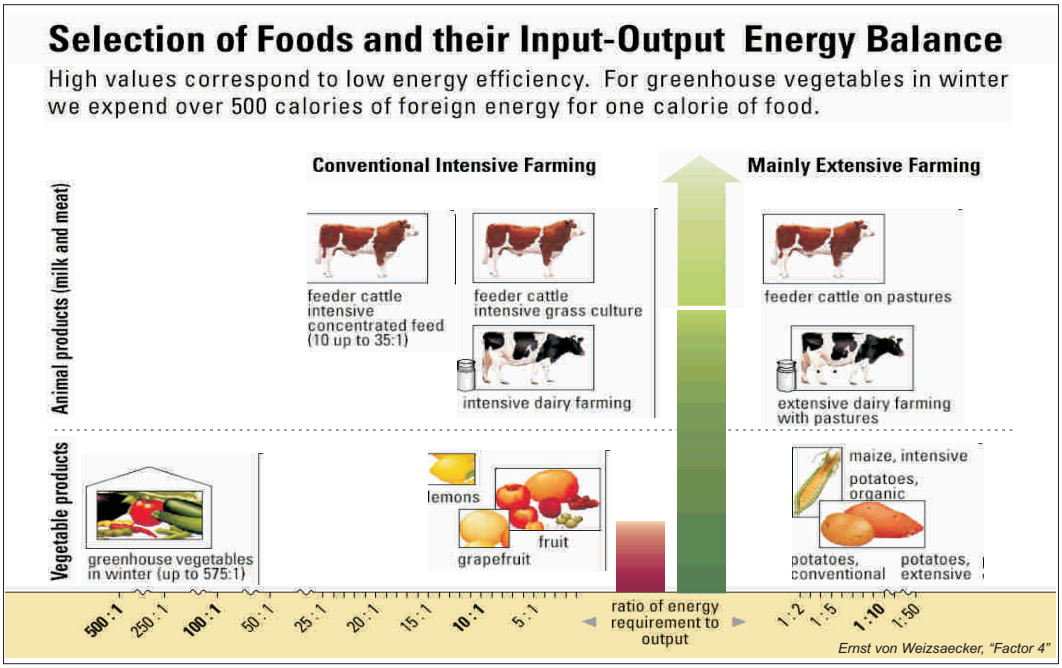
Annex 4 (Contd.)

Other policies that affect the food security of the population:

- Economic and fiscal policies that maintain or exacerbate economic disparities, and particularly poverty
- Trade policies in all sectors, not just on importing raw materials needed for producing agricultural inputs and for exporting food products (e.g., critical assessment of subsidies for export oriented produce, need for secure access to key foods)
- Energy, environmental and other policies, or the inadequacy thereof, to mitigate or adapt to climate change and its impacts on food security (e.g., biofuels and – or versus – food, extensive agriculture vs. input-intensive agriculture)
- Infrastructure development policies and programmes, especially for irrigation, storage, distribution, etc (e.g, salinisation of soils, spread of diseases)
- Policies and investments in research, especially in areas with clear private benefits such as GMO trials,

In identifying the policy issues that need to be examined and possibly modified, whether they are intra-sectoral within the food security nexus domain or extra-sectoral, their relationships and commitments to the three fundamental values of sustainability – commitment to equity, environment and economy – must be carefully made explicit to enable a meaningful public debate. For example, as the chart below shows, the energy intensity of the chain of agriculture and food from land to table has, over the past six decades, evolved through several orders of magnitude in energy use.

Simply put, the chart shows that the extensive farming practices employed by the grandmother of today's modern farmer (represented by the right side of the chart) produced 50 calories of food energy for every calorie of input. Today's modern farmer, who has drifted to the intensive farming and food processing methods depicted on the left side of the chart, produces 1 calorie of food energy for the several hundred calories of inanimate energy he puts in. Within half a century, the farming practices currently attracting policy support now use three orders of magnitude (one thousand times) as much



energy than the ones that actually produced much healthier foods at the table for millennia. Even if the energy mix that goes into intensive agriculture shifts from fossil fuels to renewables, this form of food production will still make huge demands for scarce resources such as water and phosphorus and pollution causing inputs such as fertilisers and pesticides. This is a rudimentary example of the conflict between national policies purporting to encourage "modern agriculture and food systems" and those that are intended to conserve increasingly scarce resources such as energy, water and land.

Annex 4 (Contd.)

Implementation

The concepts outlined above will be meaningless unless they are implemented and lead to results on the ground. Most of these concepts are well known to government officials, businesses and civil society – but the formulation of policies does not seem to be influenced much by this knowledge. Clearly, there exist considerable barriers to rational policy making.

One of these is, of course turf or territorial issues. The silos within which ministries work and the bureaucratic instinct to protect that turf from all new-comers is probably the biggest barrier to rational policy making.

Other barriers include ignorance of the issues, lack of data and attention to research findings, inadequate support to research, lack of respect for the views of others (the "Not Invented Here syndrome"), fear of the unfamiliar, narrowly-defined professional or personal self-interest and the other well-known societal or individual frictional processes such as corruption, inefficiency and lack of concern for the national good.

But such barriers have been overcome in various places and at various times, and given the magnitude of the problem in our nation, India has little choice but to make this the place and time when it happens.

Many conferences take place every year on the subject of "Food and Nutrition Security". The one convened by the Club of Rome - India offers a valuable opportunity to probe the fundamental, root causes across disciplines and sectors, and find solutions that can be translated into policies in officialdom and action on the ground to enable the country to eliminate hunger, malnutrition and indeed all forms of poverty within a very short time.

THE STARK NEED FOR POLICY COHERENCE

The goals of food and nutrition security for all can only be attained if we bring

Annex 4 (Contd.)

