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Sowing Autonomy

Gender and seed politics in semi-arid India

Carine Pionetti

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Reclaiming Diversity and Citizenship

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I wish to convey my respect to the people who, in India and elsewhere, live with the land and renew, every day, their commitment to this life—and to none other—despite the increasing difficulty in upholding that choice.

Hyderabad, May 12th, 2005.

Note on the author

Carine Vatturi-Pionetti has been involved in environmental activities from a young age, first in Vancouver (Canada) and later on in Southern France and in the Alps. Simultaneously, she has been pursuing a growing interest and concern for farming and rural communities in India. Since her first initiation on agriculture through informal exchanges with Bengali farmers in 1992, she has continued to learn about the interconnection between farmers' knowledge systems, crop diversity and livelihoods, with a growing emphasis on gender issues. She has contributed to the organisation of farmers' exchanges and international workshops on gender, environment and development in Europe and India.

From 1999 onwards, her research journeys have essentially taken her to the Deccan Plateau of South India. In her doctoral work, she explored the autonomy component of localised seed systems and sought to understand how new forms of control associated with industrialisation transform the livelihoods of small Indian farmers, as they have transformed the lives and insights of farmers in Europe and North America. She recently received a doctorate in Political Ecology from the University of Orléans (France). Her earlier training at the University of British Columbia in Vancouver was in Anthropology and Women's Studies.

Executive Summary

The diversity of crops and livestock in existence today results from natural evolution coupled with the domestication practices of farmers across the globe. For millennia, farmers have developed farming practices adapted to local conditions; they have domesticated plant species and emphasised the adaptive and productive potential of crops and animal breeds. Agricultural biodiversity is extremely high for crops like rice, potato, wheat, barley and sorghum. It is estimated, for example, that over 50,000 varieties of rice were grown in India before the Green Revolution.

Women, through their multiple roles as farmers, cooks, gardeners, keepers of culinary traditions, seed custodians and healers, have played a major role in shaping this diversity. Women's knowledge and use of plants not only concerns crops, but also uncultivated species that are gathered to meet food, fodder, fuel or health needs.

Over the last five decades, seeds have slipped out of farmers' control by gradually becoming the prerogative of breeders, genetic engineers, commercial seed growers, registered seed dealers and bureaucrats in charge of seed market regulations. Commercial seeds are developed against a background of technological control, economic efficiency and rational management. The commercialisation and adoption of new crop varieties is undermining women's roles in the realms of seed and crop management, and has serious implications for the maintenance of agro-biodiversity.

This book explores these threats in a case study of the farming system of the Deccan Plateau in South India. The author looks in particular at women's roles in agriculture and especially the important part women play in saving and reproducing seed. This is set against the backdrop of the increasing commercialisation and centralisation of the seed sector and agriculture in general.

Research approach

This study is based on participatory research in eight villages from Medak and Adilabad districts in Andhra Pradesh. Both are dryland districts and farming is largely rainfed. These eight villages include a range of dryland farming systems, allowing the author to study and compare two major types of seed systems: one largely run by farmers and based on local crop varieties adapted to dryland

conditions, and the other driven by a commercial logic and based on hybrid seeds developed by the public and private seed industry.

This work draws on a number of disciplines and schools of thought. Firstly, political ecology seeks to comprehensively address the linkages between environment, poverty and the problem of control and access to resources. The second, gender studies, provides methodological and theoretical tools for a study of gender relations in various cultural contexts. Finally, the author uses Ivan Illich's frame of analysis to understand the interplay between autonomy and heteronomy and to explore questions like what the shift from self-produced seeds to commercial seeds means for freedom, equity and gender relations; whether informal and formal seed systems can co-exist; and how the development of a techno-structure (the seed industry and its research, marketing and regulatory apparatus) affects individual farmers' capacity to produce their own seeds.

Seeds and survival on the Deccan Plateau

In the Deccan Plateau there are three types of seeds: farmers' seeds in the case of local varieties (sorghum, pigeonpea, safflower, mustard…); farm-saved seeds in the case of improved open-pollinated varieties (rice, blackgram, greengram…) and commercial seeds in the case of hybrids (cotton, maize, sorghum, chillies…).

Seed production by farmers is highest in rainfed systems where food crops make up a substantial part of agricultural production. In their seed-saving practices, farmers have two distinct and complementary goals: to reproduce the distinctive characters of each local crop variety and to increase the variability and adaptability of plant genetic resources. This book provides many examples of how farmers, mainly women, have developed an in-depth knowledge over generations of the techniques for selecting, storing and sowing seeds to ensure their families have enough nutritious food from one year to the next.

Detailed farmers' accounts of why seed-saving is essential invariably emphasise the interconnectedness between self-reliance in seed, crop diversity and nutrition. By extension, the realms of food culture and religious rituals (which entail the use of traditional crops) are also linked to seed autonomy. What is most significant about the intertwining of seed-saving, crop diversity and nutrition is that these three realms are largely under women's control. Being able to save their own seed means that women can ensure:

- diversity in crops and food
- crop characteristics that meet their own specific needs
- the ability to sow at the optimal time

- the accumulation of seed capital
- self-reliance and bargaining power within the household

Individual women's seed work merges with practices of seed exchange at the community level to form a 'localised seed economy'. This provides farmers with a local and non-monetarised source of seeds, enabling small and marginal farmers to access a vital agricultural input at no cost. These transfers of resources promote social networks based on reciprocity and cooperation that extend far beyond kin and caste relations. They are also extremely significant for ecological reasons, allowing the dryland farming system to continue to evolve and adapt to the local environment.

The growth of the industrial seed and farming sectors

For most actors in the commercial seed sector, the use of local varieties and farm-saved seeds by the vast majority of farmers across the developing world is nothing less than an aberration. The development of the seed industry is commonly seen as running parallel to the modernisation of agriculture. A clear connection is thus established between the seed industry's capacity to earn returns on its investment, farmers' access to improved germplasm and the development of agriculture. This view sets the stage for fully-fledged institutional support for commercial seed models over farmer-centred seed systems, reputed to be inefficient and obsolete.

Like any other seed industry in the world, the Indian seed industry has a vested interest in increasing the seed replacement rate, i.e. the proportion of seeds purchased annually, for all major food and cash crops. In India, this rate averages around 30 to 35%, with relatively low rates (below 30%) in food crops like rice, wheat and millets and much higher rates (to the tune of 95%) in commercial crops like cotton or maize. The industry proposes raising the overall replacement rate to 65% in the coming decade. In other words, the aim is to create a seed market catering to 500 million farmers, at the very least. Another objective is to banish seed-saving practices on-farm, as these severely limit seed sales and therefore hinder the growth of the seed industry.

The author therefore explores in depth the *modus operandi*, the motives and the strategies of the Indian seed industry, which is divided into the public sector, present for over 40 years, and the private sector, whose emergence is more recent. Trends in the seed and biotechnology industry result from the interplay between these two sectors.

On a global scale, the seed industry undermines the scope for farmers to save their own seed through a mix of technological, legal and economic strategies:

1. Biological controls, like reducing the genetic variability of new crop varieties through pureline breeding methods; the sale of 'one-time use' seeds or planting material that farmers cannot freely reproduce; genetically engineered seed sterility such as 'terminator technology'.
2. Legal controls, imposed through intellectual property rights regimes such as breeders' rights and patents which make it illegal for farmers to reuse seeds.
3. Policy controls, such as variety registration which is designed to meet the needs of monocropping systems in high-input agriculture; seed certification schemes backed by economic rules or subsidies; and gender-blind laws which provide no scope for enhancing women farmers' practices, choices and concerns in the realms of biodiversity and seed production.

The impact of commercial seeds on women and crop diversity

In most villages on the Deccan Plateau, localised seed systems co-exist with the formal commercial seed system. Farmers rely on the latter for high-yielding varieties of greengram, blackgram, pigeonpea and, more importantly, for hybrid varieties of cotton, sorghum, maize, chillies and a range of vegetables. However, the need to purchase these seeds imposes a whole series of constraints on cash-poor farmers and invariably leads to indebtedness. The moment farmers adopt one or several components of the agro-industrial system, they inevitably find themselves locked into a production chain where the choice of inputs and the use of the harvest are pre-determined by agro-chemical and food-processing firms. Thus, 'modern' farmers progressively lose their ability to make autonomous decisions about modes of production, crops, type and quantity of inputs and use of the produce. They also become increasingly dependent on technical information generated by specialists (agricultural scientists, chemists, genetic engineers, nutritionists…) and transferred to farming communities by agricultural extension workers or technicians.

The growth of the commercial seed sector has had a profound impact on local seed exchange systems. In areas where commercial crops have almost completely displaced food crops, the practice of seed-saving itself is disappearing, with subsequent loss of local knowledge on maintaining agrodiversity, traditional breeding, seed selection, seed production and storage. By losing their prerogative over seeds, women have lost their main means of ensuring mixed cropping in their fields, with adverse consequences for the land and for plant diversity. As cropping systems lean towards commercialisation and away from dryland food crops, women's role in decision-making about cropping cycles and practices diminishes. Furthermore, with most cash crops women farmers have very little control over the harvest and its uses.

Thus the processes of industrialisation and institutionalisation in the seed sector are undermining the very basis of autonomous seed production by:

1. degrading farmers' knowledge systems and innovation capacity
2. destroying an activity that provides a living for marginal and landless farmers, especially in female-headed households
3. undermining solidarity networks on which poor rural households critically rely
4. undermining women's status and intra-household bargaining power as their role in seed and grain management is eroded by market forces
5. destroying localised seed economies: seed regulations hamper farmer-to-farmer seed exchanges that have been shown to reinforce ecological sustainability and to secure livelihood and social capital in rural communities

Conclusions

The Indian seed industry is developing at a fast pace in a context of economic liberalisation and poses serious threats to the very existence of farmer-centred seed systems. Therefore, public policies need to be re-oriented towards a) providing support to the informal sector and b) building synergy with localised systems of innovation, production and exchange of seeds, as suggested by Ivan Illich. The institutional system has to work on the development and sustainability of a seed system suited to the needs of small dryland farmers through the following goals:

1. Institutional support for decentralised seed systems

- Support farmer-led participatory breeding and selection in public research institutes and enjoin scientists to give priority to breeding criteria such as low-input requirements, yield stability, food and fodder quality
- Recognise and enhance women's role and expertise in the selection, production, storage and distribution of seeds in farming communities
- Support community gene banks which improve farmers' access to seed for local varieties, reduce small farmers' dependence on large farmers and act as seed insurance systems in the event of large-scale crop losses
- Encourage landless households (especially female-headed households) to take part in village seed production for local food crops but also for tree crops and medicinal plants
- Help farmers develop seed certification schemes based on local criteria to guarantee seed quality and to favor the circulation of farmers' seeds at the regional level

2. Strengthening diversity-based farming systems in the drylands

a) On the ecological front:

- Ensure farmers have timely and appropriate access to livestock, organic inputs, biopesticides and seeds for dryland crops
- Document local practices which foster agrobiodiversity on farmlands
- Intensify people's involvement in watershed development and discourage costly and risk-prone irrigation based on the unsustainable use of groundwater
- Increase the resilience of dryland agro-ecosystems to environmental change through participatory studies on climate change and its impact on plant biodiversity

b) On the economic and social fronts:

- Increase the viability of organic and low-input farming practices through adequate price support mechanisms for dryland food crops and through a re-orientation of subsidies in favour of ecologically-sound agriculture
- Provide low-cost methods for long-term grain storage as well as processing technologies for dryland crops
- Develop alternative land-based livelihood activities for small and marginal farmers and for landless households
- Democratise local institutions and introduce the goal of gender equity in regimes of access and control over productive resources
- Protect small farms from the adverse impact of global trade agreements

3. Change of policy orientations on technological and legal developments

a) On new technologies and corporate practices

- Develop mechanisms for a systematic independent assessment of the ecological, socio-economic and gender impact of new technologies on small and marginal farmers and on farming communities
- Introduce measures that limit the adoption of technologies known to generate indebtedness in farming communities (chemical pesticides, transgenic seeds)
- Monitor and regulate the use of commercial arrangements (contracts, technology-user agreements…) that pose a threat to the informal seed sector
- Make private corporations accountable for any damage caused to farmers

b) On intellectual property rights

- Asssess the seed industry's demands for more stringent intellectual property rights over seeds in the light of long-term economic, social and psychological impacts on farming communities
- Refuse patenting of plant and animal life
- Strengthen farmers' rights on local crop varieties and penalise Indian and foreign breeders violating these rights

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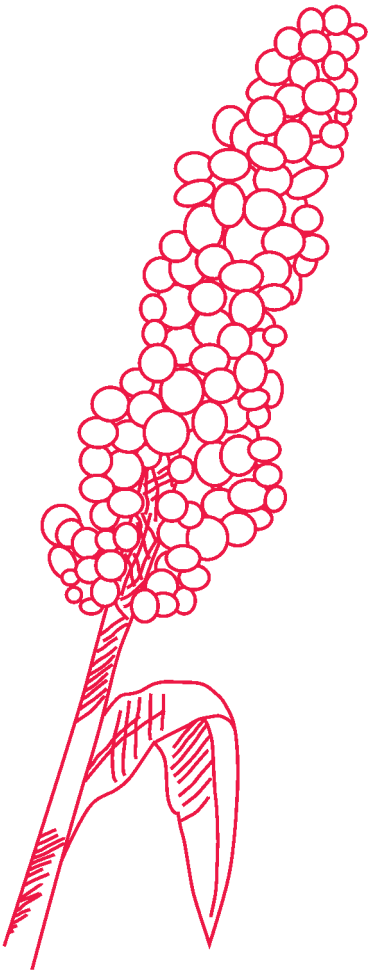


Agriculture, gender and power

Dryland farming is often associated with marginality, poverty and dependency. These aspects constitute an important rationale for relief-based interventions and for the introduction of technical improvements into these systems. Yet, there is a growing recognition that indigenous ecological knowledge systems and local forms of resource management in semi-arid areas may be sounder than external development formulas.

Local crop varieties (or landraces) developed by farmers are adapted to local climatic and agronomic constraints and although they often primarily meet subsistence needs (food, fodder and fibre), they are also grown to fulfil local market demands. In addition, some varieties are associated with particular culinary or ritual practices. Landraces still prevail today in marginal agricultural zones and highly heterogeneous environments and in 'traditional' farming systems characterised by small-scale farms and subsistence production; they are also commonly associated with poverty and ethnic minorities (Orlove and Brush 1996).

Throughout the world these local crop varieties are being replaced by externally-developed higher-yielding varieties in an attempt to increase crop productivity and to improve the livelihoods of marginal farmers. But this strategy has far-reaching implications for agro-biodiversity, women's roles and the resilience of rural households.

The significance of gender in understanding the knowledge, practices and representations associated with crop diversity is still to a great extent underestimated. One primary reason for this is that women's contributions to agriculture are still largely ignored or undervalued by researchers, extension workers and policymakers alike. Yet, crop diversity has been shown to be a gendered domain in several respects:

1. Women and men have different responsibilities for agriculture and food production, for which they possess different sets of skills and practices. For

instance, processing, selection, preservation and storage of foodgrains are typically female tasks, which require specialised ethnobotanical knowledge and related skills in domestic post-harvest and culinary practices (Howard 2003).

2. Men and women use different criteria when choosing and managing crops. Women's choices reflect their multiple roles as farmers, cooks, gardeners, keepers of culinary traditions, seed custodians and healers.

3. It has been argued that women's welfare and social status are strongly related to their management of plant diversity and their plant-related contributions to subsistence, technical environment and cultural knowledge (Howard 2003: 27).

4. The commercialisation of agriculture affects women and men differently. The adoption of new crop varieties induces changes in practices and responsibilities that women farmers experience in unique ways.

Over the last five decades, the reproduction of seeds has gradually moved out of farmers' fields and into the realms of formal science, experimental plots of research institutes, gene banks, commercial seed suppliers and bureaucratic processes of seed certification (Yapa 1996; Kloppenburg 1988). Commercial seeds are developed against a background of technological control, economic efficiency and rational management.

The means through which control and access to resources—seeds or genetic resources in our case—are secured, contested and restricted is now recognised as a central theme in the field of political ecology. Control is a recurring topic in studies of the interaction between human societies and nature. Indeed, living organisms like domesticated crops or animals are increasingly subjected to various forms and degrees of management, regulation, manipulation and control. Control is imposed by one party and borne by another: this implies power relations that are not always explicit, but nonetheless very real, between at least two entities or groups (states, communities, individuals, corporations).

Power can be defined as 'the ability, actual or potential, to exercise command and control over resources and ideology… The extent of power depends on the differential capacities of actors within a system to secure access to and consequently control over valued advantages and resources' (Pant 2000). Power almost invariably generates counter-powers and resistances, as shown by James Scott in the context of peasant societies, and Michel Foucault in the context of industrial societies (Scott 1985; Foucault 1977). Documenting resistance at the ground level is therefore an important task, and needs to be complemented by a critique of hegemony and domination.

Control, power and resistance: these are fundamental notions in my approach to the politics of seeds, a sub-theme of the larger topic of gender and crop diversity.

Understanding seed politics means unravelling the nexus of power relations and the role played by institutions, private actors and communities in the management of plant genetic resources. In this book, I look into knowledge and power structures in agricultural diversity and seeds, not only in the political arena but also in the social, ecological, cultural, technological and economic realms, both at the local and at the national and global levels.

This book contains six major sections. Chapter 2 presents detailed accounts of the methodology used and of the rationale for choosing participatory feminist research methods. Chapter 3 describes the agro-pastoral system of the Deccan Plateau, with a particular focus on the interrelations between the diversity of livelihoods and the structure and organisation of agrarian society. Chapter 4 looks into crop diversity management from a gender perspective. The importance of gender power relations in the strategies, perceptions and practices of small women farmers is explored in the context of both subsistence and commercial farming systems. Chapter 5 'zooms' into one important dimension of the localised village economy: seeds. It outlines farmers' rationale for seed-saving and describes the informal seed system in its ecological, social, economic and gendered dimensions. In Chapter 6, I explore the formation and evolution of the Indian seed industry with a focus on breeding approaches, seed regulations and intellectual property rights. Chapter 7 explores the wider agro-food system and exposes the linkages between concentration in the industial sector and loss of autonomy in farming communities. In the concluding chapter, I suggest an alternative model based on synergy between the institutionalised sector and localised seed systems and rooted in the principles of farmers' control and limits to industrial growth.

Defining the stakes

The marginalisation of dryland rainfed farming

Rainfed farming remains the most prevalent mode of agriculture in India and throughout the world, in spite of sustained efforts to bring arable land under irrigation. Rainfed agriculture is associated with rainfall variability, which introduces an element of risk in all natural resource-based livelihoods, especially crop production. In India the risk factor considerably increases in semi-arid areas, which cover 42% of the country. Ranging between 400mm and 1200mm in these areas, annual rainfall is characterised by high inter-annual variation, which makes farming difficult and uncertain. Drought is a regular phenomenon and is a major factor behind the decline of agricultural income, problems in accessing food and drinking water, poverty and temporary migration of resource-poor farmers. Yet dryland farming has supported, and can continue to support, millions of people in semi-arid areas.

The challenges of farming in the rainfed drylands should have led to concerted public policy efforts to secure the viability of dryland farming for small as well as large farmers and to support and diversify the livelihoods of rural people living in these regions. Yet over the last four decades, agricultural development has largely consisted of increasing the productivity in the best-endowed regions through introducing new agricultural practices and technologies. Alluvial plains and deltaic areas have benefited from Green Revolution technologies (including large-scale irrigation) that minimise the risks inherent in agriculture. In contrast, the 'least endowed regions' from an agro-climatic point of view—including drylands, uplands with erosion-prone soils and hilly or mountainous regions—have received considerably less attention. The same patterns of modernisation of agriculture can be observed in industrialised nations, where the development of large, high-input farms located in fertile plains has been favoured at the expense of dry regions, wetlands and mountain zones. Whilst the Green Revolution approach is not suited to dryland environments, a similar investment of research and money could considerably enhance agricultural productivity in these regions.

World agriculture therefore consists of three largely co-existing agricultural systems: highly productive industrial agriculture in Europe, North America, Australia and parts of Latin America; irrigated Green Revolution agriculture in many parts of Asia; and what has been termed 'complex, diversified and risk-prone agriculture' in sub-Saharan Africa, Central Asia and the drylands of Asia. It has been estimated that 1.4 billion people, i.e. more than a quarter of the world population, depend on this diversified and low-input agriculture (Chambers et al. 1989).

The low agricultural productivity of dryland regions is held to be one of the major causes of poverty for most of their inhabitants. Yet the experiences of the poor reveal that poverty is multidimensional and cannot be simply defined as hunger and inadequate income. It is intimately interlinked with powerlessness, social isolation, deprivation, gender inequity, state corruption and violation of dignity (Narayan et al. 2000). Constraints to managing physical, human, social and environmental assets are increasingly identified as key factors underlying poverty. The existence of these constraints raises questions about the efficiency and appropriateness of technical improvements and economic profits in addressing poverty (Mortimore et al. 2000).

Yet nothing indicates that the trend of declining returns from agriculture in semi-arid areas is irreversible. Recent experiences show that it is possible to limit the incidence of vulnerability and to increase productivity in these risk-prone regions, provided that the social organisation of production and exchange are well-understood and accounted for and that solutions foster sustainability and equity (Pretty et al. 2003).

Women's declining role in preserving agricultural diversity

The diversity of crops in existence today results from natural evolution processes coupled with the domestication practices of farmers across the globe. For millennia, farmers have developed farming practices adapted to local conditions; they have domesticated plant species and emphasised the adaptive and productive potential of crops and animal breeds. Biological diversity, or biodiversity for short, is defined in the Convention on Biological Diversity as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other ecosystems and the ecological complexities of which they are a part; this includes diversity within species, between species and of ecosystems' (UNEP 1995). Agricultural biodiversity, or agro-biodiversity, refers to the diversity of crop species and to the genetic variability within species, which is extremely high for crops like rice, potato, wheat, barley and sorghum. It is estimated, for example, that over 50,000 varieties of rice were grown in India before the Green Revolution.

Women, through their multiple roles as farmers, cooks, gardeners, keepers of culinary traditions, seed custodians and healers, have played a major role in shaping this diversity. For example, in various geographical and cultural contexts, women farmers give more consideration than men to the cooking time, nutritional value and modes of processing of different crop varieties. This applies equally to maize varieties in Mexico, pigeonpea varieties in India and dryland cereals in Mali (Howard 2003:10-11). Women's knowledge and use of plants not only concerns crops, but also uncultivated species that are gathered to meet food, fodder, fuel or health needs. Throughout the world, such gathering is primarily done by women.

The commercialisation and adoption of new crop varieties can undermine women's roles in the realms of seed and crop management, and has serious implications for the maintenance of agro-biodiversity. In the Himalayan regions of Northern India, for instance, 'traditional systems of knowledge have been undergoing transformation over the past three decades largely due to the introduction of hybrid varieties of seeds and the loss of genetic variation… This tension between *old* and *new* knowledge systems has particularly negative consequences for women who draw on [local] practices in their daily work and who, in any case, lack access to new information and products' (Mehta 1996).

The lack of gender-disaggregated data on women's knowledge about agrodiversity and on the impact of agrarian changes on women's farming practices leads to misconceptions and erroneous information. For instance, when farming systems are modified through the introduction of modern crop varieties, the benefits in terms of income and welfare gains tend to be overstated as the reallocation of women's labour largely goes unaccounted for (Jiggins 1986). There is also evidence that women are affected uniquely by technical changes in food cropping. These changes include more capital intensive approaches, mechanisation, the introduction of external knowledge and the development of crop and varietal characteristics geared to the

requirements of commercial commodity production. However the precise nature of these effects is neither well-documented nor well-understood.

The erosion of agrobiodiversity

The erosion of biological diversity has emerged as a major environmental problem over the last two decades. The dominant model of agricultural development is in large part responsible for the loss of crop and genetic diversity, not only in industrialised nations but also in virtually all farming systems across the world. Three main causes for agrobiodiversity erosion are generally put forward:

1. the displacement of local varieties by improved or exotic varieties
2. the intensification of agricultural systems that, together with the intensified use of agrochemicals, result in large-scale habitat destruction
3. the over-exploitation of plant resources through over-grazing, excessive harvesting of wild plants and other forest products (FAO 1997).

The mandates of the national and international agricultural research institutes spearheading the Green Revolution have revolved around a limited number of widely grown crops. This fails to reflect the reality of subsistence agriculture in many parts of the world. Local varieties of crops such as pearl millet, sorghum, cassava, plantain, groundnut, pigeonpea and lentil account for a large part of the food energy supplies of people living in Central Africa and in the drylands of Asia. Moreover, dozens of species of semi-wild and uncultivated plants still form part of the diet of rural people in many parts of the globe. These plants provide edible green leaves, berries and tubers that play a major role during periods of food scarcity. These 'minor' cultivated crops and uncultivated plants have been completely bypassed by institutional crop improvement research programmes. This partly explains why half of the food needs of the planet are met by only four main crops today (wheat, maize, rice and potato), implying high levels of uniformity in food production.

Modern plant breeding concentrates on developing varieties that are adapted to highly artificial growing conditions and to uniform farming systems that foster very little off-farm diversity. The massive substitution of local varieties by high-yielding varieties (HYV) or hybrids is responsible for a drastic reduction in genetic diversity. For instance, 91% of maize varieties, 94% of pea varieties and 81% of tomato varieties have disappeared over the last 100 years in the United States (Fowler 1994). In India there are no precise figures for the extent of loss of indigenous crop diversity, but 'some idea can be gauged by the fact that a handful of HYVs are now grown over 70 per cent of the paddy land and 90 per cent of the wheat land of the country. Thousands of varieties of cereals (rice, wheat, etc), cotton, minor millets, pulses and other crops are no longer in use on farms' (Kothari 1997: 54).

As crop genetic diversity is such an essential dimension of agricultural production in low-input farming systems, a reduction in diversity often leaves small cultivators more vulnerable (Cleveland et al. 1994). The destruction of hedges in and around farms and the degradation of commons also have negative impacts on the sustainability of small farms as they severely limit gene flows between cultivated and semi-cultivated species (these transfers play an important role in preserving the genetic variability and adaptability of local crops). At the ecological level, 'decreased biodiversity interferes with all manner of essential ecosystem functions such as pollination, the maintenance of soil health, water cleanliness, the assimilation of wastes, especially toxic wastes, and the cycling of carbon, nitrogen and sulphur'. In other words, biodiversity loss undermines 'the capacity of life to survive and reproduce itself with vigour and reliability' (O'Riordan 2002: 10).

In addition, current systems of food processing and distribution cannot accommodate a large diversity of crops, nor do they foster genetic diversity. It is more profitable from the point of view of agro-food industrialists and food supply chains to offer a limited range of standardised food products for sale. This is an additional factor behind the reduction in agrobiodiversity. Changes in food habits due to migration, urbanisation and globalisation via the expansion of food commodity markets only favour uniformity and standardisation of crops at the expense of agrobiodiversity, indigenous foodstuffs and local culinary traditions.

The informal and the formal seed systems

Seed has been a central element of farming systems for millennia. Farmers alone know the true value of seed and many cultural practices across the globe attest to the special place of seeds in agrarian culture. Two seed systems need to be distinguished:

1. the informal seed system, run and controlled by farmers
2. the formal seed system, run by professional breeders and commercial seed dealers, and supported by well-defined rules and procedures

The informal system involves farm-saved seed, farmer-to-farmer exchange and informal markets. According to some estimates, this sector accounts for 80% of planting materials worldwide (Manicad and McGuire 2000).

In developing countries alone, it is estimated that 90% of all seed demand is met by local seed supply (Almekinders et al. 1994). In farmers' seed systems, the selection, production, storage and exchange of seed are integrated within the agronomic and sociocultural practices of farming communities. It has been shown that informal seed systems often belong to the female domains, with strong taboos to keep men away from seeds in some cultures (Bellon and Risopoulos 2001).

In most developing countries, formal seed systems, designed along the lines of western organisation patterns of seed supply, co-exist with local seed supply systems (Almekinders et al. 1994). The growing—yet still extremely marginal—recognition of the limitations of formal seed systems is leading to the emergence of the concept of 'integrated seed supply', which starts with an assessment of the values and limits of both systems.

The development of biotechnology—and more specifically of genetically engineered crops—in the 1980s and 1990s poses a new set of challenges to all farmers, in industrialised and developing countries alike. Although biotechnology is often presented as a way of combining productivity objectives with sustainability, it can also easily be interpreted as yet another step in the process of industrialisation of agriculture. The potential of genetically modified (GM) crops for developing countries appears limited if we consider the fact that GM crops are largely being developed for high-input farming systems and have little to offer complex and risk-prone agriculture. Moreover, stringent intellectual property rights regimes are associated with genetically modified seeds. Patented seeds modify power relations in agriculture by introducing new constraints on farmers' access to seeds. Coupled with the emerging discipline of bioinformatics, gene research inaugurates new modes of production and reproduction. Thus, the fundamental stakes of this 'biocybernetic' 21st century are on the one hand the ability to control essential life sources such as genetic resources, and on the other, the ability to master and transform information flows and financial, computer and genetic networks (Vandelac 2001).

Theoretical framework

No single discipline can embrace the intricacy of environmental, developmental and gender issues associated with the politics of crop diversity. My work therefore draws on a number of disciplines and schools of thought. The first is political ecology, which has sought to comprehensively address the linkages between environment, poverty and the problem of control and access to resources. The second, gender studies, provides methodological and theoretical tools for a study of gender relations in various cultural contexts. Put together, these two disciplines form the core of feminist political ecology which explores the gendered relations of ecology, economics and politics. Finally, I use the frame of analysis developed by Ivan Illich to understand the interplay between autonomy and heteronomy (Illich 1977).[1]

1 Autonomy is a mode of functioning whereby a social group or a nation defines its own needs and limits and sets the course of its own development. Heteronomy refers to a system that is driven by an industrial and productivist rationale.

Political ecology

Fairly recent in origin, political ecology combines scientific ecology with political economy to address the political, economic and social dimensions of environmental problems. The discipline emerged from a criticism of the deterministic approach of ecological anthropology to the study of societies. The term 'political ecology' was first used in the 1970s 'as a response to the theoretical need to integrate land-use practice with local-global political economy' (Peet and Watts, 1996). Political ecologists study power relations underlying the definition, negotiation and transformation of environmental practices, techniques and property rights. In the 1980s, a number of researchers used this innovative analytical framework to criticise the tendency by the state and development sector to place the burden of environmental degradation on poor people in the developing world.

Six fields of investigation have been identified within the ambit of political ecology, focusing on the following topics (Peet and Watts, 1996):

1. the interrelations between capitalist growth and environmental problems

2. the integration of political action (everyday resistance, civic movements, organised party politics…) into questions of access and control over resources at various levels of analysis (household, community, institution, state, interstate)

3. the interface between civil society and the environment, based on two main objects of study: environmental movements on the one hand and local knowledge systems on the other, with a focus on the role of local institutions in the management of resources and in the production and transmission of ecological knowledge[2]

4. the plurality of perceptions and debates about environmental issues, leading to a critique of knowledge-power relations and institutional relations of global environmental governance and management

5. the practice of environmental history as a means of capturing long-term ecosystem changes and the process of commodification of nature[3]

6. a rethinking of the term 'ecology', long associated with stability, resilience and systems theory, to now embrace the complex dynamics of local environmental relations

This theoretical background opens up several important lines of inquiry for the issue of crop diversity. It helps us understand marginality not only as an environmental

2. On the theme of local ecological and ethnobotanical knowledge, the pioneering work of Paul Richards with rural societies from West Africa ought to be mentioned: Richards, P. 1985, *Indigenous agricultural revolution. Ecology and food production in West Africa*, Hutchinson and Westview press, London and Boulder.

3. One well-known example of this line of work in India is: Gadgil, M. and Guha, R. 1992, *This Fissured Land: An Ecological History of India*, Oxford University Press, New Delhi and Melbourne.

phenomenon, but also as a social and political construct. It allows us to compare perceptions and discourses on living organisms and to understand power relations underlying the hierarchy of knowledge systems that deal with life.

Political ecology looks for linkages between decision-making processes and ecological concerns. Thus, it entails a thorough understanding of the respective roles of local communities, state institutions and private actors in the management of natural resources. This approach helps me answer such questions as: Who makes decisions about cropping patterns or seed stocks? On what considerations, knowledge and goals are these decisions based? What is the relative importance of the social, ecological, cultural, technological and economic dimensions of agricultural diversity for various actors at the local, national and global levels? How are distinct conceptions of resources and rights defined and negotiated within rural communities and between communities and external institutions?

In sum, political ecology provides a framework for studying the impact of national and international decisions, agendas, political and technological orientations on the relationship between local populations and their environment and on local perceptions of well-being, autonomy, innovation and change.

Gender studies and feminist scholarship

The feminist movement of the 1970s, coupled with a growing recognition in the academic context of the gender bias present in many disciplines like history and anthropology, biology and agricultural sciences, led to the emergence of disciplines like women's studies and gender studies. Women's studies seek to shed new light on a range of pre-existing bodies of knowledge by focusing on the specific experiences of women and the reasons for their 'invisibility'. Gender studies concentrate on gendered differences in the way people relate to their environment, conduct their social life, take care of their health or perceive notions of space and time. Gendered relations are also extensively studied in the context of economic changes and political transformations and with reference to the global environmental crisis. A number of schools of feminist scholarship are directly concerned with environmental issues. The major approaches have been described as ecofeminism, feminist environmentalism, socialist feminism, feminist poststructuralism and feminist political ecology. These perspectives differ in their conceptualisation of identity and knowledge, of production and reproduction systems, and in their interpretation of the relationship between women and nature. For instance, ecofeminists suggest that women identify with nature, leading to a more caring attitude towards natural resources. Feminist environmentalists, on the other hand, argue that men and women's relationship to the environment is anchored in their

material reality and rooted in modes of production, reproduction and distribution that are specific to gender, class and caste.[4]

Feminist political ecology adopts the emphasis of political ecologists on decision-making processes and power relations; in addition, it 'treats gender as a critical variable in shaping access and control, interacting with caste, class, race, culture and ethnicity to shape processes of ecological change, the struggle of men and women to sustain ecologically viable livelihoods, and the prospects of any community for "sustainable development"' (Rocheleau et al. 1996).

One of the contributions of gender studies to environmental issues has been to identify and explore the lack of data on women's role in agriculture, natural resource management and plant genetic resource management. Most research dealing with agrobiodiversity tends to focus on market-oriented production and undervalues the significance of productive activities in the 'domestic' domain, like processing and storing foodgrains or tending home gardens (Howard 2003).

With respect to ethnobotanical research, three major shortcomings can be identified (Howard 2003): the failure to research women's knowledge and use of plants, which represents an error of *omission*; the *unreliability* of sources that are not well-informed because women have not been included in the research as informants or participants; and the difficulty of *interpretation* of research results describing people-plant relations in a 'gender-blind' manner (without taking into account the critical component of gender relations). These shortcomings reproduce and reinforce the 'invisibility' of rural women's knowledge and practices in the field of biodiversity management and perpetuate gender-blind policies in this domain.

Another major contribution of gender studies has been the identification of the household (or the family) as a political unit where power relations are played out, translating into inequality in the division of labour, in the distribution of resources and in the allocation of authority and decision-making power (Kabeer 1995). Recent work focuses on 'how the strategic behaviour of individuals within households is linked to wider social processes, institutions and power structures. Community structures, public services and markets, for example, are not neutral but operate according to rules and norms which afford different access to women and men' (Kanji 2003).

These theories and concepts inform and shape my work in several ways. First, the concept of 'gender-blindness' has given me valuable insights into areas that need to be reinforced through research, and methods that need to be adopted to ensure that women are included at all stages of the research process.

4. For a more detailed analysis of these diverging interpretations, see Agarwal, B., 1999, "The Gender and Environment Debate: Lessons from India", in N. Menon (ed.), *Gender and Politics in India*, Oxford Uniervsity Press, New Delhi, pp. 96-142.

Secondly, my emphasis on gendered power relations in the ownership and control over resources is informed by the political ecology approach. The gender variable is of critical importance in the study of access and control over productive resources. Indeed, in spite of women's primary role in meeting the family's daily requirements for food, fodder and fuelwood, men's control over household, land, capital and other valuable assets is deeply entrenched in most of Indian rural society.

Thirdly, the mounting evidence that 'gender dimensions of people-plant relations affect use, rights, knowledge, management, conservation and erosion of plant biodiversity' has led me to give a central place to gender in my work on crop diversity management in dryland areas (Howard, 2003). Some of the underlying questions that have framed my research with women farmers are: Who makes decisions about cropping patterns in the household? What are the factors influencing such decisions, and do men and women perceive these factors differently? Do women farmers have a special stake in maintaining a diversity of crops on their farms? Who is in charge of seed processing and seed storage activities at the community and household levels? How does the introduction of new crop varieties redefine gender roles and responsibilities and women's status?

Autonomy and heteronomy: a radical critique of modernity

The radical ecology movement born in the 1960s was essentially concerned with 'the impoverishment of the bonds uniting human beings with the world and with others or, in other words, the degradation of the environment *and* of social relations' (Gollain 2004). The loss of capacity for autonomy and self-determination is a direct consequence of the expansion of the industrial, heteronomous model of development rooted in commodity production. An important mechanism in this process is what Ivan Illich has termed 'radical monopoly': 'the substitution of an industrial product or a professional service for a useful activity in which people engage or would like to engage', leading to the deterioration of autonomous systems and modes of production (Illich 1996). Radical monopolies replace non-marketable use-values with commodities by reshaping the social and physical environment and by appropriating the components that enable people to cope on their own, thus undermining freedom and independence (Illich 1976).

The notion of 'radical monopoly' is linked with the creation of scarcity caused by certain forms of development (Box 1).

Ivan Illich argues that owing to the 'industrialization of our world view', the fact that commodities produced by the industrial sector compete with individual capacities for autonomous production is often overlooked. He also shows that 'the invasion of the underdeveloped countries by new instruments of production organized for financial efficiency rather than local effectiveness and for professional rather than lay control inevitably disqualifies tradition and autonomous learning'.

1

Box 1: The construction of scarcity in agriculture

Scarcity can be created by an expansion of uses for a given commodity, as in the creation of a demand for new goods through advertising, or through the manipulation of sources of supply. In the ecological realm, scarcity is constructed in two ways: (1) by replacing the 'reproductive capacity' of nature with the 'productive capacity' of industrial inputs, and (2) by degrading conditions of production (Shiva 1991).

Two examples from agriculture illustrate the concepts of radical monopoly and the creation of scarcity. The growth of the pesticide industry—in the fields of research, development and marketing—has stunted the development of alternative low-cost techniques based on farmers' knowledge and innovation. These include biological controls, cultural methods such as crop rotation, and crop breeding to develop disease-resistant plants. It has been argued that the main reason why chemical solutions have received considerably more support than all the other organic techniques of pest control is that they generate exchange value in the form of profit, as opposed to biological controls that are produced from local resources and therefore have a use value but no market price.

Similarly, techniques for soil fertility regeneration that had a use value but no exchange value (such as applying animal manure, multiple cropping, incorporating nitrogen rich legumes in agricultural production, etc…) have been systematically underdeveloped. Thus, 'apart from increasing costs of cultivation, the use of chemical nitrogen contributed to increasing scarcity by reducing the supply of naturally available organic nitrogen'.

Source: Yapa, L. 1996, 'Improved seeds and constructed scarcity', in R. Peet and M. Watts (eds), Liberation Ecologies: Environment, development, social movements*, Routledge, London, pp. 69-85.*

Having closely studied heteronomous models of health, Ivan Illich developed a critique of the institutional medical sector and its impact on people's capacity to take care of their own health. This analytical framework can be applied to the seed sector through four shared characteristics:

1. formal health and seed sectors are driven by an industrial logic
2. both sectors have been heavily institutionalised over the past three to four decades
3. autonomous practices existed prior to the establishment of heteronomy-based systems
4. local health traditions and local seed systems are non-monetary in nature, whereas formalised systems are market-based

This raises several questions: What does the shift from self-produced seeds to commercial seeds mean for freedom, equity and gender relations? Can informal and formal seed systems co-exist? How does the development of a techno-structure (the

seed industry and its research, marketing and regulatory apparatus) affect individual farmers' capacity to produce their own seeds?

How these theoretical backgrounds have been combined into a specific research methodology is discussed below.

A composite research methodology

My research had four objectives:

1. to understand the relevance of diversity-based cropping systems for small dryland farmers

2. to study the linkages between gender and agricultural diversity and the implications for women farmers of a shift towards commercial crops

3. to consider the ecological, social and political relevance of localised seed systems in dryland environments

4. to assess the impact of industrialisation on localised seed systems.

There are two major components to this research. One rests on *empirical* research with small farmers from the Deccan Plateau and focuses on women-run localised seed systems and on the transformation that these systems are currently undergoing (objectives 1, 2 and 3). The other is more of a *conceptual* look at the formal seed sector and at the processes of institutionalisation and industrialisation at work in this sector, both at the national and global levels (objective 4). Overall, this work is an attempt to understand the divide, the contradictions and the possible synergies between autonomy-based seed systems and the institutional heteronomous model, based on Ivan Illich's analytical framework.

My methodology, informed by the theoretical background described above, draws on three distinct but interrelated research approaches: participatory research, anthropological research and feminist research.

Central to participatory research is the idea of a partnership between the researcher and participants, where participants are positioned not as objects of research but as active subjects. The major objective of participatory research is 'to increase participants' understanding of their situation and their ability to use this information, in conjunction with their local knowledge of the viability of different political strategies, to generate change for themselves' (Wright and Nelson 1995). Although participatory research generates local knowledge for local use and contains a clear empowerment agenda, it is generally 'based on a limited theoretical understanding of processes of domination and change'. This gap could be bridged by anthropological theory which examines processes of knowledge construction and has developed a powerful critique of domination (Wright and Nelson 1995).

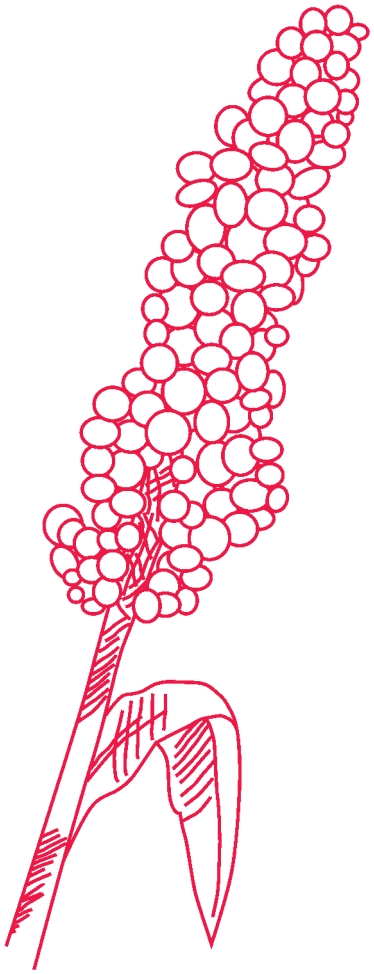
In recent years, anthropological work has been evolving a dialogical approach[5] by studying not only patterns of vulnerability and oppression amongst marginalised groups, but also patterns of domination and control amongst those who hold positions of power in government institutions, development organisations and even in the corporate world. In my work I have tried to adapt a similar approach to the politics of seeds by studying institutional dominance as well as local perceptions.

The third methodological approach I used is feminist theory which also addresses subject-object dichotomy and questions the construction of the female as 'the other'. Feminist research has sought to tackle issues of power, knowledge, representation and authority, even though 'post-modernist preoccupations with discourses, representations and texts have increasingly undermined the direct link between politics and feminist studies that was so clear in the beginning' (Schrijvers 1995). My decision to integrate gender concerns into the research by focusing on women farmers' experience was based on two factors: my previous research experience on farming practices in the Deccan Plateau in 1999, which revealed stark differences of perceptions between men and women farmers (Pionetti 1999), and a widening recognition of the lack of gender-disaggregated data in environmental studies in general, and in research on farmers' management of agricultural diversity in particular (Howard 2003).

Thus, I used a participatory and gender-sensitive methodology for the empirical work on the Deccan Plateau, while the study of seed regulations, policies and the seed industry relied on more conventional anthropological research methods. In the next chapter I discuss these methodologies in more detail. But first I set the scene by describing the research context—dryland farming on the Deccan Plateau of South India.

5. Where research is conceived as dialogue—see Box 3.

2



Research site and approach

Research context

The Deccan Plateau receives scanty rainfall, is regularly hit by drought, and is characterised by increasing out-migration—seasonally or permanently—in search of more secure livelihood opportunities. At the same time, this region is home to a rich rural agrarian culture, and it still harbours a very significant diversity of crops and livestock. Moreover, 'rural livelihood systems in drylands have, by their persistence over several decades, demonstrated a *resilience* which runs counter to some predictions of imminent irreversible degradation or collapse' (Mortimore et al. 2000).

Of the numerous factors that define rural livelihoods in the Deccan Plateau, three need to be highlighted: the specific nature of rainfed dryland agriculture; the cultural, economic and political marginality of the region and its inhabitants; and the processes of industrialisation that are rapidly transforming rural economies.

Dryland agriculture in India's semi-arid tropics

The semi-arid tropics (SAT) of India are home to 45% of its population. Over 250 million people derive a livelihood from these areas, despite the fact they are considered to be inhospitable. In total, 60% of the country's arable land is in semi-arid regions, which include 156 districts spread over 11 Indian states (Gulati and Kelley 1999). The agro-climatic conditions of semi-arid areas are extremely variable, but share several features: high inter-annual variation in rainfall; prolonged dry spells that increase the likelihood of drought; high rainwater run-off leading to severe soil erosion problems; and inadequate drainage, contributing to soil salinity and waterlogging (Joshi et al. 2001). Annual rainfall ranges from 400 mm to 1200 mm. About 30% of India's SAT regions are currently irrigated, compared with 17% in 1970. Agriculture therefore remains essentially rainfed, with a growing period extending from 120 to 150 days.

Together, these agro-climatic conditions pose severe constraints for agriculture. Yet a wide range of dryland crops are cultivated in these regions. It is estimated that 87% of minor cereals, 79% of pulses, 82% of oilseeds and 90% of cotton produced in India are grown in semi-arid areas (Gulati and Kelley 1999).

Small and marginal farmers form, along with landless labourers, the major agricultural workforce in the Deccan. Amongst low castes and women, the degree of involvement in agriculture is particularly high. In Andhra Pradesh, 48% of rural women work, compared to a national figure of only 30% (Duvvury 1998). Casual work in the agricultural sector is more common among women (53%) than men (43%). Child labour is more widespread in Andhra Pradesh than in other states: 25% of rural children between the age of 10 and 14 work, compared with 9% in the rest of India.

The invisibility of women's work in agriculture is of particular concern. Many statistics on women's role in agriculture grossly underestimate their contribution to this sector. According to figures produced for 2001-02 by the A.G. Ranga Rao Agricultural University in Hyderabad, for instance, women in Andhra Pradesh do 33% of the work in agriculture, and 2% of poultry and animal husbandry work; they make up 46% of agricultural labour and 2% of landowners.[6] More realistic statistics do recognise women's work in agriculture, however. According to figures for the whole country, women's average contribution to overall farm production is estimated at 55% to 66% of total labour, with percentages much higher in certain regions (Venkateswaran 1992).

Rainfed agriculture in the drylands is considered to be doomed by many policymakers because of its low production potential when measured with the conventional indicators of agricultural income, yield levels and crop productivity. Pearl millet, sorghum and cotton-sorghum cropping systems are characterised by lower incomes and higher risks than irrigated rice and rice-wheat cropping systems (Joshi et al. 2001). Yet the research and planning efforts targeted at developing dryland agriculture have been both inadequate and insufficient. In fact, it is estimated that 70% of agricultural innovations developed by the formal sector for dryland agriculture fail to reach farmers' fields (Chambers et al. 1989).

The interplay between marginality and vulnerability

Marginality refers to a status of deviance or 'backwardness', and in India, this term is commonly used—including in government jargon—to refer not only to unproductive lands or territories but also to people belonging to the lowest castes. A link can be established between marginality and vulnerability, which 'relates to a household, or a larger grouping, that is exposed to danger and decreasingly capable

6. Statistics produced by the Department of Agricultural Economics of A.G. Ranga Rao Agricultural University, Department of Agricultural Economics.

Figure 1: Map of Andhra Pradesh

of avoiding or absorbing that threat, and usually unable to exert any political demand to improve its conditions' (Stoll-Kleeman and O'Riordan 2002). Today, the determining role of society in creating or reinforcing vulnerability and patterns of powerlessness is widely acknowledged, and environmental factors, albeit influential, are considered to be less decisive. The potential for adaptation or resilience is built into vulnerability analysis, as we will see in the coming chapters.

The notions of marginality and vulnerability are relevant to the situation of farmers from the Telangana (where I conducted my research). Telangana—one of the three regions in the state of Andhra Pradesh—falls under the SAT, along with Rayalaseema (Figure 1). Both of these regions are on the Deccan Plateau, regularly face drought, and have high levels of chronic poverty. By contrast, coastal Andhra is endowed with a more favourable climate. It has also benefited from large public investments in irrigated agriculture as part of the Green Revolution.

The contrast between the state's hinterlands and its coastal belts goes beyond environmental factors; it extends into two essential cultural domains, language and food culture. While sorghum and millets are the traditional staples of the Deccan Plateau, rice is the major cereal consumed in the coastal areas. Millets are strongly associated with the rural identity and the slow, seasonal rhythm of life on the Deccan. This identity is also characterised by its idiom: the Telugu spoken in Telangana is considered to be more 'rustic' than that spoken in the coastal region.

In recent years, this identity has lost some of its vitality partly because of the decline of the 'millet culture', but also due to the stigmatisation of the Deccan way of life by urban dwellers and by people from coastal regions, forming the majority in government offices and other sites of authority. Many Deccan farmers have internalised this cultural marginalisation, as illustrated by these words from a Telangana peasant woman to a researcher from the coast: 'You, the coastal people, you eat rice and you speak well. Our language is plain, and we sustain ourselves on these grasses [referring to millets]'. This perceived inferiority is challenged by the fact that millets are nutritionally superior to rice.

Caste brings an added dimension of social marginalisation and exclusion for Dalit and other 'backward castes' located at the bottom of the social ladder and who constitute about one-fifth of the Indian population. There is a clear demarcation between the upper castes, who generally have the resources to practise a range of livelihood options, and the lower castes who live with the overriding concerns of finding enough food and drinking water and fodder for their cattle. In India, 85% of Dalit households either own no land or own very small plots (0 to 0.2 ha). Given their lack of access to productive resources, especially land, working as agricultural labour is a crucial way for Dalit marginal farmers and landless labourers to achieve food security throughout the year. The percentage of landless labourers amongst Dalits is as high as 49%, whereas it is only 25% in the general population.

Amartya Sen draws attention to the vulnerable 'breakdown position' of those owning few productive assets other than their labour power, and to their vulnerability to exploitative rural employment under circumstances of acute food scarcity (Sen and Drèze 1989). Poverty is, indeed, a matter of 'capability deprivation', a notion which refers to the lack of real opportunities in choosing a particular livelihood or type of living.

Industrial transformation and agrarian crisis

Agriculture has been undergoing many changes over the past two to three decades. The increasing intervention of the state in agriculture, and the Green and Yellow Revolutions,[7] have prompted agricultural changes throughout the Deccan Plateau, especially in land ownership, cropping patterns, irrigation, credit and extension, agricultural productivity and prices, and marketing.

In rainfed areas, the shift to commercial crops like groundnut, cotton and chillies has been a major force driving the industrialisation of agriculture. Commercial crops are associated with the use of modern inputs like hybrid seeds, chemical fertilisers and pesticides, all of which are produced through industrial methods and marketed through networks of public and private dealers.

The widespread cultivation of commercial crops is accompanied by a decline in food crops. Traditional crop rotation practices and the use of organic manures have largely been replaced by monocropping and the intensive use of chemical fertilisers. These new cropping practices have led to an initial rise in productivity, but they also translate into significant increases in costs of production and severe environmental and health problems, including the pollution of water tables.

Agricultural development is set in motion by institutions ranging from government bodies to local agents who carry an inherent bias in favour of well-off and often high caste farmers. The combination of technology and institutional bias towards large 'progressive' farmers places non-literate and socially marginalised small cultivators at a great disadvantage. The current trend towards a reduction of government extension services and the introduction of private paid services may further increase small farmers' technological and financial dependence on profit-driven agencies.

Farmers' increased dependency on the state on the one hand and the market on the other are major causes for the 'gathering agrarian crisis' highlighted by a Citizen's Report prepared by a group of social scientists in Warangal District (Citizens' Report 1998).

7. Agricultural policies have revolved around a series of so-called 'revolutions': the Green Revolution essentially focusing on rice and wheat, the Yellow Revolution on oilseeds and the Blue Revolution on aquaculture in coastal areas.

Dryland agriculture in the Deccan Plateau thus has to be understood not only in the context of vulnerability and resource scarcity, but also resilience and adaptability. Industrial and technological transformations are reshaping agrarian relations and rural livelihoods.

The study site: the Telangana region of Andhra Pradesh

The field research was carried out in the Telangana region of Andhra Pradesh over a 15-month period in 2000-2002.

Most farmers in the semi-arid Telangana region are small farmers. According to the latest published agricultural data (covering 1995-96), 59% of farmers are marginal farmers owning less than 1 hectare of land and 23% own between 1 and 2 hectares. In other words, 82% of farmers belong to the category of *small and marginal farmers* who own less than 2 hectares of land. Together, they have access to only 43% of the 4.3 million hectares of land cultivated in the Telangana (out of 11 million hectares under cultivation in the entire state in 1998-1999). Interestingly, landless, small and marginal farmers own 70% of the livestock raised in the region, comprising of cattle, buffaloes, sheep, goat, pigs and poultry.

