National Round Table Discussion on Sustainable Agricultural Systems

19th Jan 2016

A Synthesis Report

NABARD CHAIR UNIT
Xavier Institute of Management
Xavier University, Bhubaneswar, Odisha

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National Round Table Discussion on Sustainable Agriculture Systems

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Preface

The rationale for undertaking this round table discussion on sustainable agricultural systems is to resolve one of the key dimension of building sustainable community organizations and sustainable community systems. Among the eight internal and external design dimensions of sustainable farmer based community organization, viz., size, scope, technology, management, ownership, market, institutional architecture and convergence; the dimension 'Technology' is the focus of this RTD.

Technology here refers to production technology and process technology of agricultural produce. Without a sustainable system of agricultural production the organization and institution around will have little relevance. Among the two broad paradigms of agricultural technology that we have today, viz., external input intensive, green revolution based agriculture and agro ecological sustainable agricultural systems; the latter is considered as the appropriate 'Technology' for all farmers and most of all to the small and marginal farmers who form over 70% of farmers in the Indian context.

This round table discussion was organized with this backdrop. Interacting and coordinating with so many senior farmers, scientists/researchers, policy experts and policy makers have indeed been very enriching. The variety and richness of literature relating to sustainable agricultural systems, cases, agro ecology, policy documents, reports, and policy analysis by researchers shall be very useful for subsequent building of this knowledge system.

The RTD brought out the basic foundation for building sustainable agricultural systems. The key pillars include ***Seed, Soil, Moisture, Diversity*** and ***Ecology***. The recognition and appreciation of '*interconnectedness and interdependence'* are the basic values to sustainable agriculture and that '*systems thinking*' is need of the hour for policy intervention were also the outcome of this RTD.

Although this RTD on sustainable agricultural system was organized after the RTD on optimal design of farmer producer organizations; by the end of both the RTDs, it was apparent if the designers of farmer organizations understood the complexities and nuances of agriculture and the factors for its sustainability; farmer organizations or farmer communities could be designed better with much ease. I did feel at the end of the RTD that in the upcoming national conference, the factors of sustainable agricultural systems could be first discussed before discussing the optimal design issues of Farmer Producer Organizations.

Amar KJR Nayak
Coordinator, RTD 2016

Acknowledgements

At the outset, I would like to thank the Department of Economic Analysis & Research, NABARD, Tata Trust, and XIMB to kindly provide all support to organize this workshop on optimal design of farmer producer organizations. I would like to express my sincere appreciation to Shri M V Ashok, Chief General Manager, NABARD and Shri R Venkataramanan, Executive Trustee, Tata Trust for the whole hearted support and encouragement to financially support this RTD. I also thank Prof (Dr.) Paul Fernandes, VC, Xavier University Bhubaneswar for his kind support to organize this RTD.

The sharing of ideas was fruitful due to the active participation of all the participants and delegates of the RTD. About 50 academics, practitioners and policy experts/executives participated in the face to face interactions of RTD (list in Annexure 5) and over 40 members in all joined in the online discussions prior to the RTD and after the RTD. I sincerely thank one and all for making the discussions as diverse and lively as possible. The insights and valuable contributions from live experiences of successful and wise farmers from across India such as Shri Subhas Sharma, Shri Natabara Sarangi, Shri PVS Satheesh, Shri Tony Thomas and Dr. K Ramakrishnappa were of great learning to the participants and delegates. The analysis provided by Dr. (Mrs.) Rajeswar Raina, Dr. KJS Satyasai, Dr. Radhamohan, Ms. Shalini Bhutani, Dr. Arun Sharma, Shri Subhash Mehta, Dr. A R Khan, and Dr. Srijit Mishra were of immense help. Joining of Prof. Puspha Bhargava and Dr. Peter Kenmore through video call added to the richness of the discussions. Among many others Dr. Cluade Alvares and Prof. Swaminathan also shared this views and good wishes for this round table. However, it was the joint efforts of all the participants as in Annexure 5 of the report that made this RTD an important milestone in systems thinking on Agriculture in India.

Due to another significant national level gathering on organic farming in Sikkim with the Prime Minister of India on 18-19th Jan 2016, some of the senior farmers/scientists/facilitators of sustainable agricultural systems had to attend to it and could not participate in this round table discussion. However, I would like to thank Dr. G V Ramanjeneyulu, Ms. Kavitha Kuruganti, Mr. Umendra Dutt, Mr. Deepak Suchde, and Mr. Debjeet Sarangi who showed great enthusiasm and provided valuable contributions to this national round table discussion.

I also thank Fr. (Dr.) Tony Uvary, Fr. (Dr.) Arockia Das, S.J. and Fr. Lourduraj Ignacimuthu, S. J. for their kind support and guidance. Without the support and assistance by the RTD organizing team members; viz., Mr. Bibhuti Sahoo, Mr. Rahul Pratyush Mohanty, Ms. Sangeeta Barla, Mr. Dilip Rath, Ms. Sadhna Dash, and Ms. Sunanda Sahoo of XIMB-XUB, this work would not have been complete. I also thank all my colleagues at XIMB-XUB for their direct and indirect support for organizing this RTD.

Amar KJR Nayak
Coordinator, RTD 2016

National Round Table Discussion on Sustainable Agricultural Systems in India

A Synthesis Report

1. The Context of Farmers & Agriculture in India

Underlying the serious symptoms of *high food price*, *farmer suicide, and increasing subsidies* are many factors viz., agricultural policy, price signal, nature of agricultural practice, mono cropping, high cost of agricultural inputs including cost of inorganic fertilizers, chemical pesticides, terminator seeds, cost of farm labor; climate changes, high transaction cost of market intermediation, low nutritional value of food, food safety, negative incomes to farmers, outmigration of farmers from agriculture, etc. The intricate interrelationship among these factors has been driving the agricultural sector into an inescapable *chakravyuh of un-sustainability*; especially when the above symptoms are not comprehensively dealt with by the governments, research institutions and practitioners at the grass root levels.

The *reductionist approach* in agricultural research; a methodology where a problem is studied in isolation of other associated and interrelated problems usually cannot provide holistic solutions required at a smallholder farmer level. Second, agriculture policy of governments that promote *industrial approach* of agricultural production and distribution appear to have ignored the warnings from the ground that the science and culture of agriculture are indeed different from industrial culture of competition, specialization and scale economies. Further, government and bureaucracy have gradually locked into a top down decision making process bereft of the nuances of ground realities.

Contrary to these traditional approaches, the science of agriculture appears to be rather based on the principle of ***diversity***. Agriculture is visibly a highly interconnected and interdependent system and production output in this system is a result of deep and dynamics relationships among various living and non-living organisms in a micro ecosystem. As a recognition and significance of diversity for agricultural efficiency and the ability of family farmers to be able to manage such diversity in farms, the year 2014 was celebrated as the *International Year of Family Farming*. More than the external industrial inputs of inorganic fertilizers, chemicals pesticides and terminator seeds; simultaneous management of local seed, soil, and moisture, mixed cropping and integration of agriculture with livestock, forestry and overall micro ecology can make agriculture safe, enjoyable and prosperous.

Empirical evidences in India and world-wide show that farmers adopting diverse agriculture are less vulnerable to climate changes and market forces. The cost of cultivation is very low, yield is higher and hence net incomes are very high. On the other hand traditional farmers in irrigated areas adopting mono cropping with costly industrial inputs tend to incur very high losses and are susceptible to committing suicides.

In the recent years, there have been some winds of change globally in agricultural practices from mono culture to diversified agriculture systems. Food and Agricultural Organization, UNCTAD and the European Union in the last couple of years have begun to promote sustainable agricultural practices. A large number of agricultural scientists and researchers globally are now suggesting for agro ecology as a method for long term sustainability.

In India, the central government and several state governments have initiated number of policy measures on organic farming. More than seven state governments have separate organic farming policy. The government of Andhra Pradesh has adopted community managed sustainable agriculture. Indian Council of Agricultural Research (ICAR) has several research centres and programmes on organic farming, integrated crop management, integrated farming systems for a long time. In 2014, Government of India initiated the National Mission for Sustainable Agriculture. However, the inertia of industrial approach to agricultural research and policy especially in the new industrial and market economies like India appear to stall the process of change for better and has been responsible for confusing signals to the farming community.

Interestingly, study of agricultural practices of farmers and farming communities in India show a variety of sustainable agricultural practices followed since time immemorial in different parts of the country. Some of the practices include Natural Farming, Natueco Farming, Bio-dynamic Farming, Permaculture, Zero Budget Farming, Indigenous Micro Organism based farming, Effective Micro-organism based farming, Organic Farming, Low External Input Sustainable Agriculture (LEISA), Integrated Agriculture, Sustainable Agriculture, etc. However, the exponents of these different methods and vocabulary of sustainable agricultural systems do not often share their experiences and findings with each other.

Focus of the RTD

With the above backdrop, a round table discussion was proposed to discuss the following issues:

1. Codification of sustainable agricultural practices (*technical perspective: soil health, seed, moisture, crop mix, integration of agriculture with livestock, horticulture with the local ecology in different agro climatic and topographic conditions*)
2. Replication of sustainable agricultural practices (*socio-technical and behavioral perspectives: of smallholder farmers on agricultural practices and their organizational issues for collective action*)
3. Common vocabulary across different approaches (*organic, natural, natueco, LEISA, homa, Zero budget, sustainable agriculture, CMSA*, and *agro ecology*) for Sustainable Agricultural Systems.

The discussions and deliberations were expected to provide common understanding and agreement on the following issues for better policy formulation and effective implementation to make agriculture sustainable from long term to inter-generational terms.

- Common understanding and appreciation of the different approaches to sustainable agricultural practices in India and agreement on some common terminologies for policy.
- Plan for compilation and codification of different sustainable agricultural practices.
- Draft on Transition Strategy & Policy for replication on sustainable agricultural practices.
- Plan for a national/state level Seminar/Conference/Workshop on Sustainable Agricultural Systems in 2016-17.

2. Literature Review & RTD Discussions

Distress among small and marginal farmers and unviability of agriculture in the Indian context has been reported more often in the present times than before. Systematic research studies have also established this point of view (Swaminathan, 2006 Radhakrishnan R 2007, NABARD 2015, Satyasai 2015, Nayak AKJR *et al* 2015). The highly interconnected problems of Indian agriculture have been very well captured in Bhargava & Chakrabarti (2014). The policies of the government have largely been responsible for mixed signaling, confusion and appear to have had negative impact on farmers and agriculture in general (Rajeswari S.R. 2014, Rajeswari S.R. 2015, Nayak 2014, 2015, 2016)

It is increasingly being pointed out that sustainability of agriculture shall depend on systematic and scientific management of soil, seed, moisture, agricultural diversity, and local ecology. More than the external industrial inputs of fertilizers, chemicals, pesticides, healthy soil management have been explained to be the key to high yield and sustainable production (Howard 1943, 2013). Soil health is linked to the overall management of other dimensions of moisture management, seed, cropping pattern, and integration of agriculture with livestock and forestry. All these improve the micro ecosystem that enhances the condition for better plant protection and better agriculture (Collette & Kenmore et al, FAO 2011, Rupela 2011).

Similarly, the scientific experiments in the recent years in India prove the above points (Gopalakrishnan & Rupela et al 2012, Pannerselvam 2013). A large number of research studies across India also lead to the same conclusion that productivity and efficiency in agriculture lay in sustainable agriculture practices (Shiva 1993, 2010a, 2010b, Alvares 2009, Nayak 2012, CRIDA 2012, and Nayak 2014, 2015a, 2016).

International research and studies across the world by different agencies are also building up the argument that agriculture has to adopt sustainable methods by following the basic principles of bringing back life to the soil through integrated agro ecological agricultural practices (IAASTD 2009, Third World Network 2012, and UNCTAD 2013). Several research reports from across the world indeed argue for small scale diversified and integrated methods of agriculture. These studies essentially suggest that it would be logically flawed if '*economies of scale'* were applied in agricultural ecosystem unlike the logic of scale in industrial production.

The core contextual difference between agriculture and industry is on the nature of production system. On the one hand, high bio-diversity in the life systems, deep interconnections and high levels of interdependence characterizes the open system of agricultural production. On the other hand single product specialization, sequential, linear and uni-directional relationships are the characteristics of a closed industrial production systems.