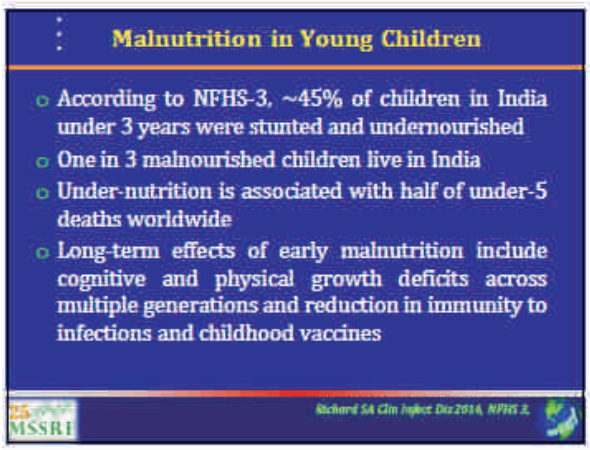
Development Alternatives

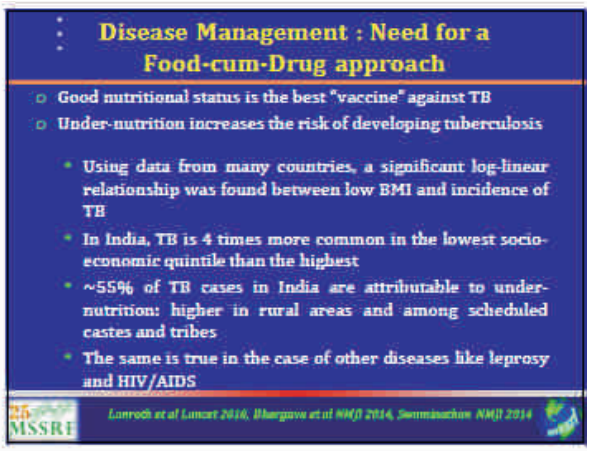
Development Alternatives (DA), a not-for-profit action research and development organisation, is the primary knowledge partner of CoR - India. DA innovates and disseminates sustainable solutions aimed at reducing poverty and regenerating natural ecosystems and their services. Established in 1982, its eco-solutions deliver basic needs products through the small, local enterprises that generate green jobs and sustainable incomes. Based on its innovative environment-friendly technologies and market principles, these enterprises help build local economies and communities while

Contact: mail@devalt.org

Annex 5

Dr. M. S. Swaminathan's PPT presentation at the conference





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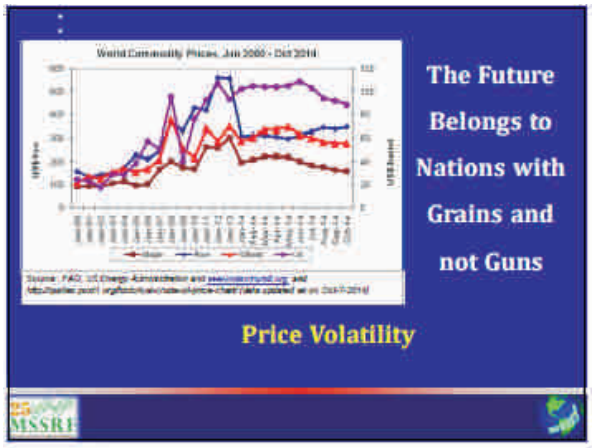