The agrarian scenario of the Telangana region is intimately linked to the history of land struggles (Box 2).

The first land reform followed the 1946-1951 peasant uprisings (Box 2). It abolished *Zamindars*' (big landlords) monopoly over arable land and established a land ceiling to minimise the state's inequitable land distribution. However, the impact of these reforms was mitigated by the fact that many *Zamindars* proceeded to transfer their land titles to relatives and friends (Appu 1996). Moreover, they retained the most fertile land, only surrendering their least productive areas. This explains why much of the land owned by low caste farmers tends to be of poor quality. The *Andhra Pradesh Land Reforms Act* of 1973 was a further step towards allocating surplus land to landless households.

It should be noted, however, that the recent development of contract farming[8] in many parts of Andhra Pradesh tends to jeopardise what has been progressively achieved through land reforms. There are reports of small farmers being pressed to either sell or lease out their land to large farmers or corporations engaged in large-scale, export-oriented commercial farming (Chowdry et al. 2000).

In spite of recent socio-economic changes to agriculture and agrarian structures, the proportion of food crops grown has remained high in the Telangana region: 73% of all cultivated land is under food crops. This is compared to only 38% in the

8. Contract farming is a particular form of industrial agriculture where a contracting firm provides services and inputs to farmers, including seeds and farm chemicals, financing and marketing.

2

Box 2: A glimpse of the history of struggle in Telangana Region

The region which is now known as Telangana was ruled by the Muslim Asaf Jah Dynasty for several centuries. The last of seven successive rulers—known as Nizam—surrendered power over the Hyderabad State in 1952, i.e. after India's Independence, leaving an important historical and cultural legacy. Palaces, forts and mosques are still scattered throughout Telangana districts. In many villages, mosques and dargah (the tombs of venerated saints) coexist with temples devoted to Hindu gods and goddesses. Muslim communities play a significant role in village life. They are, for instance, called upon for carrying out animal sacrifices during important Hindu festivals.

Telangana region's history is marked by peasant struggles. The Armed Front waged a violent opposition to the ruling elite between 1946 and 1951. It had three major objectives: to ensure land for the tillers, to raise the wage of agricultural labourers and to put an end to the sexual exploitation of women workers by landowners. Around three million men and women from over 3000 villages took part in this struggle, which paved the way for a succession of land reforms from 1951 onwards. Despite the active engagement of women in the movement, their demands (such as the eradication of the dowry system or equity between men and women in access to land) were not taken seriously (Agarwal 1994).

In the late 1960s, another revolutionary struggle sparked off in Srikakulam district. The Girijans, a Tribal minority, played an important role in this movement. Throughout the 1980s and 1990s, the revolutionary Naxalites pursued their struggle in Khammam, Warangal, Karimnagar and Adilabad Districts. In recent years, the Maoist leadership of the 'People's War Group' has agreed to negotiate with the Government of Andhra Pradesh in an attempt to put an end to a five-decade long armed conflict that has taken many lives in rural areas.

neighbouring Rayalaseema region, where commercial crops like groundnut have displaced the traditional millet-based cropping systems. In the Anantpur district of Rayalseema, for instance, groundnut occupies over 70% of the cropped area.

My research was conducted in two districts of the Telangana region: Medak district and Adilabad district. Both of these districts have a fairly large percentage of marginalised Dalits (Scheduled Castes) and Adilabad district also has a large population of Adivasi (Scheduled Tribes; Adivasi means 'aboriginal'), who are also amongst the poorest sections of Indian society (Table 1).

Table 1. Demographic information on the study areas

	Area (in hectares)	Total population (1991)	Rural population (%)	Population density (inhab/km^2)	Scheduled castes (%)	Scheduled tribes (%)
Medak District	951,903	2,269,800	85	234	18	4
Adilabad District	1,620,437	2,082,479	77	129	18	17
Andhra Pradesh	27,500,000	66,508,000	73	242	16	6

Source: Government of Andhra Pradesh, Directorate of Economics and Statistics, Handbook of Statistics 1998-1999.[9]

Apart from these socio-economic factors, I chose the districts of Medak and Adilabad because of the wide range of dryland farming systems present. Although rice ranks first amongst food crops both in production and area in Medak district, it is largely confined to the irrigated eastern belt. In the rainfed areas on which my study focuses, diversified sorghum-based farming systems still prevail. Cash crops like turmeric, ginger, sugarcane and chillies are gaining ground in many villages. Small farmers tend to use locally available organic inputs, but chemical fertilisers and pesticides are also present. The district of Adilabad receives slightly more rainfall than Medak district (Table 2). It has a combination of sorghum and maize-based multicropping systems in the interior Adivasi areas and more commercial cropping patterns based on sorghum, cotton and soyabean in the northern parts, near the Maharashtra border. Although cotton is traditional to the area (it has been a part of the local agrarian economy since the 18th century), it is exclusively grown as a commercial crop today and it is associated with high input costs.

This study is based on participatory research in eight villages from these two districts: Timmapur, Nawabpet, Shamshuddinpur and Pastapur in Medak district and Satmoori, Pipri, Vaizhapur and Bhoraj in Adilabad district.[10] In addition, collective discussions were held with farmers from two villages of Warangal district during one of the several cotton crises, in the autumn of 2001.

9. The population statistics are the latest published figures for 1991, which are not fully accurate. The total population for Andhra Pradesh rose from 66 million in 1991 to 75 million in 2001.

10. My doctoral research was based on a larger sample of 14 villages. For the sake of conciseness and clarity, however, this book draws on participatory research conducted in eight villages. However, some individual case studies and farmers' testimonies cited in the following chapters do originate from one of the other six villages that were initially selected. These villages are Chillamammadi, Humnapur, Kalmela and Acchampet in Medak district and Wadiguda and Kerimeri in Adilabad district.

Table 2. Agro-ecological data on the study areas

	Mean annual rainfall (mm)	Forests (% of total area)	Fallow land (% of total area)[11]	Livestock population (cattle only)	Area under food crops (%)	Main crops (% of total cultivated area)
Medak District	898	10%	26%	469,496	89	Rice (23%) Sorghum (19%) Pulses (19%) Maize (15%)
Adilabad District	1132	42.5%	16%	753,800	63	Cotton (28%) Sorghum (25%) Pulses (15%)
Andhra Pradesh	1008	22.5%	17%	10,570,817	66	Rice (32%) Groundnut (15%) Pulses (12 %) Cotton (9%)

Source: Government of Andhra Pradesh, Directorate of Economics and Statistics, Handbook of Statistics 1998-1999.

Together, these villages present a range of situations and contexts, reflecting a sort of agricultural continuum extending from extensive traditional farming systems to more intensive and commercially-oriented ones. Within this continuum, there is a high degree of heterogeneity in each system. This heterogeneity is played out both at the village level and at the farm level. For instance, in a given village, a few farmers may grow crops like chillies and potatoes while most cultivate sorghum, pearl millet and their associated pulses and oilseeds. At the farm level, commercial crops like ginger, castor or bishop's weed often have a place—albeit marginal—on land largely devoted to traditional dryland crops. Likewise, food crops like greengram, mustard and sesame do sometimes find their way into farms that are otherwise largely dedicated to cash crops.

The selection of villages with a range of dryland farming systems makes it possible to study and compare two major types of seed systems: one largely run by farmers and based on local crop varieties adapted to dryland conditions, and the other driven by a commercial logic and based on hybrid seeds developed by the public and private seed industry.

11. I estimated the figures for 'fallow lands' by adding up the areas recorded under 'culturable waste', 'current fallows' and 'other fallows'.

The research: a dynamic process

Much of my research with men and women farmers from the districts of Medak and Adilabad is based on a participatory methodology imbued with feminist research practices. This approach initially evolved through interactions with researchers and field project staff from Deccan Development Society who had a long and solid experience in using participatory methods for action-research and empowerment of marginalised groups (Box 3). It was refined in the course of the research as new challenges emerged, many relating to the need to overcome local gender dynamics.

Language and interpretation were also of concern. Although I started to learn Telugu during my previous research in Andhra Pradesh in 1999, my Telugu was not fluent enough to conduct the research independently. I therefore worked with several interpreters at different stages of the research, two of whom acted as research partners as they had extensive research experience on the issues we were addressing. The other three interpreters were enthusiastic college students whom I thoroughly 'briefed' on the participatory and gendered nature of our work.[12] My partial knowledge of Telugu helped me identify sensitive dimensions of participants' testimonies, implying the need for care with translation and interpretation. The facial expressions and gestures of women participants gave clues about inner feelings that they could not easily express but often did voice as the dialogue went on.

What follows is a detailed account of situations or incidents that had a direct connection with the research methods. Many such instances led to readjustments in the method or to new insights about the practice of participation and about the meaning of feminist research.

An experience in feminist participatory research

Both participatory and feminist research are dynamic in nature, and rely on interactive processes involving an exchange between the participants in the research and the researcher. Research is dynamic when participants co-determine the course and agenda of the research. In our work on the Deccan Plateau, hypotheses largely arose out of repeated interactions with women farmers and out of a keen attention for the concerns expressed or simply hinted at. For instance, after hearing a number of testimonies on the implications of commercial agriculture for women I became convinced that the dynamics underlying agricultural change were profoundly gendered and had to be addressed from a gendered perspective.

12. My attempts to work with a woman interpreter failed as none of the young bilingual (English-Telugu) women whom I contacted could convince their family of letting them 'roam around the countryside' for days at a time.

3 Participatory approaches to development in Andhra Pradesh. Bridging the gap between communities and institutions?

The recognition of the limitations of the Green Revolution and transfer of technology approaches led in the 1970s to the development of the Farming Systems Approach, geared towards the greater participation of farmers in agricultural research and extension. Simultaneously, new research techniques aimed at a more comprehensive understanding of the complexities faced by rural communities began to develop. Termed Rapid Rural Appraisal (RRA), these methods helped in eliciting factors of seasonality, variability and vulnerability in fragile environments like drylands. Participatory Rural Appraisal (PRA) emerged out a growing need to 'shift from outsiders' data collection to local empowerment as the dominant mode' (Chambers 1995). As participation in PRA does not depend on literacy, people from different socio-economic groups can make use of PRA to share their own systems of knowledge and representation. This means that even the most marginalised groups, whose voices are rarely heard or acknowledged, are involved. PRA techniques also help participants to work out a strategy and concrete means of action to imbue development with a pro-poor and gender-sensitive agenda. Participation is meant to be emancipatory: it is a process of learning, enabling and empowering, especially for poor and vulnerable groups. Examples of emancipatory actions include altering existing structures of land ownership, focusing on restoring the commons or local water bodies and retrieving lost crop varieties.

Participatory methods of management, monitoring and evaluation have widely been used in Andhra Pradesh since the mid-1990s by a range of actors including governmental organisations like the Andhra Pradesh Rural Livelihoods Programme (APRLP), local non-government organisations like Deccan Development Society (DDS), institutions like the Institute for Public Enterprise and donor agencies like the UK Department for International Development (DfID). They have encountered varying degrees of success.

Participatory approaches to natural resource management are portrayed as an alternative to centralised planning methods that have failed to sustain natural resources and rural livelihoods. In the case of forests, for instance, institutional management plans have been replaced by Joint Forest Management programmes where local communities are involved in the management, use and protection of degraded forests. Similarly, many of the government-funded programmes on watershed development have an element of participation in them. They have, however, been found lacking on several fronts, including insufficient involvement of the poor; a focus on irrigation and private land and neglecting the degraded commons that poor people depend upon; and failing to challenge the power and authority of the local elite (Baumann et al. 2003). This example shows that the use of participatory methods is not a guarantee, in and of itself, of the empowerment of the most marginalised sections of society.

The Dalit women's *sangams* ('collectives') working with Deccan Development Society are proof that participatory approaches combined with a gender and community-based focus do carry genuine potential for change. The *sangams* have been able to conceive and implement concrete solutions to the difficulties faced by poor Dalit women, including food scarcity and lack of access to common land. By regenerating common degraded land through a programme of Dalit watershed, the DDS *sangams* have regained control over 'wasteland' and secured a source of foodgrains, fodder and fuelwood for their families (Satheesh and Pimbert, 1999).

The research process itself was constantly shaped by the need to overcome barriers linked to power relations in knowledge, expertise and agendas at the household level, in the community and between farming communities and state policies.

1. Significance of collective research approaches

Participatory research involves numerous 'pre-steps' which serve to establish contact with villagers, get a sense of local realities, develop mutual trust and, ultimately, open up the research agenda for consideration and discussion. This process takes several hours and sometimes extends over several days. In our research, this preliminary ground work proved to be of great significance. It enabled us to develop an idea about the village, its internal dynamics, its resource base and its issues and to gather some clues for deciding how to orientate the research work (around which specific issues, with which particular groups, using which kind of research methods). At the same time, it was often a moment of mutual sharing where I would not only put forth our desire to work collaboratively with the villagers on agriculture-related issues, but also explain some elements of the farming situation in other parts of India or Europe in order to point to some of the issues and contradictions at work and to present this research in its larger context. This approach frequently generated reactions and feedback from the farmers and sometimes helped clarify our position (especially in the few instances where we were held to be, successively, government officials distributing land and extension workers promoting new crops into the area!).

We found it essential to ensure that these preliminary exchanges took place on a collective basis, rather than with only one or two informants. Collective discussions allow for the expression of contradictory or complementary viewpoints, and they give an insight into local issues of contention or debate. In particular, the focused collective discussions that preceded specific PRA exercises proved essential in allowing key points of concerns to emerge and in determining the way in which the PRA ought to be conceived.

Quite often, these discussions provided information about people who play an important, unusual or controversial role in the village, in matters of access to resources, livelihood or authority. Such people may have a particular skill or talent, or have overcome difficulties in an original way and be admired for it by others; or on the contrary, they have been neglectful in their behaviour and are cited as a 'counter-example' to the approved social norm. For instance, in a focused group discussion preceding a participatory exercise around seed-saving in Shamshuddinpur, farmers repeatedly cited the case of two 'out-of-norm' farmers: one was an old lady (landless) who had lived in poverty most her life and who had turned seed-saving into a kind of trade to earn a livelihood; the other was a widowed farmer, one of the few farmers in the village who purchased seeds in the market. In both cases, individual interviews were subsequently conducted and they brought out very important information on the

local practice of seed-saving and on the stakes associated with seed in the case of landless, female-headed households.

Finally, collective discussions have proved extremely useful in doing gender-sensitive research. Thus, if one woman farmer describes something of the personal, 'secret' realm, other women find an arena to express similar concerns. What could seem like an insignificant issue—if seen in isolation—can turn out to be a very general concern of a whole section of the population (for instance, the ways in which women manage food scarcity at the household level). Gender-blind research naturally does not allow for such concerns to emerge, be recorded and analysed.

2. Working with marginalised groups in a context of caste hierarchies

As mentioned earlier, much of our research involved farmers or landless labourers from the lowest castes who are not only economically disadvantaged but also socially marginalised in their communities. In about half of the selected villages, self-help groups or women's *sangams* had been formed in the past 3 to 15 years, either under the impetus of the government or with the assistance of a local NGO. In those villages we found it relatively easy to work with Dalit women as they had been somewhat empowered through the *sangam* and could readily voice their concerns. Even in these villages, however, we made a point of including a large number of non-sangam members in our research so as to ensure a representation of 'politically non-organised' villagers. Overall, in *sangam* villages there is an acceptance—be it wilful or feigned—of the fact that the marginalised *can* speak for themselves: this social factor did reduce tensions over caste hierarchy and ease our work.

In villages without a *sangam*, the initial rapport building required more effort. However, we carefully avoided using the pattern that prevails amongst extension workers and agricultural scientists, which consists of establishing contact with a few of the better-off, high caste households in a village and in periodically visiting these households without paying much attention to the rest of the village.

When it was absolutely necessary, we did pay a visit to the *Sarpanch* (village head) to explain the purpose of our work. Then we went on identifying the castes to which the majority of small and marginal farmers belonged, a process which did not always go smoothly. In one village we found that amongst the households we had pre-selected with the help of the Sarpanch, several had significant earnings through government jobs and trading activities. This significantly reduced their stake in agriculture and set them apart from the majority of small farmers relying primarily on farming and livestock husbandry. In that village, we had to rework the sampling of households which had been biased either due to the internal politics of the village or because we fell short in our explanations of our research agenda. Such problems never arose where we directly approached more neutral resource persons (like teachers), *sangam* leaders or a recognised 'authority' amongst low castes in the village and explained our research problem to them.

A few times, two or three over-confident high caste observers 'invited themselves' into collective discussions with small farmers. We had to hint to them that their presence in this time and space was not called for, the underlying reason being that many low caste people hesitate to speak openly in front of their current or former landlords. Mixed participatory exercises did take place with large, medium and small farmers from different castes, but not without a prior common understanding of mutual respect and shared experience. These exercises brought out many interesting points of difference and sometimes also commonality. When we did individual interviews with farmers of different socio-economic background, the high caste households were generally visited last, so as not to ostracise marginalised farmers by replicating a pattern of exclusion they know only too well.

3. Working with women in a context of male dominance

Although gender was integrated into the research from the start, gender-sensitive methodological considerations almost entirely evolved as a part of the research process. In several villages, we found that women and men farmers presented very different pictures of their farming systems. In other cases, as we expressed our desire to focus on women's practices and knowledge, men would start questioning this decision by making such statements as: 'Why don't you ask us? We will tell you' or 'What do women know about agriculture?'. Progressively, it became clear that (a) the kind of insights shared by men and women often differed significantly; (b) women were not expressing the same concerns when they spoke in mixed groups and in all-women groups; and c) men needed to hear strong and irrefutable reasoning for the research emphasis on women.

These elements led us to develop a more appropriate methodology, combining individual interviews, mixed group discussions and all-women group discussions, all backed with participatory exercises to explore specific issues. We started to look more carefully for appropriate times and spaces where women would be able to speak and participate freely. Most of the work took place in the morning, when women have finished the main household chores and can spare a few hours, or in the evening. Public spaces being strongly associated with men, the research with women took place either indoor or in well-defined outer spaces: in small meeting halls, in or around school premises, in front of someone's house. In the villages where a women's *sangam* existed, the *sangam*'s meeting place often became the 'natural' place for holding our discussions. In the case of mixed group discussions and exercises, shaded open public spaces were generally selected. In most cases, it was the research participants and sometimes local facilitators who made those decisions.

In mixed group work, I also learnt to develop a rationale to explain the necessary presence of women. Sometimes, all that was required was to ask men: 'Who takes care of seeds in your home?' Since seeds are women's responsibility, and part of our research dealt with seeds, men generally accepted our stand as 'reasonable enough'

once that question was asked. What this shows, however, is that power relations in the home get replicated in research, and extreme care has to be taken to 'diffuse' these patterns at the start, by transforming research into a dialogue (Box 4).

4 'Who holds the truth?' A feminist outlook on the construction of knowledge and reality

Feminist social science has largely dispelled the myth of *value free research* and neutrality in the research process. It has also sought to develop research methods embodying more equitable relations during the research process where the 'objects' of research become participants and co-determine the outcome. Emphasising the need to address the power relations embedded in research, Joke Schrijvers writes: 'If people belong to a socially and economically vulnerable group, there is a good chance that more powerful people, although belonging to the same society, will deny the 'truth' of the interpretations they adopt' (Schrijvers 1995). Power dynamics may marginalise the views of the least empowered people in at least two ways: a) because of the researcher's own bias and b) because of the power relations existing within the group taking part in the research. Two examples from our research illustrate this point.

During a research trip to Warangal district in 2001, I accompanied a Delhi-based researcher in a series of short interviews with highly indebted cotton growers. In one instance, the researcher interviewed a farmer who had just lost his cotton and chilli crops, and since his wife was standing next to him, I suggested that she too take part in the discussion. To this the researcher answered: 'Let us first hear the fact [from the husband] and then we will hear her opinion'. By the time the man had spoken, his wife had nothing more to add. This example shows that gender-blind and gender-biased research reinforces distorted power relations as it stifles information about women's realities.

A second example arose from a study on agricultural changes in an Adilabad village. With commercialisation, local dealers had become the main suppliers of inputs, and whenever I tried to direct my questions at women during mixed group discussions, at least one man would intervene by saying: 'They don't know anything', which invariably discouraged women from speaking up. After facing this scenario several times, it occurred to me that this comment was not merely a 'show of power' by dominant men in the village, but also a sign of the marginalisation of women's domain of expertise in agriculture as a result of commercialisation. This formed a new hypothesis which I then tried to explore through women-only collective group discussions and participatory exercises.

In order to resolve issues arising out of the 'politics of research', Joke Schrijvers puts forward 'a critical, dialectical approach' that allows for interpretations which question the dominant norm. One way of allowing these 'counter-interpretations' to emerge is by adopting a *dialogical* approach—where research is conceived as dialogue—which creates space 'for a plurality of views and for advocacy and action based on those views which are not part of the dominant discourse' (Schrijvers 1995).

Feminist researchers have argued that a feminist agenda is defined by the kind of research question chosen, the angle of approach, the interactive nature of the research, the mode of inquiry (inclusive, interactive…), the accountability of researchers to participants (action-research) and a socially-defined objective. More specifically, our research experience shows that at the theoretical level, feminist research entails a number of commitments, including:

1. Inquiring into power relations, not only along gender lines but also with specific attention to class, caste, age and ethnicity.
2. Paying attention to how gender inequality is constructed and reproduced through different social roles, responsibilities and access regimes to land and other productive resources.
3. Assessing whether women's understanding of well-being, emancipation and change are recognised or neglected within the household, the community and by the state.
4. Evaluating interventions (employment programmes, new technologies, micro-credit…) based on how they affect women in terms of labour, income, security, well-being, etc…
5. Paying attention to the factors that either enhance or constrict women's abilities to make changes in their daily lives.
6. Focusing on the creation or consolidation of knowledge which can help bring about socio-political change as defined by the research participants.

In terms of research methods and approach, participatory feminist research requires a vivid attention to detail, to subversive discourses, to gestures, to power dynamics at the community or household level. It needs a proper assessment of spaces, contexts and times: marginalised people may not speak 'their' truth in just any place, at any time and in the presence of anyone. To sum up, at the field level, participatory feminist research hinges on the following aspects:

1. inclusive and interactive modes of inquiry at all stages of the research
2. flexibility of research site and timings to accommodate women's daily schedule
3. encouraging both male and female members of a household to express their views, without prioritising one over the other
4. facilitating male-only and female-only group discussions on similar topics so as to obtain data that is disaggregated and can be analysed on the basis of gender
5. identifying female-headed households for additional interviews in order to elicit the concerns, opportunities and difficulties faced by these vulnerable households

Methodology

Above and left: Drawing of individual field maps with details on land types and crop mixes (Nawapbet)

6. in mixed group discussions, being prepared to give a clear and irrefutable reason for the presence of women, in case one or several men deny the necessity for their participation in the discussion on the basis of their alleged lack of knowledge.

4. Working on traditional dryland farming practices in a context of commercial agriculture

In agricultural contexts where 'modern' practices and inputs have been introduced and adopted to a significant extent, traditional practices tend to be depreciated and considered as obsolete. This creates a context that is not conducive to open debate about local practices.

Local dryland crops and traditional methods of farming may still exist on the ground, but young people do not feel inclined to talk about them, and the older people do not dare to speak up in fear of disapproval or stigmatisation. In that context, 'forcing the issue' never proved to be very useful. We found it more appropriate to let the discussion follow its natural course and re-address the 'delicate' issue either later, or through individual discussions. For instance, I used this approach in order to provide a 'safe space' for Gangamma, a middle-aged Reddy farmer from Bhoraj, to express her dismay at the displacement of food crops on the household's land. Ultimately, as the discussion went ahead, she was also able to admit that she did cultivate minor quantities of pulses on the field bunds, despite her son's disapproval.

There are also cases where farmers—often men—hold local food crops to be virtually non-existent even though they are still grown by a segment of the farming community. Going to the fields to see what is actually grown is often the best way of getting a clear perspective and of re-focusing the discussion on actual local practices. In Vaizhapur, for instance, a short visit to the fields with Adivasi women farmers revealed that not only did they still grow sorghum, but also a wide range of millets, alongside cotton (the major commercial crop in the area). This visit sparked a very significant discussion on mixed cropping practices and collective methods of storing foodgrain.

These examples clearly show that the study of change in agriculture calls for a gendered methodology. This is not surprising given that the construction of 'agricultural modernity' is highly gendered: the vast majority of policymakers, extension workers, local dealers and money-lenders are men who have paid little attention to women's approaches to agriculture. One of our objectives has been to explore the implications of this dynamic for women farmers.

It is important to underline that conducting participatory research does not always yield the same degree of success. In some cases, a truly interactive frame of research could be developed, and women farmers were completely involved, not only in exploring their own knowledge systems and practices (through various exercises described below), but also in analysing the socio-political mechanisms that influence the conduct of

agriculture in their communities. These experiences gave us a sense that the participants had been empowered by the research process itself.

In other instances, however, the involvement of farmers in the analysis of the work turned out to be very minimal. In one case, we conducted a PRA on the extent of cultivation of dryland crops. The idea was to prepare a map of the village where one person from each household would come and place a sample of the crops grown on their land. This work plan was debated and agreed upon by a fairly diverse group of about 30 farmers. Yet, as the process unfolded, the level of participation gradually declined. Although a fairly large number of people took part in the initial mapping exercise, the subsequent step of representing individual cropping patterns onto the map to visualise crop diversity did not yield much participation, even though this collective exercise had been very successful in a neighbouring village. There are three possible explanations: a) we had not allowed enough time to build a basic understanding with participants; b) we had not properly addressed gender relations (as relatively few women came forward); and c) many of the local food crops had been displaced by irrigated or commercial crops, and there was nothing to show for as far as crop diversity was concerned. This last hypothesis proved to hold at least part of the explanation: during a completely unplanned discussion with a small group of older farmers, hours after the PRA had ended, we discovered that with the recent proliferation of tubewells, everyone had started to grow rice as a food and cash crop. Most other crops had been superseded by rice. Referring to dryland crops, someone even said: 'These are the crops that we have let down'. It would have been useful to refocus our research in this village on this issue and what it meant to farmers, but time did not allow this.

5. Interpreting and returning results

One of the challenges of participatory research is to return the research results to the participants in a way that brings some benefit to marginalised groups (in our case, small women farmers). Action-research is usually the fruit of interdisciplinary teamwork and needs to be open-ended. However, as my research was part of doctoral work that was time-bound and individual, it was not possible to engage in a truly transformative process.

However, I attempted to make the interpretation of result findings as dynamic and participatory as possible. At the end of each session involving participatory exercises, there was a kind of debriefing with participants. It was a time for sharing insights about the exercises and discussions held over the past few days. In several cases, this 'debriefing' allowed farmers to reflect on the current trends in agriculture and to explore their feelings towards these changes. Those moments turned out to be extremely crucial. For instance, as we collectively reflected on the rate of use of chemical inputs in one village, a woman farmer said: 'We used to be humans, now

we are animals', a powerful commentary on the 'costs' of chemical farming and the powerlessness associated with it.

In another case, after completing a ranking exercise on crop diversity, Adivasi women farmers found, by 'reading' the matrix on the ground, that cotton came last in their priorities. This enabled them to voice larger concerns over cotton cultivation and to express the fact cotton was grown because it was high on their husband's agenda. From there, we could explore the mechanisms of commercial agriculture, and come to an understanding of how crops like cotton spread on the land of small farmers despite women's disapproval of this trend. Gradually, the discussion shifted to household dynamics, and to the difference between influence and decision-making power, which play a major role in gender relations. That women participants could express so much in just of few hours of participatory research is proof, in my opinion, of the value of this method of work. It also revealed that research informed with a feminist agenda can contribute to women's empowerment and initiate processes of transformation. This analysis corroborates one of the conclusions of a feminist researcher working with women in refugees camps in Sri Lanka. Commenting and reflecting on the outcome of her research, J. Schrijvers writes: '[B]y telling their own stories to a complete outsider, they gained some power to conceptualize their own experiences—a first step towards re-defining their identities' (Schrijvers 1995).

In the final stage of my field work I exposed my major research findings (using posters with drawings and flow charts, in line with PRA's visual approach, see below) to a group of 25 farmers from several villages in Medak district. Our discussion was lively and their feedback helped in refining some of the major findings. The experience of sharing research findings with the people who had generated this knowledge and understanding was both challenging and meaningful. It was also an opportunity to present the notions of autonomy and heteronomy by drawing from concrete examples from Deccan farming systems and industrialised European agriculture. I have found that once they understand the larger continuum, farmers are not only in a position to know 'where they stand', but they are also able to articulate a profound critique of the entire system and to identify which trends, policies and technologies are beneficial to them and which are detrimental to their well-being.

In addition to this, I had the opportunity of sharing my research findings with social scientists and activists in Hyderabad and Delhi through seminar presentations. In order to link the practice of participatory research with the actuality of policymaking, I tried to integrate a number of suggestions made by farmers themselves about enabling policies. Elements of this work were also presented to an audience of farmers in Southern France. To my surprise, I found that it fuelled a rising awareness among French farmers about the necessity to recover their autonomy in seed selection and to revive seed-saving practices.

Tools for participatory research

Participatory rural appraisal (PRA) techniques help in collecting and analysing local knowledge with the full involvement of the people concerned.

The steps taken when using participatory techniques are as follows:

1. select a group of participants
2. together identify important issues or concerns
3. determine the most relevant PRA exercises and the criteria to be used (in the case of scoring diagrams) with input from participants
4. explain the process and objective of the exercise
5. participants develop the diagram, map or matrix with help from the researcher(s)
6. participants interpret results (it is important at this stage to keep a record of the points that could not be illustrated through the PRA and may need further investigation at a later stage)
7. share perceptions and feelings about the process of engaging in PRA

PRA techniques complement each other and can be used to explore various dimensions of rural communities, including social make-up, primary sources of livelihood, available resources, main cropping systems, seed use patterns and so on (Table 3). In my research, I tried to encourage participants to prepare diagrams and maps to show the distribution of resources and assets in a village and to represent seasonality of livelihoods and agricultural tasks. Maps, diagrams and ranking exercises are done on the ground in a public space using locally available materials such as stones, seeds, soil or coloured sand.

Matrix ranking has proved particularly useful in bringing out differences in criteria for crop choices based on social factors like age, gender or caste or based on environmental factors like rainfall and soil characters. In ranking exercises, once the participants have agreed upon a set of criteria, they themselves set out to find materials that can be used to represent each individual criterion. For example, during a PRA on the genetic diversity of sorghum and pigeonpea varieties in Shamshuddinpur, a few women brought small quantities of seeds to represent the 11 sorghum and six pigeonpea varieties grown in the village and placed them on one axis of the matrix. Meanwhile, another small group went about gathering a piece of sorghum bread, bits of straw, small sticks, soil, a small water container and a one rupee coin to represent, respectively, the food, fodder and fuelwood value of the different varieties, their adaptability to different soil conditions, their moisture requirement and their market value (these are just a few of the criteria identified by the farmers).

In addition, I designed seed-related exercises in order to explore the relationship between crop diversity, seed-saving, landholding size and gender (household seed registers) and to get an understanding of the circulation of seeds in a community (seed flow chart).

Apart from PRA, I used individual case studies to get detailed information from households on specific issues (culinary knowledge, seed lending practices, indebtedness related to irrigation or pesticide use, change in labour relations…).

Table 3. Participatory Rural Appraisal techniques used

Technique	Aspect of farmers' knowledge investigated	Participants	Villages M=Medak /A=Adilabad
Resource mapping	Representation of natural resources locally available (forests, water tanks, village commons, fields)	Mixed group of farmers, landless labourers, artisans	Timmapur (M) Vaizhapur (A) Satmoori (A) Nawabpet (M)
Seasonality analysis	Seasonal sources of livelihood (gathering from commons, farming, livestock rearing, labour migrations…)	Marginal, small, medium and large farmers	Timmapur (M) Acchampet (M)
Social mapping	Distribution of habitat in the village and social stratification (based on caste)	Mixed group of villagers (all castes and occupations)	Nawabpet (M) Pastapur (M) Vaizhapur (A) Chillammamadi (M)
Individual field mapping	- Representation of crops grown on individual lands - Matching soils and crops - Change in cropping patterns over a decade	Individual farmers from different categories (small, medium and large)	Shamshuddinpur (M) Satmoori (A) Bhoraj (A) Pipri (A)
Matrix ranking	- Criteria for assessing local crop varieties - Rationales of small, medium and large farmers for saving seeds - Evaluation of benefits from dryland subsistence vs. commercial agriculture	Group of small women farmers primarily	Shamshuddinpur (M) Kalmela (M) Pipri (A)
Household seed registers	Type and amount of seed saved at home, borrowed or given on loan for kharif and rabi crops	Individual households of all categories	Shamshuddinpur (M) Kalmela (M)
Seed flow chart	Flow of seeds between households and to/from nearby villages	Farmers of all categories	

Studying the institutional and corporate sectors

Exploring the workings of various systems of domination is on the agenda of both political ecology and anthropology. An emerging trend in anthropology is indeed to study 'up' into institutions that are vested with political and economic power. The objective of such research is to understand how decisions are made, for what reasons and for whose benefit and how these decisions maintain or reinforce patterns of dependency or vulnerability among various sections of society.

The notions of hegemony and rationalisation are of particular significance to this approach. Antonio Gramsci developed the concept of hegemony to describe the successes of a social group, or a state, in imposing its interests on the rest of society (Gramsci 1971). Hegemony is socially constructed and it 'always involves the exclusion of alternatives, for if one way of knowing and living is raised to a universal standard, others are marginalized as *merely local and particular*' (Purdue 1995). The nature of hegemony itself thus contains seeds of subversion: resistance is an integral part of hegemony, and it needs to be studied in conjunction with processes of domination. Rationalisation refers to a process whereby social action is intellectualised, subjected to calculability and sanctioned by pre-established norms. Rationalisation of the health sector, for instance, involves the development of norms of what is 'good' and 'bad' medical care and the exclusion of alternative health systems considered to be deviant from the norm.

Understanding hegemony and power

A set of questions and approaches arises in the study of sites of power and authority.

First, it is important to carefully identify and distinguish interrelations between sites of power so as to differentiate between their respective vested interests for a particular issue and context. In the field of development, for instance, international donor organisations and local agencies do not necessarily share the same goals, even though both hold some power at their respective levels. Understanding patterns of influence amongst powerful groups is also essential. In any given issue of relevance to industrial society (be it water, nuclear energy or agriculture), we see that professional associations, lobbyists, scientific experts and the media maintain critical interactions with policymakers and bureaucrats, forming a 'nexus' of relations.

A second question relates to the process of legitimisation, which is essential for any institution or group to maintain its position of power. According to Max Weber, the main source of legitimacy in 'modern' society is rational-legal authority derived from enacted law, embodied in impersonal roles of procedure and staffed by a bureaucracy devoted to impersonal routine (Holton and Turner 1989). Thus, modern institutions derive their legitimacy from a *technostructure* of managers, engineers and other experts belonging both to the public and private sectors. The ideology of progress and the notion of public interest are commonly used by modern institutions

(state bureaucracies, scientific organisations…) to construct their legitimacy. In a study on the role of the biotechnology industry in the hegemonic project of establishing a global regime of intellectual property rights over living material, D. Purdue shows that 'the hegemonisation of key scientific discourses, agricultural practice, legal definitions of knowledge, trade and international relations occurs simultaneously' (Purdue 1995).

A third level of inquiry is the means and mechanisms of control developed by dominant groups. Law is undoubtedly one such means: examples of legal arrangements designed by powerful institutions and groups (states, landlords…) to assert their rights over property or knowledge abound in history. Well-known cases include the enclosures of the commons by landlords in England from the 16th century onwards, and natural resource laws granting state monopoly over forests and village commons in India after Independence.

In my own research, a study of Plant Breeders' Rights to impose monopoly rights over new plant varieties clearly illustrated the fact that law could become an instrument of domination in the hands of a powerful group. In the course of an interview on the 'partiality' of a law that forced farmers to pay royalties in order to re-use farm-saved seeds, a French plant breeder asserted that 'When there is law, you have to respect it'. This comment completely disregarded the fact that the law in question had been evolved by plant breeders, with very little or no consultation with farmers. It is only through a detailed study on the political history of intellectual property rights over plants that this law reveals itself to be part of a larger hegemonic agenda. Interestingly, this study also brought to light the involvement of marginalised groups (farmers who opposed the royalty provision) and their failure to make policymakers understand the validity of their viewpoint. This example illustrates the interplay of hegemony and resistance in knowledge-power struggles.

Rationalisation is yet another mechanism to enforce institutional control over a particular domain of existence, be it food, knowledge or agriculture. The development of industrialised society is closely interconnected with the 'rationalisation' of local health, food or seed systems. I have tried in my work to delineate and describe how this is occurring in the seed sector.

Finally, a study of hegemonic processes ought to concentrate on how dominant models are promoted, alternatives suppressed and criticism engulfed by powerful or dominant groups. In the field of agriculture, for instance, industrial models are promoted through the allocation of subsidies, the channelisation of budgets, the creation of research results and of legal definitions of knowledge, and the development of strategic policies. Alternative viewpoints are eliminated in this process of constructing a uni-dimensional model of development. The appropriation of language that is considered to be either critical or subversive is a common strategy used by dominant institutions to assert their authority and legitimacy.

Methods of inquiry

The methods I used in this part of the study consisted of a thorough literature review, including company reports and official records, backed up by a wide range of formal interviews with public and private actors in the seed industry, both in India and in France. These interviews helped elucidate the trends in the development of the seed industry in both countries at the political, economic and technological levels. They also aimed at eliciting the research strategies, economic standing and intellectual property position of seed firms belonging to different categories (independent, cooperative, multinational…). I focused on the seed strategies of large multinational players (Syngenta, ProAgro) and smaller firms operating in the state of Andhra Pradesh and, in some cases, in adjacent states (JK AgriGenetics, Prabhat Seeds, Manisha Agribiotech, Gangakaveri Seeds).

Through individual interviews and participation in seminars I studied the positions and seed policies of various government[13] and non-government bodies[14] on the national and international biodiversity scene. I also gathered the views of scientists on a wide range of issues including crop improvement, biotechnology, transfer of genetic resources, farmer-scientist collaboration and participatory approaches to technology development. This was done through a series of interviews in Hyderabad and Patancheru with researchers from the National Research Centre on Sorghum (NRCS), the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), the Institute of Public Enterprise and the Centre for Sustainable Agriculture.

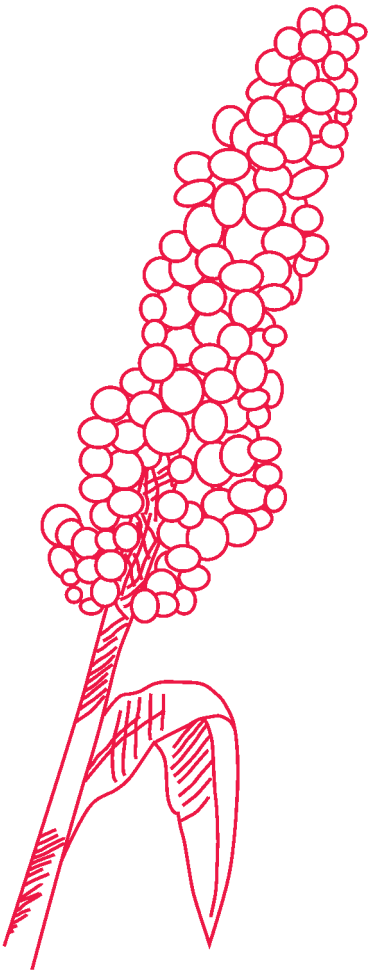
I have also drawn on case studies of the French seed sector. This data originates from a corollary investigation in France (during the period 2000-2003) as part of my doctoral research. Its main focus was the historical development of the institutional sector and the progressive marginalisation of the autonomous seed sector. In the course of this work, I also looked into French farmers' responses to the process of industrialisation and the emergence of resistance and alternatives, like the creation of the *Réseau Semences Paysannes* (Farmers' Seed Network).

Finally, I sought to understand the global politics of biodiversity by analysing the negotiations around Intellectual Property Laws on new plant varieties and farmers' rights. Thus, I interviewed various negotiators during the Seattle Summit of the World Trade Organisation in 1999, with a focus on India's perspective and propositions. Two officials from the World Intellectual Property Organisation (WIPO) and from the Union for the Protection of Plant Varieties (UPOV) also shared their views on the recent evolution of the concept of farmers' rights and on their respective organisations' mandates and ways of functioning.

13. Including the Indian Council of Agricultural Research, National Bureau of Plant Genetic Resources and Council for Scientific and Industrial Research.

14. Including the Gene Campaign, Research Foundation for Science, Technology and Policy, PILSARC, Research and Information System for the Non-Aligned and Other Developing Countries and Kalpavriksh.

3



Livelihoods and social organisation

This chapter introduces various aspects of the socio-economic system that has evolved on the Deccan Plateau. I try to take a systemic approach by tying together cultural representations, structures of land ownership, patterns of labour relations and the non-monetary village economy.

Rural livelihoods are intrinsically linked to natural resources and to seasonality in dryland environments. A livelihood can be defined as the capabilities, assets (including both material and social resources) and activities required for a means of living. Diversification has been found to be essential to the sustainability of livelihoods, which hinges on the capacity to 'cope with and recover from stresses and shocks' and to 'maintain or enhance… capabilities and assets' in the present and in the future without undermining the natural resource base (Chambers and Conway 1992).

Dryland livelihood systems combine the use, management and reproduction of natural resources, human resources like skills and knowledge, social resources like solidarity networks, and financial and physical assets such as capital, credit and labour. What sets dryland livelihood systems apart from other livelihood approaches is the fact that people have to operate in a context of scarce resources and limited options. Rainfall, soil fertility and water, as well as regimes of access to resources and markets, pose severe constraints. This explains why off-farm and even migrant incomes are an integral part of the system.

Environmental constraints inherent to dryland agroecosystems have been at least partly overcome through the development of local systems of production, exchange and distribution. However, these are often overlooked in studies that focus on poverty and resource depletion.

The agrarian society of the Deccan Plateau

Agrarian society on the Deccan Plateau is composed of an array of communities and castes of various ethnic and religious backgrounds. In the Telangana region virtually each village has a different social configuration. Communities and castes vary greatly from one district to another and even from one village to another. Although Hindu communities prevail, Muslim and Christian communities are also present.

Adivasi communities like the Lambadi, Gound and Nayapod are scattered throughout the Deccan Plateau. Their way of life, language, belief system and socio-economic marginalisation set them apart from other rural communities, though they are increasingly being integrated into mainstream agrarian society and into the market economy. While environmental degradation takes a heavy toll on all rural people, this is especially so for Adivasi communities, whose sources of livelihood are intimately linked to natural resources like forest, water bodies and grasslands.

Caste and ethnicity in the Telangana region

In order to understand the social and economic dynamics of Telangana villages, one has to look into the caste system, which largely determines people's perceptions, values and knowledge. It also shapes more 'objective' aspects of social life, such as land tenure and water management practices. The caste system was officially abolished by the 1950 Indian Constitution. In practice, however, it continues to exist, though its *modus operandi* and socio-political relevance have continuously evolved over the past decades (Box 5).

In rural areas, caste is more than a social hierarchy based on religious principles of purity and impurity: it is also synonymous with occupation and livelihood. Each village in India is made up of different castes co-existing with each other and co-managing their immediate environment. It is not uncommon for two or three castes to share a source of livelihood or trade. For instance, the shepherd community consists of the Kurma and the Golla castes in the Deccan Plateau. The Reddi and Kapu have traditionally been large landlords, but land is owned and cultivated by virtually every caste today, due to the decline of numerous traditional occupations.

In Timmapur, for instance, the majority of farmers belong to the Mouthiraj caste (initially a caste of fishermen). There are also Golla and Goud farmers, who continue their traditional practice of sheep-rearing and extraction of sap from toddy palm trees, respectively, alongside agriculture. The Mala and Madiga are two communities of low caste Dalits who primarily work as agricultural labourers. Most households are landless, or own very small patches of land (less than 1 ha). These castes form the majority of the population, representing 176 households out of the total of 187 households in Timmapur (Figure 2).

5 Contradictory theories on caste and communities

The caste system in traditional rural India has been described as a 'redistributive exchange system in which the dominant caste in a village, under the authority of the government, controls the production of the crop, the distribution of it and even the allocation of services' (Klass 1980). Ecologists have shown that this hierarchical, patriarchal system regulated an agricultural system in which livestock was completely integrated: the system had ecological soundness as long as it remained outside the influence of market forces. For the ethnographer Louis Dumont, caste is nothing but the institutionalisation of a religious hierarchy underlying every form of social life (Dumont 1970). Interestingly, Dumont's analysis reveals that purity and pollution were measured by the degree of interaction with organic life. Involvement with agriculture, childbirth and fertility are therefore perceived as 'polluting acts'.

Other studies have sought to show that the caste system was constructed by the British during colonial times as an instrument of regulation and control of rural society (Dirks 2001). Historical interpretations aside, the fact is that policymakers have not been able to put an end to discriminations linked to caste since Independence. People from low castes continue to face severe socio-economic constraints, especially in villages, where all socially defined dimensions of life, from land tenure to moral values, hinge upon the caste.

Yet, it has been argued that castes and communities have a fluid and pluralistic character, leading to multiple forms of complementarity and solidarity amongst and between communities (Pandey 1993). For instance, the Indian Dalit community is composed of 150 million people and comprises hundreds of castes and dozens of languages and political ideologies. Moreover, caste is now being redefined through two major processes of change. Sanskritisation refers to the adoption of Brahminic ideology and practices in order to secure upward mobility. Substantialisation designates the increasing competition among low castes at the cost of interdependence.

Artisan castes include Kumeri (potters), Vadla Kumeri (carpenters) and Kamerol (blacksmiths). Several 'service castes' are also at the bottom of the social ladder: Sakkali (washermen and washerwomen), Mangali (barbers) and Dappulu (traditional drummers). Every village has one or two households belonging to the Komati or Baniya caste (two relatively high castes), who act as traders and money-lenders, and to the Brahmin caste of Hindu priests, the highest caste in the social hierarchy.

Thus, apart from the Brahmin high castes engaged in religious affairs, most of the other castes—i.e. the vast majority of rural people—are involved in livelihood activities ranging from farming to craftwork and local trading. Households of a given caste practise a specific activity and hold customary rights of access to the basic resources needed to pursue this activity (arable land, grassland, wood, clay…). Within each caste or community, the resources, knowledge, tools and skills required

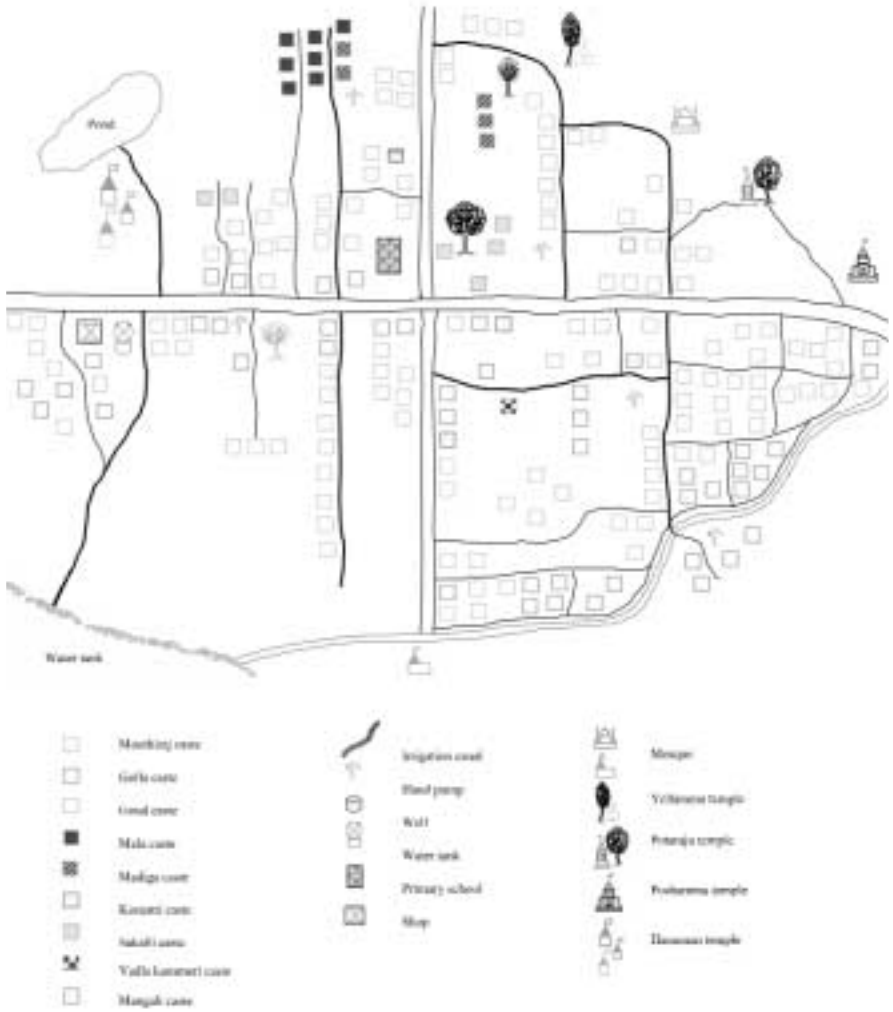


Figure 2: Social map of Timmapur village

for the pursuit of livelihood activities are passed down from father to son and from mother to daughter. For example, a Kurma woman teaches her daughter…

> … how to separate the wool from the thorns that stick to it and to prepare it for thread-making (*taadu wadakadam*). All these tasks are extremely skilled... The girls of these families are also taught, at a young age, how to seed the furrow by carefully dropping seed after seed. They are taught how to weed and even out extra growth in the crop; they learn how to plant with bent backs, moving backwards in the muddy land. Quite a lot of explanations by the adults go into the teachings of these activities to the young ones. Invariably, there are experts in each activity who acquire a name for themselves. Young people are proud to emulate such experts (Ilaiah 1996).

Thus, even though low caste women face various forms of discrimination, they are involved in productive activities and they enjoy a much higher degree of mobility than high caste women, who tend to be confined to the household by ritual and ideological restrictions.

The hierarchy of gods and goddesses

To farmers, the notion of territory starts with the village, which is generally divided into two sections: the *uru*, where non-Dalit families live; and the *Dalit wada*, inhabited by Mala and Madiga households (Figure 2). This spatial differentiation of caste in the village is reflected in the distribution of landholdings: Dalit farmers' fields are usually located on upper ridges, in a radius of 1 to 4 km from the village. These ridge lands are not very fertile and are highly prone to wind erosion. The fields tended by farmers from higher castes are generally situated much closer to the settlement and support more fertile black and alluvial soils (see Chapter 4 for more detail).[15]

The uru usually has several temples dedicated to the main Hindu gods and goddesses like Shiva, Vishnu, Ganesh, Lakshmi or Hanuman. Many villages also have a mosque and some have a church. In and around the *Dalit wada* are small temples dedicated to the divinities worshipped by Dalit and other so-called 'backward castes', like Pochamma and Yellamma. In addition, there are many sacred spaces outside the village—often close to the water tank or underneath a large tree—which Dalits visit to worship other deities like Kattamaisamma (a water deity). These pastoral deities are also integral to the religious practices of Adivasi communities.

15. In many villages, Dalit farmers received some land as a result of a government policy of land redistribution to the poorest sections of society. Some of these lands were surrendered by large farmers at the time of implementation of the land ceiling legislation in the 1970s and 1980s. It goes without saying that these farmers kept the 'cream' and parted with the least productive fields.

Thus, the understanding of territory and sacredness varies greatly between communities, as does the consciousness of the spiritual realm. A scholar from rural Telangana explains why local deities are a part of daily life for Dalit families:

> For children from our castes, Jeja (the concept of God) is introduced in the form of the moon. As children grow up, they also get acquainted with Pochamma, Polimeramma, Kattamaisamma, Kaatamaraju, Potaraju and other deities. Among Dalitbahujans [Dalits], there is no concept of a temple in a definite place or form. Goddesses and Gods live in all forms and in all shapes and in different places... Every Daliltbahujan child learns at an early age that smallpox comes because Pochamma is angry. The rains are late because Polimeramma is angry. The village tank gets filled or does not get filled depending on the sympathies of Kattamaisamma. Crops are stolen by thieves because Potaraju is angry. For Kurumaas [Kurmas], whether sheep and goats will prosper depends on the attitude of Beerappa, a caste-specific God (Ilaiah 1996).

There are also caste-based differences in the nature and modes of worship, as revealed in a participatory exercise on agricultural diversity in Medak district (Satheesh et al. 2002). When Dalit women asserted that proso millet plays a part in their rituals, an upper caste woman objected that this minor millet was only suitable for the worship of 'devils', and not of gods. This perceived dichotomy between 'high' and 'low' deities is explained by the fact that for Brahmins, 'Pochamma and Maisamma are "Sudra" [low caste] goddesses and supposed to be powerful but in bad, negative ways'. According to them, these goddesses do not command the respect that Lakshmi or Saraswathi do, 'because Lakshmi and Saraswathi are supposed to be ideal wives of ideal husbands, whereas no one knows who Pochamma's husband is, any more than they can name Maisamma's husband' (Ilaiah 1996).

Land rights and labour relations

In the agrarian society of the Deccan Plateau, land is the primary form of property and the most valuable productive resource, although it is often said that water availability, and not land, is the major constraint faced by farmers. It is undeniable, however, that land is the main livelihood asset for most of the rural population. Land rights stem from inheritance, transfers from the state, tenancy arrangements and land purchases.