Contrary to the basis of efficiency in a closed system, the basis of efficiency in an open system is the high degree of interdependence and cooperation. The high frequency of interactions and high degree of relationships among the various actors and actants are the sources of efficiency in production. The network of relationships is often of dense and complex in nature. Bio-diversity is the essence of life in such networks.

The idea of scope can be appreciated by analyzing the relevance of '*economies of scope'* at the base of our production system (plant-process-person) viz., plant as a source that converts the solar energy to plant biomass and food crops. It exhibits a dynamic interrelationship of sunlight, moisture, air, soil, plant/crop bio-diversity, micro-organisms, livestock and seeds for sustainable production in an open agricultural ecosystem. In other words, *economies of scope* seem to provide a coherent logic of agricultural ecosystems and the basis of efficiency and sustainability in agriculture.

Seed:

There is a growing concern on farmers losing sovereignty over their most important input for agriculture that is seed. Successful and prosperous famers rely on their own locally grown and hand-picked seeds (Sarangi Natabara, RTD 2016, Radhamohan, RTD 2016, Sharma Subash, RTD 2016, Satheesh PV, RTD 2016, Thomas Tony, RTD 2016 and Ramakrishnappa K, RTD 2016). Farmers such as Natabara Sarangi and Radhamohan have successfully preserved over 400 varieties of paddy through their efforts. Production yield of some of these varieties are far higher than that achieved by hybrid varieties developed by scientists and research laboratories. The fear of seed control by a few corporations is best exemplified by cases pending at the honorable Supreme Court of India by Aruna Rodrigues and argument placed by Bhutani Shalini, RTD 2016). Shiva, V (1993) articulates very well the issues of loss of indigenous seeds due to aggressive monopolization and seed control by large corporations.

Soil:

Soil health of farm land have been degrading and becoming more and more saline with increased usage of inorganic fertilizers. However, farmers not applying these inorganic fertilizers but have been following use of organic manure such as crop residue, green manure, plant biomass, cow dung, organic pesticides have been able to preserve the life of their soil. Such soil is found to be more fertile than farms where inorganic fertilizers and chemicals have been applied (Rupela OP 2011, Young R 2015, Hameeda B et al 2011, FAO 2011). Regular application of Amrit jal in farmland of Deepak Suchde has significantly raised the soil health and fertility (Rupela OP, XXX, Deepak, Suchde 2015). Howard (1943, 2013) provides the best scientific evidence on better soil health with little cost through on farm organic manure and plant biomass.

Moisture:

The issue of whether huge amount of water through large dams and irrigation facility is critical for better crop yield has often been argued against by farmers adopting sustainable agricultural practices. Farmers adopting sustainable agricultural practices do not need much water but only some moisture. Farmers such as Subash Sharma in drought prone regions like Vidharba in Maharastra, DDS trained women farmers of Zaheerabad district in Andhra Pradesh or tribal farmers of Rayagada district in Odisha trained by Living Farms have proven this point over the years. Sharma Subhas (RTD 2016) showed that through a systematic gridding and trenching in his farm land he is able to save every drop of rain in his farmland based in Vidharba region that receives scanty rainfall every year. After sufficient utilization of the ground water he is still able to save a lot of water as the ground water level of his land has been improving by the year.

Diversity:

Diversity is the mantra for sustainability in agriculture (Nayak 2015, 2016). Very interesting research shows inverse relationship between biodiversity and pest level in farms. Lungren JG and Fausti SW (2015) have empirically observed that greater is the bio-diversity of a farm lower is the pest levels in the farm. From studies across the world, FAO (2011) also establishes the point that diversity makes farms resilient to climate changes. Nayak (2014, 2015a, 2015b, 2016) argues that although industrial production may be efficient with economies of scale, the science of efficiency for agriculture is certainly not the same. The logic of ‘economies of scope’ is relevant for agriculture and especially small and marginal farmers for nutritional security and better risk management through a diverse product basket. Sharma A K (RTD 2016) provides evidences of the power of farm diversity to deal with issues of desertification and pest control in farms.

Ecology:

There has been a growing consensus among agricultural scientists across the world that ecological agriculture is the way forward to deal with the myriads of problems in agriculture and among farmers (IAASTD, 2009, Gleissman S R, et al FAO 2015). Other studies or collection of studies (La Via, XXX, Mehta S, RTD 2016) similarly argue that agro ecology is the way forward to tackle the problems of agriculture. Nayak (2014) shows farms across India that have adopted integration and simultaneous augmented local indigenous seeds, soil health through on farm biomass, in-situ water conservation, and farm diversity including crops, horticulture, livestock and agro forestry have been performing well. The gross expenditure as a percentage of incomes earned on these farms is between 3% - 16% only. Most farmers adopting specialized mono cropping on the contrary; end up in debt over a period of time. Thomas T (RTD 2016) and Ramakrishnappa K (RTD 2016) argue and demonstrate successful farming in forest type environment.

3. Summary and Recommendations of RTD

The key concerns raised during RTD were primarily on the rising risks for farmers and rising risk to agriculture and ecology. The problems of green revolution continue to persist and have been difficult to deal especially with the market agencies and external forces associated with green revolution technologies.

The RTD did recognize that there has been increased agricultural production during the last five decades. However this has not lead to better distribution and affordability in terms of food prices. The group reiterated the various challenges that India as whole faces today in terms of tackling hunger, malnutrition and disease; ways to reduce household poverty, rising food prices for consumers, rising cost of agricultural inputs without commensurate rise in farm gate prices for the farmers.

Agriculture today is also encountering the challenges of countering effects of climate change and unpredictability of rainfall, safe guarding farmers' rights over seeds as fundamental to survival of small farmers; loss of food crop gene pool, and degrading soil health. Further, developing ecosystem services for sustainable agricultural production, increasing yield through sustainable agro-ecological agricultural methods and bringing agri-scientists and farmers to co-operate in building valuable scientific knowledge that is appropriate to the regions agro-climactic condition and socio-economic situation are other coordination challenges.

The larger challenges include how to transit from conventional agriculture to sustainable agricultural practices that will require a shift from reductionist agricultural research to holistic research involving the entire eco-system. It will require empowerment of farmers- recognizing them as thinking and active subjects, respecting their traditional knowledge systems and their experiential knowledge as valuable and supporting them to take better decisions. Further we need to build sustainable communities through mutual support, trust and cooperation that would ensure a balanced diet, education and health to the poor population in India.

In the above context, there is a great need for codification of input and process technologies of sustainable agriculture systems for replication. For this to take place, we need to develop clarity among the various stakeholders on the key principles and nomenclature of sustainable agricultural systems for appropriate policy making, practice and replication.

The RTD reiterated the significance of interconnectedness and inter-dependence of various actors and actants in agricultural ecosystems. It also felt and sensed the need to emphasize on the general principles of ***sustainable agriculture systems*** than recommend a particular type or nomenclature of agriculture for long term sustainability of our diverse ecological systems in India.

In each of the presentations of the successful farmers adopting sustainable agricultural practices; who came from different parts of India expressed a few common principles in their respective practices. Accordingly, the five key dimensions that sharpened and evolved as pillars of *sustainable agricultural system*s include:

1. **Seed**
2. **Soil**
3. **Moisture**
4. **Diversity**
5. **Ecology**

Seed:
Seed refers to indigenous seeds of various food crops in India and their gene pool in India. It is the diversity of the gene pool and their stability to survive in different agro-climatic conditions that have been the strength of farmers in India. Ability of a small and marginal farmer to preserve and to have access to these indigenous seeds is indeed a pillar of strength under climate changes and market forces.

Soil:
Biological life in soil is what makes soil fertile and suitable for plant growth. Available soil nutrients become water soluble with biological life in soil. Usage of inorganic fertilizers and chemicals kills life in soil and makes soil infertile. However, use of local biomass, residue plant matter, cattle dung and urine make the soil fertile with little cost and no wastage and pollution. Good plant-cover on the land; not only make soil healthy but also it requires less water for plant growth.

Moisture:
Sustainable Agricultural systems do not need too much water; rather it requires sufficient moisture only. Therefor the fear of insufficient rainfall is often averted. Land however has to be trenched in such a way that all the rain that falls on the land will not run off from the land but will seep into the soil of the land. In situ water conservation techniques would help capture every raindrop that falls on the land and provide sufficient ground water reserve for bountiful harvest throughout the year and meet the water requirement of farmer family and his/her cattle.

Diversity:
Diversity includes not only crop diversity but inclusion of horticulture, medicinal plants, agro forestry, animal husbandry and general bio-diversity at the farm level. The science and culture of agriculture is not the same as that of scale economies of industrial production and distribution system. Agriculture is visibly a highly interconnected and interdependent system of production and its output is a result of deep and dynamics relationship among various living and non-living organisms in a micro ecosystem. Diversity indeed is the mantra to sustainability of agriculture and small farmers.

Ecology:

Ecology refers to an ecosystem view of agriculture. For agriculture to be sustainable; it needs to ape the local natural systems that are balanced and stable over generations. In other words, the above aspects of soil, seed, moisture and diversity need to be integrated and synthesized with respective local ecology for long term sustainability of agriculture. Accordingly agro ecology has seven key features viz., Adapting to local environments, Providing the most favourable soil conditions for plant growth, Promoting biodiversity, Enhancing beneficial biological interactions, Minimizing losses of energy and water, Minimizing the use of non-renewable external resources, and Maximizing the use of successful farmers' knowledge and skills in the area.

Accordingly, both codification and replication of sustainable agriculture systems need to incorporate the above five principles. Codification of causal relationship can help easier replication. The existence of different sustainable practices across India under different nomenclature appears to reflect the diverse ecosystems and knowledge systems in India. ***Sustainable Agricultural Systems*** with the above five principles may however be the umbrella phrase to represent all the different sustainable agricultural practices in India.

The RTD also reiterated the critical need for a bottom-up approach for agriculture to be sustainable; that includes letting farmers choose the kind of agriculture and not heavily determined by scientists or marketers, type of support that they require, and respect their norms and language system. It was also pointed out that cluster/community based approach for sustainable agriculture is a necessity and that the need to include the excluded, poor, and marginal farmers in agriculture is necessary for making agriculture sustainable.

In summary, the science of efficiency is in preserving and promoting indigenous seeds, bringing back life in soil by stopping inorganic fertilizers & chemicals, in-situ water conservation, farm level agricultural diversity, promote and support agriculture that is in synch with local ecology. It will only be prudent for the central government and state governments to consider the above points very seriously and take necessary policy measure immediately for recreating sustainable agricultural systems before it is further late. Adopting a bottom up approach in understanding and implementation of sustainable agricultural systems on the above principles with successful local farmers leading this movement is the only way forward for sustainability of food production, nutritional security of the population, food safety and affordability of safe food for all.

4. Proceedings of Discussions

Inaugural Session:

At the outset Fr. Dr. Paul Fernandes S.J. Vice Vice-Chancellor & Director Xavier University Bhubaneswar welcomed all the participants/delegates of the RTD to XIMB for the important discussions on sustainability of our food production systems. He thanked NABARD Chair Unit for organizing this RTD and the participants. He conveyed his good wishes for the discussions.

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Opening Remarks by Prof. Amar KJR Nayak:

Firstly, Prof. Nayak, thanked all the participants for their keen interest and commitment to work towards making agriculture sustainable in India. He also highlighted the rich online discussions prior to the RTD and thanked all who participated in the discussions. He thanked all the experienced and senior farmers, senior policy executives and senior researchers/academics/legal experts to have kindly taken the trouble to travel from different parts of the country to participate in the face-to-face interactions. He also thanked NABARD and Tata Trust for their grant support to make the round table discussion possible.