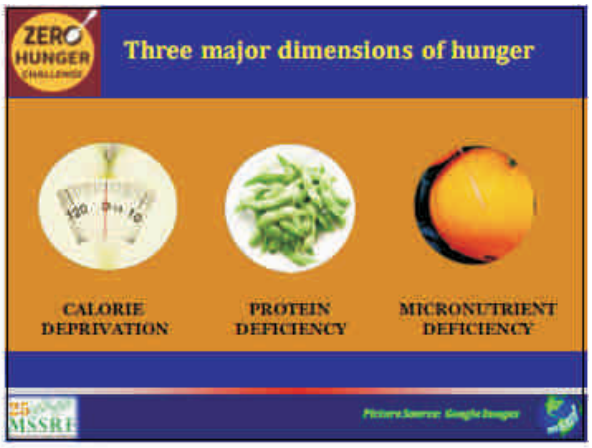

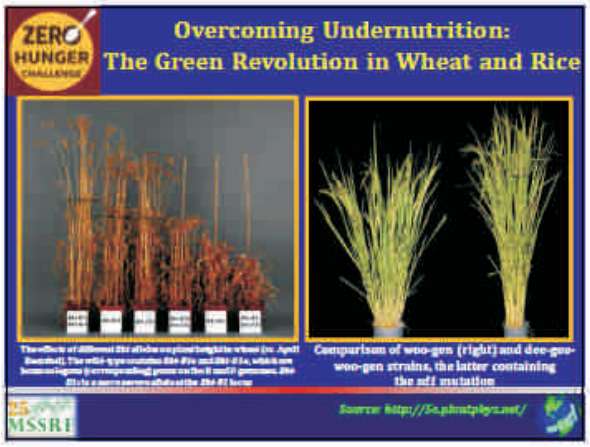

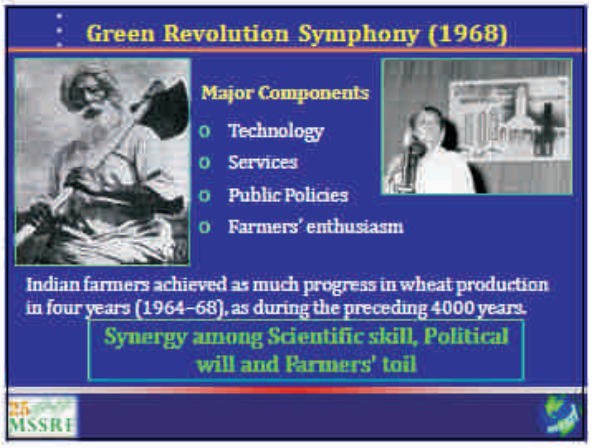

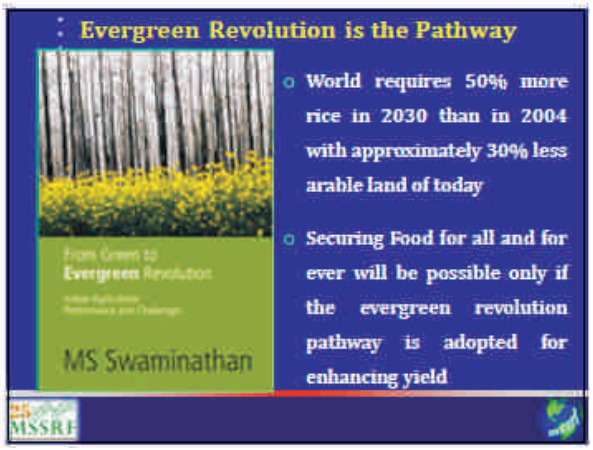

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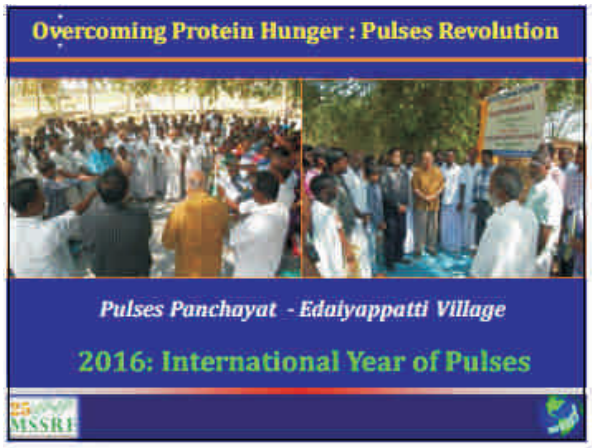