Until the late 1970s, arable land in Deccan villages was essentially under the control of large landowners who used to own as much as 300 or 400 hectares. The implementation of the land reforms has put an end to this monopolistic pattern of land ownership. The redistribution of ceiling surplus land has increased the number of small and marginal farmers, who make up 82% of farmers but only hold 43% of private lands in Telangana. Landless peasants continue to form between 15% and 20% of the population of villages. Medium and large-scale farmers who cannot

cultivate their entire landholdings lease out some to tenants or share-croppers. There are various types of land-related contracts on the Deccan, as we will see further on. Tenants have, to some extent, seen their rights over land secured. For example tenants now have the pre-emptive right to purchase the land if the landholder wishes to sell the land and the registration of the lease. However, tenancy legislation in the Telangana still contains many flaws and biases.

Land is inherited through a patrilineal system: sons receive land from their fathers and pass it on to their male heirs. Legally, daughters also inherit land, but in practice they rarely enjoy usufructs from that land since they move to their husband's household and village after marriage. Most private land is therefore cultivated by married couples, with the help of children and sometimes elders. Women live and work on their husband's farms, but they have no legal rights to the land or decision-making power over land use changes (Box 6).

There are cases where land is tended by a single or widowed man, or by a woman who finds herself to be the head of her household. This happens either when the husband has passed away and there are no male children living in the village, or if the husband has migrated to earn a cash wage to support his family.

The phenomenon of male outmigration is rising in dryland areas due to the crisis in agriculture and the need for poor households to earn off-farm incomes in order to sustain themselves. As a result, an increasing proportion of rural households are headed by women, not only on the Deccan Plateau, but throughout semi-arid India. According to recent estimates, the percentage of female-headed households ranges between 20% and 30% in semi-arid districts (Ryan and Spencer 2001). With the rise in seasonal or permanent migration by men, women are often left to take care of land and livestock on their own. This calls for dramatic shifts in land rights and agricultural policies so as to enhance rural women's capacity to sustainably manage local natural resources.

It should be noted that village commons play a particular role in the livelihood strategies of poor rural women. Indeed, 'given their limited rights in private property resources such as agricultural land, rights to communal resources have always provided rural women and children (especially those of tribal, landless, or marginal peasant households) a source of subsistence, unmediated by dependency relationships on adult males' (Agarwal 1999). Processes of degradation and privatisation of village commons have multiple repercussions for rural women. For instance, without secure access to grazing lands, women cannot think of raising dairy animals or goats.

Historically, labour relations in agriculture have been closely related to the monopolistic control over land by landlords that prevailed until land reforms came about. Apart from vast areas of land, these landlords used to own large cattle herds

6 Gender and land rights

Feminist researchers have shown that in India and throughout most of South Asia, the ownership of land is skewed in favour of men. Customary patrilineal practices and legal systems relating to the inheritance of land—the principal way of accessing land in agrarian societies—combine to pose constraints on women's ownership of land.[16] In both Hindu and Muslim communities, land almost invariably goes to male heirs, and property titles (patta) are registered in the name of the male head of the family. Government schemes facilitating land acquisitions for Dalit household are not devoid of gender bias in the Telangana region, and only in rare cases have Dalit women been able to secure independent ownership rights over such land. Recently, India's Five Year Plans have given some recognition to women's land claims, directing state governments to allot 40% of ceiling surplus land to women alone and the rest jointly to both spouses (Agarwal 2002).

Because of the skewed pattern of land ownership, women farmers face difficulties in accessing agricultural loans—whether through public cooperatives or through the private sector—as credit is only granted to those who possess land titles. Social stigma also acts as an obstacle for rural women to actively take part in and define agricultural development initiatives. Women farmers therefore lack the ability and legitimacy to play their part in the decision-making processes leading to changes in cropping practices, resource use patterns and modes of crop use.

A small section of the research community and NGO sector has attempted to tackle this problem by advocating for independent land rights for women through innovative institutional arrangements including: (a) collective purchase and joint management of land by groups of women; (b) group lease of private lands for joint cultivation; and (c) joint management of land transferred by government (Agarwal 1998). Such arrangements have been tried with success in Andhra Pradesh and Kerala.

of up to 50 or 60 animals. They used to employ many agricultural labourers, and had specific families from the Madiga caste 'attached' to their property through a system called *madigatanam* (Box 7). This system set out a series of responsibilities and rights for each of the two parties, although the Madiga households remained dependent. It is important to note that while relations between labourers and large farmers have tended to be exploitative, the relations between artisans and farmers are generally more equitable.

Labour relations at the community level have seen a rapid evolution in recent times. Increased political consciousness of caste hierarchies and alternative economic opportunities have led landless workers to move away from traditional labour

16. A law recently introduced by the government, the Hindu Succession (Amendment) Bill, 2004, attempts to redress the situation by giving equal property rights to female and male heirs and by empowering female heirs in the management of property held by a joint family. The Hindu, 21 December 2004.

7 The Madigatanam: between servitude and security

Until five to ten years ago, the *madigatanam* was still practised in Deccan villages. It was a particular economic relationship 'binding' a landless Madiga household to a family of large landowners from the Kapu, Reddi, Lingayat or Golla castes. The *madigatanam* defined a number of duties and rights for each party. The Madiga household was entrusted with a particular area of arable and had to watch over the crop from sowing until harvesting. It was also responsible for post-harvest work and daily care for livestock. In return for this labour, the Madiga household received a share (around 5%) of all the crops grown by the landlord in both seasons. A Dalit woman who experienced this system in her young age testifies that after a harvest, her parents' house was 'full of all sorts of grains', ranging from cereals to oilseeds. Other food items like turmeric, ginger, garlic and jaggery (a by-product of sugarcane) were also generally given to the Madiga family, who could freely gather fodder, fuelwood and edible plants from the fields and bunds owned by their landlords. The Madiga family would frequently borrow money from the Reddi or the Kapu to meet the large expenditures incurred for weddings, festivals or funerals. These loans would be repaid in labour, but they tended to accumulate to such an extent that the Madiga family could never fully repay the capital. This kept the family bonded, in a sense, to the landlords (even though the *madigatanam* is not synonymous with bonded labour). For a Madiga household, this relative servitude represented a guaranteed income (largely paid in kind) and a sense of security derived from the long-standing social links between the two families. Landlords had a moral duty to protect families that were economically dependent on them.

arrangements with the landed class. Nowadays, few labourers choose to work for a whole year for one large landowner. Instead, they tend to work for daily wages paid either in kind (around harvest time) or in cash (in the case of weeding work and harvesting of cash crops like sugarcane or cotton).

Some studies have shown that when rural women's monetary contribution to the household increases, they are in a better position to exert influence in decision-making processes. Furthermore, 'the greater visibility of remunerated outside work is seen as a crucial factor in determining women's ability to bargain not only for higher wages but also for a greater share of household resources' (Pant 2000). This analysis contrasts with the perceptions expressed by women from marginalised groups in the Deccan. Madiga women assert that payments in cash are not as attractive as grain payments used to be. Cash payment does not build household foodgrain stocks, nor does it carry the kind of social benefits that used to exist as part of the *madigatanam*. Payments in grain are a significant part of the food strategies of resource-poor households, which is why landless women and marginal women farmers generally like being paid in grain instead of money. For instance, Chandramma explains that if she and her husband can get 15 solid days of employment during the greengram and blackgram harvest in September, they can

put aside enough of these pulses to meet their own needs for four to five months. On a different note, it is interesting that when they get paid in grain, women try to maximise their earnings. When landowners give them a choice between grain (*dhaniamu*) and earheads (*eenu*) in the case of a payment in sorghum, they opt for earheads (which they process themselves into grain). By doing so, they get 'one *ser* [1.5 kg] instead of one *sola* [0.75 kg]', which makes a considerable difference when foodgrain stocks fall short, which often happens in the households of the landless and marginal farmers.

Another factor of change in labour relations is the fact that many medium and large farmers have shifted to commercial crops which do not require the same sustained attention as dryland crops. Many have also sold their large cattle herds and purchased tractors, decreasing the need for labour to take care of the cattle and spread manure on the land. Large farmers have thus relinquished old ties with landless families and they now turn to the growing labour market to hire daily labourers when needed. Apart from the landless peasant, small and marginal farmers also depend on farm employment to supplement the incomes earned from their own land.

Thus, in spite of its apparent stability, agrarian society is constantly evolving. Conflicts over resources periodically lead to negotiated arrangements between communities sharing the same resources for their livelihoods.[17] Apart from such internal changes, external factors also play an important part in redefining the equation between caste and livelihood. New economic opportunities in rural but also in urban areas, geographical mobility and pressures on natural resources are driving people away from their traditional caste occupation, and encouraging them to diversify their means of livelihood and to rely on income earned outside the village.

Seasonality and rural livelihoods

Contrary to a deeply entrenched notion that agriculture is the sole source of livelihood for rural households, there is growing evidence around the world of the plurality and complementarity of rural people's livelihoods. For small and marginal farmers owning less than two hectares of land, farming is but one way of getting food or earning an income. When work in the fields declines in intensity, they engage in a wide range of activities depending on the season, on their means of accessing resources, on their tools and skills, and on the opportunities offered by the market economy.

17. In the Adilabad region, old people remember that when the Kurma, a shepherd community, started weaving activities, the Doodekla, a caste of traditional weavers, protested in an attempt to protect their profession and source of livelihood. They claimed that no other caste was entitled to use the weaving technique that characterised their work for generations. The Kurma had to comply with this demand to avoid further conflicts. Interview with Ravindra Sharma, Adilabad, November 2001.

The village territory provides a large part of the resources used to derive seasonal livelihoods. Village commons are used for an array of purposes, from collecting fodder and other useful grasses to grazing animals and making mud bricks. Grassland and uncultivated areas play a major role in livestock rearing. Forested areas support a range of gathering activities. Water bodies provide fish.

In my study villages, a village territory varied between 150 and 350 hectares. Timmapur for instance has a territory of about 240 hectares, 100 hectares of which are forested. Other villages, like Nawabpet, have very little forest, but have several water tanks.

There is therefore great variation in livelihood sources and these depend on the area, as well as on the customary habits of the people. On the whole, Adivasi communities tend to rely more heavily than other communities on gathering wild plants and animals from forests. Fishing may be a caste-based occupation, or else an occupation that most households engage in on a seasonal basis. Farming, of course, remains a significant dimension in virtually all areas, and for practically all communities, including those whose traditional occupation is non-agricultural.

Farming in the *kharif* and *rabi* seasons

There are two main growing seasons on the Deccan Plateau for rainfed crops. The rainy *kharif* season begins in June and extends into September and October, which is the harvesting period for most *kharif* crops. The *rabi* or winter season starts in October after Diwali and ends in March (Figure 3).

Sorghum (the main cereal grown in dryland agriculture in India, along with pearl millet and maize) is grown in both seasons. *Kharif* sorghum is invariably grown with one or several pulses (pigeonpea, cowpea, greengram, blackgram, horsegram) and with at least one oilseed crop (mustard, sesame, groundnut). Pearl millet is often grown along with sorghum and minor millets (foxtail millet, finger millet and small millet), which now occupy a much smaller area than in the past. In regions where annual rainfall reaches the 1200 mm level, maize replaces sorghum in the rainy season. The traditional cropping system of the Deccan Plateau also features a range of vegetables (gourds, beans, tomato, eggplant, spinach), spices (chillies, coriander) and cash crops (castor, turmeric, ginger, bishop's weed and cotton).

The *kharif* agricultural season begins in May with bullock-ploughing to prepare the land. After the first ploughing, sorghum stalks are removed. Some fields are ploughed three or four times. Then manure is transported to cultivated lands by bullock cart and spread on the fields, which are ploughed one more time to integrate the manure into the soil. Sowing is the next major task, and is done after the onset of the first rains, in the first week of June, a period known as *Mirgum* according to

1 – *Kharif* season
2 – *Rabi* season
3 – Main agrarian festivals

Main agrarian festivals and rituals

- ***Ganesh Chaviti***: worship of Lord Ganesh, the god of commencement and performing of ***Chaviti Puja***, worship of farming tools
- ***Dasseru***: worship of the Goddess Durga & ***Gatilu***, seed germination ritual (*rabi*)
- ***Dipavali***: worship of the Goddess of prosperity Lakshmi & ***Nagula Panchami***, worship of the Snake Goddess
- ***Soonyam Pandaga***: worship of Mother Earth and celebration of agrobiodiversity
- ***Sankranti***: main harvest festival in Andhra Pradesh (especially in Coastal Andhra)
- ***Endlegatte Punnam***: honouring of maturing earheads in the *rabi* season
- ***Shivaratri***: worship of Lord Shiva & ***Holi***, festival of colours
- ***Ugadi***: Telugu New Year & reading of the *Panchangam*, predictions for the coming year based on Hindu astrology
- ***Iddiri***: *kharif* seeds presented to the local deity Poshamma in Adivasi villages
- ***Erukka Punnam***: worship and celebration of plough bullocks

Figure 3: The agricultural cycle and its associated rituals

the Hindu lunar calendar.[18] For crops like sorghum and pearl millet, labour-intensive weeding is done in July and August. The average growth period for *kharif* crops is 90 days, but some crops like foxtail millet mature in 60 days while others, like pigeonpea, have a growing period of approximately 150 days. Thus, the *kharif* harvest is a staggered one, extending from the beginning of August right through until November (Figure 3). Women farmers do all the post-harvest tasks of beating, winnowing and threshing the earheads (for cereals) and pods (for pulses). The clean grain is then stored in the houses, and seeds are prepared separately by women and stored until the next season.

Sowing for the *rabi* crop takes place at the end of October and harvesting extends from January to March. By the end of February, the three-month Deccan summer sets in, with peak temperatures rising above 45° C. This period constitutes a short fallow for most cultivated lands.[19] Unlike the rainy season crop, the winter *rabi* crop is not directly dependent on rain; it gets enough moisture from the morning dew brought by cool nights (night temperatures fall below 10° C from November to January). In soils with good water absorption capacity, the winter crop also benefits from the residual soil moisture following the rainy season. *Rabi* cereals include winter sorghum (*saijonna*), wheat, dryland rice and barley. A number of pulses (lentil, chickpea and lathyrus) and oilseeds (safflower, groundnut) are also grown in the winter season.

Livestock rearing

Livestock consists of buffaloes, bulls and cows, sheep and goats, chickens and other fowls, and pigs. Except for the poorest sections of society, most farming families own at least one pair of bullocks, essential for manure production and draught power. They are also a means of transportation and are highly valued. Owning bullocks gives landless households access to land through the negotiation of a share-cropping arrangement with a land-owning household. They can also rent out their bullock cart for transportation purposes on a daily basis.

Crop residues (sorghum and pearl millet stalks, husks of various pulses, sugarcane leaves) and green fodder collected in and around the fields constitute the main source of food for cattle. A recent study conducted in six regions of Andhra Pradesh and Maharashtra shows that women are responsible for 60% to 90% of the daily chores involved in cattle-rearing (maintaining stables, preparing manure, milking).

18. The Hindu calendar is a succession of *Nakshatras* that refer to the placement of astral bodies. Each lunar month brings two *Nakshatras*, each lasting for 14 days. Certain *Nakshatras*, like *mirgum* which begins on June 7th, carry a particular significance in the agricultural cycle as they designate time periods when crucial tasks need to be accomplished (sowing, transplanting, harvesting…).

19. Red lands that do not carry *rabi* crops remain uncultivated throughout most of the winter and summer seasons, amounting to a longer fallowing period of 5 to 6 months. The small plots of land left fallow in the rainy season are a result of difficulty of access to draught power and labour faced by small farmers. Long fallows (one year or more) are not used by small farmers as a soil management measure, but they do occasionally play a role in the strategy of large farmers.

However, as far as animal health is concerned, men are the primary knowledge-holders and practitioners of traditional healing methods, which restricts women's autonomy in rearing activities (Ramdas 2001).

As a result of a government scheme offering low interest loans to Scheduled Caste households to purchase dairy animals, a significant percentage of Dalit households (50% in some villages) rear one or two buffaloes for milk production. Buffaloes also produce large amounts of manure, which can either be used to fertilise one's own land, or else exchanged or sold. Goats are also commonly reared by poor households, for whom they are a source of income and insurance. Sheep herding is still largely restricted to the castes who traditionally derive their livelihood from this activity. During the dry season, sheep herders take their animals to distant lands in search of water and pasture. Sheep penning—the stationing of a herd on land for fertilisation purposes—is in high demand amongst farmers (Box 8). In every village, numerous households rear a few fowls as a source of food and income but also as a saving mechanism managed by women. Chickens are often sacrificed (before starting a harvest for instance) and used as a gift in return for small favours.

Trends in livestock in Telangana over the last two decades show an increase in the populations of buffaloes and goats on the one hand, and a reduction in the cattle population on the other. Figures show a 21% reduction in cattle in Medak district between 1987 and 1998.[20] Declining levels of fodder production and the degradation and encroachment of grazing lands are major reasons for this trend.[21] Other explanatory factors include the decreasing importance of bullocks as a source of draught power in cultivation and pumping of water, reduction in farm size, scarcity of labour for herding cattle and the rise of a bovine meat export market (Conroy et al 2001). Large farmers who used to keep dozens of cattle are only left with a few animals. Amongst small farmers, however, the percentage of cattle-owning households has remained quite high, varying between 50% and 80% depending on the district and village.

In some parts of Medak district, small farmers have also been able to acquire cattle sold by larger farmers who are unable to manage big herds without hiring a substantial labour force. The increasing ownership of bullocks by small farmers has enabled them to lease land for cultivation from larger farmers (Adolph et al. 2002). Yet, throughout the Deccan region, there are also numerous cases of poor households selling their cattle in order to meet other expenses or to pay off a debt, or because they are unable to bear the increasing costs of raising livestock. This

20. In Medak district, the population of cattle has gone down from 595,163 in 1987 to 469,496 in 1998. Government of Andhra Pradesh, Directorate of Economics and Statistics, Statistical Abstracts 1998-1999.

21. In the district of Medak alone, grazing areas have fallen from 59,800 hectares in 1980 to 42,900 ha in 1996. Government of Andhra Pradesh, Directorate of Economics and Statistics, Handbook of Statistics 1997-1998, Medak District.

8 Sheep penning, or the integration of ecology, society and culture

Anjanna and Ratnamma are part of the Golla community of Shamshuddinpur. One of their sons is in charge of the sheep and goat herd, which has a total of 40 animals. From January to March, he takes the herd to different parts of the district, his primary aim being to locate water sources where the animals can quench their thirst and grasslands where they can freely graze. He can go as far as 100 km from his village. Along the way, local farmers who need their land to be fertilised by the animals' droppings and urine ask him to leave his herd on their lands for one or several days. Sheep manure is highly valued by farmers because it increases soil fertility, improves soil structure and increases the moisture holding capacity. In return for keeping the herd on the field, the shepherd receives a daily meal. In addition, farmers offer sorghum flour, jaggery or a payment of Rs. 50 per day for a herd of 20 to 50 animals.

Anjanna and his father know exactly what kind of herbal treatments to give to sick animals and they also know where to find the plants needed for these treatments. Ratnamma is in charge of all the processing activities at home. One of these is spinning yarn, an activity that requires skill, dexterity and endurance. Having produced thick thread out of raw wool, she weaves large blankets. Shepherds can be spotted from a distance on the red lands of the Deccan because of these black blankets which they wear from head to knees, in the hot summer and rainy seasons alike.

happens more and more frequently in areas where fodder-producing crops like sorghum have decreased in area, meaning that fodder has to be bought, as is the case in northern parts of Adilabad district. When a poor household relinquishes its bullocks, this leads to difficulties in getting hold of draught power and organic manure, leading to a vicious cycle of declining returns from the land.

Gathering as a source of food and income

Gathering activities are very common in the Deccan Plateau, especially amongst the poorer sections of rural society. They are largely done by women, who are expert in identifying and maintaining a range of useful plant species on the village territory. Rural women's interest in uncultivated plants is not unique to the dryland Deccan. Similar observations have been made throughout South Asia, Africa, South America and the Middle East (Howard 2003).

Gathering is a seasonal activity and depends on the nature and extent of locally available natural resources. It can be done to meet household food, fodder, fibre, fuel and medicinal needs, or to earn cash. These two components of gathering activities—one subsistence-oriented and the other market-oriented—are complementary components of rural livelihoods. For instance, apart from a great variety of items collected for their own consumption and use (edible greens, berries,

tubers, roots...), the Gound Adivasi also earn money from the sale of mushrooms, fodder grasses and medicinal plants.

In the whole of India, millions of rural people engage in seasonal gathering activities, which play a particularly important role for resource-poor households. The sale of gathered items makes up to 20% of the income of poor households, who also critically depend on village commons for meeting their firewood and grazing needs. The viability of small farmers' private property resources is intimately linked to their access to the commons for grazing animals (Jodha 1986). Moreover, in times of scarcity and during dry spells, gathered items represent a very significant part of the diet of rural people. In addition to their knowledge of the nutritional and medicinal properties of plants, roots and trees, women thus hold 'a wide reserve of knowledge of edible plants not normally used but critical for coping with prolonged shortages during climatic disasters' (Agarwal 1999).

In forested areas, gathering is an important livelihood source during the dry summer; a lean period for foodgrains. During March, April and May over 30% of households in Timmapur resort to the collection and sale of a range of wild resources, including Mahua flowers (used to make an alcoholic drink), Ganuga seeds (used to make oil), berries and leaves (used in the preparation of pickled items and in the confection of beedies and leaf plates, respectively). If we look at the whole of India, this mode of natural resource use involves millions of people, especially Adivasi communities living in forested areas.

The collection of edible greens is largely associated with the rainy season, when field bunds, fallow lands, common grazing areas and water tank bunds are covered with a great diversity of plant species. Rural women have developed an ability not only to identify these plants, but also to ensure their return year after year (Box 9).

In Medak district, the most commonly gathered plants are thota koora (*Amaranthus*), doggali koora (*Amaranthus polugamus*), mullu doggali koora (*Amaranthus spinosus*), ponnangati koora (*Althernantera sessilis*), shyama koora (*Colocasia antiquoram*), gunugu koora (*Celosia argentia*) and gangavayeli (*Portulaca oleracea*) (Satheesh and Reddy 2000). As women repeatedly emphasise, these green leafy vegetables are 'good for health' (*balam*). The nutritional analysis of these plant species corroborates this observation: their leaves are a good source of calcium, iron, magnesium, carotene, vitamin C, riboflavine and folic acid (Gopalam et al. 1989).

Apart from nutritional advantages, gathering also carries economic benefits in the form of savings and earnings. In poor households, 30 to 50% of the annual consumption of vegetables is met by leafy greens gathered from common lands. Depending on the frequency of gathering, a household may save between 500 and 1,000 rupees a year.

Testimonies from women farmers clearly indicate that gathering is declining for a number of reasons. Older women assert that chemical fertilisers, now fairly widely

9 Ensuring the return of 'volunteer crops' in the fields

Rural women speak of three major sources of edible greens to supplement the daily diet:

- the green leaves of crops in their early stages of development, like chickpea, mustard, fenugreek and roselle
- the weeds—more appropriately called 'volunteer crops'—removed from cultivated fields
- the wild or semi-wild species that grow 'on their own' on non-cultivated land.

Many women farmers have developed a keen knowledge of uncultivated plants that are useful to them. Samamma of Bidakanne (Medak district) explains that by letting seeds of these weeds enter her compost pile, she ensures they return to her fields in the following season. While weeding, she is also careful not to remove all plants of a given species, so as not to jeopardise its natural reproduction. 'Once a plant starts to grow in a field, it will keep on appearing for years', says Samamma.

Similarly, farmers from Mali in Africa make a conscious effort to leave uncultivated strips of land along their field borders, as these explicitly serve as genetic reserves for graminous species (Luxereau 1994). These 'weeds' are in fact semi-wild relatives of cultivated crops. The American botanist JR Harlan has shown that the morphology and adaptation of such species combine features from both the wild species and the cultivated ones (Harlan 1992). A number of agro-ecological studies from other parts of the world suggest that farmers deliberately maintain these semi-wild relatives of crops in the agroecosystem in order to enhance the genetic diversity of the crops (especially cereals) that they are related to (Altieri 1987).

used, 'harden the soil' and interfere with the growth of small shoots. They also render uncultivated plants unfit for human consumption. The degradation of communal lands takes a toll on the diversity of wild plant species and impedes the inter-generational transmission of knowledge about uncultivated plants. Today, many young women admit to knowing much less about the local flora than their mothers and aunts.

Artisan and service activities

Village artisans include carpenters, masons, potters and tile-makers, blacksmiths, goldsmiths, cobblers, basket-weavers and handloom weavers. Every village has its own artisans, who make up a minority of the population.[22] Though artisans also make use of locally available natural resources, they are less dependent on the seasonal cycle than farmers and herders. Traditionally, artisans and service castes (barbers, washermen and washerwomen, musicians, grave-diggers etc.) are paid in

22. With the exception of certain Adivasi villages where the entire community is engaged in craftwork (brass work, wood work etc.).

Livelihoods

Above: Raising goats as a source of income, insurance and investment

Right: Selling fodder grass and edible greens gathered from village commons

Far top: Working as a farm labourer for a wage in grain (sorghum, pearl millet, pulses…)

Far right: Selling one's crop in the market with the hope of good monetary returns: farmers taking their sugarcane crop to the sugarcane factory near Zaheerabad

foodgrains. In the village of Acchampet, for instance, the potter receives 10 to 12 kg of rice or maize from each farming household every year. In the Zaheerabad area, sorghum is given instead of rice.

A decade ago, potters used to provide a larger number of earthen cooking vessels to each family, and would receive a yearly payment worth twice as much as they receive today. Throughout India, the introduction of steel and plastic substitutes has lessened the demand for pottery. The replacement of locally made tools, toys, vessels, utensils and agricultural equipment by manufactured substitutes not only affects potters, but also blacksmiths, tile-makers, wood-carvers, basket-weavers and handloom-weavers. In many areas, artisans have taken up agricultural work (as tenants or labourers) to complement the dwindling livelihood they receive from other villagers. Some artisans are even forced to leave the village. They may still strive to return to their village on a seasonal basis, like the blacksmith of Acchampet who spends the summer in his village repairing the ploughs and sharpening iron tools before the onset of the *kharif* season.

The means of livelihood existing in a given village depends on the resources available in the area, on the regimes of access and current state of these resources and on the social history of the region. The relative importance of each source of livelihood varies not only throughout the year based on seasonal cycles, but also from year to year and over longer periods of time.

The collection and sale of forest leaves is declining due to the degradation of forest cover in many parts of Andhra Pradesh. The same trend can be observed in fishing and sheep rearing activities. In Timmapur, for instance, fishermen use to derive their livelihood from the village tank, from which, until the late 1980s, they provided every household with from 5 to 10 kg of fish a year. The development of tube wells and consequent neglect of the tank have completely extinguished what was once a livelihood for fishermen, a source of protein for villagers and a system of small-scale irrigation.

In contrast, some activities have increased. The sale of animal dung is on the rise in many parts of the Deccan Plateau, providing an additional livelihood source to those who collect and sell this increasingly scarce and precious resource (Adolph et al. 2002). The cultivation of vegetable crops on irrigated plots during the dry season is also developing in certain parts of the Telangana region. In view of the fact that dry season activities and income play a vital role in the food security strategies of resource-poor households of semi-arid regions, there should be a concerted effort to strengthen these local initiatives, especially for the least-endowed farmers.

Paid agricultural labour is also changing as new crops and new cropping practices set in. In the short run, such opportunities may seem to reduce the incidence of seasonal migration during the off-season periods, where marginal and small farmers

take up employment in road construction, in stone mine or in small towns to earn wages. Yet, the long-term social and environmental impacts of new opportunities also have to be taken into consideration when assessing the relevance of different livelihood opportunities in rural areas.

The local economy of natural and human resources

Extended fieldwork in sub-Sahelian Africa led the anthropologist Michael Mortimore to reject the notion of 'equilibrium' in relation to dryland systems in favour of 'perpetual transition'. He shows that rural communities of this semi-arid zone live in a constant state of instability and that decisionmaking in all realms of activities is characterised by uncertainty (Mortimore 1998). This observation also applies to the Deccan communities, who are confronted with high levels of climatic and environmental fluctuations.

Reflecting on the relationship between subsistence and risk, Amartya Sen and Jean Drèze argue that 'uncertainty and vulnerability can be features of subsistence production (involving exchange with nature) as well as of market exchange… It would be a misleading simplification to regard self-provisioning as synonymous with security. The peasant farmer, like the landless labourer, has no guaranteed entitlement to the necessities of life' (Sen and Drèze 1989).

Yet, there is ample evidence to show that rural communities living in precarious environments tend to develop sophisticated institutions and strategies in order to reduce or manage the risk in their lives. These include 'the diversification of crops and herds, the exploitation of geographical complementarities in the ecosystem, the pursuit of "symbiotic exchanges" between different communities, the development of patronage or reciprocal gift-giving, the recourse to complex dietary adjustments and the storage of food or body fat' (Sen and Drèze 1989).

Having established that livelihood diversification is a common practice for Deccan peasants, I now explore the concept of 'symbiotic exchanges' and the existence of a non-market village economy as a mechanism developed by Deccan agrarian society to manage risk and ensure its own reproduction.

Resource transactions at the community level

Today's village economy in the Telangana region is neither purely subsistence nor fully integrated into the market economy. A village's location is one major factor determining its degree of insertion into the market sphere: those located close to major connecting roads (like the Hyderabad-Mumbai highway) are for instance more dependent on purchased agricultural inputs and goods than villages located over 20 km from any major road. In relatively remote villages, one still come across vibrant non-monetary economies. These are characterised by frequent transfers or exchanges of assets and

10 Grain transfers in village communities: a moral economy of provisioning?

The anthropologist AR Vasavi identified three forms of institutionalised resource transactions in dryland communities of Karnataka (Vasavi 1999):

- *dasoha*, or commensal provisioning, consists of donations of foodgrain and money given by the wealthy to the other communities during the annual festival celebrating each of the village deities (in the period July-August)
- *aya*, or hereditary shares of grain and food, are a kind of payment provided by the landed members of the village to the service castes and ritual specialists (Lingayat priests, Muslim mullahs, flower sellers, shepherds and menial servants)
- *dana*, or merit-accruing donation, is the giving of grains by the landed class to poor people at the threshing ground during the harvesting period

Dasoha and *dana* have moral and religious origins and are local manifestations of a moral economy of provisioning. Yet neither *dana* nor *aya* are done in times of resource scarcity, when employment opportunities and sources of income are limited for the least-endowed households.

The retreat of many households engaged as menial servants by large landowners (cf. Box 7) from these transactions prove that they are embedded in a social order that goes beyond the notion of moral economy: they also serve to reproduce and strengthen the high status of the dispenser on the one hand, and the low position of the receiver on the other. This voluntary withdrawal on the part of the most vulnerable sections of society from their 'traditional rights' to receive sustenance from well-off households speaks of the importance of retaining their dignity. Commercial agriculture and the resulting shifts in production organisation and distribution activities have also contributed to the erosion of provisioning transactions throughout the Deccan Plateau.

material goods, and by various forms of joint or shared management of resources. Transfers of grain from the richest to the poorest households are embedded in customary practices known as *aya*, *dana* and *dasoha* (Box 10).

Grain transfers may provide temporary relief from hunger for poor households, but their impact on reducing vulnerability is limited by the fact that they tend to break down in times of widespread scarcity, such as drought: 'In times of famine, the ordinary rules of patronage, credit, charity, reciprocity and even family support tend to undergo severe strain and can hardly be relied upon to ensure the survival of vulnerable groups' (Sen and Drèze 1989).

Gifts and exchanges of valuable resources like manure, fodder and seed continuously take place amongst different households based on well-defined rules of reciprocity. Though these transfers seek to reinforce communal ties and enact a socially rewarded solidarity, they also represent a material and social investment. Transactions of cattle dung are a good illustration of these transfers within the village

community. Small cattle-owing farmers give—and sometimes sell—animal manure in exchange for fresh produce or fodder from larger farmers. Cow herders collect the dung from the grazing animals and earn additional income by selling it to farmers. Transactions in organic nutrients have been shown to be a source of income for a section of the rural poor, especially female-headed households (Rao 1996). Sheep penning is also a good example of the cooperation between farmers and shepherds in Telangana villages. It also shows how communities cooperate, through 'symbiotic exchanges', in securing each other's livelihood and in maintaining the fragile balance of agro-ecological systems.

Traditional forms of co-management of resources

There are a number of customary arrangements for managing land and livestock. Share-cropping arrangements are of many kinds and depend on prevailing customary practices and on the types of resources controlled by each party (labour, livestock and capital).

One common form of cultivation contract in the Telangana region is known as *palle*. It is an arrangement between farmers who own land but no draught animals, and farmers who have cattle but little or no land. The two households enter into an oral agreement for joint land cultivation (Box 11). The harvest is divided into two unequal shares: 25% goes to the livestock owners and 75% to the landowners.

The *palle* contract thus helps to avoid land being left fallow for lack of draught animals, and under-utilisation of draught power for lack of land. However, the decrease in livestock population in villages is undermining this ingenious system of resource-sharing.

Interestingly, livestock rearing can also entail some form of shared arrangement. For a household owning livestock (especially goats, cows and buffaloes), this involves entrusting a young female animal to another household. When this animal gives birth, the first-born is given back to the original owner. The household that has reared the mother is entitled to the second offspring. Known as *batai*, this contract is often entered into by small farmers who cannot afford to buy an animal. For them, entering into a *batai* arrangement may be the only way of accessing livestock. *Batai* is therefore a local form of long-term investment in livestock rearing, which is especially valuable in the case of cows and cow buffaloes, because of the money to be made from selling milk and manure.

The existence of local institutions for water management or small-scale irrigation systems in dryland also deserves to be mentioned. Although these community-based water management systems have lost much of their vitality in the past few decades for a range of reasons, especially counter-productive government interventions, there are many records of their past and present existence (Agarwal 1997). Reports of

11 Pooling land and cattle for mutual benefit

Lalamma and Balvanti own 1.6 ha of black land in Kalmela village, but they don't have any draught power. Draupadi and Sidram rear two bulls and two female buffaloes and they farm 0.8 ha, not enough to meet the food needs of the six family members. Draupadi and Sidram therefore seek, every year, to cultivate extra land under the palle protocol. This is how they started to collaborate with Lalamma and Balvanti. Together, the two families cultivate 1 ha of land. Draupadi and Sidram take care of ploughing, sowing and harvesting while the landowning family procures seeds, a portion of the manure and labour. Weeding is a shared responsibility, though it involves the land-owning family more heavily. At the end of the season, Draupadi and Sidram get 25% of the harvest and Lalamma and Balvanti get 75%. Both benefit in several ways: Draupadi and Sidram earn extra food for their family (which saves them money) and make good use of their cattle, and Lalamma and Balvanti find a way of bringing a good portion of their holding under cultivation without needing to hire bullocks or pay for a tractor to plough the land.

agrarian life in the 18th and 19th centuries mention community-based management of water where 'villagers would dig irrigation canals themselves and they would build large water tanks, some of which still exist today' (quoted in The Madras Group 1983: 70). Water-harvesting systems were continuously monitored, repaired and maintained by the community and they ensured equity in the distribution of scare water. They were based on an ingenious property rights system, not only to share water but also to maintain harvesting networks. Though not always equitable in their mode of functioning (the powerful landed class often benefited more than small peasants), these systems had a strong element of sustainability built into them, largely because responsibility for resource management was linked to resource use via local community institutions.[23]

Social and ecological significance of the village economy

The forms of resource transactions and co-management of land and livestock described above are rooted in a localised, non-monetary economy (Figure 4). There is no doubt that these systems are undergoing tremendous change with the expansion of the market economy. Localised economic systems are under threat, but there has been little attempt to understand their social and ecological potential in semi-arid conditions. The major benefits of community-based management systems lie in the following arenas:

Ecological sustainability

1. Land and livestock-based arrangements help to integrate different production systems, thereby reinforcing the reproductive capacity of the system as a whole.

23. On the sustainability of community water management, see Sengupta, N., 1985, "Irrigation: Traditional vs. Modern", *Economic and Political Weekly*, Special Issue, November, pp. 1919-1938.

2. Manure transfers (including sheep-penning) ensure that the total amount of manure available at the community level is shared out, thus optimising the use of a resource that plays a crucial role in regenerating soil fertility.

3. The sharing of resources (land, draught power, labour, manure, seeds…) at the community level also reduces the incidence of fallow lands, which are often directly related to the lack of access to inputs at the household level. Reducing fallows is agriculturally sound, as uncultivated lands suffer from wind and sun erosion in semi-arid regions.

Increasing livelihood opportunities for poor households

4. Co-management systems help diversify livelihoods of individual households and minimise the adverse consequences of unequal land allocation for resource-poor households

5. The existence of a local economy of natural resources (through non-monetary resource transactions) broadens the livelihood options of the poorest section of a village, who may employ themselves, at least for some periods of the year, in the provisioning of manure, green fodder or firewood collected from the wild.

Mutual insurance against risk

6. Non-monetary transfers of grain, manure, fodder and seeds minimise the impact of a natural catastrophe (especially drought) on all households, since a resource that a household can not produce or generate for itself may be provided by another household. Communal transactions therefore act as a mutual insurance mechanism with a better distribution of risk across households.

Solidarity networks and cooperation

7. Local institutions for sharing resources build up networks of solidarity as no household can truly function as an autonomous entity (including the wealthiest families who often need to employ labourers).

8. Solidarity networks translate into mutual cooperation for labour-intensive operations like weeding, monetary loans in times of crisis and daily loans of small quantities of food, firewood or fodder. Women—and especially poor women—rely heavily on these networks, which they maintain and develop through daily social interactions, gift-giving and occasionally, through direct involvement in arranging matrimonial ties (Agarwal 1999).

To say that the village economy carries, on the whole, social and ecological significance does not imply that it is devoid of social oppression and market-related uncertainty. Women's access to essential resources (like land and livestock) is often mediated through their dependency on men, leading to inequitable control over

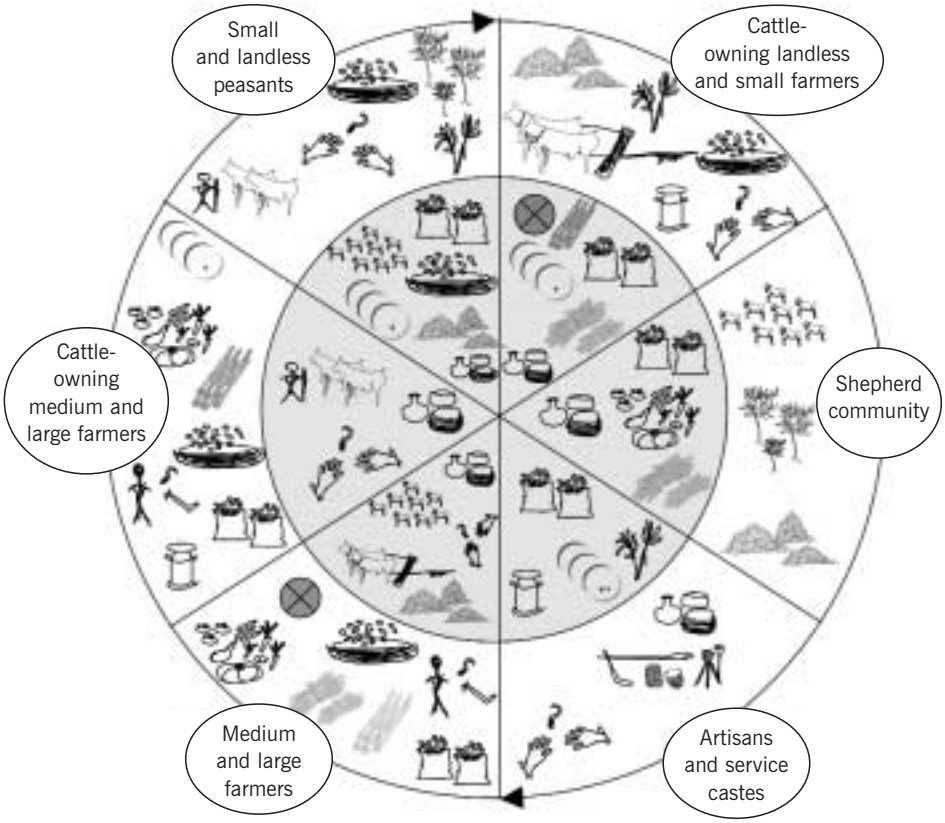


Figure 4: Circulation of resources, skills and services in the village economy

Legend

Human resources and modes of retribution for labour work

- Employment on farmlands
- Farm labour
- Cow and buffalo herder
- Grain contributions and grain wages
- Retributions in cash

Natural resources associated with agricultural activities

- Land for cultivation under share-cropping arrangement (palle)
- Plough bullock (for share cropping arrangement)
- Organic farmyard manure
- Sheep penning
- Seeds of dryland crops

Wild and semi-wild resources and produce from agriculture and from artisan work

- Wild forest produce (bark, tubers, leaves, mushrooms...)
- Uncultivated edible or medicinal plants
- Green or dry fodder
- Construction wood
- Vegetables from the farm
- Milk and milk products
- Wooden objects, farming tools, earthern pots, toys

Resources, skills and services contributed by each group to the village economy

Resources, wages and produce obtained by each group from the village economy

resources within the community. Resource ownership remains highly skewed in favour of a minority of high-caste farmers. Today in Andhra Pradesh almost 40% of arable land remains in the hands of less than 10% of medium to large farmers (those owning over 4 hectares)

Moreover, the ties that bind agricultural workers to landowners have long been exploitative in nature. As stated by Drèze and Sen, 'the miserable employment conditions which permanent farm servants are often willing to accept in exchange for some security of employment are a telling example of the sacrifices that may be involved in insuring against the worst eventuality' (Drèze and Sen 1989). In recent years, there has been a noticeable improvement in the working conditions and social status of agricultural labourers, who now often negotiate higher wages.

Another important downside of the localised economy is its vulnerability within the context of the market economy. As wages are increasingly paid in rupees, foodgrain bought and agricultural inputs purchased, the non-monetary economy faces critical drawbacks. Current technological and economic developments heavily undermine autonomy-based approaches to livelihood. Reversing this trend is one of the greatest challenges lying ahead for rural communities as well as policymakers.

Autonomy, dignity and well-being

The notion of autonomy refers to the social, economic and political mode of functioning of a human group, be it a rural community or a whole nation. Generally speaking, a society can be said to be autonomous when it controls the terms of its own reproduction. More specifically, autonomy resides in a society's capacity to define its needs and its limits, to self-manage its resources, to determine the nature and modes of production, exchange and regulation, to define the course of innovation and to reproduce what it considers to be its own cultural, social and ethical values.

Understanding what autonomy means to rural people is difficult, especially as the present development paradigm severely undermines rural conceptions of autonomy and self-reliance. The ways in which farmers speak of their attachment to their land, to traditional crops and crop varieties, to home-grown food or to local culinary traditions provide valuable insights into the linkages between identity, livelihood, autonomy and dignity in rural society (Box 12).

Self-respect appears to be closely related to the notions of autonomy and self-reliance (Box 13). One of the rare studies directly addressing the question of self-respect yields instructive results. When asked if they gave more value to food or to self-respect, 49 out of 58 Bengali farmers who responded gave priority to self-respect despite recurring food shortages in their village (Beck 1989). This concurs with the results of a study on local perceptions of well-being conducted with

12 Local perceptions of well-being

To grow one's own food is not a mere production activity for women farmers of the Deccan Plateau. Repeatedly, a sense of contentment and self-respect comes across when farmers speak about their land and dryland crops. As stated by the anthropologist AR Vasavi, 'to eat grains from one's own land is considered to be a sign of independence, a fruition of fortunate endowment, hard work and cooperation with fellow agriculturists' (Vasavi 1999). To take good care of one's lands, crops and animals is another important value in rural culture. Staying healthy without spending money is also something which people value. This idea contains the notions of vitality and autonomy that rank high in the perceptions of Deccan people. In fact, the three essential values attributed by farmers to traditional dryland agriculture are: the autonomy it generates, the organic nature of the land and crops, and the strength or vitality bestowed on those who consume the food produced. While very much alive in the minds of middle-aged and old farmers, this view is not as strongly adhered to by the younger generations, who are more inclined to fully participate in the market economy and to rely on consumer goods.

Interestingly, the Embu of Kenya have similar conceptions, as they 'view a good farmer as one who grows enough maize, beans, potatoes, sweet potatoes, cassava and bananas to feed the family without purchasing such staples and without relying on income from wage labour to purchase goods that could be grown at home. This local ideal is precisely the opposite of the pattern [of specialised cropping and market dependence for selling products and buying labour and food] called for in theories of economic development' (Haugerud 1989).

women from the Girisia Tribal community in arid parts of Rajasthan. Two primary and interrelated concerns among Girisia women are 'to maintain their self-respect on one hand, and, in the face of increasing economic hardships, to meet their subsistence needs and prevent the degrading economic and social effects of the processes of impoverishment, on the other' (Unnithan-Kumar 1997).

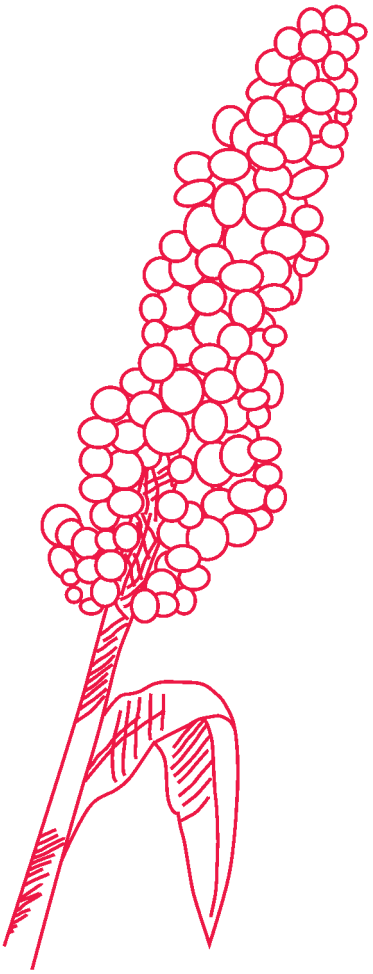
These findings have considerable bearing on the very concept of development. Agricultural development as envisioned today remains primarily centred around improving productivity and incomes, despite increasing attention on environmental issues. The impact of new modes of agricultural production on solidarity networks, on the livelihood of the poor and on small farmers' sense of dignity are neither studied nor taken into account in policymaking processes. In reality, emancipation is not purely a function of material well-being; it is also a struggle for dignity and self-respect, as has been shown for landless women in Andhra Pradesh (Mies et al. 1983).

13 The interplay between self-reliance and self-respect

The anthropologist AR Vasavi reports that in Bijapur (a semi-arid district of the State of Karnataka), old people remember being told in their childhood not to accept biscuits or food from missionaries or charitable organisations. To feed oneself by eating roots and tubers was considered to be the only acceptable strategy during famine. Pride, self-respect and a sense of decency combined with social rules to make famine-relief work an unattractive option. Villagers would suffer hunger rather than leave their village to benefit from relief programmes (Vasavi 1999). The lack of interest displayed by rural people in the initial phases of relief programmes bears testimony to a sense of pride deeply rooted in the practice of autonomy. This is true amongst even the poorest sections of society, i.e. the ones most exposed to risk. It took many years for dryland farmers in Karnataka to come to terms with and begin to accept the idea of external assistance during drought.

A similar need for self-reliance is expressed by rural women from West Bengal. When asked whether they buy any food—and especially pulses—at market to supplement their diet, a group of Adivasi Santal women fervently replied: 'Why should we buy *dal*?! There are plenty of green leafy plants to pick up from the [uncultivated] land around our fields!' Many rural women thus find meaning in gathering freely available food items from the wild, not only for economic reasons, but also because of a strong reluctance to lose their independence and identity.

4



Engendering crop diversity. Women farmers' strategies in the drylands

The Indian sub-continent is one of the most vibrant illustrations, worldwide, of what diversity means in agriculture. Diversity manifests itself in the wide range of farming systems that have evolved to suit the agro-climatic features of varied ecosystems. These ecosystems range from coasts to mountains, from plains to highlands, and from the most arid regions to the most well-endowed ones in terms of water resources, tree cover and soil fertility.

In many parts of the North-Eastern states (Assam, Mizoram and Meghalaya), people have developed cropping patterns that suit the complex ecology of hillsides and forests. They grow crops like maize, beans, gourds; tubers like potato, sweet potato, cassava; and tree crops like coffee and rubber on cleared plots of land. Changes in the landscape and agrosystems are carefully monitored and managed by the local people.

In the Garhwal Himalayas further west, the *baranaja* system of farming was designed by small farmers to optimise the use of land, water, sunlight and space:

> Literally meaning 'twelve grains', this once-common practice involves the sowing of a mixture of crops into a single plot of land. Rajma (kidney beans), urad (blackgram), mung (greengram), kulth (horsegram), marsha (amaranthus), mandua (finger millet), jhangora (barnyard millet) and other crops are grown in a jumbled profusion which to a modern agricultural scientist would appear a mess, but which is actually a carefully considered way of obtaining optimal and sustained yields (Kothari 1997).

Low input diversity-based systems like the *baranaja* system provide some stability in terms of overall crop yield, and they tend to be sustainable both with respect to natural resources and to livelihoods.

The reputed spice gardens of Karnataka and Kerala are another illustration of farmers' intricate understanding of the characteristics and needs of different crops in terms of sunlight and shade, horizontal and vertical growth, root systems, nutrient cycles, soil moisture, etc... On a one-hectare farm, cultivators interplant coconut and

arecanut trees. These tall trees shelter vanilla and pepper twiners, and provide shade to a crop of turmeric and to banana trees. A separate plot is often reserved for the cultivation of field crops like paddy, chillies and vegetables.

The semi-arid and allegedly 'backward' areas of India also have diversified farming systems, with livestock playing a major role. Where the land begins to undulate and soils become prominently red, where irrigation canals are few and far between, and where the wind mercilessly brushes away the topsoil from red and yellow tablelands, this is where dryland farming takes on its full meaning.

Environmental and economic constraints are primary reasons for the diversity of crops and livestock found in various parts of the country. Historical and cultural considerations also shape and determine the ways in which farmers use and maintain agrobiodiversity in their fields. These broad categories may give a general understanding of the rationales for crop diversity but they do not necessarily account for the finer nuances of small farmers' motives for growing over 12 crops on less than two hectares of land. In order to comprehend this cropping strategy, one has to embrace non-tangible and non-obvious motives that are part of rural realities. One also has to look into how gender relations are enacted in the household, community and society and how they shape decision-making over cropping patterns. Finally, one has to examine current trends in agriculture and the way policies foster or hinder the use and preservation of crop diversity in farmers' fields.

Basic principles of dryland farming

> To preach dryland farming to men to whom it was a hoary tradition when Englishmen used paint instead of clothing did not appear to me the surest way to gain the confidence of the Kunbi [Indian farmer], nor did I consider it wise to suggest seed selection in a land where 4,000 different sorts of paddy are grown in one province alone, and carefully differentiated according to their qualities and the land suitable to them.
>
> John Kenny, *Intensive Farming in India* (1912).

Farmers from dryland regions have to deal with two fundamental properties of their ecosystems: their aridity and the unreliability of rainfall. For about five months, there are virtually no rains and during the rest of the year, rainfall is irregular and varies considerably from one year to the next. For example, the district of Medak received 1012 mm of rain in 1996-97, 658 mm in 1997-98 and 964 mm in 1998-99. As a result, rainfed farming in the drylands is episodic, with periods of intense work interspaced by periods of relative inactivity when other livelihood activities are pursued.

Conducting agricultural operations—like ploughing, sowing, weeding—at the *right time* is of utmost importance for dryland farmers. Here, the intuition and experience of

farmers play at least as important a role as the prescriptions found in ancient texts. The instructions received through oral tradition and based on the Hindu calendar (*Panchangam*) are modulated in accordance with local climatic conditions, collective farming practices and skills, and individual capacity for discernment. For instance, although sowing is in principle associated with the *Mirgum Nakshatra* in early June, farmers may delay sowing by one, two and sometimes three to four weeks if there are no substantial showers in early June. The notion of 'appropriateness' does not exclusively apply to agriculture: it also concerns the harvesting of fruit from various tree species like tamarind and mango and the harvesting of fish in freshwater. Farmers are always on the lookout for environmental indications that determine particular courses of actions. This pragmatic and secular understanding of time and natural cycles has a religious counterpart, 'auspiciousness', which also influences farmers' conduct and decisions (Box 14).

Agriculture primarily consists, for dryland farmers, of understanding the characters of a given land, of managing the problem of water scarcity, of preserving and enhancing the fertility of soil and of cultivating crops that are suited to the micro-environment and that will not deplete the soil. All of these components are closely interconnected, and they reinforce each other in making farming not only possible but also viable under the harsh semi-arid conditions of the Deccan Plateau.

14 Auspiciousness and 'embedded ecologies'

Ancient texts, like the Krsi-Parasara written in the 10th century, describe the importance of each Nakshatra and spell out guidelines about the appropriate time—based on the position and influence of planets—for various agricultural operations. The compost heap must, for instance, be worshipped during Magha Nakshatra and spread on the field with devotion on an auspicious day (Majumdar and Banerji 1962). While certain days of the lunar calendar are considered to be auspicious for starting agricultural tasks, others are deemed to be highly inauspicious (like Amavase, the new moon day) and distinctly marked out in people's minds.

Just as there is a right time and an auspicious moment for beginning important tasks in the Deccan, significance is also placed on the sacredness of space. Drawing kolam (mugu in Telugu) with rice flour or chalk on the threshold of houses is a daily practice of rural and urban women alike in many parts of India. It is but one example of the 'making' of space to increase auspiciousness.