Prof. Nayak reiterated the rising risks of farmers and various stakeholders in agriculture and food production system in India and highlighted the focus of the RTD. The key issues of the discussions included the following:

- **Codification** of sustainable agricultural practices
  Technical perspective: soil health, seed, moisture, crop mix, integration of agriculture with livestock, horticulture with the local ecology in different agro climatic, soil and topographic conditions

- **Replication** of sustainable agricultural practices
  Socio-technical and behavioral perspectives of smallholder farmers on agricultural practices and their organizational issues for collective action

- Common **Vocabulary** across different approaches *for Sustainable* Agricultural Systems
  O*rganic farming, natural farming, natueco farming, LEISA, homa farming, Zero budget farming, sustainable agriculture, CMSA, and agro ecology*

Preliminary Round of Introductory Remarks

In the preliminary round of introductory remarks, the participants raised several concerns and challenges facing Indian Agriculture. A brief summary of these included the following:

Concerns:

1. Problems of the green revolution persist
2. Rising risks for the farmers

3. Rising risks to Agriculture
4. Rising risks to the ecology
5. The ambiguous role of 'organic' certification agencies
6. The need for codification of input and process technology of sustainable agriculture systems for replication
7. Clarity in the language or the vocabulary for appropriate policy making

Challenges:

1. Tackling hunger, malnutrition and disease. Increased production has not led to better storage or proper distribution.
2. Reducing rural house hold poverty
3. Countering effects of Climate Change
4. Transition from the conventional to sustainable agricultural practices.
5. Developing ecosystem services for sustainable agricultural production
6. Improving Soil Health
7. Developing effective Water Management Systems
8. Increasing yield through sustainable agro-ecological agricultural methods
9. Empowerment of farmers- recognizing them as thinking and active subjects, respecting their traditional knowledge systems and their experiential knowledge as valuable and supporting them to take better decisions.
10. Bringing agri-scientists and farmers to co-operate in building valuable scientific knowledge that is appropriate to the regions agro-climactic condition and socio-economic situation.
11. Shift from reductionist agricultural research to holistic research involving the entire eco-system.
12. Safeguarding farmers' rights over seeds as fundamental to the survival of small farmers. The threat by IPR.
13. Building sustainable communities through mutual support, trust and cooperation that would ensure a balanced diet, education and health to the poor population in India.

Issue Wise & Farmer Case Discussions

1. Peter Kenmore

The issue of sustainable agricultural systems is more basic and encompasses the issue of FPOs. India's food production has reached 257 million metric tonnes yet it has been unable to eliminate hunger proving that heightened production leading to availability does not solve hunger, mal nutrition and stunted growth and other poverty related issues.

Agricultural production depends on eco-system services and its holistic management. Agricultural research which has so far been reductionist needs to connect to the entire eco-system. A holistic management needs to be encouraged for which the farmer needs to be empowered to take better decisions. Farmer Field Schools are necessary to put together scientific information, farmer day to day observations and their experiences to help them manage consciously. Farmers also have a better understanding of bio-diversity and know more than scientists. To transit from conventional to agro-ecological agriculture Steven Gleisman's article on the levels of transition in the Report of the Agro-ecology Symposium organized by FAO in September 2014 could be referred to: http://www.fao.org/3/a-i4327e.pdf

2. Subhash Sharma

Foundational Science of Agriculture

- An understanding of the inter-dependence of nature is the science on which agriculture is founded. This can be perceived as a perfectly balanced tower of four stones. The first foundational stone has the elements of the Earth, Water and the Atmosphere. The second placed above it is the plant world on which is balanced the third stone that represents the animal kingdom and the last stone on the top represents man. Any imbalance created in this system effects the top-most stone representing human beings as it would topple down first. Mutual Support is therefore the key to the science of agriculture. Support between the four tiers of this tower of stones would hold them together.

- **Practices: low cost systems to increase soil fertility**
  - Step 1: Restoring soil health: increasing organic carbon in the soil by using cow dung. Dung needs can be met be rearing two cows per acre.
  - Step 2: land management

    15% of the land in a farm should be invested for improving the quality of air, water and soil; that is:
      - 3% for water harvesting
      - 2% for soil fertility
      - 10% ecological balance
  - Step 3: availability of quality water for farming through water harvesting methods such as gridding and trenching
  - Step 4: good quality self produced native seeds

    Seed sashtra- follow non violent farming by allowing insects, birds and animals to survive as they help in the production of quality seed through cross-fertilization
  - Step 5: Prem ka economics- taking care of labour as co-farmers.

- **Policy Implication**
  - Organic farming to be cluster/ community based- bio communities to be promoted though FPCs/FPOs.
  - Quality seed production by organic farmers.
  - 15 % direct transfer of subsidy to organic farmers

Natabara Sarangi

Transition from conventional to organic agriculture is necessary as there is increasing desertification in Orissa, up to 37% due to conventional farming with high use of chemical fertilizers and pesticides. To transit from conventional to organic farming a time period of three years is required. During this time there will be no big gains but there would be no big losses either.

- **Practices**
  - Step 1: Leaving 'crop- residue' in the field to improve soil fertility.
  - Step 2: Allowing earth worms to work on the soil for increasing water retention in the field.
  - Step 3: Introducing organic compost- cow dung and urine. Indigenous breeds of livestock should be opted for as they are more sturdy
  - Step 4: conservation of native seeds and quality seed production

- **Policy Implication**
  - Production as the basis of farming should be discarded and focus should be for increasing the nutrition level in food
  - Organic farming should not be introduced in selective crops but in all crops
  - Subsidies for chemical fertilizers should be extended to farmers who adopt the agro-ecological farming.
  - Promote bullocks just as milch cows and provide loans and subsidies.

3. P. V. Satheesh

Focusing on the marginalized to create sovereign people

- **Practices**
  - Working with people with multiple marginalization as the key to building sustainable communities
  - Collective farming
  - Total faith in the community as the community has the best solutions to their problems
  - Food-sovereignty- ensuring local food security through local production, storage and distribution.
  - Right to healthy and culturally appropriate food
  - Household food security leads to health security, nutrition security, fodder security and ecological security
  - Internalized input systems in farming
  - Diversity in crops opposed to mono-cropping
  - Rain-fed agriculture
  - Seed Sovereignty
  - Creating local markets alternate to the mainstream market for local produce

- Nurturing mutual support and sharing through communication among the peasants in a community and between communities.

- **Policy Implication**
  - Creation of seed banks at the levels of the farmer, community and FPC/FPO.
  - Policy of no seed sale but a banking system where one withdraws and deposits it back.
  - Promoting crop diversity

4. Radha Mohan

Sambhav: dry-land, low input, organic farming

It is possible to have an alternate agricultural system which is economically viable, ecologically sustainable and environmentally sound. The myth of agriculture that chemical based agriculture alone would solve low production that leads to starvation and death needs to be undone. It is time the community of agricultural policy makers and agri-scientists are held accountable for the fall out of the green revolution that has increased the incidence of suicide and diseases such as cancer. It would not be in-appropriate to explore legal options towards this. Violence in agriculture has built a violent society and therefore respect for bio-diversity must be nurtured.

- **Practices**
  - Introduction of Nitrogen fixing crops
  - Production of organic manure
  - Emphasis on crop diversity
  - Seed banks

- **Policy Implication**
  - Indigenous seed banks
  - PDS to procure and distribute native varieties of grain
  - Setting up of an organic farming resource centre

5. Tony Thomas

Recreating the Forest

The trees trap the energy from the sun to create food. For trees to flourish a hybrid soil with a high moisture level, balanced Ph level and microbes is essential. By not disturbing the trees and other under-growth that come up naturally the forest can be recreated. This increases soil fertility by preventing top-soil erosion and increases the moisture content of soil.

- **Practices**
  - Step 1: Allowing the forest to re-grow.

- Step 2: Shift to mixed farming to provide for all food needs
- Step 3: Water conservation through cropping pattern and small check dams using bamboo plantation
- Step 4: Indigenous live-stock to provide for dung that would increase the microbial level in the soil, bio-gas and milk requirements of the farmer.
- Step 5: Balancing soil Ph with sea-shells which is the only external input to the farm.
- Step 6: Marketing produce locally. A personal relationship and bonding with his consumers as they are closer to him and trust his product and are committed to him as he is to them.

- **Policy Implication:**
  - Scientists should observe farmers and learn from their practices rather than interfere.
  - Organic Certification should not be mandatory for selling in local markets. A trust relationship with consumers is more appropriate.

6. K RamaKrishnappa

Farming for sustainable development

Farmer is not a commodity but an expert who understands the issues of size, diversity, climactic conditions, etc. Unfortunately scientific knowledge is not serving the farmer and the community has lost trust in it. He should be exposed to genuine knowledge. In a patch of seven acres he demonstrates smaller model farms to farmers in the area to be assured of agro-ecological practices.

- **Practices**
  - Ecological farming
  - Improving Soil health, fertility and productivity through different cropping models

- **Policy Implication:**
  - Sustainable farming systems to meet the needs of small farmers is possible and desirable as it can prevent farmer suicides

7. Shalini Bhutani

- The Intellectual Property (IP) Laws related to seed are poised heavily against the interests of the small farmer. It impinges on the rights of farmers to produce, store, and share/sell or re-sow seeds. There is a need for legal pluralism. It is therefore urgent to explore flexibility in national law that allow farmers seed freedom. Agriculture is a state subject and therefore there is a possibility to work towards this at the state level.

- There is a shift towards uniformity of IP laws in the Asia Pacific. This will lead to a wider and tighter IP regime that is going to adversely affect the farmers who produce and own seeds and seed banking farmers groups. It becomes mandatory for farmers to register their seeds with the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Authority, failing which it becomes the property of the State. Registration involves a fee and scientific documentation both of which are difficult for the small farmer.

- This exposes the total disregard for traditional knowledge systems and the intent of the state to control farmer freedoms to serve the MNCs in the seed industry.

8. Rajeswari Raina

- For sustainable agricultural systems an agro-ecological approach is most suitable over the commodity based and input based conventional agriculture.
- The scientization of agriculture has led to increasing centralization and control of agricultural knowledge and vocabulary. Instead we should promote diversity and a set of epistemic communities that work on the principles of agro-ecology.
- There has been a complete negation of social systems that support sustainable agriculture.
- Promote a whole new vocabulary that would support a decentralized, bio-diverse, knowledge based, location specific, agro-ecology. The language that should define policy should come from the farmers. This would encourage ownership of knowledge by farmers.
- Codify practices of causal relationships that work in an ago-ecological system. Relationships within the various components of the eco system including human relationships between farmer and labour.
- Collective decision making is essential and beneficial for sustainable agricultural systems.
- The concept of an economic threshold in production is alien to the concept of sustainable agricultural practices. Focus on yields needs to be avoided.
- The inter-relationship between human needs and agricultural systems needs to be further explored to understand how agricultural systems have changed human needs before codifying ways of replication.

9. KJS Satyasai

High input conventional agriculture has served its purpose of increasing production. For the replication of sustainable agricultural systems it is necessary for more economic evidence to be generated. Doubts persist about the suitability of sustainable agricultural practices for meeting the needs of India's huge population. Perhaps solid evidence would convince policy makers and farmers to transit from conventional input based agricultural systems to agro-ecological farming.

Sustainable agricultural systems need to be demonstrated for smallholder farmers (less than 2 hectares) to be certain that this method would be than answer for future. Instead of research in isolation, integrated research needs to be undertaken such that we generate more scientific evidence to inform policy accordingly. Emphasis may be given to local specific models that may be replicated in the respective local ecosystem.

10. AR Khan

- It is time for agricultural policy to clearly define and promote sustainable agricultural practices. The present ambiguity in policy is sending mixed signals to the detriment of the farmer, agriculture and the ecology.
- It should be mandatory for FPOs and FPCs to adopt sustainable agricultural systems for banks to help them as this reduces economic risks and also helps build social capital and meet community needs.

11. Subhash Mehta

- A bottom-up approach is necessary for sustainable agricultural systems to take root. Agriculture must be introduced in school curricula from the primary level upwards. Schools must adopt gardening where food is grown which is then prepared by parents for the mid-day meal. This would help in addressing the issues of mal-nutrition and stunted growth in children.

Annexure-2

5. EXECUTIVE COMMITTEE FOR ANNUAL CONFERENCE

An executive committee for the follow-up National Conference on the subject was proposed at the end of the RTD and the following members volunteered to form the Executive Committee for the proposed National Conference.

