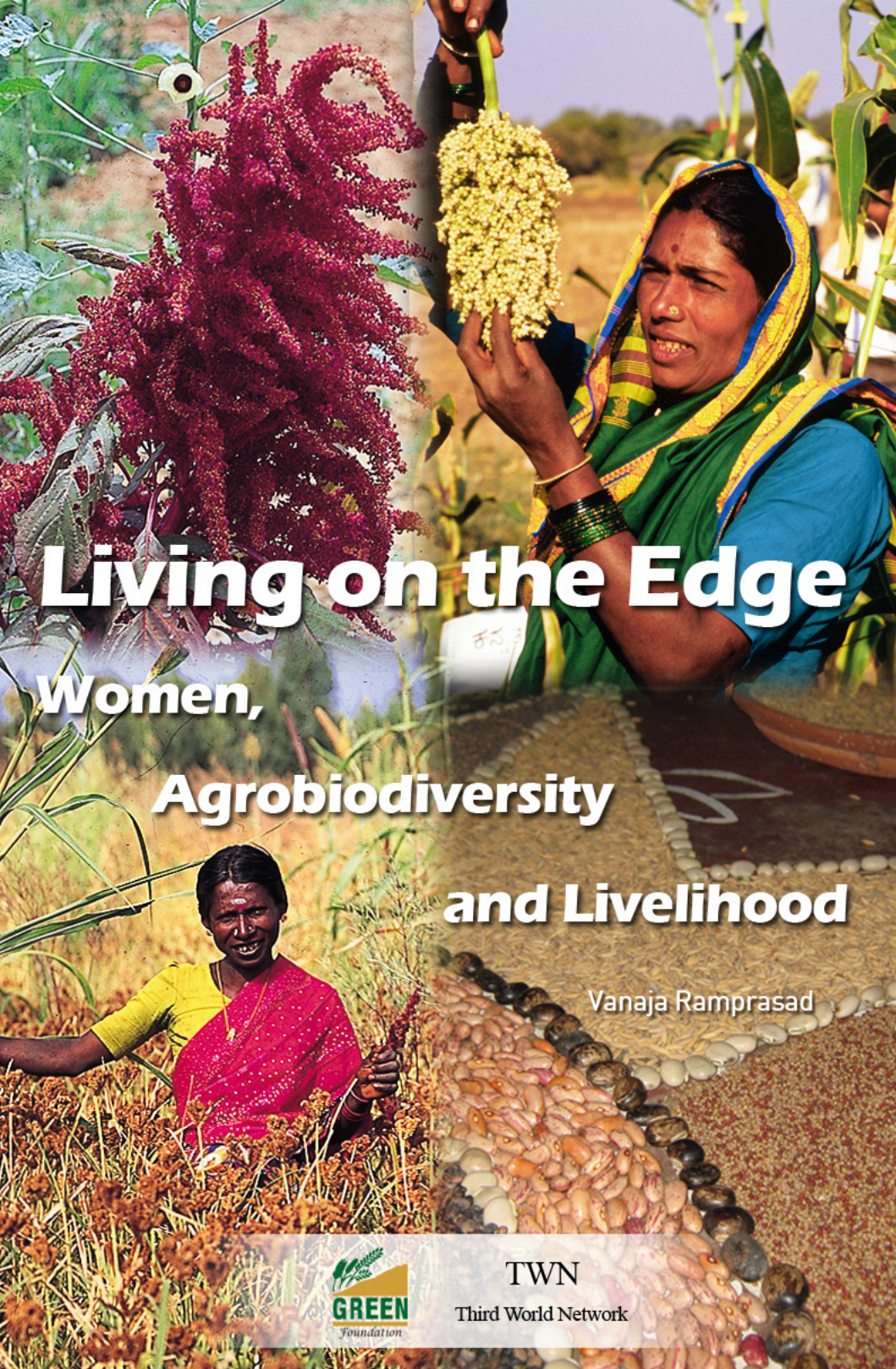

Living on the Edge
Women,
Agrobiodiversity
and Livelihood
Vanaja Ramprasad
GREEN
Foundation
TWN
Third World Network

# About the author

Vanaja Ramprasad was born in a village in Tamil Nadu state in South India in a humble setting bordering the forest; her name means “born in the forest”. She was educated in an atmosphere of idealism and commitment to serving humanity. With a background in the science of human nutrition and biochemistry and later in health management, she found her way to working with the rural poor and undernourished children.

Inspired by the revolutionary thinkers, Vanaja sought answers as to what lay behind a situation of poverty amidst plenty. It was her work among poor agrarian communities which eventually led her to the doorstep of women who saved seeds. Together with five of these women farmers, she started her journey in saving seeds as a counter-response to corporate control over the basic unit of food production. Her 20-odd years of work with marginalized farmers contributed to the establishment of a seed network among farmers in the dry land regions of Karnataka in South India, and to restoring agricultural biodiversity in these areas.

Vanaja has served on the World Board of the International Federation of Organic Agriculture Movements (IFOAM). She was also one of the lead authors in the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD). Vanaja is the founding trustee of GREEN Foundation, an organization that has worked in different agro-ecological regions of Karnataka.

# LIVING ON THE EDGE

Women, Agrobiodiversity and Livelihood

Vanaja Ramprasad

GREEN Foundation

TWN
Third World Network

First published February 2015

Edited by: Bharathi Ganashyam
www.aequum.in
Design by: Cheluvaraj HR



ISBN: 978-967-0747-08-8 (TWN)

**This book is dedicated to the seed collectors, small and marginal farmers around the world**

To be of the earth is to know

The restlessness of being a seed

The darkness of being planted

The struggle towards light

The pain of growth into light

The joy of bursting and bearing fruit

The love of being food for someone

The scattering of your seeds

The decay of the seasons

The mystery of death

The miracle of birth

John Soos

# Contents

# Foreword

Are voices of concern and interest backed up by commitment and action? Rarely. However, Vanaja Ramprasad's work with and for GREEN Foundation and on issues related to sustainable agriculture is one such rare case. Over the past 25 years she has diligently and persistently worked to promote sustainable agricultural practices and to highlight the multiple challenges confronting small agriculturists and the potential they represent. As detailed in this summative study by her, the sovereignty of agriculturists, their rights to seeds, land and resources, the need to recognize multiple and localized agricultural practices, and to scaffold new forms of production and distribution are issues that are of national and international importance. Even as varied forms of agriculture are being absorbed into the global capitalist apparatus, there is an urgent need to address the loss of agricultural biodiversity, the knowledge and skills of agriculturists, and the centrality of food as a part of people's cultural diversity. Vanaja's efforts in this regard have been exemplary and she represents the voice of civil society organizations that are attempting to stall the gargantuan machinery of capitalization and commercialization of all agriculture. In a context where the representation of agriculturists in policy-making, trade negotiations, and agricultural programmes is bypassed, Vanaja has sought to assert the visibility and legitimacy of the small agriculturist. She has paid special attention to marginalized women agriculturists who in reality are the mainstay of India's agriculture. Drawing on the work of GREEN Foundation, of which she is the founder, she highlights the rich diversity of seeds, production practices, and conservation efforts that are underway. In tracing the trajectories of problems faced, Vanaja calls attention to the need for new organizational efforts where agriculture must be seen as an interlinked process and

where new imaginaries are required to make the interlinkages between ownership-production-distribution and consumption.

Although Vanaja's work has concentrated on South India, the lessons she chalks out and the issues she raises have international validity. How can small agriculturists survive in the face of their increasing marginalization and the spread of the hegemonic capital-technology and external input-based agriculture? How can unfair trade practices which devalue the plant genetic resources of the Global South, but which capitalize the technology and patent regimes of the Global North be challenged? How can trends such as the growing feminization of agriculture and the absence of political clout of agriculturists be addressed? How can global climate change be factored into varied practices so that agricultural production is not stalled? These are issues that need to be addressed at multiple levels and by various sectors. Contradictory trends such as the burgeoning urban food markets, including the diversity of foods available to the elite, and the promotion of grains such as quinoa or chia as 'super foods' are obfuscating the need for all people to have access to a diversity of foods that are nutritious, safe and affordable. The growing financialization of land and the attendant land speculation have rendered much of the land into a real estate grid and the need to safeguard land for agricultural and local food requirements is often overlooked. All these trends are challenges that require us to think out of the box and seek solutions that are grounded in the everyday world of marginal cultivators. Vanaja's effort in this monograph is one such undertaking and we must all heed the warnings and the potential that she flags.

**A.R. Vasavi**
Bangalore
February 2015

# Preface

**“The greatest obstacle to discovery is not ignorance-it is the illusion of knowledge.”**

**- Daniel J. Boorstin**

The United Nations declared 2014 the International Year of Family Farming (IYFF) to highlight the importance of family and smallholder farmers. This is an initiative that could not have happened at a better or more opportune time. The global food crisis has provoked furious debates across the world, and instances of widespread hunger make the news with despairing regularity almost every day. This begs a question. Have we stopped to think where the root causes lie?

Ironically, they lie in the unbridled efforts to increase food production. The chemical and seed industries which are allied together in this effort are embedded in modern agriculture that is capital- and technology-intensive. It is this same capital- and technology-intensive agriculture which has created a plethora of economic, environmental and social problems. The dependence on fossil fuel for sustaining energy- intensive production of agrochemicals, which are severely polluting, portends an unsustainable future for food production.

The current food crisis has also been exacerbated by corporate monopoly over the supply chain in agriculture and corporate efforts to introduce newer technologies that are based on unsound scientific principles. While agrofuels are sought as an answer to carbon pollution and climate change, their production is directly in competition with food production.

It is also more than obvious that it is not the lack of food, but artificially driven high prices coupled with poverty and entitlement gaps which are the real issues. It is reported that prices of food have risen 83 percent since 2011 and today there

are 110 million more poor who are at risk of hunger. It is predicted that by 2025 there would be 1.2 billion who will go hungry (Runge and Senauer, 2007).

How could surplus production and malnutrition coexist? It was my quest to find an answer to this intriguing question which prompted my journey across India beginning from 1974. I was also inspired by the book *Where Our Food Comes From*, written by Gary Paul Nabhan where he retraces Nikolay Vavilov's "quest to end famine". In the foreword K.B. Wilson quotes Carlo Petrini, the founder of the Slow Food movement, who has said so eloquently that much of humanity no longer knows how to put their hands into the soil and instead specializes in curating with microwaves, long-dead objects found in their refrigerators.

I undertook several trips across India to interact with farmers. During my journeys across the different farm lands I saw the loss of diversity driven by economic interests. I quote further from Wilson's foreword where he says, "What drives this model of development is a cultural idea of 'modernization' in which the outside object is fetishized and local people are deemed ignorant or passively needing their share of the 'benefits of science'."

Nabhan pointedly brings out the fact that Vavilov's legacy is more than just the seeds he collected from around the world, for what he most valued were the seeds that remained in a peasant's field, adapting and changing, along with traditional knowledge of where, when and how to plant them.

It was this inspiring read which led to my understanding that agricultural biodiversity is the cornerstone for building greater food security for humankind. Without it our food systems will collapse, crippled by pestilence, droughts, floods, global warming and climate change, and the politically driven economic and environmental effects of neoliberalism and globalization.

I had the fortune of learning about seed saving from none other than the renowned geneticist Dr. Melaku Worede whose message was, "We should do more on-farm conservation through on-farm use of these crops. For this we have to identify the values that guided the selection of seeds by farmers. We have to understand farmers' logic, their traditional means of community-based seed saving and exchange."

The Seeds of Survival programme founded by Worede promoted a strategy of planting in one single field, a diverse admixture of several farmers' varieties with different physiological tolerances and other adaptive responses among them. In almost all lots where such admixtures have been tracked across several years, yields through time have been found to be higher and more stable than those of any single so-called high-yielding variety.

With this backdrop, if we take a stand that another agricultural transition is possible, what are our options? The pathway to a more sustainable system lies in protecting the valuable biodiversity that is the heritage of humanity. My interactions with small farmers, largely women, in the last 40 years – of which the last 20 years have been spent on intensive work with them – have resolved a nagging question in my mind of why farmers are living on the edge. My involvement with farmers has also given me an understanding of the economic, ecological, cultural, political, and gender aspects of how agrobiodiversity and livelihoods are interlinked. I have often felt as if I was piecing a jigsaw together.

This book is an attempt to showcase the whole jigsaw. Beginning with the historical evolution of India's agriculture and its roots, which go back to the Vedic times, we have traced agricultural practices and protocols as they existed at the time for soil and manure management.

What happened subsequently, particularly during the colonization of India, and later, during and after Independence? India's agricultural system in the early days of colonization, as documented by various British historians and scientists, was highly commended. The ecological soundness of agriculture in India and its cultural linkages during that period have been lauded by eminent writers and scientists like Albert Howard and John Augustus Voelcker and Indian historians like Dharam Pal.

However, this prosperity and ecological wisdom did not last. The advent of Independence saw us food-insecure and hopeless. These were the developments that laid the foundation, and gave birth to the Green Revolution, as elaborated in a section of this book.

The subsequent sections outline the decades that followed, which have witnessed the ascendancy of globalization and neoliberalism. These are the decades when India, with its growing population, became a burgeoning market for agribusiness and trade. This is also the period which saw the World Trade Organization (WTO) and the clauses of its Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) having an impact on the genetic resources of the countries of the Global South. The genetic resources of the South were the raw materials for biotechnology firms and corporations that opened the floodgates for genetically modified crops, with the message that these crops were imperative to feed the hungry millions. What is the truth?

The next section offers arguments that debunk the myth that the world can be fed with genetically modified foods. The examples of Golden Rice and Bt crops are cited. Later chapters highlight farmers' rights and the international response to initiate a *sui generis* system of laws and the national laws that are binding.

They also unravel the challenges faced in introducing farmer-based on-farm *in situ* conservation. In the process it is also seen how seeds that belonged to the farmers were sent into internal exile.

What is the transition we are looking for to ensure food sovereignty? Women have played a major role in sharing their knowledge of conserving plant genetic resources. Despite the narrow margins of hope, what are the challenges that we face in on-farm, *in situ* conservation? A section of the book expands on the transition needed in agriculture to save livelihoods and genetic resources.

The lessons learnt during the last decade and a half have raised some critical questions. How do we mainstream the role of diversity in feeding the world? What are the attempts at rehabilitating *ex situ* collections from the gene banks and how do we circumvent the poor germination encountered?

What is the impact of land use change in keeping diversity alive? What is the impact of national-level laws that deter efforts to revive the diversity on farmers' lands? How can on-farm conservation be sustainable and economically viable for

small farmers? How can we combine both technical and social aspects in the approach to conservation? These and many other important questions surfaced in the attempt to conserve diversity with farmer participation. The experiences in swimming against the current are shared in one section. The major role played by women in conserving agricultural biodiversity, selecting and saving seeds and providing food for their households is highlighted through on-field, real-life instances.

Where do we go from here? There have been attempts across the world to revive holistic ways of growing food. Agro-ecology is rooted in the synergy between ecosystem diversity and agriculture and rejects the limiting factor of production in a uni-modal system but establishes the fact that it is multifunctional.

Agro-ecology is the science to transition organic farming towards a truly sustainable and resilient form of agriculture. Presently organic farming is perceived as bound by cumbersome norms of third party certification, resulting in unaffordable products, available only in niche markets and more suited for export than local consumption. If the benefits of organic farming are to accrue to the environment, enable food security and conservation and alleviate poverty and hunger, the road we take has to be a clearly thought out one. It should enable organic farmers to produce food in environmentally sound and socially equitable ways without adopting a specialized industrial model of production and distribution.

According to Miguel Altieri (2012), a renowned ecologist, “the technological determinism that the organic movement emphasizes via development and dissemination of low input or environmentally appropriate technology is not only naïve but dangerous as it assumes these technologies in themselves have the capability of initiating beneficial social changes.”

If the movement is to be sustained, major policy changes in market opportunities and relevant research will be necessary. Governments and public organizations must encourage and support effective partnerships between universities, NGOs and farmers' organizations to mainstream and empower organic farming.

The vision of organic farming can be totally relegated to the background if organic production is primarily geared towards the consumption of the rich. The organic sector will gradually be taken over in the name of economies of scale by the same forces that dominate conventional agriculture. The solution lies not in increasing organic farming and production for the privileged, nor in transporting organic products to distant markets for generating profits for the few. Organic farming must be rooted in a complete change in vision to a new future for the next generation.

The democratization of our food system requires a change in the way we manage it. Of course the changes require a proper understanding of the issues and the degree of political will that emerges from social pressures and social movements for food sovereignty. Most often, however, the reality becomes murky when feeding the population is posed as the critical need. Different movements converging together and creating the necessary pressure is thus required today to realize the right to sustainable food systems and a transition in agriculture.

People are passionate about their food. We have strong ties to our traditions and food plays an important role in this relationship with our culture. Where does food ultimately come from? Definitely not from the supermarkets. Diversity in agriculture is what gives us the luxury of varied foods. We have inherited this diversity in food from agricultural and horticultural

# Food and Diversity

***Millets are a popular staple crop prevalent in the dryland tracts of South India and are highly nutritious, drought resistant and capable of cultivation in poor soils. In the recent past they were neglected in favour of other crops and became stigmatized as a poor mans crop. GREEN Foundation has been working to reintroduce and popularise the traditional grains to strengthen food security. There are seven botanically distinct millets, many different species and even more varieties with farmer given names.***

*Finger millet (Eleusine coracana) popularly known as Ragi , originated from Africa but introduced to India more than 3,000 years ago. The only millet in India which has been able to touch an average productivity level of more than 1 tonne per acre. Ragi is nutritious and staple food crop of many regions in India.*

*Sorghum (Sorghum bicolor) was domesticated in Ethiopia about 5000 years ago and brought to India around 1000 years BC. It is an important crop for various reasons-the ability of the crop to withstand drought, adjust to various soil conditions, comparative quick growth and good yields of not just grain but large quantities of fodder.*

*The recent past has seen the neglect of these in favour of other crops and became stigmatized as a poor man's crop. There are different distinct millets like little millet (Panicum sumatrense), pearl millet (Pannisetum typhoides), barnyard millet (Echinochloa colona), proso millet (Panicum miliaceum) kodo millet (Paspalum scrobiculatum).*

*Foxtail millet (Setaria italica) is popularly called as 'navane' in the vernacular. Foxtail millet is an ancient crop domesticated in Eastern Asia, mainly confined in India to the lower Deccan Plateau. Three to four decades ago, foxtail millet was consumed as the staple food. The straw yield may be 1000-2000 kg per hectare.*

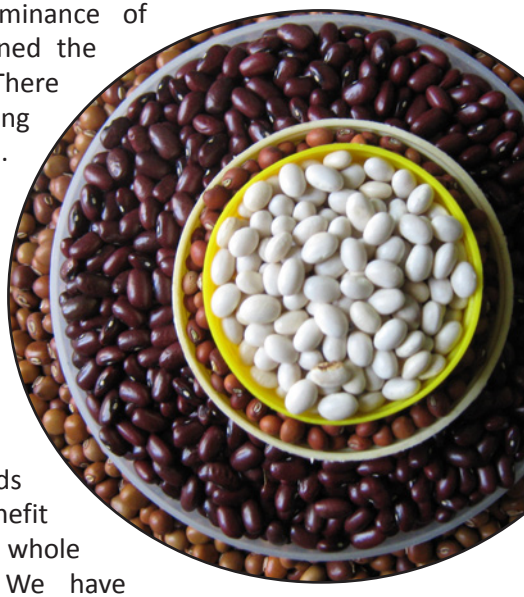
**GREEN Foundation**

570/1, 'Padmashree Nilaya', 3rd Main, 4th Cross, N.S. Palya, BTM II Stage, Bangalore - 560 076, Karnataka State, INDIA
Tel: +91-080-2678 4509 Fax: +91-080-2659 1729 E-mail: greenfound@vsnl.net, Web: www.greenconserve.com

crops that have been maintained over the centuries. Unless we continue to safeguard this diversity and pass it on to our next generation we will be disconnected from our cultural heritage. The way the principles of agro-ecology are put into practice in promoting organic cultivation is also presented in the book.

We have to facilitate advocacy of organic farming which promotes an agricultural system that is local, small-scale, family-operated, and biologically and culturally diverse. This system has to also be humane, socially just and accessible to the poor.

In the last century, in the name of development, we have undervalued nature and subjugated ourselves to empty promises. The dominance of global capitalism has undermined the livelihoods of small farmers. There is a growing middle class veering towards unbridled consumerism. In the last decade we have witnessed how high agricultural subsidies in the North to the tune of $400 billion combined with forced removal of import restrictions in the South are a readymade recipe for farmer suicides.