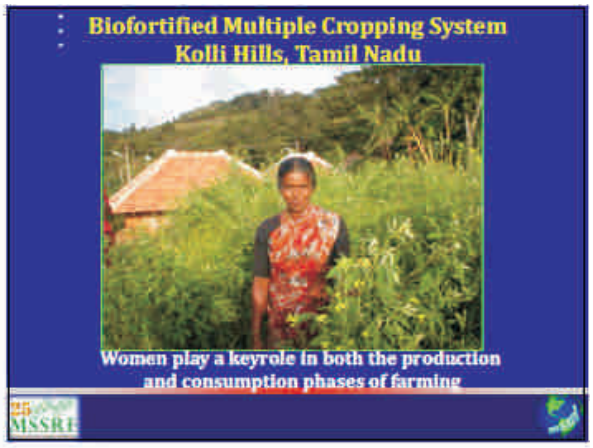

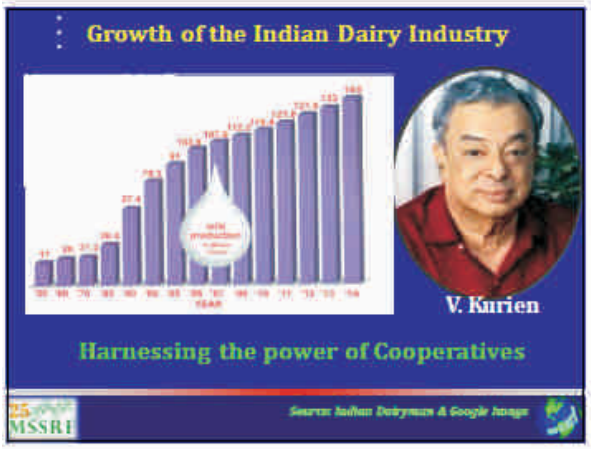

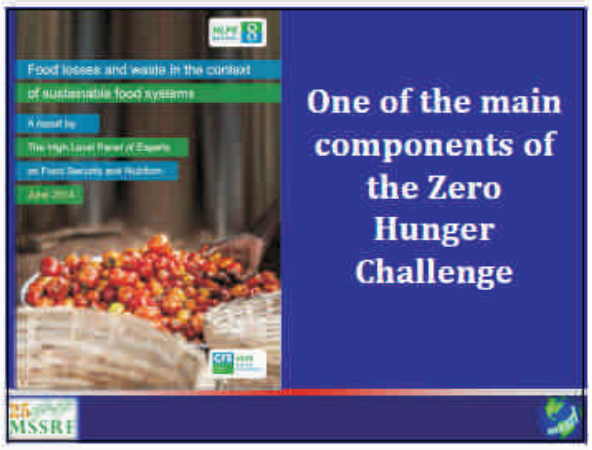

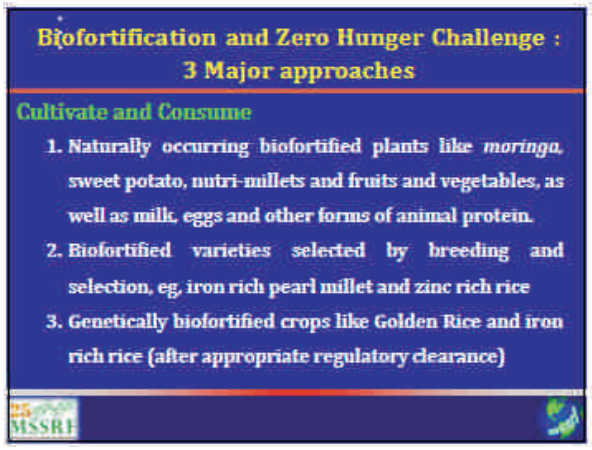

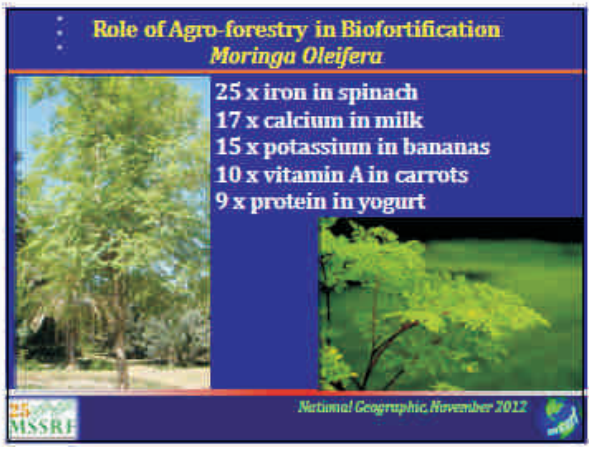

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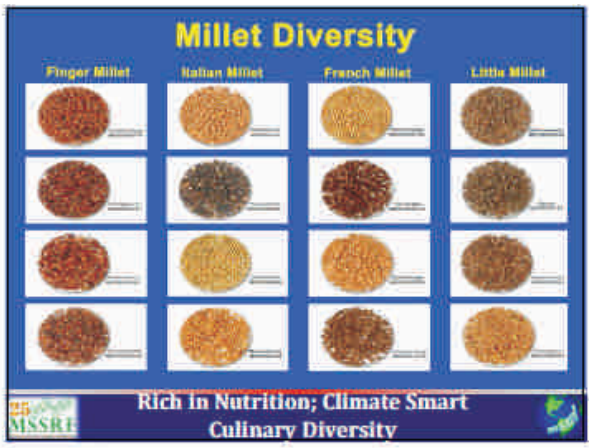

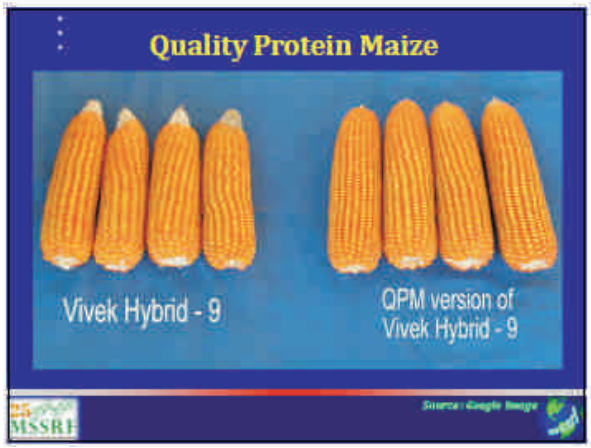

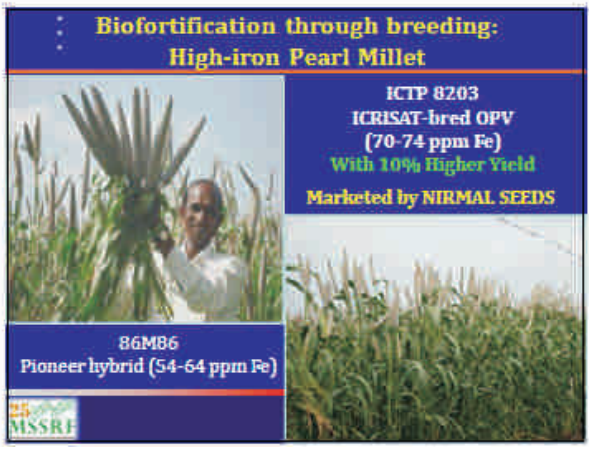

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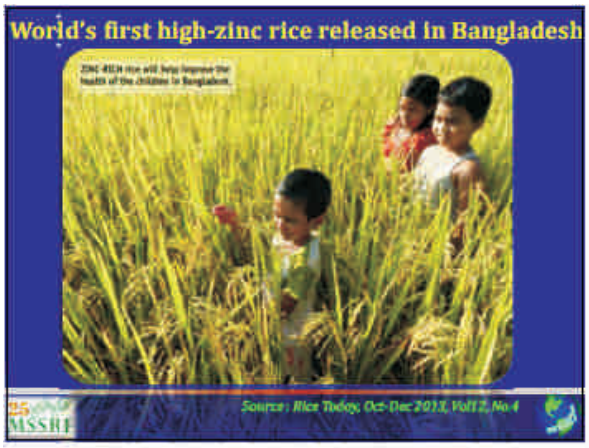
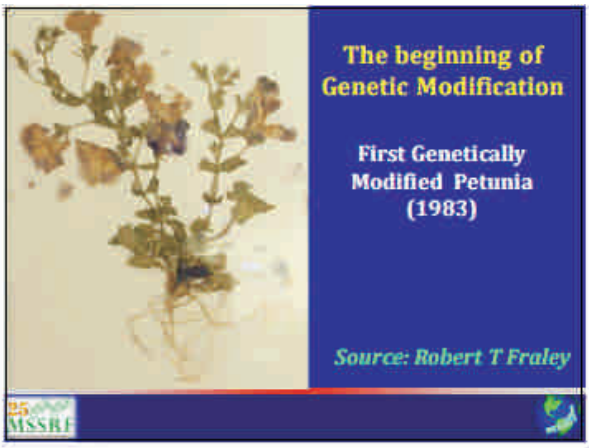
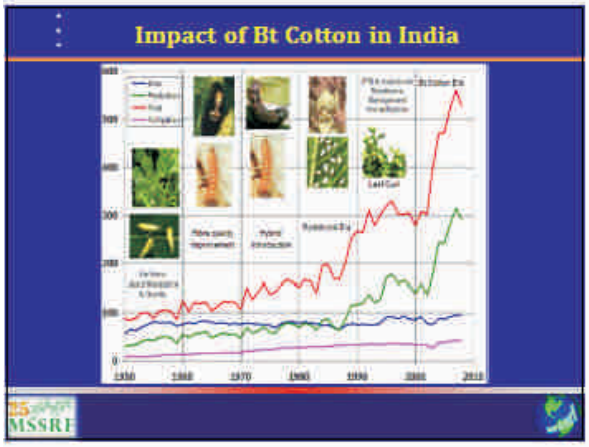
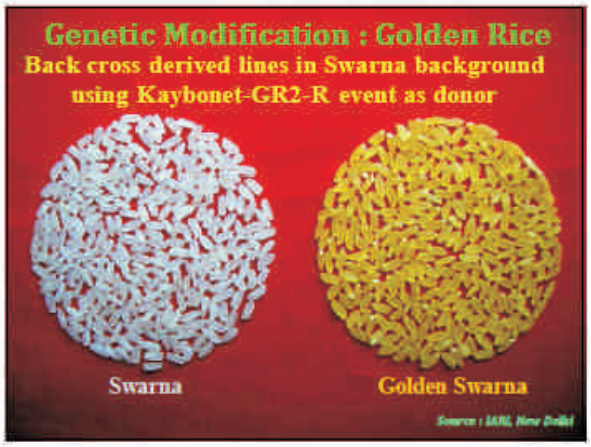
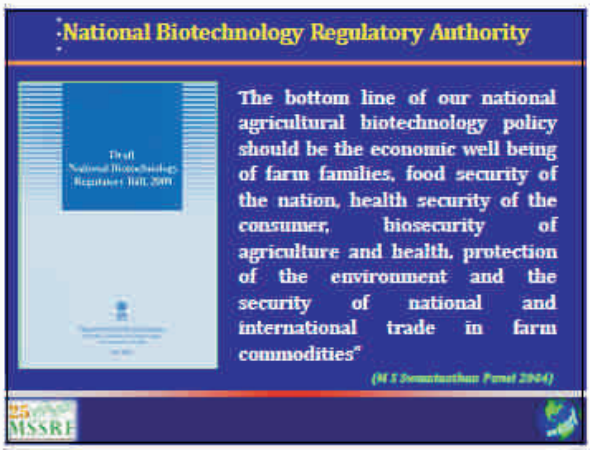










