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Organic Farming Potentials and Strategies

Millenium Guest Lecture delivered at
S.V. College, Tirupati on 3rd June, 2005

by

Dr. Mangala Rai

Secretary (DARE), Director General, I.C.A.R.
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*Distinguished Vice-Chancellor, ANGRAU,
Dr S. Raghuardhan Reddy, learned faculty
members, scientists, friends, ladies and
gentlemen!*

It is indeed a matter of great pleasure for me to be here with you today in this holy city of Tirupati. I feel we are very fortunate to be here and I can say this based on my strong belief that unless HE wills it, no one can come here. I not only offer my humble prayers to Lord Balaji but also offer my respects to the people who live in Tirupati. I am grateful to the University for inviting me for the Millennium Guest Lecture and wish to share with you some of my thoughts on Organic agriculture.

2. The Green revolution technologies involving greater use of synthetic agrochemicals such as fertilizers and pesticides with adoption of nutrient- responsive, high-yielding varieties of crops have boosted the production output per hectare in most of the cases. However, this increase in production has slowed down and in some cases there are indications of decline in growth of productivity and production. Priorities in agriculture

research are gradually moving from a focus on individual crop performance to a total system productivity with due attention on product quality and environment safety. Environmental and health problems associated with agriculture have been increasingly well documented, but it is only recently that the scale of the costs have attracted the attention of planners and scientists.

- 3 In the words of Shri Bankim Chandra Chatterji, we have nature's bounties in form of

Vande Mataram!
Sujalam, suphalam, malayaja shitalam,
Shasyashyamalam, Mataram!

When translated it means

I bow to thee, Mother,
richly-watered, richly-fruited,
cool with the winds of the south,
dark with the crops of the harvests,
The Mother!

4. In the rapid pace of development we have inflicted serious damage to the natural resources and consequently we are now faced with questions as where is that **Sujalam** (clean water)? Where is that **Suphalam** (healthy crop)? and where is that **malayaja shitalam** (refreshing air)? These questions have given rise to a process of serious

thinking to safeguard the environment and the quality of natural resources for sustainability. As a result more and more emphasis is being given towards returning to nature and adoption of organic agriculture.

The concept of organic agriculture

5. Organic farming is not new to Indian farming community. Several forms of organic farming are being successfully practiced in diverse climate, particularly in rainfed, tribal, mountains and hill areas of the country. Much of the forest produce of economic importance like herbs, medicinal plants, etc., by default come under this category. Among all farming systems, organic farming is gaining wide attention among farmers, entrepreneurs, policy makers and agricultural scientists for varied reasons such as it minimizes the dependence on chemical inputs (fertilizers; pesticides; herbicides and other agro-chemicals) thus safeguards/ improves quality of resources, and environment it is labour intensive and provides an opportunity to increase rural employment and achieve long term improvements in the quality of resource base.
6. Organic production systems are based on specific standards precisely formulated for food production and aim at achieving agro ecosystems, which are socially and ecologically sustainable. Many definitions have been proposed for organic agriculture with primary focus on

ecological principles as the basis for crop production and animal husbandry.

7. Codex Alimentarius Commission, a joint body of FAO/WHO defines *“organic agriculture as holistic food production management systems, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological and mechanical methods, as opposed to using synthetic materials, to fulfil any specific function within the system”*. In its simplistic form Organic agriculture may be defined as a kind of diversified agriculture wherein crops and livestock are managed through use of integrated technologies with preference to depend on resources available either at farm or locally. It emphasizes more on optimising the yield potential of crops and livestock under given set of farming conditions rather than maximization. To promote organic agriculture and to ensure fair practices in international trade of organic food, the Codex Alimentarius Commission, also framed certain guidelines for the production, processing, labelling and marketing of organically produced foods.
8. The popularity of organic farming is gradually increasing and now organic agriculture is practiced in almost all countries of the world, and its share of agricultural land and farms is growing. As per a recent report of International Federation of Organic Agriculture Movements (IFOAM) the total organically managed area is more than 24 million hectares world-wide Organic farming is practiced in approximately 130 countries of the world and the area under organic management is continually growing. Although production of organic crops is increasing across the globe, sales are concentrated in the industrialised parts of the world.
9. In addition, the area of certified wild harvested plants is at least a further 10.7 million hectares, according to various certification bodies. The market for organic products is growing, not only in Europe and North America but also in many other countries. The global market for organic food is expected to touch US\$ 29 to 31 billions by 2005. The demand for organic food is steadily increasing both in developed and developing countries, with annual average growth rate of 20-25%.
10. Official interest in organic agriculture is emerging in many countries, shown by the fact that several countries have a fully implemented regulation on organic farming or are in the process of drafting regulations. The countries with the largest areas of organic farmland are: Australia,