We should move towards a world that functions for the benefit of all life, and towards a unified whole and interconnected system. We have responsibilities as co-creators of the future in cooperation with the laws of the universe. Therefore we need to set aside narrow self-interest and cooperate with other cultures, races, nations and religions for the wellbeing of all life.

We have a choice of either taking the unnecessary, unwanted and hazardous path offered by self-styled engineers of life or following our own deep traditions and values to choose abundant, safe and healthy food for our children, families, our communities and our nation.

We have to realize that local prosperity is based on the welfare of the small and marginal farmers. In light of this, GREEN Foundation is a people's movement to safeguard diversity in agriculture and food. We have in the last 15 years focused on this aspect by working with the small and marginal farmers who eke out a living in the fragile ecosystems of the semi-arid tracts. It is also true that it is the subsistence farmers in the dry lands who are the custodians of the diversity. Small farms, farmers and their diversity are disappearing fast, however, overwhelmed by the challenges that the above factors have thrown in their path.

It is also seen that this diversity which is at the heart of organic agriculture is being pushed into internal exile. If we are to resist the onslaught of monocultures and the push for genetically modified seeds in the name of increasing production, we will have to continue to work with the diversity of the dry land regions. The concept of productivity based on diversity has to be re-defined.

*Living on the Edge* will hopefully provide a way forward for this through the examples, arguments, compelling evidence and commitment highlighted in its pages.

This compilation of impressions on two decades of work with women small farmers, examining their role in conserving agricultural diversity and sustainable agriculture and studying the impact on their livelihoods, is the result of a long personal quest. This is not so much an academic exercise as a simple narrative. While every section in this book can stand alone as a document in its own right, I have at the same time taken a bird's-eye view of all the issues that impact women farmers' livelihood based on agrobiodiversity and not dealt with them in too fine detail.

- Vanaja Ramprasad

# The Beginning

**“The world has enough for everyone’s need, but not enough for everyone’s greed.”**

**- Mahatma Gandhi**

Food, along with air and water, constitutes the very foundation of life. These ‘life support systems’ spell the difference between existence and the absence of it, whether it be plant, animal or human. Food, as a source of sustenance, is also not something that can be produced or accessed independently of the other elements, i.e., water, air, soil, seed etc.

It would be stating the obvious to say that only a canvas painted with all these elements can sustain plant, animal and human life. Healthy interplay between these elements can ensure that life is sustained on planet Earth. This, however, is not easy to achieve as there are factors that constantly hamper this interplay – some natural and others man-made.

Food as a source of sustenance was not always produced as it is today. If one were

to look around, food and its sources always were and continue to be omnipresent. The animal kingdom accesses food from its own environment; humans have the means to make themselves food-sufficient just by drawing on what the earth has to offer;

*In Vedic texts (c. 3000-2500 BP) there are repeated references to agricultural technology and practices, including iron implements; the cultivation of cereals, vegetables, and fruits; the use of meat and milk and animal husbandry. Farmers ploughed the soil, broadcasted seeds, and used a certain sequence of cropping and fallowing. Cow dung provided fertilizer, and irrigation was practised. The Greek diplomat Megasthenes (c. 300 BC) in his book* ***Indika*** *(McCrindle, 1877) provides a secular eyewitness account of Indian agriculture:*

*"India has many huge mountains which abound in fruit-trees of every kind, and many vast plains of great fertility. . . . The greater part of the soil, moreover, was under irrigation, and consequently bears two crops in the course of the year. . . . In addition to cereals, there grows throughout India much millet . . . and much pulse of different sorts, and rice also, and what is called bosporum [Indian millet]. . . . Since there is a double rainfall [i.e., the two monsoons] in the course of each year . . . the inhabitants of India almost always gather in two harvests annually."*

*Land management was particularly strong during the regime of Akbar the Great (reign: 1556-1605), under whom scholar bureaucrat Todarmal formulated and implemented elaborate methods for agricultural management on a rational basis. Indian crops — such as cotton, sugar, and citric fruits — spread visibly throughout North Africa, Islamic Spain, and the Middle East.*

*Kautilya mentioned use of cow dung, animal bones, fishes and milk as manure (Nene, 2002). In the* ***Kural*** *(dated between the 3rd century and 1st century BC) by Thiruvalluvar, it is stated that manuring is more beneficial than ploughing. The* ***Agnipurana*** *(Shastri and Gangadharan,1986) recommends application of excreta of sheep and goat and pulverized barley and sesame allowed to be soaked in meat and water for seven nights to increase flowering and fruiting of trees. In Varahamihira's* ***Brahat Samhita*** *growing of sesame to flowering stage and then incorporating it as green manure is recommended. In* ***Vrikshayurveda*** *Surapala (c.1000 AD) describes the "ancient" practices of preparing liquid manure (kunapa) by boiling a mixture of animal excreta, bone marrow, flesh and dead fish in an iron pot and then adding to it sesame oil cake, honey, soaked black gram and a little ghee (clarified butter).*

even plants are food-sufficient. Notwithstanding this, food consumption has evolved a great deal. From a position of gathering or hunting for food, cultivation and breeding of animals for the purpose of food became known when humans became more settled and less nomadic.

## History of Indian agriculture – a bird's-eye view

In India, there are records of cultivation of food, i.e., agriculture, even as early as the Vedic times, and methods were prescribed for managing soil, seed, water, and practically every aspect associated with agriculture. This activity was associated with divinity; the elements were worshipped and food was celebrated and offered to the higher spirits before consumption. Food signified an intense universal energy and was worshipped as nature's gift. It was also synonymous with diversity, culture, culinary skills and healthy, happy people.

Centuries passed, and by the time India, the nation as we know it today, attained Independence after 200 years of colonization by the British, food and agriculture had undergone a sea change from what they were during the Vedic times.

Much has been written about the condition of, and change in, the lives of Indian farmers during the colonial regime.

Annex 1 describes the life of communities as recorded by the Chengalpattu Survey conducted by the British between 1767-74. The survey (Sundaram, 2006) clearly indicates that agriculture was alive and thriving, and comparable with the best anywhere in the world. It also establishes that no community in the region was threatened by lack of food security. While the data is restricted to one region, anecdotal evidence suggests that India was overall a prosperous region in the early days of British rule. The process of deterioration appears to have set in during colonization.

Through a succession of Acts and Laws that gave supremacy to landowners over cultivators, and indeed created owners where there were none, the position of the Indian farmer was rendered more and more tenuous and she was pushed into a vicious cycle of debt and poverty and became demotivated towards farming. Additionally, the discouragement of all other trades and occupations drove greater numbers into farming, thus creating an imbalance between the land available for farming and those engaged in it. Development and growth dipped to abysmal levels when India was part of the British Empire and the region went from prosperity to poverty (Annex 2).

Amartya Sen has commented (O'Malley, 2013), "The rate of economic growth was close to zero percent a year for about 200 years when India was part of the British Empire. Adam Smith

suggested in 1776 that India was one of the richest countries in the world. That quickly changed. Literacy rates in India when the British Empire ended in 1947 were abysmally low, something like 15 percent. In the British period famines occurred on a regular basis in India. The last famine in India was in 1943 – four years preceding independence."

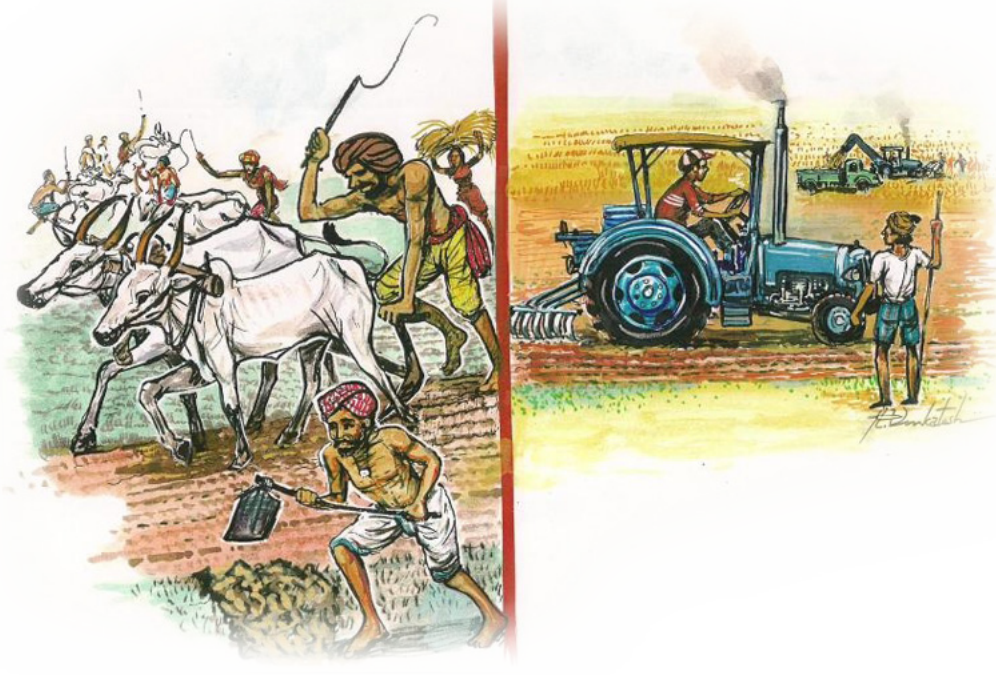
And yet, there are records to prove that this stagnation need not have occurred. In an inquiry conducted by Dr. John Augustus Voelcker, Consulting Chemist to the Royal Agricultural Society of England, during 1889-91, he was asked to make recommendations (Voelcker, 1893) for the improvement of Indian agriculture.

He observed that, "… On one point there can be no question, viz., that the ideas generally entertained in England, and often given expression to even in India, that Indian agriculture is, as a whole, primitive and backward, and that little has been done to try and remedy it, are altogether erroneous… the conviction has forced itself upon me that, taking everything together, and more especially considering the conditions under which Indian crops are grown, they are wonderfully good. At his best the Indian *raiyat* or cultivator is quite as good as, and, in some respects, the superior of, the average British farmer, while at his worst it can only be said that this state is brought about largely by an absence of facilities for improvement which is probably unequalled in any other country, and that *raiyat* will struggle on patiently and uncomplainingly in the face of difficulties in a way that no one else would…"

His report also recommended that "… it isn't the introduction of Western practices that will help progress the state of Indian agriculture but the transference of the indigenous methods from one part of the country to another…" (see Annex 3 for more excerpts). This recommendation, however, seems to have stayed within the confines of the report.

## Independent India and the Green Revolution

Independent India began its existence with a multitude of problems, of which food insecurity was probably the most severe. Food stocks were perilously low, and two million people, including



children, had died of hunger just prior to Independence in the Bengal famine. The country had seen a very bloody partition; people were reeling from homelessness and hopelessness and the situation seemed irretrievable. According to the Food and Agriculture Organization (FAO) of the UN (Nawani, 1994), "…Partition of the country in 1947 left India with 82 percent of the total population of undivided India but only 75 percent of the cereal production. The surplus province of Punjab was partitioned and West Punjab, which had a well-established network of irrigation canals, went to Pakistan. Sind province, which too was a surplus province, also went to Pakistan. These two provinces together used to supply about one million tons of food grains to other provinces in undivided India. At the time of independence, thus, the new nation India started its tryst with destiny with lots of handicaps as far as food security was concerned…".

Agriculture under the British regime had seen almost no growth, and had stagnated. The situation was grave enough for Pandit Jawaharlal Nehru, independent India's first Prime Minister, to remark, "Everything else can wait but not agricultural self-sufficiency." In line with this priority, the 1960s saw the advent of the Green Revolution. M.S. Swaminathan, popularly called the Father of the Green Revolution in India, says (Raghunathan

and Viswanthan, 2013), "…there was once a ship-to-mouth food situation in India. Such was the intensity of the food shortage that large quantities of wheat had to be imported and sent immediately for consumption…"

The Green Revolution is credited with having made India food-sufficient. According to an FAO (1996) report titled "Towards a New Green Revolution", "…beginning in the 1960s, improved, high-yielding varieties of wheat spread quickly across Asia, soon followed by new strains of rice. Within 20 years, almost half the wheat and rice land in developing countries was being sown with the new varieties. In Asia, where the impact of the Green Revolution was greatest, almost 90 percent of wheat fields were planted with modern varieties and plantings of high-yielding rice had increased from 12 to 67 percent.

"In order to reap the potential of the new seeds, farmers also rapidly increased their use of mineral fertilizers, pesticides and irrigation. Between 1970 and 1990, fertilizer applications in developing countries shot up by 360 percent while pesticide use increased by 7 to 8 percent per year. The amount of land under irrigation increased by one-third. The gains in production were dramatic: world cereal yields jumped from 1.4 tonnes per hectare in the early 1960s to 2.7 tonnes per hectare in 1989-91. Over the past 30 years, the volume of world agricultural production has doubled and world agricultural trade has increased threefold. These rapid gains helped avert a major food crisis in Asia and provided the springboard for rapid economic growth in China, Southeast Asia and South Asia…"

## A heavy price has been paid

The Green Revolution's contribution towards mitigating hunger at a time when the country's food security was threatened, is uncontested. In the process, however, India, and indeed the whole world, can be said to have paid a price heavier than the gains it achieved.

The above-quoted FAO report endorses this. "…The green revolution of the 1960s and 1970s depended on applications of fertilizers, pesticides and irrigation to create conditions in which high-yielding modern varieties could thrive... But it also taught

scientists and policy-makers some important lessons for the future.

"Reliance on seeds that have to be bought rather than saved from year to year and that require expensive inputs may exclude many poor farmers from the benefits of a green revolution. In many areas, water is being pumped out of the ground for irrigation faster than it can be replenished. Up to 60 percent of the water withdrawn for irrigation may never reach the crop. Poorly managed irrigation causes waterlogging and salt buildup that can turn fertile fields into a wasteland... Widespread use of just a few high-yielding varieties of wheat and rice may lead to the loss of traditional varieties and increase vulnerability to pests and diseases. By the end of this century, as few as 12 varieties of rice may cover 75 percent of the fields in India.

"The environmental damage caused by misuse of fertilizers and pesticides sometimes outweighs their advantages. Experts estimate that only about half of the fertilizer used may actually benefit the crops; the remainder is lost from the soil by leaching, run-off and volatilization. Similarly, a large percentage of pesticides may not reach target pests. Instead, they contaminate people, land, water and air, and foster the emergence of resistant strains of pests."

The following section deliberates on the aftermath of the Green Revolution and the advent of neoliberalism.

# The Green Revolution and After: The Advent of Neoliberalism and Globalization

## The current context

As outlined in the last chapter, while the Green Revolution ushered in a situation of perceived food security, inequities continue to challenge the poor and the marginalized. In place of the plentitude of food and over-arching prosperity that was envisaged, the opposite has happened. The market economy holds sway over agriculture and food availability, pushing farmers into exile from their land, putting food out of the reach of multitudes of the world's poor and generating a raft of ruinous effects, of which hunger is probably the most challenging.

Technological developments also introduced other, more threatening dimensions into the production, distribution and consumption of food. This included global politics of control over food in all its domains, which has resulted in the undermining of indigenous knowledge. There is not one, but several threats that are facing food production itself. It is but inevitable that in such situations, the lives of food producers, i.e., farmers, particularly small and marginal farmers, have become severely vulnerable. The more obvious threats to their livelihood and food security are reduced opportunities to work at their primary occupation, farming. A combination of factors are responsible for this, chief among them being:

- Reduced fertility levels in soil which lead to input- and resource-intensive farming, which small farmers cannot afford
- Conversion to monocropping and cash crops over food crops, leading to indebtedness and lack of food security

» Loss of land for cultivation owing to rapid urbanization

» Reduced motivation among farmers to remain in farming, due to social welfare programmes that encourage trades and occupations other than farming.

## Larger threats, greater implications

Threats which are not so obvious, and yet are equally or more damaging to the lives of small farmers, are gaining a foothold across the world. Neoliberalism is firmly entrenching itself in the arena of food and its production.

A book titled *Hungry Corporations: Transnational Biotech Companies Colonise the Food Chain* (Paul and Steinbrecher, 2003) says, "…Neoliberalism generally involves a belief in unfettered market forces, promoting freedom of movement for capital, goods and services, and the removal of government controls over private enterprise…"

This situation begs the question: If neoliberalism is touted to be the deliverer of progress, why is there food insecurity in the world? Why do inequities exist?

The same book provides answers. "…[Neoliberalism] breaks links to particular localities and seeks to remove regulation because this distorts markets. It dismantles community networks of care for the weakest members of society, believing they should be replaced by individual responsibility... The emergence of biotechnology and genetic engineering cannot be divorced from this context of neoliberal globalization.... As has been pointed out by many researchers, food production and consumption were local until market economies emerged, which in turn drove the growth of global food trade. In order to pay back their debt, countries are still being encouraged to switch from agricultural production for their own local and national needs to the export of cash crops. This is leading to local and national food insecurity, with countries being urged to continue to export food, even when threatened by national shortages (Ireland and Ethiopia during famines, and Malawi in 2002–3)..."

There are efforts to manipulate food from its very genetic makeup and treat it as a commodity to be traded across borders.

Food is increasingly being seen as another weapon to strengthen the arsenal of globalized controls. Neoliberalism has also resulted in insidious but increasing controls over natural resources like land, water and biological wealth by giant corporations.

Neoliberal policies, which were seen as a panacea to the world's problems of hunger, poverty etc., have actually resulted in the opposite. While people at the bottom of the pyramid slide lower on all social indices, the upper half has continued to grow and prosper. A publication by Pesticide Action Network Asia and the Pacific (Watts, 2010) points out the stark inequities that face the world today: "…100 million more people faced hunger in 2008, and 37 developing countries were in urgent need of food,

> "... When a farmer stores and sows biotech seeds patented by Monsanto, he should understand that he is in the wrong. This holds true even if he has not signed any contract at the time of procuring seeds (that is, if he recycles or if he buys seeds illegally from a neighbour). He is pirating ... Moreover, this pirating of seeds could cost the farmer hundreds of dollars per acre by way of damages, interest and legal costs, apart from having to undergo the inspection of his fields and records over many years." (de la Perriere and Seuret, 2000)

whilst Monsanto's net income doubled, the net income of Cargill — the world's biggest grain trader — soared by 86 percent, and Archer Daniels Midland — one of the world's largest processors of soy, corn and wheat — increased its earnings by 42 percent…"

## The impact of neoliberalism on agriculture and food security in India

The shifts in policies and global efforts to encourage free markets have hit farmers in myriad ways. The small farmer who engages in subsistence farming is inevitably the most threatened. The primary threat is probably the impact on the seed security of small farmers and their rights to cultivate their lands in the ways most appropriate for them. It is here that the conflicts become most evident.

Farming across the world (for the purpose of this document, more specifically in India) can be clearly classified into two types.

Technology- and input-intensive farming, which is heavily dependent on proprietary seeds, chemical fertilizers and pesticides, and patented technologies, makes up one system. This system is heavily regulated and calls for large cash investments in seeds and other inputs, something that small farmers are not equipped for. Pursuing this system of farming has decimated the livelihoods of a huge number of farmers in India and the farmer suicide figures in the country are evidence of this.

The other system, more commonly known as traditional farming, is one which thrives on local knowledge and holistic systems, and which has been the way of life for farmers for centuries. No less scientific, it adopts multiple cropping systems, uses cost-effective farm-saved seeds, and is less dependent on chemical inputs.

Seed saving is common in this form of agriculture and whole communities, particularly women, come together to save and exchange seeds and farming technologies. The majority of the world's small farmers depend on this system to enable food security for themselves, and to stay seed-secure.

Traditional agriculture, however, does not find favour with governments. Large corporations have the ability to influence governments and policies, and this results in traditional systems getting sidelined and patronage being extended to branded seeds and chemical pesticides and fertilizers as governments bow to corporate interests. The renowned Indian journalist P. Sainath endorses this view: "One of the dangers that neo-liberalism brought to our country is the shift in food crops to cash crops,

which has resulted in greater domination of corporate houses on agriculture."

The farming community, directly in conflict with what its traditional practices demand, is increasingly having to contend with complicated links that governments forge with agro-chemical companies, seed companies, veterinary drug manufacturers, banks, food processors, retailers, packers and other stakeholders in the food production and distribution chain. Each link in the chain is being increasingly controlled by giant corporations. The biggest tragedy probably is that in the forging of these links and setting of priorities, farmers have not been consulted and decisions which divest them of all rights have been made without their input.