Annex 5 (Contd.)

Farming System for Nutrition (FSN)*

"FSN involves the introduction of agricultural remedies to the nutritional maladies prevailing in an area, through the mainstreaming of nutritional criteria in the selection of the components of a farming system involving crops, farm animals and where feasible, fish. While finalizing the components of a farming system, the gender and age dimensions of human nutritional needs are kept in view, such as the special needs of pregnant women and nursing mothers, and new born babies during the first 1000 days after conception and birth". **Biofortified crop varieties are introduced in FSN wherever available.**

Agric Res DOI 10.1007/s40003-014-0119-5, 5 August 2014

Role of Community Hunger Fighters in the Zero Hunger programme

- Become well-versed on the causes and cures for the endemic and hidden hunger prevailing in the village / town through a nutrition literacy programme
- Identify and introduce agricultural remedies to nutritional maladies based on gender and age
- Introduce in the farming system biofortified crops and varieties

From Ship to Mouth to Right to Food National Food Security Act of India, 2013

Goal : To provide food and nutritional security by ensuring access to adequate quantity of quality food at affordable prices

Special Features :

- **Life Cycle approach** with emphasis on the 1000 days of a child's life
- **The senior most woman** in the household will be designated the Head of the Household from the point of view of food entitlements
- **Enlargement of the Food Basket** by including nutri-millets and other orphan crops in the Public Distribution System
- **Entitlement :** Every person belonging to priority households shall be entitled to receive five kilogram of foodgrains per person per month at subsidised prices.

No Time to Relax : Major Challenges Ahead

- Food losses and Food Waste
- Climate change : scientific checkmating of adverse impact
- Shrinking per capita land and water resources
- Expanding biotic and abiotic stresses
- Adverse cost-risk-return structure of farming
- Market volatility
- Reluctance of youth to take to farming
- Controversies over genetic modification

Securing Food for All The Human Dream

New Frontiers of the mind and technology are before us, and if they are pioneered with the same vision, boldness and drive with which the battle against food shortage was fought through the green revolution, we can achieve the goal of Food for All sooner than generally considered possible.

- Adapted from President Roosevelt's American Dream

Annex 6

BOOK REVIEW:
Reflections on Managing
WATER
Earth's Greatest Natural Resource

Authors : Indira Khurana, Romit Sen, Shilpi Jain
Editors : Ranjit Barthakur and Indira Khurana

The book entitled "*Reflections on Managing WATER: Earth's Greatest Natural Re-source*", published by Balipara Foundation, was released at the end of the Plenary Session of the Global Conference on "*SECURING FOOD FOR ALL – The Critical Need for Coherence in Policies and Action*", held at New Delhi, October 30-31, 2014, by Mr. Ranjit Barthakur and Dr. Indira Khurana, Joint Editors and launched by the plenary session members present, Mr. S. Ramadorai, Prof. N. T. Uphoff, Shri T Nanda Kumar, Dr. Ashok Khosla, Shri A. K. Seth and Dr. M. S. Swaminathan.

The book is studded with quotations, images, statistical analysis and facts on water, which makes the book very readable. In the introduction, Ranjit Barthakur quotes Jacques Cous-teau as saying that "We forget that the water cycle and the life cycle are one." He goes on to discuss the water challenges, biodiversity, management and tapping human resources to reverse the trend in mismanagement of water resources in the country.

> "Let there be work, bread, water and salt for all. Access to water is a common goal. It is central in the social, economic and political affairs of the country, African continent and the world. It should be a lead sector of cooperation for world development."
>
> ***Nelson Mandela***
> *President of South Africa from 1994 to 1999*

In the 'Executive Summary' and through eleven chapters, the authors of the book have put together a comprehensive document about water that would be of interest to a wide range of readers, from scholars who need access to factual information to writers who may have a need for social information.

