# Technology for change

SIKK

<u>Jrganic</u>

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#### Abbreviations used

AH & VS	:	Animal Husbandry and Veterinary Services
AICCIP	:	All-India Coordinated Crop Improvement Project
a.i./ha	:	Active ingredient per hectare
BADP	:	Boarder Area Development Programme
BD	:	Biodynamic
BSI	:	Botanical Survey of India
CFRI	:	Central Fruit Research Institute
CPP	:	Cow Pat Pit
CPRI	:	Central Potato Research Institute
CSS	:	Centrally Sponsored Scheme
CRRI	• :	Central Rice Research Institute
DESME	:	Directorate of Economics, Statistics and Monitoring and Evaluation
DONER	:	Department of Development for North-East Region
EAI	:	Education Attainment Index
EM	:	Effective Microorganism
FAO	:	Food and Agriculture Organization
FCI	:	Food Corporation of India
FPE	:	Fermented Plant Extract
FPS	:	Fair Price Shop
FS & ADD	:	Food Security and Agriculture Development Department
FYM	:	Farm Yard Manure
GDI	:	Gross Development Index
GDP	:	Gross Demestic Product
GOS	:	Government of Sikkim
GSDP	:	Gross State Domestic Product
H&CCDD	:	Horticulture and Cash Crop Development Department
HDI	:	Human Development Index
HK-H	:	Hindu Kush Himalayas
HQC	:	Hydroxyquinoline citrate
HYV	:	High Yielding Variety

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	ICIMOD	:	International Centre for Integrated Mountain Development
1	ICAR	:	Indian Council of Agricultural Research
	IPM	:	Integrated Pest Management
	IRRI	:	International Rice Research Institute
	Lim	:	Limboo language
	MPCS	:	Multi Purpose Cooperative Societies
	MSP	:	Minimum Support Price
	MTA	:	Mid Term Appraisal
	Mt	:	Metric tonne
	NBSS & LUP:		National Bureau of Soil Survey & Land Use Planning
	NDC	:	National Development Council
	NEC	:	North Eastern Council
	Nep	:	Nepali language
	NER	:	North-Eastern Region
	NHPC	:	National Hydro Power Corporation
	NPK	:	Nitrogen, Phosphorus and Potash
	NSC	:	National Seed Corporation
	NSDP	:1	Net State Domestic Product
	PCYI	:	Per Capital Income Index
	PDS	:	Public Distribution System
	pH	:	Range of acidity or alkalinity measurement
	RM & DD	:	Rural Management and Development Department
	SARD	:	Sustainable Agriculture and Rural Development
	SARD-M	:	Sustainable Agriculture and Rural Development in Mountainous Region
X	SSC	:	State Seed Corporation
	TERI	:	Tata Energy Research Institute
	t/h or t/ha	:	Tonnes per hectare
	q/h or q/ha	:	Quintal per hectare
	UV	:	Ultra Violet
	VLW	:	Village Level Worker

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# Preface

The Green Revolution technologies in India, primarily due to their faulty application, proved not to be green. However, facing the worst food crisis during 1940s to 1960s, it brought an unprecedented progress in the national food production leading to the alleviation of hunger and poverty in the country. It transformed India from a "Shipto-Mouth" situation to the "Right to Food Status", with a sizeable food and agricultural export by 2014. The Green Revolution has now waned; and there is an urgent need for developing and deploying greener technologies for "Second Green Revolution", to achieve desired productivity and environmental sustainability systems to support the ever-growing population of the country. Organic Agriculture could be a vital supplementary option for the small and marginal farmers of the 11 (eleven) mountainous Himalayan "Special Category States" of India "to combat the impact of mountain specificities". FAO definition of "Organic Agriculture is a unique production management system which promotes and enhances agroecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs".