In the last decade, food and agriculture have been caught in the clutches of biotechnology and genetic engineering. And these are being offered as solutions to reduce hunger and malnutrition through higher yields and genetically modified seeds. There are serious concerns about the so-called pro-poor biotech that is emerging. Local companies are riding piggyback on the biotech revolution only to serve the interests of the US/ European companies.

A concrete example of this is the case of Bt cotton in India. Bt is the generic designation for genetically engineered seeds to which a gene from the soil bacterium *Bacillus thuringiensis* (Bt) has been added. This gene enables the plant to produce protein that is toxic to some types of "insect pests" especially the American bollworm. In India, more than half the pesticides used are on cotton. The use of Bt cotton was sought to be justified on the grounds that otherwise, as farmers in India get on the pesticide treadmill, more poisons would be required. This argument, however, does not hold water since the cotton

crop is also attacked by 17 other pests besides the bollworm, for which continued use of pesticides is still necessary. Therefore, the large-scale introduction of Bt cotton met with resistance because of implications such as monopoly control and increasing dependence for seed and other inputs.

Another genetically engineered crop, Golden Rice, promises the alleviation of malnutrition and malnutrition-induced blindness in rice-eating populations. The advent of Golden Rice has to be viewed against a backdrop of market control rather than as a humanitarian exercise. To offer the poor and malnourished a Golden Rice technology tied up in multiple patents and which has cost more than $100 million to invent and may cost much more to develop, is much like what Leo Tolstoy said: "I sit on a man's back, choking him and making him carry me, and yet assure myself and others that I am very sorry for him and wish to ease his lot by all possible means except getting off his back."

India's food production levels peaked at around 209 million tons in the year 2000, and yet about 42 percent of the rural population consumed less than 2,430 kcal per consumer per day. Inadequate calorie consumption is seen among those cultivating less than one acre and the landless labour households. The Food Corporation of India (FCI) was established in the early 1960s to support the Green Revolution. The Agricultural Price Commission (APC) and the public distribution system (PDS) were the two main support systems of the FCI. The PDS was the subsidized food system that allowed food produced at high costs during the Green Revolution to reach the consumers at low prices. Nevertheless, the country's large PDS network through which grains were made available at subsidized costs does not seem to have had much of an impact on the consumption of calories, which again underlines the fact that it is not a single nutrient that is missing in the diets of people but food as a whole. The truth is that hunger in the midst of plenty is the hallmark of today's 'development'.

According to Amartya Sen, in his essay "Hunger: Old torments and new blunders", the technological limits have been widely expanded. He goes on to say that what holds up Indian food consumption today is not any operational inability to produce

## SEZs and Their Impact on Agriculture

According to the Citizen's Research Collective Report in March 2007, the Indian Central Government has approved 237 Special Economic Zones (SEZs) in 19 states occupying about 86,107 hectares of land. The total amount of land to be acquired across India is about 150,000 hectares. It includes not only dry lands but also multi-cropped fertile lands which are capable of producing close to 1 million tonnes of food-grains. If this trend continues in the future, it will severely affect the country's food security and the livelihood security of small and marginal farmers.

Estimates show that close to 114,000 farming households (each household comprising five members on average) and an additional 82,000 farm worker families who are dependent upon these farms for their livelihoods, will be displaced. In other words, at least 10 lakh (1 lakh = 100,000) people who primarily depend upon agriculture for their survival will face eviction. Experts calculate that the total loss of income to farming and farm worker families will be at least Rs. 212 crores (1 crore = 10 million) a year. This does not include other income lost (for instance of artisans) due to the demise of local rural economies.

Source: Soundarapandian (2012)

more food, but a far-reaching failure to bring entitlement to food within the reach of the more deprived sections of the population. Sen also points out that we in India seem determined to maintain, at heavy cost, India's unenviable combination of having the worst of undernourishment and starvation deaths in the world and the largest unused food stocks in the globe.

It is obvious that the crisis of food is the result of an unsustainable global economic system that is marked by over-consumption by a small minority and that is based on profit and greed born out of unequal power relations. There is a notion that food trade is vital to world food security. Localization of food production at the level of the community, state, or region is rejected as a viable alternative. Food insecurity is not identified as a result of privatization and commercialization of food production and consequent destruction of ecological conditions of production and the living environment.

Adding insult to injury, sovereign nations have been left powerless and have been compelled to commit to provide intellectual property protection for plant varieties, either through patents or an effective *sui generis* system or a combination of both, due to obligations set out in the WTO's TRIPS Agreement. Moreover, through bilateral free trade agreements as well as other means, the Northern countries have pressurized the weak Southern countries to join the International Union for the Protection of New Varieties of Plants (UPOV), which is not required by the WTO, but which imposes developed-country standards of plant variety protection and undermines farmers' rights, including the right to save, use, exchange and sell farm-saved seeds and propagating material. The consequences of this for food sovereignty in developing countries are grave.

Furthermore, the patenting of plant varieties will limit access to genetic resources, provides even stronger protection for the patent owners, and could further undermine traditional seed exchange at the local level and raise costs of inputs for agriculture through higher seed prices. The patent system can severely undermine the potential for technology transfer and moreover recognizes the individual and not the community. This will eventually destroy the notion of collective knowledge and creativity that has hitherto contributed to local knowledge systems.

Indian agriculture has never been as threatened as it is today. A report published by *The Times of India* (Shrinivasan, 2013) says, "There are now nearly 9 million fewer farmers

than there were in 2001, the first time in four decades that the absolute number of cultivators has fallen. Census data shows that while the proportion of cultivators to the total workforce has been falling steadily, this is the first time since 1971 that the number of cultivators has fallen in absolute terms. Cultivators remain the second-largest group at 119 million after 'others' but are now less than a quarter of the total workforce, a decline of over 7 percentage points over 2001. Over the last 50 years, the proportion of farmers to the total population has been in steady decline, but the fall has not been big enough for the absolute number to go down, given population increases. But in the last decade, the fall in farming has combined with the slowing rate of population growth to create a fall in the absolute numbers of farmers. As in previous decades, the proportion of agricultural labour has increased; there are now 144 million agricultural labourers, 30 percent of the total worker population against 26.5 percent in 2001. 'The rise in agricultural labour could be explained by the falling size of land holdings over time,' census commissioner C Chandramouli suggested."

To complicate matters further, there is competing demand for the precious little land that is available for farming. Requirements for Technology Parks, Special Economic Zones (SEZs) and other forms of corporate activities have rendered thousands of farmers landless and pushed them into forced migration into already overburdened cities. Because they are not equipped for any occupation other than farming, they are forced to work as construction labour in cities and the meagre earnings they muster are inadequate for them to lead lives which provide for food, healthcare and education for their children and other needs. Additionally, they are also separated from their own communities and support systems – a vexing situation overall. The figures prove this; the box on page 27 quotes a report of 2007 on land which has been lost to agriculture. The situation since then can reasonably be assumed to have become more aggravated and severe.

Threats to farmers aside, it is time to recognize that the general population too has been rendered vulnerable by the changes in the agriculture sector. We are now increasingly

being faced with a situation where we are compelled to eat food that is laced with unacceptable amounts of pesticides; we are compelled to eat food that has travelled thousands of food miles; we eat food that has been banned or restricted in the developed countries and is being dumped in developing countries. Additives are being added in increasing quantities and we can no longer be sure of getting safe farm-fresh food. We are also beginning to eat more and more food 'off the shelves' of supermarkets. The following section explodes a few myths on safe food.

# Safe Food: Myth or Reality?

Urban and rural India are united by the common problem of unsafe food. It is a fact, however unpalatable, that safe food in a country like India is a distant dream for the millions who live in unhygienic conditions and for those living below the poverty line. However, even the wealthier and middle-class urban consumers are exposed to various forms of unsafe food. One of the critical factors threatening the safety of food is the problem of pesticide residues.

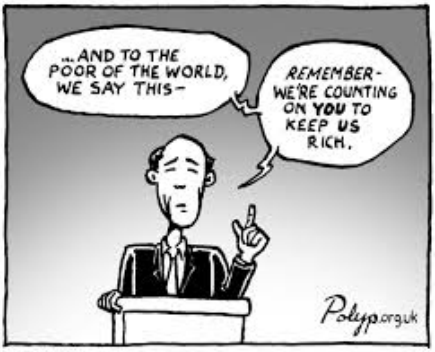
It started with the modernization of agriculture, where pesticides played (and still play) a major role. Research has established that over the last 20 years, vegetables, meat, grains, water, soil, and even blood have begun to contain pesticide residues. Chemicals (banned elsewhere) such as DDT, BHC, Dieldrin, Aldrin, Endrin and Malathion have been detected in the soil, water, vegetables, grains, pulses, roots and tubers, spices, oil seeds, fish, eggs and milk in India.

Various studies and surveys conducted in India demonstrate ample evidence of pesticide residues in food. A survey conducted by Dr. Balwinder Singh from the Department of Entomology at Punjab Agricultural University (PAU) (Dhaliwal, 2002) revealed DDT and BHC residues in wheat grains and flour, rice grains and maize flour. More than 80 percent of the samples were found to be contaminated. According to this study, most of the samples contained residues of DDT above the legal limit of 0.1 parts per million.

The daily ingestion of DDT through cereals alone was 69 percent of the prescribed safe level of 0.005 mg/kgb.w/day and

was much higher than the total dietary intake in most developed countries (Kalra and Chawla, 1983).

Analysis of samples of infant formula (milk) revealed the presence of DDT and BHC residues (Dhaliwal, 1990). The studies show that even the spray-drying process in manufacturing of formula does not reduce residues of DDT below the tolerance level. Mother's milk is also not spared and 130 samples collected from Punjab were found to be contaminated with residues of DDT and BHC (Kalra and Chawla, 1983). Whether it is breast milk, infant formula, vegetables or blood, the levels found in India are very high when compared to those in other countries.



'MUTUAL AID'

In the case of Malathion, chronic manifestations have been observed which include significant reduction in plasma and red blood cell cholinesterase levels.

Consumers are still far from becoming aware of contaminated food, let alone of the laws on compulsory labelling and banning of harmful additives in food. As more and more processed and canned foods containing chemical preservatives pile up on supermarket shelves, it is important to be aware that chemicals like butylate hydroxy toluene, sodium nitrates and nitrates, benzoic acids and brominated vegetable oils in soft drinks are harmful to health. Chemical dyes that are added to intensify or restore the natural colour destroyed during processing are also found to be harmful.

India is also under assault by Western fast-food chains selling hamburgers, pizza and fried chicken. Aided by media advertising and attractive packaging, processed foods in the modern urban context convey the impression that the production of these foods has little or no relation to agriculture, farming communities and rural life.

The entry of multinational corporations such as McDonald's and KFC, which have dubious reputations in their own countries, has resulted in their intervention into primary areas like agriculture, food processing and pharmaceuticals. One of the grouses against these fast-food outlets relates to the exceptionally high use of chemicals to fatten poultry and livestock, which has resulted in increased incidence of diseases in farm animals. For example, DES (diethyl silbesterol) is known to be used to fatten animals and can cause hormonal imbalances in the consumer.

Convenience foods, fast foods and processed foods, contrary to popular belief, are not making our lives easier. They are, if anything, bringing in a new spate of diseases such as hyperactivity in children fed with coloured sweets and squashes, increase in carcinogenesis, heart disease, asthma, skin allergies and obesity, to name a few, in people who consume high-calorie, low-residue food.

## Seeds and chemicals - the nexus

Despite the various drawbacks seen in the chemical-intensive Green Revolution, there appear to be few lessons learnt. If chemical pesticide use is one aspect of modern industrial agriculture, organized seed production is another. The Gene Revolution has panned out in a no less exploitative and unplanned manner than the Green Revolution. As a result of liberalization, multinationals have entered the area of seed production. The seed industry in India is primarily engaged in the production and distribution of seeds that depend on high doses of chemical fertilizers and pesticides, even while there is proof that several traditional seed varieties yield as much or more, with the application of simple and cost-effective farmyard manure. The

**Some controversial patents**

- Popping beans (Ehlers & Sterner, 2000)
- Neem tree oil (Roland and Blouin, 1996)
- Maca (Lepidium sp.; DeLuca et al., 2000; Zheng et al. 2001, 2002)
- Basmati rice (Sarreal et al., 1997)
- Turmeric (Curcuma longa; Das & Cohly, 1995; overturned)
- Ayahuasca (Banisteriopsis caapi; Miller, 1986)





market for hybrid seeds is growing and multinational companies have taken full advantage of this by collaborating with Indian companies.

The multilayered problems are not only with regard to health hazards but also touch on aspects such as monopoly control through intellectual property rights. The stark differences between the Green Revolution technology and the now much touted so-called evergreen technology are well brought out by Suman Sahai (2006): "The Green Revolution (GR) was a publicly-owned technology belonging to the people. The research was conducted with public money to fulfil a public need — inadequate food production — and it created public goods to which everyone had access. There were no Intellectual Property Rights (IPRs), no patents vested with multinational companies, no proprietary technologies or products. If there was ownership of the GR, it was with the farmer. Once the seed reached the farmer, it was his; he moved it where he wanted. Therefore, despite its drawbacks, the Green Revolution addressed farmers' needs and India's food production showed an upward curve.

"The Evergreen Revolution (ER) is almost the exact opposite. It is a privately-owned technology. Six corporations (Monsanto, Syngenta, Bayer Crop Science, DuPont, Dow, and BASF Plant Science) control practically all research and output in the field of transgenic plants. Processes and products, including research methodologies, are shackled in patents and the farmer has no say, let alone any control. The technology creates only private goods that may be accessed only at significant cost (a bag of Mahyco-Monsanto's Bt cotton seed in India costs Rs 1,600, as compared to between Rs 300 and Rs 400 for superior varieties produced locally)."

'HANDLE WITH CARE'

She continues, "The seed belongs to the company, which strictly controls its movement.

With the development of the popularly termed 'terminator' or sterile seed technology, the farmer is reduced to a helpless consumer, not a partner as in the case of the GR. The Evergreen Revolution has in its 20 years not yet produced a crop variety that has any direct connection to hunger and nutritional needs. The most prevalent crops remain corn, soya, cotton and canola, and the dominant traits are herbicide tolerance and insect resistance. Despite its other faults, the Green Revolution was able to put out a number of crop varieties in a short span of time that enabled direct yield increases, which brought immediate benefits to farmers. That, in short, is the contrast between the two revolutions, so assiduously camouflaged by the agbiotech spin masters.

"India participated enthusiastically in the Green Revolution and is on its way to equally enthusiastically embrace the Gene Revolution or agbiotechnology. Yet there is little debate in the country on whether any lessons have been learnt from the Green Revolution. There is even less discussion by policymakers and other stakeholders about the path that agbiotechnology should take in India. There is no consultation with the public, as in many other countries (for example, in Europe), or any sharing of information as is done in almost all countries that are implementing genetic engineering technology."

It was, among others, to counter the growing objections and opposition to pesticide usage that industry offered genetically engineered crops, which purportedly needed less application of pesticides. It has been assumed by proponents of genetic engineering that since genes determine the characteristics of organisms, one can engineer organisms to fulfil all our needs. Lendman (2008) calls it an unregulated mass human experiment, the results of which are unknown, and emphasizes that agribusiness giants allow nothing to interfere with profits, safety is off the table, and all negative information is quashed. As a result, their studies are substandard, adverse findings are hidden, and they typically "fail to investigate the impacts of GM [genetically modified] food on gut function, liver function, kidney function, the immune system, endocrine system, blood composition, allergic response, effects on the unborn, the potential to cause

cancer, or impacts on gut bacteria" (Smith, 2007).

"Arpad Pusztai was one of the first scientists to raise concerns about the safety of genetically modified foods. In the late 1990s, Pusztai, a respected molecular biologist, conducted research on GM potatoes for the Rowett Institute in Scotland. The potatoes were genetically altered to produce lectins, natural insecticides, to protect them against aphids. Pusztai conducted feeding studies on rats and found that the potatoes damaged the animals' gut, other organs, and immune system. In 1998, Pusztai expressed his concerns about GM foods on a British television programme and was promptly suspended and forced to retire from his position. Dr. Pusztai's research was later peer reviewed and published in *The Lancet*, a leading British medical journal..." (Roseboro, 2009).

Today, there are no effective surveillance systems in place for most diseases. If GM foods create new diseases, the situation

## Bt brinjal in India – the controversy

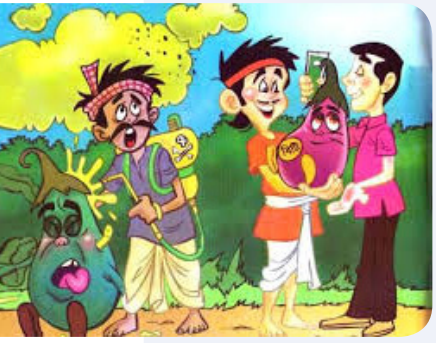
Advocates of genetically modified crops say they can boost yields to feed the burgeoning population and also be advantageous to farmers in raising output and mitigating the use of pesticides. However, opponents point to the fact that introducing Bt genes, for example, into food crops can be hazardous to the environment and public health, and threaten biodiversity.

The controversy around the introduction of Bt brinjal (also known as eggplant or aubergine) in India has been ongoing since 2010. It sparked a heated debate when farmers and consumers took to the streets across India.

Bt brinjal is a suite of transgenic brinjals created by inserting a crystal protein gene (*Cry1Ac*) from the soil bacterium *Bacillus thuringiensis* into the genome of various brinjal cultivars. The insertion of the gene, along with other genetic elements such as promoters, terminators and an antibiotic resistance marker gene, into the brinjal plant is accomplished using *Agrobacterium*-mediated genetic transformation. Bt brinjal has been developed to give

resistance against lepidopteron insects, in particular the brinjal fruit and shoot borer (*Leucinodes orbonalis*). The genetically modified brinjal event is termed Event EE 1. The Event EE 1 was introgressed by plant breeding into various local varieties by the University of Agricultural Sciences, Dharwad and Tamil Nadu Agricultural University, Coimbatore. Some of the cultivars of brinjal include Malpur local, Manjari gota, Kudachi local, Udupi local, 112 GO, and Pabkavi local. Bt brinjal was approved for commercial release in Bangladesh in 2013.

The Government of India put commercial cultivation of Bt brinjal on hold following pressure from 13 state governments. India's then Environment Minister Jairam Ramesh announced an open-ended moratorium on the introduction of Bt brinjal until independent scientific studies could establish that it was safe for human consumption. However, the moratorium was only on approving commercial trials of Mahyco's Bt brinjal variety using the *Cry1Ac* gene. The brinjal was genetically engineered by a consortium of scientists at Mahyco and the state agricultural universities in Coimbatore and Dharwad.



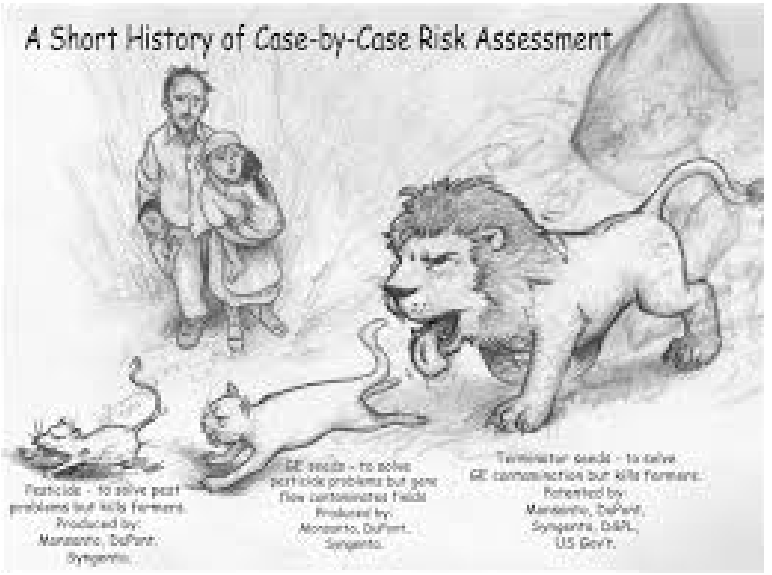
Other institutions such as the Indian Institute of Horticulture Research, Bangalore are pursuing their research which was reported in 2010 as being at an advanced stage, using the *Cry2A* Bt gene. Similarly, institutions such as the Indian Institute of Vegetable Research, Varanasi had also developed a variety of brinjal using a different gene (Singh, undated). Along with this it is reported that dozens of research groups are trying to engineer cauliflower, mustard, rice, soya bean and tomato, among other crops, in an effort to import new traits into plants. For example, a team in New Delhi is conducting research on a tomato variety that can survive without refrigeration for 45 days. The moratorium on Bt brinjal had no implications on efforts to develop other GM


crops. There were a number of scientists from India, Australia, France, the UK and the US who had written to the minister raising serious reservations about the GM brinjal and the way the tests have been done in India.