The first two chapters introduce the subject of water as the 'the world's aqua resource' and 'India's water can', containing copious amounts of information on the global water resource, fresh groundwater and surface water. There is an impressive box on the vanishing Aral Sea. There is a great deal of information on India's water resources. There is a great deal of information on rivers, water bodies and waterfalls in India, concluding with a dismal outlook on the future of water supply—showing a gap of 754 billion cubic meters of water between water demand and supply for the year 2050.

Chapter 3 is titled 'Revering and celebrating water' and cites the positive practices related to water of at least nine religions, whilst documenting the negative impact of water—such as the way water is

Annex 6 (Contd.)

wasted—by religions, as well. The chapter deals with the phenomenon of Kumbh Mela in detail, billed as the largest gathering of humanity in recorded history.

Chapter 4, 'Water at work', is the largest chapter in the book, and covers the impact of freshwater in all sectors—agriculture, industry and domestic, in the order of use. The chapter has an interesting water timeline, types of water use and efficiency, rural water supply and other related measures. It says that water scarcity is no longer a threat, but also fast becoming a reality. This could have serious implications on production and is an opportune time to develop a framework for industrial water management. There is an interesting discussion on the Singapore water model, which does not credit the government's policies on increasing the state's water encashment policies and projects, but goes on to speak of the desalination plants and other strategic issues of water security.

The next three chapters—five through seven—deal with desecration, wrath and drought. Water quality is spiked with bacterial contamination, and there is a long list of polluting industries. The main economic burden is the impact on human health. There is a useful discussion on water pollution regulations in India. Next comes a discussion on 'Demystifying Floods' and flood-prone areas in India, where the main cause of concern is 'unbridled urbanization'. Finally, we have the 'specter of draught' explained in graphic detail, with a section devoted to an account of drought-proofing India.

Chapter 8 deals with harnessing the rain bounty. There is a historical account of rain water harvesting and water management systems and technologies practiced thousands of years ago. There is also a 'box' of information related to the revival of rainwater harvesting in hilly towns.

Chapter 9 deals with linking water and nature for life … sustainable livelihoods apparently depend on nature. The impact of ecological balance relates to water scarcity and reduced human sustenance.

Chapter 10 deals with legal landscape of water. The National Water Policy recognizes the existing situation and designs a framework for a plan of work with unified national perspectives—that water as a natural resource is fundamental to sustenance of life.

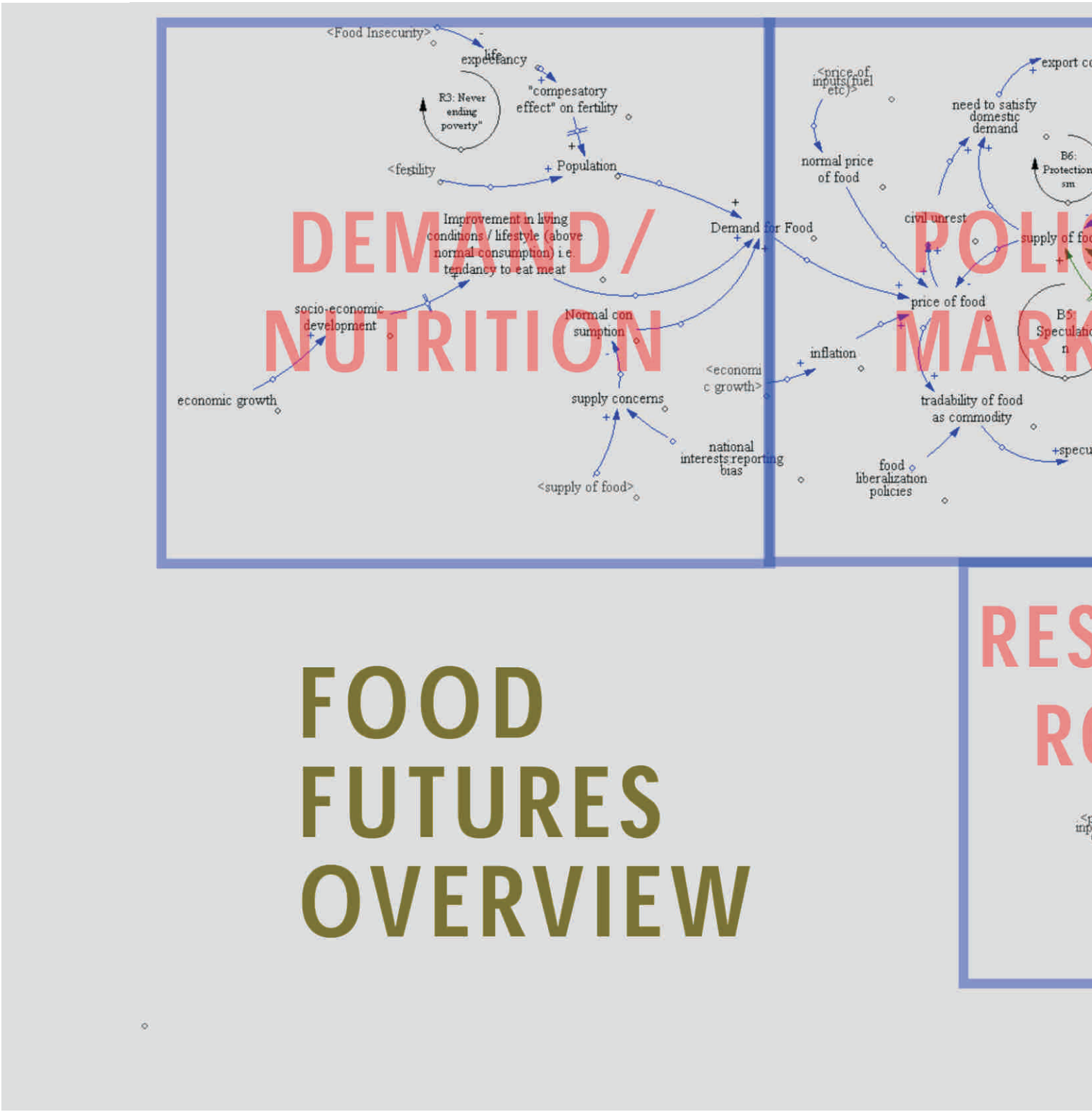
The last Chapter 11 deals with assuring water security, through the subjects of informed involvement, equity, right to water, creating water banks, towards water-responsible busi-nesses, water efficiency, waste-water, desalination and innovation.