Mr. M. V. Ashok, CGM DEAR NABARD

Dr. A R Khan, GM, NABARD

Mr. Tony Thomas, One Earth One Life, Kerala

Dr. Ramakrishna Kampalappa, President, Belavala Foundations, Karrnataka

Mr. Subhash Sharma, Farmer, Maharastra

Mr. Subhash Mehta, Trustee, Devarao Shivaram Trust

Mr. Natabar Sarangi, Rajendra Deshi Chasa Gabesana Kendra, NIALI, Odisha

Dr. Amar KJR Nayak, Professor, XIMB

6. Summary of Technical/Research Papers, Cases, & Policy Analysis Papers

RESEARCH ON KEY DIMENSIONS OF SUSTAINABLE AGRICULTURAL SYTEMS

Of soils, Subsidies & Survival: A report on living soils

O P Rupela, 2011

The brief report emphasizes that soil is one of the basic natural resources that supports life on Earth. It is an ecosystem, which is home to several living organisms, which makes soil alive and gives it good structure and texture. A living soil ecosystem nurtures and nourishes plants by providing a healthy medium to take roots and through a steady supply of nutrients.

It argues that use of chemical fertilisers disturbs the natural soil ecosystem and its indiscriminate use has resulted in the degradation of soil. Degraded/dead soils lead to poor plant growth and hence reduced productivity of an agricultural system. Chemical fertiliser subsidy policy of successive governments at the Centre from the late 70s has been a major driver that catalysed and is still catalysing indiscriminate use of chemical fertilisers. A total neglect of ecological/organic fertilisation by policy makers, extension officers and farmers during the peak Green Revolution period (70s to 80s) also added to soil health crisis.

The report, in the first chapter attempts to define a living and healthy soil and tries to list down the vital indicators for that. This is followed by a chapter on the need for ecological fertilisation of soil. The third chapter looks at the current situation of intensive synthetic fertiliser use and assesses the impacts of it in the Indian context. The fourth chapter critically analyses Central Government policies and schemes on soil health management in the light of this understanding. The fifth and final one presents a way forward. This chapter is a compilation of the recommendations from public hearings in the five states where the social audits were conducted and also the recommendations from the National Workshop held in New Delhi on 13th December, 2010.

Trading biodiversity for pest problems

Jonathan G. Lundgren and Scott W. Fausti

Recent shifts in agricultural practices have resulted in altered pesticide use patterns, land use intensification, and landscape simplification, all of which threaten biodiversity in and near farms. Pests are major challenges to food security, and responses to pests can represent unintended socioeconomic and environmental costs. Characteristics of the ecological community influence pest populations, but the nature of these interactions remains poorly understood within realistic community complexities and on operating farms. We examine how species diversity and the topology of linkages in species' abundances affect pest abundance on maize farms across the Northern Great Plains. Our results show that increased species diversity, community evenness, and linkage strength and network centrality within a biological network all correlate with significantly reduced pest populations. This supports the assertion that reduced biological complexity on farms is associated with increased pest populations and provides a further justification for diversification of agro ecosystems to improve the profitability, safety, and sustainability of food production systems. Bio inventories as comprehensive as the one conducted here are conspicuously absent for most agro ecosystems but provide an important baseline for community and ecosystem ecology and the effects of food production on local biodiversity and ecosystem function. Network analyses of abundance correlations of entire communities (rather than focal interactions, for example, trophic interactions) can reveal key network characteristics, especially the importance and nature of network centrality, which aid in understanding how these communities function.

Save and Grow

Food and Agriculture Organization of the United Nations, Rome, 2011

The book is a very good policymaker's guide to the sustainable intensification of smallholder crop production. It highlights one key challenge for agriculture and describes six policy measures viz.,

1. The challenge: To feed a growing world population, we have no option but to intensify crop production. But farmers face unprecedented constraints. In order to grow, agriculture must learn to save.
2. Farming systems: Crop production intensification will be built on farming systems that offer a range of productivity, socio-economic and environmental benefits to producers and to society at large.
3. Soil health: Agriculture must, literally, return to its roots by rediscovering the importance of healthy soil, drawing on natural sources of plant nutrition, and using mineral fertilizer wisely.
4. Crops and varieties: Farmers will need a genetically diverse portfolio of improved crop varieties that are suited to a range of agro-ecosystems and farming practices, and resilient to climate change.
5. Water management: Sustainable intensification requires smarter, precision technologies for irrigation and farming practices that use ecosystem approaches to conserve water.
6. Plant protection: Pesticides kill pests, but also pests' natural enemies, and their overuse can harm farmers, consumers and the environment. The first line of defence is a healthy agro-ecosystem.
7. Policies and institutions: To encourage smallholders to adopt sustainable crop production intensification, fundamental changes are needed in agricultural development policies and institutions.

Economies of Scope: Context of Agriculture, Smallholder Farmers, and Sustainability

Amar KJR Nayak, 2013

Tracing the evolution of theory and practice of ‘economies of scale’ during the last three centuries of industrial revolution, the paper shows the irony of adopting economies of scale time and again only to face greater economic recession, market failures, climate changes, food crisis and growing un-sustainability of our ecosystem. The article analyzes the significance of ‘economies of scope’ in the context of (a) basis of efficiency in agriculture versus industry, (b) operational dynamics of scope and scale across sectors in agriculture (c) organizational design and institutional architecture with the logic of scope. Further, through empirical evidences from smallholder farmers and farmer producer organizations from across India, the paper highlights that ‘economies of scope’ in agriculture is not only more efficient for nutritious food production and climate smart but also for the sustainability of agricultural ecosystems and the overall socio-economic-environment. Based on the analysis and empirical observations, the article provides three tracks for future research for long term sustainability of global food production and supply system. The three tracks include (a) science of economies of scope in agriculture, (b) optimal organizational design in the light of economies of scope, and (c) optimal institutional architecture for stable relationship among producer organizations and markets. From the available action research outputs during the last about eight years, it is imperative that agricultural and rural development policy to adopt sustainable agriculture facilitated through optimally designed producer organizations at 1-2 Gram Panchayat level where these producer organizations are saturated at the district level.

Soil degradation: a major threat to humanity

Richard Young, Stefano Orsini and Ian Fitzpatrick (2015)

Soil degradation needs to be recognised, alongside climate change, as one of the most pressing problems facing humanity. Solutions need to be developed and introduced which address both issues simultaneously. Research by the Economics of Land Degradation Initiative in 2015 calculated that soil degradation is costing between $6.3 and 10.6 trillion dollars per year globally, but these costs could be reduced by enhancing soil carbon stocks and adopting more sustainable farming methods. A research group at Cranfield University estimated that in England and Wales soil degradation costs £1.33 billion annually. Half of this cost relates to loss of soil organic carbon (SOC), and the intensity of farming is a major cause of soil carbon loss. Land use change can significantly reduce soil organic carbon and increase carbon dioxide (CO_2), nitrous dioxide (NO_2) and methane (CH_4) emissions. Changing land use from pasture to cropland results in the greatest loss of SOC. Farming practices can be employed to improve soil quality and increase soil carbon, including optimal fertilisation, crop-grassland rotation, hedgerow planting and animal manure application. The effects of other practices to SOC stocks, like no-till and green manures, are debated: recent studies show that their contribution is often limited, and in many situations no-till actually leads to yield declines compared with conventional tillage systems. In arid and semi-arid regions, salt-induced soil degradation is one of the most widespread soil degradation processes. It has been estimated that over the last 20 years, 2,000 hectares of agricultural land per day, an area the size of France, has been lost due to salinisation. This is equivalent to a global economic loss of $27.3 billion per year. Efficient water management, along with better fertiliser use and improved crop varieties could significantly reduce the negative effects of salt induced soil degradation. Given the technological advances that have been made in recent years and the greater scientific understanding of the issues today, all types of soil degradation are potentially reversible, as long as there is sufficient public support, understanding and political will.

Growth promotion of maize by phosphate solubilizing bacteria isolated from composts and macro-fauna

B. Hameeda, G. Harini, O.P. Rupela, S.P. Wani, Gopal Reddy, 2011

Five bacterial strains with phosphate-solubilizing ability and other plant growth promoting traits increased the plant biomass (20–40%) by paper towel method. Glasshouse and field experiments were conducted using two efficient strains Serratia marcescens EB 67 and Pseudomonas sp. CDB 35. Increase in plant biomass (dry weight) was 99% with EB 67 and 94% with CDB 35 under glasshouse conditions. Increase in plant biomass at 48 and 96 days after sowing was 66% and 50% with EB 67 and 51% and 18% with CDB 35 under field conditions. Seed treatment with EB 67 and CDB 35 increased the grain yield of field-grown maize by 85% and 64% compared to the un-inoculated control. Population of EB 67 and CDB 35 were traced back from the rhizosphere of maize on buffered rock phosphate (RP) medium and both the strains survived up to 96 days after sowing.

Evaluation of Crop Production Systems Based on Locally Available Biological Inputs

O.P. Rupela, C.L.L. Gowda, S.P. Wani and Hameeda Bee

While a variety of crops and practices are known to be able to contribute to farming system success, it is not known to what extent they can be used jointly in ways that are sufficiently productive and profitable, as well as sustainable, to improve the lives of farmers. It is not necessary that any system be advantageous for all farmers, since no single farming system should be expected to be optimal for everyone. The effort described in this paper was to design a crop production system that could be particularly beneficial for small landholding.

The biological approaches reported here — use of plant biomass as surface mulch, agriculturally beneficial microorganisms, and other practices — have enhanced soil biological and chemical properties of a rainfed Vertisol in the semiarid tropical environment in southern India. Yields were comparable to the conventional system of crop production that used standard agrochemical inputs. In the crop husbandry systems receiving biological inputs only, depending on the crops grown that year, stover yield ranging from 6.6 to 11.6 t ha21 and grain yield ranging from 4 to 5.9 t ha21 was harvested annually when there was $628 mm of rainfall. There is, however, the need to evaluate such systems in other locations for soil and climatic differences, so that one can better understand the many interfaces between biotic and abiotic subsystems as they respond to anthropogenic interventions in pursuit of human livelihoods and sustenance.

Agroecology, Putting Food Sovereignty into action

La Via Campesina International

This is a collection of 9 articles around the world talking about various aspects of Agroecology. They are (a) Why We Need Agroecology by Ibrahima Coulibaly - National Coordination of Peasant Organizations (CNOP), Mali, (b) Agroecology: A Way of Life by Dena Hoff - National Family Farm Coalition (NFFC), USA, (c) The Battle of Two Agriculture Models by Janaina Stronzake - Landless Workers Movement (MST), Brazil, (d) Agroecology and the Fight against the Green Revolution by Sheelu Francis - Tamil Nadu Women's Collective (TNWC), India, (e) Youth, Struggle, and the Historical Context of Agroecology by Blain Snipstal - Southeastern African American Farmers' Organic Network (SAAFON), USA, (f) Awakening and Recovering Agroecology by Yolanda Gomez and Blanca Moreno - Farmworker Association of Florida (FWAF), USA, (g) Indigenous Cosmovision, Women, and Agroecology by Amarilis Guamuch - Women's Association for the Development of Sacatepéquez (AFEDES), Guatemala, (h) Agroecology Empowers Communities Alma Maquitico - Sustainable Urban Rural Collaborative (SURCO), USA, (i) Agroecology: Ending Hunger and Building Food Sovereignty by Chavannes Jean-Baptiste - Peasant Movement of Papaye (MPP), Haiti.

Agroecology is a science and practice defined in the daily lives of millions of families worldwide. It represents both a form of agricultural production and a process for organizing and building community self-determination. The origin of agroecology is the accumulated knowledge of rural people, systematized and further developed through a dialogue of different kinds of knowledge: scientific knowledge, knowledge of organizing communities, and the everyday practical knowledge of agroecology and food production." This publication embodies the ongoing dialogue of grassroots knowledge and features peasant and indigenous men, women, and youth who are the stewards of agroecology in the US and the Global South.

Agroecology belongs to communities, so we hope that the knowledge summarized here will help to generate dialogue in other communities and among consumers and food producers. And further we hope this publication will expand our collective struggle for justice and international solidarity and support the leadership of communities around the world facing the impacts of the commodification of food and the growing influence of international agribusinesses in our food system. Agroecology brings communities together in the creation of their own solutions to produce healthy food and conserve soil and water. Agroecology is based on communities having access to and control of local resources like land, water and seeds and on working toward local food sovereignty. Because it is developed by communities and maintained through democratic social movements, agroecology nourishes the local and global struggle for food sovereignty and climate justice, which is growing more urgent every day. Though agroecology relies on local knowledge and local resources, the efforts to "scale up" and "scale out" agroecology are global. "Scaling up" — increasing support from institutions and policymakers — and "scaling out" — spreading agroecology to other farmers and communities — are critical, and the movement is strengthened through sharing the different practices of agroecology from around the world.