According to the Indian anthropologist V. Nagarajan, the kolam is an invitation to a divinity (generally the goddess of wealth, Lakshmi) but also an act of reciprocity. By the end of the day, 'the household has fed "a thousand souls", that is the small birds, ants and insects that have come to the threshold of the house and grazed on the kolam and in turn, the gods and goddesses may protect the household.... The kolam exemplifies the ephemerality of "spirit" in Hindu ideology and the continual need to attract the attention of the divine through various acts of ritual generosity reflects one aspect of embedded ecologies' (Nagarajan, 2000).

The anthropologist Robert McNetting argues, based on ample evidence from many geographic and cultural contexts, that the process of intensification is not linked to any given model of unilineal technological development. Nor does it necessarily require large capital or labour investments. On the contrary, intensive agriculture is practised by smallholders under many conditions, and in a multitude of ways. The critical elements in the process of intensification are:

> knowledge of the local environment and the specific requirements of domesticated plants and animals, combined with a tool kit of practices for soil manipulation, water control, nutrient conservation and restoration, and the protection of cultigens that act to increase and sustain biological production. Intercropping, rotation, diversified grain-tuber-vegetable-tree crop production, stall-fed livestock, terracing irrigation and manuring [all of which are intensive practices] can all be carried out with different physical means and with various cultigens (Netting, 1993).

Intensification is thus described as an inherent component of traditional farming systems, an observation which entirely applies to the dryland system of the Deccan Plateau, as we will see throughout this chapter.

Red lands and black lands

British agricultural scientists who studied Indian indigenous farming practices in the 18th and 19th centuries commented on the complexity and refinement of farmers' knowledge about soils. In 1878, AO Hume wrote:

> Nothing, indeed, is more perplexing than the enormous number of names applied by native agriculturists to soils, the more so that probably almost every district rejoices in at least a dozen purely local names which are unknown elsewhere… Independent of names indicative of the quality of soils, they make use, in describing their land, of names having reference to external conditions, the frequency or recency of cultivation therein, its situation as regards inhabited sites, its position as upland or recently-formed alluvium, its occupation for pasture, fields or gardens (quoted in The Madras Group 1983: 65).

In the Deccan, the productive potential of land is intimately linked to moisture availability, a major constraint in dryland areas. The ability of soils to retain moisture is therefore an important factor in farmers' appreciation of soils. Other variables also come into play, such as colour, depth, texture (sand, silt and clay properties), smell and taste (to test acidity and salinity), growth of certain weeds and grasses, compactness or looseness, suitability for specific crops, presence of absence of soil fauna (like earthworms) and drainage properties (Butterworth et al. 2003).

The two primary categories of soils identified by farmers are red lands (*erra bhoomi*) and black lands (*nalla bhoomi*). Often located on the undulating hills, red lateritic

soils are ill-suited for agriculture because of their low moisture retention capacity and their vulnerability to wind erosion. Deep black soils are considered to be the best soils for agriculture on the Deccan Plateau. They have good moisture-holding capacity and respond well to the application of organic manure. Apart from red and black soils, which are sub-divided into different groups based on depth and sand or clay content, dryland farmers identify three to six additional soil types depending on the area. They also have a detailed mental record of the crops most suited to each soil type (Table 4).

Table 4. Farmers' knowledge of soils and crop-soil partnerships in Medak district

Soil type	Major soil characteristics	Most adapted crops
RED SOILS	High silt content, low fertility level, very poor moisture retention capacity	*Kharif* crops only: pearl millet, little millet, sorghum, niger, roselle
Mixed silt	Relatively high clay content, good drainage, fertile, good water retention	All dryland *kharif* and *rabi* crops including paddy and millets, pulses and oilseeds
Clay loams	High porosity, low to medium fertility, very poor moisture retention capacity	*Kharif* crops only: groundnut, field bean, pigeonpea, sorghum and all millets
Shallow sandy	Low to medium fertility, relatively good moisture retention capacity	*Kharif* crops only: sorghum, dryland rice, finger and foxtail millet, sesame, greengram, niger, blackgram
BLACK SOILS		
Shallow silt	Very fertile, deep (up to 1.5 m), very good water retention capacity	All dryland *rabi* crops: wheat, chickpea, linseed, safflower
Deep clay	Clay loams, good drainage, high fertility, good moisture retention capacity	All dryland *kharif* crops and safflower and chillies in rabi (after a *kharif* fallow)
Mixed	High sodium content, low fertility, unsound for cultivation	Horsegram exclusively
SALINE SOILS	Low soil content, low fertility, poor moisture retention capacity	Three *kharif* crops: sorghum, pearl millet, pigeonpea
ROCKY SOILS	Very poor drainage	Rice in *kharif* and chickpea or lentil in *rabi*
WATER-LOGGED		

Source: PRA conducted by Deccan Development Society, 1999.

15 Social differentiation of land management

In most villages of the Deccan, black and mixed soils are generally found near the village, forming a garland of well-maintained fields cultivated in both kharif and rabi, ie. for nine out of 12 months in the year. These intensively-managed fields primarily belong to the higher and middle caste farmers, and some of them are irrigated. Further from the settlement are the predominantly red soil fields tended by lower caste farmers. Except for mixed red soils which carry crops during both agricultural seasons, red lands are cultivated exclusively during the rainy season. Smallholders who own cattle may be in a position to intensively cultivate a small field by applying large quantities of manure onto their fields. But overall, resource-poor farmers tend to use extensive farming methods, with a pattern of labour use that is highly responsive to rainfall distribution and crop performance. This means that a significant amount of time is only invested if the rain pattern seems adequate and the crop promising. As marginal farmers need to earn cash as an additional source of livelihood, they may choose to engage in daily paid labour during the peak agricultural periods. In that case, their own plots of land get ploughed, manured, sown and harvested last, leading to productivity losses that compound other factors of low productivity such as inadequate moisture retention capacity of red soils. Farmers assert that a significant delay in sowing can lead to yield losses of 25% to 40%. The poorest farmers sometimes have to forgo cultivating their land altogether for lack of financial means to carry out the basic clearing and ploughing operations.

Interestingly, farmers perceive dryland food crops that are well adapted to low fertility red soils as 'feminine' in nature, whereas cash crops like sugarcane, potato and ginger that are associated with black soils of greater productive potential are held to be 'masculine'. In addition to this *cultural* perception of land, there is a *social* differentiation of land management practices applying to red and black lands. We saw earlier that for historical and political reasons, much of the red land is owned by low caste farmers. Socio-economic inequality thus maps itself out on the land in the Telangana region, creating a socially-sanctioned differentiation in patterns of land management, labour use and resource use. While black lands are managed intensively, red lands tend to be managed more extensively (Box 15).

The co-existence of extensive and intensive farming systems in the cropped area of a single village—which reflects the social stratification of rural society—defies the common perception of farming systems being *either* extensive *or* intensive.

The different plots tended by a single household are rarely located in the same area: they are usually scattered around the village territory. Many households therefore have fields of varying type and quality, which have to be sown with different crop mixtures. A study in Peru shows that the distribution of small farmers' fields across a relatively vast area (as opposed to a single consolidated holding) contributes to yield stability and diminishes the risk of total crop loss (Goland 1993).

Dealing with water scarcity

Farmers in the drylands have had to devise multiple ways of managing water scarcity, including a high degree of flexibility, cultural skills for assessing and predicting rainfall, cropping practices that are adapted to moisture stress and techniques that conserve water and use it optimally.

The importance of rainfall in dryland areas has led farmers of the Deccan to develop a body of knowledge for predicting rain patterns. In certain parts of Karnataka, an annual rain divination ritual is conducted annually under the guidance of a shepherd from the Kuruba community, well-known in the region for its talent in predicting rain patterns (Vasavi 1999).

Michael Mortimore, who has closely studied farmers' responses to risk in the dryland environment of Sahelian regions in Africa, shows that farmers need to constantly improvise in order to keep up with agro-climatic and other environmental changes (Mortimore 1998). The same observation applies to farmers of the Deccan Plateau, who continually need to assess weather conditions and tactically decide whether or not to sow, how many rounds of manual weeding to plan for, which pest control method to use, and when to start harvesting.

Identifying the correct moment to sow one's fields is of vital importance for dryland farmers. The onset and consistency of the first monsoon rains determine the right time for sowing. Farmers may delay sowing by up to four weeks if there are no substantial showers in June and they are not confident that the crops will 'make it through'. Under rainfed conditions, rainfall is not only essential at the time of sowing but also in the first few weeks of crop development. Indeed, many cultivated dryland species can endure moisture stress once they have reached a certain level of maturity, but not immediately after germination. In years of acute moisture scarcity, it is not uncommon for farmers to sow their fields again if the first sowing has been lost due to lack of rain. The same has been reported for African farmers from the sub-Saharan regions. This common practice is a good illustration of the need for flexibility and adaptability in dry regions.

The wide cultivation of 'hardy' dryland crops is another key component of farmers' management of water scarcity. Four major criteria come into play in evaluating the degree of hardiness of a crop, and these are similar to the concept of ecological resilience (Box 16). The criteria for hardiness essentially hinge on moisture constraints and soil quality and fertility requirements:

1. the crop's need for moisture at different stages of growth
2. its capacity to endure moisture stress for extended periods of time
3. its requirements in terms of soil texture, mineral content, depth and water holding capacity
4. the level of fertilisation required for good development of the stem, leaves, roots and fruit or earhead.

16 Farmers' environmental knowledge: crop hardiness and ecological resilience

Farmers' understanding of hardiness shares features of the scientific notion of ecological resilience. This notion is based on the idea that 'ecosystems may evolve and respond chaotically, in a non-linear fashion, without clear trajectories of adjustment' (O'Riordan 2002). The assumption of non-linearity is a part of dryland farmers' perceptions of their environment. When opting for hardy crops, they assume non-linearity and uncertainty in weather conditions. They seek out the species that will absorb the highest degree of disturbance without severely modifying their growth and maturation patterns.

Recent findings on the relationship between biological diversity and the efficiency and resilience (or stability) of ecosystem functioning provide evidence that 'the richer and more heterogeneous the species mix, the more robust the ecosystem as a whole' (O'Riordan 2002). Deccan farmers practise this ecological principle through complex associations between a wide range of crops and crop varieties, thus fostering a high genetic variability that plays a primary role in the evolution and adaptability of species.

Ecologists further argue that the survival of ecological complexities hinges upon the preservation of critical interconnections between resources and ecosystems. Not only do farmers and herders from risk-prone areas have an intuitive understanding of these interconnections, but they also possess the ecological knowledge required to constantly readjust and renegotiate the ways in which they manage and relate to their environment.

Not all dryland crops are equally adapted to the least favourable conditions (a combination of low rainfall, moisture stress, poor soil texture and low organic content and soil fertility). Apart from finger millet, which requires a certain level of rainfall in order to germinate and start its growth, millets have the lowest water requirement of all cereals. According to farmers from Medak, a few showers in the initial weeks are enough for short-duration crops like foxtail millet and little millet, as well as sesame and coriander, to reach maturity. Pearl millet, foxtail millet, little millet, sorghum and niger are the only crops that can endure long dry spells, provided weeds are regularly removed. Four crops stand out for their ability to adapt to a variety of soils: kharif sorghum, pearl millet, groundnut and pigeonpea. Foxtail millet, little millet and niger can be cultivated on degraded soils. Most other crops need a well-fertilised soil in order to give reasonable yields (Satheesh 2002).

Since small and marginal farmers lack access to good arable land and face resource shortages (in the form of organic and inorganic inputs, labour, transport, etc.), they have a particular stake in selecting hardy crop varieties: these minimise the costs of cultivation as well the risk of crop loss if the rainfall pattern is inadequate.

Finally, throughout semi-arid India but also in other arid parts of the globe, farmers also make use of a range of soil and water conservation techniques to conserve and

use water for farming in the dry season. These include field bunds and drains on boundaries, boundary waterways along major slopes, criss-cross cultivation (where a plough is used), gully structures and tanks. Deep ploughing in the summer (April-May), sowing across the major slope, furrowing and cross-ploughing, shallow interculture and short-term or rainy season fallow are some of the practices that farmers commonly use in order to increase moisture conservation (Kerr 1991).

Regenerating soil fertility

Deccan soils experience high levels of organic and mineral depletion as a result of high temperatures (inducing a high level of evapotranspiration), wind erosion and the low capacity of organic matter absorption of lateritic soils. Compensating for these losses and regenerating soil fertility are key to dryland farming. Farmers' strategies to achieve this depend on the interplay between soil, livestock, crops and farmers' knowledge and manpower.

The main strategy is to enhance soil fertility through regular applications of organic matter and animal manure. Every rural family maintains a compost heap comprising kitchen remains, crop residues and bedding material from the cowshed. This organic matter is mixed with animal dung and urine (from buffaloes, bulls and cows, chicken, goat, donkeys) to make farmyard manure and transported to the field before the sowing season. The dung and urine of buffaloes, cows and bulls can also be applied directly to the fields. Farmers without cattle make compost out of household wastes, leaf litter and crop residues and they may try to access sheep manure through sheep penning. Though less frequently used, poultry and pig manure are also applied onto cultivated lands.

Old farmers speak with great conviction and eloquence of the properties of organic manure: 'The more we apply manure to our land, the greater the number of grain bags we will have in store in our home after harvest', says Ellama. Gowravva adds that organic manure ensures a good yield for three to four years, provided there is no shortage of rainwater during the growing season. Plant health is also a function of soil fertility according to farmers: a well-manured soil greatly reduces the risk of insect pests and parasites damaging the crop.

A farmer's ability to use manure as a soil fertility management strategy is determined by ownership of cattle (and indirectly, therefore, access to fodder), access to transportation and distance from village to field, labour availability in the household and the capacity to give an attractive payment to a shepherd for penning his animals on the fields. This explains why small farmers find it difficult to apply large amounts of manure on their land if they do not own some cattle.

Other techniques for improving soil fertility include growing green manure crops; applying tank silt, sand or ash, depending on the composition of the soil; and incorporating green leaf manure, vermicompost or powdered neem cake into the soil (Butterworth et al. 2003).

Another common way of maintaining soil fertility is to combine and rotate crops (these practices are described in detail below). Leguminous crops play a particular role in crop associations and rotations in the Deccan through their capacity to enrich soils by fixing nitrogen. In the case of crops like sunhemp and pigeonpea, leaf fall protects against soil erosion. Farmers of Gopanpally (in Medak district) identified six crops that clearly bring benefits to the soil: niger, groundnut, pigeonpea, blackgram, chickpea and sunhemp (Adolph et al. 2002). Though sunhemp cultivation has decreased considerably in the last 25 years, farmers assert that it is now reappearing as a green manure crop in areas where sugarcane is grown (sugarcane needs soils with high moisture and organic content).

Soil conservation techniques consist of building soil or stone bunds around fields to reduce water run-off, planting perennial vegetation on field bunds, building small stone check dams and subdividing landholdings into smaller fields (Kerr 1991). Soil and water conservation measures are undertaken at both farm and community level.

Crop rotation and associations

Crop rotation and crop associations are an essential part of dryland farmers' agricultural practices. Systematically carried out by farmers of all categories (small, medium and large), crop rotation consists of planning out cropping cycles so that the same plot does not carry the same crop mix every year. Thus, if a field is sown with a mix of wheat and chickpea one winter season, it will be dedicated to a different set of crops the following winter (sorghum, safflower and niger for instance). As each crop mix interacts with the soil in a specific way (by drawing nutrients, fixing nitrogen, providing organic matter through leaf fall, developing shallow or deep root systems, etc…), the texture and fertility of soils benefit from a cyclical rotation of crops.

Coupled with crop rotation, the practice of associated crops optimises the use of soil fertility and moisture and protects crops from predators, parasites and diseases. Much ethnographic work has supported the relevance of crop association and rotation for smallholders. For example, a study of the Nigerian Kokyar subsistence cultivation practices shows that 'systems of rotation combined with interplanting and manuring may reduce and finally eliminate fallowing, allowing a field to be permanently productive' (Netting 1993). The pioneering research conducted by Paul Richards on farmers' knowledge systems in West Africa reveals that crop associations are an essential means of intensifying land use and of reducing the risk of harvest failure (Richards 1983). Polyculture has been shown to be the key to ecological stability and sustainable and reliable yields in subsistence agriculture, whereas intensive monoculture of genetically uniform industrial varieties has led to major disasters, like the Irish potato famine of the 1840s.

Women's role in maintaining agrodiversity

While most ethnobotanical research tends to overlook gender as an important variable, gendered approaches to the study of people-plant relations leave no doubt

about the interrelationship between plant biodiversity, gender roles, household food security, culinary knowledge and cultural practices. A matrix drawn by women farmers from Satmoori illustrates how these criteria interact in their subsistence-based dryland cropping system (Table 5).

It is women who generally have the most stake in increasing crop diversity as they see a direct relationship between crop diversity and food security. Indeed, the entire responsibility for preparing meals, and, to a large extent, feeding the cattle, rests on women. This section explores these linkages in the context of the Deccan Plateau.

Crop diversity in practice

When women farmers from Vaizhapur village describe their cultivation methods and cropping patterns, they say: '*Kalpi estamu*' ('we mix and sow'). Mixed cropping occurs throughout the Deccan Plateau, in both subsistence and commercial cultivation systems.

Crop associations range from simple ones—combining two crops like pigeonpea and cotton—to very complex associations featuring up to 12 different crop varieties. There are no strict rules for crop mixes: they depend on the soil type and the needs of the farmer and her household. In Vaizhapur, women farmers interplant cotton, a purely commercial crop, with a diversity of food crops. They sow a *kondra*, a row-of-its-own-kind containing a mix of seeds, after every five rows of cotton. Nagubai uses seeds of blackgram, cowpea, a local sorghum variety (*Appal Jonna*) and roselle to make her *kondra*. Rukmabai opts for a slightly different mix containing pearl millet, greengram and sesame. Hundreds of kilometers from Vaizhapur, women farmers from Chilamammadi follow the same practice of mixed cropping regardless of the size of their holding. On her one hectare land, which is subdivided into four plots of red and mixed red soils, Lakshmamma grows a vast range of crops, mostly for family consumption (Figure 5).

Farmers' reasoning for diversifying crops in their fields encompasses many dimensions, including agro-climatic constraints, the need to make the best of a small land holding, to minimise the risk of crop loss, to regenerate soil fertility, to manage labour demands from agriculture and to meet multiple food, fodder and fibre needs throughout the year. The major aspects of farmers' reasoning for crop diversity can be summarised as follows.

1. Minimising the risk of harvest failure

Sources of stresses are numerous in the drylands (drought, insect attacks, diseases, high temperatures, off-season rains…) and one of the major ways farmers try to minimise risk is by growing a diversity of crops and crop varieties. 'If we sow ten or twelve crop varieties in our fields, we are sure to get a crop from at least four or five of them. This ensures that we harvest at least some grains to eat', say two farmers from Humnapur. Relying on various varieties of a single species is another risk-

Table 5. A farmers' matrix on the multiple values of crop diversity in Satmoori

	Importance and value as a food item	Side-production of edible greens	Can be prepared into *ambali*	Can be used to produce cooking oil	Used as an ingredient of food offering	Fodder production	Soil fertility-enhancing properties	Low moisture need	Low overall production costs	Market value
Sorghum	✓✓✓		✓✓✓			✓✓✓		✓✓✓	✓✓	
Rice	✓✓✓				✓✓✓	✓✓✓	✓✓✓		✓✓	
Greengram	✓✓✓	✓✓✓			✓✓✓	✓✓	✓	✓✓	✓✓	✓✓
Cowpea	✓✓✓	✓✓			✓✓✓	✓✓	✓	✓	✓✓✓	✓
Blackgram	✓✓✓	✓				✓✓✓	✓✓✓		✓✓	✓✓
Field bean	✓✓	✓✓				✓✓✓			✓✓✓	
Sesame	✓			✓✓✓	✓✓✓	✓				✓
Pigeonpea	✓✓✓	✓✓✓				✓✓✓				
Chickpea	✓	✓			✓	✓✓✓		✓✓✓		
Roselle	✓	✓✓		✓✓✓					✓✓✓	
Maize	✓✓✓		✓✓			✓✓✓				
Little millet	✓✓				✓				✓✓✓	
Foxtail millet	✓				✓				✓✓✓	
Soybean				✓	✓		✓✓✓		✓	✓✓✓

Source: *Participatory exercise with 22 women farmers from Sattmoori (January 2002)*

Understanding the Crop Diversity Matrix (Table 5)

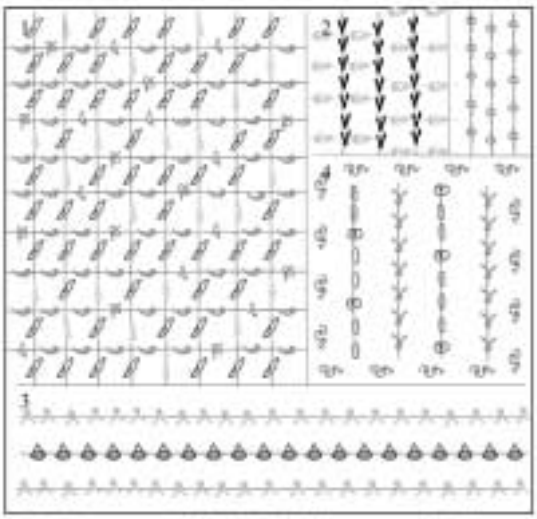
The collective work that led to this matrix took place in the small Adivasi village of Satmoori (45 households), located in a remote part of Indervally Mandal, in Adilabad district. It took place on a Friday, i.e. on the day of the weekly market day in the town of Sirigonda, situated 12 km away from the village. Consequently, most men farmers had gone to the town. This made the research with women farmers smooth and constructive. After an initial discussion on the various crops grown in the village, several women went and brought samples for each variety grown on their land. This formed the y-axis of the matrix. The parameters of the x-axis were evolved collectively. Together, they represent the agronomic, nutritional, ritual and market values of various crops. They were symbolized as follows:

Importance and value as a food item:	a piece of sorghum bread
Side-production of edible greens:	edible green leaves
Can be prepared into *ambali*:	a bowl filled with flour and water
Can be used to produce cooking oil:	a can of coconut oil
Used as an ingredient of food offering:	a stone with fingertips of yellow and red powder
Fodder production:	sorghum stalks
Soil fertility-enhancing properties:	a piece of cowdung
Low moisture need:	a handful of wet soil
Low overall production costs:	one rupee coin
Market value:	a set of weights

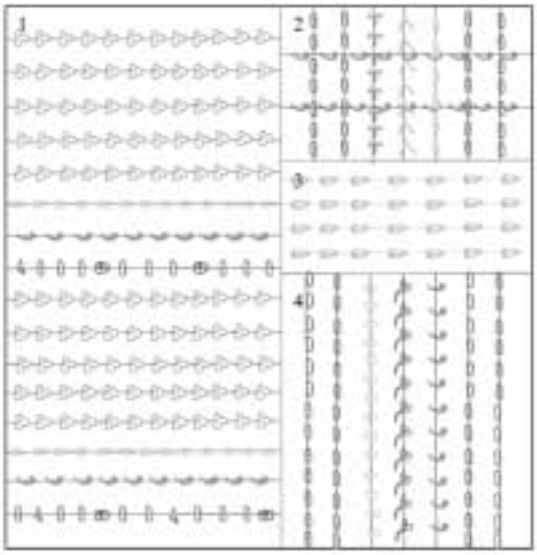
The women chose yellow (*paspu*, the auspicious colour of turmeric) to represent the highest score, red for a medium ranking, green for a low score and no colour when the ranking is exceptionally low, or when the parameter does not apply for the crop considered (eg. 'sorghum' and 'cooking oil'). In Figure 5, these colour codes have been translated into a dot-based system: one dot represents a low ranking (eg. foxtail millet does not play an important role in the daily diet); two dots represents a medium ranking and three dots a high degree of correlation (eg. sorghum is highly appreciated for its low moisture need and its resistance to drought).

At the end of the exercise, we tried to assess the matrix and unravel its deeper meaning. The women participants started to look for the crops where yellow had been used most often in the ranking. One of them took some sorghum grains and proceeded to place one, two or three handfuls of grain next to each crop, based on its perceived overall value. This final ranking gave the following results:

- **Primary crops** (staple food grains): rice and sorghum
- **Secondary crops** (essentially pulses consumed daily): blackgram, pigeonpea, greengram, sesame, cowpea and field bean
- **Tertiary crops** (crops used more occasionally): chickpea, maize, roselle, soybean, foxtail millet and little millet
- **Purely commercial crop** (of least value in women farmers' ranking): cotton



Lakshmamma's fields in Chillammamadi village



Nagubai's fields in Vaizhapur village

Figure 5: Maps of two small farmers' fields in Medak and Adilabad Districts

17 'Rainbow in the field': multi-coloured varieties as an adapatation to drought

When she sows foxtail millet on her land in Humnapur, Ratnamma tends to mix all three indigenous kharif varieties: Erra korra (the red variety), Nalla korra (the black variety) and Tella korra (the white variety). Of these three varieties, she identifies the red one to be the most tolerant to drought. A fourth variety, Manchu korra (Manchu meaning 'frost') is a winter variety whose moisture needs are met by the morning dew. Lakshmamma adds that out of the three common varieties of field bean, Erra, Tella and Nalla anumulu, only the red and black varieties grow well in rabi in spite of the absence of rain. Likewise, 'black rice varieties need less water than white rice varieties'. Black paddy yields less than white paddy, but it has more flavour than the more common white varieties.

Interestingly, botanical research has established a correlation between the colour and the duration of local varieties. Analysing ethnobotanical data on maize, pearl millet, rice, beans and cassava, D. Clawson shows that the duration and the yield of Mexican maize varieties are correlated with their colour (Clawson 1985). Yellow varieties are latest-maturing and the ones giving the highest yield in the continuum of yellow–white–blue-purple–red. This study further suggests that varieties of different colours differ in their germination mechanisms. Growing varieties of various colours—a very common practice amongst Deccan farmers for foxtail millet, sorghum and rice but also for field beans, cowpea, pigeonpea and sesame—is thus an adaptation to climatic risk. Ratnamma's appreciation of her foxtail millet varieties does reveal differences in how the red, black and white varieties fare under moisture stress.

minimisation strategy. Ratnamma tries to increase her chances of getting a foxtail millet crop by growing three varieties instead of one, as these varieties respond differently to uncertain weather conditions, and especially to moisture stress (Box 17).

2. Soil fertility and plant health

Another benefit of intercropping is that leaf fall from crops like sunhemp and pigeonpea add to soil fertility. Plants of different height and with different properties benefit from each other. Crops like chickpea, pigeonpea and field beans improve soil fertility (by fixing nitrogen), thus complementing the nutrient losses associated with the cultivation of cereals. Likewise, tall crops like castor provide shade for crops of medium height like pigeonpea and sesame. Short plants (also known as cover crops) like chickpea, greengram and groundnut provide a vegetative cover for the soil, resulting in three major benefits: weed growth is hampered because of the 'living mulch' provided by the short plants, moisture loss through evapotranspiration is reduced and the soil is protected from erosion.

3. Protection from pests and predators

When small farmers plan out a cropping pattern for their field, they consider the strengths and weaknesses of each crop and the ways in which different crops

interact with each other, both at the root and foliage levels. Crops endowed with a natural resistance to diseases or with insect-repelling properties are planted in strategic places in the field. Thus, since marigold flowers repel insects, Lakshamma plants marigold plants amongst her vegetable crops. Castor is grown all along the field borders. The tall castor plants act as a disease control crop, checking the spread of diseases to ginger and turmeric crops. Chickpea and wheat are sown in association in the *rabi* season. 'This is to divert the rats' attention from the wheat crop', explains Lakshmamma. Coriander protects chickpea against *Helicoverpa*, a devastating pest (a caterpillar). Laxshmamma adds that this practice is only effective if no chemical pesticides are used in the area. In other words, once a farmer starts using chemical pesticides, the presence of natural predators decreases and harmful pests like *Helicoverpa* become more vigorous, translating into intensified pest attack for more and more farmers in the area. Niger also helps protect other crops from pests, which is why it is sometimes found around the borders of finger millet fields in certain parts of the Deccan.

4. Managing labour constraints

Crop associations ease farmers' work since most labour-intensive tasks, especially weeding and harvesting, are spread out over several weeks or months. There are several benefits. First, as the harvest of different crops is well spaced-out over time, small farmers do not need to hire outside labourers in order to weed or harvest their fields: they can rely on their own family labour for these tasks. Apart from raising the total productivity of the field, interplanting allows labour to be applied to several crops and to meet their specific needs at the same time, thus increasing labour productivity (Netting 1993). A staggered harvest also means that foodgrains and green fodder yields are well distributed over time, instead of becoming available all at once. This ensures a drawn-out supply of green fodder to animals and it makes women's work in post-harvest operations like cleaning and processing the grain less intensive and therefore more manageable.

5. Securing an early harvest

For all the major dryland crops like sorghum, pearl millet and pigeonpea, farmers cultivate varieties of different duration. Samappa, a small farmer from Metlakunta, grows sorghum varieties which best meet his needs: *Thoka Jonna* gives good quantities of fodder, which makes it valuable to cattle-owning farmers like himself, and it has a loose earhead which ensures good drainage of water in the event of late rains. *Kakimuttani Jonna* (meaning, literally, 'the sorghum which the crows do not touch'), is not a particularly tasty variety, but it matures earlier than all other varieties, and when one's total landholding is less than one hectare, one faces food scarcity by the beginning of the rainy season. It is therefore extremely important to secure an early harvest in order to replenish foodgrain stocks. This is why

Kakimuttani Jonna is also known as *Gareeb Jonna*, 'the sorghum of the poor'. By growing sorghum varieties with different maturation periods (roughly from 90 days to 120 days), farmers like Samappa also minimise the risk of losing their entire staple crop to rainfall irregularities: early-maturing varieties may evade the adverse consequences of a dry spell in the middle or at the end of the growing season. Late-maturing varieties give higher yields, but they tend to be vulnerable to late rains that damage the earheads and can even lead to grain germination on the plant. It is noteworthy that Samappa grows a late-maturing variety (*Thoka Jonna*) that is not prone to crop damage due to rain thanks to its earhead shape. Short-duration varieties of sorghum (like *Kakimuttani Jonna*) and pigeonpea (like *Nalla Togari* and *Burka Togari*) have another advantage over long-duration ones: they tend to be less susceptible to pests and diseases than other varieties, which is no small consideration for marginal and small farmers.

6. Meeting multiple needs

Perhaps the most fundamental rationale underlying agrobiodiversity is the need to grow crops that meet a range of household requirements: food for the family, fodder for the livestock as well other needs like fibre and cash. Women often explain that growing a large enough variety of crops to meet the many household needs is their responsibility. For example, finger millet is often grown for the sake of old parents or relatives who remain attached to the traditional *ambali* summer drink. As sorghum leaves and stalks are the main source of fodder, cattle-owning farmers tend to increase the amount of sorghum in their crop mixes.

For small women farmers, it is of the utmost importance to cultivate not only staple foods but also a variety of pulses and oilseeds like safflower, groundnut and niger, as all of these crops have a special place in their culinary practices. Women are also concerned to produce grains that are used only occasionally, like chickpea and sesame, for preparing special dishes for guests or festivals. Growing the crops needed to prepare offerings is another dimension of women's relationship to crop diversity: foxtail millet is needed to make a porridge in honour of their ancestors on *Peddala Amavasya*, and a particular sorghum variety is required to venerate the Snake Goddess on *Nagula Panchami* (Box 18).

Because rituals vary based on caste and social groups and require different grains, some crops are more widely grown by certain castes. For example, proso millet is used by low caste women for worshiping divinities, whereas high caste families only use rice. Food habits also vary with economic status and religion. Small women farmers place great value on green leafy vegetables grown on their land as a source of vitamins and iron. The same is not always true of wealthier farmers who can readily access fruit and meat products.

18 *Pyalala Jonna*, an essential offering for the Snake Goddess

On the Deccan Plateau, the Snake Goddess is revered on the day of *Nagula Panchami*. For people who live in the countryside, it would be quite a dishonour to approach an anthill—where she is thought to live—without the proper offering: a few handfuls of puffed sorghum, which are dropped on the ground all along the way. This is why Nagamma, like other farmers from Shamshuddinpur, grows a small patch of *Pyalala Jonna*, the variety used to prepare puffed sorghum.

Kalawatti and her husband Ganga farm 18 acres in Pipperwada, a few kilometres from Adilabad town. Hybrid sorghum was introduced into their village over ten years ago, and it is grown as a monocrop. But surprisingly, a handful of *Pyalala jonna* invariably finds its way into the sorghum field. Kalawatti simply has to harvest a few earheads of *Pyalala jonna* every year. 'We can't worship the Snake Goddess without an offering of puffed sorghum', she says. Apart from puffed *Pyalala* sorghum, she also offers grains of chickpea, maize, redgram, as well as milk and a coconut to the respected dweller of the anthill.

In Pipri, an Adivasi village of Adilabad district, Jangubai and Parvattabai both grow local sorghum varieties like *Ramkuri*, *Dukri* and *Vaina jonna*, as well as *Pyalala jonna* and hybrid sorghum. *Vaina jonna* is used to prepare a special sweet. *Pyalala jonna* plays a crucial role on the day of *Nagula Panchami*. Sesame seeds have a particular significance in the worship of other Adivasi deities like Vittal and Rukmabai.

Women from Pipri assert that, 'Men don't think about all this. Their main contribution is to plough and manure the fields. They sow the seeds which we women give to them. After harvest, they bring the bags of grain home and from then on, it is our responsibility to take care of the grain and seeds'.

Household food security

Research findings from different parts of the world suggest that women and men often hold a different set of perceptions and knowledge about crop varieties grown on their land. They may share similar concerns and perceptions about agro-climatic factors like land types, soil fertility, pest problems and moisture stress, but when it comes to choosing varieties to grow on the family land, there is a divergence due to the differing conceptions about what constitutes food security, about the work involved in processing crops, about the management of food stocks and about the need to earn cash.

Most small women farmers want most of the daily diet from their own land. This reinforces their sense of security and comfort. Having to purchase essential food items in the market is often seen as a liability as it means travelling to the market, having enough cash, and settling for what the market has to offer. Women farmers who are used to growing their own food find the diversity and quality of pulses and cereals lacking in shops. However, this is not the case for younger women, who generally show less reluctance than their mothers to buy foodgrains from the market.

Food storage is an important component of a wider strategy to deal with seasonal food shortages and years of drought. This is remarkably well-illustrated by the attention given to storing foodgrains and the skills displayed for generations in traditional grain storing methods in the Deccan Plateau. In the 19th century, the British agronomist AO Hume observed that Indian peasants:

> are great adepts in storing grain, and will turn it out of rough earthen pits, after 20 years, absolutely uninjured. They know the exact state of ripeness to which the grain should be allowed to stand in different seasons; in other words, under different meteorological conditions, to ensure its keeping when thus stored; and equally the length of time that, under varying atmospheric conditions, it should lie upon the threshing-floor to secure the same object (quoted in The Madras Group 1983: 95).

Old farmers from Adilabad district still refer to a system of underground grain storage consisting of large pits plastered on the inside with cow dung mixed with straw, and with a storage capacity of several hundred kilograms of grain (sorghum and other millets). During a drought, these stocks could ensure the survival of the community until the next farming season.

Women's concerns for household food security are reflected in their varietal choices. Several studies point to the fact that women farmers tend to grow a larger number of varieties of a single crop than men. This is true, for example, of rice cultivation in the Borneo island of Indonesia, where varietal diversity has been found to be greater in fields where women are more involved in agriculture and where farming is oriented towards meeting the food needs of the community (Colfer 1991). Similarly, in Rwanda, small women farmers sow a larger number of bean varieties than men on the plots over which they have direct control (Sperling and Scheidegger 1996).

Women farmers from the Deccan multiply the number of varieties used for a given crop in order to reduce the risk of harvest failure, to meet various needs and also to satisfy their aesthetic sense. Beyond these factors lies a more subtle and 'hidden' logic: women farmers diversify their crops in order to increase their bargaining power in the household.

A small farmer from Chillammamadi explains that by sowing three varieties of chickpea instead of one, she obtains a harvest composed of three small volumes (25 to 30 kg) of black, red and brown chickpeas. This subdivided harvest does not make for a good market sale which gives her a good reason for dissuading her husband from selling the harvest to a grain merchant or a trader. If the harvest amounts to one quintal of a single chickpea variety, it is more difficult for her to convince her husband to store the grain instead of selling it. This compelling micro-economic logic shows that genetic diversity can help women fulfil their double agenda of ensuring household food security and of building up food stocks for lean agricultural periods. Although this conception of household food security has been ignored by national food policies, local organisations

19 Strengthening household food security

Women's household-level management of nutritional security indicates that centralised approaches aimed at improving national food security through the procurement of grain at subsidised prices (the Public Distribution System) may not be an adequate way of tackling the problem. It is precisely this observation, backed by multiple testimonies from rural women, that has led various organisations to devise different approaches. One of these is the Alternative Public Distribution System initiated in 2000 by Deccan Development Society in 32 villages of Medak district (Srinivas and Thaha 2004). Its originality and success lie in the fact that in each village, Dalit women's collectives control and manage the Community Grain Fund. Similarly, a pilot project for the formation of local granaries managed by rural women is being developed in certain parts of Madhya Pradesh under Women and Child Welfare programmes.

In both cases, the basic idea is to enhance local food security by strengthening the local farming system, increasing its resilience to natural calamities, and encouraging women to establish and manage grain storing systems that can bring direct relief to the poorest households in case of food shortages.

The transportation of grain over long distances, the decline of nutritious millet-based diets and in women's control over food, and the centralisation of decision-making can all be avoided through such decentralised, women-led approaches to food security. Given the dependence of rural people on food gathered from forests and village commons during periods of food scarcity, the issues of access to and control over common property resources also need to be integrated into the food security question, especially—but not exclusively—in dryland areas.

working with women's collectives are trying to pay heed to women-centred approaches to food security in rural areas (Box 19).

Gender studies of crop diversity management have shown that women farmers are often more able than men to give a detailed description of the nutritional qualities and of the modes of preparation and preservation of crop varieties. Moreover, women very often use a broader set of selection criteria than men, including criteria relating to production, processing, storage and preservation characteristics as well as culinary qualities (Howard 2003). This is true also in the semi-arid Indian context. I have found that a wide range of food-related concerns influence women farmers' varietal choices and crop management practices, and that these factors do not play any role in men's varietal selection criteria. When women farmers decide which varieties to grow, they consider:

- whether the variety can be grown in complex crop associations
- whether it is susceptible or resistant to storage pests and how long it can be stored without any risk of damage
- its cooking time—as this affects the amount of fuelwood required (this especially applies to pigeonpea which is cooked daily)

- the range and kind of recipes that a given variety can be used for
- the taste and appearance of the food made from a particular variety
- whether the variety plays a part in food offerings (prasadam) and food prepared for special occasions and festivals.

Very similar considerations underlie women's preferences for maize varieties in the Chiapas region of Mexico (Bellon and Risopoulos 2001). Women emphasise the taste of the variety, the quality of the *pozol* (a maize-based dish) it makes, its preservation over a long period of time and its usefulness for making *atole* and *tamales*. Men, on the other hand, look at the variety's yield in weight, its resistance to lodging, the capacity of the grain to preserve itself, and the yield of gourds grown in association with the maize.

These different preferences and cropping choices emphasise that households are not homogeneous; there are clear differences in perception, preference and interest between men and women. Recent research shows that household decision-making occurs through bargaining amongst household members, and intra-household interaction contains elements of both cooperation and conflict (Agarwal 1997).

A rural person's bargaining power within the household is defined by individual economic assets like land, as well as by communal support systems, local institutions, social norms and perceptions about contributions and needs. The degree to which women participate in household decision-making plays an important role in determining their bargaining power: 'Women who participate in decision-making concerning, say, agricultural production or cash expenditure in the home may be said to have greater bargaining strength than those excluded from such decision-making altogether. But more fundamentally, relative bargaining power is revealed in whose interests prevail in the decisions made, namely in final outcomes: in the intra-family distribution of resources, goods, services and tasks, the treatment meted out by family members, the control exercised over resources, and so on' (Agarwal 1997).

Based on this analysis, I argue that by controlling seeds, women farmers can influence and even steer cropping decisions in order to ensure household food self-sufficiency. Moreover, the diversification of crops and varieties is a strategy small women farmers use to increase their bargaining power with their husbands over the use of the crop (self-consumption vs. sale), as clearly exemplified by testimonies from Chilammamadi farmers. Women also clearly stress that having food stocks in their homes gives them command in the household and in their community. 'If I have sufficient grain in my house, I have command. I can give grain to people who come and ask for it without asking my husband', says Bichamma. Yet women farmers' bargaining capacity is extremely precarious, and even more so due to their lack of fall-back options such as individual landholdings. If men's cropping choices start prevailing because of endogenous or external factors, then conflicting interests arise within the household, as we will see further on.

Dryland crops and culinary practices

For women farmers there is a direct correlation between the diversity of crops grown in their fields and the diversity of foodgrains stored in their house. Culinary traditions of the Deccan Plateau rest on the ingenious association of a range of food items originating mostly from the fields, but also from village commons and wooded areas: cereals, pulses, oils, vegetables, fruits and berries, roots and tubers, herbs and spices, milk and animal products. Skill and talent are needed to supplement the daily diet of cereals and pulses with spicy condiments (*pachari*), oilseed powder (*karam*) and a range of snacks and sweets consumed more occasionally.

Sorghum or pearl millet bread is the staple of farmers in Telangana villages. Rural women prepare flat sorghum bread twice a day, which is a relatively time-consuming task as each loaf has to be cooked over an open fire. Finger millet, sorghum and maize flour can also be used to make a liquid porridge (*ambali*), which is consumed during the hot summer days because of its 'cooling' property. Pigeonpea is eaten daily as a spicy soup (*pappu*) into which women often put green leafy vegetables like spinach, roselle, coriander, chickpea and amaranthus leaves. Alternatively, a more watery, tamarind-based soup is prepared out of pulses (*pappucharu*). Seasonal green leafy vegetables can also be cooked separately with a ginger and garlic paste and a range of other spices like mustard, cumin and turmeric, just like any other vegetable. Freshly picked chickpea, greengram and beans can be either boiled or fried with spices and eaten as snacks. Chillies and other spices are used in condiments, an essential component of any Indian meal. Oilseeds like sesame and niger are pounded along with a few spices into a powder. Eaten along with sorghum bread, these oilseed powders make a very nutritious breakfast. A more elaborate breakfast (*korra kechuri*) consists of a porridge made out of foxtail millet mixed with three kinds of pulses (greengram, chickpea and lentil) and one or two kinds of green vegetables (spinach, roselle, fenugreek leaves…). Foxtail millet sometimes replaces rice in a sweet porridge that can either be very simple or enriched with nuts, dry fruits and homemade clarified butter (ghee). These *paisham* are usually prepared in the honour of a divinity and on the day of the ancestors. Wheat, barley, rice and chickpea flours; sesame and safflower oils; molasses from sugarcane and fresh coconut are used to make various offerings, sweet dishes and spicy snacks like *pollale*, *harizelu*, and *murukullu* for festivals like Dasera or Sankranti, the harvest festival in January.

'We honour Saijonna like a woman': respect for plant life

Of the numerous festivals that punctuate the agricultural cycle, two are directly linked to the maturation of dryland crops grown in the winter season. The first is *Soonyam Panduga*, which is celebrated in December. *Rabi* crops—especially *Saijonna*, the winter sorghum, which plays a pivotal role in winter cropping patterns—sown in

October are slowly maturing in the fields. Women say that Mother Earth, Bhootalli, is 'pregnant' with a diversity of crops. The entire family goes out to the farm with offerings and sings while going around the fields. 'It is that time of pregnancy when the Mother Earth craves to taste different things. To satisfy her craving, [women] cook Bajjikoora, a fascinating dish in which all the available vegetables (leafy and otherwise) and tender grains (including the green pods of pigeonpea, field beans, chickpea, chillies, green peas, lathyrus, amaranthus) are cooked together and offered to the Mother. The singing also is to please the Mother' (Satheesh et al. 2002).

A woman farmer explains the act of going to sorghum fields with offerings and prayers by comparing it with how pregnant women are visited and honoured during their pregnancy: 'When a woman is pregnant, she calls other women to her house during the fifth month. Sweets are always offered on this occasion. Thus, we honour *Saijonna* like a woman' (by going to our sorghum fields with offerings). She adds that all women farmers practise this ritual in one form or another, regardless of caste and religion. They get up early, clean the house, bathe and then start cooking the special offering. Men are not as involved as women; in some cases, instead of joining in the celebration, 'they get impatient if the meal is not ready when they come home for lunch' tells Lakshmamma.

Another important ritual for farmers is *Endlagatte Punnam*, which takes place in February, just a few weeks before the *rabi* harvest. Here again, some women claim that their husbands sometimes scorn this festival. To women, however, it is a moment of celebration of the maturing crops: sorghum earheads have taken shape, linseed pods have formed, and the orange petals of safflower start to emerge from the plant. Women bring home a variety of earheads from their fields which they offer, along with sweets and cooked rice, to the Village Goddess, *Ooredamma*. Then they tie the earheads on a string (*thoranam*) and decorate their house by hanging it across the door. Here, women establish an analogy between the first matured earheads and a woman who has just delivered: 'When a woman gives birth, there is special celebration. Similarly, when the first earheads mature, we pay our respect to the crop'.

An element of sacredness is also associated with the threshing ground around harvest time. This ground is prepared afresh every harvesting season, and its significance in the agricultural cycle is emphasised by a number of ritualised practices (Box 20).

These varied illustrations of the interlinkages between food, health and culture show that wherever strong cultural traditions have been retained—in the culinary, therapeutic or religious realms—a diversity of crops continues to be grown. The same logic applies to animal diversity. In many cases, indigenous breeds of chicken, sheep, goat and cattle are still raised today, not only because of their high level of adaptability or resistance to climatic conditions, but also because of their socio-cultural role. A particular cattle breed may be associated with a local deity and venerated on the day

20 The threshing ground: a sacred place

The word *kolam* designates a very special space in the agricultural landscape: it is the threshing ground, the place where bundles of sorghum, pigeonpea and all the other plant harvested from the fields are stacked, left to dry, processed, measured and distributed. The *kolam* is also the place where grain and dry fodder are shared out amongst all those who have contributed time and labour to the harvest: farmers, labourers and sometimes farm servants, who are also entitled to all the grain that falls on the ground during threshing.

This space is reconstituted at the time of each harvest. This highly ritualised activity entails removing grasses, stalks and stone, cleaning and levelling the ground and then spreading wet soil. The person in charge of preparing the kolam draws a line of ash all along the perimeter, invoking the goddess Lakshmi. Farmers explain that this ash boundary protects the harvested crop from ill-will and other dangers. The tools used for beating and threshing are handled with care and respect. The sacred *kolam* is therefore a place for collective work, sharing of foodgrains and worship of the most important deity in agriculture, the goddess of prosperity and abundance.

associated with that deity. Local breeds also continue to be raised because of their usefulness in local health or crafts traditions. The making of remedies, ornaments and tools requires animal products of all sorts (wool, feathers, leather and animal organs thought to have curative properties). Moreover, local breeds do not require the same degree of attention and reliance on external advice as exotic breeds: they feed on locally available resources, and people know exactly how to take care of them.

In this section I have explored crop diversity and gender relations in the context of the Deccan's subsistence farming systems. The expansion of commercial agriculture and the integration of farming activities into the market economy redefine gender roles in households and communities. As a result, women farmers' management of agrobiodiversity is transformed in various ways. In the following section I study these transformations in detail.

Changes in cropping patterns and the emergence of new risks

Recent years have brought about a whole series of changes to the agriculture of the Telangana region. These are affecting cropping patterns and crop productivity, the role of livestock, soil nutrient balances, groundwater availability, sustainability, food security and the economic viability of small farms. Some of the key concerns include the increasing costs of production and rising levels of indebtedness, negative effects of the use of agro-chemicals on soil biology and human health, and the lack of competitiveness of smallholder rainfed agriculture.

The changing agricultural situation in the Deccan Plateau is the result of multiple factors including climate change, new agricultural policies, socio-economic transformations and institutional incentives for the expansion of cash crops.

Climatic trends

When asked about current rainfall patterns, farmers time and again expressed dismay at the disappearance of the 'four-month cycle' (*nallagu nellalu kalamu*). The region's traditional weather pattern used to be a succession of three four-month seasons: the rainy season (*varsha kalamu*) from June to September, the winter season (*challi kalamu*) from October to January and the hot summer season (*vesal kalamu*) from February to May. According to farmers in different parts of Telangana, the last eight to ten years have been marked by a high degree of irregularity in the weather, with frequent failure of rain at crucial periods of the agricultural cycle or untimely rains that damage crops just as they have matured.

Farmers assert that it is because of weather changes that they have had to stop cultivating crops like finger and foxtail millet and local varieties of groundnut. Though adapted to dryland farming, finger millet needs consistent showers during the monsoon season and farmers say that irregularities in the rainfall pattern hinders the proper formation of earheads. An old woman from Wadiguda testifies: 'Foxtail millet earheads used to bend over, full of grains. But if we grow it today, there are hardly a few grains on the earheads'. The assessment made by Deccan farmers is corroborated by research findings showing a correlation between climate change and agricultural diversity (Box 21).

Influence of coastal settlers

In the Telangana region, the spread of cash crops is associated with a recent sociological phenomenon: the migration of relatively wealthy farmers from coastal regions over the past 10 to 20 years, depending on the area.[24] These settlers, pursuing new economic opportunities, have brought with them a commercial approach to agriculture, earning cash by growing crops like cotton, chillies or potatoes. While some families from coastal districts permanently settle in interior regions, many stay for two to four years and then return to their natal village, 'after having exhausted the land' as Telangana farmers incisively put it.

This settlement pattern has been the source of profound changes in the Deccan farming system. In Nawabpet, when people describe local cropping patterns, they make a clear distinction between the time 'preceding the arrival of Andhra farmers' and the time 'following their settlement'. Before the Andhra farmers came, crops like

24. This phenomenon is to be clearly distinguished from the seasonal migrations of labourers who leave their villages for three to nine months every year due to the scarcity of local resources (especially water) and lack of livelihood opportunities. In the driest parts of the state, about 60% of households leave their village for at least three to four months a year. In these regions, migration networks are well-established and labourers are recruited by local patrons in the village for a given period of time. Bonded labour arrangements are still extremely frequent despite their illegality. Personal communication with David Picherit, a French anthropologist working with migrant workers in Mahaboobnagar district of Andhra Pradesh, December 2004.

21 Climate change and agricultural diversity

The Intergovernmental Panel on Climatic Change (2001) has developed a list of potential implications of climatic change for agrobiodiversity (IPCC 2001):[25]

- The migration of plants and animals is likely to increase at rates faster than local adaptation.
- Species sensitive to current temperature and precipitation patterns will become stressed and more threatened. Extinctions will dramatically increase, including of many species not yet recorded.
- Adaptation through gene banks, special reserves, transference corridors and zoos can offset such extinctions, but may prove costly and ephemeral.
- The 'natural resilience' of species to ecosystemic changes may be impaired, leading to fundamental alterations in the mechanisms of response, adaptation, migration and opportunism.
- Biodiversity disruption could undermine various aspects of the natural environment (soil, water, micro-climate…) and of the social structures associated with it (land and livestock management systems, knowledge and innovation, technologies, conservation strategies) with consequential impact on livelihoods, economy and demography.

finger millet, little millet, foxtail millet, horsegram, linseed, safflower, lathyrus, chickpea and pigeonpea used to be widely grown. 'Then people started to imitate the Andhra farmers, and they began to grow cotton. Since then, we hardly have any more grain in our houses', recounts Andalu.

Initially perceived as 'progressive farmers' by the local people, Andhra farmers have indeed set the trend for agricultural development in many villages. Dryland farmers of all categories strive to emulate their practices, often disregarding the fact that they are investment-intensive and therefore carry a level of risk that may substantially jeopardise their livelihoods in the long-run. This is illustrated by the case of Warangal district, where cotton now has a 10 to 12-year history and occupies over 40% of the cultivated areas in districts like Rayaparthi. The costs of production have dramatically risen, and a sense of disillusionment pervades the district. Farmers say: 'cotton has betrayed us' or 'cotton was a "sweet" crop at the beginning, but now all we are left with is poison'.

Food policies

The Public Distribution System (PDS) aims to ensure food security throughout the country. It hinges on three major policy measures: procuring foodgrains (rice and wheat) from farmers at a minimum support price, maintaining grain stocks by the

25. Intergovernmental Panel on Climatic Change, 2001, *Third Assessment Report: Summary of Policy Makers*, Climate Change Secretariat, Bonn.

Food Corporation of India and distributing a few essential food items at subsidised rates in ration shops.

Although it has undoubtedly relieved countless numbers of households in food-insecure positions, both in rural and urban areas, the PDS has also had adverse effects on rural livelihoods. The cheap availability of rice and wheat on the market is one of the reasons for the decrease in cultivation of sorghum, despite its essential role in the livelihood of poor households as a source of food, fodder and employment (Dayakar et al. 1999). The PDS has thus helped to shift the diet of the poor away from sorghum and millets and towards rice, a less nutritious cereal. Between 1972 and 1994, the consumption of sorghum, pearl millet and chickpea has declined amongst the poorest 30% of the Indian population (Ryan and Spencer 2001).

Agricultural policies

Agricultural policies have revolved around a series of so-called 'revolutions': the Green Revolution essentially relating to rice and wheat, the Yellow Revolution for oilseeds and the Blue Revolution for aquaculture in coastal areas. Interior regions of Andhra Pradesh have been largely neglected by the Green Revolution which primarily focuses on irrigated areas with high productivity potential. Nonetheless, the Green Revolution has had an indirect impact on farmers and farming systems of the Telangana region through the general push to commoditise agriculture. The creation of organised markets, the introduction of minimum prices and the availability of credit (crop loans) for commercial crops are major factors behind the adoption of crops like sugarcane, cotton, maize, sunflower, chillies. The implications for the poorest farmers are many, as shown below.