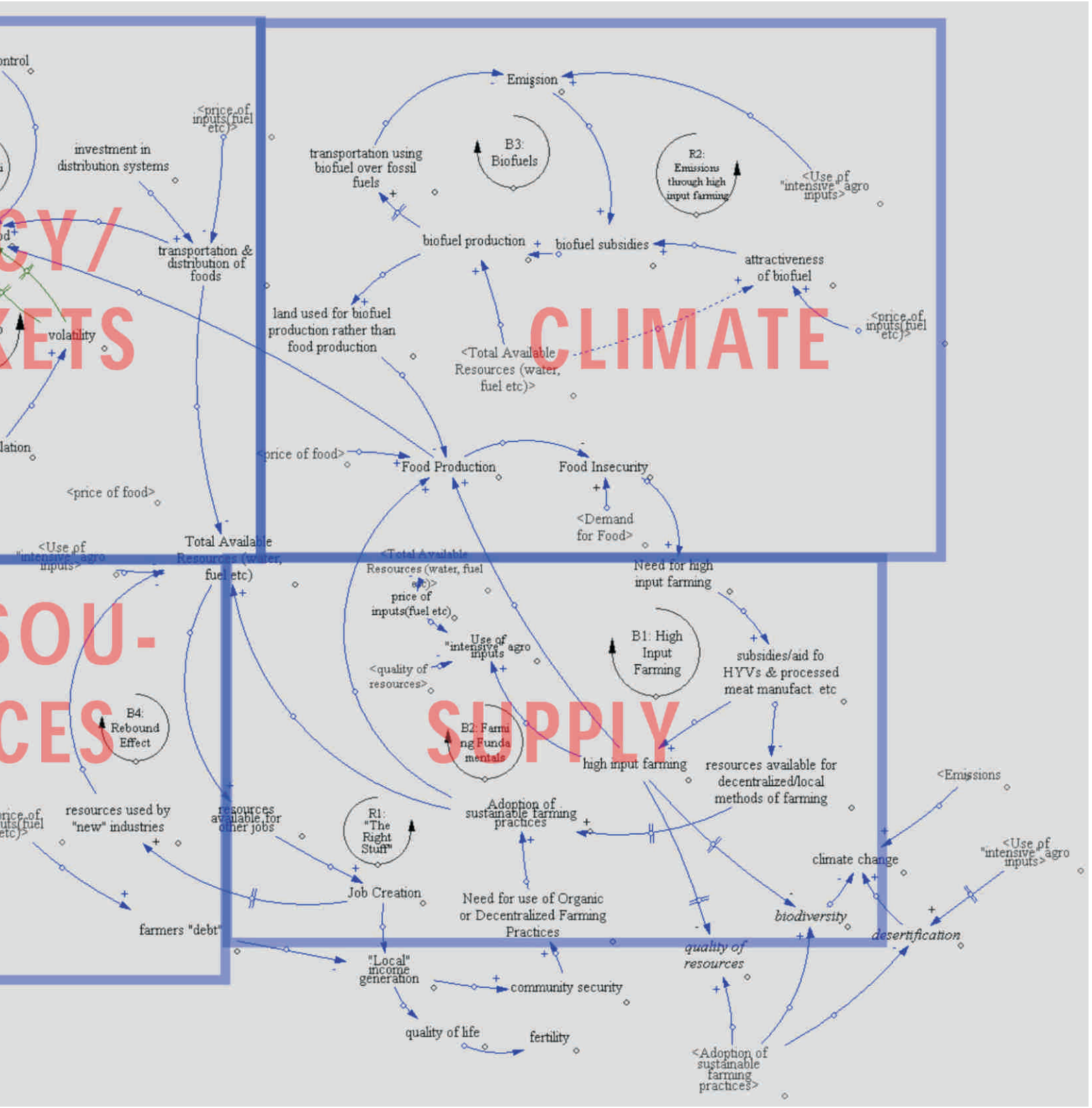
The book ends with interesting notes from Lester R. Brown, *President, Earth Policy Institute*; Naina Lal Kidwai, *Director HSBC*; Ashok Khosla, *Co-Chair, International Resource Panel*; William Mc Donough, Chair, *WEF's Meta Council on the Circular Economy*; Shyam Sharan, *Former Secretary and Chairman, National Security Advisory Board*; and Mr. S. Ramadorai, *Chairman, National Skill development Agency*.

The book, supported by a chapter-wise list of references, is a must read for anyone with a desire to know more about water and its varied implications.