Results of analyses of the soil samples from Krushi Tirth, Bajwada, indicate a challenge for agriculture scientists

O P Rupela

This is a report based on study conducted by ICRISAT on soil samples and crop yield. They undertook this study at a newly acquired place of Malpani trust where crops were just 3 months old. The signs of high productivity and other factors indicated above made them to take detailed soil sampling and we analyzed all possible parameters for which facility was available at ICRISAT. There they found no signs of nutrient deficiency, diseases and insect-pests worth worrying. The fact that this method does not need agrochemicals, make it environment and farmers friendly, another ‘lowcost biological option’ that can help farmers. The method is worth exploring further and seems to have surprises for we scientists (plant pathologists, entomologists, soil fertility experts, agronomists, soil physics, crop physiologists, environmental economists.

SRT Rice Cultivation: No more puddling and transplanting, yet great crop and improved fertility

Chandrashekhar S. Bhadsavle & Changdev K. Nirguda

This brochure discusses the crop rotation techniques, without regularly tilling the land that improves soil health. This also talks about Saguna Rice technique which is a new method of cultivation without ploughing, puddling and transplanting. This method reduces about 30 to 40% cost of production and as puddling, transplanting and hoeing not required, it saves about 50% of labour. The yield is more and also it saves the lie organisms as in this method one can see many earthworms on field. The harvest also gets ready about 10 days earlier and this method is suitable for organic farming too. This brochure explains the technicalities of planting methods which is less labour intensive. This method also insists that after harvest all roots and small part of stem to be left on field for slow rotting which will serve as nutrients for next crop. Weeds also are controlled manually which prevents shocks to the plants during puddling, ploughing and hoeing.

Food Analysis reports on samples from Malpani Trust

Ashwamedh Engineers

There are different reports on (a) Gilke (b) Kadi Pata (c) Drumstick leaves, (d) Bottle Guard, (e) one more sample of bottle guard etc conducted by Ashwamedh engineers on various nutritional values and their report found the items grown organically had much more nutritional value than average available in market. In one sample taken from outside the Vitamin B12 is even below detection limit whereas the organically grown bottle guard has well above average vitamin content.

The Precautionary Principle (PP) requires to be interpreted critically and Pre-emptively for its Proper Application to the Unique Risks of GM crops

Aruna Rodrigues

This article reveals that how toxins – Cry proteins or Bt toxins – involved with GM crops are injurious to health. Besides, this toxin is not helpful in any way to make agriculture sustainable and to maintain agro ecological equilibrium. This paper has focused on the genesis of GMO, The Cartagena Protocol on Biosafety (CPB) to the Convention on Biological Diversity (CBD), and different aspects of Bt and HT crops. It cites that GM crops are driven by production goals and short-term profit maximisation incentives. GM crops developed thus far are economically profitable within a system of high-input industrialised monoculture that is largely unsustainable in its reliance on external, nonrenewable inputs. In such systems, economies of scale allow the farmer to outweigh the higher costs of production of such farming practices.

The GM crops raised much hue and cry amongst different stakeholders in India. The Government of India through the Ministry of Agriculture (MoA) has formally stated its commitment to GM crops in an Affidavit in the SC in 2012, that *"GM Crops are needed to meet India's food security"*. Given the proven serious conflict of interest in our Regulators, public sector institutions of agriculture, and the DBT (Department of Biotechnology) of the Ministry of Science and Technology (MoS&T) this statement is unsurprising, but nevertheless flags the mindset that is able to completely discount the sheer weight of evidence against Bt and HT crops, (neither of which are engineered for yield gain as a trait), and which represent 99% of current commercialised GM crops planted worldwide (ISAAA). This raises justified alarm at the dim prospect emanating from the government for corrective national policy. The empirical evidence of crop data on yield drag, resistant pests, super weeds, increased herbicide and pesticide use, (26 percent more chemicals per acre were used on GE crops than on non-GE crops in the US - USDA data78), rising seed and farmer costs and greater use of fertilisers is clear. The US Department of Agriculture's Review of 10 years of GM crop cultivation in the States, which has the longest history of GM crops, has concluded:

"Currently available GM crops do not increase the yield potential... In fact, yield may even decrease if the varieties used to carry the herbicide tolerant or insect-resistant genes are not the highest yielding cultivars… Perhaps the biggest issue raised by these results is how to explain the rapid adoption of GE crops when farm financial impacts appear to be mixed or even negative." USDA

The article also focuses on Indian Law on this point:

"Notwithstanding anything contained in sub-section (2) and sub-sections (1) and (3) of section 15, no variety of any genus or species which involves 'any technology' injurious to the life or health of human beings, animals or plants shall be registered under this Act. For the purposes of this subsection, the expression "any technology" includes genetic use restriction technology and terminator technology." (Ref. Protection of Plant Varieties and Farmers' Rights Act, 2001 section 29 (3)).

The consensus of opinion of International agencies viz. UN, FAO, WWI (World Watch Institute), the UNCTAD etc on GM crops is that the solution to food and nutritional security is through agro ecological sustainable models of agriculture.

Sustainable Agricultural Practices in India:

All India Baseline Study on Producer Companies & Natural Farming Practices: Part 2

Amar KJR Nayak, 2014

This study reveals many important findings on the natural farming practices and sustainable agriculture in the country. The study and the findings are especially significant given the overall issues and impending crisis in the practice of industrial agriculture; which has been an outcome of the green revolution and the market economy adopted in the country during the last about five decades.

1. There has been progressive change in the agriculture policies of the state governments towards sustainable agriculture. Seven out of the twenty eight states in India have already introduced a separate policy on sustainable agriculture. The National Centre for Organic Farming (NCOF) under the Ministry of Agriculture, Government of India has also begun to change its policies to facilitate sustainable agriculture.

2. The practice of natural farming or sustainable agriculture is quite promising. Farmers adopting sustainable agriculture are doing quite well and their net income has been improving as their total cost of agriculture as percentage of gross income is reducing. It is also interesting to observe that the mixed cropping reduces the total cost as a percentage of gross income. Further, as the size of farm increases beyond a point, the total cost as percentage of gross income increases.

3. The science and practice of sustainable agriculture is very limited with regard to research and codification. Currently, a few of the leading farmers of sustainable agriculture have codified some aspects of their respective techniques and practices. These farmers have been able to demonstrate the agricultural outputs more than systematically explain the science of it. The processes of sustainable agriculture have not been fully codified such that the small and marginal farmers could adopt them without hesitation. There have been little public investments on research for empirical evidences and codification of sustainable agriculture and hence the tacit and intricate knowledge system of sustainable agriculture has not been popular in practice. As a result of this lack of scientific study, codification and subsequent training, the adoption and replication of sustainable agricultural practices are much slower as compared to the huge potential it offers to mitigate the risks of farmers and the growing demand for safe and nutritious organic food by the consumers and the producers.

4. Empirical observations of different practices and literature on sustainable agriculture suggest that basic dimensions to sustainable agriculture include (a) soil health, (b) seeds, (c) water (moisture) management, (d) mixed cropping for better plant protection, (e) integration of agriculture to local livestocks, (f) converging integrated agriculture to local ecosystem by agro-forestry and social forestry.

5. The core challenges of implementing sustainable agriculture across India include (a) issues of adoption by the conventional farmers as they fear the loss of production in the early years, (b)

lack of codification and simplified knowledge systems, the conventional farmers are not confident to move forward with the unknown and apparently complex system, (c) lack of adequate market support to agricultural produce in general and hence does not encourage the farmers to invest in anything new, (d) the current institutional arrangement also does not provide commensurate support to overcome the existing challenges of sustainable agriculture, and (e) the policies of the state governments and central government have been rather confusing to the farmers in the country. As of today, only one state viz., Sikkim provides a clear policy on Organic Farming. Nine (9) states have both agriculture policies on external input based industrial agriculture and on farm input based sustainable agriculture. All the other states in the country have only external input based agriculture.

Recommendations

1. Agriculture Policy: Agriculture Policy needs to take a clear direction towards sustainable agriculture for minimizing the risks of the farmers and increasing risks of climate change (Nayak, 2013c). Some of the key areas of intervention that the policy needs to cover are on farm/agro forestry, kitchen garden, fodder cultivation, cattle shed, kitchen gardens, in-situ water conservation, bio-villages, action research and codification of science of sustainable agriculture, facilitate training of sustainable agriculture with the help of locally successful sustainable agricultural farmers. This also means that policy should develop a clear time plan to exit from the external input based industrial agriculture.

2. Institutional Architecture: To make the policy on sustainable agriculture work among the farmers, an appropriate institutional architecture needs to be set up to deliver both ecosystem services and effectively deal with the pre harvest and post-harvest needs of the small and marginal farmers (Nayak, 2013a).

3. Producer Organization Design: Facilitate formation, revival and stabilization of local level optimally sized organizations owned and managed by the small farmers that can serve as a single window for delivery of the ecosystem services and provide external linkages including local value addition and marketing of surplus produce on behalf of the community of small farmers in a cluster. The present institutional platforms of the poor and small farmers such as SHGs, CIGs, Joint Liability Groups, Farmer Clubs, SHG Federations, Producer Groups, PACS, and Producer Companies are not scientifically designed to optimize the various issues of the small farmers, characteristics of agriculture and the charactreristics of the market economy (Nayak, 2012b, 2013a).

4. Codification: The science and practice of sustainable agriculture needs to be invested upon and systematically codified for better knowledge transfer and to develop a ‘System of Sustainable Agriculture’ that may be referred to by all stakeholders (farmers, students, researchers, research institutions, Universities, NGOs, & policy, & public/consumers) in agriculture. The foundation of such a body of knowledge seems to be rooted on soil health, seed, moisture, mixed cropping, integrated agriculture, and convergence with the local ecosystem (Howard, 1940, 1947, Gopalakrishnan, 2012, Rupela, 2011, Nayak, 2012a, 2012c).

5. Adoption: Replication of the existing and improvised practices of sustainable agriculture is critical to transform today's unsustainable agriculture to sustainable agriculture. All the above points need to be taken care of, to encourage farmers to adopt sustainable agriculture. Through regular training and social communication, farmers need to be made more and more aware about the inter-connectedness of agricultural practices and the critical need for better understanding of the logic of inter-dependence and cooperation for greater productivity and sustainability of our agricultural ecosystem (Nayak 2013b).

2016 RTD Note

Arun K Sharma, 2016

Codification: The ***ready to use*** mentally developed in farmer during green revolution is also need changes. If these trigging factors are not removed the whole strategy for sustainability will not give results. There may be components like seed, water, livestock, trees and many more as per the agro ecology but more important is there efficient use+ recycling and a complimentary system. ***Producing more*** -never leads to sustainability rather quality production with grading and primary processing, better storage at farm level may help in economic viability and better use of resources.

Replication: There may be basic principles and practices of SAP but techniques must be location specific. The technology must be 1. Suitable to agro-climatic zone and 2.Costomised for farmers conditions with some alternate/options.

Common Vocabulary: Every system have specific identity to make it brand e.g. organic= no chemical, natural= all depends on nature/least disturbance, zero= no external input. We must define agriculture and its principles only; what is the aim, objectives and mandate of agriculture is to provide food to all and livelihood to farmer for long term basis.

<u>POLICY ANALYSIS & PERSPECTIVE PAPERS</u>

Smallholder Farmers and Agriculture in India: Challenges & Way Forward

Amar KJR Nayak, 2016

The first part of this note highlights the present state of nature of risks to farmers and agriculture, rise of new monsters in agriculture, disobedience to science of efficiency in agricultural production system and consequent high cost of insurance, lack of grass root level convergence in government schemes with dissipating social capital and high transaction cost of extension services, inability to balance diversity in production and scale & specialization in marketing in absence of optimal farmer producer organizations and institutional architecture. The second part of this note points to the transition strategy and policy measures to overcome the deep rooted challenges of present agriculture and rural economy in India.