Growing indebtedness

Private investments in agriculture have considerably increased throughout the Telangana region amongst all categories of farmers. Although institutional sources of credit have expanded, they cannot meet the growing credit requirements of small and marginal farmers, who turn to private sources, like money-lenders, input dealers and commission agents (who purchase commercial crops from farmers). The interest rate on loans from money-lenders ranges from 24% to 48% annually. Important year-to-year fluctuations, not only in the yield of commercial crops but also in their prices, make monetary returns to farmers extremely uncertain, leading to rising levels of indebtedness in many parts of the state. Indebtedness jeopardises children's education and introduces new forms of alienation like a rural exodus which is still limited but could reach much higher proportions in the coming decade (Box 22). Growing indebtedness is one of the major factors behind the suicides of cotton farmers which began in the 1997-98 season in Andhra Pradesh. In 1998, 89% of farmer suicides occurred in the Telangana region, especially in the districts of Warangal, Medak and Karimnagar (Parthasarathy and Shameen 1998). This is an unambiguous sign of a profound agrarian crisis. Its victims are mostly small and marginal farmers driven out of agriculture in spite of decades of personal investment and hard work.

Crop Diversity

Above: Red land cultivation: mother and son sowing their half-hectare field of red soil

Right: A woman farmer beating sorghum earheads after harvest and teaching essential gestures and skills to her child.

Far top left: Collective winnowing of sorghum in Bidakanne. The leaves on the twig used to gently sweep the grain into a heap have insecticidal properties

Far top right: Traditional grain storage structure in an Adivasi village

Far bottom: Preparation of sorghum bread (*jonna roti*) on an open fire

22 The village of Kothuru in the debt spiral (Warangal District)

Population

- 940 households, including 140 Scheduled Castes (Dalits), 740 Backward (low) Castes (Goud, Yadav, Kurma, Telega, Mouthiraj, Padmashal), 10 Scheduled Tribes and 100 Forward (high) Castes.
- 70 households originally came from Coastal Andhra
- around 850 households depend solely on agriculture as a means of livelihood
- 60% of households own less than 2 ha and 30% own between 2 and 4 ha
- about 50 landless families
- 50% of all households own livestock

Cropped area, soils and irrigation

- total cropped area of 1,080 ha: 65% is rainfed, 35% is irrigated from three natural reservoirs, 50 tubewells and a few open wells
- red soils occupy 65% of the arable land, black soils 30% and iodised soils 5%
- out of 10 tubewells recently dug, nine have been failures. Each attempt costs between Rs 10,000 and 25,000

Main crops

- today: cotton (50% of the cropped area), rice (30%), chillies (8%), maize, pigeonpea and minor food crops (sorghum, field bean, greengram, blackgram, groundnut, turmeric, vegetables)
- ten years ago, the main crops were tobacco, sorghum, sesame groundnut, chillies, blackgram, foxtail millet, pearl millet and maize during the kharif season; and wheat, coriander, chickpea and lentil during the rabi season

Data on cotton cultivation

- current annual investment: Rs 20,000 per ha (Rs 25,000 if own labour costs are included) both for rainfed and irrigated cotton, compared with Rs 6,000 to Rs 10,000 in other parts of the state. This difference is largely due to the increasing use of chemical pesticides (in an attempt to overcome pest resistance) in Warangal district
- yield of irrigated cotton: between 10 and 12.5 q/ha (down from 14 to 16 q/ha five years ago). Current rainfed cotton yield: 2.5 to 4.5 q/ha
- cotton price: Rs. 1,800 to 2,000 per quintal

Data on indebtedness and its consequences

- about 80% of households have an accumulated debt of Rs 50,000. The debt for the entire village amounts to about Rs 35 million
- 80% of women have either mortgaged or sold their mangalsutra (a golden necklace received on the wedding day) in exchange for a Rs 2,500 loan to purchase pesticides
- many families have difficulties sending their children to school (due to the cost of school fees). The illiteracy rate in the village is 50%
- 10 families of S.C and S.T have left the village, abandoning their houses and land to money-lenders to whom they were indebted

Small dryland farmers often point to the inadequacy of credit, subsidy and pricing policies for supporting their own traditional low-input cropping systems. Many argue that loans to purchase livestock or support prices for millets would be much more useful to them than the existing system of credit and subsidy. By accessing greater amounts of organic manure, they would be able to increase the productivity of their land and check the trend of declining yields of local dryland crops that respond well to farmyard manure but not to chemical fertilisers.

Increased use of chemical fertilisers and pesticides

Chemical fertilisers are promoted and advertised both by government extension workers and by private dealers as an easy solution for increasing crop productivity. The use of chemical fertilisers is on the rise in dryland areas, despite increasing evidence of their negative effects on soil structure and water retention capacity in semi-arid areas. Subsidies for nitrogen fertilisers have accentuated imbalances in soil nutrients in at least two ways: through the over-emphasis on nitrogen-based fertilisers until the early 1990s, to the detriment of potassium and phosphate; and through the depletion of soil organic matter content through the over-use of chemical fertilisers.

It has been shown at the global level that subsidies for agriculture (including subsidies for farm inputs, credit, water and electricity) cause severe environmental damage. Agricultural subsidies 'foster overloading of croplands, leading to erosion of topsoil, pollution from synthetic fertilisers and pesticides, release of greenhouse gases, and grand-scale loss of biodiversity habitat' (Myers and Kent 2001). All of these trends are visible in India today, with drastic reductions in the diversity of local crops and breeds and the genetic variability within species.[26]

The increasing use of mineral fertilisers and synthetic pesticides on crops like pigeonpea, chickpea, chillies, cotton and vegetables results in rising costs of production. Most farmers buy these inputs on credit from dealers, commission agents or local money-lenders at the start of the farming season. These loans have to be reimbursed immediately after selling the crop; farmers who fail to do so because of a poor harvest get trapped in a cycle of debt. Warangal district ranks second in the state in the consumption of pesticides. Many cotton farmers use between 10 and 12 kinds of pesticides.

Declining health

Farmers' account of the status of human health is unequivocal: there has been a net decline in general health since the introduction of chemical inputs. What is even more concerning perhaps is that new kinds of diseases and allergies have emerged, and these diseases 'cannot simply be cured by using herbal remedies', explains Jangubai.

26. For a discussion of the processes of biodiversity loss in India, see Kothari, A., 1997, *Understanding Biodiversity. Life, sustainability and equity*, Orient Longman, New Delhi.

'Neither can we afford the high hospital costs'. This is a strong statement about the loss of autonomy in health care experienced by many people in rural areas. Health-related expenditures have considerably increased over the last two decades. Andalu, for instance, had to spend Rs 10,000 to get her son treated after he was poisoned while spraying pesticides on their cotton crop (a cost which should be deducted from the crop earnings for a genuine cost-benefit analysis of this cropping strategy).

Having been through several years of battles with cotton pests, Warangal farmers speak eloquently about this problem: 'In the last two to three years, pesticides would still kill the pests, and human were not affected. But this year, the pests are staying alive, and human beings are the ones dying'. In 2001, many people died while handling pesticides in this district. Farmers' tendency to mix pesticides—in an attempt to remedy the inefficiency of pesticides that year—was thought to be one of the causes of this human tragedy. Consuming pesticides is fast becoming the major way that farmers commit suicide in Andhra Pradesh.

Environmental problems

The decline of traditional dryland practices like crop rotations and multicropping is a direct consequence of the adoption of cash crops that need to be grown on their own (like groundnut) or that occupy the land for eight or nine months at a time (like cotton). Combined with the genetic uniformity of varieties, this trend creates a breeding ground for diseases, viruses and pests. Hundreds of hectares of groundnut were devastated by a virus in 1998 in Anantapur District. Many of the problems faced by cotton farmers throughout the state can be traced to the proliferation of *Helicoverpa*, a pest that causes great damage to cotton, chickpea and pigeonpea crops.

Indigenous knowledge is unable to deal with such new risks; generally farmers are only aware of them when the tragedy unfolds before their eyes. For instance, in the face of fierce pest attacks, farmers try to save their crop by increasing pesticide applications, which compounds the problem while harming the environment (due to the high toxicity of chemical pesticides).[27] Farmers observe pests and disease are now widespread, affecting not only cotton but also food crops like pigeonpea, blackgram and rice. For example, a disease causing rice plants to dry up caused a 30% drop in rice yields in many parts of Warangal District in 2001.[28]

Small farmers are doubly hit by these environmental risks. First, because of the limits imposed by their socio-economic status (illiteracy, lack of financial assets, discriminatory practices by dealers), they are more vulnerable to these risks. Secondly, they may be exposed to these risks not necessarily because of any change to their

27. Research on cotton pests shows that the untimely use of chemical pesticides (too early or too late) favours the development of harmful pests like Helicoverpa, a fact unknown to most farmers.

28. Personal communication with Dr. Jalapathi Rao, Director of the Agricultural Research Station, Warangal, November 2001.

own agricultural practices, but because better-off neighbouring farmers have shifted to intensive chemical agriculture. An old woman from Chillamammadi recounts that since her neighbours started using chemical pesticides, her own crops are infested with pests, and none of the pest control methods known to her (such as spraying neem-leaf extract or sugarcane solution, or shaking the plant) appear to work.

Transgenic varieties of cotton introduce another set of ecological risks. In its publicity for Bt-cotton, the company Mahyco-Monsanto argues that given the small size of farms in India, there is no need to provide for refuge zones (aimed at slowing down the rate at which pests targeted by the Bt toxin develop resistance to this toxin). This 'logic' is expressly spelt out by Indian scientists who suggest that farmers who grow Bt cotton would benefit from neighbouring fields acting as refuge zones for their transgenic crops.[29] In other words, the risk of increased pest resistance gets "evenly" distributed amongst farmers… including those who never opted for Bt cotton in the first place. Genetic pollution is another serious threat: the transfer of transgenic genes to and contamination of non-transgenic and organic cotton crops is highly likely, as has happened with other transgenic crops elsewhere (like canola in Canada, see Chapter 6 for more detail). The contamination of the rare local cotton varieties that are still grown (essentially on organic farms) in South India also represents a threat to the preservation of valuable genetic resources.

Increase in irrigation

Another significant change worthy of attention from an ecological perspective is the spread of irrigation in the Telangana region, and especially in the district of Warangal, where the net irrigated area increased from 25% of the net cropped area in 1960-61 to 59% in 1998-99. Well irrigation (borewells and open wells) currently accounts for close to 70% of the irrigated area, while tanks account for only 27%, reflecting the lack of policy attention to tank irrigation which used to account for 80% of irrigated area in the 1960s. Unlike tanks, borewells lead to the depletion of groundwater tables.

Policies on irrigation are shaped on the assumption that irrigated systems are more productive and can therefore improve the economic viability of dryland farms. But historical data comparing the productivity of rainfed and irrigated farming systems do not necessarily bear this out.[30] Furthermore, there is a common perception

29. Refuge zones are fields where non-Bt crops are grown adjacent to Bt-crops. The idea is to provide an area where insects need not develop resistance to Bt genes. Technically, the process of insect resistance to Bt crops is slowed down by allowing resistant insect populations to breed with non-resistant populations from refuge zones. Seetharama, N., Shyamala Rani, T. and Harshavardhan, D., 2001, "Will the Poor Benefit from the Agricultural Biotechnology Revolution?", Journal of Plant Biology, 28(2):139-146.

30. A historical study of the productivity of rainfed and irrigated rice systems in Cambodia in the early 20th century reveals that the former gives more stable and on the whole higher yields than the latter, a fact which the colonial authorities persistently denied due to their assumption that irrigated rice systems are more productive than rainfed ones. See Guérin, M., 2001, "Essartage et riziculture humide: Complémentarités des écosystèmes agraires à Stung Treng au début du XXième siècle", Asèanie, No.8, Décembre, pp. 35-56.

amongst planners that irrigation can end the high risks associated with rainfed farming. While this may appear to be true at the individual level, and in the short-run, farmers' testimonies tell a different story. They report frequent problems with collapsing wells; declining watertable levels, translating into a need to go ever deeper to find water; motor breakdowns; and irregularities in electricity supplies. All these combine to increase the financial investment and risks associated with irrigation.[31] In Warangal District, where borewell irrigation started to develop over a decade ago, villagers assert that nine out of ten attempts at digging new borewells end in failure, representing a net loss of 10,000 rupees per borewell dug.

Research and extension policies

Public research programmes on rainfed farming systems and dryland agriculture have prioritised yield increases for individual crops, whilst overlooking the ecological functioning of mixed cropping systems, yield stability and the vital role of livestock in dryland farming. Much extension work promotes technological packages which combine improved varieties with chemical fertilisers. High yielding varieties of sorghum and pearl millet cover about 40% of the area under these crops in Deccan villages with strong market linkages both on the input and supply sides. Drought tolerant and disease resistant varieties of pigeonpea, chickpea and castor have also been released by public research institutes. While the adoption of these varieties has led to substantial improvements in productivity, yield stability and resistance to pest and diseases (Joshi et al. 2001), many of the newly released varieties of sorghum, maize, sunflower and vegetables are hybrids characterised by a high dependency on chemical inputs and ill-suited to multicropping systems. Their non-agronomic performance (taste, cooking features…) also leaves much to desire from women farmers' point of view.

There is also a direct link between the adoption of new technology in agriculture and changes in consumption patterns. A recent study in Tamil Nadu shows that while 85 to 90% of the pearl millet produced in 1975 was consumed in the villages, only 5 to 30% of this coarse cereal was still consumed locally in 1996. This is because 85% of the crop is today sold as poultry feed. The study reveals that this development coincides with the widespread adoption of private sector pearl millet hybrids. Similar findings have been documented in Maharashtra and Andhra Pradesh with the adoption of sorghum private hybrids. This means that the adoption of hybrid varieties has a profound impact on local food systems. Hybrids are also a major driving force behind the shift from subsistence production to market-oriented production.

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31. Similar observations have been made in semi-arid Sahelian countries in Africa: 'In spite of the security that irrigation is meant to bring about, the risk factor has often played a determining role in the mitigated technical results that have in turn undermined financial outcomes (collapse of wells, repeated breakdown of water pump motors, power cuts leading to pump shut-downs, lowering of water tables)'. Raynaut, C., 1997, Sahels. Diversité et dynamiques des relations sociétés-nature, Editions Karthala, Paris, p. 172.

The large investments needed for technological innovations explain why 70% of innovations released for dryland cultivators never reach farmers' fields. Most of these innovations do not provide solutions to the varied and complex production constraints faced by small farmers. Farmers' knowledge of soils and local crops has largely been ignored by scientists. Only a few isolated initiatives have deliberately sought to involve rural people in collaborative research projects in order to evolve solutions that arise directly from the local configuration of livelihood opportunities and constraints.[32]

Challenges to women's control over food production

We have seen that where food crops continue to prevail, crop diversification is one strategy used by women farmers to ensure food security at the household level. In farming systems more oriented towards commercial production and more integrated into the market economy, one might expect women to show little interest in the diversity of food crops and to focus more on cash crops. Yet my field studies reveal a much more complex and nuanced scenario, with gendered power relations playing a central role.

Testimonies from women farmers of Adilabad and Medak districts highlight how perceptions and strategies are changing in the shift from subsistence-oriented farming to commercial agriculture. It should not be assumed, however, that these findings can be generalised to the whole of semi-arid India or that they exhaustively reflect women's perceptions. Farmers' responses are highly context-specific, and they vary according to many factors including caste, age and gender; the nature and pace of economic change; the existence of off-farm livelihood sources; and local capacity to develop collective responses to emerging challenges.

Where farmers have organised themselves into collectives, for instance, they have been able to meet new market demands for fresh vegetables, fruit or poultry. Thus, in some Adilabad villages, farmers have intensified their traditional practice of growing vegetables in the rainy season and they have created commercial networks with wholesalers. Women are actively involved in these activities, especially in female headed households where women have direct control over the proceeds from selling vegetables. In parts of Nizamabad, women take part—along with their husbands—in the lucrative activity of producing seeds of pearl millet, sorghum and maize for various seed companies. Managerial decisions are usually made by men, but women also benefit from the substantial revenues earned from seed production activities.

However, such experiences of 'well-managed change' are often confined to specific areas or villages. Their importance tends to be overemphasised by development

32. For details of a participatory breeding project on pigeonpea with small farmers, see Pimbert, M., *Participatory Research with Women Farmers*, a film by Development Perspectives, Hyderabad. For an assessment of women's needs in the management of small livestock, see Ramdas, S. et al., 2001, "Changing livelihoods, livestock, and local knowledge systems: Women stake their claim in Andhra Pradesh and Maharashtra", *op.cit.*

planners and even agricultural scientists who have a stake in 'believing' that the present agricultural regime is a success. But as other researchers have shown, visual signs of increased purchasing power (like better clothing and greater mobility) and conspicuous consumption (like cement houses or television antennae) tell very little about new forms of dependencies, about gendered shifts in status, workloads and responsibilities, and about the long-term socio-economic implications of the new agricultural model (Mehta 1996).

On the Deccan Plateau, the displacement of local dryland crops coupled with the adoption of high-yielding varieties radically transform women's understanding of food security and health. Regardless of caste and class, women who are old enough to have experienced the shift from subsistence to commercial agriculture invariably express concern about a range of food and health issues:

1. 'Our grain baskets remain empty after harvest'.

In the village of Pastapur, where sorghum, millets and dryland pulses and oilseeds are increasingly being displaced by ginger, turmeric, potatoes, onions and sugarcane, Tirupatamma, an elderly lady, comments: 'Before, even with a single crop coming to fruition, our houses were full of grain. Today, we may grow four different crops, but our grain baskets still remain empty'. Pondering the new meaning of farming, she asks: 'What is the use of cultivating the land today? Our sons don't listen to us anymore, they grow what will sell'. This testimony points to a different viewpoint based on gender but also on age: middle-aged and elderly women generally consider young women to be less hard-working than they were in their youth and more inclined to adopt 'easy solutions' like buying rice instead of preparing sorghum bread or buying seeds instead of saving them from the previous harvest.

2. 'Where is the fodder for our cattle?'

Fodder production is of great concern to rural women. 'Hybrid sorghum is no good: it doesn't produce fodder for our cattle' explains Parvatamma, expressing a very common observation on the poor quality of hybrid sorghum stalks as cattle feed. 'Our animals simply refuse to eat it', say some farmers. Another concern is conveyed by Subadrabai in Pipri, an Adivasi village where virtually every household still owns at least one head of cattle: 'If we start growing only cotton, where will be the fodder for our cattle? We can't just think of ourselves. We have to think of our animals too'.

3. 'Our own pigeonpea varieties used to give a better *pappu*'.

Wherever improved varieties of pigeonpea and hybrid varieties of sorghum have come in, women farmers invariably say that the bread and pappu made from traditional local varieties were tastier. Moreover, women from various parts of Adilabad feel strongly that sesame and safflower oil (which they used to produce from their own crops) had better qualities than the groundnut and sunflower oils they now purchase. Also, throughout

Medak district, farmers assert that millet-based diets were much more nutritious and 'strength-giving' (*balam*) than the current rice-based diet.

4. 'This [hybrid] sorghum can only be stored for one year'.

In areas where hybrid sorghum is widely cultivated, there is a consensus amongst women that this grain cannot be kept for over a year. 'Earlier, we could store sorghum for two to three years without any risk of damage' says Gangamma in a grumbling tone. In Bhoraj, many women are equally dissatisfied with a grain that gets heavily damaged by pests within 10 months of its harvest, i.e. when stocks are still expected to last and to feed the family. This has particular implications for poor households, because unlike wealthier people, they do not necessarily have the means to buy foodgrains from shops when their stocks run out or become unusable. As the main food providers, women are especially affected by the poor quality and storage capacity of hybrid sorghum and other foodgrains.

5. 'Nowadays, everything we eat has pesticides in it'.

There is widespread concern in rural areas over the declining health of the entire population. This change is largely attributed to new methods of producing food. People see a clear connection between the large amounts of fertilisers and pesticides used on crops and the increasing rate of disease. In areas where intensive agriculture has gained ground in recent years, it is extremely frequent for farmers to declare such things as 'Everything we eat is adulterated' or 'We are no longer healthy; we are getting sick; the food we eat is full of pesticides'.

In the dominant paradigm of agricultural development, cash crops are supposed to bring incomes that 'liberate' farmers from the necessity of having to grow their own food. Yet small women farmers do not necessarily correlate money with food. The prospect of earning money through the sale of cash crop gives them little, if any, confidence that the household food needs will be met. Several reasons explain this concern:

a) There is a difference between revenues and benefits, as Jangubai clearly explains: 'Simply by selling our cotton crop, we can't buy all the food we need. Men think that a harvest of 2 quintals of cotton will bring in Rs. 4000. But with that money, they first need to clear their dues. By the time all the debts have been reimbursed, there is hardly anything left'.

b) Money earned from cash crops is not in women's control. Women farmers often admit to not having any idea about the amount of money earned from cotton or other cash crops. Therefore, they cannot count on it to buy food.

c) Even with some money in hand, one is not guaranteed of getting foodgrains of a good quality and variety from town shops. 'We don't always get what we want if we have to buy foodgrains in the market', says Bichamma. This also explains why most women would rather avoid having to depend on purchased food.

Naturally, not all women farmers share these concerns. Some women farmers do show an interest in growing cash crops. In Nawabpet, a number of them have 'tried their luck' with cotton after hearing of the success of Andhra farmers. One of them, Lakshmi, grows cotton and finger millet on a single acre of land. She gives the following reason for deciding to grow cotton: 'Everybody is making money. So I thought I too would sow cotton and see'.

The marginalisation of 'small change crops'

Mixed cropping is an essential component of traditional dryland farming and although there are gender differences in how men and women perceive and use crop diversity, men farmers do not contest the logic of mixed cropping where agriculture has a strong subsistence component. This situation changes dramatically when farming gradually becomes a commercial activity. One major indicator of change is the growing divide between what is known as *paisa pantalu*, the cash crops, and what is referred to as *chillar pantalu*, the 'small change crops'. These two categories take on new meanings and connotations. They epitomise two contradictory and conflicting conceptions of agriculture that are largely embedded in gender relations. That this gendered conflict of interest has remained invisible to most observers is an issue of great concern, especially in the light of the enormous socio-economic and ecological stakes that it carries.

Paisa pantalu, the 'male' crops in farmers' own terminology, are the crops that bring in monetary income as they are grown to be sold. *Chillar pantalu* are 'female' crops that are grown to be stored and consumed by the family. Typically, they are grown in relatively small quantities and they do not earn any significant income. Staple crops like sorghum, pearl millet and maize are not designated as *chillar pantalu*, which comprise only minor millets and all dryland pulses and oilseeds, with the exception of pigeonpea (grown on large areas as a food-and-cash crop). Newly introduced oilseeds like sunflower and soybean come under cash crops.

The large-scale adoption of commercial crops undermines the importance of minor food crops for several reasons:

1. Most of the land previously sown to food crops is now used to grow cash crops.
2. Certain cash crops like cotton occupy the land for ten months, which eliminates the possibility of growing *rabi* season crops, a number of which are 'minor crops' (linseed, chickpea, lathyrus…).
3. Men farmers are relatively easily convinced by extension workers or private dealers to adopt commercial crops as they are supposed to generate monetary returns and they are strongly associated with modernity.
4. Credit and subsidies are only provided for commercial crops.

5. The monetarisation of agrarian economies associated with commercial crops discriminates against crops that do not bring in a substantial income (especially when debts accumulate and need to be paid).
6. The growing emphasis on technical knowledge (associated with commercial crops and chemical inputs) devalues women's knowledge of dryland food crops.

These factors lead to the marginalisation of 'small change crops'. Such attitudes are easily identified in the discourses of extension workers (the majority of whom are men) and men farmers. For instance, when women start speaking about these crops in the presence of their husbands, the latter either show little interest or plainly object to these crops being discussed on the grounds that 'they are of no significance'. This shows that men have little or no interest in 'small change crops' *when they are in competition with cash crops.* Similarly, extension workers pay very little attention to women farmers' concerns and are quite unwilling to hear about the problems cash crops are causing women.

Far from being oblivious to these subtle but far-reaching changes in men's cropping agendas, women farmers often respond by readjusting their own practices and strategies in order to continue growing the crops that they value. But they face many constraints, including land availability, the disapproval of their husbands and sons, lack of recognition of their fully-fledged 'farmer' status and shortage of labour, manure and seeds. The following accounts show how women farmers from all socio-economic backgrounds try to circumvent these obstacles and create spaces to pursue their own agenda—however unworthy this agenda may be deemed by the rest of the family.

In the village of Pastapur, Parvatamma tends 1.6 hectares of land with her son, who grows sugarcane on 1.2 hectares. On the remaining 0.4 hectares, she grows food crops like sorghum, niger, safflower, wheat and chickpea, even though she faces disapproval from her children for doing so. 'They think that I grow too many kinds of crops… They don't mind if we don't grow any grain for ourselves', she says. Yet she is determined to continue growing these crops, which is still possible because she has kept the upper hand on a small portion of the family land.

In Pipri, women farmers described quite a different strategy. In order to ensure a harvest of pulses and oilseeds, they discreetly mix seeds of the 'minor' crops into the bulk of sorghum seeds before handing over the seed bag to the person who is in charge of sowing (husband, son, mother-in-law, brother-in-law…). Sowing is done by two people, often by a man and a woman, the man driving the plough and the woman dropping the seeds in the driller. Jangubai explains: 'If my husband and I go together for sowing, I prepare the seeds of all the varieties I want to grow and bundle them up in my *saree* while he is busy preparing the plough'. When her husband realises that what is being sowed is a mixed crop, 'he grumbles for a little while, but

there is not much more he can do'. A variation of this 'tactic' is explained by Mirabai: 'If I want to sow field beans in a sorghum field [that has already been sown], I send my husband and my mother-in-law to sow a different plot, and meanwhile I go and sow my fieldbean seeds'. Men's major objection to mixed sowing is that the small bean and pea plants get in the way of the plough during the process of intercultivation (a plough-aided weeding technique). Beyond this technical issue lies the fact that they do not place the same value on minor food crops as women do.

In the village of Bhoraj, cotton occupies over 40% of the arable land, the remaining land being devoted to sorghum, soyabean and pigeonpea. This crop prevails in the fields of large and small farmers alike and there is a dearth of land to grow food crops other than hybrid sorghum (which incidentally, is also considered to be a commercial crop). Yet, women farmers have not given up on 'their' crops, which they try to grow on field bunds or wherever they find space. One common practice consists of going into cotton fields two weeks after sowing with seeds of greengram, blackgram or field beans, spotting all the empty spaces where cotton seeds have not germinated, and carefully sowing these seeds. When asked whether men also take part in this, women categorically answer: 'No, *we* are the ones who do this'.

Surprisingly, this practice is not confined to poor women farmers. Despite belonging to a wealthy and high-caste household, Gangamma still continues to save seeds of greengram and blackgram to sow on the family holding. She does this very discreetly, knowing that no-one in her household—neither her sons nor her daughters-in-law—believe in it. In fact, it took a long time for her to reveal this practice in my interview, which suggests that she had internalised the worthlessness attributed by others to her practice of growing 'small change crops'. In the end, she mentioned that she was constantly being told by her sons: 'Why do you bother to grow greengram when we can purchase it in the market?'.[33] What is most revealing perhaps is that none of this has deterred her from growing minor pulses. Yet it must also be noted that the status of 'small change crops' in Bhoraj is so low that women have no choice but to resort to surreptitious means in order to grow very small amounts of these crops.

A study in semi-arid Kenya reveals that Embu women farmers resort to the exact same tactics in areas where cotton cultivation has displaced most of the local food crops:

> Farmers noted how monocropping cotton led to the degradation of their soils and left little land to grow food. They could no longer grow traditional food crops such as legumes, sorghum, or millet.... Given the out-migration

33. Women farmers' determination to grow pulses is supported by research findings on the economy of pulse cultivation. Agricultural scientists have shown that it is possible to produce enough dryland pulses to meet a family's needs by spending only 25% of the amount needed to purchase the same quantity from the market. Sanyal, B., (1999), "Working with watershed elements in the drylands of West Bengal", The Debacle, Vol. V, No.1-2, pp. 40-44.

> of men and division of labor in Mbeere, which puts women in charge of food production, it was women who most keenly felt the brunt of these difficulties. Less land meant less food for their families. Since they could not afford to buy food, they had to find other alternatives, one of which was to intercrop beans with the cotton where the agricultural extension officers would not catch them (Wangari et al. 1996).

What emerges from these findings in semi-arid Kenya and from my work in the Deccan is that commercialisation of agriculture leads to a marginalisation of women's cropping choices. This process occurs both at the household level and at the institutional level, since women farmers also face hostility from male extension workers. The decline of 'small change crops' furthers the erosion of agricultural diversity—including genetic diversity—in farmers' fields, with adverse implications in terms of dryland agrosystem resilience and stability.

A feminist sociologist working on gender relations in Moroccan society highlights the contrast between 'men's strategies' and 'women's tactics' (Granié 2002). This opposition denotes unequal power relations and it perfectly illustrates the redefinition of gender roles that commercial agriculture inexorably leads to. The persistence displayed by these women can be interpreted as an indication that 'eating grains from one's own land' is a strong value for rural women, one that ties together identity, dignity and autonomy.

This explains why women put up so much resistance to the large-scale expropriation of this intimate realm of theirs. Surrendering this realm to market forces is a form of alienation from which women farmers try to protect themselves.

Transfer of knowledge and power

The adoption of cash crops progressively modifies existing structures of knowledge and power in rural communities. There is a widespread notion amongst development planners, agricultural extension workers and increasingly amongst farmers, that commercial crops are synonymous with progress:

> Villagers refer to the need of becoming *sistam* [i.e. modern] and they appreciate things that incarnate the *sistam*. The houses of educated people are *sistam*, city people are more *sistam* than rural people, and a marriage with a young man from an urban and educated family will infuse *sistam* into their rural lives. The representation of their lives as being 'without *sistam*' denotes the impact of new agricultural practices [improved seeds, chemical fertilisers] and of their urban bias (Vasavi 1999).

The adoption of new crops and farming methods creates new power dynamics based on access to and exclusion from new sources of knowledge. The imposition and the diffusion of agro-industrial techniques and products into the rural domain also lead

23 Power relations vested in cash crops

In 1992, women farmers involved in *sangams* (collectives) in the Zaheerabad region organised a public protest against the increasing cultivation of cotton in their villages. Their main arguments against this crop were that:

- it increases the level of pests in their fields to the point where traditional methods like shaking the plant and applying jaggery solution and neem extract no longer work
- it does not produce food or fodder for their cattle
- it diverts scarce land and water resources away from food crops and towards a crop that according to them, brings no significant benefit
- it dramatically increases the costs of cultivation and the incidence of indebtedness

By protesting and by exerting social pressure on cotton growers in the area, they were able to stop the advent of cotton in their villages. This case illustrates Amartya Sen and Jean Drèze's analysis of the politics of commercial crops at the local level (Sen and Drèze 1989). Weighing the odds of cash crops against the development of hunger and famine, Sen and Drèze make the following points: (1) Households are driven to adopt cash crops against their own interests, through coercion and delusion. (2) Economic and social change, of which expansion of cash crops is an integral part, lead to impoverishment and vulnerability, even though in these reduced circumstances an individual household may gain from growing cash crops. (3) Some household members adopt commercial crops to the detriment of *other members* of the household. (4) The adoption of cash crops by some households makes them rich at the cost of undermining the entitlements of *other household*s.

There is a marked resemblance between the analysis made by *sangam* women and that of Sen and Drèze (1989) when the latter argue that 'the large-scale adoption of cash crops by certain households can, under certain circumstances, pose an important threat on the entitlement rights of other groups that are potentially more vulnerable'. Two examples support their analysis: the conflicts over land between herders and farmers in Ethiopia and Sudan, and the conflicts caused by the adverse environmental effects of cash crops like cotton.

to a form of symbolic domination of farmers by extension workers and dealers. More importantly, the 'modernisation' of agriculture introduces new risks that small farmers are particularly ill-equipped to deal with.

Modern agriculture transforms money-lenders, fertiliser and pesticide dealers and middlemen into valuable information sources. Having noone else to turn to, most farmers follow their advice. But small farmers admit to feeling that they are at a disadvantage: 'Large farmers remember everything the Saukar [money-lender] says. We don't', says a low caste woman farmer. She also adds that people from the Dalit community face various kinds of discrimination in the shops.

Interestingly, some women farmers are critical of their husband's accepting attitude: 'This mute fellow [my naïve husband] brings back whatever the *Saukar* [money-

lender] gives him and he spreads it on the crop without any further ado' says Ellamma in Bhoraj. Women have also been the ones pointing to the drawbacks of cash crops, which can potentially introduce new forms of inequity and discrimination in communities (Box 23).

Furthermore, current forms of agricultural modernisation tend to increase the invisibility of women's work and to marginalise their contributions to and management skills in agriculture. One compelling illustration of this mindset came from an agricultural officer in the town of Adilabad: 'women simply act as labourers under the guidance of men'. Bina Agarwal identifies two major ways in which existing forms of development affect 'women's indigenous knowledge':

> First, the process of devaluation and marginalization of indigenous knowledge and skills impinges especially on the knowledge that poor peasant and tribal women possess. Existing development strategies have made little attempt to tap or enhance this knowledge and understanding. At the same time, women have been excluded from the institutions through which modern scientific knowledge is created and transmitted. Second, the degradation of natural resources and their appropriation by a minority results in the destruction of the material basis on which women's knowledge of natural resources and processes is founded and kept alive, leading to its gradual eclipse (Agarwal 1999).

The exclusion of women from the circles of knowledge and power created in the wake of the development of chemical and commercial agriculture can be inferred from the change in gender dynamics at the community level. Wherever commercial agriculture has taken hold, men farmers are quick to say that 'women don't know anything' about agriculture. While this assertion is far from true, it certainly highlights a general attitude of superiority by men over women. Manjari Mehta makes very similar observations based on her study of agricultural change and gender dynamics in Uttar Pradesh. Commenting on emerging forms of access to information, she writes:

> The emerging gender monopoly over information confirms an unspoken local belief that those who work the land are not necessarily considered 'farmers'— highlighting the chasm between women's labouring roles and men's managerial roles. It also serves to reinforce women's dependence on men to act as mediators to critical resources, services, the banking system, and to various personnel (e.g. the agricultural extension agent) of the market economy. These levels of dependency not only have material consequences, but also legitimise women's ideological inferiority to men by reinforcing the cultural norm that 'money is a matter for men' and that 'women do not know anything about it'… Women's inability to acquire necessary information also affects household agricultural strategies and threatens to lower agricultural productivity over the longer term (Mehta 1996).

24 Women's insights into chemical agriculture

Cotton cultivation is essentially a man's affair. Tarabai explains: 'People come by jeep to the village to sell pesticides. They only talk to men. They don't talk to us. We don't know how to read and write. We don't know anything about pesticides. We only see the containers that our husbands buy and store… Full boxes of them!'.

In most villages, men make most decisions about the cotton crop. 'What about the *rabi* crop?' I inquire. 'How can men grow the *rabi* crops without asking us?!', comes the reply. This reveals that when it comes to the traditional dryland cropping patterns, women retain their expertise and decision-making power in the household.

The discussion goes on.

- *Do you find that men are generally tempted to increase the acreage under cotton?*
- Yes, this is happening.
- *How many of you face this situation?*
- Everyone is experiencing this.
- *What are the benefits of growing cotton?*
- What benefits?! exclaims Rukmabai. So much money goes into buying pesticides. I would rather grow pigeonpea instead. But in the last few years, we are observing that flowers fall off during the cold winter nights.
- This is our *kismat* [destiny], adds Tanubai. We used to get good yields from our crops without spraying any fertilisers or pesticides. Now everything has changed.
- *Do fertilisers and pesticides have any impact on the land?*
- Soil fertility is declining. We don't have enough manure any more. That's why we have to use chemical fertilisers. There is barely enough cowdung in the village to plaster the walls of houses.
- *Is everyone aware that the land is getting damaged?*
- Yes everyone knows this.
- *Then why have people let fertilisers become so widespread? Are there no alternatives?*
- We used to be humans. Now we have become animals, answers Rukmabai.

As commercialisation sets in as a ruling model, women find themselves with fewer options and responsibilities. Tirupatamma, a high caste woman who used to run a 16 ha farm with the help of labourers, is well aware that present development trends leave little room for traditional agriculture. 'We don't have a place here any more, the graveyard is calling for us', she says. This commentary unequivocally points to the sense of worthlessness developing in older women, echoed in Mehta's study of

agricultural change in the Himalayan region: 'The increased emphasis on money to meet domestic needs and men's roles in acquiring it has also contributed to an erosion of the social power older women once had in the domestic domain' (Mehta 1996).

The increasing power, wealth and control of money-lenders is of concern to many farmers who refer, in particular, to their increasing earnings: 'The *Saukar* are filling bags with money nowadays'. The profits made by money-lenders and private companies are proportional, according to some farmers, to their own demise and loss. Many poor people find themselves unable to cope with the new economic situation of 'declining yields and increasing costs of cultivation'. As one farmer bluntly puts it: 'Those who have money will live; the rest will die'. Dealers and money-lenders frequently harass or humiliate the farmers who have not paid their debts. This problem affects farmers, and in particular small and marginal farmers, throughout the Deccan region. Indebtedness alters the character of agriculture and social relations and brings unprecedented change to the region's rural livelihood scenario.

The ecological consequences of intensive agricultural practices are not unknown to farmers. In fact, farmers frequently comment on the impact of chemical inputs on soil and human health (Box 24). Many women farmers, like Rukmabai, express their dismay at the fact that farmers are progressively losing the physical capacity, the resources and the knowledge to deal with the new challenges facing them. Agriculture has metamorphosed into a peculiar paradox: in order to produce food, to earn money and to repay their debts, farmers adopt practices that degrade the land—the very foundation of their livelihood and culture.

Finally, various studies show deteriorating social networks and a decline in cooperation over agricultural work in many agrarian communities of the Deccan. Sagari Ramdas, a researcher and activist with many years of experience in working with rural communities, points to the decline of collective farm activities that used to maintain social bonds and create opportunities for cultural expression:

> Specific songs were sung during sowing, weeding and harvesting of different crops. Special harvest festivals were celebrated for specific crops. Women had the public space to sing, dance and celebrate. All this has stopped with the shift to new crops. There are no songs to be sung, no harvests to be celebrated. Women in many areas have virtually stopped the collective celebrations that were so much a part of their lives. This has further disempowered them and restricted their freedom and creative expression (Ramdas 2001).

It has been argued that plant genetic resources and botanical knowledge fall into the category of cultural creations. Culture 'embraces the everyday activities that people engage in, including organising their working day and growing food. Indeed, it may be that the apparently mundane activity of growing food is the most "cultural"

activity of all, deeply connected to beliefs about the work and the community's relationship to it. The Hopi Indians of Southwestern United States, for example, believe their unique blue-coloured corn to be a sacred gift from the "Creator" to them specifically' (Stenson and Gray 1999).

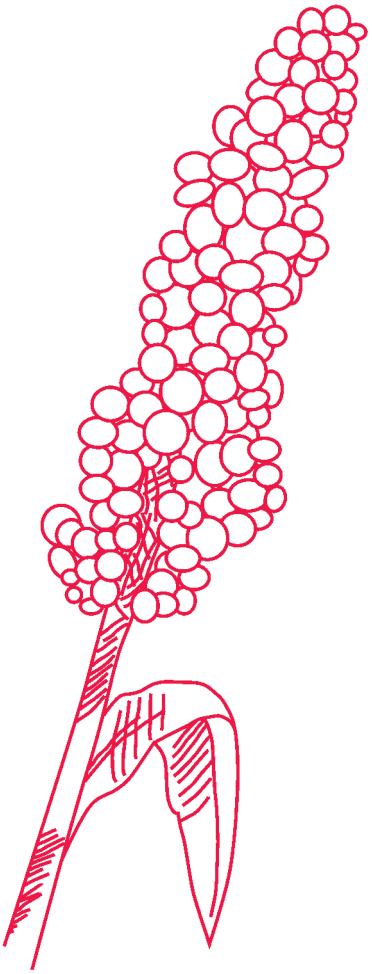
As 'cultural creations', crop varieties have a deep significance for the individual members of farming communities and especially for women farmers, whose status, identity and autonomy is closely intertwined with the diversity of crops they grow in their fields. We have seen that women use crops as a means of increasing their bargaining power in the family. When commercialisation jeopardises their practices, women farmers practise resistance by continuing to uphold 'small change crops' in the increasingly reduced and marginalised spaces that they still control.

Even though they have been consistently ignored by most agricultural extension workers and development planners, these gendered strategies exist in many contexts and villages. An agricultural scientist from Medak district thus testifies: 'I was regularly being told by women farmers of the Deccan Plateau that in the absence of their husbands, they would take small quantities of seeds stored in their house—sesame, mustard, lathyrus, roselle, blackgram, etc.—and discreetly mix them with the sorghum seeds to be sown in the fields. So I went and asked my mother, who runs the farm with my father. She told me that she does it too'.

In other words, women's strategies are only invisible to those who either assume that no such thing exists and who pay little attention to women's knowledge and concerns in agriculture. That this mindset needs to change is evident for several reasons:

- The erosion of agricultural diversity is partly linked to the lack of attention given to women's role in plant diversity management.
- Because of their role and responsibilities, women farmers have a different approach to risk, which may be more 'conservative' but also more sustainable in the long-run.
- The increasing levels of indebtedness in rural areas point to the need for a better balance between high-input, high-cost and high-risk practices and low-input, risk-proof alternatives that women tend to practise.
- The increasing phenomenon of male migration to towns and cities means that women farmers have to play a greater role in dryland agriculture. Yet women's ability to make independent decisions is hindered by their lack of legitimate control over land, credit, inputs, etc… This suggests that policymakers should focus on policies that meet women farmers' needs in terms of access and control to resources.

5



Localised seed systems

> "The cultivator, manure, field, bull, mass of clouds—all these become useless when the seed is barren. This rule is declared for sesamum, paddy and barley. Therefore, take care of the seed; the wealth of harvest depends on the seeds" (v. 166 & 167).
>
> Krsi-Parasara (11th century)

In India it is estimated that over two-thirds of farmers produce seeds from their own harvest (Sahai 2000). This estimate is remarkably high if we compare it to the percentage of farmers who use farm-saved seeds in Europe, which varies between 10% and 50% depending on the crop and the country. In India there are also great disparities in the use of locally-produced seeds depending on the agricultural system and the type of varieties grown.

Seed production by farmers is highest in rainfed systems where food crops make up a substantial part of agricultural production. This is the case for Himalayan regions in Himachal Pradesh, Uttaranchal and the north-eastern states, and for semi-arid areas in Rajasthan, Gujarat, Madhya Pradesh and Andhra Pradesh. Farm-saved seeds are also common in the irrigated rice systems of West Bengal and Tamil Nadu, where farmers only 'renew', i.e. purchase their rice seeds every two to three years. The same is true of the Green Revolution wheat varieties grown in Uttar Pradesh and Punjab.

However, self-production of seeds is extremely low in regions where commercial crops dominate. Cultivators of cotton, sunflower, maize, pearl millet, vegetables and flowers in Maharashtra, Gujarat, Karnataka and Andhra Pradesh essentially buy hybrid seeds every year from seed dealers.

In order to understand the seed system of the Deccan Plateau, we first need to distinguish between three types of seeds present in the region: farmers' seeds in the case of local varieties (sorghum, pigeonpea, safflower, mustard…); farm-saved seeds in the case of improved open-pollinated varieties (rice, blackgram, groundnut…) and

commercial seeds in the case of hybrids (cotton, maize, sorghum, chillies…). Each of these has a distinct seed production system:

1. **Farmers' seeds:** Farmers' seeds are produced from local varieties; those which have been cultivated in the region for at least one generation of farmers, i.e. for over 30 years (Louette et al. 1997). Farmers' seeds therefore include varieties that have been a part of the traditional agricultural system 'for generations' (farmers say 'since our forefathers' time') as well as varieties that were introduced into the agricultural system before the 1970s. Initially developed by professional breeders, these were subsequently selected and adapted by farmers and became an integral part of the localised seed system. In fact, farmers do not distinguish between a local variety and an introduced variety that has been cultivated in the region and reproduced on-farm for over a decade.
2. **Farm-saved seeds:** Farm-saved seeds are produced from recently introduced varieties often referred to by farmers as *Sarkar*, which means 'government'. In many cases, these varieties do originate from breeding programmes undertaken by the government, but they may also have been developed by private breeders or international research institutes like the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT, located in Patancheru, Andhra Pradesh). In my study villages I came across improved varieties of greengram, pigeonpea, rice, chillies, groundnut and sugarcane. There are two ways of getting hold of these varieties: either by purchasing seeds from a merchant, or by borrowing seeds from someone who already grows the improved variety. In both cases, the farmer will reproduce the seeds in his or her own field after the first harvest, thus producing farm-saved seeds for an average of three to four years.
3. **Commercial (or industrial) seeds:** Commercial seeds comprise hybrid varieties, and now transgenic varieties, that are bred, produced and distributed through industrial channels, by the professional and heteronomous sector.[34] The development of hybrid varieties is currently done by breeders from the public and the private sectors alike. Seed production for these varieties is a highly skilled process, done by seed producers working on a contract basis with seed companies. Hybrid seeds are marketed by a range of licensed distributors and dealers. Seeds produced on-farm from a hybrid crop do not possess all the characters of the original seed, leading to a substantial drop in productivity. Hence, for the most part, hybrid and transgenic seeds are purchased every year.

Local systems of selection, management, production and exchange of seeds only deal with farmers' seeds and farm-saved seeds. Commercial seeds originate from the industrial domain, and they are neither reproduced nor exchanged by farmers.

34. The opposition between heteronomy (i.e. driven by an industrial rationale) and autonomy (i.e. driven by needs and limits defined within the system) is further discussed and analysed in Chapter 6.

In this chapter, the first three sections revolve around the localised seed system, its mode of functioning and its ecological and social significance. In the last section I look into farmers' responses to commercial seeds.

Cultural and symbolic attributes of seeds

Farmers of the Deccan Plateau do not consider cattle, seeds, manure and agricultural implements as mere means of attaining an economic goal of production. Each of these living and non-living entities deserves a particular consideration. The rituals, the rules of conduct and the daily practices observed by farmers bear testimony to an intimate relationship with these resources.

Reverence towards seed

In many villages, it is a customary practice for women farmers to take their seeds to a temple right before the sowing season, i.e. early in June in the case of the *kharif* crop. In many villages in Adilabad district, women farmers perform a collective *puja* to Pochamma, the Village Goddess, whose temple is usually on the outskirts of the village. When asking for Pochamma's benediction, a chicken or a goat is sacrificed. Men do not take part in this ritual, which entails strict rules (in some villages, no-one should leave the village or do any household work on that day).

According to Kanchan Ilaiah, an author and scholar whose roots lie in rural Telangana:

> Pochamma is the most popular of Dalitbahujan Goddesses in Andhra Pradesh (...). Her relationship to human beings is gender-neutral, caste-neutral and class-neutral. She is supposed to take care of everyone in the village. She herself relates to nature, production, procreation. The closeness of the relationship that exists between Pochamma and the people is evident in the belief that she understands all languages and all dialects. The people can speak with her in their own tongues (...). They talk to the Goddess as they talk among themselves: 'Mother', they say, 'we have seeded the fields, now you must ensure that the crop grows well; one of our children is sick, it is your bounden duty to cure her...' (Ilaiah 1996).

In October or November, right before the sowing of the *Pedda Panta*, the *rabi* crop, a much more elaborate ritual involving seed is performed by women. Known as *Gattilu*, this germination ritual takes place entirely in the intimacy of the house (Box 25). The ritual begins on the first day of Durga Puja, when the Goddess Durga is worshipped and it ends on the day of Diwali, ten days later. While Dasera marks a festive period for all, the fully-fledged ritual around the germination of seeds is now only observed by upper caste households.

25 Seed germination ritual during the Dasera festival

On the first day of the ten-day *puja*, the eldest woman in the house collects soil from a winter sorghum field and sows a mixture of five seeds in it: chickpea, oat, sorghum, safflower and wheat. She places this soil on a leaf, pours water on it, and then lights an oil lamp (*diya*) next to it. A copper vessel is also placed on the leaf, which is then covered with a mounted structure made out of sugarcane and sorghum stalks and mango leaves. This small altar is thus maintained for five to nine days, depending on the family's capacity to keep the diya going by adding oil regularly. In upper caste families, the woman has to stay inside the house throughout this period. By the last day of Durga Puja the seeds have sprouted. This day is known as Diwali (the festival of lights), which falls on the 10th day of the waxing moon in the month of Kwar according to the Hindu calendar. If all seeds germinate, it is an indication that the *rabi* crop will come up well. Women then take the sprouted seedlings to their fields while singing incantations to Lakshmi, the goddess of wealth and prosperity.

Rituals like this one, or like the elaborate *puja* performed in honour of Durga in West Bengal, reveal a remarkable integration between plant and ecosystem diversity on the one hand, and spiritual practices on the other. The five plants used in the Dasera germination ritual are the main *rabi* crops, all of them highly appreciated for their nutritional value and adaptation to dryland conditions. The ritual thus contributes to the reproduction of the biodiversity essential to dryland agroecology.

Similarly, a wide range of grains and fruit, but also medicinal plants, balms, oils, water and soil from different origins is needed to perform the *puja* to the Goddess Durga. Although this rule appears to be primarily religious, one can argue that it is an effective strategy for preserving plant genetic diversity and the wider biotic environment. Furthermore, the sacred offering associated with the prayer fortifies the 'symbiotic relationship between the seasonal character of food and the biological rhythms of the human body': the offerings are composed of food items that are rich in vitamins and minerals, which strengthen the body at the onset of the winter (Khanna 2000). Through offerings and special dishes, festivals therefore help in maintaining a nutritional balance, especially in poor households that go without protein-rich items in ordinary times.

Skills involved in seed selection and production

Women farmers from the Deccan Plateau say that it takes talent to be a good seed-keeper. Indeed, not everyone has the same 'luck' with seeds. In each village, there are a few households whose seeds invariably get spoiled by pests. But there are also families who are reputed for the quality of their seeds, and these houses are often visited by farmers facing seed shortages for one or several crops.

Farmers choose sorghum and pearl millet earheads in their fields for producing seeds. Selection in the fields is considered important since it is the only way of inspecting the entire plant while choosing an earhead. Local seed selection hinges on three broad selection criteria:

1. **Health, vigour and height of the plant:** the plant should be of average height (very tall plants tend to produce a smaller earhead), healthy and free of fungus (if the inside of the stem shows some red spots, the earhead of that plant will not be considered for seeds).
2. **Shape and size of the earhead:** tight, round and dense earheads are preferred. Earheads that have been damaged by birds are rejected (this is also true for pearl millet).
3. **Shape, size, health, colour and odour of the grain:** well-rounded, healthy and fat grains are preferred. Off-coloured or dotted grain, grains with thick husks and grains that have been damaged by a fungus or carry an unpleasant smell are separated out and discarded.

Several researchers and breeders working with dryland farmers in various parts of the world have shown that in their selection practices, farmers have two distinct and complementary goals: to reproduce the distinctive characters of each local crop variety and to increase the variability and adaptability of plant genetic resources (Box 26).

A detailed study of farmers' selection criteria for pearl millet in semi-arid Rajasthan shows that farmers' selection criteria are highly diversified and effective in meeting their objectives. Frequently used criteria include grain size, number of productive tillers, nodal tillering, stem diameter, panicle girth and leaf width (Vom Brocke 2001). Farmers have an elaborate knowledge of the association between different plant types and particular adaptive abilities under specific growing conditions: for instance, high tillering indicates a high level of resistance to drought and low input requirements. Studies from other parts of the world show that farmers' selections give good results in terms of increasing yield without undermining year-to-year yield stability, as has been shown for Syrian farmers cultivating landraces of barley (Ceccarelli and Grando 2000).

Once seeds have been selected, there is a significant amount of work involved in preserving seeds. *Kharif* and *rabi* seeds are saved separately, as distinct crops and crop varieties are grown in these two seasons. What is required on women's part is skill and attention, more than time. Each step involved in producing farm-saved seeds requires an interesting combination of skills, know-how and traditional knowledge relating to ecology and spiritual auspiciousness. Women farmers identify six major steps in the preparation of 5 kg (one *adda*) of sorghum seeds:

26 Selecting millets in the dryland: farmers' seed selection practices

Farmers' seed selection techniques help to maintain a diversity of crops, not only on individual farms, but also at the community level. The well-known American botanist JR Harlan studied the practices of sorghum growers in Africa in the 1960s. He observed that choosing seed for the next sowing season is a farmer's first activity before beginning to harvest. The cultivator walks around his or her fields and carefully selects the earheads to be preserved. Sometimes the earheads look alike and other times the farmer choose earheads that feature an impressive diversity both in the earhead type and in the features of the grains on the earhead (Harlan 1992). This 'double play' observed by JR Harlan has been interpreted in studies of traditional breeding and management of diversity. These studies highlight two components or objectives in farmers' strategies. The first is to maintain agromorphological diversity, ensuring that diverse needs are met (colour, flavour, plant architecture and crop types). The second is to preserve diversity in terms of the crop's adaptive characteristics, such as adaptation to micro-environments, environmental stresses or biological hazards such as pests (Eyzaguirre and Iwanaga 1996). This entails maintaining a high level of genetic variability, hence the selection of earheads 'that feature an impressive diversity'.