Indian organic initiative started with setting up of regulatory mechanism, necessary for exports, rather than technological research and development. The decision of government of Sikkim to go organic was based on the premise that farming in this hilly state was traditionally organic before its merger to the Indian Union in 1975; and it will be to the benefit to the farmers who own an average of 1.9 hectares of farmland with minimal chemical fertilizer use (12 kg/ha

compared to 90 kg/ha of national average) and inorganic pesticides even at its post-merger period (2002); but also to maintain quality of environment of the state. Furthermore, with the implementation of "Technology Mission for Integrated Development of Horticulture in North-Eastern Region," during the VIII, IX Five Year Plan and onwards, the farmers of Sikkim had already started cultivation of 'Comparative Advantage Horticultural Crops' in different Agroclimatic Zones of Sikkim for optimum benefit. The state also has opportunities to develop niches based organic agribusiness enterprises, providing self employment to educated youth and improving state economy. Because of unique agro-climatic conditions and traditional farming cultures, there are recognizable crop produce niche commodities in Sikkim, such as large cardamom, green ginger, oranges, quality tea, seed potato, passion fruits, buckwheat, and temperate and European off-season vegetables. Adding value, by way of growing these organically, holds the promise to make these niche commodities, for state tourism, and national and international markets. There exist strong possibilities of developing the Sikkim Brand of Organic Commodities.

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With these positive points of the state, Shri Pawan Kumar Chamling, the Chief Minister of Sikkim envisioned to develop the Sikkim's "Subsistence Agriculture" into a "High-Value Organic Enterprise" by transforming Sikkim to a "Fully Organic Sikkim" in 2002-03. He made a historic declaration by announcing a policy to transform Sikkim into "Totally Organic State" by passing a resolution in the Sikkim Legislative Assembly in the year 2003. With this, Sikkim became the first State in the country to enact such a far sighted and visionary policy of transforming Sikkim into a 'Sustainable Organic Farming Enterprise'. His dream of transforming every inch of Sikkimese soil into organically viable and sustainable enterprise has been wholeheartedly accepted by the farming community of Sikkim. This vision of the Chief Minister of Sikkim has become a goal of the Nation for all the eleven Himalayan 'Special Category States of India' with the address of the Prime Minister of India in both the Houses of Parliament on 11th June 2014.

 The Strategy adopted in the initial period (2003-09) to transform the dream of Organic Sikkim was:

- Formulation of Concept and Action Plan 'Going for Organic Sikkim';
- · Constitution of Sikkim State Organic Board;
- Discouraging use of Chemical Fertilizers and Chemical Pesticides;
- Promoting Organic Manures through Resource Mobilization;
- Development of Bio-Villages;
- Improving and Creating Manure Production Infrastructures;
- Technology Development through Research mobilization;
- Organic Seed Production;
- · Soil Health Assessment and Improvement; and
- Conduct of National and State Workshop on Organic Farming regularly for Road Map preparation and concurrent evaluation of the progress.

From 2010 onwards, the State Government is implementing "Organic Mission 2015" to transform the entire "Subsistence Agriculture" into "High-Value Organic Enterprise" by 2015. The strategies adopted for the Mission is:

- Institutional Framework setup for Implementation of Sikkim Organic Mission 2015 - Establishment of Executive Body of Sikkim Organic Mission;
- Setting up Livelihood Schools on Organic Agriculture;
- Capacity Building of Local Youth;
- Technology refinement on Organic Orchard Management;
- Combating Ginger Rhizome Disease in Organic Way;
- Internal Control System (ICS) Development;
- Incentives for Adoption of Organic Farming;
- Improving Organic Inputs for Soil Health Management;
- Streamlining Integrated Pest Management (IPM) in Organic Way;
- Conducting Workshops and Seminars regularly to clear the bottlenecks;
- Branding and Marketing linkages;
- Exploring the Organic Village Tourism;

- Development of Organic Seed Production;
- Adopting Animal Husbandry as part of Organic Mission; and,
- Development and Adoption of Participatory Guarantee System (PGS) for Organic Certification and Sustainable Organic Farming;

The two books on organic farming in Sikkim already published namely, "Sikkim Towards Fully Organic State by 2015" by FS&ADD and H&CCDD, Government of Sikkim, and "Organic Sikkim leading the Change" by Tej Pratap and C.S. Vaidya. The books have highlighted the details of "Road Map" and "Push factors based organic strategy" inclusive of "Sikkim – Organic Mission 2015". Dr. Tej Pratap and C.S. Vaidya have also emphasized the next step, i.e., implementing "the pull factors based strategy." "Yuma, Arizona... Showing What We're Growing?" Arizona State of USA demonstrated the best example of promoting **Agri-Tourism** in the world. Similar benefits could be harnessed in Sikkim also in future.