Argentina, Italy, Canada and USA. Some countries have reached a substantial proportion (close to or more than 10%) of organic land; these include Sweden, Austria, Switzerland, Finland and Italy.

11. There is a lot of debate between the proponents of organic farming and a section of the community who questioned the scientific validity and feasibility of organic farming. The most often debated issues on organic agriculture are:
 - a. Can organic farming produce enough food for everybody?
 - b. Is it possible to meet the nutrient requirements of crops entirely from organic sources?
 - c. Are there any significant environmental benefits of organic farming?
 - d. Is the food produced by organic farming superior in quality?
 - e. Is organic agriculture economically feasible?
 - f. Is it possible to manage pests and diseases in organic farming?

Impact of organic agriculture

12. In intensive farming systems, organic agriculture decreases yield; the range depends on the intensity of external input used before conversion. In the green

revolution areas (irrigated lands and well endowed water regions), conversion to organic agriculture usually leads to almost identical yields. In traditional rain fed agriculture (with low external inputs), organic agriculture has shown the potentials to increase yields. A number of studies have shown that under drought conditions, crops in organic agriculture systems produce significantly and sustainably higher yields than comparable conventional agricultural crops, often out-yielding conventional crops by 7 – 90 per cent. Others have shown that organic systems have less long-term yield variability.

Organic agriculture and food security

13. Crop management practices such as crop rotations, green manuring, crops residue recycling, water management, efficient plant types etc., are adopted through a combination of structural and tactical management options to ensure farm produce of sufficient quantity and quality for livestock and human consumption. Normally, a crop rotation involving a leguminous crop is preferred over others. Organic farmer preferably grow locally adopted varieties having some quality traits for the premium markets.
14. The common understanding is that large scale conversion to organic agriculture would result in drastic reduction in world food supplies or large increases in

conversion of undisturbed land to agriculture has not been borne out in modelling studies. Conversion studies showed that domestic food consumption would not suffer, exports would vary depending on crop, but the structure of farming would definitely change with more diversification of agriculture. Widespread conversion to organic agriculture would result in crop yield increase over the current averages as a result of increased investment in research and extension. Organic farmers grow a variety of crops and maintain livestock in order to optimise use of nutrients and the space between species. This ensures economic advantages through low crops production or yield failure due to biotic and abiotic factors in all of these simultaneously. This can have an important impact on local food security and resilience should an unwanted phenomena happens. In rain-fed systems, organic agriculture has demonstrated to out- perform conventional agricultural systems under environmental stress conditions. Under the right circumstances, the market returns from organic agriculture can potentially contribute to local food security by increasing family income.

Nutrient management in organic farming

15. Organic farming is often understood as a form of agriculture with use of only organic inputs for the supply

of nutrients and management of pests and diseases. In fact, it is a specialized form of diversified agriculture, wherein problems of farming are managed using local resources alone. The term organic does not explicitly mean the type of inputs used; rather it refers to the concept of farm as an organism. Often, organic agriculture has been criticized on the grounds that with organic inputs alone, farm productivity and profitability might not be improved because the availability of organic sources is highly restricted. True organic resources availability is limited; but under conditions of soil constraints and climate vagaries, organic inputs use has proved more profitable compared to agrochemicals.