Deccan farmers appear to have a similar rationale in their selection practices. When selecting seeds for sorghum varieties, most farmers attempt to choose earheads that carry the distinct features they attribute to a given variety: round-shaped earheads with light-coloured seeds in the case of *Gundu jonna*, elongated earheads in the case of *Thoka jonna*. Apart from such mass selection practices, some farmers insist on selecting plant types that obviously deviate from the 'norm'. These 'odd types' vary in height, shape, colour or grain density. This second selection strategy helps to enlarge the variability within seed lots, creating heterogeneity within the population sown for a given variety. Variability is a great asset to smallholders as it increases crop adaptation to unanticipated agro-climatic conditions and it allows farmers to develop landraces that fit holistic criteria of hardiness, multiple objectives and cultural preferences.

1. Choosing the earheads in the fields, a task usually undertaken on an auspicious day (1 to 2 hours).
2. Beating the earheads with a wooden stick in the *kollam* or on any flat and hard surface (1/2 hour).
3. Several rounds of threshing with a bamboo to remove straw bits and small stones (20 – 30 min).
4. Sieving seeds using a fine mesh to eliminate the smaller debris (10 min)
5. Sun drying seeds in front of the house (a three-day process that requires constant vigilance by women).

6. Preservaing the seed—mixed with cow dung cake ash and neem leaves—in bamboo baskets sealed with a layer of fresh cow dung (1 to 2 hours).

Sundrying seeds is a crucial step since it largely determines whether or not the seeds will keep until the next sowing season. It takes at least three days for the seeds to completely dry out, and Narsamma explains that she hardly does anything else while her seeds are spread out in the sun in front of the house. Indeed, if a hen or a cow were to start eating away at the seed during a moment of inattention, all her efforts would be ruined.

Seed production extends over a fairly long period because of the staggered harvest. It starts in September with seeds of foxtail millet, greengram and blackgram, and ends in late October when most *kharif* crops (except pigeonpea) have been harvested. *Rabi* seed production takes places in March and April.

Producing seeds requires care and attention. As Narsamma points out, 'seeds are delicate: they can easily turn black or start rotting'. Unlike the grain kept aside for consumption, seeds are never left out to dry on a road, nor allowed to be trampled by bullocks during the processing stages.

The modes of seed preservation vary depending on the degree of vulnerability of a given species, but also in accordance with locally available material and with local customs (Table 6). Mixing neem leaves and ash with seeds is a very common way of preserving seeds of pulses, wheat and millets throughout India.

Table 6. Diverse means of preserving seeds on the Deccan Plateau

Cultivated species	Method of seed preservation
Sorghum	Seeds mixed with ash and neem leaves and placed in a large baskets sealed with a mixture of wet soil and cow dung.
Foxtail millet	Full earheads stored in a jute bags
Pigeonpea, blackgram, greengram	Seeds mixed with ash and neem leaves and preserved in bamboo baskets or earthen pots
Cowpea, field bean, horsegram, ladies' fingers	Seeds placed in homemade straw baskets (in Adivasi villages) or in small earthen or glass containers
Roselle, sunhemp	One whole plant is wrapped in straw and hung against a wall inside the house
Gourd, pumpkin, eggplant	A matured fruit is hung whole above the cooking fire (smoke from the fire protects the fruit from damaging pests)
Spinach and other green vegetables	The tiny seeds are deposited in a moist cow dung cake which is then stuck to the wall near the fire place

The diversity of seed storing techniques present in India underlines the innovative capacity of farmers. Farmers are always trying new methods, for example for preserving pulse seeds, which are highly vulnerable to pests and fungi. Yellamma asserts that dipping the seeds of greengram, horsegram, cowpea, field bean and redgram in boiling water for a short while before putting them out in the sun reduces the incidence of fungus.[35] When storing pulse seeds in a bag, she adds foxtail millet seeds to fill up the empty spaces (thanks to their very small size), making it more difficult for pests to find their way into the seeds.

Another farmer sprays her sorghum seeds with cow urine before drying them out in the sun. Some women, like Sangamma, store a few selected earheads with neem leaves in a large bag instead of preparing seed baskets. Just before sowing, she beats the earheads and cleans out the seeds. As for foxtail millet seeds, she simply keeps them in a jute bag. 'These seeds can remain healthy and free from pest for several years', she says, but one must remain on the look-out for rats, as 'they are very smart animals'.

Many rules governing the preservation of seeds have been passed down orally from generation to generation, and continue to dictate people's conduct. In Wadiguda, Salabai says that once they are stored, the seeds should not be touched again. A little more probing reveals that elders hold the following saying to be true: 'Once a seed has been touched, it is bound to get damaged on the eighth day'. The Krsi-Parasara, an ancient Sanskrit text dating back to the 11th century, is also replete with precautions to be taken with seeds, as illustrated by the following excerpts:

> Do not keep seeds on an ant-hill, in the cowshed, in the place where a woman has been delivered of a child, nor in a house [where] a barren woman lives (v. 161).
>
> Do not allow the seeds that have come into contact with remnant of food, a woman in her monthly impurity, a barren woman, a woman in the family way and a woman just delivered of a child (v. 162).
>
> The cultivator should not, even by mistake, keep on seeds ghee, oil, butter-milk, lamp and salt (v. 163).
>
> The seed that has come in contact with a lamp, fire, smoke, that has been damaged by rain, and has been covered up in holes, is always to be rejected (v.164).

35. Water-based treatment may be beneficial to seeds in other ways. In *Rices of India*, RH. Richharia refers to a 'method of selection for drought resistance in wheat, rice and millets', which consists of soaking seeds in water at 15-16‡ C for four hours and then immediately subjecting them to high temperatures (above 45‡). This technique was found to increase both the rate of germination and the resistance to drought. Richharia, R.H. and Govindaswami, S., 1990, *Rices of India*, Academy of Development Science, Kashele, Maharashtra, p. 10.

> Never, even by mistake, sow the seed that is kept underground and is mixed up; the seed that is a chaff or mixed with particles (of grains) becomes barren (v. 165).

The act of sowing

Sowing lies at the intersection between culture and agriculture. It is a very crucial step in the farming cycle and one that ought to be done at a specific time. Sowing late—to the tune of 10 to 25 days—invariably leads to a decrease in the yield of crops. When sowing time approaches, farmers are attentive to environmental changes that signal the right time for sowing. With the arrival of the monsoon, the atmosphere gets charged with humidity. Farmers watch out for such phenomena, and they have their own ways of identifying them. Women farmers in Chillammamadi watch their seed bags carefully at this time of the year. Farmers know that the time for sowing is approaching when they notice a swelling in the volume of seeds stored in bags, or as Lakshammama puts it, 'when the seeds are pregnant'. This allusion to pregnancy illustrates that women farmers see a real link between the fecundity of a woman and seed at the time of sowing.

Elsewhere in the world, farmers also look out for signs of change in the environment. These signs have a double meaning: they are indicators of the optimal time for sowing and they are embedded in a highly specific understanding of nature. In Indonesia, Bunaq farmers consider seeds of cultivated crops to be masculine and cold in nature. These seeds germinate when they meet with 'the feminine and hot seeds of the earth, that become visible when the first rains fall on the heated soil at the end of the dry season' (Friedberg 1997). The 'seeds of the earth' become manifest as streaks of vapour rising from the moist soil; they are also said to be the 'breath of the earth'. When these fumes appear, sowing has to be started at once.

In the Deccan, the main person involved in sowing is not supposed to leave the fields until the work is over, so as to ensure continuity in sowing. This lends a sacred air to the very special configuration of time and space when seeds are placed in the ground. The sacredness of this process conveys an attitude of submission to forces of nature that lie far beyond farmers' control.

An anthropologist observed a similar concern for continuity amongst Iban farmers from the Island of Sarawak in Malaysia in the 1950s. When the household head left the house to select rice earheads in her fields for seed production, she had to proceed without any interruption. Indeed, according to Iban representations of nature, spirits accompany her, and if the continuity is ruptured, there is a risk that the spirits will go astray (Freeman 1955).

Seed-Related Practices

Below: Sowing is done with a bullock-plough and it involves at least two people, and sometimes more in the case of multiple-line sowing.

Bottom left and right: Two traditional sowing techniques of the Deccan: single-line and triple-line sowing. Sowing devices are made out of wood, bamboo and thin ropes and they are made by local artisans.

Far top: The seeds needed for a mixed crop (sorghum, blackgram, cowpea, field bean, sesame) are prepared by women and brought to the field wrapped in a cloth. Loose earth mixed with powdered neem kernels is sometimes mixed in with the seeds while sowing.

Far middle: After being carefully sorted out and freed from debris, seeds are placed in baskets, earthen pots or glass jars and stored in the home until the next season.

Far bottom: Large baskets containing several kilos of seeds are prepared by women for crops like sorghum and pigeonpea

The act of sowing itself requires concentration and precision, so as to sow exactly the right density of seeds. Crop density is an important way of optimising land productivity. In 1795, Captain Thos Halcott described the traditional method of sowing, still in use in the Deccan Plateau today. In a text entitled "On the Drill Husbandry of Southern India", he shows that the Indian drill plough is much more effective at 'dropping the grain equally' into the soil than the patent drill plough used in England at the time. He also marvels at the skilfulness displayed by women while sowing their fields:

> In working the plough, the cup is not filled with grain, but is fed by hand; this labour is performed by a woman, who walks on the left side of the plough with a bag or large pocket of grain before her, her right arm stretched out, and her wrist resting on the edge of the cup; her hand is filled with grain, and by moving her fingers, she lets drop into the cup as much grain as supplies the three drills in due proportion. When the grain in her right hand is nearly expended, she fills it again from her left hand, observing never to take her right hand from the cup, while the plough is in motion, as that would leave a vacant space in the field. The Drill plough [used in England], which drops the grain by some piece of mechanism, will probably never sow a field so equally as is done in this way.[36]

Clearly, women farmers play a primary role in preserving and maintaining seeds. The responsibilities they shoulder for seed production entail a vast range of talents, skills and knowledge that constitute an intrinsic part of their identity and sense of self-esteem. This close relationship between seeds and farmers may be the reason why farmers frequently assert: 'Our seeds are good', and why they ask: 'Why should we buy seeds since we have our own?'. This corroborates an observation by the botanist JR Harlan that local varieties 'engender trust' even if they do not give very high yields (Harlan 1992). It is precisely this relationship of trust that Deccan farmers maintain with the seeds they have been saving from their own fields for generations. We will see in the third part of this chapter how commercial seeds transform this relationship.

36. Quoted in Dharampal, 2000, Indian Science and Technology in the Eighteenth Century, Collected Writings, Vol.I, The Other India Press, Goa, p. 204. The plough described in this excerpt is composed of three 'teeth' making three furrows into the soil as the plough moves ahead. Three hollow bamboo poles, each connected to a wooden cup (pierced with three holes at the top), drop the seeds into each furrow: three rows are thus simultaneously sown. A more complex version of this drill plough is composed of two extra single-whole drills enabling the sowing of two extra rows.

Women's strategies in managing seed stocks

The degree to which locally produced seeds are used in a given village depends on a range of factors including the extent of irrigation, the dominant cropping patterns, the availability of market seeds and women's role in agriculture.

Seed purchases remain marginal in isolated villages that have little involvement with the market economy. This is the case for Shamshuddinpur where dryland crops prevail, and where less than 10% of seeds are purchased. Women remain the primary producers and managers of seeds.

The introduction of commercial crops tends to modify seed production and management patterns. In Nawabpet, for example, where cash crops like chillies and cotton are now commonly grown, self-production continues to be the largest source of seeds, but purchases account for about 25% of seeds sown in the village. The commercial seed sector is entirely under men's control.

Yet another scenario is illustrated by Timmapur, a village where about 40% of arable land has come under irrigation in recent years. Rice is the major crop today, followed by finger millet, maize, pigeonpea, wheat, cowpea, horsegram, mustard, chillies and aniseed. Local rice varieties have disappeared and several improved rice varieties (known as Hamsa, 1001 and BPT) are now cultivated. Surprisingly however, all rice-growing households rely on farm-saved seeds and close to 60% of households also save seeds of other local crop varieties (like finger millet, maize, cowpea, etc).

In other words, saving seeds from one's own crop remains the rule for farmers, even in villages where dryland cropping is no longer dominant (as in Timmapur). Seed-saving practices also continue to be significant in the initial years following the introduction of commercial seeds (as in Nawabpet). These practices do decline considerably, however, as an outcome of larger processes of transformation in agriculture as I argue in the last section of this chapter.

The extent and limits of self-reliance in seeds

While commercial seeds are always bought, seeds of local varieties can be accessed in several ways. Producing seeds from one's own crop and borrowing seeds from other farmers are the two most common sources. But local varieties also circulate in rural communities through seed gifts, grain-payments and share-cropping arrangements. Although limited in scope, these local ways of accessing seeds deserve mention because they reveal the intricate workings of farmers' seed systems.

Seed gifts are quite frequent in farming communities. A medium-scale Dalit farmer from Shamshuddinpur, for instance, explained that she often gives away small amounts of finger millet, pearl millet, roselle, greengram, ladies' fingers, eggplant, spinach, mustard and chilli seeds to neighbours and friends. Seed gifts are also

embedded in cultural traditions: in many parts of rural India, mothers traditionally give seeds to their daughters at the time of marriage, when the young woman leaves her home to go and live with her husband's family.

The grain which small farmers receive as payment for doing work on other people's land is another source of seeds. Many marginal landholders—especially amongst female headed households—use a part of this grain to produce seeds for their own land: it is a way of renewing their seed stocks and sometimes of accessing local varieties that they have not able to grow themselves due to the limited size of their holding.

Share-cropping is yet another way of procuring seeds. It is quite common for the cattle-owning family (who provides draught power and labour under the *palle* contract described in Chapter 3) to turn a portion of their crop-share into seeds. This enables the household to enlarge or diversify its own seeds stocks, which are used to sow fields cultivated individually. The role of share-cropping in the circulation of seeds at the community level has been documented in other places. In the Mexican highlands, for example, share-cropping is mentioned as a significant way of procuring seeds (Louette et al. 1997).

In summary, in the traditional agricultural system, seeds can be accessed through six distinct means:

1. production from one's own farm
2. gifts or exchanges from neighbours or relatives
3. seed loans from within the community
4. grain payments from medium and large landowners
5. grain earned as part of a share-cropping arrangement
6. purchase from local dealers (and occasionally from other farmers)

Thus, seeds of local varieties do not always originate from a farmer's own farm: sometimes they come from neighbouring farms in the same village territory, and in the case of seed exchanges with relatives, they come from distant farms. As we will see, these transfers of seed material have a particular significance both from the point of view of system ecology and crop genetic diversity.

Since self-reliance in seeds continues to play a critical role in many parts of the Deccan Plateau, it is important to understand the meaning and value attributed to seed autonomy in the household and at the community level.

Saving seeds at the household level

'Save seeds, no matter what'. This simple formula encapsulates the wisdom passed down by mothers and mothers-in-law in the realm of seed management. A number of sayings and proverbs that are part of local oral traditions anchor the importance of saving seeds in women farmers' mind in Telangana villages. Four of them go as follows:

- "From their father, boys learn about agriculture; from their mother-in-law, [young women] learn about seed-saving".
- "Keep aside a minimum amount of seeds. You may have to start with a small quantity, but it will multiply in the field".
- "If you take out a loan in order to procure seeds, the seeds themselves will ensure that you can pay it back".
- "Even if you don't have enough grain to feed yourself, save seeds, and your will see your kids prosper".

These sayings speak distinctly of the inherent capacity of seed to reproduce and multiply. For crops like foxtail millet, farmers emphatically assert that 'a handful of seeds will give a bountiful harvest'. For crops like chickpea or pigeonpea, the seed requirement per hectare is higher, which means that larger volumes of seeds have to be saved, but the multiplication factor applies all the same. This particular quality of seeds explains why having seeds in hand is equated with having an asset. This perspective is expressed with astonishing clarity in the following words of a small woman farmer from Shamshuddinpur: 'If we didn't have our own seeds in our hands, we would simply have to leave our land fallow'.

The following seed records for two individual households of Shamshuddinpur and Kalmela concretely illustrate what it means, for small and medium farmers, to save their own seeds.[37]

Case 1.

Poshamma is a Dalit farmer from Shamshuddinpur. She cultivates 0.8 hectares of land with her husband and their three children. They have one bullock left (after selling another bullock and two buffaloes to buy land for cultivation). Every year, Poshamma produces about 70 kg of seeds for over 15 different crop varieties (Table 7).

37. The data presented in Tables 6 and 7 below were collected at the end of the 2002 rabi season, i.e. at a time of the year when seeds for the rabi crops have just been put aside, and seeds for the kharif crops have not been sown yet. The level of detail provided by women farmers is quite remarkable and it proves that farmers have a very solid mental record of the resources they manage as part of their daily activities.

Table 7. Seed stocks of a small farmer from Shamshuddinpur

Kharif crops	Quantity of seeds produced and sown		Rabi crops	Quantity of seeds produced and sown	
Greengram *Kiriki pesari* *Tiga pesari*	 6 serlu _ gidda	 9kg 0.175kg	Winter sorghum	_gidda	0.175kg
Redgram	1 adda	6 kg	Chickpea	2 addalu	12 kg
Field bean	1 ser + 1 sola	2.25 kg	Lentil	1 ser	1.5 kg
Sorghum *Tella jonna* *Malle jonna*	 5 serlu 3 serlu	 7.5kg 4.5kg	Safflower	2 serlu	3kg
Pearl millet	_ gidda	0.175 kg	Sunflower	1 gidda	0.35 kg
Roselle	_ gidda	0.175 kg	Linseed	1 ser	1.5 kg
			Mustard	_ gidda	0.175 kg
			Coriander	4 addalu	20 kg
Total		**29.77 kg**	**Total**		**38.7 kg**

Understanding grain measurements in the Telangana region

1 adda = 2 manedu = 4 serlu
1 adda (pl. addalu) = 5 to 6 kg depending on the grain
1 manedu = 3 kg 6 1 ser (pl. serlu) = 1.5 kg

1 ser = 2 solalu = 4 giddalu
1 sola = 750 g 6 1 gidda = ~ 350 g
1 charedu = a glass 6 1 chattak = a handful

Case 2.

Together with her two daughters-in-law, Sushilamma produces some 260 kg of seeds every year (Table 8). These seeds enable the household to grow 20 different crops on 2.8 ha of land cultivated by Sushilamma and her husband. They belong to the Golla community and raise a large herd of sheep, thus keeping alive the traditional occupation of their caste.

Table 8. Seed stocks of a medium farmer from Kalmela

Kharif crops	Quantity of seeds produced and sown		Rabi crops	Quantity of seeds produced and sown	
Greengram *Ganga pesari* *Kiriki pesari*	3 addalu 2 serlu	18kg 3kg	Winter sorghum	5 addalu	30kg
Blackgram	2 addalu	12 kg	Oat	1 adda	6 kg
Redgram *Erra togari* *Tella togari*	2 addalu 2 serlu	12kg 3kg	Wheat *Neela godhma* *Khate godhma*	8 addalu 6 serlu	48kg 9kg
Sorghum	6 addalu	36 kg	Chickpea	5 addalu	30 kg
Foxtail millet	1 ser	1.5 kg	Lentil	3 addalu	18 kg
Little millet	1 ser	1.5 kg	Lathyrus	2 serlu	12 kg
Finger millet	1 gidda	0.35 kg	Safflower	2 addalu	12 kg
			Linseed	1 adda	6 kg
			Chillies	1 gidda	0.35 kg
			Mustard	1 chattak	0.1 kg
Total		**87.35 kg**	**Total**		**171.45 kg**

Women's motives revealed

The motives that drive women farmers to become self-sufficient in seed emerged during a series of collective discussions and participatory enquiries. One exercise consisted of developing a matrix plotting various parameters for seed-saving (identified by farmers) against farm size (Table 9).[38] The farmers' different categories (horizontal axis) emerged through a consultative group process.[39] The category of 'marginal and landless farmers' includes people with access to tiny holdings 'of the size of an underwear' as Paramma, herself owning one-tenth of a hectare, put it. It was also the participants' decision to use five degrees of scoring (the higher score, the more important the criterion) in order to show with great precision the differential weight carried by each motive behind seed-saving and how they related to landholding size.

38. This collective work took place in Shamshuddinpur in March 2001 with 23 farmers (16 women and 7 men). The rationales for saving one's own seeds were represented symbolically along the vertical axis, using locally available materials (stones, seeds, flowers, soil....).

39. During the discussion before we made the matrix, I asked whether the reasoning behind seed-saving may be a function of caste. Several women rejected this hypothesis, arguing that seed-saving motives were closely related to the size of farm, which was why this was a major parameter in the matrix.

Table 9. Small, medium and large farmers' rationales for saving seeds

Parameters \ Categories of farmers	Marginal and landless (0 to 0.4 ha)	Small (0.5 to 1 ha)	Small to medium (1.1. to 1.9 ha)	Medium (2 to 4 ha)	Large (above 4 ha)
Crop diversity on farm	-	✓✓✓✓✓	✓✓✓✓✓	✓✓✓✓	✓✓✓
Diversity in foodgrains	✓✓✓✓✓	✓✓✓✓✓	✓✓✓✓✓	✓✓✓✓	✓✓✓✓
Ability to sow fields in time	-	✓✓✓✓✓	✓✓✓	✓✓✓	✓✓✓
Interest on seed loans	✓✓✓✓✓	✓✓✓✓	✓✓✓✓	✓✓	✓
Seed lending as a livelihood	✓✓✓✓✓	✓✓	✓	-	-
'Standing on our own feet'	-	✓✓✓✓	✓✓✓✓	✓✓✓	✓✓
Independence from the market	-	✓✓	✓✓✓	✓✓✓✓	✓✓✓✓✓

Marginal, small, medium and large farmers identify multiple and diverse incentives for saving seeds from their own harvest. These can be grouped into four interconnected objectives: diversifying crops and enhancing nutrition, overcoming agricultural constraints, deriving a livelihood from seed loans and securing a degree of self-reliance. Below is a detailed analysis of the main benefits of seed autonomy at the household level.

1. Diversity in crops and food

Detailed farmers' accounts of why seed-saving is essential to them invariably emphasise the interconnectedness between self-reliance in seed, crop diversity and nutrition. By extension, the realms of food culture and religious rituals (which entail the use of traditional crops) are also linked to seed autonomy. What is most significant about the intertwining of seed-saving, crop diversity and nutrition is that these three realms are largely under women's control. Saving seeds is their

prerogative, ensuring crop diversity on land their agenda, and preparing nutritious meals and offerings their responsibility.

While discussing the diversity of crops on their land, small women farmers frequently point out that growing such a wide range of crops would not be possible if they did not have the seeds 'in their hands'. This concern is unequivocally expressed by Manemma when she asks: 'Where would we get small amounts of seeds for our traditional crops if we did not save them ourselves?'. This question encapsulates two very fundamental issues.

First, small farmers need relatively *small amounts of seeds* for a *large number of crop varieties*: 100 g of sesame, 500 g of blackgram, 1 kg of finger millet, a handful of roselle seeds etc. Secondly, women farmers have very specific crops which they want to grow in addition to staple crops like sorghum or maize (in parts of Adilabad). There is no guarantee that outside seed agencies can provide them with seeds for all these crops. Therefore, the surest way—and perhaps the only way—of accessing these seeds is to save them from one's own harvest. This logic is upheld not only by most small farmers, but also by many medium-scale farmers like Sushilamma. Thanks to their seed stocks, women farmers can maximise the number of crops grown on their land, and thus produce grains for a varied and nutritious diet.

2. Maintenance of local seed selection practices

By selecting their own seeds, farmers can ensure that crop characteristics meet their own specific needs. During collective discussions in Shamshuddinpur, Anjanna, a Golla farmer, asked: 'How can we select the best seeds if we do not keep our own seeds?', giving two examples to illustrate his point. Since *Malajonna*, a local sorghum variety, is susceptible to charcoal rut disease, it is important while selecting seed earheads to discard those affected by the disease. Likewise, in crops like pigeonpea and chickpea, farmers need to be able to select seeds from plants that are the most resistant to damaging pests.

Seed selection can also help farmers meet specific needs. For example, in certain varieties of pearl millet there a small spikelet at the tip of each grain which makes it difficult for birds to nibble away at the earheads. A farmer growing pearl millet in an isolated location may try to select grains that have long spikelets to protect his crop from birds. In an area where everyone grows pearl millet, and where children regularly spend time in the fields to watch over the crop, earheads with long spikelets may not be so essential.

3. Sowing at the optimal time

Saving one's own seeds is often the only way of ensuring that fields are sown on time. As Narsamma plainly puts it, 'Once the time is gone, there is no more point in

sowing'. Seed loans from other farmers are rarely availed of on time, as these farmers only give seeds away once their own sowing is over. This makes the position of seed-borrowers somewhat precarious. Buying seeds depends on the monetary status of the household and on market dynamics (farmers often complain of late supplies and rising prices at the time of sowing). Late sowing has serious consequences. According to Bichappa, a 15-day delay in sowing invariably leads to a significant drop in yield for three reasons: the upsurge of pest attacks coinciding with crucial stages of plant growth, the greater vulnerability of plants to diseases and the concordance of the flowering stage (of pulses especially) with seasonal rains, causing damage to the flowers and leading to a decline in yields.

4. Building up seed capital

When asked whether they ever refuse to give seed loans, women farmers give an astonishing answer: 'Why should we?! Don't we get twice the quantity back?'. This answer sums up one of the main 'engines' behind the local seed economy in villages like Shamshuddinpur. Once seeds have been cleaned and sorted, they become a genuine asset in the hands of women farmers. A surplus of seeds can be given away as a loan that will be reimbursed in grain at the end of the season.

Although all types of farmers exchange seeds (with some variation depending on landholding size, social belonging, etc...), small and medium farmers are the most involved in these transactions (both at the giving and the receiving ends). Amongst marginal farmers and landless households, some virtually turn seed-making into a skilled trade which they use to increase the meagre quantity of foodgrains they rely on for their subsistence. In this way, the act of lending seeds becomes an additional source of livelihood.

5. Autonomy as an asset for small farmers

One of the strongest reasons for farmers to save their own seeds is undoubtedly the desire to be self-reliant. This eliminates the need to depend on other farmers or on the market for seeds. For a small farmer like Tuljamma, who farms a 0.4 ha plot, 'even buying a single *ser* [1.5 kg] of seeds is very difficult'. Hence, saving seeds is vital in order to keep her land productive. Moreover, seeds represent an asset that women have control over, unlike money: 'Money doesn't last, but seeds *do* remain with us' says Narsamma. Dalit women farmers find it especially important to 'stand on our own feet' by being self-sufficient in seeds, so as to be spared the trouble of having to ask upper caste farmers for seeds in case of shortage.

Medium and large farmers have different reasons for being self-sufficient in seeds: without seeds of their own, they would have to spend large amounts of money in order to sow their land.

'Seeds kept like a secret': women's custody of seed stocks

That seeds are the domain of women farmers is by now quite well established. Far from merely being a manual activity requiring time and labour, the production and management of seeds entails a number of skills, responsibilities and strategies on the part of women, such as:

- knowing precisely the volume of seeds required to sow the family holding
- producing seed from harvested grain for each cultivated variety
- ensuring that seed stocks remain intact until the following cropping season
- before the sowing season, checking the health of seeds and testing their germination capacity (for some crops only)
- borrowing seeds from other farmers if necessary
- taking seed samples to the local deity
- preparing seed bags corresponding to the crop mixes to be sown in each field
- after harvest, returning adequate quantities of grain for each seed type borrowed

Depending on needs and opportunities, individual seed management strategies either serve to enlarge and diversify seed stocks, secure the household's seed autonomy or generate a livelihood.

We have seen earlier that farmers prepare seeds from their own crops, but also from grain received as payment. Interestingly, small women farmers explain that if a landowner offers either sorghum earheads or grain as a wage for a day's work, they invariably choose earheads, in order to carry out a more complete seed selection process. Another reason for opting for full earheads is that they end up getting more grain than they would by accepting payment in grain. Women farmers also say that when there is a shortage of greengram seeds in their homes, for instance, they deliberately seek work in a field where greengram is being harvested. The grain payment will give them a chance to prepare greengram seeds.

Once seed lots have been produced and stored, farmers are faced with another challenge: keeping these stocks intact. For farmers whose landholding does not provide for the family's yearly needs in foodgrains, the temptation to turn to seeds in times of food scarcity is quite high. A popular saying relates to this situation: 'Even if you have to go to bed hungry once, do not feed yourself on seeds. Never use seeds to prepare food'.

Yet when farmers have to decide whether to go hungry, to borrow grain or buy it on credit, or to use stored seeds as food at the risk of not being able to sow their land the following season, their decision is largely a matter of individual ethics and choice. When faced with food scarcity, Bichamma and Sangamma, both small Dalit

farmers from Shamshuddinpur, adopted different strategies. Bichamma has always been able to save her seed stocks. To meet immediate food needs, she has borrowed grain locally. Sangamma, on the other hand, has broken open her seed baskets more than once in the past to feed her family. But interestingly, in recounting these instances she is quite apologetic, emphasising the fact that she was influenced by her husband, whose words she quotes: 'Break open the basket and make *pappu*. We'll see what to do tomorrow. The kids cannot go without food'. She complains that men only ask about seeds when the sowing season comes. In other words, the responsibility for ensuring that seed baskets remain intact solely rests with women, who are well aware that consuming seeds completely lacks common sense as it exposes the family to future problems. As Sangamma puts it, 'we know that if we break open our seed baskets to eat the grain, we will have to borrow seeds to sow our fields and then pay back these loans with double the quantity of grain'.

Most women find it advantageous to be the sole managers of seed stocks. Grain and seeds are very much a part of the domestic sphere controlled by women. They use various strategies to maintain this control, including concealing information from their husbands. The notion of 'not giving the exact information' in order to safeguard the freedom 'to do as we please' repeatedly comes up during discussions held in the absence of men.

Amongst the 42 women farmers I interviewed about seed management strategies in four villages (Sattmoori, Pipri, Kalmela, Shamshuddinpur), 28 stated that seeds are their exclusive responsibility and that they do not always keep their husbands informed about how much seed they are saving. 'If I keep aside two *addalu* [12 kg] of seeds, I'll tell my husband that I've prepared one *adda*; that way I can give the other *adda* as a seed loan without telling him' explains Tuljamma. In well-off households, women do not generally feel the need to conceal information about grain and seed stocks from men. This difference highlights that each measure of grain represents a much higher stake in poor households than wealthy households.

Small women farmers' testimonies led a male observer witnessing a collective discussion in Pipri to declare that 'women keep seeds like a secret'. This astonishing commentary exposed, in a nutshell, the magnitude of gender relations in the management of crop diversity and seed stocks.

Securing bargaining power in the household

By shouldering the responsibility for grain and seed, women undeniably gain status and credit in their household and communities, regardless of their socio-economic status. They are respected for this major contribution to the household economy.

Seeds are one of the rare resources over which women farmers exert direct and uncontested control. Seed stocks are a bargaining chip for women to use in intra-

household negotiations over land use. The relationship between control over plant resources and negotiated authority in the household is highlighted by other studies on gender relations in various parts of the world. In Himalayan regions of north India, 'older women talk with pride about how it was their expertise in differentiating the various qualities of seeds, of knowing which ones would be saved for the next season's sowing and which used for consumption, that often helped their families through difficult times. Their knowledge constituted a major contribution to production and was one acknowledged as such' (Mehta 1996).

In the high plains of Central Anatolia in Turkey, 'women attempt to enlarge their area of influence within the household and in the society through their knowledge of plants', and they draw on their activities of wild plant gathering and use in order to negotiate and expand their social space (Ertug 2003). More generally, it has been argued that 'in studies that reveal the sex of resources managers, women are shown to be the primary managers of plant resources, and their ability to promote and perpetuate the resources that are essential to survival brings them high status and respect' (Turner 2003). This statement cannot however be extrapolated to all societies and all contexts. Based on a review of a large body of literature on gender relations in plant diversity management, Patricia Howard argues that 'the relationship between women's knowledge, their position as specialists and their social status is not always straightforward' (Howard 2003). Furthermore, the shifts in women's status in relation to the erosion of biodiversity need to be accounted for.

Because of their control over seeds, women farmers can use seeds to implement cropping strategies that help fulfil their own vision of agriculture. Sushilamma (whose seed records are presented in Table 7 above) is one of many women farmers who take pride in storing seeds for up to 20 dryland crops in their own home. These diversified seed stocks enhance women's influence in household decision-making processes related to cropping patterns. They empower them to make independent decisions on the use of these resources.

Seed loans are not merely a way of marginally increasing seed stocks. The acts of giving and lending are part of a wider strategy implemented by poor women to maintain and preserve the solidarity networks on which they critically depend. A similar attitude towards giving is displayed by rural women in Anatolia (Turkey):

> Women create networks among their kin and with neighbours to be able to obtain reliable help when needed… These networks are not limited to the village but may also extend to friends and relatives outside the region. Freshly collected wild plants, garden products and home-made goods are given as gifts to maintain these ties. Through presents and frequent visits, women maintain relationships between various families within and outside their communities, at the same time extending the necessary information channels within their society (Ertug 2003).

There is a growing body of literature on women's autonomy, gender relations and bargaining power at the household level. According to Bina Agarwal, women's ability to make autonomous decisions and to put their viewpoint across in the management of household assets and goods depends on their fall-back option, such as individual assets or sources of incomes (Agarwal 1997). In the absence of direct control over property, land, capital and money—something that should be relentlessly questioned—it is essential that women retain their control over foodgrain and seed stocks.

The localised seed economy

Women's household level seed work merges with practices of seed exchange at the community level to form a 'localised seed economy'. Local exchange of seeds, seedlings and plant material is not confined to the Indian sub-continent, but is widely practised in many agrarian societies (Synnevag 1997). Farmers in Mexico, for example, exchange maize seeds within their own communities as well as throughout a wider region, which explains why up to 25 maize varieties can be cultivated in a single village (Louette and Smale 2000).

Seed loans are managed and regulated through social sanctions (see below). Wherever it exists, the system of local seed transactions provides farmers with a local and non-monetarised source of seeds.

Three major reasons account for seed exchanges: a shortage of seeds after a poor harvest, the damage caused by storage pests to individual seed stocks, and the desire to obtain and try out a new variety. In a given community, up to two-thirds of landowning households may be involved in seed transactions. For instance, we estimated that out of the 160 households comprising the Shamshuddinpur community, approximately 120 partake in the local seed economy, as givers, as takers, or as both givers and takers of seeds. These transfers of resources promote social networks based on reciprocity and cooperation that extend far beyond kin and caste relations.

Customary rules of reciprocity

While gifts of seeds essentially take place amongst relatives and close neighbours on the Deccan Plateau, seed loans transcend kinship relations and extend to virtually all social groups in a given community. Caste is not a primary determining factor either: low-caste farmers frequently turn to higher caste farmers to ask for seeds, and the opposite is also true, although it is less frequent. Existing networks of social relations count more than caste in defining the basis of the local seed exchange system. These networks are founded on notions of reciprocity and trust, and many social bonds cut across caste by linking, for instance, a landowning household, a

family of tenants and the labourers who regularly come forward for work opportunities. Moreover, in a village, everyone knows whose fields are well tended, whose crops come up well and whose seeds are healthy and well-preserved. These observations guide women farmers when they need to borrow seeds.

Women are largely—but not exclusively—responsible for acquiring and repaying seed loans. In many rural societies, the exchange of seed material is a woman's role, as for instance exchanges of cassava cuttings in Brazilian Amazonia (Boster 1996). Well-established rules regulate these transfers of plant materials, which are repaid in cuttings or in products like cassava flour.

On the Deccan Plateau, the local seed economy is governed by customary reciprocity rules which everyone is expected to abide by. The repayment of seed loans take place in accordance with two distinct 'protocols': *nagu* and *deedi*. The crops falling under the *deedi* regime are essentially *rabi* crops (chickpea, lathyrus, lentil, field pea and wheat), characterised by a lower yielding capacity than *kharif* crops. Seed loans of sorghum varieties (including *saijonna*, the *rabi* sorghum) and all *kharif* crops are governed by *nagu*. Two measures of grain must be returned after harvest for every measure of seeds borrowed in the case of *nagu*, and one and a half in the case of *deedi*.

Abiding by these rules is quite straightforward when crops grow and mature well. Yet the uncertainty inherent in dryland climates leads to relatively frequent crop failures, which put farmers who borrow seeds in a difficult position.

In the event of a mediocre harvest, the seed lender may accept grain of a similar value for crops like sorghum, greengram, blackgram, roselle (blackgram for greengram, wheat for sorghum...). But for grains considered to be of higher value, like chickpea or pigeonpea, it is generally not acceptable to return any other grain. Hence, either the loan has to be repaid in grain purchased from the market, or the debt gets carried over to the following year. This prospect is dreaded by small farmers because of the compelling arithmetic of the *nagu* and *deedi* rules. In the case of *nagu*, four measures (2 x 2) will have to be returned and three (1.5 x 2) in the case of *deedi*. Thus, with every new cropping cycle, the debt burden increases.

Small farmers are well aware, when they borrow seeds, of the risk of a compounded seed debt. They have vivid memories of hardships caused by the inability to repay seed loans in the community. In Shamshuddinpur, everyone remembers a Village Committee ruling ordering a family to transfer part of its land to its seed-lender in compensation for an outstanding seed debt. The seed-lender acquired a temporary right of cultivation on these fields in order to make up for the seed – and crop – losses incurred. This memorable case now forms part of the oral history of the community. Large seed debts are more commonly settled in grain and sometimes by giving an animal (Box 27).

27 When seed debts get out of hand

Here are a few of the stories circulating in Shamshuddinpur which remind farmers that saving one's own seeds remains the safest and most viable option!

- Long ago, a farmer borrowed 8 *addalu* of chickpea. For two successive years rains were scarce and he did not harvest any grain. After two years he had to give back 18 *addalu* (8 + 4 = 12, 12 + 6 = 18 *addalu*), a huge quantity of grain (108 kg).
- In need of chickpea seeds, Ramulu and his wife took 6 *addalu* (36 kg) of seeds as a loan. They were therefore supposed to return 9 *addalu* (54 kg), but they only had 8 *addalu* and 2 *serlu* (51 kg) in hand to give back. The *deedi* rule applying, the pending 2 *serlu* became 3 *serlu* the next season (4.5 kg), and subsequently 1 *adda* + 1 *sola* the following year (6.75 kg). Only on that third year was the family finally able to return the seeds thanks to a good harvest. This instance illustrates a rather compelling law at work, the law of *deedi*, which though imperious, is not quite as exacting as her sister *nagu*, as the following story illustrates.
- Mogullappa had brought a bag of groundnut seeds from Hulgera, a nearby village. The bag contained roughly 15 *addalu* of seeds, so he and his wife were meant to return 30 *addalu* of groundnut, since groundnut comes under nagu. Yet a dry spell set in after the sowing period, and their crop dried out. The 30 *addalu* of grain to be given back to the lender thus became 60 *addalu*. One more year went by, and the debt clearly went beyond the family's capacity to settle its seed debt from its own harvest. Nor did the household have enough money to purchase enough groundnuts to pay back the Hulgera farmer. In the end, the latter demanded a bullock in compensation for the lost seeds. The bullock had to be handed over. 'From that time onwards', concludes Kamlamma, Mogullappa's own daughter-in-law, 'we have made it a point to always save seeds in our family'.

As constraining as they may be for small farmers, the seed exchange protocols help maintain the dynamics of seed transfer at the community level since, as we will now see, seed-givers earn substantial interest in kind.

Village seed transactions

Although a number of ethnobotanical studies mention the existence of seed exchange practices, only a few offer a thorough analysis of the nature of these exchanges, despite their obvious relevance from an agronomic and socio-cultural viewpoint.[40] In this section I try to understand how a farmer-managed seed economy works and to draw out some of its major benefits and drawbacks in terms of biodiversity use, social capital and environmental sustainability.

40. See for instance Rhoades, R.E. (1990), "Potatoes: genetic resources and farmer strategies. Comparison of the Peruvian Andes and the Nepali Himalaya", in K.W. Riley, N. Mateo, G.C. Hawtin and R. Yadav (eds.), *Mountain Agriculture and Crop Genetic Resources*, Oxford and IBH Publishing, New Delhi, pp. 293-304.

On the Deccan Plateau, the involvement of a household in the localised seed economy depends largely, but not solely, on its economic status. Small farmers undoubtedly make up the bulk of seed borrowers, but seed transfers within a village cannot be understood by considering this trend alone. Certain households contribute to this informal economy by lending seed; others systematically borrow seeds in order to fill the gaps in their own seed stocks, and many are engaged both at the giving and at the receiving ends (Table 10). It is interesting to observe that even in Brazilian Amazonia, similar trends characterise the exchange of cassava cuttings. In the local dynamics of plant material transfers, 'certain families never interact, others are in position to give cuttings and others are constantly in need, thus defining "sources" and "wells"' (McKey at al. 2001).

Table 10. Different seed strategies adopted by various categories of farmers

Seed strategy	Category of farmers	Reasons given for the strategy adopted
Those who readily give seeds on loan	Medium and large	Long family tradition of seed-keeping and lending
	Medium	Have a seed surplus after finishing their sowing
	Small and marginal	'If we give seeds, we get twice the quantity of grain in return'
Those who never give seeds on loan	Small and large	'Our seed stocks are barely sufficient to sow our own fields'
	Small, medium or large	'If we give seeds of chickpea and get sorghum back, we lose out. Why should fight over seeds?'
Those who borrow seeds frequently	Small and marginal	Shortage of seeds due to a poor harvest
	Marginal, small, medium or large	Stored seeds have been damaged by pests or rats
	Medium and large	Wish to cultivate a known variety that was not grown in the previous year, or an unknown variety
Those who avoid borrowing seeds	Small and marginal	'Our own seeds are good. They meet our needs'
		'Seed loans are not available when you need them'
		In the event of crop loss, it is difficult to pay back the seed debt

We now turn to a more detailed analysis of the 'supply' and 'demand' components of the non-monetary seed economy in the Telangana region.[41]

41. This section is based on a detailed study of the seed strategies of 34 households (belonging to all categories, but with a majority of small farms) in the villages of Shamshuddinpur and Kalmela, in Medak district.

Who lends seeds?

In villages where local crop varieties are still widely grown, a few families are well-known for their skill and success in seed-keeping. Most of the time, these families tend a significant amount of land (between 3 and 8 ha on average) and they grow a wide variety of crops. In Shamshuddinpur there are three such families, all belonging to the Golla caste. The women of these households are respected throughout the community for their skills and knowledge in seed-keeping, and other villagers—regardless of their caste—know that they can turn to them for seeds.

Other medium and large farmers may or may not choose to take part in the local seed economy (as shown by the table above). Some households, like those of Lalamma and Balvanti in Kalmela, readily lend seed. Others deliberately keep away from such transactions. Several Muslim households from Kalmela appear to follow this principle. Mahabub, the head of a large family, explains their unwillingness to lend seeds: 'Why should we give, why should we fight?', and he adds 'Say we give seed to someone and they don't return it[after harvest]. We'll have to go and start a fight'. Interestingly, his old mother, who has always been in charge of seed-keeping in the family, recollects giving seeds only to very close people, when her husband was still alive. 'We used to give seed on a one-to-one basis", she recalls. In other words, they did not apply the *deedi* and *nagu* rules.

Apart from medium and large farmers, marginal and small farmers also play an important role in the informal seed economy. What sets them apart from the more reputed 'seed-keepers' of the community is that for them, giving seeds is a matter of livelihood more than it is a matter of status. Unlike larger farmers (who generally have more fertile lands, plus cattle and sheep), small farmers have few assets, and some see their seed stocks as capital which can be used to invest in grain.

In Shamshuddinpur, out of ten small farmers, seven regularly give small seed loans. One of them is Tuljamma, who is convinced that her household benefits from these loans. For virtually every crop, she saves a lot more seeds than she needs for her own 0.4 ha land. In all, she gave seeds to 15 people in 2001. The volume of grain which she has earned amounts to approximately 30 kg. This is not a huge quantity, but it translates into significant savings on monthly expenditures, especially in the case of costly pulses like pigeonpea. This explains why small women farmers—who have very limited access to cash—favour this practice.

As we saw earlier, landless households and marginal farmers also engage in the local seed economy. According to estimates from farmers in Shamshuddinpur and Kalmela, out of five landless (or near-landless) families, at least one lends seed (Box 28). This practice has a particular significance for female-headed households, like that of Paramma, who lives with one of her daughters and three grand-daughters (one of whom takes care of small herd of goats). The grain the two adult women produce on

28 Seed loans: a source of livelihood for landless and near-landless households

Hanumamma is an old lady from the Golla community of Shamshuddinpur who now lives with one of her four sons and his wife, Narsamma. Her husband was a weaver and she has always worked in the fields. They sustained themselves and their eight children by cultivating a very small plot of land and by working as daily labourers. They were one of the poorest households in the community. Since farm labour was always paid in grain (sorghum, field bean, blackgram, redgram, groundnut or any other crop grown by the landlords), Hanumamma developed the habit of selecting seeds out of that grain so as to lend seeds to anyone who asked for them. She remembers giving out four large bags of groundnut seeds one year. She also used to sell some of the sorghum earned from her farm labour. These activities helped the family avoid severe food shortages.

Her daughter-in-law Narsamma is keeping up these practices. Today, she does most of the work involned in the 'making of seeds', although Hanumamma continues to keep a close watch over seed stocks.[42] The family has recently leased a 0.8 ha field where they grow a large range of crops.

Narsamma's seed transactions are quite impressive, both in terms of the range of crop varieties handled and the number of people to whom the two women supply seeds (Table 10). In 2001, Hanumamma and Narsamma handed over more than 50 small seed loans to other farmers. This makes them one of the most active households in the village seed economy.

This case clearly demonstrates the ingenuity and skilfulness with which poor households have been able to turn seed transactions into a living. Whether they will be able to continue to do so largely depends on future agricultural and seed policies and on the imagination of policymakers in enhancing these skills and efforts to secure the livelihood of the least-endowed female-headed households.

their 0.2 ha plot and earn by working in other people's fields is a source of food, revenues and work. Paramma summarises their activities thus: 'We eat the grain, we sell it, we turn it into seeds and if anyone asks, we give seeds [on loan]'. The returns from their seed loans are used as foodgrains as well as for producing more seeds.

The contributions of small and marginal farmers to the village seed economy can be quite significant, as revealed by Narsamma's seed records (Table 11). During a collective discussion on seed-saving practices in Shamshuddinpur, several people pointed out that marginal farmers are perhaps the most reliable seed-keepers as they give seeds 'at the right time'. This is because, unlike medium and large farmers, they do not have to sow their own fields first.

42. I was lucky to be able to meet Narsamma, who was very eloquent in explaining why she lent seeds, and could very easily remember what kinds of seeds she had given, and to how many people. Eliciting such precise information from farmers is not always so straightforward. For instance, it proved almost impossible to get a complete picture of Paramma's seed-related activities: the processes of sorting and selling grain, and storing and lending seeds were so obvious to her that she could see no point in further inquiries!

Table 11. Multiplying seed stocks and loans: the strategy of resource-poor households[43]

Crop (and name of local varieties)	Quantity of seeds produced	Quantity of seeds sown	Quantity of seeds given on loan	Source of seeds – Harvest	Source of seeds – Wage	Number of beneficiaries
Kharif crops						
Kharif sorghum	5 addalu	6 serlu	4 addalu + 2 serlu	✓	✓	3
Foxtail millet	6 serlu	1 ser	5 serlu	✓	✓	5
Pearl millet	1 adda	2 serlu	2 serlu	✓		2
Finger millet	4 solalu	1 sola	3 solalu	✓		3
Greengram *Pacha pesari* *Tiga pesari*	6 addalu	2 addalu 1 sola	4 addalu 2 serlu	✓	✓	4 2
Blackgram	6 addalu	1 adda	5 addalu	✓		5
Pigeonpea	3 addalu	1 adda	2 addalu	✓	✓	4
Field bean	2 addalu	2 serlu	6 serlu	✓		3
Horsegram	4 serlu	1 ser	3 serlu	✓		3
Cowpea	2 serlu	1 sola	3 solalu	✓		3
Roselle	2 serlu	1 sola	3 solalu	✓		4
Rabi crops						
Rabi sorghum	5 serlu	1 ser	1 adda	✓		2
Chickpea	8 addalu	3 addalu	5 addalu	✓	✓	2
Coriander	4 addalu	-	4 addalu		✓	1
Safflower	2 addalu	1 ser	7 serlu	✓		4
Linseed	2 serlu	-	2 serlu		✓	1
Chillies	1 gidda	1 gidda	-	✓		0
Mustard	1 chattak	1 chattak	-	✓		0

43. See Appendix 4 for conversion of local units into kilograms

Table 12. Seed loans as a remedy for seed shortages: Bhujamma's case

Crop (and name of local varieties)	Quantity of seeds produced		Quantity of seeds taken on loan		Source of seeds – Harvest	– Wage	Origin of seed loans
Kharif crops							
Greengram *Neela pesari* *Kiriki pesari* *Tiga pesari*	5 serlu 1 ser 1 charedu	7.5kg 1.5kg 0.25kg	-	-	✓	✓	
Pigeonpea	-	-	4 serlu	6kg			Neighbouring village (bought)
Blackgram	-	-	2 serlu	3kg			Balamma, friend and seed-keeper
Cowpea	1 gidda	0.35kg	-	-	✓		
Field bean	1 chattak	0.1kg	-	-	✓		
Roselle	1 chattak	0.1kg	-	-	✓		
Sesame	-	-	1 gidda	0.35kg			Balamma, friend and seed-keeper
Eggplant	10 seeds		-	-	✓		
Tomato	-	-	8 plants				Neighbour
Chillies	-	-	1chattak	0.1kg			Neighbour
Rabi crops							
Rabi sorghum	1 ser	1.5kg	-	-		✓	
Chickpea	-	-	4 addalu + 2 serlu	27kg			Landlord Kapu Hanumantu
Safflower	-	-	2 serlu	3kg			Landlord Kapu Hanumantu
Mustard	1 chattak	0.1kg	-	-	✓		
TOTAL	**11.4kg**	**39.45kg**					**4 sources**

Who borrows seeds?

Seed shortages—for one or several crop varieties—are a frequent problem for small and marginal farmers. In villages where the local seed economy has not been undermined by commercial practices, the main remedy for seed shortages lies in borrowing seeds from other farmers. This is illustrated by Bhujamma, who only managed to produce just over 11 kg of seeds in the 2001-2002 season. As a result, she had to borrow nearly 40 kg of seeds (with a large proportion of chickpea and sorghum) to meet her needs (Table 12).

Medium and large farmers also occasionally resort to seed loans. Tukamma and Hashappa, who cultivate 3 ha of black land and rear four bullocks, three buffaloes, a cow and a calf, are a good example. One of the well-to-do households of Kalmela, they also happen to be one of the rare families growing hybrid sorghum, for which they obtained seeds through another farmer. Just prior to the 2001 *kharif* season, Tukamma brought seeds of greengram and blackgram from Sattyaram, her mother's village. They also had to borrow seeds for chickpea, because they did not grow chickpea in the previous *rabi* season. They had to approach four different people (including two Dalit families) to get the full 10 *addalu* (above 50 kg) needed for their land.

Local seed systems and sustainable rural livelihoods

That farmers give and take seeds from each other, for dozens of crop varieties, without any money changing hands, is extremely significant for ecological, economic, social and cultural reasons (Figure 6).

First, this seed economy allows the dryland farming system to continue to evolve and adapt to the local environment. The continuous exchange of seeds for local crop varieties circulates genetic resources from one field to another within a village territory and beyond. Gene flows in turn enlarge the variability and adaptability of crops in a given region. Research findings on the genetic make-up of cassava varieties in Amazonia demonstrate the positive impact of local exchanges of cuttings and regional circulation of varieties on varietal diversity (McKey 2001). The dynamic management of genetic resources enhances the stability of traditional agrosystems, increases the adaptation potential of local crops to evolving environmental conditions and limits the risk of genetic erosion.

Moreover, seed transactions play a role in ensuring that no-one leaves their land fallow for lack of seeds, thus ensuring that arable land is cultivated regardless of individual farmer's investment capacity. Again, there are benefits associated with this, as growing well-adapted crops is one of the most efficient ways of avoiding soil erosion and increasing the soil's organic matter content and water retention capacity.