This book entitled "Organic Sikkim – Technology for Change" has documented the technologies on 'Organic Farming' presently available with us. The book may be useful for extension functionaries, educated youth and the farmers in general who are involved in transforming the 'Substance Agriculture' into a 'High-Value Organic Enterprise' and thus 'reduce the impact of mountain specificities' in the Hindu-Kush Himalayan Region.

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# **Organic Farming – A Need**

Organic Farming is gaining grounds in the wake of serious threat to Food Security and restoration of our natural resources of land, water and rich biodiversity of flora and fauna in Sikkim. As the land resources are shrinking, the per capita available land has come to around 0.10 ha. Soil degradation due to erosion (16 t/ha. on an average) entails a tremendous loss of nutrients in a high rainfall region like Sikkim. Water logging particularly in command areas especially . during summer in Sikkim makes crop production difficult. Our resources are also not well managed. Deforestation, intensive cultivation without organic matter, excessive irrigation without drainage, dryland and rainfed farming without scientific land management practices have all undermined our wealth resources. With intensive farming systems since the dawn of democracy in 1975 A.D., spring water resources are also depleting. Reservoirs and other water-bodies have lost their capacity due to disturbance of natural drainage systems caused by rural road network construction and urban settlements. With enhanced use of fertilizers and pesticides from the dawn of democracy due to intensive cultivation of crop till 2002, the quantity and quality of land, water, biodiversity have tremendously affected.

Fertilizers have been found to contain lead, cadmium and radium 226, a fact, which was not recognized hitherto (Urea contains 5 ppm lead and 1 ppm cadmium; DAP contains 188 ppm lead and 109 ppm cadmium; Super Phosphate contains 609 ppm lead and 187 ppm cadmium). Some of the common pesticides are highly toxic and affect our food chain (Malathion – Toxic >40 times on breaking down; Aldrin, Dieldrin, Lindane, BHC, HCH, DDT, 2, 4-D persistent in food chain). Persistent organic pollutants are deadly poisons. Residual effects of pesticides are high in fruits and vegetables. Potable water for drinking, soil fertility, environment and human health ' would be severely affected. Our market survey indicates that the fruits and vegetables are highly contaminated with pesticides. Spinach, cauliflower, *bhindi* and brinjal are with pesticides and heavy metals chromium (0.97 mg/l) and cadmium (0.02 mg/l). The consequences of continuous use of fertilizers and pesticides over a prolonged period revealed that: 70% of leached NO<sub>3</sub> and agrochemicals reach water bodies; soil fertility build up is neglected; imbalance in use of nutrients; micro-nutrient deficiencies increase; toxins build up in soils; and pesticides cause decline in pollination, due to mortality of pollinators; etc.

# **Basic Information on Organic Farming**

#### 1.0 Definition :

Organic farming is first and foremost an approach to agriculturehorticulture-sylviculture system where the aim is to create integrated, humane, environmentally and economically sustainable production systems, which promote soil, plant, animal and environmental health and well being. It is also defined as a policy seeking to promote technically sound, economically viable, environmentally nondegrading, and socially acceptable use of natural resources – land, water and genetic endowment to promote sustainable development of agriculture. It is a production process of organic food products under the legally enforceable standards and is subject to tight controls on inputs and an increasing number of consumers for high standards of assurance about production methods.