Annex 7

Food-futures overview




Emission
B3: Biofuels
R2: Emissions through high input farming
transportation using biofuel over fossil fuels
<Use of "intensive" agro inputs>
investment in distribution systems
<price of inputs(fuel etc)>
transportation & distribution of foods
biofuel production
biofuel subsidies
attractiveness of biofuel
land used for biofuel production rather than food production
<Total Available Resources (water, fuel etc)>
volatility
CLIMATE
<price of food>
Food Production
Food Insecurity
<Demand for Food>
Total Available Resources (water, fuel etc)
Need for high input farming
price of inputs(fuel etc)
Use of "intensive" agro inputs
<quality of resources>
B1: High Input Farming
subsidies/aid fo HYVs & processed meat manufact. etc
B4: Rebound Effect
B2: Farming Fundamentals
SUPPLY
high input farming
resources available for decentralized/local methods of farming
<Emissions
resources used by "new" industries
resources available for other jobs
R1: "The Right Stuff"
Adoption of sustainable farming practices
climate change
<Use of "intensive" agro inputs>
Job Creation
Need for use of Organic or Decentralized Farming Practices
biodiversity
desertification
farmers "debt"
quality of resources
"Local" income generation
community security
quality of life
fertility
<Adoption of sustainable farming practices>

Organized by

INDIAN NATIONAL ASSOCIATION

Established in 2011, The Indian National Association for the Club of Rome is a non-profit organisation, which aims "to act as a global catalyst for change through the identification and analysis of the crucial problems facing India and the communication of such problems to the most important public and private decision makers as well as to the general public." The broad goal of the national chapter, CoR-India, is to help design an agenda for governments in India, the business sector as well as all its citizens' organisations that could enable everybody in this country to live a full life in harmony with their surroundings by the centenary of the nation, 2047.
(www.clubofromeindia.com)

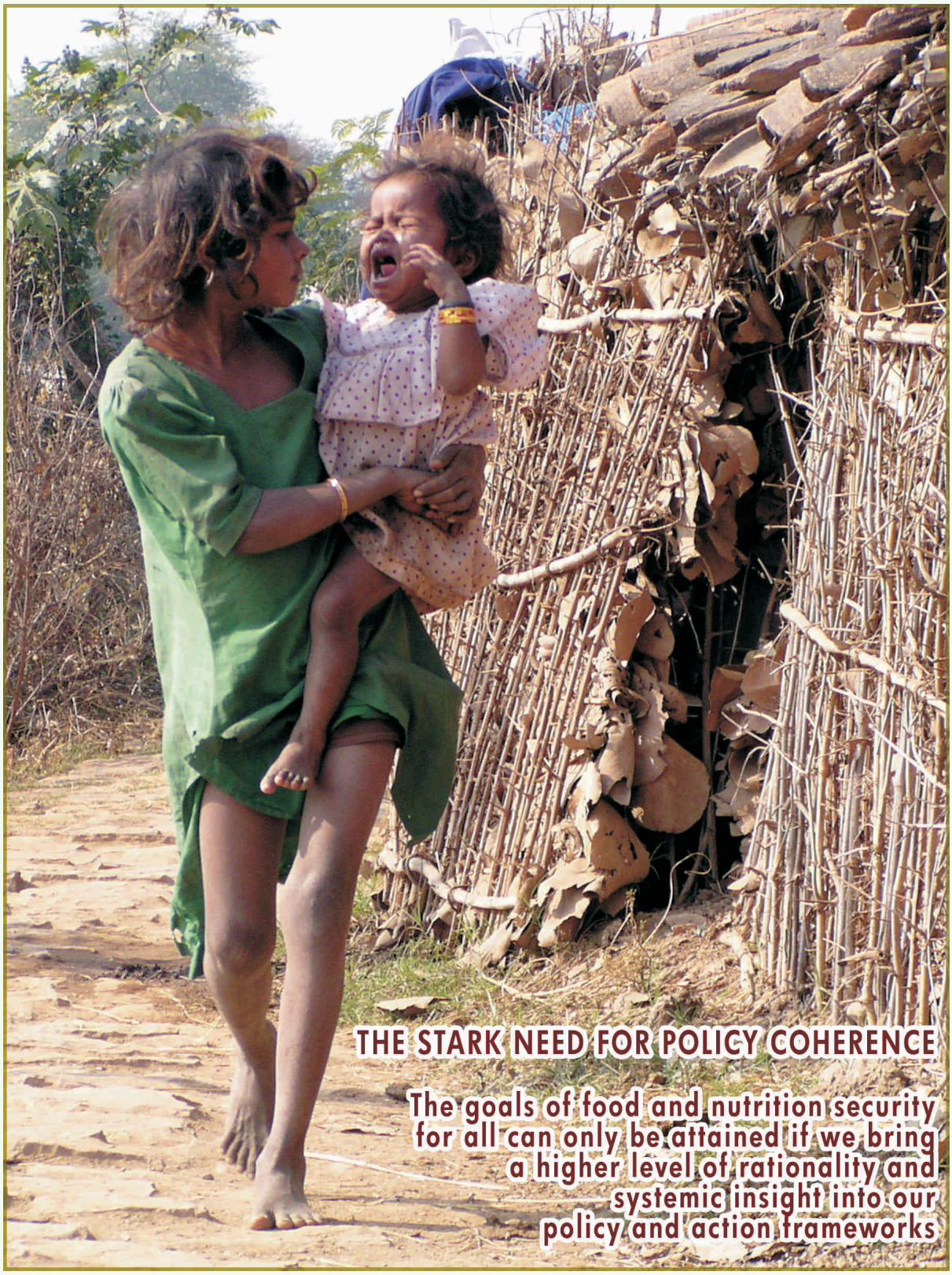
Contact: info@clubofromeindia.com

In partnership with

Development Alternatives

Development Alternatives (DA), a not-for-profit action research and development organisation, is the primary knowledge partner of CoR - India. DA innovates and disseminates sustainable solutions aimed at reducing poverty and regenerating natural ecosystems and their services. Established in 1982, its eco-solutions deliver basic needs products through the small, local enterprises that generate green jobs and sustainable incomes. Based on its innovative environment-friendly technologies and market principles, these enterprises help build local economies and communities while maintaining a minimum ecological footprint.
(www.devalt.org)

Contact: mail@devalt.org



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