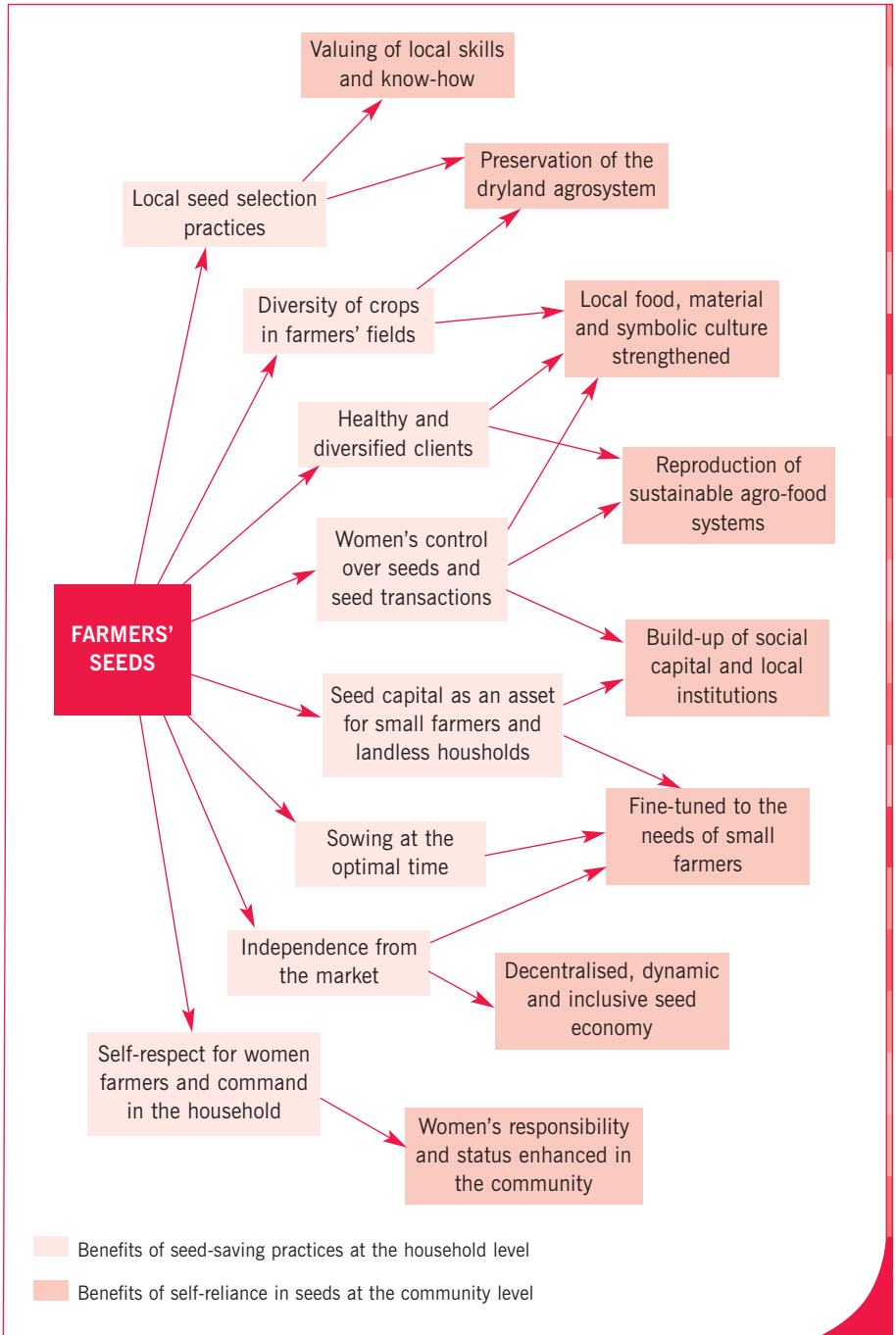


Figure 6: The virtues of self-reliance in seeds at the household and community levels

Overall, the local seed economy therefore reinforces the ecological balance between climate, crops and soils, thereby countering the instability inherent in semi-arid regions.

Dryland crops also lie at the root of the region's traditional diet and food culture, a culture which women reproduce and nurture. Indirectly, then, the local seed economy strengthens the transmission, from mothers to daughters, of skills in seed production, grain processing and food preparation. Through teaching and learning, knowledge, skills and technologies change, adapt and evolve. As long as seeds and other primary inputs like manure and pest-control agents are produced by farmers, the community retains control over these resources and over the innovation processes associated with them.

By emphasising the importance of selecting their own seeds, farmers express a desire to shape their crops according to their own criteria and constraints. This concern reflects an intuitive understanding that to forgo seed selection is to surrender the capacity to make crucial decisions about farming systems. More broadly speaking, self-reliance in seeds enables farmers to use their own observations and skills to meet dietary and other needs and in finding answers to the challenges of dryland agriculture. However, this does not preclude collaboration between farmers and breeders from the formal sector in participatory plant breeding. Indeed, this could help to enhance and enlarge the genetic pool available to farmers.

Furthermore, the local seed economy amounts to the most decentralised seed supply system that can be imagined. If a farmer faces a seed shortage, she or he is sure to find a source of local seeds within the community itself. A study of seed exchanges in Mexico showed that farmers find security in the knowledge that the maize varieties they do not cultivate themselves are still available as someone in the community or in the region grows them (Louette et al. 1997).

Seed transfers thus help individual farmers and they also strengthen social ties in the village: farmers rely on each other for seeds. Although large farmers—especially those who act as money-lenders—have historically tended to have the upper hand in seed transactions in rural India, small farmers also contribute to the local seed economy and inter-caste or inter-class seed transfers are very frequent. Thus, in spite of the significant social and economic disparities within rural society, for local seeds there are no pre-determined inequalities: the community as a whole is in control of the genetic variability contained in its seeds, and there is no scope for its appropriation by a single group.[44]

44. However, there is a risk of appropriation of crop genetic resources by external agencies through commercialisation or the imposition of intellectual property rights. Numerous such cases have been reported in several countries including India, and they are being addressed through various legal and institutional measures. These include the establishment of Community Biodiversity Registers (Andhra Pradesh Coalition in Defence of Biodiversity), the creation of a digital database on traditional knowledge (Council for Scientific and Industrial Research) and the development of agreements and laws that recognise and protect the rights of local communities over their own resources, like the Model Law of the Organisation for African Unity (2000).

In parts of the Deccan Plateau where the traditional diversity-based cropping pattern still prevails, farmers estimate that at least 20% of all landless and small farmers derive some degree of livelihood from seed loans to other farmers. This means that local seed economies play a certain role in securing a livelihood for the poorest, and that, consequently, quite a significant number of families have a special stake in the persistence of the informal seed domain.

In other words, the localised seed system helps build social capital at the community level. As shown by Bina Agarwal, rural women in India heavily rely on social relationships with kin and with villages outside the kin network, as these 'provide economic and social support that is important to all rural households but especially to poor households and to the women. This includes reciprocal labour-sharing arrangements during peak agricultural seasons; loans taken in cash or kind during severe crises such as droughts; and the borrowing of small amounts of foodstuffs, fuel, fodder, and so on, even in normal times' (Agarwal 1999).

And last, but not least, the local seed economy largely falls under women's sphere of influence. Women farmers use seeds to meet their own agenda, in terms of farming, nutrition, and livelihood, and in the process, imbue this resource with social, cultural, spiritual and economic meaning.

The many testimonies by small women farmers presented here show that in order to make their land productive and to feed their families, they opt for small amounts of seeds for many dryland crops. Dynamic local seed economies enable small women farmers to fulfil this vital agenda in the most reliable manner, without sacrificing the ecological balance of their fragile environment, and without generating economic demands that can only be met through credit and debt. This is why farmer-centred seed systems are one of the backbones of agrarian economies throughout the world.

In fact, seed self-reliance at the community level may well be the only way for small women farmers to practise farming that provides sustenance and gives them some autonomy in the economic, cultural and, by extension, political spheres. This underlines the absolute necessity for local seed economies to continue to exist.

Impact of commercial seeds on society and livelihoods

Studies of the adoption of improved and hybrid seeds generally paint a bright picture of the benefits of new crop varieties to farmers in terms of productivity per hectare, income or resistance to pests and diseases. The 'adoption' of new technologies is assumed to be a positive phenomenon for all farmers, regardless of class, caste or gender. In reality, there are few detailed studies of the wider socio-economic impact of the introduction of new crop varieties into farming systems, and gender-disaggregated data in this domain are extremely rare.

Yet a small Dalit woman farmer and a large-scale high-caste male farmer are bound to have different experiences with a new technology. The constraints faced by farmers and their ability to deal with new risks largely depend on their socio-economic status. Moreover, the decline of traditional systems of resource management, exchange and social support affects farmers from different categories in different ways.

'Like sowing in water': The problem with commercial seeds

In most villages on the Deccan Plateau, localised seed systems co-exist with the formal commercial seed system. Farmers rely on the latter for high-yielding varieties of greengram, blackgram, pigeonpea and, more importantly, for hybrid varieties of cotton, sorghum, maize, chillies and a range of vegetables. Farmers from Nawabpet give several reasons for their increasing use of purchased seeds:

1. 'better yields': the single most important factor given for switching over to commercial seeds, especially rice, chillies, piegonpea and maize
2. higher income from the sale of the crop in the market in the case of high-yielding rice varieties (farmers report a difference of about 800 kg per hectare between local varieties and improved varieties)
3. availability of credit to buy seeds and fertilisers
4. lack of alternative sources of seeds for purely commercial crops like cotton

However, farmers who have been using commercial seeds for a number of years have become aware of their drawbacks. One of the main issues of concern is the difficulty getting hold of commercial seeds. The need to purchase these seeds imposes a whole series of constraints on cash-poor farmers, i.e. on the majority of cultivators, as a small woman farmer from Vaizhapur explains:

> To start off, we have to go to the Saukar [money-lender] and ask him for a loan. Then we have to go to the city to buy seeds and fertilisers. Sometimes we have to wait in line. After harvest, there are credits to be reimbursed and interests to be paid.

Purchasing seeds is almost like opening a Pandora's Box for small and marginal farmers who face multiple constraints in accessing and using these seeds.

1. 'Buying seeds is always difficult for small farmers like us'

The cost of seed is the first obstacle. To sow one hectare of hybrid sorghum, farmers have to spend about Rs 500 on seeds. For one hectare of hybrid cotton, the seed cost varies between Rs 1,000 and 2,000 depending on the quality of the seed and time of purchase. Farmers report an increase in the price of seeds prior to sowing season, when farmers need seeds most. The cost is as high as Rs 3,600 for one hectare of transgenic Bt cotton seeds, which suggests that with the

introduction of GMOs, large increases in seed cost are inevitable. Seed companies could easily play havoc with farmers by limiting supply and thus create an artificial situation of seed scarcity where farmers have to purchase seeds at exorbitant rates.

2. **'Market seeds only make you happy once'**

Another drawback of market seeds is that, as a large farmer from Pastapur puts it, 'they only make you happy once', i.e. when you sow them for the first time. This is true, to some extent, of improved varieties that need to be renewed every two to three years, but this remark pointedly applies to hybrid seeds, that cannot be re-sown. The obligatory yearly seed expenditure associated with hybrid seeds increases the economic burden on small farmers, and reinforces their dependency on money-lenders and input dealers.

3. **'Sowing these seeds is like sowing in water'**

A common perception of commercial seeds amongst women farmers is that they are not reliable. In Bhoraj, Gangamma speaks emphatically about this problem: 'Sowing these seeds is like sowing in water. You can never be certain that the seeds will grow'. In Gangamma's village, every farmer has either heard about or had a bad experience with market-bought seeds. Sometimes the seeds do not germinate properly. Other times, many plants fail to flower and fruit properly, leading to drastic declines in yields. Such problems are recurrent with low quality or 'spurious' seeds marketed by small seed companies. Some of these are referred to as 'fly-by-night' companies: the seed outlets disappear overnight and farmers have no-one to turn to when they realise that they have bought poor-quality seeds (there are reports of seed outlets bagging grain to sell it as seed).[45]

4. **'If we go to a shop wearing these [shabby] clothes, we are sure to get second rate seeds'**

This remark by Poshamma, a small woman farmer from Bhoraj, points to the fact that poor people have little bargaining power when it comes to buying inputs from dealers. First, they cannot afford to buy the 'high quality' branded seeds that large farmers buy, and which tend to give better results. Secondly, being largely illliterate, they are unable to read labels or identify seed packages and thus to discriminate between 'low quality' and 'good quality' seeds. Furthermore, they often lack information on how to use commercial inputs (including hybrid seeds that entail precise management practices). Thirdly, their low social status, often associated with a lack of self-confidence, hinders small farmers from demanding higher quality seeds and other inputs or stops them from protesting when shoddy

45. The Government of Andhra Pradesh has tried to address this problem by encouraging seed companies to enter into a Memorandum of Understanding on Self-Certification (developed in 2000). This Memorandum enjoins seed companies to certify their own seeds, to register themselves with the government and to provide for compensation to farmers in case of crop losses due to germination failure or inadequate genetic purity of the seed.

Table 13. Women farmers' evaluation of the changes in cropping patterns in Bhoraj

	Small farmers			Medium farmers	Large farmers	Money-lenders
	Women	Men	Household			
1. Loss of diversity in food crops *Pigeonpea grains*	☹☹	☹	☹☹	☺	☺	😐
2. No more saving of own seeds *Blackgram seeds*	☹☹	☹	☹☹	☺	☺	😐
3. Necessity to buy seeds *Bag of cotton seeds*	☹	☹☹	☹☹	😐	☺	☺
4. Difficulty to store hybrid sorghum *Pest-infested sorghum*	☹	😐	☹	😐	😐	😐
5. Fluctuations in crop prices *Soybean and cotton*	☹	☹☹	☹☹	😐	😐	☺☺
6. Increasing need for credit *One rupee coin*	☹	☹☹	☹☹	😐	😐	☺☺
7. Scarcity of dry and green fodder *Straw and leaves*	☹	☹☹	☹☹	😐	☹☹	☹☹
8. Scarcity of organic manure *Cowdung cake*	☹	☹☹	☹☹	😐	☺	☺
9. Advice from company agents *Tomato (cash crop)*	☹	☹☺	☹☺	☺	☺	☺☺

Source: *Participatory exercise with a group of women farmers from Bhoraj., February 2002.*

Legend:

☹☹ = significantly losing out

☹ = slightly losing out

😐 = not affected

☺ = marginally benefiting

☺☺ = benefiting a great deal

☹☺ = depending on the situation, may lose or benefit

Understanding the Bhoraj matrix (Table 13)

Located close to the Hyderabad-Nagpur Highway, Bhoraj has experienced vast changes in cropping pattern over the last two decades. There are about 550 households in the village. Medium and large farmers largely belong to the Reddi and Golla castes. Most small farmers are Mala and Madiga (Scheduled Castes). Sorghum and cotton are the main crops grown today, and both are traditional to the area. Two decades ago, farmers used to cultivate local varieties, but today, these have entirely been displaced by hybrid seeds, as shown in the table below. Together, all the minor food crops (sesame, cowpea, field bean, greengram, blackgram, roselle) occupy less than 10% of the cultivated area in the village.

Crop	Grown since when	Type of varieties	Source of seeds
Hybrid sorghum	Last 10-15 years in the case of hybrids	Hybrids only	Purchased every year
Hybrid cotton	Last 15-20 years in the case of hybrids	Hybrids only	Purchased every year
Pigeonpea	"Since our forefathers' time"	One local variety and several improved varieties	Poor farmers sow local varieties; rich farmers buy improved seeds
Soybean	Last 5-6 years	Improved varieties	Purchased every year
Sesame, cowpea, field bean, greengram, blackgram, roselle	"These crops have been grown for a very long time"	Local varieties only	Saved from own harvest Poor farmers sometimes buy a handful of seeds from large farmers

Several collective discussions with small and medium women farmers led to a participatory exercise (Figure 7) which consisted in weighing the benefits and costs of the present cropping pattern, with a differentiation on the basis of gender (for small farmers only) and economic category (through landholding size). Initially, I had thought to have the 'community' as an additional category, in order to find out whether for each factor, the community as a whole has benefited or lost out after the change in agricultural scenario. But the women participating in the PRA decided that it would be more relevant to introduce another important set of players in the community: the *Saukar* (money-lenders). There are about ten money-lenders in Bhoraj, some of whom own land and cattle.

While drawing the matrix on the ground, the women came up with the following objects and symbols to represent each category of actors: a bangle for 'women'; a *beedi* (Indian cigarette) for 'men'; a small stone for 'small farmers'; a medium-sized stone for 'medium farmers'; a bigger stone for 'large farmers'; a large triangular rock for 'money-lenders'. The objects used to represent the different parameters in the vertical axis are inscribed in italics in the figure. In order to do the ranking, the women opted for three colours: purple for adverse impacts, green to represent the absence of positive or negative impact and yellow (*paspu*) for positive changes and economic gains. The quantity of coloured powder used created an additional nuance to differentiate those who 'slightly gain' from those who 'significantly gain' (and likewise in the case of adverse impacts).

While considering each component of the changes in cropping patterns, women did not limit themselves to economic considerations. For instance, they felt they lost greatly from the poor quality of hybrid sorghum and the impossibility to store the grain because food preparation and food storage come under their domain and responsibility. Similarly, they singled out small male farmers as losing out most as a result of the increasing need for credit because it is men who have to go and ask money-lenders for cash advances and who face humiliation when they can not repay a loan on time. Likewise, the recent phenomenon of fodder scarcity puts men at a greater disadvantage as they have to seek commercial sources of fodder, which sometimes entails travelling long distances and paying fairly large sums of money.

It is noteworthy that in their ranking, the women repeatedly emphasize the benefits accruing to money-lenders as a result of the commercialisation of agriculture.

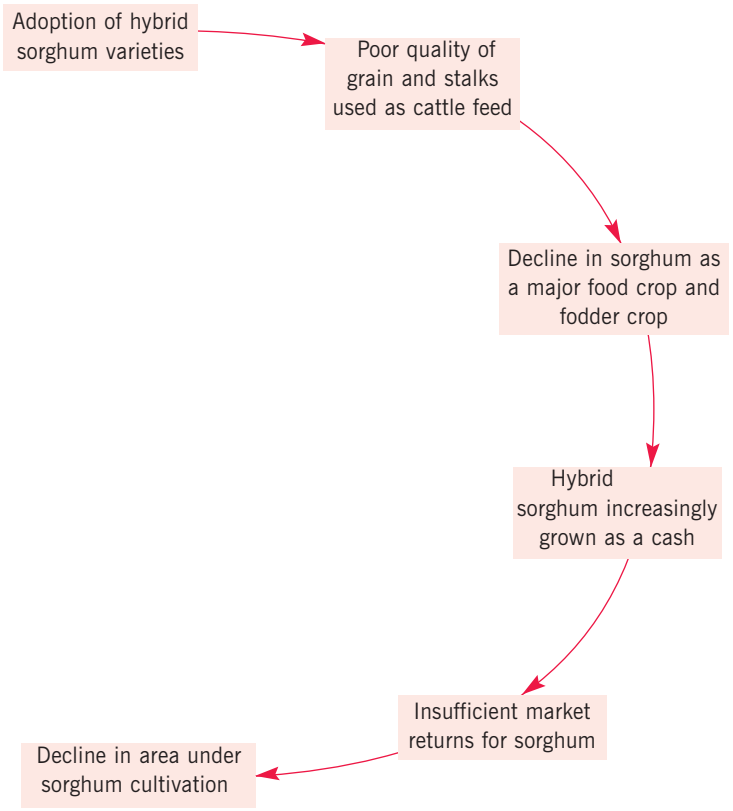


Figure 7: Agrarian change in Andhra Pradesh following the adoption of hybrid sorghum *Source: adapted from Hall and Yoganand 2000*

products are sold to them. In fact, it is not uncommon for input dealers to take advantage of poor farmers' unawareness: 'I sell second rate pesticides to the illiterate people that I don't know', says a pesticide dealer from Warangal District.

Together, these three issues point to an alarming connection between illiteracy and poverty on the one hand, and access to quality inputs and information on the other. Small farmers are most vulnerable to the risk of 'spurious seeds'. The commercialisation of seeds and other agricultural inputs creates new forms of discrimination against small and marginal farmers. Given that in intensive chemical agriculture the capacity to access inputs largely determines crop yields, the potential of this 'new' agriculture is in reality extremely limited for small non-literate farmers (Table 13).

5. **'The yield? It depends on how much we spend!'**

Hybrid seeds do not come up well unless chemical inputs are regularly applied to the crop. This is a common observation by farmers who often comment on the fact that the required levels of inputs do not remain stable, but increase from one cropping cycle to the next (this is true for both fertilisers as well as pesticides). Speaking of hybrid sorghum, Adivasi women farmers from Vaizhapur compare the local sorghum varieties they used to grow with hybrid sorghum: 'At that time, as long as you had the seed, you could get a good crop. You just had to sow *Pedda Jonna* and it would grow. Now we need to get seeds from middlemen. We have to buy fertilisers on credit and pay an interest on them. If you apply fertilisers, the crop grows. Otherwise it doesn't'.

When asked to compare the yield of hybrid sorghum with that of local varieties, most women farmers respond as follows: 'Nowadays, it depends on how much we spend! To grow [today's] crops, we need to spend rupees… by the thousand!'.

Thus, with commercial seeds, there is no such thing as the 'intrinsic worth' of a seed. These added layers of dependency on purchased inputs increase the risk of a crop failing for lack of sufficient investment.

Hybrid seeds or 'the end of peasants'

In India, hybrid sorghum was developed in the 1960s by the public sector. Breeders pursued three major objectives: higher yields, increased pest resistance and a shorter maturation period. Thanks to its high yielding capacity, hybrid sorghum would enable farmers to free up some of the land allocated to food production for cash crop cultivation.

Hybrid sorghum began to spread in the 1970s, with varying degrees of success. In 1995, privately developed hybrids accounted for 29% of the area under sorghum in Andhra Pradesh, 46% in Karnataka and 18% in Maharashtra (Ramaswamy et al. 2002). The average yield of hybrid sorghum for the period 1991-1995 was 0.74 tonnes per hectare in Andhra Pradesh. An econometric study on the adoption of

Table 14. Indian and French farmers' perceptions of hybrids in two different eras and contexts

	Indian farmers' perceptions of hybrid sorghum (2000)	French farmers' perceptions of hybrid maize (1950)
Changes in the farming system	• 'All the *rabi* food crops are gone' • 'Our baskets used to be full of foodgrains ; now they are empty' • Fodder now has to be purchased : small farmers who can't afford to buy it have to sell their cattle	• Hybrid maize displaces the wheat crop and pushes farmers towards marketable mass productions (maize and milk) • 'Why apply fertilisers in order to help the weeds grow, and then be forced to apply weedicides?'
Technical dependency on outsiders	• '[Men] buy whatever [inputs] the *Saukar* sells to them and apply them on the fields without any further ado'	• 'We have to re-learn how to cultivate this crop and scrupulously follow what the technician says'
New economic burdens and liabilities	• 'In order to secure a good harvest [using hybrid varieties], we have to spend thousands of rupees…' • 'If we can't reimburse our loans on time, we have to bear insults and humiliation from the money-lender'	• 'This new maize, we practically have to buy it before we can harvest it' • Hybrid maize cultivators have to buy a tractor to optimise the production potential • 'When we buy on credit, we become the loan's maid'
Socio-economic implications	• 'If we go to the market with these [shabby] clothes, they give us second-rate seeds' • 'Companies are earning a lot of money' • 'Only those who have money will survive; the rest will die'	• Hybrid maize kills the local farming system and small farmers • Hybrid maize is the end of independence and economic security and the beginning of speculation
Impact on human and animal nutrition and plant health	• 'This hybrid sorghum grain gets infested with pest within one year' • 'Our cattle refuse to feed on hybrid sorghum stalks and leaves' • The 2001 crop was hit by grain mold disease: over 30 % of the grain was unfit for consumption	• 'If I feed my hens with hybrid maize, they are hungry two hours later' • Farmers do not trust this hybrid maize which requires a lot of extra care: they fear the onset of new crop diseases
Changes in cultural perceptions	• 'Our traditional sorghum varieties were better. They could be stored for 3 to 4 years' [which brings a sense of security to women especially]	• 'The direct sale of hybrid maize is a regression of the system and a negation of farmers' multiple skills' • 'A farmer who does not make his own bread, what kind of a farmer is that?'
Socio-political implications	• 'The government is telling us to grow all these new crops, but it is not helping us'	• Hybrid maize is a new means for the authorities and the administration to intervene in farmers' affairs

Source: Group discussions and participatory exercises in four Adilabad villages (on hybrid sorghum) and excerpts from Mendras, H. (1984) on hybrid maize.

private hybrids of sorghum, pearl millet and maize suggests that average district yields were significantly higher for districts growing a higher proportion of private hybrids. This provided 'econometric evidence of the contribution of private hybrids to agricultural productivity in developing countries' (Ramaswamy et al. 2002).

However, this conclusion is based on a narrow conception of yield as the production per unit area of a single crop and on the assumption that monoculture is an adequate production system. As we have seen, these assumptions are highly questionable in the context of small dryland farms. A more suitable measurement would be the total output of a farm, ie. the sum of everything a small farmer produces including various cereals, pulses, oilseeds, fodder, fruits, vegetables, animal products, etc. Furthermore, agroecologists show that 'while a monoculture may allow for a high yield of one crop, it produces nothing else of use to the farmer. The bare ground between the crop rows—empty 'niche space' in ecological terms—invites weed infestation. The presence of weeds makes the farmer invest labor in weeding or capital in herbicide' (Rossett 1999).

Thus, although seed industry analysts argue—without solid evidence—that 'it is likely that poor farmers in SAT areas have gained from the spread of private hybrids' (Ramaswamy et al. 2002), a closer look at socio-economic factors involved in the adoption of hybrids leads to a different interpretation. A livelihood-based analysis revealed that the introduction of hybrid sorghum in dryland Andhra Pradesh has precipitated the decline of sorghum as a major staple crop for rural households, and especially for poor households (Hall and Yoganand 2000). The fall in sorghum cultivation is the outcome of interrelated agronomic, economic and cultural factors (Figure 7).

This diagram shows how the adoption of improved varieties can have a profound affect on the entire production system and can lead to far-reaching changes in agriculture.

Ample evidence for these changes also comes from studies of the introduction of hybrids into Europe, which dates over half a century. The first maize hybrids came from the United States and were introduced into Europe in the late 1940s. A detailed study conducted at the time by a rural sociologist predicted 'the end of peasants' and shows how the adoption of hybrids precipitates a whole series of changes in farming practices and in the organisation and structure of agricultural production (Mendras 1984).

Farmers of the Basses-Pyrénées (a region in Southern France) report a number of differences between their main local maize variety, the *Grand Roux Basque* and an introduced hybrid variety (Mendras 1984). These include the mandatory purchase of seeds, the use of high levels of chemical fertilisers and weedicides and other treatments to compensate for the vulnerability of hybrids to parasites and their poor adaptation to local climate. When grown according to the prescribed specifications,

hybrid maize produced twice as much grain as the local varieties. However, this involved much higher production costs than local varieties.

Interestingly, ten years after the initial introduction of hybrid maize, 84% of surveyed farmers continued to grow the local variety alongside hybrid varieties for two major reasons: hybrid maize was deemed to be 'too demanding in care, work and investment' and it did not render the same services as the local maize, especially as a feed for fowl. The study reveals that farmers were also extremely attentive to the socio-economic and cultural changes induced by the cultivation of hybrid maize. It is astounding to see the similarity in farmers' response to hybrid maize in Southern France in the 1950s and to hybrid sorghum in the Indian Deccan Plateau fifty years later (Table 14).

The moment farmers adopt one or several components of the agro-industrial system, they inevitably find themselves locked into a production chain where the choice of inputs and the use of the harvest are pre-determined by agro-chemical and food-processing firms. Thus, 'modern' farmers progressively lose their ability to make autonomous decisions about modes of production, crops, type and quantity of inputs and use of the produce. The transformation of farmers from independent producers to providers of raw material for industry also means that farmers become dependent on a network of technical information generated by specialists (agricultural scientists, chemists, genetic engineers, nutritionists…) and transferred to farming communities by agricultural extension workers or technicians.

As a result, 'the farmer is no longer his own master and he continuously needs a teacher to instruct him. This technical command imposed by progress goes beyond technique by creating a psychological situation that mirrors childhood and schooling' (Mendras 1984).

The demise of the non-monetary sphere

The growth of the commercial seed sector has had a profound impact on local seed exchange systems. In Nawabpet, an old man comments on the changes that have occurred since commercial seeds have come into the village: 'There is no more giving and taking'. Seed exchange amongst farmers has drastically declined for all crops, even though a large number of farmers continue to produce their own seeds for local food crops.

In areas where commercial crops have almost completely displaced food crops, the practice of seed-saving itself is disappearing, and seed exchanges stopped a long time ago. In Bhoraj, for instance, all the seeds needed to grow cash crops are bought from the market. It is usually men who are responsible for buying the seeds. Women farmers only save a few handfuls of seeds for 'small change crops' like greengram, blackgram, mustard and sesame. Instead of mixing the seeds with ash and neem leaves as they used to do, they use a chemical powder. Often the quantities harvested are so minimal that putting seeds aside is not possible. In that case, small farmers turn to large

farmers. A Dalit woman explains: 'For Rs 10, you can obtain half a kilo of sesame or greengram seeds. But if you don't have the money in hand, they don't give any seeds. They don't even let you pay the next day. If we don't have the money, they simply turn us out!'. Low-caste women farmers thus face humiliation by high-caste farmers who demand money for their seeds. The traditional modes of seed exchange have entirely disappeared and seed has become a monetarised commodity, even within the community. Only older women remember that once upon a time, seeds were exchanged based on *nagu* and *deedi*. Young women have never heard these terms.

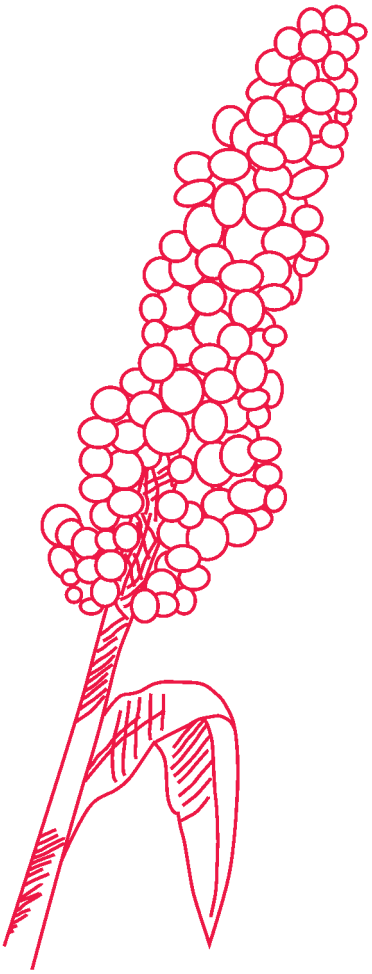
This situation is very different from the way it used to be. Posani, who is now well into her 50s, remembers: 'In the past we used to keep seeds for numerous crops. We used to have all the seeds in our house. Now we don't have anything. Now every seed is purchased'. The entire localised seed system has 'slipped through women's fingers' with the adoption of commercial agriculture. The same can be observed in Himalayan regions, where 'the marginalization of the traditional crops now compels households to purchase a large portion of seed stock (both vegetable and foodgrain like wheat) in the local market, an activity generally performed by men. In addition, with the growing commercial value of potatoes, men are now playing a greater part in the selection and preparation of seed potatoes. As a result, women's role in the selection and storage of seeds has become more or less restricted to the less valued millets' (Mehta 1996).

One can deduce, from this analysis, that by losing their prerogative over seeds, women have lost their main means of ensuring mixed cropping on their land. As cropping systems lean towards commercialisation and away from dryland foodcrops, their role in decision-making about cropping cycles and practices diminishes. Furthermore, with most cash crops women farmers have very little control over the harvest and its uses. In the case of cotton, for instance, the harvest goes straight from the field to the nearest cotton market yard, where commission agents unilaterally determine its quality and set prices.

There is no question of taking the grain to the *kallam*, cleaning and distributing it there, and subsequently bringing it home for further processing before storing it for the year's food supply. Wherever they are still performed, all these tasks are under women's responsibility. It is indisputable that women derive some status and bargaining power within the household and community by virtue of these contributions to the family's welfare. Yet, 'bargaining power is dependent not only on economic parameters, but also on social norms, and social perceptions about contributions and deservedness' (Agarwal 1999).

When women are deprived of some of their major responsibilities, the precarious balance within families tends to tilt in favour of men. Unless women farmers reinvest in new economic spheres (through farm labour or emerging land-based or non-farm activities), it is inevitable that their loss of control over such crucial domains as seeds, crops and foodgrains will translate into a net erosion of their social status in the village.

6



Industrialisation of the seed and farming sectors

The development of the seed industry is commonly seen as running parallel to the modernisation of agriculture. Commercial seeds are meant to provide farmers with higher yields, and they are assumed to be more reliable than farm-saved seeds in terms of quality, germination and genetic purity. The turn-over of varieties developed by professional breeders is associated with notions of genetic progress and economic growth. For most actors in the commercial seed sector, the use of local varieties and farm-saved seeds by the vast majority of farmers across the developing world is nothing less than an aberration. This is demonstrated in a recent communiqué from a spokesman of Delta & Pine Land Company. This company (now owned by Monsanto) developed, along with the United States Department of Agriculture, the Technology Protection System, also known as Terminator Technology. This genetic engineering technique is used to make seeds sterile and thus limit the practice of seed-saving for genetically modified and other crop varieties. Many players in the global seed and biotechnology industry share the view expressed in the quote below:

> The ability to prevent multiple use from one purchase of improved varieties of self-pollinated crops will benefit the world agricultural community by insuring that farmers in all areas of the world have an opportunity to share in the advantage of enhanced planting seed…The centuries old practice of farmer saved seed is really a gross disadvantage to third world farmers who inadvertently become locked into obsolete varieties because of their taking the 'easy roads' and not planting newer, more productive varieties.[46]

A clear connection is thus established between the seed industry's capacity to earn returns on its investment, farmers' access to improved germplasm and the development of agriculture. This view sets the stage for fully-fledged institutional

46. Collins, H. (Vice-president of Delta & Pine Land Company), 1998, "New Technology and Modernizing World Agriculture", quoted by Kneen, B., 1999, *Farmageddon. Food and the Culture of Biotechnology*, New Society Publishers, Gabriola Island, B.C., Canada, p. 14.

support for commercial seed models over farmer-centred seed systems, reputed to be inefficient and obsolete.

Like any other seed industry in the world, the Indian seed industry has a vested interest in increasing the seed replacement rate, i.e. the proportion of seeds purchased annually, for all major food and cash crops. In India, this rate averages around 30 to 35%, with relatively low rates (below 30%) in food crops like rice, wheat and millets and much higher rates (to the tune of 95%) in commercial crops like cotton or maize. The industry proposes to raise the overall replacement rate to 65 to 70% in the coming decade.[47] In other words, the aim is to create a seed market catering to 500 million farmers, at the very least. Another objective is to banish seed-saving practices on-farm, as these severely limit seed sales and therefore hinder the growth of the seed industry.

There are high stakes, therefore, in understanding the *modus operandi*, the motives and the strategies of the Indian seed industry and in assessing whether commercial seeds are a viable proposition for small farmers of semi-arid regions.

In this chapter, I look at the seed industry—also termed the 'formal' seed sector—as a system comprising breeders, seed producers and distributors. Understanding this sector means studying how commercial seeds are developed and distributed, and the mechanisms through which they are released, tested, registered, certified and protected. Pursing the political ecology approach set out in the first chapter, I analyse decision-making processes underlying research orientations (breeding techniques and biotechnology), seed policies and legal dimensions (intellectual property rights and seed laws), commercial activities and market trends.

Development and expansion of the Indian seed industry

The formal seed sector is divided into two domains: the public sector, which has been present in India for over 40 years, and the private sector, whose emergence is more recent. Trends in the seed and biotechnology industry result from the interplay between these two sectors. Seed policies have largely contributed to the growth of the private sector and to the entry of foreign players.

The public sector

The early phase: 1960-1988

Technological development and crop improvement programmes increased in intensity and scope at the start of the Green Revolution in the 1960s. Agricultural research was conducted in numerous National Research Centres as well as state

47. Personal communication with S. Kataria, Seed Association of India, a Delhi-based national organisation that represents the interests of the Indian seed industry, January 2001.

agricultural universities throughout the country, with the Indian Council of Agricultural Research (ICAR, created in 1929) as coordinating body. The United States funded several university-based research projects between 1960 and 1970. Hundreds of improved varieties for a wide range of crops, including rice and wheat but also pulses, oilseeds, tobacco, cotton, jute and sugarcane were released. Dryland millets received less attention in plant breeding programmes because of the emphasis of the Green Revolution on regions with high productivity potential such as irrigated areas.

To ensure the transfer of new crop varieties to farmers, centralised seed production and distribution systems were developed. Two national organisations were created for this purpose in the 1960s: the National Seeds Corporation (NSC) and the States Farms Corporation of India Limited (SFCL). For over a decade, the NSC was the sole agency in charge of the production and marketing of commercial seeds. The Rockefeller Foundation and US Agency for International Development provided assistance and training to NSC staff in quality control and seed production. The mandate of the SFCL was to produce breeder, foundation and certified seeds of high-yielding varieties on large mechanised farms in eight states. During the 1970s and 1980s, 13 State Seed Corporations (SSC) were established with funding from the World Bank under the National Seed Project (Pray 1997). These state-managed corporations largely took over the role of the NSC in individual states.

In the early stages of the seed industry, therefore, national research institutes and public seed production companies enjoyed a virtual monopoly over the most important staple crops. It was only when India started to liberalise its economy in the late 1980s and, more importantly, the early 1990s, that the private sector and foreign companies began to diversify their activities and to play a significant role in the seed sector. Seed policies were modified in order to facilitate these changes.

Recent developments

The public sector's approach to plant breeding and seed production has evolved over the years. Growing emphasis has been placed on the release of hybrid varieties and on the development of genetic engineering, with a growing neglect of open-pollinated varieties that can easily be reproduced by farmers. This trend is visible in the work done by breeders of the National Research Centre on Sorghum and the Directorate of Oilseed Research, two research institutes based in Hyderabad.

In 1996, a group of scientists and industry representatives appointed by the government designed India's biotechnology plans for the period 1997-2002. A budget of US$ 255 million (over five years) was allotted to step up the country's

biotechnological capacities. These plans are based on two main objectives: first, creating new jobs through the use and production of biotechnology (including tissue culture, biological pest control agents and organic compost) and secondly, an emphasis on the needs of rural women and people from the economically weaker sections of the society (Dhar and Chaturvedi 1998). Agricultural biotechnology is to be used for increasing yields, for the diversification of crops and for improving crop quality, such as higher nutritional value. Sophisticated technology like DNA-markers is to be used for crop improvement and identifying pathogens and pests. This plan has been criticised on several accounts:

1. It places no emphasis on food crops that have long been neglected like sorghum, millets and cassava, thus reinforcing the bias of agricultural policies against dryland rainfed systems deemed to be 'unproductive'.
2. It falls short of clearly identifying the needs of the rural poor, making it unlikely that biotechnology will effectively contribute to bridging the gap between well-off and resource-poor rural households.
3. There was no consultation with civil society while drafting the plan, and no use of participatory approaches to define the objectives and methods for biotechnology development.

In contrast with this national plan, the Andhra Pradesh Netherlands (APNL) biotechnology programme 'aims at the interactive development of biotechnologies appropriate to the needs of small-scale farmers' (Prasad and Reddy 1999). They used a participatory methodology to ensure the involvement of farmers in designing 40 projects, including pest and disease control among major crops, the preparation of vermicompost, the production of biopesticides and biofertilisers and the propagation of local tree species (neem, teak, tamarind, etc.) through the use of tissue culture.

What is peculiar about the APNL programme, however, is that its instigators see the participatory development of 'soft biotechnologies' as a stepping stone for the later adoption of 'hard biotechnologies', i.e. genetically modified crops.[48] It is therefore doubtful whether there will be any scope for farmers involved in the projects to opt out of genetically engineered organisms and instead adopt, for instance, organic farming practices.

Another significant challenge facing the public sector lies in the rising costs of agricultural research. Along with budgetary cuts, these make public research more and more precarious (except in fields which the governing élite is intent on developing, like biotechnology). This situation is driving public institutions into

48. Interview with Dr. Janaki, Project Associate, Institute of Public Entreprise (the institute responsible for carrying out the APNL project at the field level), Osmania University, Hyderabad, February 2002.

29 Public-private partnerships at ICRISAT

Since the middle of the 1990s, many International Agricultural Research Centres (IARCs) have turned to various kinds of collaboration with the private sector in order to remedy the reduction in public funding, a trend hitting all of the 16 IARCs of the Consultative Group on International Agricultural Research (Manicad 1999). In India, the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) has been developing partnerships with the private sector since 2000. ICRISAT is seeking research grants for projects to diversify sorghum and pearl millet hybrid parental lines for Asia. A wide range of small to large companies was approached for funding. To date, 29 public and private companies have joined the Sorghum and Pearl Millet Research Consortia. They provide research grants for the development of improved germplasm and the release of hybrids with increased performance in terms of grain yield, grain size and shoot fly resistance. Seven private seed companies form a similar research consortium for pigeonpea.

In its proposal sent out to potential private donors, ICRISAT argues that new research is urgently needed to 'further diversify the hybrid parents and thus sustain improvement of sorghum productivity and stability'. This acknowledges that current breeding techniques lead to a dangerous narrowing of the genetic variability of crops.

research partnerships with the private sector. As similar financial constraints are weighing on international agricultural research centres, they too are turning to private funds in order to keep their research programmes afloat (Box 29).

In the domain of seed multiplication and commercialisation, the main responsibility of the public sector today lies in meeting the national seed requirement for 'high volume, low value' seed crops. These include self-pollinated crops like rice and wheat (for which farmers reuse purchased seeds for two to three years) and crops like chickpea and groundnut (for which large volumes of seed are required). The Andhra Pradesh State Seed Development Corporation produces seeds of hybrids and improved varieties of paddy, sorghum, pearl millet, cotton, sunflower, castor and open-pollinated varieties of pulses, oilseeds, fibre crops and vegetables in almost all districts.

Except for the states of Andhra Pradesh, Maharashtra and Karnataka, most State Seed Corporations have run into financial problems over the past decade. Highly focused on productivity, cost efficiency and rational investment, the World Bank-funded National Seed Project III seeks to redress the situation of these public institutions and upgrade their infrastructure.

Inadequate seed supply to farmers and problems of seed quality have led certain state governments to rethink seed supply strategies. The government of Andhra Pradesh is for instance currently working on developing the informal sector through

the establishment of seed villages, fostering farmer-managed seed production in various parts of the state.[49]

The private sector

Private seed firms began to emerge in the late 1960s and throughout the 1970s, but their role remained minimal until the late 1980s. A number of them benefited from technical assistance provided by the National Seed Corporation, the Indian Council of Agricultural Research or the Rockefeller Foundation. In the early 1980s, the Indian Government decided to make public-bred varieties available to private seed companies. Many started off in the seed business by multiplying and distributing these varieties or by multiplying seeds for American seed companies such as Pioneer, in the case of maize. As accessibility to national and international research institutions increased, private firms could obtain breeder seed and a number of them started to develop breeding programmes of their own and released improved cultivars. Analysts of the Indian seed sector note, for instance, that:

> The International Crops Research Institute for the Semi-Arid Tropics started inviting private seed companies for field days in the late 1980s, facilitating the exchange of germplasm and information. The Mahendra Hybrid Seeds Company's experience is an example wherein such initiatives from international research centres and subsequently from the Indian National Agricultural Research System provided a fillip to the growth and development of private seed companies. Pearl millet, sorghum, cotton and tomato are some of the crops in which free germplasm exchange from public research institutions provided the initial momentum for the growth of the Indian Private seed sector, which was subsequently sustained by appropriate policy initiatives (Selvarajan et al. 1999).

Thus, transfers of improved genetic material from public institutes helped many private firms considerably during their initial years of establishment. Concerns are being increasingly expressed today over the privatisation of resources that were once maintained by farming communities and used by breeders from national research institutes strongly abiding by the principle of public interest (Box 30).

By and large, private firms concentrate on crops for which hybrid seeds can be easily bred and multiplied (eg. cross-pollinated crops like pearl millet, cotton, sunflower, maize and sorghum). The high seed replacement rate associated with hybrids—linked to inbreeding depression and the segregation of characters in the second

49. Personal communication with G.V. Ramanjaneyulu, Director, Centre for Sustainable Agriculture, Hyderabad, January 2005.

30 Use and ownership of genetic resources: transfers from the public to the private sphere

Throughout the world, private seed companies have 'inherited' the collections of public institutes either by legal means (through purchase) or through illicit transfers of material by breeders. In India, numerous breeders from small, medium and large seed companies started off their activities with germplasm acquired from national or international research institutes. The years of research and breeding done 'in the public interest' by the government sector has thus helped to build up private profits, a fact that is often overlooked when analysing the merits and performance of the private sector.

A related concern is the recent evolution towards protecting improved germplasm through intellectual property rights regimes. On the one hand, plant breeders' rights over plant varieties (and patents over genetically modified life forms) effectively turn biological resources into privatised commodities. On the other hand, farming communities who have—willingly or unwillingly—contributed genetic material and precious crop-related information to public and private breeding programmes have very little scope to claim any rights over their genetic resources. Moreover, once local varieties disappear from their fields under the onslaught of commercial varieties, they have no alternative but to purchase commercial seeds at increasing market rates, as is the case for hybrid cotton seeds or vegetable seeds.

generation—ensures good returns for the industry, which is not the case for high-yielding varieties of crops like wheat or rice. Seed analysts estimate that hybrid varieties account for 60% of varieties produced and over 90% of varieties bred by the private sector, regardless of the crop (Selvarajan et al. 1999). This is true for all seed companies with the exception of small companies, for which rice accounts for over 80% of cereal crop seed production (although there is a growing market for hybrid rice seed, most of the rice seed production remains non-hybrid).

Internationalisation of the seed industry

A set of seed-related reforms has catalysed the expansion and internationalisation of the private sector. These include foreign investment rules, industrial licensing policies and seed import policies (Selvarajan et al. 1999). Until the 1980s, policy restrictions meant that no large or foreign-owned seed company could operate in India. Seed imports were also banned in order to protect national seed production initiatives and to minimise competition with public seed organisations. These restrictions were gradually lifted with the introduction of the New Policy on Seeds Development in 1988. Resulting new provisions consisted of:

1. allowing foreign-owned firms and large Indian conglomerates to enter the seed industry

2. removing barriers to the import of commercial vegetable seeds
3. authorising the import of commercial seeds of foreign varieties of coarse grain, pulses and oilseeds for a two-year period, provided that seeds are produced on Indian territory after the initial period (imports of wheat, rice and cotton seeds continued to be banned)
4. facilitating the exchange of germplasm for research purposes

The main official arguments for the introduction of a comprehensive Seed Policy and, later on, of a legislation on intellectual property rights were the easing of technology transfer and the earning of foreign exchange through cut flower and vegetable exports. Yet it has been shown (Batra 1995) that the introduction of the 1988 New Policy on Seeds Development was closely linked to the need expressed by the multinational company PepsiCo to import a variety of potato well-suited to the demands of the agro-food industry (the Russet Burbank, a potato variety widely used worldwide for industrial transformation). In 1991, as a part of the new economic policy of liberalisation, restrictions on the role of foreign firms and technology transfer were further reduced.

The latest National Seeds Policy was introduced in 2002 in answer to the industry's expectation of higher market shares in the seed sector. It opens up new avenues for the 'growth of a competitive and localised seed industry' and seeks to 'encourage import of useful germplasm' and to 'boost exports', in line with the latest national agricultural strategy (Government of India, *National Seeds Policy*, 2002).

These policies have enabled the private seed sector to develop into a fully-fledged industry and to gain substantial market shares in sorghum, pearl millet, cotton and vegetable seeds. They have also favoured the entry of industrial groups into the seed sector. A large number of Indian, as well as partially foreign-owned companies, previously involved in fertiliser production (SPIC, Harrison Malayalam, J.K.) or other industrial activities (Godrej, Hindustan Levers, ICI, Sandoz, Hoechst, Indian Tobacco Company) diversified into seed production. Several joint ventures were established between multinational companies and Indian companies throughout the 1990s.[50]

The development of biotechnology has driven a number of large national companies to tie-up with private multinational companies. By 2000, over a third of Indian seed companies had established collaborative linkages with global partners in the seed or biotechnology industry. A recent example is the company ProAgro-PGS India Ltd, a joint venture between the Belgian biotechnology company Plant Genetic Systems (PGS) and the Indian company ProAgro. The alliance aims to combine PGS's DNA-

50. Examples of such ventures include: Ganga Agriseed and Agrigenetic for sorghum and sunflower seeds (1992); Mahyco and Monsanto for cotton hybrids (1996); SPIC and Pioneer for sorghum, maize, sunflower, mustard and rice (1992); and Nath and Royal Sluiss for vegetable seeds.

based technology with ProAgro's research expertise and germplasm collection to develop transgenic hybrid oilseed rape, transgenic mustard and disease-resistant tomato (Selvarajan et al. 1999).

The first transgenic cotton variety commercialised in India in 2001 resulted from collaboration between Mahyco (Maharashtra Hybrid Company, one of the leaders in cotton hybrids) and Monsanto, a multinational agro-chemical seed firm based in the United States. Subsequently, several other Indian seed companies have entered into licensing agreements with Monsanto in order to distribute genetically modified versions of their best cotton hybrids. These agreements involve stringent rules restricting autonomous research efforts by the Indian partner on traits or technologies which Monsanto is researching.[51] Multinational companies with a vested interest in agricultural and seed production have also been able to influence policies through various forms of lobbying and economic pressure.

In response to the formation of conglomerates around multinational agro-chemical and biotechnology companies, a small group of Indian seed companies have formed a national consortium called *Swadeshi*. Its main thrust is to reduce research costs and pool together expertise in breeding and genetic engineering in order to increase the capacity of Indian firms to compete in an increasingly globalised seed market.

Structure of the seed industry

There are several stages in the process of producing seeds of improved varieties. Breeders' seeds released in small volumes by breeders are handed over to registered growers who produce foundation seeds. These are in turn used to produce certified seeds through a final process of multiplication carried out by networks of seed producers. Improved varieties developed by the private sector do not have to be certified, as they can be commercialised as 'truthfully labelled' seeds (discussed later on).

Public sector seed production

The production of certified seeds has traditionally been the responsibility of the State Seed Corporations. The Andhra Pradesh State Seed Development Corporation produces foundation and certified seeds through 7,500 growers, of which 5,800 are shareholders in the Corporation. Certified seeds are distributed and commercialised by various agencies of the Department of Agriculture and by private dealers.

Registered seed producers have to follow a number of rules and recommendations in order to insure genetic purity and seed quality. Seed crops can only be grown in fields used for a different crop the previous year. Specified minimum isolation

51. Personal communication with a breeder from the company J.K. Seeds, Hyderabad, February 2002.

distances have to be observed to limit the incidence of cross-pollination with other varieties. Recommended cultural and plant protection practices include regular weeding and roguing (i.e. pulling out off-types from the crop), the use of specific inputs and extra care during harvesting and threshing.

After harvest, commercial seeds undergo a processing phase consisting of drying, cleaning, grading, testing and applying disinfectant and anti-fungal products. The seed lots are then bagged and labelled. Seed certification is the responsibility of the State Seed Certification Agency. It is based on field inspection and seed tests for purity, germination rate and moisture content.

Small private companies follow the same procedures when they produce seeds of improved varieties. One main difference lies in the last stage of certification: most often, seeds produced by private companies are not certified but simply sold as 'truthfully labelled' seed by authorised seed dealers.

The informal seed sector

Seed producers often keep a share of their seed harvest, which they sell to farmers directly instead of delivering it to the public seed corporation or to the private firm for whom they multiply seeds. These seed sales are largely unaccounted for in official records. They form a part of the informal seed sector, the alternative channels through which farmers obtain seeds. The informal sector consists of sales, transfers and exchanges of seeds to farmers—through unofficial networks—from research stations, from registered seed multipliers, from farmers' cooperatives and from unregistered seed growers or individual farmers.

The importance of the informal seed sector should not be underestimated. Largely monetary in nature, these seed transfers are a key way for farmers to obtain seeds of improved varieties of rice, pulses, oilseed, chillies, etc. in many parts of the country. It also operates in areas where the non-monetary localised seed economy (described in Chapter 5) became virtually extinct following the shift to commercialised inputs and market-oriented agriculture.

Thus, this sector is highly significant not only because of the large volume of seeds distributed, but also because the informal distribution channels play a major role in spreading new crop varieties developed by public breeding institutes from village to village. This is true for rice, but also groundnut, pigeonpea, castor and soybean (Tripp and Pal 2000a).

Hybrid seed production

In the case of hybrid seed production—largely done by the private sector—seed companies make arrangements for contractual production with farmers. Andhra Pradesh is the leading state in hybrid seed production in India. Over 80% of hybrid sorghum seeds and 70% of hybrid cotton seeds are produced in Andhra Pradesh

31 Contractual cotton seed production in Andhra Pradesh

Close to 70% of hybrid cotton seeds are produced in three semi-arid districts of Andhra Pradesh (Kurnool, Mahaboobnagar and Rangareddy). About 60% of cotton seeds produced in AP are marketed in other Indian states or exported overseas (Venkateshwarlu and Corta 2001). National and multinational seed companies enter into contracts with local farmers—often a group of farmers in a village—who grow the seed crop on their own land under the supervision of company agents. Seed companies pay for labour charges and they buy the seed crop at a fixed price. Other expenses (inputs, electricity in case of irrigated crops) have to be borne by the farmer. In Kurnool District, most farmers engaged in contractual seed production originate from coastal districts, and they produce seed on leased lands.

Hybrid seed production is intensive in capital and labour: it requires nine times more labour than cotton cultivation. A study on labour relations and gender indicates that:

1. Labour is essentially female: seed companies hire women and young girls, who are reputed to be more 'docile', efficient workers and paid at lower rates than men.
2. The rate of child labour is very high in cotton seed production: approximately 250,000 young girls (between 7 and 14 years of age) are engaged in cross-pollinisation on cotton seed farms in Andhra Pradesh. The study mentions a 28 hectare seed farm spread over 14 villages where 560 girls work under the supervision of 14 company agents.
3. Labour on seed farms is largely 'precarious employment': the work is part-time, seasonal, paid by piece rates rather than on an hourly or monthly basis. There is no social or medical security (in spite of the toxicity of pesticides used on cotton crops and inhaled by workers).
4. Companies induce poor families to provide labour by providing credit advances: the parents of working girls receive a sum of money ranging from Rs. 100 to 3,000 rupees for the promise of sending their daughter for the entire season (from July to February).

Source: Singh, S., 2003, Contract Farming in India: Impacts on Women and Child Workers, Gatekeeper Series No 111, IIED, London.

alone. In total, some 260 seed companies carry out seed multiplication activities with approximately 100,000 farmers. A research study on the economics of seed production for maize, sunflower and cotton in three districts shows that this activity entails high costs of production but also generates large revenues for farmers (Radha 2002). Researchers from ICRISAT also stated that some villages from Nizamabad district (in the Telangana region) have become much more prosperous after the establishment of seed farms for producing hybrid sorghum, pearl millet and maize seeds.