#### 2.0 Why Organic Farming?

"Organic Farming" is essential - to restore our natural resources, to safeguard our environment and to obtain pesticideresidue-free vegetables, fruits, spices and other food commodities. "Organic Farming" is now regarded as the best solution. Organic or Ecological Farming has been observed to be feasible in the long run in terms of soil fertility, stability of crop yields and economy. Though labour expenses are high in organic farming the input costs especially from external sources are minimal, thus effecting good returns. This is in spite of lower yields by about 10 per cent in the initial years of "Conversion" in the organic farms or orchards. Production of fruits (47 mt), vegetables (81 mt), cashew (0.43 mt), arecanut (0.3 mt) and other horticultural crops on about 7 per cent of total cultivated area under all crops consumed around 24 per cent of the pesticides used in the country (2002). Even if 40 to 50 per cent of the area under these crops in the country is raised organically, they can redress the ecological disaster to a great extent. Besides, they fetch a high premium of 20 to 30 per cent for vegetables and sometimes 100 to 200 per cent for fruits. Export of organically produced fruits and vegetables can be promoted. From this country's scenario, the ecological disaster and the future fate of biodiversity hotspot - Sikkim could be imagined.

#### 3.0 Concerns and urgency to adopt Organic Farming:

Major concerns to be examined if we do not switch over to organic farming are:

- i. Fertilizer consumption will raise to 30 m tonnes by 2025 A.D. from the current level of 15 m tonnes;
- ii. The demand for pesticides would double from the current 0.8 lakh tonnes;
- iii. Draining the exchequer goes unabated for buying fertilizers and chemicals and if subsidies are not cut down;
- iv. Even with the increase in the use of fertilizers and chemicals, the rate of food production may not increase;

- v. Safe food and residue-free vegetables and fruits would not be available;
- vi. Other sad and catastrophic effects that follow would undermine our resources and lead us to permanent sickness and even to our death knells!
- vii. Leached nitrates, phosphates and agro-chemicals reach water bodies making them unfit for drinking. While 45 mg NO<sub>3</sub>/litre is the upper limit for portability, many of our wells and other water sources exceed this limit. Oxygen is depleted. Accumulation of NO<sub>2</sub> in the human bladder can lead to cancer;
- viii. Pesticide-residues observed in our vegetables and fruits, in many instances have reached 10 to 120 ppm.
- ix. Even breast milk has become unsafe as presence of DDT is detected in breast milk;
- x. Food chain is affected leading to eco system imbalance and atrophies in man and animals;
- xi. Continuous threat to Bio-diversity of flora and fauna, exists with intensive chemical-agri-horti-sylviculture systems; and
- xii. Sikkim has an amazing natural environment, with a rich variety of fauna and flora within a very small geographical area. Indeed such is the variety, that the area is termed as a biodiversity "hotspot" – one of only two in India (and thirty four worldwide). Although Sikkim comprises only 0.2% of the land area of India, it contains an astounding 26% of the nation's biodiversity (including 4,500 species of flowering plants, 550 species of birds and more than 600 species of butterflies). Unless Organic Farming is adopted there is a continuous threat to the State's Biodiversity of flora and fauna with the intensive chemical-agrihorti-sylviculture system in the biodiversity "hotspot" of Sikkim.

#### 4.0 Advantages and disadvantages of Organic Farming:

#### 4.1 Advantages:

- Envisages developing and maintaining an ecological system where nature solves problems with proper management, thereby offering clear benefits to the environment.
- Does help in conserving natural resources and in improving biodiversity;
- Energy use in organic farming systems is lower than that in conventional farming systems;
- Contributes to reduction of carbon dioxide emissions and pollution;
- Have been found to conserve or promote soil fertility and structure more effectively than conventional counterparts. Soils of organic farms have higher organic matter content in general;
- The manure management under organic farming systems advocates the use of organic fertilizers, manures, composts and legumes as part of rotations. The practice has demonstrated to minimize the rate of nitrate leaching per hectare from soil as compared to conventional farming systems;
- Prohibited from using herbicides, fungicides and pesticides, runoff and spray drift pose no problems;
- · Envisages containing biotic pressures on land;
- Some evidences show that cows have more lactations and longer life expectation;
- The restrictions that the standards impose on antibiotic use provide a stimulus for organic farms to adopt husbandry

methods that are health and welfare friendly;

- · / Produces social and economic benefits;
- Improve upon the prevalent mixed farming system by integrating farming systems in more scientific and sustainable manner to generate steady farm incomes;
- Involves the development of farming sector with maximum reliance placed on locally or farm derived renewable resources;
- The holistic approach implicit within the overall organic philosophy should foster humane and enlightened practices, satisfying both producer and consumer aspirations;
- Organic food products lend positive results with respect to food quality and health. Organic farming means precaution. It engulfs programmes to prevent the problem from happening, and not to treat the problem once it emerges.