16. Nitrogen availability from organic resources often limits to realize full yield potential of cereals under organic production system. Under restricted water availability or rainfed conditions, the differences in crop yields between organic and conventional production narrow down to between 10-15%. FYM used in these experiments usually contains N, 0.5-0.8%, P, 0.2-0.4% and K, 0.8-1.0% with no mention of quality of organic matter/manure or alternative methods of efficient use. This nutrient rich manure helps to raise crop productivity even at lower application rates (5-10 t ha⁻¹) compared to the use of 15-20 t/ha FYM with and without chemical fertilizer. In addition, use of liquid manures prepared through fermentation of green leafy materials, cattle urine and

other locally available resources are common. The differences in quality of manures used is probably the reason for wide difference reported in crop yields under organic and conventional system of crop production. There is however a need to scientifically evaluate the nutrient supply methods in organic *vs.* conventional systems. Their efficient use is an area of future research investigation.

17. Livestock keeping at farms is an age old practice. Livestock play major role in organic agriculture as the intermediary between the utilization of crop residues or fodder produced at the farm and the return of nutrients as manure. Dairying in particular has helped number of small and marginal farmers to improve their income. Field survey revealed that marginal and small farmers, even in progressive states like Punjab, have helped to raise farm profitability as well as availability of cattle dung in sufficient amounts. Storage and application of their resources seldom attract proper attention of the farmers resulting in 40-60% losses in nutrients, especially N. Leaching of NO₃-N polluting the ground and surface water resources is usually observed from cattle dung pits. Organic farmers and farming methods take adequate care in minimizing these losses through adoption of technologies on composting, vermi composting etc. This not only improve the nutrients availability from organic sources but also prevent potential hazard of ground water

pollution. I would suggest harnessing the power of micro-organisms in ameliorating such adversaries in soil.

18. Organic farming systems rely on the management of soil organic matter to enhance the chemical, biological and physical properties of the soil. One of the basic principles of soil fertility management in organic systems is that plant nutrition depends on 'biologically-derived nutrients' instead of using readily soluble forms of nutrients; less available forms of nutrients such as those in bulky organic materials are used. This requires release of nutrients to the plant via the activity of soil microbes and soil animals. Improved soil biological activity is also known to play a key role in suppressing weeds, pests and diseases. What is now required is to harmonize and bind the components in a system synergy and all round complementarity.
19. Animal dung, crop residues, green manure, biofertilizers and bio-solids from agro-industries and food processing wastes are some of the potential sources of nutrients of organic farming. While animal dung has competitive uses as fuel, it is extensively used in the form of farmyard manure. Development of several compost production technologies like Vermi composting, Microbe Mediated, Phospho composting, N-enriched Phospho composting, etc. improves the

quality of composts through enrichment with nutrient-bearing minerals and other additives. These manures have the capacity to fulfil nutrient demand of crops adequately and promote the activity of beneficial macro- and micro-flora in the soil.

20. Presently, only 30% of total cultivable areas in the country has irrigation facilities where agrochemicals use is higher compared to rain-fed zones. It is here that ingenuity and efforts are required to increase crop productivity and farm production despite recurrence of environmental constraints of drought and water scarcity. The basic requirement in organic farming is to increase input use efficiency at each step of the farm operations. This is achieved partly through reducing losses and adoption of new technologies for enrichment of nutrient content in manure. Technologies to enrich the nutrient supply potential from manure, including farmyard manure three to four times are being widely used in organic farms. According to a conservative estimate, around 600 to 700 million tonnes (mt) of agricultural waste is available in the country every year, but most of it is not used properly. We must convert waste into wealth by converting this biomass into bio-energy, nutrients to starved soil and fuel to farmers. India produces about 1800 mt of animal dung per annum. Even if two thirds of the dung is used for biogas generation, it is expected to yield about 440 mt per year

of manure, which is equivalent to 2.90 mt N, 2.75mt P₂O₅ and 1.89 mt K₂).

21. Organic farms and food production systems are quite distinct from conventional farms in terms of nutrient management strategies. Organic systems adopt management options with the primary aim to develop holistic farms, like a living organism with balanced growth, in both crops and livestock holding. Thus nutrient cycle is closed as far as possible. Only nutrients in the form of food are exported out of the farm. Crop residues burning is prohibited, so also the unscientific storage of animal wastes and its application in the fields. It is, therefore, considered more environment friendly and sustainable than the conventional system. Farm conversion from high-input, chemical-based system to organic system is designed after undertaking a constraint analysis for the farm with the primary aim to take advantage of local conditions and their interactions with farm activities, climate, soil and environment, so as to achieve (as far as possible) closed nutrient cycles with less dependence on off-farm inputs. This implies that the only nutrients leaving the farm unit are those for human consumption. I would suggest to minimize the loss of nutrients, which otherwise continues without any let off.