Though scientists have varied opinions, there is broad consensus that India is the centre of diversity for brinjal (Singh, undated). John Samuels articulates a major concern on the potential for transgene flow from Bt brinjal to wild and weedy relatives, which would enable them to become aggressive weeds, with considerable potential for disruption of ecological balance and plant diversity. He also adds that the knowledge of the diversity and taxonomy of the wild relatives of brinjal in South and South-East Asia is incomplete. More importantly the general concerns over transgene escape and other risks have resulted in an international law on biosafety, the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, to which the South Asian countries are signatories.

would be even more complex.

As Dr. George Wald said, “Up to now, living organisms have evolved very slowly, and new forms have had plenty of time to settle in. Now whole proteins will be transposed overnight into wholly new associations, with consequences no one can foretell, either for the host organism, or their neighbours.... going ahead in this direction may be not only unwise, but dangerous. Potentially, it could breed new animal and plant diseases, new sources of cancer, novel epidemics” (cited in Jackson and Stich, 1979). To quote Stephen Lendman (2008), “The process of creating a GM plant requires scientists first to isolate and grow plant cells in the laboratory using a tissue culture process. The problem is when




it's done it can create hundreds or thousands of DNA mutations throughout the genome. Changing a single base pair may be harmful. However, widespread genome changes compound the potential problem manifold.

"Promoters are used in GM crops as switches to turn on the foreign gene. When done, the process may [accidentally] switch on other natural plant genes permanently. The result may be to overproduce an allergen, toxin, carcinogen, anti nutrient, enzymes that stimulate or inhibit hormone production, RNA that silences genes, or changes that affect fetal development. They may also produce regulators that block other genes and/or switch on a dormant virus that may cause great harm. In addition, evidence suggests the promoter may create genetic instability and mutations that can result in the breakup and recombination of the gene sequence.

"Plants naturally produce thousands of chemicals to enhance health and protect against disease. However, changing plant protein may alter these chemicals, increase plant toxins and/or reduce its phytonutrients. For example, GM soybeans produce less cancer-fighting isoflavones. Overall, studies show genetic modification produces unintended changes in nutrients,

toxins, allergens and small molecule metabolism products."

In light of the above, it is heartening to see the Global Network of Physicians and Scientists for Responsible Application of Science and Technology (1999) categorically committing themselves to the following statement:

"…Because we do not have enough knowledge to understand all of the hazards which GE [genetically engineered] foods present, or have fully reliable methods to test their safety or estimate the risks of introducing them into the food supply, it must be concluded that GE foods cannot be reliably certified as safe at this time.....

"There are several known ways in which the artificial insertion of a gene may cause unexpected complications of a kind that never occurs in conventional breeding. Some unexpected effects have been experimentally verified... In addition, because the knowledge about DNA is very incomplete, there may be effects that cannot be even imagined presently…"

This section would be incomplete without adequate attention being paid to the controversy surrounding Bt brinjal in India (see box).

In a world where consumers have little choice over the kind of food they eat; in a world where farmers have lost access to their own resources; in a world that is being governed by corporate priorities, which are limited to profit-making, what relief can farmers expect? The majority of the world's farmers lack voice and the ability to protect their own interests against the onslaught of corporate might. It is obvious that political will has to be demonstrated towards protecting their basic rights. The situation calls for stronger laws and treaties that can protect farmers and their rights over what they grow. The following section makes a case for farmers' rights.

# Farmers' Rights: A Top-Down or Bottom-Up Approach?

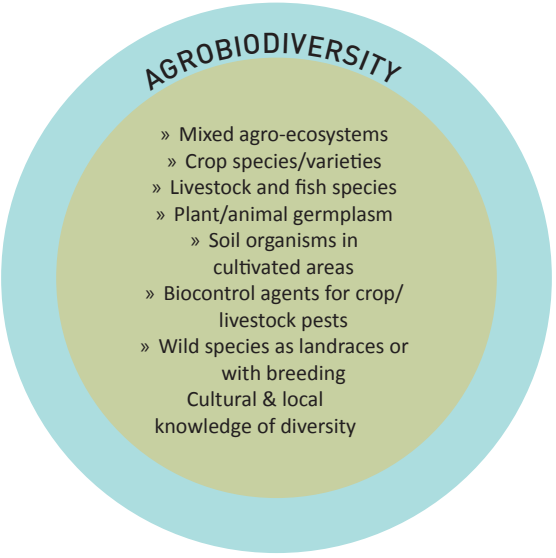
**Seeds and plants are not "genomes" to farmers, but they are life, livelihood and the very basis of a sustainable life.**

This section begins with the basic premise that the benefits of farmers' rights do not accrue to the farming community alone, but also to the rest of the world. Every living entity, human or animal, that consumes food is impacted by how food is produced. The section will examine the implications of taking away farmers' rights and giving greater control over food production to corporations. This control is combined with the attendant freedom and protection to research, modify and put on the market, seeds and other agricultural inputs that might be improperly or inadequately researched without keeping long-term health considerations in view as food production is 'engineered' with commercial interests as the prime concern.

To begin with, it is important to recognize that plant genetic diversity is crucial to the future of food security and that these diverse genetic resources provide protection against pests and diseases, in both humans and plants, as well as changing climatic conditions. Diversity also plays a vital role in the survival of millions of small and marginal farmers who depend upon small-scale farming for their livelihoods, as well as general consumers who might not be directly producing but merely consuming what the farmers produce.

Killing diversity and substituting it with patented, proprietary, genetically engineered products will have disastrous consequences for humanity in general, as the previous section amply demonstrated. It is vital to recognize that this situation occurs directly as a result of farmers being divested of their rights to conserve their diverse crop varieties and seeds.

The diversity of domesticated landraces is disappearing at an alarming rate across the world.




## 100 YEARS OF AGRICULTURAL CHANGE: SOME TRENDS AND FIGURES RELATED TO AGROBIODIVERSITY

- Since the 1900s, some 75 percent of plant genetic diversity has been lost as farmers worldwide have switched from planting their multiple local varieties and landraces to genetically uniform, high-yielding varieties.
- 30 percent of livestock breeds are at risk of extinction; six breeds are lost each month.
- Today, 75 percent of the world's food is generated from only 12 plants and five animal species.
- 4 percent of the 250,000-300,000 known plant species are edible. Of these, only 150-200 are used by humans.
- Animals provide some 30 percent of human requirements for food and agriculture and 12 percent of the world's population live almost entirely on products from ruminants.

| Loss of crop plant genetic resources: examples at country level | | | |
|---|---|---|---|
| **Country** | **Resource** | **Varieties lost** | **Notes** |
| China | Wheat varieties | 90% loss | Of 10,000 varieties used in 1949, about 1,000 (10%) remained in the 1970s |
| Korea (S) | Garden landraces | 74% loss of 14 crops in home gardens | 26% of landraces present in 1985 remained in 1993 |
| Mexico | Maize varieties | 80% loss | Only 20% of maize varieties planted in the1930s remain, maize having been replaced by more profitable crops |
| USA | Varieties of apple, cabbage, field maize, pea, tomato | 80-95% loss | Percentage loss comparing varieties grown in 1804-1904 and present |

The example of the Irish potato famine of 1845-48 (Donnelly, 2008) brings out the possible consequences of a lack of genetic diversity in the food supply chain. The potatoes consumed by the Irish peasants lacked inter- and intra-species diversity, which caused the famine that killed 1.5 million people and forced many to emigrate from Ireland.

Across the world, there is an increased interest in biotechnology and the commercial use of genetic resources. This is also bringing in a regime of intellectual property rights (IPRs) and new seed regulations at national level. Ever since the WTO was established and IPRs included on its agenda, an anti-commons (genetic resources are considered a common property of humanity) situation has arisen, with multiple actors excluding each other from the right of access to plant genetic resources. Article 27.3(b) of the TRIPS Agreement states that members may exclude from patentability "Plants ….and essentially biological processes for the production of plants …however, members must protect plant varieties with patents, a *sui generis* system or combination of the two" (Helfer, 2004). The TRIPS Agreement thus requires WTO members to adopt some minimum level of plant variety protection. Unfortunately this is not seen as a threat to the conservation and sustainable use of these resources. This is

seriously impacting food security and the outlook for combating poverty in the world.

## Farmers' rights

Let's examine a paradox. Over time, a situation has developed where farmers are struggling to retain rights over what has belonged to them without question since the dawn of agriculture. And yet, biotechnology firms from developed countries have unbridled access to the same genetic diversity grown by local farmers. They are able to modify these resources into engineered varieties without any compensation to the farmers who have been the custodians of the resources for centuries. Conversely, the engineered crop varieties, which these same farmers are then compelled to buy, come to the developing world with huge price tags. Corporations argue that newly bred varieties deserve both IPRs and monetary compensation since they invest money and time in developing them. There is increasing international pressure for intellectual property protection for plant varieties and farmers' rights are insidiously being usurped.

This trend was first recognized a few decades ago, and there have been some efforts to restore the rights of farmers to continue to have access to their practices and knowledge. The concept of farmers' rights was first officially addressed in 1986 by FAO in a working group but it was to become one of the most contested issues. In the negotiations that followed, most developing countries as well as some industrialized countries like Norway advocated comprehensive and internationally binding recognition of farmers' varieties, whereas countries like the US and Australia did not support this stance. Finally, in 1989, the heated debates resulted in a compromise in the form of a Resolution on Farmers'

**RELEVANT LEGISLATIONS IN INDIA**

- Copyright Act 1957 (amended in 1980, 1984, 1992, 1994)
- Design Act 1911
- Communications Act 2000
- Patents Act 1970
- Information Technology Act 2000
- Protection of Plant Varieties and Farmers' Rights Act 2001
- Biological Diversity Act 2002

Rights, which was annexed to the International Undertaking on Genetic Resources.

Following the adoption of the agreed text of the Convention on Biological Diversity (CBD) in 1992, negotiations for a revision to the International Undertaking began. This culminated in the adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in 2001. The realization of farmers' rights is the cornerstone of the Plant Treaty. The Treaty was adopted by 120 contracting parties and entered into force in 2004. The objectives of the Treaty are:

- Conservation and sustainable use of crop genetic resources
- Fair and equitable sharing of the benefits arising from their use for sustainable agriculture and food security.

Two articles of the Treaty that have an important bearing on farmers' rights are Articles 6 and 9. Article 6 emphasizes the fact that diverse farming systems are needed to enhance sustainable use of agricultural biodiversity and that the contracting parties should expand the use of local and locally adapted crop varieties. Article 9.1 says that the contracting parties recognize the enormous contribution that the local and indigenous communities and farmers of all the regions of the world, particularly those in the centres of origin and crop diversity, have made and continue to make for the conservation and development of plant genetic resources. In accordance with their needs and priorities, each contracting party should, as appropriate and subject to its national legislation, take measures to protect and promote farmers' rights.

India has the distinction of having contributed to the debate on farmers' rights. With the Protection of Plant Varieties and Farmers' Rights (PPVFR) Act that was passed in 2001, India in principle granted farmers' rights by protecting both breeders and farmers. However, the Act had originally emerged as a response to the seed industry's demands for breeders' rights and the

provisions on farmers' rights were added due to pressure from NGOs. The PPVFR Act has successfully acknowledged the rights of the farmers. Despite the fact that many stakeholders are not even aware of the law, the PPVFR Act of India is a far-reaching one in terms of recognizing farmers' rights.

## Plant variety protection (PVP) in the Indian law

Farmers' varieties are usually developed collectively and spread over large geographical regions. Often the same variety is found in several villages and, sometimes, even across national borders of neighbouring countries with similar agro-ecological regions. Farmers have also been traditionally exchanging, selling and saving seeds without let or interference. But traditional knowledge is dynamic and changes over time. Additionally, when it is associated with biological and agricultural diversity, this knowledge has to be treated with an understanding that they are two sides of the same coin.

The National Biodiversity Authority recognizes the rights of the communities over traditional knowledge. Articulation of farmers' rights and protection of traditional knowledge in the Indian legislation is spread over a number of national laws, i.e., the PPVFR Act 2001, Biological Diversity Act 2002, the Patent Amendment and the pending Seed Bill of 2004. The intention of particularly the PPVFR Act was to reflect farmers' rights as stated in the International Treaty. Article 39 of the legislation states that farmers who have bred or developed a new crop variety shall be entitled to the same plant breeders' rights to which breeders themselves are entitled. According to the Indian government

PROPOSED GOALS OF THE PPVFR ACT 2001

- To encourage the development of new varieties.
- To protect plant breeders' rights (PBR).
- To stimulate the growth of the seed industry.
- To recognize and protect the rights of farmers.

it is a national response to the *sui generis* option of the TRIPS Agreement to protect plant varieties. However, there are several contradictions that emerge from this.

From a review of literature on plant variety protection (PVP) laws it is evident that however good a law appears on paper, the net result is a privatization of the planting material. For a group of farmers who toil to get a farmers' variety PVP certificate, there is no clarity on how counter-claims on the same variety from other farmers will be dealt with. Considering that Indian farmers are traditionally used to an environment free of controls, this raises the question of how appropriate the PVP system is in the Indian context. Greater numbers of PVP certificates being issued only mean more breeders having control over plants and seedling material which hitherto were freely available to the farmers.

The Indian PPVFR Act is greatly influenced by the 1991 UPOV Convention (UPOV 91). The key criteria for providing plant variety protection under UPOV are that the plant variety must be novel, distinct, and uniform and stable (DUS criteria). These criteria contradict the needs of farmers involved in farming, especially organic farming, as uniformity is the opposite of diversity. Varieties that are able to adapt to different conditions are not stable. Novelty and distinctness apply to varieties that are stable and uniform.

The Indian PPVFR Act has adopted the provisions of the CBD relating to benefit sharing, without a proper instrument to implement it. Given the vague system of registration and benefit sharing in the law and the inability of farmers to apply for registration, it seems far-fetched that farmers' rights are going to be protected.

The PPVFR Act has also provided for "The Plant Genome Saviour Community Recognition Award to Recognize the Contribution of Rural and Tribal Communities to Genetic Resource Conservation and Enhancement". The Act makes it clear that the award is only for those farmer varieties which have some "economic value" for breeders and which have been

used as base material or donor crop for further development by breeders. In other words the rewards to farmers are from money obtained from the privatization of farmers' genetic material. It is essential to remember that farmers do not simply save genes when they select and develop a variety; they sustain a way of life and a culture. The pressure for community control over genetic resources has pointed to the fact that the law actually threatens to alienate farmers from their crops by granting IPRs over plants to a few individuals or corporations.

To label them merely "genome saviours" is to reduce the holistic nature of what farmers do, to a phrase they would neither understand nor appreciate. Seeds and plants are not "genomes" to farmers; they are life, livelihood and the very basis of a sustainable life. Critics further stress the fact that an Act like this which claims to recognize the contribution of farmers and tribal communities is actually stripping the poor of their collective rights over resources and paving the way for further marginalization.

The tightening of the PVP system will have a large impact on farmers' seed practices, particularly farmers' access to seeds. The Seed Bill of 2004, which has not received official sanction even 10 years after it was drafted, was formulated with the intent of regulating seed quality. It focuses on private participation in seed production and distribution achieved through a system of compulsory licensing. The Seed Bill has been criticized for taking away even the scant benefits offered by the PPVFR Act. In the light of legislation that is having a far-reaching impact on farmer-saved seeds, a set of measures are called for to address the compatibility of seed laws and plant variety protection with communities' needs. Literature abounds on the topic which recommends reinforcing the traditional sharing system with a system of peer production and distribution of germplasm as an alternative way to develop crop varieties and dynamically sustain genetic diversity.

The debate around the Act has highlighted the fact that it was defined by national-level decision makers without taking into account regional and local-level perspectives. It has been pointed out by those who have studied the history and evolution of the law that the focus has been more on asserting and assigning ownership rights, than on utilizing traditional knowledge and genetic resources for the benefit of the farmers. There is a clear disconnect with what the ITPGRFA aims to ensure as farmers' rights.

Yet another point worth noting is the lack of coordination between various laws and bodies that has posed a problem in realizing farmers' rights. The different acts like the Biological Diversity Act, Patents Act and the pending Seed Bill look at only one aspect each and overall agricultural development in the country is not taken into account. The PPVFR Act was passed even before the Treaty came into force, and does not engage itself with the provisions of the different Treaty articles meant to ensure farmers' rights. Also some studies of the Act have concluded that the ownership-based approach has not provided significant economic returns.

There are glaring examples of farmers like Dadaji Khobragade from Maharashtra who developed the HMT rice variety, but who has not been successful in registering his variety with the PPVFR authority. This farmer has toiled for the last 30-odd years and has developed unique varieties that have been grown on almost one lakh acres in five states and in several districts of Chattisgarh, but still lives in poverty.

Farmers' rights need to be actualized; and in the light of the increased stranglehold by corporations over seeds and other inputs required by the agricultural sector, implementation is also urgent.

The story of Larry Proctor, who brought a bag of mixed beans from Mexico back to the US, is often cited as one of the cases

> Mexican beans, South Asian basmathi rice, Bolivian quinoa, Amazonian ayahuasca, Indian chickpea, Peruvian nuna beans and Andean moca have all been subject to predatory intellectual property claims.
>
> (Ribeiro and Wetter, 2009)

of misappropriation of genetic resources. The beans from Senora in Mexico were later separated into black and yellow and planted over several seasons, and the best plants were replanted and selected. A few years later Proctor declared his selected beans as an invention and applied for a patent on the plant in the US. With the patent in hand Proctor's company started enforcement actions against importers warning them of infringement and the need to pay royalties. Ultimately thousands of farmers whose families and communities had cultivated the beans for generations were economically impacted. The patent had to be challenged and after a long battle the rights of the farmers were restored. The case of the enola bean, which was named after Proctor's wife, is not an isolated one. There are other examples, like the Turkish landrace of wheat that supplied American varieties with genes for resistance to stripe rust, a contribution estimated to have been worth $50 million per year. The Indian selection that provided sorghum with resistance to the greenbug has resulted in $12 million in yearly benefits to American agriculture. The protection conferred by an Ethiopian gene to the American barley crop against yellow dwarf disease has been valued at $150 million per annum. It is no exaggeration to say that the plant genetic resources received as free goods from the Third World have been worth untold billions of dollars to the advanced capitalist nations.

However, rights or no rights, communities have ways of resisting control and asserting their independence. There are instances across the world where people have risen collectively to resist oppression and control. In recent times the Tahrir Square protests in Egypt and the anti-corruption movement in India are just two examples. It is no different in the arena of agriculture. Resistance movements in the agriculture sector are coming alive across the world and the following section gives a glimpse into the significance and impact of these movements.

# Farmers' Movements: Seeking to Fight Back

In response to the various threats farmers' resistance movements have come to life across the world. These movements have adopted various bottom-up approaches and vast efforts have sprung up all over the globe especially amongst agrarian communities to spread the concept. The movements have stood out for their efforts to resist the various pressures and exploitative tactics being used against them.

Women farmers have played a major role in changing the mindset of the Green Revolution era which did not look at regional variations. They have demonstrated that food supply is not a mere route to profit but a source of nutrition and sustenance. There have been efforts to empower women to remodel farming into integrated systems that encompass water, flora and fauna, and to perceive them as systems for survival.

The most important lesson emerging from the movements is that the circular loops of fertility, seeds and resilience of communities in the food web are not just about economics. They are also about sustainable localized food production.

It begins with the seed itself. Multiplying and exchanging seed within communities establishes the right to their livelihood. Saving the seed symbolizes the spirit of self-determination and the spirit of regeneration, and the effort to regain control over resources and

> "Public action includes not only what is done for the public by the state, but also what is done by the public for itself." – Amartya Sen, "Hunger: Old torments and new blunders"

rights to food. Those who participate in these mega-efforts are the small and marginal farmers in rain-fed areas.

Politically conscious social movements are focusing on the concept of "food sovereignty" in place of food security. Food sovereignty is not a matter of semantics alone but is of social, cultural and ethical significance as well as inspiring political resistance against control over food systems in a globalized world.

The common purpose of the movements is to reclaim the value of food as a source of nourishment and not poison, as a source of peace and not conflict. Food must be a source of health and not disease, a source of prosperity and not poverty, and must nurture rather than destroy and decimate.