#### 4.2 Disadvantages:

- No comprehensive research and requisite organic inputs available, not only in Sikkim but in whole of the country;
- In the absence of localized research information and support, it would be very difficult to convince farmers to adopt organic farming;
- No prescribed national organic standards so far for organic food production;
- No accreditation and certification procedures have been framed till to date in the country;
- Organic food markets are yet to be developed;
- Lack of infrastructures for production of organic seeds, organic

fertilizers, bio-fertilizers, manures, bio-pesticides and beneficial micro-organisms;

- Lack of trained manpower for organic food production;
- Lack of well-equipped and scientifically manned quality control laboratory;
- Lack of organic animal feeds;
- Lack of co-operative marketing for organic foods;

# 5.0 Initial Difficulties in switching over to Organic Farming:

Organic Farming to be adopted on a large scale offers its share of difficulties in finding alternatives to fertilizers and plant protection chemical pesticides which the agriculturists are so accustomed hitherto. Package of practices to be adopted for the crops in question are not readily available for organic farming. Inputs for organic farming especially for disease and pest management involve labour intensive practices. This indigenous traditional knowledge needs to be explored. Considering the nature of hazards that these chemicals land us in leading to upheavals in health and harmony of nature, we have to shun these chemicals right now. In Sikkim, the people are very rich in indigenous knowledge systems whether it is for indigenous food resources management systems or bio-diversity protection systems. Otherwise also, the state has started using these chemical fertilizers and pesticides since 1975-76 onwards only and their consumption is also to a limited extent.

Safe use through Integrated Nutrition Management (INM) and Integrated Pest Management (IPM) is not tenable and acceptable if "Organic Standards" have to be adhered to. The very manufacture of these deadly poisons is not safe to biosphere and human welfare either for now or for future. Let our people and generations to come breathe healthy air, savour unpolluted fruits, vegetables and enjoy nature. Towards this end, let us strive to pool all our Indigenous Knowledge on safe agricultural practices and evolve new organic farming technologies.

In order to switch over to organic farming, a conversion period of 4 to 5 years is required. Principles of organic farming have to be studied; difficulties in securing or finding out indigenous knowledge systems for all organic alternative inputs; and adopting them in the area specific agri-horti-sylviculture system practices to evolve a new organic farming technologies have to be learnt and sorted out.

- i. Biomass production has to be enhanced. If bountiful crops have to be obtained the plants have to have a good structure and growth. This is achieved if soil fertility is built up and maintained. Incorporation of plant biomass in the form of green manures, green leaf manures and crop residues would build the organic matter in the soil. Organics in the form of animal wastes and bye products like cow dung, urine, biogas slurry, blood meal, bone meal, fish and fish products etc. have to be from organic origin only. Crop residues should be utilized well to make compost along with FYM and biogas slurry. The quality of FYM is poor and direct application of poultry manure is not safe. Therefore, composting with green available biomass from trees, leaf litter, crop residues, biogas slurry, FYM, poultry manure and cow urine can improve nutrient contents by four to five-folds compared to use of mere FYM;
- Legumes should be incorporated wherever feasible. Even 35 to 50 days growth of green manure in the basin of a tree can enrich nitrogen. Green leaf manure and slashed weeds be used for mulching to reduce soil erosion;
- Pests and diseases have to be controlled by a combination of intercrops, rotations, mechanical cultivation, use of botanical

- and biological pest control methods and other general practices depending on the situations and crops;
- iv. Shade and support trees be legumes, green manuring or trap crops; Solarised soil inoculated with VAM and *Trichoderma* is useful in nurseries; Bioagent *Trichoderma* can be used for seed treatment, potting mixtures and main field; Plant based insecticides like *neem* can be suitably but restrictedly used as decoction, oil, cake, leaf decoction and seed kernel extract. Nicotine decoction or nicotine sulphates, *annona*, *Lantana camera*, *occium*, garlic, chilli powder, pyrethrum, *Salli-bisalli*, *Piresotar*, etc. are identified as other useful plant extracts;
  - v. Genetically Modified crops or organisms are not permitted in organic farming. Long term effects are not known when an organism is introduced intentionally into a crop.