22. Crop rotations and varieties are selected to suit local conditions having the potential to sufficiently balance the nitrogen demand of crops. Requirements for phosphorus, potash, sulphur and micronutrients are met with local, preferably renewable resources. Organic; agriculture is therefore, often termed as knowledge-based rather than input-based agriculture. Further more, organic farms aim to optimise the crop productivity under a given set of farm conditions. There are ample evidences to show that agrochemical-based, high input agriculture is not sustainable for long periods due to gradual decline in factor productivity, with adverse impact on soil health and quality. Harnessing the varietal potential by appropriate biotechnology input is neglected area and needs adequate attention.
23. The impact of organic agriculture on natural resources favours interactions within the agro-ecosystem those are vital for both agricultural production and nature conservation. Ecological services derived include soil forming and conditioning, soil stabilization through buffering and structural improvement, waste recycling, carbon sequestration, nutrient cycling, predation, pollination and habitats. The environmental costs of conventional agriculture are substantial, and the evidence for significant environmental amelioration via conversion to organic agriculture is over-whelming. There are also

high pre-consumer human health costs to conventional agriculture, particularly, in the use of pesticides. It is estimated that 25 million agricultural workers in developing countries suffer from pesticide poisoning each year.

Safety and quality of organically produced food

24. There is a growing demand for organic foods driven primarily by the consumer's perceptions of the quality and safety of these foods and to the positive environmental impact of organic agriculture practices. It has been demonstrated that organically produced foods have lower levels of pesticides and medicinal and hormonal residues and in many cases lower nitrate contents. Nitrates are significant contaminants of foods, generally associated with intensive use of nitrogen fertilizers. Studies that compared nitrate contents of organic and conventional products found significantly higher nitrates in conventional products. Quality after storage has been reported to be better in organic produce relative to chemical based produce after comparative tests. 'Organic' in organic agriculture is a labelling term that denotes products that have been produced in accordance with certain predefined parameters and certified by a duly constituted certification agency or authority. The organic label is therefore a process claim rather than a product claim. Organic standard will not

exempt producer and processors from compliance with general regularity requirements such as food safety regulation, pesticide registration, general food and nutrition labelling rules, etc.

Pest and disease management in organic farming

25. Pest control in organic farming begins by taking right decisions at right time, such as growing crops that are naturally resistant to diseases and pests, or choosing sowing times that prevent pest and disease outbreaks. Careful management in both time and space of planting not only prevents pests, but also increases population of natural predators that have natural capability to control insects, diseases and weeds. Other methods generally employed for the management of pests and diseases are: clean cultivation, improving soil health to resist soil pathogens and promote plant; growth; rotating crops; encouraging natural biological agents for control of diseases, insects and weeds; using physical barriers for protection from insects, birds and animals; modifying habitat to encourage pollinators and natural enemies of pests; and using semi-chemicals such as pheromone attractants and trap pests. I would emphasize to search for non-monetary inputs arising from natural resources for control of biotic stresses.
26. Organic farmers have long maintained that synthetic fertilizers and pesticides increase crop susceptibility to

pests. Organic crops have been shown to be more tolerant as well as resistant to insect attack. Organic rice is reported to have thicker cell walls and lower levels of free amino acids than conventional rice. Plant susceptibility to insect herbivory has been shown in numerous studies to be associated with high plant N levels on account of high inputs of soluble N fertilizers. Organic N is available slowly as the plant grows at thus acts as a self-control against the disease.

27. Soil-borne root diseases are generally less severe on organic farms than conventional farms, while there have been no consistent differences in foliar diseases between the two systems. The successful control of root diseases in organic systems is likely to be related to the use of long and diverse crop rotations, crop mixtures and regular application of organic amendments. Increased levels of soil microbial activity leading to increased competition and antagonism in the rhizosphere, the presence of beneficial root-colonizing bacteria and increased levels of vesicular-arbuscular mycorrhizal colonization of roots have all been identified as contributing factors; in the control of root diseases. This is an unexplored area where native organisms provide protection against other harmful organisms.