Resistance movements are voicing concerns and responding in different ways. There are the campaigns against

1. El Salvadoran farmers protest millions in US aid over GM seeds:http://www.geneticliteracyproject.org/2014/07/10/el-salvadoran-farmers-protest-millions-in-u-s-aid-over-gm-seeds/
2. Farmers, activists protest sale of genetically modified seeds: http://timesofindia.indiatimes.com/city/coimbatore/Farmers-activists-protest-sale-of-genetically-modified-seeds/a
3. Kenyan farmers in protest over Monsanto's genetically modified corn: http://africanbiodiversity.org/kenyan-farmers-in-protest-over-monsantos-genetically-modified-corn/
4. National farmers and social strike gets seeds control law 970 suspended: http://therealnews.com/t2/index.php?option=com_content&task=view&id=31&Itemid=74&jumival=10722
5. Burma: big farmers' protest over government failure to resolve land grab problems: http://www.seedsoffreedom.info/burma-big-farmers-protest-govt-failure-resolve-land-grab-problems/
6. Forcing farmers to plant genetically modified seeds: Colombians revolt against seed control and agricultural tyranny: http://www.globalresearch.ca/colombians-successfully-revolt-against-seed-control-and-agricultural-tyranny/5352534

biopiracy and the patenting of biodiversity. Movements have resisted the co-option of national governments and insisted upon developing national-level legislation to protect and promote local knowledge systems. Movements have engaged themselves in seeking clarifications for ambiguities, highlighting the traps, bottlenecks and challenges faced.

The links in the box above point to some of the agitations held in the recent past, protesting against GM seeds and the efforts of corporations to kill local biodiversity.

But these have more or less remained as pockets of action; what is required today is a collective uprising: a mass movement that can resist the onslaught of corporations attempting to usurp the rights of farmers through IPRs and the subscription of governments to WTO dictates. This movement has to be bottom-up in nature and large enough to 'push back' against agribusiness pressures. It has to be large enough to break the links in the corporate food chain and must have the power to wrest back lost strength and rights, and restore a happy future for generations to come.

## The importance of local efforts at sustaining life in all its biodiversity

Small and marginal women farmers have a huge role to play in preserving biodiversity and saving the source of food, soil, water and genetic resources despite the heavy odds. In the midst of an ecological and economic crisis, political control over food production and cultural collapse, women have proved that they are the backbone of food production for their families and their communities.

Having worked for more than two decades on this issue and very intensively in the last decade on biodiversity-based sustainable agriculture, we at GREEN Foundation understand that food is central to our lives. We have to stop thinking we can feed the world through 'life'- eroding manipulations at the seed level. Instead, we have learnt from women and small farmers that we have to pause to restore the balance that is now continuously being disrupted.

The following chapters will delineate the importance of preserving biodiversity in agriculture at the farm level; they will build a strong case for encouraging small and marginal farmers to make greater use of low-cost, environment-friendly methods of farming. They will bring to life the efforts that women farmers have made to keep their rights over seed, food, and how to produce it. Their experiences will demonstrate the power of local efforts at biodiversity conservation and the success stories that are associated with it.

The following chapters will also give a glimpse into the economics of small farms and the priorities that small farmers have, which are very different from what a corporation views as priorities. They will also give concrete examples of the work of GREEN Foundation, an organization that has worked with small and marginal farmers in conserving biodiversity at the farm level – in a bid to demonstrate what is possible.

# On-Farm Conservation: The Key to Preserving Agricultural Biodiversity

Before examining the importance of on-farm conservation and its unambiguous role in preserving agricultural biodiversity, it is important to understand the significance of India's traditions and culture, which farmers held sacred with regard to seeds and integrated farming systems. India has been acclaimed as one of the mega-diversity centres of the world. The different agro-climatic conditions of the country lend themselves to the growing of diverse crops that are acclimatized to local conditions. To give an example, India, at one time, was home to more than 100,000 rice varieties. Similarly, India shares with Africa the pride of being home to several millets like bajra, finger millet, foxtail millet, little millet, kodo millet and sorghum in the semi-arid tracts and desert zones. The temperate zones of the hilly regions and irrigated areas nurture cereals like wheat, barley and oats.

Subsistence farming has traditionally been pursued in India for almost an eternity, with the dry deciduous forests providing a strong support base. They provided leaf-litter for manure and fodder for animals. In turn, the livestock manure enriched forests and farms. Good forests, especially the broad-leaved forests, were essential for the preservation of water

in springs, which was in turn necessary to irrigate the fields. Knowledge and practices in a traditional society living in close proximity with nature functioned like a well-oiled system. It was a highly interdependent network of actors. The very foundations of subsistence farming lay in the careful conservation of biodiversity. The heirloom seeds held carefully by farmers were the living links that kept their relationships with the land unbroken. Farmers, centuries ago, saw the wisdom of preserving their heritage and began domesticating crops with the simple act of selecting seeds for re-sowing. Saving seeds became a part of the culture and tradition that made agriculture a way of life.

Home gardens maintained by women were a repository of their knowledge on the different uses of flora. Women had the knowledge and understanding of the different crops to be cultivated for the needs of the family, and this knowledge kept their families food-secure. Preservation of seeds was a very important function within the agriculture systems they followed. Women also had excellent knowledge about collection, storage and use of seeds. They selected the seeds according to predetermined characteristics and decided on the quantity and variety to be saved as well as the methods of preservation. Women decided what was to be sown and what was to be used as food.

Women's knowledge has been the mainstay of crop production, animal husbandry, dairy farming and forestry. This helped them to maintain the characteristics of the local varieties. Women's work and knowledge was thus central to biodiversity conservation and sustainable utilization of resources in rain-fed agriculture.

The multi-cropping system practised by farmers was also vital for food security and biodiversity conservation. Farmers combined species and structural diversity in time and space through both vertical and horizontal organization of crops.

The greater biodiversity of plants, microbes and animals inherent in these systems supported production of crops and mediated a reasonable degree of biological recycling of nutrients. The biodiverse crops exploited the full range of micro- environments which differed in soil, water, temperature, altitude, slope and fertility within a field. They engaged in effective recycling practices and relied on biological interdependence that made for vibrant predator-pest relationships.

Several combinations of crop mixtures are widely grown in India. Pulses and oil seeds are grown with maize, jowar and bajra. In the case of upland rice, several mixtures are prevalent in eastern Uttar Pradesh, Chotanagpur division of Bihar and Chattisgarh region. The patterns that have been observed testify to the fact that there has been a wide range of mixtures, i.e., 30 rice-based farming patterns, 12 maize-based cropping patterns, 17 jowar-based patterns, 9 ground nut patterns and 16 cotton patterns.

During the kharif (monsoon) season especially in the unirrigated areas of the north, wheat and barley or gram or wheat, barley and gram are the mixtures observed. Brassica and safflower are grown mixed with gram or even with wheat (College of Agricultural Banking, 2007).

When the crops began to flower, women observed them and harvested seeds based on size, grain formation, and resistance to pests and diseases. They relied on local resources as well as human and animal energy without dependence on modern technology. Traditional knowledge was the cornerstone of these communities and it provided locally manageable, sustainable and cost-effective survival strategies for them, especially to the poor. The Green Revolution largely benefitted the farmers in the irrigated areas, the fertilizer and seed industries and urban consumers while leaving a negative effect on small farmers in the dry lands. Today, industrialization of farming has undermined the role of the farmers in contributing to seed security. Subsistence farming still remains people's main source of livelihood, but it cannot be seen in isolation. Forests, grasslands, farms, livestock and water are all organically linked with each other and in the past, everybody respected these links. In the case of domesticated

biodiversity, *in situ* conservation and sustainable use were more or less synonymous as far as crop and livestock use was concerned.

Overwhelming evidence is now available on the severe loss of diversity in the transition to modern agriculture where agricultural fields are immensely simplified with single crop production. The overall loss of genetic diversity cuts across both domesticated and wild flora and fauna. More than 90 percent of India's rice diversity has been lost and the rest are under threat of extinction. Intercropping and inter-species diversity is severely reduced and genetic diversity even within a single crop is lost in modern agriculture.

In the last decade, however, the revival of traditional agriculture has indirectly established a lifeline for species, varieties and breeds threatened by under-use or extinction. The future of biodiversity conservation depends on involving the end users of diversity in conservation initiatives. The efforts in this direction must include involvement of local communities, and establishment of networks of farmers working in different parts of the country. It is a well-known fact that despite the vast diversity in food crops, only rice, wheat and maize are now used as staple crops. Taking this observation further brings us to the question of the varietal diversity within the abovementioned species that has been neglected due to the over-emphasis on breeding new lines for increased productivity.

## Role of indigenous varieties

Indigenous varieties/seeds that have potential for high yields and other characteristics like pest and drought resistance, in different soil and agro-climatic conditions, have been under-utilized and neglected. As argued by the well-known geneticist Melaku Worede, a wide variety of plant and animal species provide material for nutrition, food, feed, fibre and medicinal uses. Such diversity is also crucial to sustaining current production systems, improving human diets and supporting biological systems, essential for sustainability/livelihood of local communities. Unfortunately, many of these varieties have been sent into internal exile.

The fact that diversity has special significance for the maintenance and enhancement of quality and productivity in agricultural crops has been well acknowledged. Historically, farmers have managed many varieties and breeds according to their agronomic and culinary properties. Considering the need for a wide gene pool to improve and multiply genetic resources for food and agriculture, breeding requires access to seeds and breeds from the formal and informal sectors. Open-pollinated varieties, which represent an important gene pool for resource-poor farmers living in marginalized and stress-prone areas, are rapidly vanishing. They are replaced by a few hybrid varieties which require inputs

not affordable to poor farmers and which entail dependence on large seed companies and increased quantities of water. Therefore, maintenance of species and varietal diversity in farmers' fields is crucial to sustainable agriculture, especially for resource-poor farmers practising agriculture under on-farm input management in marginal lands.

Diversity within species has narrowed over the last few decades. Taking the example of rice, the vast diversity comes from the different geographical regions and the different varieties each have special characteristics that have evolved in tune with the environment. Unfortunately, these have been neglected with the advent of the Green Revolution, where the focus has only been to increase productivity through a narrow genetic base backed by synthetic inputs and increased quantities of water.

Limitations and threats associated with crops have led many farmers, especially in the horticulture sector, to produce their own seeds. In order to do this, they have often had to rescue local varieties and develop their own systems of selection and distribution. In many cases, the systems include the exchange of seeds between farmers (e.g., through bio village seed banks). Farming systems which do not depend on chemical inputs encourage the preservation and expansion of older, locally-bred and indigenous varieties and breeds. Farmers who save their own seeds can gradually increase crop resistance to pests and diseases by breeding for "horizontal resistance". Horizontal resistance is the ability of a crop to resist many or all strains of a particular pest (which differs from breeding for "vertical resistance", to have a gene to resist one specific strain of a disease). By exposing a population of plants to a certain disease or pest (or to several pests at one time), then selecting a group of the most resistant plants and interbreeding them for several generations, a given population becomes more resistant than the original population. Horizontally resistant cultivars are well adapted to the environment in which they were bred, but may be less suitable for other growing conditions.

Notwithstanding the demonstrated benefits of seed-saving, pressure is exerted, mainly by large seed corporations, on farmers who save seeds to switch to buying seeds. The following section elaborates on this situation.

# Seed Production by the Formal Sector: A Telling Story of Today's Reality

Technological developments have led to the transformation of agricultural systems in developing and developed countries. The organized seed production sector has brought in market-oriented technologies for plant breeding. Seed production, processing and packaging have been developed exclusively to suit high-external-input agricultural systems.

It is predicted that India can become a hub of commercial seed production for the South-East Asian region and will also be able to supply African countries. The seed sector is seen as a major driver of the agricultural sector in the country and is expected to push faster rates of seed replacement with higher use of proprietary hybrids.

One important factor attracting international seed companies to India is the country's varied agro-climatic conditions and abundant skilled and unskilled labour, as seed production, particularly hybrid seed production, is highly labour-intensive. Private seed production is largely centred around Bangalore for vegetable crops and Hyderabad for field crops, particularly cottonseeds.

The emergence of these two seed production centres is due to ideal climatic conditions, better infrastructure, technology and research leadership and the expertise of the two regions'

seed farmers in manipulating crops for perfectly synchronized flowering. The initial focus of many of the seed companies has been cottonseed, for which genetically modified (Bt) hybrids have already been approved by the Indian government for commercial cultivation, with other bio-engineered crops in the pipeline. Most of these companies have licensing agreements with Monsanto Corporation for the Bt gene; some are trying to develop their own Bt technology, legally or otherwise.

Large seed companies, domestic and multinational alike, are outsourcing the production of commercial seeds they sell. Contract seed production with farmers as producers is the model prevalent in north Karnataka. Seed companies enter into agreements with farmers either directly or indirectly through local production agents. These agreements are binding on procurement prices, terms of payment and quality standards. Farmers are paid for the produced seeds after testing for germination and purity. Some companies pay farmers in advance to help them meet the cost of production. Final payment is conditional on meeting quality standards mentioned in the agreement. The seed company takes no responsibility for crop failures due to extraneous factors such as drought, flood, wind, destruction by wild animals, endemic pests and diseases, etc. Crop protection is the sole responsibility of the farmer/producer. Farmers' fields are supervised by the company's staff throughout the production cycle. Technical staff guide them on planting, isolation, fertilization, parental line maintenance, pollination/ hybridization, pest and disease control, harvesting, maintenance of purity, drying, processing and cleansing, etc.

Chemical fertilizers and pesticides are used widely to produce the seeds of prescribed quality under the guidance of the company's staff. Training in hybridization is conducted to enable the farmer to produce the seeds. The management of

seed production is the sole responsibility of the farmer himself. Pollination/hybridization is the most important step in seed production. Two pure line varieties selected by the breeder are maintained separately during production in species having bisexual flowers like chilli, tomato, etc.

Emasculation of flowers is done to remove male parts in the bisexual flowers of the female parent a day before stigma receptivity. It is done on a daily basis during flowering for hybridization. Simultaneously, pollen is extracted from the male line by collecting the anther from unopened, mature buds and drying them under warm temperatures or an electric bulb. Hybridization is carried out every morning by supplying the pollen to the stigma of the female line. The seeds set in these female flowers are F1 hybrid seeds for commercial cultivation. Similarly, in cross-pollinated crops such as gourds and cucumbers, female flowers of the female parent are covered with butter paper to avoid cross-pollination and pollinated with pollen of the male parent to hybridize.

The seed thus produced is procured, treated with chemicals, packed and sold under the company's brand name. Companies have a network of distributors, dealers and retailers to sell the seeds to farmers. The hybrid seeds or improved varieties are used by the farmers for their commercial production with modern technologies of chemical agriculture.

In addition to seed production by private companies, public institutions such as universities and state seed corporations produce the seeds of notified varieties. (In relation to any seed a notified variety means a kind or variety notified under the Seeds Act of 1966.) They produce the seeds of crops such as sunflower, ground-nut, bengal gram, cotton, maize, sorghum, safflower, etc., in which seeds are required in bulk quantity unlike high-value crops such as vegetables. The

varieties released by public institutions are the ones whose seeds are produced by them.

The institutions breed high-yielding varieties and hybrids in many crops. Breeders evolve hybrids and then they are released for cultivation after multi-location trials. University research stations work extensively on developing new varieties and hybrids for release for commercial cultivation. The institutions have large farms maintained by them for this purpose. They also outsource seed production through contract farming.

Seeds are multiplied under the supervision of an institution's staff, which includes breeders, farm managers, seed technologists, pathologists, etc. This requires large investments on land, drying yards, storage facilities, processing machinery, seed laboratories, packing machinery, etc.

Seeds multiplied in the farm are inspected at different stages for maintaining purity and other qualities. After harvesting,

the seeds are dried and divided into lots with prescribed quantities for different crops. Samples of seeds in each lot are drawn for testing in the laboratory. They are checked for physical purity, genetic purity, germination, pests and disease infection before being cleared for commercial cultivation. Seed inspectors are responsible for quality assurance during field production stages. The seeds thus produced are bagged in bulk quantity for the market. They are sold to farmers through departmental networks under the subsidy schemes.

Under the above patterns of seed production, indigenous interspecies and intra-species diversity is being sent into internal exile. Over the years seed production has moved away from the hands of the farmers into the public sector and now into the private sector. As farmers' dependency on seeds and all related inputs from external sources has increased, the sustainability of farming has become a big question for small and marginal farmers. With commercial seeds and commercial cultivation taking centrestage, farmers and indigenous seeds are facing an uncertain future. The culture of food has also been affected with the prevalence of fast foods and imported foods.

In contrast, the diversity of food from the regions where crop diversity is more or less intact is a feast for the eyes and the taste-buds. As the globalization of food and culture rapidly intensifies, a drive to conserve the planet's diversity and stall the crisis has to be set in motion today. We cannot wait for tomorrow.

## Removing the bottlenecks – GREEN Foundation's efforts

Some of the main bottlenecks impeding successful promotion and conservation of varietal diversity within species include the loss of indigenous knowledge related to seeds/grains,

poor coordination between occurrence of rainfall and seed sowing, poor local processing facilities and lack of value addition, and poor market access. And yet, in view of the fact that millions of small farmers depend on subsistence agriculture - which often spells the difference for them between survival and failure – it is vitally important to keep these traditional systems alive, not only in India, but across the world.

The hands-on experience of GREEN Foundation working with small and marginal farmers whose livelihood emanates from the use of diverse crops, flora and fauna for their sustenance has yielded some valuable lessons in the quest for wholeness. The Foundation's experience in conservation of diversity has sought to address the question "Can indigenous varieties/organic farming feed the growing population?" by broadening the concept of food security for the small and marginalized farmers who are the custodians of diversity.

It has provided answers by promoting varieties which suit fragile ecosystems like the dry lands, coastal areas and deep waters. These are being conserved by farmers' networks facilitated by GREEN Foundation. The following section tells the story of the Foundation's efforts and the successes it has achieved, which can serve as a model for farmers "living on the edge".

# The Experience of GREEN Foundation: A Bird's-Eye View

A tiny spark is often enough to ignite a fire; a few persons are often enough to bring about change. The team at GREEN Foundation was a very small group of people, who often felt powerless against the tide of negative changes sweeping across the agriculture sector. But over time, the organization has achieved change among a section of farmers who would otherwise have been forced to give up farming and migrate to cities, or continue to labour under the joint burdens of debt and hopelessness. In the process, the Foundation has proved that sustainable agriculture, on-farm conservation, seed saving and traditional methods of farming are as relevant today as they were eons ago and that they can be the route to prosperity among small and marginal farmers.

The situation among farmers when GREEN Foundation started out was crying for change. While the country was priding itself on the self-sufficiency it had purportedly achieved through increased food production and the Green Revolution, evidence of that was missing on the ground. There were increasing numbers of the population, particularly farmers, who were displaying high levels of malnutrition. These were farmers who had been traditionally food-secure by growing their own food. It was this dilemma that prompted the team at GREEN Foundation to dig deeper into the reasons and thereafter confront the somewhat painful discovery that the face of agriculture had completely changed. In place of the progress and prosperity it was supposed to bring, it had done the opposite for the farmers of India.

GREEN Foundation, established in 1992, began by working with just five women farmers of Dinnur village in Thalli Block of

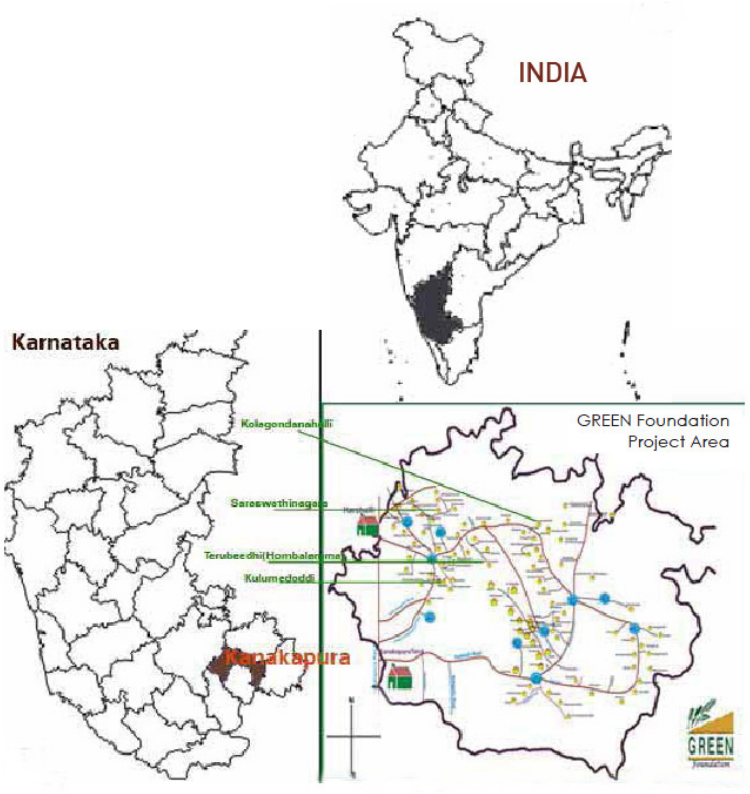
Dharmapuri district in Tamil Nadu state. The village has around 15-20 households with a population of around 120 people, all of whom are from small and marginal farming families. When its journey began, GREEN Foundation had a vision of enabling small and marginal farmers to attain food security and lead a life of dignity by adopting traditional methods of agriculture. These methods were not new to them; it is just that they had moved away and lost their own traditional heritage. The attempt was to take them back to their roots.