# 6. Organic Standards and Certification:

Currently, there is a great demand for food, fruits, vegetables and spices produced and processed without the use of any fertilizers, herbicides, pesticides and other chemicals. However, what is the guarantee that such food items are available in the market nearby? And how can you trust that whatever you buy from the organic market is really safe, produced under all precautions to exclude all chemical-inputs and practices? Therefore, the quality of inputs as well as the produce in our whole Agri-Horti-Sylvi Systems should be subjected to critical examination, supervision and adequate tests so as to ascertain that these are genuinely produced and processed organically. This calls for fixing "organic Standards" and a certification processed to be initiated to delineate organic farms and the produced obtained there-of. This is essential not only for internal market and home consumption but also from the point of food getting into world trade as organically produced grain, meat, dairy-products, eggs, fruits, vegetables, spices, etc. Organic produce fetches a premium price. Thus organic produce for internal consumption and for commercial exportable market surplus needs to confirm to Organic Standards and these require proper "Certification" and "Labeling".

#### 7.0 Regulated world trade in organic products:

World Trade in organic agricultural products has been regulated by law mainly through organizations listed.

- i. The US Organic Food Production Act, 1990. Rules are framed by NOSB (The National Organic Standards Board).
- ii. EEC-Regulations on "Organic Agriculture, 1991 (2092/91).
- iii. The Basic Rules of IFOAM (The International Federation of Organic Movements) with Headquarters at Thaley in Germany has framed rules for organic agriculture.
- iv. The "Codex Alimentarius" of the FAO (Food and Agriculture Organization). These guidelines are parallel to the EEC Regulation and guide the Law-makers.

#### 7.1 IFOAM-INDIA Standards:

In India, IFOAM-INDIA has framed "Concepts, Principles and Basic Standards of Organic Agriculture", (1996) based on IFOAM BASIC STANDARDS..

#### 8.0 Certification:

Inspections at all stages of production and marketing by recognized certifying agencies with regard to all organic inputs and produce in accordance with the basic standards would enable for securing certification of any organically raised produce. The farmer who wishes to get his produce certified has to first get his farm converted and this period may be 4 to 5 years. Till this period, his produce is not from "Organic agricultural Product", but can be sold with such labeling. Records of conversion period and thereafter on inputs, crop yields, their use and marketing have to be maintained. The biological potential of the soil has to be upgraded through green manure, cultivation of legumes, incorporation of organic material and compost preferably produced within the farm. Pests and diseases have to be controlled by a combination of measures such as rotation, choice of species and varieties, mechanical cultivation, encouraging natural enemies of pests etc. Inspection and certification are essential in five areas:

- i. Crop production;
- ii. Animal husbandry;
- iii. Storage and transportation;
- iv. Processing and packaging; and
- v. Labeling and consumer information.

At the beginning, the producer and the inspection body should draw up full details of areas earmarked for organic cultivation and all other production details followed by storage, processing, transportation and marketing arrangements. Documentation or written documents be kept for inspection for two to three scheduled visits and one unannounced inspection. List of permitted materials of organic and mineral origin have to be studied before using them. Most organic forms such as FYM, Poultry manure, slurry straw, plant residues etc., should be composted well before use. Basic slag, natural rock phosphate, limestone, chalk, gypsum, clay etc. may be used but needs to be generally approved for limited use as per needs by the inspection body. Plant diseases and pests heave to be controlled through approved preparations of plant extracts and to a limited extent through sulphur, bordeax mixture etc.

#### **Certification Ascertains that:**

- i. Biological potential of soil is upgraded with Green Manure crops, Legumes, composts. Only permitted organic and mineral inputs are used. FYM, poultry manure, slurry, straw etc. are composted.
- ii. Gypsum, Rock Phosphate, Lime are restrictedly used with approval;
- iii. Pests and diseases are controlled by choice of rotation, mechanical cultivation and bio-controls; and
- iv. Approval preparations only are used.