Organic agriculture: Relevance to Indian farming

28. Only 35% of India's total cultivable area is covered with fertilizers where irrigation facilities are available and in the remaining 65% of arable land, which is mainly rain-fed, negligible amount of fertilizers are being used. Farmers in these areas often use organic manure as a source of nutrients that are readily available either in their own farm or in their locality. The north-eastern region of India provides considerable scope and opportunity for organic farming due to least utilization of chemical inputs. It is estimated that 18 million hectare of such land is available in the North-East, which can be exploited for organic production. With the sizable acreage under naturally organic/default organic cultivation, India has tremendous potential to grow crops organically and emerge as a major supplier of organic products in the worlds organic market. Need is for putting up a clear strategy on organic farming and its link with the markets.
29. The report of the Task Force on Organic Farming appointed by the Government of India also observed that in vast areas of the country, where limited amount of chemicals are used and have low; productivity, could be exploited as potential areas for organic agriculture. Arresting the decline of soil organic matter is the most potent weapon in fighting against unabated soil degradation and imperilled sustainability of agriculture

in tropical regions of India, particularly those under the influence of arid, semiarid and sub-humid climate. Application of organic manure is the only option to improve the soil organic carbon for sustenance of soil quality and future agricultural productivity. Future of sustainable development of agriculture, next to water, depends on arresting fall in organic matter in soils.

Economics of organic farming

30. The replacement of external inputs by farm-derived resources normally leads to a reduction in variable input costs under organic management. Expenditure on fertilizers and sprays is substantially lower than in conventional systems in almost all the cases. In a few cases, a higher input costs due to the purchase of compost and other organic manure have been reported. Studies have shown that the common organic agricultural combination of lower input costs and favourable price premiums can offset reduced yields and make organic farms equally or often more profitable than conventional farms. The economics of organic cotton cultivation over a period of six years indicated that there is a reduction in cost of cultivation and increased gross and net returns compared to conventional cotton cultivation in India.
31. The interest in organic agriculture in developing countries is growing because it places more reliance on the natural and human resources available, requires

less financial input and provides safe food while conserving the environment. Studies to date seem to indicate that organic agriculture offers comparative advantage in areas with less rainfall and relatively low natural and soil fertility levels. Labour realizes a good return and this is important where paid labour is almost non-existent. Organic agriculture does not need costly investments in irrigation, energy and external inputs, but rather organic agricultural policies have the potential to improve local food security, especially in marginal areas.

32. Possibly, the greatest impact of organic agriculture is on the mindset of people. It uses traditional and indigenous farming knowledge, while introducing selected modern technologies to manage and enhance diversity, to incorporate biological principles and resources into farming systems, and to ecologically intensify agricultural production. Instead of being an obstacle to progress, traditions may become an integral part of it. By adopting organic agriculture, farmers are challenged to take on new knowledge and perspectives, and to innovate. This leads to an increased engagement in farming which can trigger greater opportunities for rural employment and economic upliftment. Thus through greater emphasis on use of local resources and self-reliance, conversion to organic

agriculture definitely contributes to the empowerment of farmers and local communities.

33. Organic farming systems can deliver agronomic and environmental benefits both through structural changes and tactical management of farming systems. The benefits of organic farming are relevant both to developed nations (environmental protection, biodiversity enhancement, reduced energy use and CO₂ emission) and to developing countries like India (sustainable resource use, increased crop yields without over-reliance on costly external inputs, environment and biodiversity protection, etc.).
34. The government, private sector and producer associations each have a necessary role to play in promoting and facilitating marketing of organic produce. How the various pieces fit together in order to increase value and marketability of farmers' produce is a challenge and will require additional work to make the system function properly. Technical advice on how these processes function in other places and the roles of the different players would be very helpful. Under no circumstances food self sufficiency and security should be comprise in our genuine needs for organic farming. Having stated that I strongly urge to identify niche areas and crops for organic farming. With that full potential of organic farming can be harnessed and country's commitment on food and other economic activity can be sustained.