GREEN Foundation was working from the conviction that farmers needed to be persuaded to go back to traditional farming, as even though they were growing food on their farms, they were not eating what they were producing and there was a lacuna in their cropping patterns. Farmers were growing food, but they were growing it for the market, rather than for consumption. The irony was that despite growing food grains for the market, they were at a loss, as they did not get the prices they expected and in fact needed to sustain themselves. In the process of converting to monocropping and cash crops, they had also compromised their own food security. From a situation where their own farms had traditionally provided them the food they required, they now had to purchase food with money they very often did not have.

> "Perhaps the biggest single environmental catastrophe in human history is unfolding in the garden. The loss of genetic diversity in agriculture – silent, rapid, inexorable - is leading us to a rendezvous with extinction - to the doorstep of hunger on a scale we refuse to imagine." (Fowler and Mooney, 1990)

The other fallout from the conversion from traditional methods of agriculture was the disappearance of traditional seeds which could be stored at the end of each harvest and used for the next cropping season. Having to buy seeds and inputs every year put a further burden on the farmers, leading them into debt. The new cropping patterns had also resulted in a situation where the rich biodiversity that had contributed towards food, fuel and fodder in the past had dwindled alarmingly.

Thus, GREEN Foundation's work with small and marginal farmers sought to impress on them that growing a single crop on




a landholding of less than one hectare does not fulfil the basic requirements of a family. It neither meets their food requirements, nor does it give them enough income to purchase what they need. Sustainable agriculture is the only viable alternative for the 70 percent of India's farmers who are small and marginal farmers, as it enables the availability of food for self-consumption as well as fodder for their cattle. Additionally, food security for these farmers emanated from seed security. Traditionally, farmers had used local varieties of seeds to grow food, as these were known to respond well to local conditions, were drought- and pest-resistant and needed very little inputs.

GREEN Foundation began with modest assets, i.e., the support of the five women farmers, a small patch of land, a handful of seeds and a strong determination to make a difference in the lives of small farmers. While seed was central to the work

of the Foundation, the focus from its inception was on women, rooted in the knowledge that women have a major role to play in the conservation of biodiversity at the farm level. It is women who take decisions regarding the amount of seed to be stored, the variety and ways to store them, and who select what crops to grow, as well as select healthy seeds for sowing.

The Foundation did not have it easy. Very early on, the team realized that traditional varieties of seeds had almost disappeared. Without seeds, the entire effort would be futile. Thus began the quest for seeds – in remote villages, and among the few traditional farmers who were still using them or were preserving them. Each time some variety of seed was found, it was brought back to Thalli and multiplied by the participating farmers. On-farm conservation slowly began to yield results; in a few years the team, along with the women farmers, were experimenting with almost 100 varieties of seeds, which included minor millets, oil seeds, dryland paddy etc., on small plots that were created for the purpose. The plots served as laboratories of sorts: the seeds, which were grown on dry land, were observed on various parameters – growth, the number of tillers they yielded etc. Fifty grams of seed was observed to yield 1 kg of grain.

Slowly, steadily, GREEN Foundation began promoting awareness among the farmers in the Thalli area on the benefits of sustainable agriculture, including the importance of soil, water and other natural resources. But it was vital to involve greater numbers of farmers in the work.

GREEN Foundation met and interacted with women from the self-help groups (SHGs) in the same areas and their meetings were used to spread awareness on the concept of sustainable agriculture. Gradually more women farmers became interested in participating. The first community seed bank was established with the cooperation of the women farmers in 1994. The seed bank helped to create a space where seeds could be stored, exchanged and borrowed by interested farmers. The men initially put up resistance to the seed bank

activities but became convinced of its usefulness after a drought which occurred in 1995, where the farmers noticed that despite the failure of rains, the local varieties survived, while the high-yielding varieties failed. This demonstrated that the local varieties were drought-resistant. However, to have a bigger impact, it was important that the seed bank concept be expanded to larger areas in partnership with the communities and other NGOs which were working in those areas. These partnerships were strategically planned in order to leverage on the mutual goodwill and support between the NGOs and communities.

Along with other NGOs in Karnataka, GREEN Foundation initiated the Community Seed Bank Network (CSBN) project in 2001. The activity was carried out in two phases with the objective of addressing the need for seed conservation and food security among small farmers through the process of conserving agrobiodiversity. To reach out to the maximum number of villages, and to achieve impact among a large number of farmers, GREEN Foundation identified organizations in different agro-climatic regions across Karnataka. The selection of each organization for the network was based on the agro-climatic region in which it was based, the nature of its ongoing work and its adaptability to the objectives of the project.

**The objectives of the network were to:**

- Conserve inter- and intra-species diversity suited to the ecological niche
- Integrate on-farm seed conservation through participation from the farming community with soil and water management
- Develop human institutions with skills by providing technical support to farmer-based conservation, and to enhance the use of local plant genetic diversity
- Initiate activities in seed conservation that are gender-sensitive
- Establish sustainability by strengthening self-reliance of local farmers to improve their livelihoods and to improve seed security through community seed banks.

**Over the duration of the project, the CSBN succeeded in reviving:**

- 43 varieties of finger millets *(Eleusine coracana)*
- 18 varieties of dryland paddy *(Oryza sativa)*
- 66 varieties of wetland paddy
- 24 varieties of sorghum *(Sorghum bicolor)*
- 4 varieties of wheat *(Triticum aestivum)*
- 7 varieties of chilli *(Capsicum frutescens)*
- 18 varieties of amaranth *(Amaranthus frumentaceous)*
- 9 varieties of pumpkin *(Cucurbit pepo)*

The seed bank concept also received recognition in December 2003 from a team of external evaluators who concluded that the seed bank initiatives had resulted in an increase in seed diversity in the project region. It also recognized the potential of networking with NGOs in different agro-climatic zones across Karnataka. The report "Green Foundation Seed Quest 2004" says, "The idea of networking with different NGOs in different agro-

climatic zones all over Karnataka is a very bold idea because it automatically means a fair amount of knowledge and technology transfer from GF [GREEN Foundation] to NGOs and capacity building of the NGOs on these issues. The experience of GF being the product of long years of hard work, such knowledge being openly shared and disseminated is wonderful."

"The community seed bank is not just a store where seed is kept for distribution or marketing, or a sophisticated storage facility which has temperature and humidity control; it is a system in the process of community agriculture which includes village-level facilities, a garden or field where traditional varieties are safeguarded.

"Through this system, farmers have played a key role in the creation, maintenance and promotion of crop genetic diversity. With the help of traditional skills which [their communities] have developed over centuries, they have been selecting crop varieties to meet their specific needs such as quality, resistance to pests and pathogens, adaptation to soils, water and climate etc. Under this system local farmers have established their own seed networks to facilitate seed supply to their families and local markets.

"The community seed bank therefore is a system composed of all of the above. It is among the major strategies for maintaining genetic diversity in crop/plant species."
Dr. Regassa Feyissa, scientist, Ethiopia

After several rounds of interactions with farmers it was decided that farmers have to benefit economically from the management of the seed banks. Each seed bank is now managed by a group of enterprising women who take the responsibility to grow out the seeds, test for germination and keep a roster of seeds available in the seed bank.

The work of women in strengthening the CSBN is noteworthy. The following section carries a clutch of stories emerging from the field. They portray some of the most active and progressive women farmers who contributed to the work of the network from its operational areas.


GREEN FOUNDATION


SEED BANK

# Portraits of Courage, Faces of Strength

This section pays tribute to some of the countless strong women across India who have either stayed rooted to tradition or recognized the value of tradition and revived it in the field. They are the seed mothers; the barefoot scientists who toil in the field, experimenting, conserving and reviving the age-old forms of traditional agriculture that they know will provide them and their families with safe, healthy, nutritious food. What's more, these women have, by conserving and lending traditional seeds, ensured that the base of traditional farming is strengthened.

## Rajamma, Kulumedoddi, Kanakapura taluk (sub-district), south Bangalore

"One year we could not find any di-ammonium phosphate [fertilizer] or DAP in the local market. We went in search of it everywhere, but we found nothing. It was a very poor harvest that year, even though there were good rains. We had become dependent on outside sources for our needs," explains Rajamma, a trusted community member in Kulumedoddi, in Kanakapura taluk, south of Bangalore.

A heavy dependency on external sources for inputs of farming had left her and her family vulnerable to fluctuating markets, weakening their livelihood security. Chemical fertilizers are not the only farming inputs that Rajamma acquired from external sources. Of particular concern was access to good-quality seeds within her community. As she says, "Everything in agriculture begins and ends with the seed."

For years, farmers in Rajamma's community would buy hybrid varieties of vegetables. "We used to wait in long queues to buy 'packet' [hybrid] seeds every year during sowing season," she recalls. "The problem with 'packet' seeds is that they cannot be saved from year to year." Community members in Kulumedoddi report that changing cultivation practices over the years resulted in a loss of indigenous varieties in the area. As farmers converted to hybrid seeds, seed conservation practices slowly began to dwindle. This affected the food security of community members, most of whom are farmers cultivating crops for family consumption. "In the olden days, there used to be many different seed varieties. If a six-month crop failed, we had a fast-maturing, two-month crop that we could grow for our families," explains Shivrudraiah, a noted community leader in the area.

Rajamma explains why indigenous seed varieties and good seed management are so important to her. "With indigenous varieties, excess seeds can be used for home consumption. This is not possible with 'packet' seeds brought from outside."

The community seed bank established in Kulumedoddi provided farmers like Rajamma access to good-quality seeds within their own community. The seed banks gave access to seeds on the condition that they return twice the amount they borrowed. "I've been using the seed bank for seed exchange since it began," says Rajamma. She points out that she no longer has to wait in long queues for seeds that may not be available; it also means she saves money because she does not have to buy seeds and very importantly, it means increased food security. "Indigenous varieties don't need much water and are resilient to climate change," she says. These varieties also strengthen the nutrition security of her family. "They have many nutritional benefits which are missing in crops grown from hybrid seeds." Good seed management and conservation also addresses

economic concerns for Rajamma. “Only when we have good seeds can we have good harvests and savings,” she says. Indigenous seed varieties also respond well to low-cost organic inputs, which cut down costs of cultivation.

## Hombalamma, Kanakapura taluk, south Bangalore

Hombalamma is an active organic farmer who has been part of the movement to save seeds. The only earning member in her large family, the six acres of land she owned were the only assets she possessed and she remembers how she had to struggle to make ends meet by cultivating the land. She recalls the time she had cultivated her fields with chemical inputs and commercial seed varieties: “I used to wonder why my yields were declining every year and why the soil on my fields was becoming hard and unproductive.”

With some amount of skepticism, she decided to adopt the practices recommended by GREEN Foundation more than a decade ago. Several years down, she beams with pride as she looks far into the distance and sees that her fields are bursting with bountiful crops of grains, pulses, vegetables and castor seeds.

Hombalamma has been able to buy six additional acres of land out of the surplus income she has earned by adopting traditional practices, using traditional seeds and believing enough in the system to stay with it. As she says, “It took two years before the soil responded to the different system of agriculture I had adopted. The fertility which had completely disappeared had to be built into it all over again. But I persevered and I am happy I did. I have built up enough assets for my entire family to be comfortable.”

Hombalamma is now much in demand as a resource person and visits different parts of the state to share with farmers know-how on traditional seeds.

## Manjulamma from Kulumedoddi in Kanakapura taluk

Manjulamma from Kulumedoddi knows the challenges of being a farmer. Lack of electricity cut off water supply to her fields for a month once, and most of her crops failed. "Everything was gone except for the indigenous varieties we had planted at GREEN Foundation's suggestion. Those crops survived. That's when we realized how important they were for us."

Capacity-building initiatives by GREEN Foundation have succeeded in raising awareness among women farmers of the importance of indigenous seeds and biodiversity conservation. Traditionally responsible for managing the seed requirements of their families, they are considered the custodians of biodiversity. In Kulumedoddi, the influence of women farmers has played a very important role in the promotion of indigenous seed varieties. The Devaralamma Community Seed Bank in Kulumedoddi is run almost entirely by women in the village. Manjulamma says that indigenous varieties have many advantages: "With indigenous seeds you can use organic inputs to get good yields. With hybrid seeds, good yields are possible only with the use of expensive chemicals."

## Gangamma leads in seed conservation

Chinnikatte is a small village situated in the semi-arid region of the Haveri district of Karnataka. Gangamma is a middle-aged woman residing in the village who led the process of tracing local varieties of food crops. Gradually, members of the seed bank who had doubted the benefits of reviving local varieties were convinced and farmers participated in GREEN Foundation's approach to the formation of community seed banks to re-introduce the local varieties. In fact they needed these varieties




for the cultural, social, nutritional, and economic values attached to them. They utilize the community seed bank in Chinnikatte, which has become a safe haven for numerous varieties including minor millet, bajra, sorghum, field bean, red gram, and castor seeds.

GREEN Foundation supported the community seed bank with a small grant for the purchase of seed storage devices and other seed treatment materials. Later, bilimaggin save (minor millet), karimaggian save (minor millet), two varieties of ragi (finger millet), red gram (pulse), chali (winter) red gram and male (rain) red gram were added to the stock of seeds at the bank.

And to address the nutritional needs of the village communities, GREEN Foundation facilitated the establishment of backyard bio-intensive kitchen gardens. (In bio-intensive kitchen



gardens fruits, vegetables, medicinal and flowering plants are grown. The gardens also have a vermicompost pit, urea pit, basket compost and live hedge fencing.) Gangamma played a key role in promoting this among the women.

The communities felt concerned about the survival of the kitchen gardens during the summer season. Gangamma showed the village folk how to use domestic wastewater, a success story that saw members initiate the kitchen gardens. The men of Chinnikatte were also an integral part of the seed bank. They assumed several responsibilities including the distribution of seeds, formation of kitchen gardens, constructing vermicompost pits and seed collection.

After the formation of the community seed bank in Chinnikatte, borrowing of seeds from moneylenders has been

scaled down. As a result, farmers' dependency on moneylenders for seeds is gradually declining. The farmers are realizing self-sufficiency in fodder production as a result of growing local varieties. It has been proved that even during the last drought season, farmers were able to get a considerable amount of grain and fodder.

The farmers are becoming convinced of the value of growing the local varieties of crops and are reducing the growing of hybrid varieties. Consequently they have reduced use of chemical fertilizers and pesticides, using more vermicomposting now instead. The seed bank has brought back several varieties which were abandoned years ago due to the adoption of modern agricultural practices. The government authorities consult members of the seed bank in implementing programmes in the villages. Gangamma, a leader and role model in the seed conservation project, organizes meetings and has been chosen as a member of the local Panchayat (a local government institution in rural areas) for her leadership qualities and selfless service to the communities.

**Seed mother Puteeramma, Dharampuri district, Tamil Nadu**

At a time when indigenous seed diversity is fast diminishing, Puteeramma, a 70-year-old woman who resides in Chanmalla village, Dharampuri district of rural Tamil Nadu, has set an example for *in situ* conservation of seeds. Puteeramma is one of those farmers who can rightly be referred to as an institution in conserving seed diversity.

## Culture and rituals embedded in biodiversity

There is plenty of evidence to show that women have played a critical role in safeguarding the culture-related activities in agriculture. "Culture is enclosed in Nature and Nature is reworked in Culture." The close links between culture and biodiversity can be aptly described as the panorama of rural livelihoods being drawn on the canvas of culture with the hues of biodiversity.

Studies on the rural livelihood systems have indicated that the kinship and folk religion of rural India, the role and significance of culturally embedded practices of food production, the articulation of rituals in changing forms and the shifting significance of cultural prescriptions are portrayed in symbolic forms. The cultural ethos of rural India goes back thousands of years. Life in rural India, as in many other parts of the world, is embedded in the symbolic worship of nature and rituals very specific to the region. The heterogeneity of the communities in the Indian subcontinent adds to the colour and life.

Agriculture as a livelihood encompasses a multiplicity of tasks combined with the judicious use of resources in the form of water, soil and biodiversity. Various natural elements, processes, flora and fauna are closely observed, understood and integrated into the cultural agenda. As we understand from the past there is not a moment of monotony in the lives of the agrarian communities, which are filled with rituals either to celebrate or probe the intricacies of nature. The indeterminate nature of the symbols used in these rituals leaves room for creative interpretation. If one understands the symbols it becomes explicit that people have not probed

into the material nature of the world but into its inner meaning. Hogger (2000), in his research on symbols and their meaning and understanding livelihood systems as complex wholes, states, "Meaning and the purport of existence cannot be researched in the outer but only in the inner reality. While meaning and purport are as important foundations of livelihood systems as natural resources and food, they do not lend themselves to the same type of description, they can be visualized, felt and communicated only in symbolic terms." It is obvious that culture is the binding factor and what emerges is the celebration of life, the diversity of life forms and the symbolic need to explore and expand the psychic dimension.

Agriculture in rural India is based on the close association of culture and biodiversity. Unlike modern agriculture, it is not just a source of livelihood, but part of the depth and breadth of the lives of the peasants. Despite the fast-eroding bond with the traditional ways of farming, farmers do maintain their links with the seasons and the calendar.

**The disappearing agricultural rituals**

The rituals start with the new plough known as "honneru" that signifies the worship of the earth. There are also rituals celebrating the arrival of the rains called "malerayana habba" and worshipping the sun and the moon during the harvest festival called "makara sankaranthi" when the constellations change their path. All these rituals have their roots in the worship of the five elements of which life is believed to be comprised (earth/prithvi, air/vayu, space/akash, water/apah, light/fire/agni).

The Negilu pooje is perhaps one of the oldest and most symbolic of agricultural rituals which was performed by the farming community on New Year's Day according to the Hindu calendar.

Two new wooden ploughs are placed in the north-eastern corner of the land which is considered sacred.

An areca palm leaf folded into a deep bowl is tied to the plough.

The palm leaf is filled with manure in which seeds are sown. The seeds represent the diverse crops like finger millet, niger, field beans, horse gram, red gram, mustard, paddy and castor. The seeds are left to germinate for a period of nine days. This is a symbolic way of testing the seeds for germination. After the nine days the worshipped bowl is transferred to a nearby water source for immersion, thereby bringing together the natural resources like water, soil and the diversity.

Farmers integrate philanthropy and a sense of self-provisioning in their farming system. Illustrative of this is the Koorige or the seed drill which has three compartments through which the seeds are dispersed. The philosophy behind this is articulated by one of the women farmers: "ondu manisharige, ondu akeekalu thinnage, mathondu dharmake," which means one portion of what they grow is for themselves, while the other two provide food for the birds and charity.

Next in the line of festivals is "karibanta", performed during the month of September and early October to protect the crops from pests. The ubbe and uttare rains bring the ear heads to maturity. During this period crops are most vulnerable to pest attack. The branch of the tree locally known as Pachadi (*Dalbargia peniculata*) is fixed in the field and acts as protection against pests while it turns black overnight. This ritual is performed by the whole community. Farmers look forward to the harvest with joy and trepidation. A post-harvest festival, the rashi pooja, also referred to as "kalada devaru", is performed between the months of January and March as thanksgiving for a successful harvest. The threshing yard is cleaned and swabbed with cow dung, perhaps to ensure purity of the harvested grains. The heap of grains is decorated with agricultural implements, weeds and flowers. Subsequently the grain is taken home after a share of it is distributed to the farmers who helped in cultivating it. Rain plays a very significant role in the lives of the farmers who cultivate in the rain-fed areas. They depend on the local wisdom to predict the onset of the rains. Rainfall is linked to the stars. Farmers narrate the impact of rainfall on their survival as "Bharani male biddara dharaniyakka

davasa", which means "bharani rains will bring prosperity by way of plentitude of food". The everyday life of farmers which is dependent on nature's vagaries is full of such events and rituals, which might not lend themselves to rational explanation but which have stood the test of local wisdom.