The perspective highlights the dependence on external inputs; viz., seeds, fertilizers, pesticides and credit as the new monster of agriculture in addition to the monsters of monsoon and markets. It calls for diversity in agricultural systems, optimally designing farmer producer organizations (FPOs), convergence of government development programmes at the GP level FPOs and saturation of FPOs from GP level to district level.

Agriculture and the Development Burden

Rajeswari S. Raina, 2015

Indian agriculture in the twenty-first century is mired in a context of rapid economic growth and widening income inequality. Record food production, increasing industrial investments, booming exports, persistent hunger, worsening malnutrition, escalating natural resource degradation and unprecedented distress within the farming community, are its key features. This chapter explores how the intermediate regime, or the state along with its ideological and functional allies, imposes its own articulation of development on agriculture. In the process it stifles the rich diversity, production potential and robustness of India’s agriculture and diverse farming communities.

Major policy concerns of food and nutritional security, environmental degradation, rural employment and farm incomes have been articulated at least over the past four decades. Solutions ranging from new legislations and schemes for food security, enhanced food production and assured rural employment (National Food Security Bill (NFSB), 2012; National Food Security Mission (NFSM), 2007; Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), 2005), to specific technologies and techniques (pesticide free and organic production, biofortification, genetic engineering, integrated nutrient management or micronutrient supply to soils, systems of rice intensification, drip and sprinkler irrigation, processing technologies), infrastructure (electricity, roads, storage spaces), and services, organisations for services or organisational formats (microfinance, farmer field schools, farmer producer companies, co-operatives, women’s self-help groups) have been recommended. Some have been accepted and implemented as part of the state’s development agenda. A rule of thumb for rejection seems to be the extent to which the solution threatens or alters the prevalent centralised supply driven administration of agriculture.

Indian agriculture can be classified into three phases, based on the place and role it found in development as articulated by the state or specifically, the intermediate regime that simultaneously constitutes and is nurtured by the state. It was ‘the basis of all development’, has been subjected to ‘modernisation for development’, and has been appropriated by strong contenders for ‘alternatives in development’. The centralising tendencies of the intermediate class and the capacity to exploit the state to their own advantage, is evident in all these phases. But the demand for local authority, decentralised knowledge and policy support for agrarian alternatives is growing. This may change the meanings of development and the burden on agriculture imposed by development as articulated by the intermediate regime.

Double or real: towards green agro-ecological revolutions

Rajeswari S. Raina, 2014

This paper discusses the double green revolution, a movement that has also been called sustainable intensification (Royal Society, 2009), and examines how and why it is different from and more pernicious than the green revolution. Proponents of sustainable intensification note that it is a goal in itself (Garnett et al., 2013) and not merely an approach to achieve the goal of food security and environmental sustainability. They demand engagement with the sustainable development agenda, despite developing country problems like institutional failures and insufficient capital, lack of data to assess crucial land use questions, and obvious environmental and welfare limits to intensification (especially animal production) (Garnett et al., 2013). Though there is some willingness now to engage with a knowledge-based bio-economic paradigm, favouring agro-ecological approaches, the production successes of the green revolution prompt governments to continue supporting the life science based paradigm of agricultural innovation and development (Levidow et al., 2012). The double green revolution undermines national and global agricultural knowledge, science and technology, and wastes several opportunities for investing in healthy and sustainable societies, ecosystems and economies.

Sustainable Agriculture

Pushpa M. Bhargava RTD 2016

Bhargava, Pushpa M. in his paper on Sustainable Agriculture makes several policy recommendations against the backdrop of the strategic importance of Indian agriculture to India in international politics; the urgent need of farmer security through sustained higher income; the necessity of achieving food security; and significantly increasing the contribution of the Agriculture sector to the GDP of India.

The recommendations call for ensuring absolute farmer suzerainty over seeds; assuring water and power in rural areas; replacement of chemical pesticides with Integrated Pest Management and bio-pesticides and a similar replacement of chemical fertilizers with bio-fertilizers and organic fertilizers. He also calls for knowledge empowerment in the rural sector through vocational training institutes and high quality schools; setting up of agro-industries in rural areas where the local farmers should have a stake and the elimination of middle men in the marketing of agro-produce; and the reduction of wastage of primary agro produce especially food material. Traditional agricultural practices need to be documented and validated as they are cost effective and at the same available modern scientific knowledge that would help the farmers to plan an effective disaster management system, create a soil atlas of every district in the country and set up soil testing laboratories and create better connectivity and communication with the urban sector should get appropriate policy backing.

The apparent schism between the Ministries of Agriculture and Rural Development needs to be bridged for better policy co-ordination and programme planning and implementation. A national programme of credit to farmers and a national programme for the promotion of rural arts and crafts would be helpful in addressing rural unemployment and poverty. Finally, Prof. Bhargava addresses the issues of bio-terrorism against Agriculture, plant diseases and their early identification through the use of space technology for quick redress and the setting up of an independent national body for plant disease identification and control.

Report of the Expert Group on Agricultural Indebtedness, Banking Division, Department of Economic Affairs, Ministry of Finance

Radhakrishnan. et.al (2007)

This lengthy report on farmer indebtedness correctly identifies it as a symptom of a much deeper malaise that plagues the agricultural sector namely: stagnation in agriculture; increasing production and marketing risks and lack of alternate livelihoods to farming. The report with the support of empirical data marks the rising credit needs of agriculture in the wake of modernization and commercialization. It calls for a slew of policy measures that would expand the production base of agriculture with an emphasis on the small and marginal farmers in order that they may be integrated to the mainstream of development. It first calls for an increase in the institutional credit availability to excluded farmer households and a qualitative improvement in the present credit delivery arrangements so that the debt burden of farmers on informal sources may be reduced and transferred to formal institutions. Further, to augment and stabilize incomes of farm households rejuvenation of the natural resource base is recommended. Effective risk mitigating measures are required to counter the adverse impact of price volatility due to fluctuations in domestic production induced by climatic conditions and also due to the fluctuations in prices of agricultural goods in the international market.

The report suggests that small and marginal farmers, should be organized through collectives like Self-Help Groups (SHGs) and cooperatives. Besides credit delivery, these collectives would be expected to help the farmers in improving their farming practices through better accessing of appropriate technology, extension services, improved processing and marketing capabilities and risk management. Credit arrangements could be complemented with arrangements for insurance against natural calamities, for social security and for health insurance. This would enable farm households to diversify their livelihood activities through the development of non-farm activities. The required adequate infrastructure and appropriate institutions for skill formation, training and education would have to be set up. Further, Producer cooperatives, federations of farmers' SHGs and other forms of collectives, would enable the farmers, including the small and marginal farmers to participate in value addition activities like marketing and processing.

The Synthesis Report of the International Assessment of Agricultural Knowledge, Science and Technology for Development

IAASTD, 2009

This report is built upon the Global and five Sub-Global reports that provide evidence for the integrated analysis of the main concerns necessary to achieve development and sustainability goals. The report first, addresses the primary concerns of hunger, poverty, livelihoods and development that should be equitable and sustainable environmentally, socially and economically. Second, it focuses on eight cross-cutting themes which include: bioenergy, biotechnology, climate change, human health, natural resource management, trade and markets; traditional and local knowledge and community based innovation; and women in agriculture.

The main challenge of Agricultural Knowledge, Science and Technology (AKST) is to increase the productivity of agriculture in a sustainable manner. AKST must address the needs of small-scale farms in diverse ecosystems and create realistic opportunities for their development where the potential for improved area productivity is low and where climate change may have its most adverse consequences.

Successfully meeting development and sustainability goals and responding to new priorities and changing circumstances would require a fundamental shift in AKST, including science, technology, policies, institutions, capacity development and investment. Such a shift would recognize and give increased importance to the multi-functionality of agriculture, accounting for the complexity of agricultural systems within diverse social and ecological contexts. It would require new institutional and organizational arrangements to promote an integrated approach to the development and deployment of AKST. It would also recognize farming communities, farm households, and farmers as producers and managers of ecosystems. This shift may call for changing the incentive systems for all actors along the value chain to internalize as many externalities as possible. In terms of development and sustainability goals, these policies and institutional changes should be directed primarily at those who have been served least by previous AKST approaches, i.e., resource-poor farmers, women and ethnic minorities. Such development would depend also on the extent to which small-scale farmers can find gainful off-farm employment and help fuel general economic growth. Large and middle-size farmers continue to be important and high pay-off targets of AKST, especially in the area of sustainable land use and food systems.

Poverty and Livelihoods: Policy options for improving livelihoods include access to microcredit and other financial services; legal frameworks that ensure access and tenure to resources and land; recourse to fair conflict resolution; and progressive evolution and proactive engagement in intellectual property rights (IPR) regimes and related instruments. Developments are needed that build trust and that value farmer knowledge, agricultural and natural biodiversity; farmer-managed medicinal plants, local seed systems and common pool resource management regimes. Each of these options, when implemented locally, depends on regional and nationally based mechanisms to ensure accountability. The suite of options to increase domestic farm gate prices for small-scale farmers includes fiscal and competition policies; improved access to AKST; novel business approaches; and enhanced political power.

Food Security: Policy options for addressing food security include developing high-value and underutilized crops in rain fed areas; increasing the full range of agricultural exports and imports, including organic and fair trade products; reducing transaction costs for small-scale producers; strengthening local markets; food safety nets; promoting agro-insurance; and improving food safety and quality. Price shocks and extreme weather events call for a global system of monitoring and intervention for the timely prediction of major food shortages and price-induced hunger. AKST investments can increase the sustainable productivity of major subsistence foods including orphan and underutilized crops, which are often grown or consumed by poor people. Investments could also be targeted for institutional change and policies that can improve access of poor people to food, land, water, seeds, germplasm and improved technologies.

Environment Sustainability: Policy options include ending subsidies that encourage unsustainable practices and using market and other mechanisms to regulate and generate rewards for agro/environmental services, for better natural resource management and enhanced environmental quality. Examples include incentives to promote integrated pest management (IPM) and environmentally resilient germplasm management, payments to farmers and local communities for ecosystem services, facilitating and providing incentives for alternative markets such as green products, certification for sustainable forest and fisheries practices and organic agriculture and the strengthening of local markets. Long-term land and water use rights/tenure, risk reduction measures (safety nets, credit, insurance, etc.) and profitability of recommended technologies are prerequisites for adoption of sustainable practices. Common pool resource regimes and modes of governance that emphasize participatory and democratic approaches are needed.

Human Health and Nutrition: Inter-linkages between health, nutrition, agriculture, and AKST affect the ability of individuals, communities, and nations to reach sustainability goals. These inter-linkages exist within the context of multiple stressors that affect population health. A broad and integrated approach is needed to identify appropriate use of AKST to increase food security and safety, decrease the incidence and prevalence of a range of infectious (including emerging and reemerging diseases such as malaria, avian influenza, HIV/AIDS and others) and chronic diseases, and decrease occupational exposures, injuries and deaths. Robust agricultural, public health, and veterinary detection, surveillance, monitoring, and response systems can help identify the true burden of ill health and cost-effective, health-promoting strategies and measures.

Equity: Inter-linkages between health, nutrition, agriculture, and AKST affect the ability of individuals, communities, and nations to reach sustainability goals. These inter-linkages exist within the context of multiple stressors that affect population health. A broad and integrated approach is needed to identify appropriate use of AKST to increase food security and safety, decrease the incidence and prevalence of a range of infectious (including emerging and reemerging diseases such as malaria, avian influenza, HIV/AIDS and others) and chronic diseases, and decrease occupational exposures, injuries and deaths. Robust agricultural, public health, and veterinary detection, surveillance, monitoring, and response systems can help identify the true burden of ill health and cost-effective, health-promoting strategies and measures. Urban agriculture; direct links between urban consumers and rural producers) will help create and strengthen synergistic and complementary capacities.

Deconstructing Indian cotton: weather, yields, and suicides

Andrew Paul Gutierrez, Luigi Ponti, Hans R Herren, Johann Baumgärtner and Peter E Kenmore (2015)

Cotton with coevolving pests has been grown in India more than 5000 years. Hybrid cotton was introduced in the 1970s with increases in fertilizer and in insecticide use against pink bollworm that caused outbreaks of bollworm. Hybrid Bt cotton, introduced in 2002 to control bollworm and other lepidopteran pests, is grown on more than 90 % of the cotton area. Despite initial declines, year 2013 insecticide use is at 2000 levels, yields plateaued nationally, and farmer suicides increased in some areas. Biological modeling of the pre-1970s cotton/pink bollworm system was used to examine the need for Bt cotton, conditions for its economic viability, and linkage to farmer suicides.