While the entire village has been enticed to grow modern high-yielding crop varieties. Puteeramma can be seen growing three indigenous varieties of finger millet (ragi) and paddy (kari munduga and bilimunduga) and four varieties of sorghum as major crops. In addition, castor, little millet (same), kodo millet (navane), huchellu (niger), thogari (green gram), field beans, horsegram, yellu (sesamum), cow pea, local safflower (a thorny variety unique to this region) and sajje (bajra) are cultivated on her 10-acre dry land farm, with the assistance of her husband Sri Gowda. The elderly woman is advancing the legacy of her mother-in-law who was known previously for indigenous seed conservation. "I continued to conserve indigenous seeds for purposes of food consumption and multiplication due to respect for my mother-in-law. She is no more. If I fail to continue this practice her soul will not rest in peace," she is reported as saying. She does not believe in selling seeds. She says, "The seed is our mother which should be revered and not be sold as a commodity." She donated 10kg of traditional munduga ragi (finger millet) seeds free of cost. Puteeramma uses traditional storage devices for storing grains and seeds. These devices include gudana (a big mud pot), maddike (earthen pot), balage (a container made of bamboo), moode (container made of ropes of paddy straw, kodo millet straw and some fibrous weeds) and vaade (pot with a cylindrical body and a narrow lid).

The women farmers profiled above are just a few from among the hundreds, possibly thousands or millions of women farmers across the country and the world who do their little bit to counter the ill-effects that chemical farming is wreaking. They are probably in the minority, but are the vital figures who will ultimately ensure that our links with tradition are preserved; and that our world still has access to priceless resources which otherwise would be lost forever. Therefore it is imperative that their interests are protected. The following section outlines the way forward for farmers such as these.

# Way Forward and Conclusions

The previous sections of this book have amply demonstrated the value of biodiversity, indigenous knowledge and traditional farming. It is also widely accepted that indigenous knowledge is a powerful resource and complementary to the knowledge available from Western scientific sources. Therefore in studying such systems and taking them forward it is not possible to separate agricultural biodiversity from the culture that nurtures it. The key to understanding how traditional farmers maintain, preserve and manage biodiversity is to recognize the complexity of their production systems (Altieri and Nicholls, 2000).

While outlining the way forward for a safer, more sustainable agriculture system that will ensure food security for the multitudes of farmers who farm on small landholdings, it is important to be aware of some vital facts. Simplistic views exist which point to narrowly specific causes that affect productivity. Some of the purported causes of reduced productivity are nutrient deficiencies and pest infestations. There is also a perception that these can be overcome merely through new technologies. This narrow approach diverts us from understanding the systemic problems inherent in agro-ecosystems. An appreciation of the context and complexity of agriculture can help us get to the roots of the problem.

According to Altieri et al. (1998), the science of agro-ecology (which is defined as the application of ecological concepts and principles to the design and management of agro-ecosystems) provides a framework to assess the complexity of agro-ecosystems. “Another agriculture is not only possible, it is

already taking a multitude of expressions of alternative agriculture from various variations of organic agriculture to more peasant based, subsistence oriented traditional agriculture" (Altieri and Nicholls, 2000).

It is also known that the principles of agro-ecology are relevant in the practice of permaculture that integrates system design, agro-biodiversity and ecosystem services. Permaculture design emphasizes patterns of landscape, function and species assemblies. The focus of permaculture is not on separate elements but rather on the relationships created among the elements like soil, water and biomass all placed together, when the whole becomes greater than the sum of its parts. Permaculture draws from several disciplines including organic farming, agroforestry, integrated farming and agro-ecology. Permaculture design seeks to minimize waste, human labour, energy and external inputs (Holmgren, 2002).

Biodiversity and healthy soil are central to ecological approaches to making farming more drought-resistant and resilient to extreme changes in weather conditions. Some proven practices by farmers are increasing cover crops and crop residues that protect soils from wind and water erosion. The cultivation of legume intercrops, manure and composts build soil rich in organic matter. It is also known that soil rich in organic matter needs less water. "Organic matter improves the activity of organisms, earthworms and makes the soil less compacted" (Tirado and Cotter, 2010).

In a country like India, small farmers still form the majority and are categorized as subsistence farmers. They continue to practise mixed agriculture integrating crops and livestock, with most of the production contributing to meeting the household's food needs and with very little surplus for cash income. It is well known that subsistence farms usually consist of small landholdings

of between 2.5 and 5 acres with cultivation of a diverse mix of traditional landraces with relatively low yield potential when cultivated as individual crops. “Livestock is often a key component of subsistence farming systems, providing the much needed milk, meat, fuel, fertilizer, draft power and transportation. Several factors such as climate, soil types, local economics, markets, and availability of labour, knowledge base and traditions influence the cropping systems and decisions on which crop varieties are cultivated” (Haque, 1995).

Traditional ways of cultivation have evolved over a period of time. They have as their foundations a deep understanding and knowledge of the local ecology, which integrates the need for food and other basic needs like fodder and fuel. The hallmark of traditional agriculture is precisely its dynamism. “Farmers’ selection of crops yields a constant stream of new varieties adapted to changing environmental conditions” (Wilkes, 1992).

It is also true that agrobiodiversity is concentrated in regions of the world where small farms still predominate. The farmers who cultivate small farms display their knowledge and understanding of growth and cultivation of crops. It is common knowledge that modern, intensive agro-ecosystems that rely on monocultures and genetic homogeneity make the crops more susceptible to diseases and pests and to climate variations.

In an exploratory study in traditional farming areas it was observed that small farms are much more productive than large farms if total output is considered rather than yield from

a single crop like Bt cotton or a high-yielding rice variety. In overall output diversified farms produce much more food than large monocultures. It has been lucidly discussed by Donald Q. Innis (1997) in his essay on intercropping and the scientific basis of traditional agriculture that under this system, numerous farmers who care about their future can feed their families, keep their families employed, keep soil on the land, utilize more of the sun and water than monocropping and solve many cultural and agricultural problems in a methodical way.

Traditional farmers in India have long practised continuous cropping without noticeable detrimental effect to the soil, probably because crop mixtures are used (Wilson and Wyss, 1937). The system of mixed crops, so common in India, is undoubtedly a successful and profitable method which has probably done more to uphold the fertility of Indian soils than any other practice.

Innis also looks at the land equivalent ratio, which expresses intercropped yields as a ratio of monocropped yields. He shows that in an intercropped field, the land equivalent ratio is 1.42. This means that all other factors being equal, the crops when grown together produced 42 percent more yield than the same crop when grown as a monocrop (Innis, 1997).

The range of issues that this volume has attempted to address starts with the traditional knowledge systems inherent in India's agricultural history, and goes on to the challenges faced in conserving the agricultural biodiversity that is the basis of people's food security and sustainable agriculture and the attempts to overcome the same.

The numerous initiatives in India and across the globe to conserve agricultural biodiversity are merely specks in the face of the large-scale drive to industrialize agriculture in its entirety. At the base of this struggle are some basic questions that need to be answered. How can people take control of their lives? The answer lies in a combination of political struggle and economic

empowerment. Most of the time technical fixes are offered as solutions in order to strengthen what is basically an economic and political effort for dominance.

Agriculture is still a small-farm story since half a billion farms of less than two hectares produce a significant proportion of the world's food, says a report from the International Food Policy Research Institute (IFPRI), and 50 percent of that from India. The livelihoods of 2.2 billion people are still linked to small-scale agriculture across the world (Singh, 2012).

The critical challenge that emerges in today's globalized world is how we can ensure sustainability for the agriculture sector. Is it through fair-trading or remaining at the edges of formal and political institutions?

Important issues that shake the foundations of agriculture have been examined in this volume, i.e. the process of globalization with its proliferation of multilateral, regional and bilateral free trade agreements. The importance of conserving agricultural diversity and the threats that weaken the process and finally the economic stakes of the small farms have also been examined, as also the role of women in keeping traditional agriculture alive.

These issues have to be examined in the context of today's fast-changing economy. Farmers are not only facing the effects of globalization and trade from the global to the local. "They are also experiencing turbulence and change in many aspects of rural society including demographic transition, urbanization, restructured food habits, land mafias, labour shortage because of migration and evolving patterns of off-farm work that restructure the ways rural people make their living" (Vorley et al., 2012).

Over the last few decades concerns have arisen about feminization of small-scale farming and gender dimensions of agriculture and employment. There are opportunities and challenges that the development of value chains presents for women's income and empowerment as social and economic

actors in their own right (FAO, 2010). “It is a well-known fact that gender stereotypes keep poor and uneducated women in lower paid, less skilled and insecure work within the value chain. The challenge is to ensure gender equality throughout the chain and to prevent traditional patterns of gender discrimination from being repeated” (Bolzani et al., 2010). Bolzani et al. (2010) also emphasize the fact that women remain the main drivers of traditional value chains in local markets for fresh or processed foods such as vegetables, fruits, grains, tubers, dairy products and fish. As the returns are often low, women are in particular need as they tend to have poorer access to inputs, extension services and markets.

Rural areas are going through a demographic shift, as cited by Proctor and Lucchesi (2012) from the National Sample Survey. It is observed that nearly 40 percent of farming households and a higher proportion of smallholders have said they will quit farming if they were given a chance. This is supported by the surveys done by Satendar Arya and Sanjeev Asthana in two Indian states which confirm that 77 to 81 percent of farmers do not want their children to take up farming as an occupation.

Under these circumstances the face of small farms will change if there are fewer farmers in the next generation. This, along with the availability of off-farm jobs and dynamic land markets, raises the question: Who will be doing the farming and on what land?

To be sure, small farm livelihoods can benefit from diversifying into off-farm and urban income sources. In situations of environmental threats like climate change, more investments are required on the farm and remittances from off-farm jobs become essential for those staying in

Taking into consideration the different sustainable ways of supporting small farms and small farmers in conserving agricultural diversity, the way forward can be summed up as follows:

- Replace some of the simplistic assumptions on what affects productivity with holistic approaches that have shown proven outcomes
- Emphasize the role of agro-ecology and permaculture in place of a reductionist approach to solving the problems faced by farmers
- Support small farmers in their critical role in practising mixed agriculture
- Preserve traditional ways of cultivation and the role played by small farmers
- Initiate community seed banks within the reach of farmers in every region
- Ensure community ownership and protect farmers' rights over the genetic diversity within the seed banks, and explore alternatives other than IPRs to protect the diversity
- Empower women to reinforce their role in conserving the diversity and build their capacity in managerial roles
- Ensure gender-sensitive policies in conserving agricultural diversity
- Recognize women's rights to knowledge of plant genetic resources within the new systems that patent, privatize or compensate knowledge and genetic resources
- Ensure access and control for women over productive resources like land, water and genetic resources.

To ensure women's role in conserving agricultural diversity the following aspects must be considered in policy making:

- Secure land rights of women
- Document knowledge of women on biodiversity which is being eroded and give it protection from IPRs
- Implement gender-sensitive research on biodiversity
- Integrate women into local institutions that deal with biodiversity management
- Introduce changes in traditionally restricting conditions that erode women's role in conserving genetic resources
- Compensate farmers for the ecosystem services they provide in conserving the diversity that is the bedrock of food security.

farming. It is also a common practice for farmers to move seasonally to work as labourers in other farms or in urban areas.

In the Green Revolution era in the 1960s and 1970s India addressed its growing reliance on food imports by promoting water- and capital-intensive technology to raise yields of rice and wheat. However, this benefitted only large farmers who had ample irrigation. The country's National Agricultural Policy in 2000 talked about sustainability, efficiency and equity as its goals but never mentioned the special needs of small farmers. It reflected a uniform view of the sector. Arya and Asthana point to a failure to recognize that smallholder agriculture requires special solutions in terms of farm inputs and social support systems. The greying of farmers is a reality and if one has to provide incentives for the youth to return to their villages with more skills and knowledge, it is vital to make village life more attractive.

If small-scale farming and rural development are to be sustained, it has been emphasized that to bring markets and small farmers together, investments in small farmers are a necessity and not a luxury. Scholars who have studied the impact of markets and economics in influencing policy have observed that they do not benefit the poor. "Rights-based development aligns the interest of small scale farmers with social movements that resist corporate penetration into agriculture, resist globalization and advocate greater democracy and food sovereignty as part of human rights" (Vorley et al., 2012). Vorley et al. (2012) cite the stand taken by Via Campesina, a peasant movement that claims

to represent 200 million small-scale farmers around the world, which has advocated since 2001 at the UN Human Rights Council for an ”international declaration on peasant rights, protecting their rights to land, seeds, freedom to determine prices and agricultural knowledge.”

The above discussion leaves us with a few questions. How can policies address the special needs of small-scale famers? What knowledge do farmers need about relevant policies, laws and programmes to make informed choices? Can farmers carve out a political and civic strategy independent of the state? How can farmers integrate the efforts required for conservation of agricultural biodiversity and their livelihoods? Are the laws conducive to protecting the farmers as custodians

of agrobiodiversity? Can markets respond to the efforts of small farmers to conserve the diversity? Can women’s co-operatives be strengthened in agricultural policy? Can the government provide the monetary support and training needed to strengthen the women producer groups? These and many other questions stir our thinking.

What can be done? It is by now well-recognized that small farmers farming in the dry land, rain-fed regions play a critical role in conserving agricultural diversity in the course of the multicropping systems practised by them. Their knowledge and agricultural biodiversity are like two sides of a coin. Economic benefits and political awareness of their role in conservation are

the key to sustainable agriculture and food security. Keeping this in mind, a wide range of answers that lead to policy changes can be envisioned.

Ever since the advent of the Green Revolution there have been a plethora of anti-small-farmer policy distortions which have favoured capital-intensive agriculture. In the process, the self-esteem of small farmers has been completely eroded. Therefore, undoubtedly, policies to boost the social recognition of the farmers should be mooted. For farmers living in remote rural areas tangible benefits of housing, transport, public health, education for their children and other civic amenities will deter them from outmigration.

What genetic diversity in food crops has taught us is that traditional varieties of grains, vegetables and fruits not only have different genetic attributes but also unique values of taste. For this very reason there is scope for development of domestic and international market value that commands a premium price. Farmers have to be compensated for the ecosystem services provided through their effort to conserve the diversity as a trade-off for low yields. Local and national governments should provide the means to sustain this. Policies that generate off-farm employment opportunities in rural areas can help to economically sustain farmers.

In conclusion, the central argument of this publication is that attempts to conserve *in situ*, on-farm diversity must go hand in hand with efforts to support the small farmer. Economists and environmentalists alike fail to appreciate the fact that diversity is the sine qua non of resilience and sustainability.

"In thrall to a romantic notion of 'wilderness' many economists and environmentalists fail to appreciate that agricultural biodiversity is just as valuable or indeed arguably more valuable from the standpoint of human wellbeing as the diversity found in tropical rainforests or the spotted owls found in the ancient forests of the north-western United States." (Boyce, 2004).

# References

## Preface

**Altieri, M.A.** 2012. Convergence or Divide in the Movement for Sustainable and Just Agriculture. In: Lichtfouse, E. (ed.), *Organic Fertilisation, Soil Quality and Human Health*. Netherlands: Springer. Available at: http://food.berkeley.edu/wp-content/uploads/2014/09/Altieri-divide-in-sust-ag.pdf [Accessed 4 December 2014]

**Nabhan, G.** 2011. *Where Our Food Comes From: Retracing Nikolay Vavilov's Quest to End Famine*. 2nd Ed. Washington DC: Island Press

**Runge, F. and Senauer, B.** 2007. How biofuels could starve the poor. *Foreign Affairs*. Available at: http://www.foreignaffairs.com/articles/62609/c-ford-runge-and-benjamin-senauer/how-biofuels-could-starve-the-poor [Accessed 4 December 2014]

## The Beginning

**Bajaj, J.K. and Srinivas, M.D.** 1994. Indian Economy and Polity in the Eighteenth Century: The Chengalpattu Survey: 1767-74. Available at: http://cpsindia.org/index.php/art/121-articles-by-jk-bajaj-andmd-srinivas/indian-economy-and-polity-in-the-eighteenth-century [Accessed 2 December 2014]

**FAO (Food and Agriculture Organization).** 1996. World Food Summit: Food for All. Rome: Food and Agriculture Organization. Available at: http://www.fao.org/docrep/x0262e/x0262e00.htm [Accessed 3 December 2014]

**McCrindle, J.W.** 1877. Ancient India as Described by Megasthenes and Arrian. Bombay: Thacker. Available at: http://www.sdstate.

edu/projectsouthasia/upload/Megasthene-Indika.pdf [Accessed 4 December 2014]

**Nawani, N.P.** 1994. Indian experience on household food and nutrition security. Available at: http://www.fao.org/docrep/X0172E/x0172e03.htm [Accessed 2 December 2014]

**Nene, Y.L.** 2002. Modern Agronomic Concepts and Practices Evident in Kautilya's *Artha-sastra* (c. 300 BC). *Asian Agri-History*, 6(3), pp. 231-242

**O'Malley, J.P.** 2013. Amartya Sen interview: India must fulfil Tagore's vision, not Gandhi's. *The Spectator*, 20 August. Available at: http://blogs.spectator.co.uk/books/2013/08/amartya-sen-interview-india-must-fulfil-tagores-vision-not-gandhis/ [Accessed 3 December 2014]

**Prasad, A. (ed.)** 2008. *Environment, Development and Society in Contemporary India: An Introduction*. New Delhi: Macmillan India Ltd

**Raghunathan, J. and Viswanthan, S.** 2013. A landmark year for M.S. Swaminathan. *Madras Musings*. Available at: http://madrasmusings.com/Vol%2023%20No%2017/a-landmark-year-for-m-s-swaminathan.html [Accessed 3 December 2014]

**Shastri, J.L. (ed.) and Gangadharan, N. (trans.)** 1986. *Agnipurana*

**Sundaram, V.** 2006. 18th century romance in Chengalpattu district. *The Hindu*, 5 October. Available at: http://hindunet.org/hvk/articles/1006/142.html [Accessed 2 December 2014]

**Voelcker, J.A.** 1893. Report on the improvement of Indian agriculture. Available at: https://archive.org/stream/cu31924001039324#page/n3/mode/2up [Accessed 3 December 2014]

## The Green Revolution and After: The Advent of Neoliberalism and Globalization

**de la Perriere, R.A. and Seuret, F.** 2000. *Brave New Seeds: The Threat of GM Crops to Farmers*. London and New York: Zed Books.

***Deccan Herald.*** 2013. Shift from cash crop to food crop cultivation. 8 September. Available at: http://www.deccanherald.com/

content/355962/039shift-cash-crop-food-crop.html [Accessed 3 December 2014]

**Paul, H. and Steinbrecher, R.** 2003. *Hungry Corporations: Transnational Biotech Companies Colonise the Food Chain*. Available at: http://www.econexus.info/publication/hungry-corporations [Accessed 3 December 2014]

**Sen, A.** Undated. Hunger: Old torments and new blunders. *The Little Magazine*, 2(6). Available at: http://www.littlemag.com/hunger/aks.html [Accessed 3 December 2014]

**Shrinivasan, R.** 2013. Farmer population falls by 9 million in 10 years. *The Times of India*, 1 May. Available at: http://timesofindia.indiatimes.com/india/Farmer-population-falls-by-9-million-in-10-years/articleshow/19813617.cms [Accessed 3 December 2014]

**Soundarapandian, M. (ed.)** 2012. *Development of Special Economic Zones in India – Impact and Implications*. New Delhi: Concept Publishing

**Watts, M.** 2010. *Pesticides: Sowing Poison, Growing Hunger, Reaping Sorrow.* Penang: Pesticide Action Network Asia and the Pacific

## Safe Food: Myth or Reality?

**Antonian, M.** 1996. Genetic Pollution. *Nutritional Therapy Today*, 6(4), pp. 8-11

**Dhaliwal, D.S.** 1990. Pesticide contamination of milk and milk products. In: Nriagu, J.O. and Simmons, M.S. (eds.), *Food Contamination from Environmental Sources*. Wiley: New York, pp. 357-385

**Dhaliwal, K.S.** 2002. Even mother's milk is contaminated. *The Times of India*, 30 June. Available at: http://timesofindia.indiatimes.com/city/chandigarh/Even-mothers-milk-is-contaminated/articleshow/14502438.cms [Accessed 3 December 2014]

**Glenza, J.** 2014. "Innate Potato" heads for market but GM watchdogs chip away at Simplot success. *The Guardian*, 8 November. Available at: http://www.theguardian.com/

environment/2014/nov/08/innate-potato-simplot-gm-watchdogs [Accessed 4 December 2014]

**Jackson, D.A. and Stich, S.P.** 1979. *The Recombinant DNA Debate*. Prentice Hall College Div

**Kalra, R.L. and Chawla, R.P.** 1983. Studies on pesticide residues and monitoring of pesticidal pollution. Final technical report, Punjab Agricultural University. Quoted in Mehrotra, K.N. 1985, Use of DDT and its environmental effects in India. *Proceedings of Indian National Science Academy*, B51 No2

**Lendman, S.** 2008. Potential Health Hazards of Genetically Engineered Foods. SteveLendmanBlog, 22 February. Available at: http://sjlendman.blogspot.in/2008/02/potential-health-hazards-of-genetically.html [Accessed 4 January 2015]

**Physicians and Scientists for Responsible Application of Science and Technology.** 1999. The Safety of Genetically Engineered Foods: Reasons to expect hazards and the risk for their appearance. Available at: http://www.psrast.org/defknfood.htm [Accessed 4 December 2014]

**Roseboro, K.** 2009. Arpad Pusztai and the Risks of Genetic Engineering. *The Organic and Non-GMO Report.* Available at: https://www.organicconsumers.org/news/arpad-pusztai-and-risks-genetic-engineering [Accessed 7 December 2014]

**Sahai, S.** 2006. Nukes in favour, crops downgraded. Available at: http://indiatogether.org/cropdown-opinions [Accessed 7 December 2014]

**Sahai, S.** 2007. Green, Gene and Evergreen Revolutions: Interesting wordplay. Infochange. Available at: http://infochangeindia.org/agriculture/analysis/green-gene-and-evergreen-revolutions-interesting-wordplay.html [Accessed 3 December 2014]

**Sahai, S.** 2014. Should India permit GM foods?. *The Tribune*, 13 October. Available at: http://www.tribuneindia.com/2014/20141013/edit.htm#3 [Accessed 7 December 2014]

**Samuels, J.** 2012. Genetically engineered Bt brinjal and the implications for plant biodiversity revisited. http://www.greenpeace.org/seasia/ph/PageFiles/415937/GE-Bt-brinjal-revisited.pdf

**Singh, M.** Undated. Centre of Origin, Inter-relationship, and Crossability in *Solanum melongena* (Brinjal). Available at: http://moef.gov.in/divisions/csurv/geac/Bt_Brinjal/Centre%20of%20Origin.pdf [Accessed 7 December 2014]

**Smith, J.** 2007. *Genetic Roulette: The Documented Health Risks of Genetically Modified Food*. Iowa: Chelsea Green Publishing.

## Farmers' Rights: A Top-Down or Bottom-Up Approach?

**Ali, M.** 2010. Farmer named by Forbes is landless today. The *Times of India*, 16 November. Available at: http://timesofindia.indiatimes.com/city/nagpur/Farmer-named-by-Forbes-is-landless-today/articleshow/6933299.cms [Accessed 7 December 2014]

**Donnelly, J.S.** 2008. *The Great Irish Potato Famine*. United Kingdom: The History Press

**FAO (Food and Agriculture Organization).** 2005. Building on Gender, Agrobiodiversity and Local Knowledge. Available at: http://ftp.fao.org/docrep/fao/009/y5956e/y5956e00.pdf [Accessed 10 January 2015]

**FAO (Food and Agriculture Organization).** 2005. What is happening to agrobiodiversity? Available at: http://www.fao.org/docrep/007/y5609e/y5609e02.htm [Accessed 26 June 2015]

**Helfer, L.R.** 2004. Intellectual Property Rights in Plant Varieties: International Legal Regimes and Policy Options for National Governments. Rome: Food and Agriculture Organization

**Ribeiro, S. and Wetter, K.J.** 2009. Fighting biopiracy. Project Syndicate, 4 September

## On-Farm Conservation: The Key to Preserving Agricultural Biodiversity

**College of Agricultural Banking.** 2007. Cropping Patterns and Diversification in India. Available at: http://cab.org.in/Lists/Knowledge%20Bank/Attachments/9/Cropping%20%20Patterns%20and%20Diversification_11_13_2007.pdf [Accessed 7 December 2014]

**The Experience of GREEN Foundation: A Bird's-Eye View**

**Fowler, C. and Mooney, P.** 1990. *Shattering – Food, Politics and the Loss of Genetic Diversity*. Tucson: University of Arizona Press

GREEN Foundation. Undated. Website www.greenconserve.com

**Portraits of Courage, Faces of Strength**

**Hogger, R.** 2000. Understanding Livelihood Systems as Complex Wholes. Mimeo

## Way Forward and Conclusions

**Altieri, M.A. and Nicholls, C.I.** 2000. *Agroecology and the Search for a Truly Sustainable Agriculture*. Berkeley: University of California

**Altieri, M.A., Rosset, P.M. and Thrupp, L.A.** 1998. The potential of agroecology to combat hunger in the developing world. 2020 Policy Brief No. 55. International Food Policy Research Institute. Available at: http://www.fao.org/docs/eims/upload/207906/gfar0052.pdf [Accessed 11 January 2015]

**Arya, S. and Asthana, S.** 2012. Cited in Vorley et al. (2012)

Benson, E. et al. 2014. Informal and Green? The forgotten voice in the transition to a green economy. London: International Institute for Environment and Development. Available at: http://pubs.iied.org/pdfs/16566IIED.pdf? [Accessed 2 January 2015]

**Bolzani, D., de Villard, S. and Dey de Pryck, J.** 2010. Agricultural value chain development: Threat or opportunity for women's employment? Gender and Rural Employment Policy Brief No. 4. FAO, IFAD and ILO. Available at: http://www.fao.org/docrep/013/i2008e/i2008e04.pdf [Accessed 4 January 2015]

**Boyce, J.K.** 2004. A future for small farmers? Biodiversity and sustainable agriculture. Political Economy Research Institute (PERI), University of Massachusetts Amherst. Available at: http://scholarworks.umass.edu/cgi/viewcontent.cgi?article=1071&context=peri_workingpapers [Accessed 2 January 2015]

**FAO (Food and Agriculture Organization).** 2010. Gender dimensions of agricultural and rural employment: Differentiated

pathways out of poverty. Available at: http://www.fao.org/docrep/013/i1638e/i1638e.pdf [Accessed 4 January 2015]

**Haque, T.** 1995. Diversification of small farms in India: Problems and prospects. National Centre for Agricultural Economics and Policy Research

**Holmgren, D.** 2002. *Permaculture: Principles and Pathways Beyond Sustainability.* Holmgren Design Services

**Innis, D.Q.** 1997. *Intercropping and the Scientific Basis of Traditional Agriculture*. Intermediate Technology Publications

**Mehta, R.** 2011. Statistics on farmers and farm management for furthering synthesis of agricultural development and related policy analysis. Paper for the 4th meeting of Wye City Group on Statistics on Rural Development and Agriculture Household Income, Rio de Janeiro, 9-11 November

**Proctor, F.J. and Lucchesi, V.** 2012. *Small-Scale Farming and Youth in an Era of Rapid Rural Change.* London: IIED and The Hague: HIVOS. Available at: http://pubs.iied.org/pdfs/14617IIED.pdf

**Singh, S.** 2012. The woes of rural labour. *Capacity.org,* 44, pp. 8-9. Cited in Benson et al. (2014)

**Spring Ridge Commons.** 2014. Permaculture. Available at: http://springridge.rd123.ca/?p=68 [Accessed December 2014]

**Tirado, R. and Cotter, J.** 2010. Ecological farming: Drought-resistant agriculture. Amsterdam: Greenpeace International

**Vorley, B., del Pozo-Vergnes, E. and Barnett, A.** 2012. *Small Producer Agency in the Globalised Market: Making Choices in a Changing World.* London: IIED and The Hague: HIVOS. Available at: http://pubs.iied.org/16521IIED.html [Accessed 4 January 2015]

**Wilkes, G.** 1992. Strategies for sustaining crop germplasm – preservation, enhancement and use. Washington DC: Consultative Group on International Agricultural Research. Available at: http://www.worldbank.org/html/cigar/publications/issues/issues5.pdf [Accessed 2 January 2015]

**Wilson, P.W. and Wyss, O.** 1937. Mixed cropping and the excretion of nitrogen by leguminous plants. *Soil Science Society of America Proceedings,* 11, pp. 289-297

# Annex 1

## THE CHENGALPATTU SURVEY: 1767-74

Undertaken by the British Government, the Chengalpattu Survey done between 1767 and 1774 provided detailed information about the organization and functioning of over 2,100 localities in South India's Chengalpattu District, which stretches 180 km long and 80 km wide at places. The survey, led by British engineer Thomas Bernard, focused on determining the value of the lands in the district and also understanding the appropriate ways to govern the district.

Significantly relevant in "understanding the essential preferences and seekings of the people of India and their ways of putting those preferences and seekings in practice in the public domain", the survey had value in shaping the future to a great extent.

## The following vital points emerged from this study:

1. Both levels of agricultural production and productivity were very high in the localities studied and compared favourably with the best levels reached at that time in other parts of the world.
2. All the artisans like weavers, carpenters, blacksmiths, goldsmiths, braziers, and silversmiths were also adequately provided for in the locality budget. Households consisting of oil pressers, woodcutters, shoemakers, stone-masons, lime-burners, salt-makers, arrack distillers, basket makers, cotton

refiners, engravers and perfume makers received their due share of the total agricultural produce.

3. The importance of households providing various administrative, cultural and other essential services to the community (such as medicine men, Pandaram households, Brahmana households engaged in scholarship and religious, cultural and temple services) was duly recognized and provided for.
4. Barbers, washer men, kanakkapillais (registrars and accountants), and Palayakkarar (militia men) were all part of the beneficiaries included in the annual society's budget.
5. In short grain allocations made included law and order, registry, education, health, culture and religion, apart from the artisan and industrial activities.

## Agricultural production and productivity

Despite not-so-fertile lands, the peasants of Chengalpattu obtained fairly high average yields and successfully managed a level of productivity that "compares favourably with the best in the world today".

From about 2 lakh kanis of land, an average annual production of around 20 lakh kalams of foodgrains was obtained, which means a kalam in this district fetched around 125 kg of paddy. Thus, the average worked out to be 2.5 tons per hectare.

Source: cps.org

# Annex 2

## CHRONOLOGY OF MAJOR FAMINES IN INDIA BETWEEN 1765 AND 1947

| YEAR | NAME OF FAMINE |
|---|---|
| 1769-70 | Great Bengal Famine<br>Occurred in Bihar, Northern and Central Bengal. An estimated 10 million or one third of the Bengal population lost their lives. |
| 1783-84 | Chalisa Famine<br>Occurred in Delhi, Western Oudh, Eastern Punjab,<br>Rajputana and Kashmir. Up to 11 million died. |
| 1791-92 | Doji Bara Famine<br>Occurred in Hyderabad, Gujarat and Marwar. An estimated 11 million people died during 1789-92. |
| 1837-38 | Agra Famine<br>Occurred in Agra Province, Delhi and Hissar. Around 800,000 people lost their lives. |
| 1860-61 | Upper Doab Famine<br>Occurred in Eastern Rajputana wherein 2 million people lost their lives. |
| 1865-67 | Orissa Famine<br>One million people lost their lives, mostly in Orissa and Bihar. |
| 1868-70 | Rajputana Famine<br>Occurred in Ajmer, Western Agra and Punjab. Around 1.5 million people lost their lives. |
| 1876-78 | Great Famine<br>Occurred in Mysore and Hyderabad and witnessed a very high mortality estimated at between 6.1-10.3 million. |

| | |
|---|---|
| 1896-97 | Indian famine<br>Occurred in Madras, Bombay, Bengal, United and Central Provinces and claimed the lives of 5 million people. |
| 1943-44 | Bengal Famine<br>Occurred in Bengal and took the lives of 1.5 million from starvation and another 3.5 million from epidemics. |

# Annex 3

**IS INDIA'S AGRICULTURE CAPABLE OF IMPROVEMENT?**

In an inquiry conducted by Dr. John Augustus Voelcker, Consulting Chemist to the Royal Agricultural Society of England, during 1889-91, he was asked to make recommendations for the improvement of Indian agriculture.

**Below is a summary of his findings -**

Despite the fact that under British rule, Indian agriculture was primitive and backward with few remedial measures undertaken, the Indian crops were "wonderfully good". Thus, the state of Indian agriculture was largely due to "an absence of facilities for improvement which is probably unequalled in any other country". These were facilities such as access to water and manure.

Yet, nowhere could one find better examples of animal husbandry, clearing the land from weeds, knowledge of soils and their capabilities, or the right time to sow and reap. Furthermore, Indian farmers knew much about crop rotation or the system of "mixed crops" as well as fallowing.

"But, to return to the question of improvement; while some have erred by calling the agriculture primitive, and, forgetting that novelty is not necessarily improvement, have thought that all that was needed was a better plough, a reaper, a threshing machine, or else artificial manures, to make the land yield as English soil does, others have equally erred by going to the opposite extreme, and have condemned all attempts at

improvement, asserting that the *raiyat* knows his own business best, and that there is nothing to teach him."

Finally, it was not the introduction of Western practices that would help progress the state of Indian agriculture but the "transference of the indigenous methods from one part of the country to another."

# Annex 4

**AGRICULTURAL SECTOR ON THE EVE OF INDEPENDENCE**

The following is extracted from the book *Indian Economic Development* (published by Saraswati House):

The Indian economy during British colonial rule was primarily an agricultural economy. Almost 85 percent of the country's population lived in villages during that period and derived its livelihood directly or indirectly from agriculture. Despite being the major source of livelihood, the agriculture sector continued to experience stagnation and deterioration during British rule.

**The state of the Indian agriculture sector on the eve of independence was as follows –**

1. Weak productive accumulation – At the time of independence, the means of production were defective, there was insufficient use of fertilizers, machines were defective etc. All these led to weak productive accumulation.
2. Unemployment and underemployment – Poor capital formation in agriculture led to rise in unemployment and underemployment.
3. Low levels of production and productivity – Farmers were poor, undernourished, had low stamina and no incentive to work. It led to low productivity of labour. Agricultural production in India was less than its demand. It produced only 508 lakh tonnes of food grains in 1947-48. At that time, just 13 crore hectares of land were under cultivation.

4. Subdivision of landholdings – Landholding is defined as the area of land which a person or a family owns. It could be one piece of land or a number of small scattered pieces of land. At the time of independence, what prevailed was division, subdivision and fragmentation of landholdings.

**Indian agriculture was stagnant. The main causes of stagnation were as follows -**

**1. Land tenure system**

- Zamindari System – Zamindars or landlords were the owners of the land. The actual collection by Zamindars was much higher than what they had to pay to the Government. This system led to multiplication of middlemen between cultivators and Government, absentee landlordism, exploitation of peasants by unsympathetic agents, enmity between landlords and tenants. Under the system intermediaries benefited at the cost of both actual cultivators and the state.

**2. Commercialization of agriculture**

- This means production of crops for sale in the market rather than for self-consumption. Farmers were forced to cultivate commercial crops like indigo. Indigo was required by the textile industry in Britain for dyeing of textiles. As a result, there was fall in production of food crops. The farmers had to suffer from frequent occurrence of famine. Indian agriculture was transformed into a raw material exporting sector for England.

# Acknowledgements

After two decades' work with women farmers in conserving the agricultural diversity which is the foundation of nutritional and food security, I had a deep desire to share with a larger community all the learning that came out of this work. I wish to acknowledge all the support I have received in making this dream a reality. I am indebted to Bharathi for her meticulous scrutiny of the text and for making it presentable. She has been very patient in accommodating all aspects of the text and carried out several iterations of editing. But for the time she spared, this volume would not have seen the light of day. I would like to express my heartfelt gratitude to Bharathi for the same. I thank Cheluvaraj for applying his design skills, which have made the presentation very attractive, colourful and lively.

I am very grateful to Dr. Vasavi, an eminent anthropologist and academician who gave her valuable inputs as I was writing this document. It would not be an exaggeration if I were to say that I drew a lot of inspiration from her writings *Harbingers of Rain* and *Shadow Space.*

I would like to thank the thousands of farmers who inspired me to undertake this journey. The warm hospitality with which they received me every time I was at their door is unforgettable. Many of them shared their joy of reaping a good harvest and often their problems, to which I may not always have had the solutions given the limitations of the circumstances in which I worked. I am grateful to them for all that they have taught me, from simplicity to sustainable living.

I have had the opportunity to mentor the many youngsters who have worked with me in this endeavour. Many of them have since

started their own initiatives to promote agricultural diversity in the state of Karnataka. I thank them for taking this forward.

I would like to thank all the colleagues who stood by me in times of trials. I would like to particularly thank Mr. Sundareshan, Sanjeev Raju, Rama, Veena Pai, Shivakumar Kiran, Sunil, Pradeep, Ramesh Hegde, Chitrani, Sindhu, Srinivas, Gangadhar and many others who worked with us in different capacities and at different periods. Every time there were demands on their time and energy my colleagues unhesitatingly gave their best. But for their hard work, we would not have been able to participate in this quest. To say the least, we worked as a family.

I wish to thank Ubinig, Mr. Paul of Polyp UK and ETC Group for permitting me to use the the cartoons reproduced in this volume.

I want to place on record the effort put in by my colleagues, particularly Rama who provided the excellent collection of photographs that have been used in this text. I would also like to acknowledge the very hard work of Shivakumar who served as a bridge between GREEN Foundation and the farmers with whom we worked. Considering the fact that the area where our work was initiated was divided by a dry deciduous forest which made reaching out to villages an arduous task, I thank all the field managers who willingly came forward to live in the villages to carry out their work, sometimes away from their families.

I would like to thank all the trustees of GREEN Foundation, Dr. Vasavi, Ashok Doraiswamy also called Dash, Ananda and Dr. Sudarshan, who were present in times of need and shared their wisdom in taking this movement forward.

Thanks to the many funders - Find Your Feet UK, Hivos—Netherlands, USC Canada, Friends of Compas Bertus and Wimheimstra Netherlands, Norad–Norway, IDRC Canada, SDC Switzerland, CBM Nepal, Development Fund Norway, the Government of India, Government of Karnataka, Rohini Nilekani Arghyam, Women's Earth Alliance, USA and the National Biodiversity Authority - who have supported our work unstintingly.

I thank my friends Jude and Michael Fanton from the Seed Savers Network, one of my very first contacts, Dr. Melaku, Dr. Fegeyasa, Pam Fernandez and Awgetchu Teshome, who were inspirational and gave me the impetus to undertake this work and encouraged me during times of crisis.

I wish to add that the work developed stronger roots in organic farming thanks to friends at IFOAM particularly Roberto Ugas, Markus Arbenz, Andre Leu, Urs Niggli and Katherine Dematto.

Last but not least, my family: Jaya, Madhu, Nanditha, Mahesh and Ramprasad, who supported my constant and long travels away and managed a home many a times without the care of a mother. I hope my grandchildren Aditya, Anahatha and Arjuna can draw inspiration from my work and dedicate their lives to a cause to protect nature.

There are many others who I may not have acknowledged here, but my gratitude goes out to the universe and everyone who I have interacted with in the course of my work.

# About the publishers

GREEN Foundation is a community-based organization which, in its over two decades of work, has undergone a metamorphosis: from starting with the concept of on-farm conservation to participation by farmers; from conserving seed to agrobiodiversity; from a project to a movement; from product to process; from target orientation to sustainability, with a focus on policy and advocacy; and from a single objective to the comprehensive concept of sustainable development of communities.

Third World Network is a research and advocacy organization working to bring about a greater articulation of the needs, aspirations and rights of the people in the Third World, and to promote a fair distribution of world resources and forms of development which are humane and are in harmony with nature.

The predominance of commercially marketed crop varieties and the supporting policy and legal frameworks in modern industrial agriculture are displacing indigenous varieties cultivated over the ages and which have been the mainstay of local farming systems the world over. This loss of agricultural biodiversity puts at risk both food security and the livelihoods of farmers who now find themselves tied to a corporate-controlled supply chain.

To counter this threat to sustainable food production, there is a need to turn to the enduring custodians of agricultural biodiversity - small farmers, in particular women farmers, who are the repositories of traditional knowledge of seed conservation and the providers of food for their households and communities. Drawing on the author's over 20 years of work with Indian women farmers in on-farm conservation, *Living on the Edge* makes it clear that efforts to safeguard agricultural biodiversity must go hand in hand with the protection and promotion of farmers' rights everywhere.

ISBN 978-967-0747-08-8
9 789670 747088