Yields in rainfed cotton depend on timing, distribution, and quantity of monsoon rains. Pink bollworm causes damage in irrigated cotton, but not in rainfed cotton unless infested from irrigated fields. Use of Bt cotton seed and insecticide in rainfed cotton is questionable.

Bt cotton may be economic in irrigated cotton, whereas costs of Bt seed and insecticide increase the risk of farmer bankruptcy in low-yield rainfed cotton. Inability to use saved seed and inadequate agronomic information trap cotton farmers on biotechnology and insecticide treadmills. Annual suicide rates in rainfed areas are inversely related to farm size and yield, and directly related to increases in Bt cotton adoption (i.e., costs). High-density short-season cottons could increase yields and reduce input costs in irrigated and rainfed cotton. Policy makers need holistic analysis before new technologies are implemented in agricultural development.

Supplementary material - Deconstructing Indian Cotton: Weather, Yields and Suicides

Andrew Paul Gutierrez, Luigi Ponti, Hans R. Herren, Johann Baumgärtner, Peter E. Kenmore (2015)

This article is a supplement to the earlier paper where the authors provide history of cotton culture and make an econometric analysis of Bt cotton, The effects of Bt cotton on the different herbivore species. The further explain phenology of cotton pests in Central India before and after the introduction of Bt 25 cotton, diapause in pink bollworm in the Punjab, Karanataka and Tamil Nadu, Variability of rain fall in Central India during 2002-2010, the effects of planting density in rainfed and irrigated cotton at Yavatmal, MH using 1995-2010 weather, ecological disruption in cotton with insecticide use, High-density short-season cotton in Imperial County, CA, Suicides among males by age class in the Indian states of Andhra, Gujarat, Karnataka and Maharashtra and change in use of insecticide in cotton from 2000 to 2013.

Ramification of Debt Waivers and the need to put in place a risk mitigation mechanism for making agriculture sustainable in Odisha

Amar KJR Nayak, B S Misra, & S Peppin (2016)

Increasing unpredictability in agricultural production outputs and post production activities seems to expose Indian farmers to greater risks in the recent years. Net income from agriculture by farmers; especially the marginal and small farmers in India seems to have been under stress. Reports on farmers' distress and suicide rate have been alarming and governments especially at the time of election time tend to waive off the bank loans taken by farmers. For instance, recently Governments of Andhra Pradesh and Telangana states announced loan waivers as per their election manifesto. In the above context, NABARD decided to undertake the study in the states of Andhra Pradesh, Telangana, Maharastra and Odisha. In addition to the common objective of assessing risk and cause for non-repayment of loans, the distinct focus of the study in Odisha was to assess the risk of farmers in different agro-climatic and institutional settings. Accordingly, the objective of study in Odisha included the following:

1. Assess the various annual expenses, gross incomes and net income of farmers. 2. Assess the different sources and cost of credit to farmers. 3. Assess the different purposes for which credit is availed by farmers. 4. Assess the capabilities and vulnerabilities of farmers in different stages of farming; viz., agricultural inputs, credit, land preparation & sowing/planting, on farm crop & animal care, post-harvest, value addition, marketing and external institutional support. 5. Assess the situation of sustainable agricultural practices and understand risk mitigation mechanisms adopted by progressive farmers in different agro climatic and institutional settings. 6. Assess the interest level of farmers to form FPO in their respective GP clusters. 7. Estimate risk of farmers based on their capabilities and vulnerabilities to understand risk and loan repayment capacity of farmers. 8. Assess the risk of farmers in different agro climatic and institutional settings. 9. Assess the risk of different social categories of farmers. 10. Understand the root cause for non-repayment of crop loans by farmers. 11. Suggest policy measures to make farmers profitable and agriculture sustainable.

Risk faced by a farmer is a function of vulnerability faced by a farmer in the agricultural, allied and all other economic activities and the capabilities possessed by the respective farmer during a particular agricultural cycle. The moral hazard of willful non repayment by farmers with paying capacity was not considered as a significant variable in this study as debt waiver in Odisha was as long back as 2008. From the above perspective, the key variables for risk assessment included the following: ***agricultural inputs, credit, land preparation and sowing, on farm crop and animal care, post-harvest, value addition, marketing and institutions***. The vulnerability and capability of these key variables were assessed for each sample farmer using a number of simple but related questions.

From the overall analysis, it appears that farmers suffer most from the externalities either from production input side (seeds, manure, water) or after harvest of crop (value addition & marketing). However, the root cause of risk at the production phase is the gradual externalization of internal capabilities of farmers whether it being in terms of seeds, manure, or farm labor. The greater dependency of farmers on external markets to procure these capabilities has made farmers more dependent on external credit. In other words, ***externalization of internal capabilities of farmers*** is the root cause of increasing vulnerability by every passing season.

Mitigating Agrarian Distress and Enhancing Farm Income
NABARD, July 2015

The deliberations covered various dimensions of agrarian distress—policies, products, practices, processes, and risk-return matrices. Some of the major aspects of the agrarian distress that emerged during the discussions include,

- Lack of cohesion during policy formulation, wherein diverse interest groups and departments pull in different directions, thereby not allowing a comprehensive and integrated approach
- Distortions in agricultural markets with currency valuations
- Protection of industry versus protection of agriculture
- Export promotion versus export regulation
- Managing the market economy

There are three dimensions to the response of agricultural finance to the distress of the agrarian community:

- One, priority sector lending mandate extended to foreign banks, which are expected to bring in new perspectives into farm credit;
- Two, capacity building institutions for new banks, small finance cooperative sector, R&D sector, and training; and
- Three, finding a way to formalize informal credit to widen the credit coverage, thus releasing the farmer from the clutches of moneylenders (mahajan/sahukaar) — the last of the three 'Ms' that tend to pull farmers down, of the other two being monsoon and markets.

However, all these responses are not entirely dependent upon agricultural finance. A more granular list of actionable learning points that emerged during the deliberations was detailed under relevant sub-heads, viz., (1) Protecting Incomes of Farmers, (2) Financial Flows: Access to credit, insurance, and rural infrastructure, (3) Influencing Farm Practices towards efficient resource use, (4) Managing Inventory, (5) Managing Inventory, (6) Holistic Policy Approaches, and (7) Tapping Advanced Finance Market

Indian Agriculture: Impressive Past & Challenging Future
KJS Satyasai, 2015

While presenting the impressive past of Indian Agriculture, the chapter highlights the various risk currently encountered. The agricultural sector in India is exposed to a variety of risks which not only endanger the farmer's livelihood and income, but also undermine the viability of the agricultural sector. Though risks and uncertainties are common in this sector, they have acquired greater importance today as they have increased in frequency and severity over the last couple of decades. Then there is the addition of a new class of risks, which has confounded risk management or mitigation efforts. The risks faced by farmers fall primarily under the following heads: a) production, b) price, c) input, d) technology, and e) institutional risk.

The author provides various suggestions to address the present distress in agriculture in terms of (a) Financial Management, (b) Risk Mitigation, (c) Social Networking, (d) Farm Practices, and (e) Other Aspects.

Swaminathan Report: National Commission on Farmers

M S Swaminathan, et al, 2006

The Report discusses the main causes behind farmers' distress and increased suicide rates in India in the recent years. The reports highlights that the major causes of the agrarian crisis include: unfinished agenda in land reform, quantity and quality of water, technology fatigue, access, adequacy and timeliness of institutional credit, and opportunities for assured and remunerative marketing. Adverse meteorological factors add to these problems.

It argues that farmers need to have assured access and control over basic resources, which include land, water, bio-resources, credit and insurance, technology and knowledge management, and markets. The NCF recommends that "Agriculture" be inserted in the Concurrent List of the Constitution.

Among many suggestions, the report recommends the following sustainable agricultural practices, viz.,

- Promote aquifer recharge and rain water conservation. Decentralise water use planning and every village should aim at Jal Swaraj with Gram Sabhas serving as Pani Panchayats.
- Ensure availability of quality seed and other inputs at affordable costs and at the right time and place.
- Recommend low risk and low cost technologies which can help to provide maximum income to farmers because they cannot cope with the shock of crop failure, particularly those associated with high cost technologies like Bt cotton.

The reports also discuss the significance of bio resources especially with reference to rural India and it recommends the following:

- Preserving traditional rights of access to biodiversity, which include access to non-timber forest products including medicinal plants, gums and resins, oil yielding plants and beneficial micro-organisms;
- Conserving, enhancing and improving crops and farm animals as well as fish stocks through breeding;
- Encouraging community-based breed conservation (i.e. conservation through use);
- Allowing export of indigenous breeds and import of suitable breeds to increase productivity of nondescript animals.

Value Chains for Nutrition

Corinna Hawkes and Marie T. Ruel (2011)

This article explains the value chain concepts, and depicts applications of value chain analysis to enhance competitive strategy in business, using it as a tool to examine process, causes and consequences of global industrial integration and as a tool to reveal agricultural development strategies. For this the authors have gone through and analysed 8 cases (a) Enhancing the nutritional value and marketability of beans through research and strengthening key value-chain stakeholders in Uganda, (b) Increasing the production, availability, and consumption of vitamin A–rich sweet potato in Mozambique and Uganda, (c) Developing nutrition programs in Sierre Leone: The case of REACH, (d) Building food systems and access to nutritious foods in northeast Iowa, USA, (e) Land O'Lakes Zambia: Developing a dairy value chain for smallholders, (f) Value-chain analysis of high-value foods in Indonesia: Implications for producers and consumers, (g) Transforming a supply chain into a value chain: The case of Sysco in the United States and (h) Shifting functions to create value for producers in the value chain for ready-to- use therapeutic foods in Ethiopia and have summarised their conclusions as below.

Altogether, these case studies confirm some of the reasons why the value-chain approach can be useful for achieving nutritional goals. They also reveal how value-chain approaches have been and could be used in ways that are relevant to improving nutrition and increasing the supply of and demand of nutritious foods by the poor. Still, there remains a lack of measured nutritional and health outcomes for these approaches. The set of case studies also does not illustrate all the potentially important contributions of value-chain approaches. Three notable absences are the global nature of food value chains, the role of policy as a value-chain intervention, and value chains linking farmers with institutional markets. There are some potential examples to learn from, but because of the lack of adequate information, they were not included in the set of case studies. The case of international fish trade illustrates the importance of considering the global scale. Value chains for fish crisscross national borders and have implications for food security: fish exports generate income for local communities, while domestic consumption provides an important nutritional contribution to the diet. Recognizing the international nature of the fish value chain and the role of fish in food security, the FAO and the Norwegian Agency for Development Cooperation (Norad) are conducting a comprehensive value-chain analysis of international fish trade with an impact assessment of the small-scale sector in developing countries. The study, initiated in 2010, compares domestic, regional, and international value chains to better understand how developing countries can increase the value—economic and nutritional—from their fish supplies. Regarding the role of policy changes in the value chain, cases are needed to examine how the overarching policy frameworks—such as broad shifts in agricultural, trade, and competition policy—affect the incentives faced by value-chain actors at all scales. No such case was identified here, but there are cases of policy and governance changes in different parts of the value chain being used to leverage agriculture for improved nutritional outcomes. Although not developed with explicit value-chain concepts in mind, a good example is the Brazilian Food Acquisition Program (PAA), which procures food directly from family farmers for distribution to populations vulnerable to food and nutrition insecurity (MDA 2010). A recent policy change in Brazil also requires that 30 percent of the food served in the national school feeding program be sourced from family farmers

Better Nutrition for Better Lives
Jomo Kwame Sundaram

Overcoming hunger and malnutrition in the 21st century does not simply involve increasing food availability, but also improving access, especially for the hungry. Creating healthy, affordable and sustainable food systems for all is the most effective way to achieve this. This article talks about problems in food system such as increasingly intensive industrial farming systems and massive food wastage are often simply unsustainable. Food production has often put great stress on natural resources - exhausting fresh water supplies, encroaching on forests, degrading soils, depleting wild fish stocks and reducing biodiversity. We need to recognize and deal with these challenges urgently. Fortunately, we also have the means to transform food production systems to make them more sustainable and healthy by empowering local communities. The article argues for strong political commitment to prioritise nutrition and improve food systems. Natural resources must be used more efficiently, with less adverse impacts, by getting more and better food from water, land, fertilizer and labour. Nutrient dense foods, such as milk, eggs and meat, are improving diets for many, while livestock continues to provide livelihoods for millions. Yet, livestock production and consumption need to be more sustainable, with far less adverse effects on climate change, disease transmission and overall health. Expenditure to address malnutrition offers very high private and social returns. Hence the author argues that this is a very smart investment every Government must act upon.

Agroecology Replaces Hazardous Agro-chemicals
Subhash Mehta, Trustee, RTD 2016

This paper argues for an agro-ecological approach to agriculture as it is low cost, low risk and ensures producer communities' access to meet their own requirement of nutritious food. It cites the Pesticide Action Network (PAN) International report on how to replace HHCs with agro ecology in the context of human and environmental health, access to and nutrition & food security, reduction hunger, mal nutrition, poverty and effects of climate change whilst improving net incomes, purchasing power and livelihood. The report also outlines a three-step process for the transition towards equitable and sustainable agroecological systems in the long term. The first step is to develop the political will; the second step is to understand what facilitates agroecology, followed by the third step which is to develop the policies, programmes, and legislation to provide an enabling environment for the uptake of agroecology by farmers and to phase out HHCs. This paper also advocates that national governments should take up the following:

First, challenge assumptions that current levels of dependency on synthetic agro chemicals are necessary, and that the large-scale, specialized farms highly reliant on high cost high risk agrochemical and fossil fuel inputs are the best way to provide food for all the increasing populations. In contrast, there is clear evidence that smallholder, diversified, agro ecologically-managed farming communities are just as productive – or more so – than external input intensive and mono cultural systems. This would also reduce the dependency of farmers on Government subsidies.

Second, it is necessary that policy protect small holder farmers, their ownership of land, tenancy rights and their access to knowledge, funding, water and locally adapted modern seeds. They also need to ensure equal rights for women in every sphere.

Third, National economic policies must strengthen the rural poor producer communities access to nutritious food systems, fund them to set up and staff farmer producer company (PC)/ org (amend IXA of the Company's Act) staffed by professionals to take over all risks and responsibilities other than on farm activities, to add value for increasing shelf life of produce thus reduce wastage during transport and storage and improve ability to sell at higher prices and enable PC to access required credit at low interest, also prevent global food retail chain domination of domestic markets and stops these chains to determine prices that result in farmers being underpaid and left struggling to survive.

SUCCESS STORIES FROM THE FIELD

Evergreen Evolution - A New Approach to Sansad Adarsh Gram Yojana

Deepak Suchde (2015)

In this presentation, Evergreen evolution concept is described and its practice at Barkheda and Bajwada by Malpaani Trust has been explained. Evergreen revolution is a continuous evolution of practices based on enrichment & enhancement of nature's free resources, creating sustainable abundance and wealth for all and to facilitate sustainable lifestyles having new forms of living, livelihood, and learning. The Evergreen Model is based on (a) Successes in Water Resource Development, (b) Soil building, (c) Food & Nutritional security, (d)The participatory, integrated planning adopted in GOI's SAGY scheme & other best practices, and (e) Making it replicable. To work on this, a replicable model starting with a cluster of 7 villages in Barkheda, Sehore District, M.P. as 'SMART' villages has been undertaken. To implement this WISE Learning Resource Centre has been created to coordinate 'SMART' village project for Capacity Building, Incubating, Facilitating and Demo Centres of processes, products and technology.

Revival of Millets based Mixed Cropping in Rayagada

Debjeet Sadangi, RTD 2016

This is a story of some tribal and non-tribal villagers in Rayagada district in Odisha where people earlier grew varieties of crops through mixed-cropping practices. This practice helped them in maintaining soil fertility .Seeds were stored after each harvest and exchanged, ensuring the local adaptability and availability of seeds to produce several varieties of foods. This practice continued till late 80s and early 90s when government extension agents came to villages to promote high yielding rice varieties, with a promise of bumper yields and higher income. Some younger generation farmers got into the trap and brought high yield seeds which gave them higher yield for initial years but started declining. When they contacted the agents, they advised to get different seeds from block office and get chemical fertilisers. Slowly they were into this vicious trap. Then how everything was slowly revived by Living Farms through creation of awareness, taking farmers to neighbouring villages, organising local food festivals, documenting local rain cycle etc and people went back to traditional practices.

Towards Sustainable Development: A Case Study on Belavala Ecological Farm

K. Ramakrishnappa

Agriculture has been the celebrated primary occupation of Mandya district in Karnataka wherein close to 70% of the population still is dependent on agriculture for their livelihood as against state's average of 59%. The district has the advantage of receiving irrigation to an extent of 46% for its cultivable land of which 80% is from the assured sources of Krishnaraja Sagar and Hemavathi dams compared to Karnataka's over all of 28%. Mandya has the privilege of having Agriculture Education and Research centre established as early as in 1991-92. Agriculture sector in the district is also supported with 31 RSKs, a Soil Health Centre, a Regional Centre for Coconut Development and a Bio control Laboratory. Mono cropping with expensive inputs of chemical fertilizers and pesticides with intensive irrigation has been the regular practice of the farmers in the district for the last 4-5 decades. Belavala Ecological farm is located at Belagola village in Srirangapatna Taluk of Mandya district in Karnataka. The total extent of the land is 7 Acres 28 Guntas.

The primary perception behind in establishment of the Farm was based on the popular belief that " An experienced farmer is an expert…he knows how to manage soils, crops and manage business. He is also a good system thinker…. know to put it all together into farming systems and farm enterprises; but all he needs is genuine knowledge". Therefore, to bridge the knowledge gap among the farmers of Karnataka in general and Mandya district in particular on ecologically sustainable and economically viable farming practices adaptable to local conditions, different models of ecological farming system are being developed at Belavala Ecological Farm. Different cropping systems involving agricultural practices that are in harmony with nature, and which make maximum use of local resources are demonstrated at Belavala Ecological farm from 2012. Future observations on the optimization of soil health and fertility and productivity of different cropping models would strengthen the knowledge base in advocating sustainable farming system to farmers and policy makers.

Up-scaling "Organic by default agriculture" – a hope spot for dry land

A. K. Sharma

This research paper focuses on organic approach that is a hope spot for low rainfall areas with light soil. It throws light on other aspects of this organic agriculture suitable for dry lands like (a) diversified farming system minimizes pest control and controls desertification, (b) growing low water-demanding crops viz. spices, oilseeds and application of manures increases water holding capacity of light soils, (c) erratic rainfall paves the opportunity to the farmers for converting to certified organic farming, (d) rich traditional know-how in those areas play an effective role in the sphere of restoration of soil fertility and control of pests, (e) natural inputs derived from plants and minerals provide plant nutrients and regulate the pH of the soils, (f) as organic farming is labour intensive it creates employment opportunity to the local rural folk.

Besides, this paper advocates that Certified model organic farm (MOF) is quite instrumental for organic farming in other low rainfall areas. The crops produced from organic farming have high market value both at national and international level.

10 Guntha Farming

S.A. Dhabolkar

This pictorial description shows how one can effectively utilise just 10 Guntha land for multi-cropping and be a successful farmer. It shows how monsoon crops, red gram, corn mung etc, vegetables, cotton, spices, fruit and oil seeds can be cultivated in just this small patch of land along with maintaining the ecosystem.

Annexure-4

7. Program Schedule

Round Table Discussion on Sustainable Agricultural Systems
Venue: MDC Conference Hall, XIMB
Date: 19 January, 2016

Time	Topic	Facilitation
8.30 am – 9.00 am	Registration	Organizing Team
09.00 am-9.05 am	Welcome	Fr. Paul Fernandes, S.J. Vice Chancellor, XUB &Director, XIMB
09.05 am - 9.10 am	Introduction to RTD	Prof. Amar KJR Nayak
9.15 am – 10.45 am	Self-Introduction & brief opening Remarks	Senior Academics, Senior Practitioners & Key Policy Executives
	Dr. Peter Kenmore, Former FAO India Representative now based in USA (10.00 am- 10.15 am, IST	Through Video Conference
10.45 am – 11.00 am	Tea Break	
11.00 am – 1.00 pm	<u>Issue-wise Discussion</u> Codification, Replication, & Vocabulary	Participants / Delegates
1.00 pm – 2.00 pm	Lunch	
2.00 pm – 3.30 pm	Implementation & Policy Recommendations	Participants / Delegates
	Observations & Suggestions (3.00 pm – 3.15 pm)	Dr. PushpaBhargava through video conference
3.30 pm – 3.45 pm	Tea Break	
3.45 pm – 4.45 pm	Summary Output on Sustainable Agricultural Systems	Rapporteurs: Dr. (Ms.) Sashmi Nayak, Professor, NISWASS & Mr. Rahul P Mohanty, Doctoral Scholar, XIMB
4.45 pm – 5.30 pm	Concluding Observations &Selection of Executive Committee for National/ International Conference on SAS& Vote of Thanks	Dr. (Ms.) Rajeswari Raina, Dr. KJS Satyasai Subhash Sharma, PVS Satheesh, Tony Thomas, Prof. Radhamohan & Prof. Amar KJR Nayak

Annexure-5

8. Participants / Delegates Present in the RTD on SAS

SN	Name	Designation	Organization
		ACADEMICS	
1	Paul Fernandes, S. J.	Vice-Chancellor & Director	Xavier University Bhubaneswar
2	Arun K Sharma	Sr. Scientist	CAZRI, Jodhpur
3	Rajeswari Raina	Principal Scientist	CSIR NISTADS, New Delhi
4	Radhamohan	Professor & Advisor	SAMBHAV
5	Srijit Mishra	Professor & Director	Nabakrushna Centre for Development Studies,
6	Samarendra Mahapatra	HoD, Agri Business Management	Orissa University of Agriculture Technology, Bhubaneswar
7	Sashmi Nayak	Professor	NISWASS
8	Goutam Saha	Associate Professor	National Institute of Fashion Technology, Bhubaneswar
9	Asish Kumar Panda	PhD Scholar	XIMB
10	Rahul Pratyush Mohanty	PhD Scholar	XIMB
11	Amar KJR Nayak	Professor	XIMB
		SENIOR PRACTITIONERS	
12	Subhash Sharma	Farmer	Vidharba, Maharashtra
13	P.V. Satheesh	Secretary	Deccan development Society Hyderabad
14	Natabar Sarangi	Retired School Teacher & Farmer	Rajendra Deshi Chasa Gabesana Kendra, NIALI
15	K. Ramakrishnappa	President & Scientist	Belavala Foundations, Karrnataka
16	Tony Thomas	Director	One Earth One Life, Kerala
17	Usha Mehta	Trustee	Devarao Shivaram Trust, NGO Association for Agricultural Research Asia Pacific (NAARAP)
18	Mathew Sebastian	Founding Executive Director	INDOCERT
19	Pradyut Ranjan Bagh	Program Officer	TATA Trusts
20	Jitendra Nayak	Odisha In-Charge	TATA Trust

SENIOR POLICY EXPERTS & EXECUTIVES			
21	M V Ashok	CGM, DEAR	NABARD HO, Mumbai
22	Jaideep Srivastava	GM	NABARD HO, Mumbai
23	A R Khan	DGM	NABARD HO, Mumbai
24	KJS Styasai	DGM	NABARD, HO, Mumbai
25	Pushpa Bhargava	Hon. Distinguished Prof, School of Life Science, JNIAS	Joined through SKYPE
26	B P Mishra	Director of Agriculture & Food Production, Odisha	DA & FP (O)
27	Shalini Bhutani	Lawyer	New Delhi
28	Suneel Padale	Program Analyst	UNDP
29	Subhash Mehta	Trustee	Devarao Shivaram Trust, NGO Association for Agricultural Research Asia Pacific (NAARAP)
	RAPPORTEURS		
	Sashmi Nayak	Professor	NISWASS
	Rahul Pratyush Mohanty	PhD Scholar	XIMB

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