However, external signs of wealth are not necessarily an indication of the overall increase in well-being of a community and they often rest on skewed social and

gender relations (Mehta 1996). The adoption of contractual seed production may distort local production structures and escalate community conflicts over natural resource use, as has happened in the Philippines (Vellama 2000). Overall, contract production has been shown to be counter-productive from a social point of view: often, medium and large farmers lease land from small farmers, as they alone can afford to invest in commercial agricultural production and to bear the risk involved in such contractual ventures. Well-documented studies from India show that contractual production creates new dependency relationships between the company and local producers and generates precarious forms of employment for women and children.[52] This is the case for hybrid cotton seed production in several districts of Andhra Pradesh (Box 31).

Commercial seed production has become more and more global in scale, and seeds are increasingly produced hundreds or thousands of miles away from where they will eventually be sown. Vegetable seed production, for instance, is highly international. Large multinational seed companies work more and more frequently with contractual producers in countries characterised by low labour costs and low environmental standards (especially in Eastern Europe and in South Asia). Seed crops are highly dependent on chemical inputs and mechanisation, even though certain operations like cross-pollination are labour-intensive.

The processing component of commercial seeds has become a highly sophisticated, technology-oriented and large-scale activity over the last two decades. Seeds of sorghum, pearl millet, maize and cotton are processed in fully mechanised processing plants owned by large national and multinational seed companies..

It is probably in the United States, however, that the ultimate industrialised seed production is encountered. In 1997, the Monsanto Company established what is deemed to be the largest seed processing plant in the world (entirely dedicated to the production of hybrid maize seeds). Situated in the state of Michigan, the plant is surrounded by over 7,000 hectares of land under contractual seed maize production (Beytes 2001). This industrial set-up of huskers, driers and sorters is composed of three green corn receiving stations (where trucks unload the corn), three husking lines and 36 sorting tables, four dryers (with a total capacity of 800,000 bushels per year),[53] a bulk storage facility (capacity of 691,000 bushels) and a nine-floor conditioning tower. The plant can process up to 50 hybrids in a season. The conditioning process is entirely controlled by computer systems and electronics.

52. See for instance Singh, S., 2000, "Contract Farming for Agricultural Diversification in the Indian Punjab: A Study of performance and problems", *Indian Journal of Agricultural Economics*, 55 (3), July-September, pp. 283-294.

53. 1 bushel of maize equals 25.4 kg

New forms of biological and technological controls

A look at the history of plant breeding reveals that the techniques and methods used for crop improvement have followed a specific trajectory, culminating in genetic engineering. Early on, in the 1950s, breeding consisted of improving local varieties by working with the dynamic genepools of farmers' varieties. The main objective of selection was to strengthen the capacity of local crop varieties to adapt to a range of environmental conditions. Implemented with success in India by the reputed rice specialist RH Richharia, who collected thousands of local varieties and directly involved farmers in his work, this approach was systematically sidelined by the Green Revolution.

Instead, the pureline breeding method started to prevail for self-pollinated crops like rice, wheat, barley, finger millet, greengram, blackgram, groundnut, chickpea and chillies. Pureline breeding consists of creating 'élite' varieties adapted to modified environments, i.e. highly responsive to chemical inputs and suited for mechanisation. Purelines are developed from germplasm stored in genebanks and are based on a narrow genetic base. The large scale adoption of a few high-yielding varieties on thousands of hectares led to genetic uniformity, a growing vulnerability of crops to pathogens and rising costs of cultivation associated with the adoption of costly technical solutions.

For cross-pollinated crops, highly heterozygous in nature, hybridisation has evolved as the most common breeding method.[54] Resulting from crosses between two or more purelines, F1 hybrid varieties provide scope for the commercial exploitation of heterosis (or hybrid vigour): the superiority of an F1 over both its parents. This character is not retained by the second generation, which largely deters farmers from saving seeds: a captive seed market is thus created. Another benefit of hybridisation for the seed industry is that the parental lines of hybrid varieties are effectively the property of the breeder, who alone can produce hybrid seeds from the two original purelines, hence the term 'proprietary hybrids'. In the case of 'often cross-pollinated' crops (i.e. crops for which cross-pollination exceeds 5% and may reach up to 40%) like sorghum, cotton, tobacco, pigeonpea, mustard and safflower, breeding methods developed for both self-pollinated and cross-pollinated crops can be used. This explains the presence of both improved varieties (also referred to as open-pollinated varieties, OPVs) and hybrids in these crops.

As a Canadian farmer and writer puts it, 'the establishment of the ideology of progress and improvement, with its individualistic, reductionist view of life, its fixation on control, and its dedication to the accumulation of capital as the measure

54. Cross-pollinated crops include maize, bajra, rye, sunflower and castor. These crops can also be improved through mass selection or recurrent selection. Many varieties were developed through mass selection in cotton, castor, maize and pearl millet before hybrids started gaining popularity, mostly for commercial reasons as they allow for the creation of a 'captive' seed market.

of success and progress, also set the stage for the emergence of biotechnology' (Kneen 1999). Genetic engineering techniques have developed over the past two decades, supposedly in order to overcome constraints faced in conventional breeding. These techniques consist of transferring genes or segments of DNA from one variety to another, but also from one species to another, which is completely unthinkable with conventional breeding methods. Living things thus become information systems that can be infinitely reprogrammed into unlimited biological combinations (Rifkin 1998).

Although genetic engineering is often heralded as a means of increasing the nutritional value of crops, reclaiming degraded soils or overcoming the consequences of drought, in reality, the vast majority of transgenic crops that have been marketed so far either carry a trait for herbicide tolerance or insect resistance. Farmers who grow herbicide-tolerant varieties (like the Roundup Ready soybean or canola varieties commercialised by Monsanto in the United States, Canada and Argentina) have to purchase both seeds and herbicides from the same company.

In sum, the seed industry has consistently attempted to consolidate its market shares and to reduce the scope for farmers to save their own seed. Four major mechanisms of biological and technological control can be identified:

1. a reduction of the genetic variability used to develop new crop varieties, which severely constrains farmers' ability to carry out selection in their own fields based on their agro-climatic conditions and which reinforces their dependence on purchased chemical inputs
2. the sale of 'one-time use' seeds or planting material that farmers cannot freely reproduce, including hybrid varieties (maize, sorghum, cotton), sterile polyploids (beetroot, for instance) and seedless varieties (grapes, papaya)
3. genetically engineered seed sterility, wherein the fertility mechanism of seeds is artificially blocked so as to prevent second generation seeds from germinating. This technology was developed and patented in the United States in 1998 as a Technology Protection System.[55] Such 'terminator technology' raises many problems for farmers, especially—but not only— in the developing world. These include unintended gene transfers leading to the sterilisation of adjacent crops (Brac de la Perrière and Seuret 1999). The Indian Government was in fact one of the first to ban this technology in the country
4. 'genetic use restriction technologies' which involve modifying the constitution of plants through genetic engineering so that vital biological functions can either be

55. For a clear and critical description of the technology, see Crouch, M., 1998, *How the Terminator terminates : An explanation for the non-scientist of a remarkable patent for killing second generation seeds of crop plants*, Occasional Paper, Edmonds Institute, Edmonds.

activated or deactivated through the application of a chemical. For instance, a gene coding for resistance to a virus can be activated by spraying a specific chemical. Inversely, a vital biological function like flowering can be artificially disabled; the only way of enabling it again being through a chemical application

It is easy to understand the extent of dependency that such technologies could generate for farmers if they were put to use by seed companies. This underlines the need for public authorities to develop strong vigilance and monitoring programmes and to set up a regulatory framework to outlaw technologies which pose multiple threats to farming communities and to the environment.

Emergence of new seed regulations

Seed legislation allegedly aims to control the nature and quality of seeds sold to farmers and to regulate seed markets in order to limit piracy through the sale of counterfeit branded seeds. In India, the need for conceiving and enforcing seed legislation emerged with the introduction of semi-dwarf high-yielding varieties of rice and wheat and the development of hybrid varieties of maize, sorghum and pearl millet in the mid-1960s. The first Seed Act was passed in 1966. It provided for the notification of varieties, the certification of public sector seeds and the regulation of the formal seed market.

A bill introduced in 2000 modifies some of the earlier provisions, especially registration of varieties and certification rules. Another recent development is the introduction of a Plant Variety Protection regime, the first of its kind in India.

Registration of varieties

The clear identification of newly released crop varieties is an important step in regulating formal seed systems and a significant element of market transparency. The variety description serves to identify a variety with a specific name, to provide clear seed labelling and to prove the variety's adaptation to specific growing conditions.

Under the Seeds Act of 1966, the registration (or notification) of varieties was compulsory only for varieties and vegetatively propagated materials developed by public institutes or state agricultural universities and released by State or Central Variety Release Committees. The Central Seed Committee (Ministry of Agriculture) was responsible for the notification of varieties based on trials conducted by the All-India Coordinated Crop Improvement Project (AICCIP).

Notification only concerned a small fraction of private-bred varieties, the majority being sold as truthfully labelled varieties. Since the provisions of the 1966 Seeds Act only applied to notified varieties, a large part of the seed market remained unregulated, with no method of quality control on the sale of seeds.

This situation has been modified under the *Seeds Act, 2000*. This new legislation makes the registration of varieties *mandatory* so as to 'ensure against marketing and poor quality or "spurious" seeds', which have become a rampant problem in many crops. The Act clearly states that 'seeds of any variety for the purpose of sowing or planting will be sold in the country only if the said variety has been registered by the National Seeds Board' (Government of India, *Seeds Act, 2000*). Registration is granted after multi-locational trials conducted over a minimum of three seasons to determine the Value for Cultivation and Use (VCU). New varieties have to meet minimum standards of germination and physical and genetic purity. The *Andhra Pradesh Seeds Regulation Act (2004)*, which enacts the National Seeds Actat the state level, contains provisions for compensating farmers if a registered variety fails to deliver minimal performance after sowing.

The government reserves the right to exclude certain kinds of varieties from registration to protect public order and morality; human, animal and plant life health; and to avoid environmental damage. More specifically, it is stated that 'any technology—including genetic use restriction technology and terminator technology—which is harmful or potentially harmful, shall not be registered'. Transgenic varieties can only be registered after clearance under the *Environment (Protection) Act, 1986.*

No sale, bartering, import or export of seed is allowed for varieties that are not registered by the State Registration Committee. A very important provision lies, however, in an exemption for farmers. The farmer's right to 'save, use, exchange, share or sell his farm seeds and planting materials' is protected both in the Seed Act and in the *Protection of Plant Varieties and Farmers' Rights Act, 2001*. The Seed Act also states that a farmer is free 'to sell his seeds on his own premises or in the local market without any hindrance, provided that the seed is not branded'. If it is respected and implemented, this provision could help ensure that farmers continue to exchange, loan and sell seeds. This would be unlike what happened in European countries after the creation of the Official List of Varieties. When the registration of varieties became compulsory in the early 1980s—almost 40 years after the creation of the first official lists of varieties—the sale and exchange of farmers' varieties became virtually illegal since none of these local varieties were officially registered. As a result, hundreds of local varieties went out of cultivation within a few years.

It is important to note, in this regard, that the Indian Plant Varieties and Farmers' Rights Act provides space and scope for the registration of farmers' varieties. Conceived as a tool to help farmers' varieties spread beyond their locality of origin, this concept may help to curtail the erosion of local varietal diversity. However, it could also turn out to be a double-edge sword if the minimum standards for registration are not completely rethought from the point of view of farmers' criteria and needs. Indeed, general criteria for variety registration tend to work against

farmers' varieties as they exclude varieties a) that are not genetically pure or stable, i.e. all farmers' varieties; and b) that do not give very high yields, but feature good levels of yield stability and local adaptability.

There is growing concern about the fact that variety registration is designed to meet the needs of monocropping systems in high-input agriculture. The trials conducted to determine whether a variety is eligible for registration rarely represent common farmer agronomic practices and they never mirror the multiple constraints faced by resource-poor farmers. Moreover, yield is the single most important criterion in these trials. But in practice, what matters most to farmers in marginal areas is yield stability under varying climatic conditions, ie. the performance of a crop under mild to severe conditions of stress like moisture scarcity and low-input conditions (Tripp and Pal 2000b).

In the end, variety release procedures often end up reducing the number of varieties available to farmers and thus do not cater for the diversity of farming systems in countries like India (Louwaars 2000). Instead of strict rules for variety registration, a more open and flexible variety information system would be more appropriate. This could provide basic and reliable information on new varieties while allowing non-registered varieties that foster crop diversity to circulate in the market and through informal seed channels.

Seed certification and seed marketing

Certification systems are designed to guarantee the quality of marketed seeds in terms of germination, moisture content, absence of weed seeds and seed-borne diseases. Under the Indian Seed Act of 1966, the production of certified seeds was largely limited to the public sector. The new Seeds Act retains the voluntary character of certification, but at the same time, it facilitates procedures for seed certification by private companies by allowing for non-state agencies to undertake certification. Private companies can develop their own system of self-certification. Table 15 highlights some of the main changes in seed legislation since this Act came into force in 2000.

Because of the large-scale problem of poor quality commercial seed in Andhra Pradesh, with frequent reports of failed germination, low rates of flowering and unsatisfactory yields for several crops (groundnut, cotton, chillies etc.), the state government drafted a Memorandum of Understanding for Self-certification of Seeds in December 2000. The main thrust of the proposal is to enjoin seed producers to:

a) register themselves with the Commissionate of Agriculture

b) opt for a system of self-certification for all marketed varieties (including un-notified varieties that are still in circulation) and label seed packages

Table 15. Comparison of the seed legislations of 1966 and 2000

	Seed Act, 1966	Seed Act, 2000
Variety registration	• Compulsory notification for public sector varieties • Optional notification for private-bred varieties • Seed legislation only applies to notified varieties	• Compulsory registration of all commercialised varieties, with an exemption for farmers' varieties • Introduction of VCU criteria in the trials • Seed legislation applies to seeds of all varieties proposed for sale
Seed certification	• Seed certification mandatory for seed produced by the public sector • 'Truthful labelling' as an option for private companies	• Seed certification for public sector varieties • Voluntary certification for private seed sector • Introduction of self-certification as an option for private companies • Incentives for accountability on quality
Seed marketing	• No mandatory registration of seed producers • Compulsory licensing for seed dealers	• Mandatory registration of seed producers and seed processing units • New system of labelling

c) set up seed testing facilities in order to control seed quality or get seed samples tested in State Government Seed Testing Laboratories

d) be accountable to farmers by offering them financial compensation in case of seed failure

Furthermore, under the new law, all seed producers and seed processing units have to register themselves with the State Seed Board, so that quality control measures can be enforced and exact data about the amount of seeds processed and certified generated. It is worth noting that this measure—which appears quite benign—has progressively become an essential component in the enforcement of Plant Breeders' Rights in certain countries. In France, for instance, the compulsory registration of seed producers and seed processing units enables Breeders' Associations to claim royalties from seed producers who multiply and sell seeds of protected varieties. It also allows them to collect a newly-introduced royalty from farmers who produce farm-saved seeds from protected varieties. This is a good example of how institutionalisation processes implemented with an alleged concern for seed quality can end up serving the interests of a dominant group.

As far as seed dealership is concerned, the pre-existing system has been relaxed in the new law; it is no longer compulsory for seed dealers to obtain a licence, except for dealers involved in the import and export of seeds. Imported varieties have to be registered in the country in order to be commercialised. Transgenic seeds and planting materials must carry a label informing farmers that they are transgenic. The case of transgenic Bt cotton seeds in India shows the limits of such regulations: in addition to being illegally commercialised prior to the official authorisation granted by the Department of Biotechnology (Ministry of Science and Technology) in 2001, Bt cotton seeds are now sold without proper labelling or identification by unauthorised dealers in many parts of Andhra Pradesh.

Plant breeders' rights and farmers' rights

Until very recently, there was no intellectual property rights protection for plant varieties in India. New varieties developed by breeders from the public and private sectors were freely multiplied by seed growers and farmers, without any restriction on the use, sale and exchange of these seeds. Like many other countries of the developing world that are members of the World Trade Organisation, India had to develop legislation to protect breeders' rights. In developing countries, changes in the legal protection of plant varieties result from a combination of both domestic and foreign demands emanating from (Jaffé and van Wijk 1995):

a) domestic and foreign private seed companies wanting a better return on their investment

b) domestic growers of fruit and ornamental plants pressured by foreign breeders to improve legal protection as a condition for getting better access to foreign varieties

c) public agricultural research institutes seeking additional sources of income to compensate for budget reductions

d) governments of industrialised countries (driven by multinational groups) with a stake in the global strengthening of intellectual property rights protection. This agenda has been cemented with the establishment of the World Trade Organisation's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

The extension of intellectual rights to plants 'is not only mediated by the developments in technology but also by the relative power positions of different interest groups' (Menon 1995). Usha Menon shows how in Netherlands, monopoly rights over new plant varieties—introduced in 1966—coincided with an important restructuring of the industry. A strong wave of concentration took place in the 1960s in the agricultural seed sector. As large seed companies began to integrate seed breeding and seed production and to turn to foreign seed markets, their vested

interests in the development of intellectual property rights over plant varieties dramatically increased.

India's need to comply with the TRIPS Agreement by the year 2000 was an important determining factor behind the development of the breeders' rights legislation. Yet, large seed companies—especially those belonging to multinational conglomerates like ProAgro and Syngenta—have also lobbied the government for the introduction of plant breeders' rights into the country. The Seed Association of India, which represents the interests of private seed companies, has played a major role in conveying demands from the private sector to public policymakers.

The first bill on Plant Variety Protection (PVP) was introduced in December 1999. Given the controversy generated by this new bill, a Parliamentary Committee was formed and conducted public hearings in the year 2000. This translated into a relatively broad consultation with civil society organisations, leading to a more thorough definition of farmers' rights and to the inclusion of a benefit-sharing mechanism for farming communities (in recognition of their contributions to plant genetic resources).[56]

Contrary to many other laws on PVP, the Protection of Plant Varieties and Farmers' Rights Act contains a number of provisions specifically dealing with the rights of farmers, such as:

a) Farmers and farming communities are entitled to apply for the registration and protection of local varieties they have developed, provided these meet the criteria of novelty, distinctiveness, uniformity and stability established as conditions for plant variety protection.

b) The National Authority is responsible for the documentation, indexing and cataloguing of new plant varieties *and* farmers' varieties.

c) Before applying for a breeder's certificate, a breeder must provide a 'complete passport data of the parental lines from which the variety has been derived' describing the geographic location of origin of the genetic material used, along with information about any contributions from any farmer, village community, institution or organisation in breeding the variety.

d) The issuing of a breeder's certificate may be opposed on the grounds that the variety is a farmers' variety.[57]

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56. Kalpavriksh, Gene Campaign and the Research Foundation for Science, Technology and Natural Resource Policy are some of the organisations that contributed to the process of redrafting the bill.

57. This provision may prove quite useful as there are reported cases of research institutes claiming to have developed varieties that were actually bred by farmers in their own fields and popularised through informal exchange channels. One such case happened in Maharashtra, with a flavoured rice variety developed by a medium farmer locally recognised for his curiosity and success in breeding rice varieties. See Menon, M., 2001, "Rice of a rural kind", The Hindu, June 17.

e) A mechanism exists for benefit-sharing with farmers or non-governmental organisations who are 'engaged in the conservation of genetic resources of land races and wild relatives of economic plants and their improvement through selection and preservation' and who have directly contributed to the development of a protected variety by providing genetic material. Such farmers are entitled to recognition and reward from the National Gene Fund.

f) Any farmer is entitled to 'save, use, sow, exchange, share or sell his farm product including seed of a variety protected under this Act in the same manner as he was entitled before the coming into force of this Act', provided the farmer does not sell branded seed of a protected variety.

These provisions underline the originality of this law and explain why it has been hailed as a progressive legislation by defenders of farmers' rights across the globe. Yet, it also has some major shortcomings.

One shortcoming is the total absence of any reference to gender issues despite the primary role of women farmers in maintaining agricultural diversity. In a country where women's status and sphere of influence are inferior to men in the domains of resource ownership, education and means of public expression, a gender-blind legislation is inadequate as it provides no scope for enhancing women farmers' practices, choices and concerns in the realms of biodiversity and seed production. In fact, gender-blind laws directly undermine women's knowledge and management systems.

It has been rightly pointed out that even though it recognises 'community-owned' varieties, the Act:

> does not seem to have considered the heterogeneity of communities or the power relations and ideological forms of control that may be used to suppress the rights of powerless groups of the community… At the household level, it is the individual farmer (treated as male) who is recognised and not the farming family, and at the community level, it is an undifferentiated community, vaguely equated with local community, or the village. Consequently, the benefit-sharing mechanism and the emerging rights under the new Act may well benefit the male head of a farming household, undermining the knowledge and skills of women farmers and other members of the farming family, thus eroding their rights (Krishna 2004).

Another drawback of this law lies in the absence of mechanisms for assessing the impact of agricultural, technological and seed policies on resource-poor farmers. The issuing of a breeder's right on a new variety is completely disconnected from the evaluation of ecological, social and economic consequences of the introduction of this variety into a range of farming systems. This is especially concerning in the case

of transgenic varieties. Procedures for registering and protecting varieties hinge on criteria that assess the agronomic *performance* of the new variety. They do not include mechanisms to evaluate the variety's *relevance* and *appropriateness* in meeting farmers' needs and bringing solutions to the larger agricultural crisis that India is facing today.

Another failing is that the legislation does not allow for a re-orientation of public sector breeding programmes away from hybrid and transgenic varieties that severely curtail the rights of farmers to save and reuse seeds from their own harvest.

Thus, by remaining anchored in a duality between breeders and farmers, this legislation fails to consider the seed sector in its entirety, including its socio-cultural, spiritual, political and gendered dimensions. Though it does not entirely lack social and political content, the Indian Law on Plant Variety Protection and Farmers' Rights remains locked in the legal demands of international agreements. With greater imagination and political vision, it may have been possible to develop a law centred on the needs of farming communities, with breeders and other seed industry actors on the periphery and truly at the service of farmers.

New forms of regulatory and legal controls

It is still too early to assess the consequences of the new Seed Act for Indian farmers. However, the history of the seed sector in industrialised nations provides evidence that pressures from the industry to institutionalise the seed sector marginalises farmers' varieties and, over a period of time, suppresses all non-industrial sources of seeds.

As variety registration becomes compulsory, the *only* varieties that can be widely sold and distributed are those developed by the seed industry, with the following consequences:

1. The catalogue is a tool in the hands of breeders to gain a monopoly in seed markets.
2. Local seed systems and the informal seed sector are excluded by the legislation. All varieties emanating from farmers' selections, most local varieties and landraces and all non-registered improved varieties that have become a part of localised seed systems gradually disappear from farmers' fields, as has happened throughout Europe over the past three decades.
3. Farmers' selection and breeding initiatives are sidelined, with a resulting loss of local skills and innovative capacity for crop management.
4. The proportion of varieties suited to low-input agriculture and non-industrial modes of cultivation and processing declines dramatically.

Likewise, when seed certification becomes compulsory, the scope for farmers to produce farm-saved seeds declines considerably. In countries like Italy, Spain and France, the reduction in the use of farm-saved seeds (still produced by farmers for certain crops like wheat, peas, barley, etc.) goes hand in hand with the promotion of certified commercial seeds.

The recognition of Plant Breeders' Rights increases the legitimacy of breeders' rights and simultaneously decreases that of farmers' rights. This takes place through the following mechanisms:

1. By constituting itself as a profession, the breeding community has been able to turn common resources into proprietary seeds. This has altered the pre-existing logic whereby common genetic resources were managed according to plural, collective and non-binary systems of thought and innovation.
2. The existence of monopoly rights over a new plant variety makes seed-saving an act of forgery as it infringes upon a legal right.
3. Over a period of time, plant breeders start claiming royalties on farm-saved seeds of protected varieties. This is now the case in the European Union. This claim is considered to be legitimate by public institutions, and in France, the entire semi-public apparatus of the seed industry provides technical and information support for breeders to levy this royalty from farmers.
4. When disputes between breeders or seed companies and farmers have arisen over the use of farm-saved seeds, tribunals have ruled in favour of the industrial sector.

The patenting of life forms, another step in the process of enclosure of living organisms, involves radical changes in the relationship between farmers and the seed industry and opens new avenues for controlling seed technology. Four points need to be highlighted with respect to patents on genetically modified crops:

1. Farmers' exemptions, i.e. the right for farmers to use farm-saved seeds, which can be protected under plant breeders' rights regimes, is completely eliminated in the case of patented seeds (in the United States for instance).
2. The researchers' exemption, a common provision in PVP legislation aimed at enabling the exchange of genetic material amongst breeders, is inexistent in patent laws on crops and crop varieties. This considerably reduces access to genetic variability for breeders.
3. Patent claims become larger in scope as competition increases between private actors: seed companies now frequently claim patents over all varieties containing their inventions (a trait for high oleic content, for example) within a given species. This strategy can be used by private companies to control very large seed markets.

4. An oligarchic control over the transgenic seed market is clearly in place, with 95% of patents on gene transfers owned by the five largest biotechnology companies based in the United States and in Europe. In total, only ten countries account for 84% of the research and development at the world level, plus 95% of patents and over 90% of royalties and transboundary licensing fees (UNDP 1999).

Apart from their association with genetically modified crops, patents pose another major threat in the form of biopiracy. This can be defined as the violation of local knowledge and resources by foreign companies. Over the last decade, many firms and research institutes from industrialised countries have filed and obtained patents on biological resources found in the developing world, including India. Two well-known examples are the patent on turmeric granted to researchers from the University of Mississippi in 1995 and the patent on basmati rice obtained—and later revoked—by the US-based company RiceTech in 1997. The Indian government and a number of non-governmental bodies have voiced strong protest against these acts of biopiracy and come up with a range of preventive and defensive measures. At the local level, many groups are involved in documenting local knowledge systems for crops and medicinal plants. At the national level, the Council for Scientific and Industrial Research is working on a Digital Library on Traditional Knowledge, a compilation of ancient and recent knowledge on plants that, once published, will help in opposing abusive patents by establishing prior art and knowledge over a vast range of biological resources.

Transgenic crops: paving the way for a radical monopoly

One of the most striking comments recorded by Henri Mendras (1984) during his interactions with French farmers was on the legal implications of adopting hybrid varieties. Pondering on the hybridisation method and on the consequences of cross-pollinisation between hybrid maize and local maize varieties, a farmer declared: 'For me, this sets the ground for trials in the future'. At the time, many must have thought that this farmer was simply letting his imagination run a bit too wild. Forty years later, however, we can see that this farmer displayed astonishing depth of perception.

Since 1998, over 500 American and Canadian farmers have been sued by seed companies for patent infringement on transgenic plant varieties. The most well known case is that of Percy Schmeiser, a Canadian farmer accused in 1998 by Monsanto of having committed multiple infringements of one of its patented seed technologies, the herbicide-resistant Roundup Ready Canola. This accusation, and the court trial that followed, came about after a spot-check by company agents without any prior warning on some of Percy Schmeiser's canola fields. This revealed that the cultivated crop contained some of Monsanto's patented genes. As Percy

Schmeiser did not have a Technology User Agreement, he was accused of using a patented product without a license. In fact, Percy Schmeiser had been using farm-saved seeds of colza for many years and had even bred his own canola variety suited to his farm's agrosystem. The genes coding for herbicide-tolerance found in his crop were therefore the result of unwanted cross-pollinisation between his varieties and the genetically modified canola grown adjacent to his farm. It is also possible that genetically modifed seeds brought by the wind could have germinated on his land. The likelihood of such unsolicited gene transfers is fairly high given the fact that at the time, over 40% of Canadian canola farmers grew Monsanto's genetically modified variety. Gene transfers from one variety to another are very common in canola as it is a cross-pollinated crop.

In its 2001 judgment, the Federal Court of Canada ordered the farmer to pay Monsanto compensation of Can $20,000. Subsequently, hundreds of farmers have agreed to destroy their crops, to pay an indemnity and to grant Monsanto the right to inspect their accounts and their farm for several years, in an attempt to avoid costly and often devastating legal proceedings (Berlan and Lewontin 1998).

Percy Schmeiser appealed the 2001 judgment and obtained a partial undoing of the original ruling. Nevertheless, the initial phase of this court case vividly illustrates the extent of power and control exerted by seed and biotechnology companies over farmers as a result of the wide adoption of genetically modified crops. Four points stand out in this respect (Louwaars and Minderhoud 2001):

1. Any agro-chemical or seed firm owning patented varieties can freely enter a farmer's private property to take seed samples to be tested. This intrusion onto someone's property is not considered unlawful. Similarly, there are no legal restrictions on the use of private detectives to 'hunt out' farmers using 'pirated seed technology' (i.e. growing GMOs without paying royalties to the patent holder and without having signed a Technology User Agreement).
2. In legal conflicts over patented seed technology, the onus is on the farmer to prove his or her innocence, even when a) the farmer is a victim of genetic contamination from neighbouring fields and b) the farmer has not benefited from the patented technology.[58] In the *Monsanto vs. Schmeiser* case, the judge argued that intention is immaterial since 'infringement is any act that interferes with the full monopoly rights of the patentee (Monsanto)'.[59]

58. In the canola case discussed above, for instance, Percy Schmeiser did not in any way benefit from the herbicide-tolerance trait of Monsanto's canola varieties since he never sprayed his crops with the associated Roundup Ready herbicide (also a Monsanto product).

59. Mr. Justice McKay, quoted in Phillipson, M., 2001, "Agricultural law: Containing the GM revolution", *Biotechnology and Development Monitor*, No. 48, December, p.3.

3. In the case of accidental contamination, farmers lose the right to reproduce their own seeds—even if they are cultivating a local non-protected variety— since the mere presence of the patented gene in their crop makes them liable for infringing the right of a patent holder. Genetic contamination thus takes away farmers' ability to grow GM-free crops on their own land, which amounts to a radical loss of freedom for farmers.
4. There are no legal mechanisms obliging seed companies to compensate farmers incurring losses due to genetic pollution from transgenic crops. Farmers alone are responsible for testing their harvests to ensure there are no GMOs present. This is especially necessary for organic farmers, but also for conventional farmers intent on producing and selling GMO-free agricultural produce.

Thus, 'an enormous power shift is taking place in global agriculture. Traditional farming practices are being rendered illegal by the extension of patent monopolies to the fundamentals of food production' (Phillipson 2001). Evidence of this power shift includes the multiplication of lawsuits against farmers and their psychological consequences, as well as the marginalisation of farming practices that do not conform to the techno-legal principles of transgenic agriculture.

The fear of being dragged into a lawsuit has become a major reason why American farmers who have been growing GMOs for several years find it almost impossible to switch from these varieties when they are unsatisfied with the results. A series of interviews conducted with farmers growing transgenic maize and soybean varieties in the United States reveals that the costs of cultivation have increased (due to an increased use of herbicides and higher seed cost) and that transgenic varieties give, on average, lower yields than their non-transgenic counterparts.[60] When asked why they continue to grow transgenic varieties despite their worsening economic situation, many farmers assert that shifting away from genetically modified varieties puts them at risk of being sued by seed companies if their non-GMO crop contains remnants of genetically modified patented genes. The likelihood of this scenario—and the fear associated with it—largely deters American farmers from rejecting patented transgenic varieties.

Transgenic agriculture is a perfect illustration of Ivan Illich's concept of radical monopoly:

> The commercial monopoly restricts the flow of commodities; the more insidious social monopoly paralyses the output of non-marketable use-values. Radical monopolies impinge further on freedom and independence. They impose a society-wide substitution of commodities for use-values by reshaping the milieu and by 'appropriating' those of its general

60. Personal communication with Michael Hart, President of the UK-based Small and Family Farms Alliance, July-August 2002.

> characteristics which have enabled people so far to cope on their own (Illich 1976).

Through the subtle, 'unintended' combination of patent rights and contamination through gene flows, the cultivation of transgenic crops renders vast territories unsuitable for *any other mode of cultivation* for a given species. It has been shown, for instance, that the high incidence of genetic contamination in the Canadian Province of Saskatchewan has made the entire province unfit for cultivating organic or conventional canola (Soil Association 2002). This critical situation led the Saskatchewan Organic Directorate to file a class action (collective legal case) against the manufacturers of transgenic canola in October 2001 (Phillipson 2001). Moreover, the massive presence of GMOs in the seed and food chain poses a serious threat to the maintenance of GMO-free seed supply and food production, especially for maize and soybean.

This totalitarian farming system is counter-productive, not only from a social and ecological perspective, but also from an economic standpoint. Researchers from the Soil Association estimate that since 1999 the use of genetically modified soybean, maize and canola have implied costs to the tune of US $12 billion for the American economy in farm subsidies, falls in prices, loss of export markets and recalling of defective food products from the market due to widespread contamination.

The introduction of GMOs into food and farming systems has sparked opposition in many parts of Europe. In France, for instance, a resistance movement started soon after the first authorisation was granted for the commercialisation (not the cultivation) of a transgenic Bt maize variety in 1997. This movement has gained momentum and public support over the years. Direct action has been a favoured mode of intervention for the militants of the *Confédération paysanne*, subsequently joined by unaffiliated farmers, environmentalists and citizens sharing common concerns about the risks and costs of genetically modified crops.[61] Their activities, including destroying transgenic seed lots and uprooting genetically modified crops on experimental plots have been strategically chosen so as to denounce:

a) the lack of responsibility on the part of public authorities in assessing the long-term ecological, social and political consequences of GMOs

b) the involvement of public sector research institutes in the development of transgenic crops, i.e. the use of public funds for highly contested technological developments

61. The *Confédération paysanne* (Peasant Confederation) is one of the minority farmers' unions in France, as opposed to the *Fédération Nationale des Syndicats d'Exploitants Agricoles* (The National Federation of Unions of Farmers). The *Confédération paysanne* constitutes of small to medium farmers critical of the dominant model of industrial agriculture.

c) dubious research partnerships between public research institutes and private companies leading to the gratuitous transfer of public skills and resources to the private sector and to the privatisation of genetic resources through the imposition of monopoly rights

d) the fact that allowing for in-field experimentation amounts to a forceful, undemocratic introduction of transgenic plants into French territory and farmers' fields

e) the lack of transparency of research institutes that make little or no effort to inform farmers and citizens about GMO trials conducted in their locality

f) the failure by researchers (public and private) to recognise the risk posed by genetic pollution to neighbouring—and especially organic—farms and to take measures to protect local farmers from economic loss and environmental degradation

Given that the contamination of non-GM crops through genetic pollution is both inevitable and irreversible, there is consensus amongst opponents of genetic engineering across the globe that what is needed is 'zero tolerance' for GMOs. In that light, the efforts made by European institutions to come up with 'acceptable threshold levels' of GM contamination of non-GM crops and products combined with compulsory labelling and sophisticated tracing methods can be interpreted as mere *institutional remedies*. This term was coined by Ivan Illich to describe the attempt of ruling institutions to deal with the contradictions of technological development without questioning its fundamental premises.

The hidden costs of industrialisation

Illich defines counter-productivity as the paradox whereby an institution undermines the ability of people to function autonomously and produce for themselves the goods or services offered by the institution. Counter-productivity cannot be externalised, as it 'is neither due to technical mistakes nor to class exploitation but to industrially generated destruction of those environmental, social, and psychological conditions needed for the development of non-industrial or non-professional use-values. Counter-productivity is the result of an industrially induced paralysis of practical self-governing activity' (Illich 1976).[62]

The notion of counter-productivity helps us evaluate the social costs associated with modern institutions and technologies. A number of ecological economics concepts and valuation methods are also useful tools for understanding the institutionalised seed system. The well-established concept of externality refers to the 'unintended

62. Illich, I., 1976, *Limits to Medicine*, op. cit., p. 217.

cost or benefit of production or consumption that affects someone other than the one who produces it and that does not enter the market' (Kerr et al. 1997: 629). We are concerned here with externalities that impose costs on others, such as damage to the environment and losses incurred by producers who depend on the degraded resources for their livelihood and whose output, costs and productivity get hampered by environmental deterioration.

Three other valuation methods are relevant to the issues of seed and biodiversity (Kerr et al. 1997):

1. Effect on production: values the impact of environmental changes such as soil erosion, deforestation, loss of wetlands and other natural systems on livelihood activities like agriculture, forestry, fisheries.
2. Human capital: values the loss of earnings which individuals suffer as a result of environmental problems like air and water pollution, as well as the resource cost of medical treatment and health care.
3. Replacement cost: identifies the cost of restoring the environment to its original state after it has been damaged.

I use these techniques to assess the invisible costs of seed industrialisation and its impact on the localised seed sector over a significant period of time. But before turning to the 'hidden costs' of industrialisation, it is important to note that *inherent internal costs* are associated with the setting up of any seed industry in the world. These functioning costs (or calculated costs) demand large expenditures that the public sector can no longer meet alone (especially in the current context of declining public budgets for agriculture), hence the need for private funding and public-private research partnership. Large expenditures are needed in order to:

1. maintain *ex situ* collections of genetic resources used by breeders to develop new varieties
2. train professionals and specialised scientists such as molecular biologists – an infinitely more costly undertaking than training farmers to become more skilled in simple breeding techniques[63]
3. fund crop improvement and biotechnology research, which is characterised by rising research costs (due to the sophistication of technologies used in genetic engineering and plant genomics)

63. With reference to the medical sector, Illich (1980) comments that the cost of training a doctor is 6,000 times higher than the cost of training a citizen in basic healing practices. He concludes that when high sums of money have been spent to train professionals, their knowledge has to be publicly protected and appreciated. This logic partly explains why public institutions are dedicated to the growth of industrial sectors at the cost of people-centred systems of health care or seed production.

4. import technology from other countries, including genes to be used in genetic engineering programmes which tend to be extremely costly (to the tune of several million rupees)
5. establish an efficient system for the evaluation, release and registration of new varieties and for the protection of intellectual property rights over new varieties
6. develop infrastructure for the large-scale production and treatment of seeds
7. distribute commercial seeds through marketing channels and advertisement campaigns

A much cheaper approach would be for public policy to support decentralised seed systems run by farmers. This alternative would make economic sense and has in fact been defended by economists in the realm of food policies to combat famines. Amartya Sen and Jean Drèze have shown that well-targeted public support can expand people's capacity without having to wait for the—hypothetical—returns of sustained economic growth (Drèze and Sen 1989). They also point out that in the relatively poorer developing economies, small public investments can have far-reaching effects if they are in synergy with existing human potentials.

A second set of costs comprises a wide range of *externalities in the environmental and social realms*, which are not accounted for at present. If the impacts of adopting commercial varieties are to be genuinely assessed, then it is not enough only to measure increases in productivity. A cost-benefit analysis of the impact of commercial varieties must also include the following costs:

1. loss of biological diversity (domesticated and wild) and genetic variability as a result of monocultures of industrial genetically uniform varieties
2. disruption to the linkages between crops and livestock, which plays a major role in the sustainability of dryland agro-ecosystems
3. adverse effects on production linked with biodiversity loss: reduction in farmers' capacity to make their land productive and rising costs of production due to the increased need for chemical inputs
4. declining human health due to the toxicity of chemical inputs linked to hybrid varieties; this represents a threat to human capital
5. environmental and genetic pollution associated with the use of commercial seeds and chemical inputs (soil, water, ecosystems)
6. genetic pollution—which is irreversible—as a result of the introduction of genetically modified organisms into farming systems
7. expansion of child labour (hired in contractual seed production) and related social consequences on education and health

8. widening gender inequity due to men's increased control over seeds and crops
9. energy spent in industrial processes of seed production and transportation of seeds over long distances (including gas emissions from long-distance transportation)

If these externalities were to be taken into consideration and remedies sought, then a third set of *restoration costs* would have to be borne by public institutions or private actors to:

1. restore biodiversity and damaged ecosystems
2. reintroduce diversity into breeding programmes by progressively enlarging the gene pool tapped into by breeders (an operation that has been attempted by French agricultural research centres and found to be very costly)
3. compensate farmers who lose a crop through poor quality seeds
4. rehabilitate farmers whose livelihoods are destroyed by rising indebtedness

Finally, the processes of industrialisation and institutionalisation in the seed sector contain an inherent *counter-productivity* in that they undermine the very basis of autonomous seed production by:

6. degrading farmers' knowledge systems and innovation capacity: the introduction of commercial seeds leads to a gradual decline in seed-saving practices and to subsequent loss of local knowledge on maintaining agro-diversity, traditional breeding, seed selection, seed production and storage
7. destroying an activity that provides a living for marginal and landless farmers, especially in female-headed households
8. undermining solidarity networks on which poor rural households critically rely
9. undermining women's status and intra-household bargaining power as their role in seed and grain management is eroded by market forces
10. destroying localised seed economies: seed regulations hamper farmer-to-farmer seed exchanges that have been shown to reinforce ecological sustainability and to secure livelihood and social capital in rural communities

In countries like France where the seed industry has been developing over the last five decades, there is clear evidence that farmers' localised seed systems get progressively displaced by the advent of the seed industry combined with biased seed regulations. Figure 8 models the growth of the seed industry in France during the period 1950-2000 (each step accounting roughly for a decade) and the subsequent decline of farmer-centred seed systems. The displacement of non-industrial seeds has given rise, in recent years, to a growing resistance movement. Throughout Europe, groups of farmers—in particular of organic farmers—are

organising themselves with the aim to regain control over seeds, to re-learn on-farm seed selection and storage and to re-establish farmer-to-farmer seed exchange networks. They are also increasingly questioning the logic of dominant seed regulations and demanding that spaces for the conservation and use of local crop varieties be provided in the European legislation.

However, the 'hidden' costs of industrialisation largely remain invisible because of a blind belief in economic development, the cult of 'expertise' and the absence of suitable criteria for measuring the ecological and social impacts of new technologies.

In India, the fragmentation of knowledge and the lack of interaction between scientists and farmers mean that 'experts' have a limited understanding of: a) the complexity of dryland farming systems and their inherent instability; b) the structures of inequity in villages, which are replicated through processes of technology adoption; c) the multiple values of subsistence farming; d) gender differences in cropping strategies and varietal preferences; and e) farmers' role in perpetuating agrobiodiversity.

Furthermore, neo-liberal economic theories promote an individual rationality that leaves no room for collective action and co-management of resources at the community level. The functioning of the market economy is such that a point comes where, 'in order to go on functioning, the market sphere has to make such high levies on the non-monetary economy that global well-being is bound to diminish' (Passet 1996).

This observation strongly suggests that for local non-monetary seed systems to remain in existence, some changes have to take place in the institutional system itself. Ivan Illich puts forth the idea of a synergy whereby the heteronomous system poses limits to its own development and seeks to foster autonomy-based modes of production and sharing. This is a political task involving civil society as a whole and not merely technicians or policymakers.

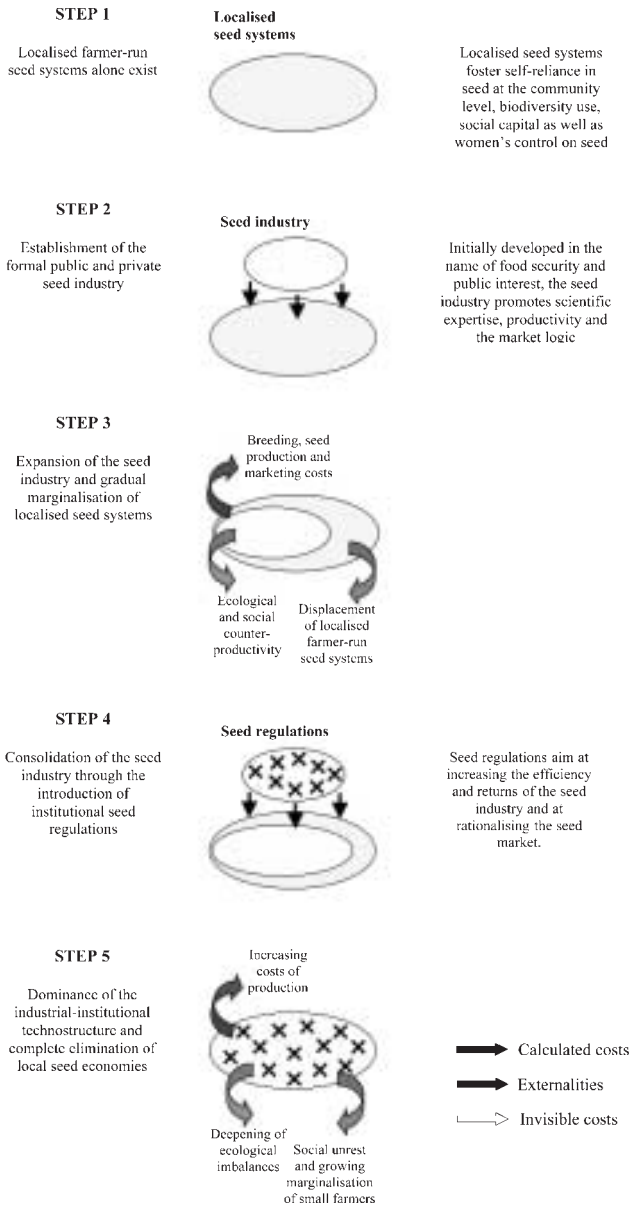

Figure 8: Transformation of the seed sector over a five-decade period

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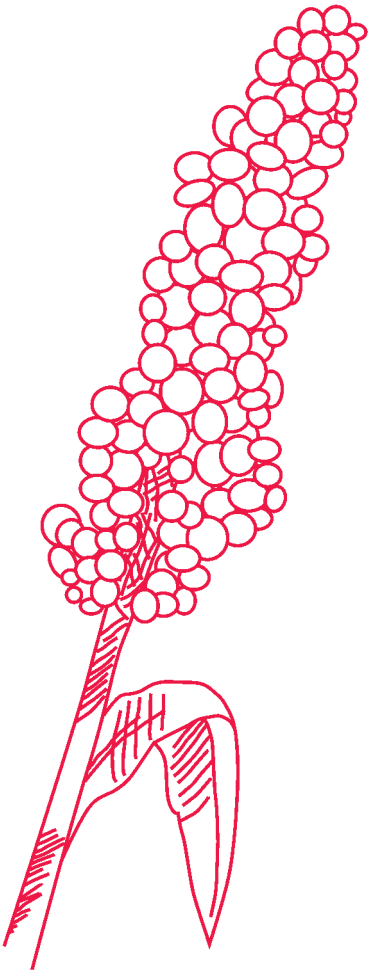

The agro-food industry: concentration and control

The globalisation of economies is associated with the restructuring of many sectors including scientific research, technological innovation, health, education and agricultural production.

Companies involved in the production and trade of pharmaceuticals, agro-food products, chemical inputs and compounds and seeds are investing in the expanding knowledge economy. New technologies involve novel approaches in research and development, communication and information analysis. Intellectual property has become the main and virtually unchallenged way of protecting innovation and expanding market shares. The analysis of supply structures shows that it is 'the property and control over non-tangible assets, especially information, trademarks and patents, rather than control over tangible means of production' that determine the power of economic actors today (Pimbert et al. 2001).

Simultaneously, large companies are exerting a growing influence on regulating bodies, decision-makers and national or international policies. The drafting of the TRIPS Agreement is a good example of the direct involvement of industrialists in policymaking. The agreement is based on a draft submitted by the Committee for Intellectual Property, a group of multinational firms with vested interests in protecting technological innovations in their respective fields (including mechanical equipment, agro-chemicals, pharmaceuticals, cosmetics, communication, informatics…).

Due to increasing costs of innovation and the privatisation of research, the number of mergers and acquisitions has skyrocketed in three major domains of economic activity: computer sciences, biotechnologies and communication. In fact, 'in all sectors featuring a high knowledge content, a small closed circle of firms controls increasingly large shares of the world market' (Bonnanno et al. 1995).

In the agro-food sector, high levels of concentration exist not only in the agro-chemical industry, but also in the domains of food-processing and marketing of agricultural inputs and food. Three major companies (Nestlé, Philip Morris and Unilever) dominate the food-processing sector in the United States. Food distribution via supermarkets is also undergoing a phase of concentration, especially in the European Union. Trade liberalisation has enabled three supermarket chains (Carrefour, Ahold and Wal-Mart) to acquire a truly global dimension since 1992.

Concentration is just one of the consequences of industrialisation and globalisation of the agro-food sector. Vertical coordination and horizontal integration, technological change, deregulation and trade liberalisation are some of the other recent trends.

The expansion of agro-industrial capital

Large firms have played an instrumental role in reshaping agricultural production all over the world. Their involvement in the agricultural sector goes back to the post-war period, and is closely intertwined with the United States' self-appointed role as a major food exporter between 1945 and 1960. Initially part of a 'food aid' campaign, grain transfers from the United States to Europe and to countries like India and the Philippines soon became part of a massive effort to expand bilateral trade with countries dependent on grain imports.

International trade of agricultural produce and food items is increasingly controlled by a small number of multinational companies. A recent study showed that five large companies control 90% of world trade in wheat, maize, coffee, cacao and pineapple, 80% of the trade in tea, 70% of the banana and rice market and 60% of the sugar market (Torres et al. 2000). In the case of milk, meat, cereals, tropical fruit and beverages, world trade already featured high levels of concentration in the early 1980s. This trend has only become more accentuated. Today, five transnational companies control more than 50% of the fresh fruit and vegetable export market in Chile.

Agro-industrial firms extend their control over farms and markets through various means. Horizontal integration is the expansion of a company's operations in a given production stage, a process which often takes place through the creation of subsidiary firms in various geographical locations. The strategy of horizontal integration involves 'the global coordination of multiple production sites for a year-round supply of fresh produce' (McMichael 1998). Vertical integration refers to the expansion of a company's activities into various production stages in order to gain control over an entire sector.

Vertical integration in industrial bread manufacturing means, for instance, that a company controls the entire production chain from the intensive cultivation of wheat varieties to the packaging and marketing of packaged bread. Agro-food companies exert a growing influence on modes of cultivation. A good example is the way in

32 Agro-industrial control and varietal diversity: the case of durum cultivation in France

Every year, agro-food processing industries conduct a series of cultivation and processing trials on new crop varieties. Based on their results and needs, they release a *List of Preferred Varieties.* Many farmers pay close attention to this list since growing a recommended variety is a security towards being able to sell one's crop. This system is well-established in France for wheat, durum and barley; three crops that are processed and marketed, respectively, by the wheat milling and biscuit industry; by the pasta industry; and by the brewing industry. In each of these sectors, the largest agro-industrial groups have created professional associations that jointly release lists of recommended varieties.

In the case of durum, the *Comité Français de la Semoulerie* (French Committee on Durum-based Agro-industries) identified 26 varieties (out of 71 varieties present on the market) in 2002. Five varieties occupied 63% of the area sown to durum that year, and four of these appeared on the list of recommended varieties

This clearly demonstrates the influence of recommended lists of varieties on farmers' varietal choices, on the incidence of varietal diversity and on relations between farmers, breeders and industrialists. This influence has wide-ranging consequences for farming in Europe, including:

1. a decline in the scope for farmers to make independent decisions about crop varieties and farming methods

2. a decrease in crop genetic diversity due to the dominance of a very limited number of varieties, with adverse ecological consequences (erosion of crop diversity and wild relatives, widespread use of chemical inputs and plant protection treatments leading to the pollution of water tables and the degradation of agroecosystems)

3. a reduction in the selection criteria retained by breeders eager to see their varieties appear on the industry's listings in order to increase the chances of high returns from a given variety[64]

4. a lack of breeding effort to develop varieties suited to non-industrial production and transformation systems (which entails favouring criteria of rusticity, adaptability to crop mixtures, taste and nutritional content)

5. a growing concentration of actors in the breeding sector, both at the national and international levels

64. The survival of medium and small breeders does depend a lot on the commercial success of their varieties. Competition amongst breeders has increased in recent years due to the high turn-over rate of varieties, the large costs involved in developing new varieties and the increasing presence of large agro-industrial conglomerates like the Groupe InVivo (ex-Sigma), Syngenta or Novartis in the breeding sector. Many of these firms have entered into the plant breeding sector either by purchasing small plant breeding companies with a long experience in the field (the strategy pursued by Novartis), or by establishing commercial agreements with well-established plant breeding companies in different countries (Monsanto's strategy).

which they influence varietal choices made by farmers through the release of lists of recommended varieties. This practice is fast expanding in cereal production, especially for crops like durum and barley. For these crops, agricultural output is almost entirely purchased by large agro-industrial conglomerates involved, respectively, in the manufacturing of pasta and related products and in the brewing of malt for beer production (Box 32).

Contract farming: undermining farmers' autonomy

An important aspect of vertical integration is contractual agricultural production which develops new forms of relations between farmers and an agro-industrial firm. Contract farming is a form of social organisation in which 'plants and animals are produced on land in relation to the complex and changing profit conditions of global competition… It is a means to introduce distinctive work routines, new on-farm technologies and labour processes, a further concentration of capital in agro-food systems and, not least, to deepen the form of appropriation by which rural production processes are converted into industrial products by agro-industrial capital' (Watts 1990).

Contract farming considerably increases the power of agro-industrial companies and it 'shifts the locus of control away from the farm toward the agro-industrial enterprise. Crucial decisions about what to produce and how much are settled by fluctuations of world commodity markets' rather than by national plans, domestic markets and local needs (Nanda 1995). Agro-exports not only reconfigure local landscapes but they also affect agricultural labour, who constitute one of the most vulnerable sections in agriculture.

Contract production is very prominent in the horticultural and tree crops, floriculture and industrial animal husbandry sectors. In Asia and Latin America, rubber, cocoa, palm oil, tea and banana plantations are generally managed through contract farming by transnational corporations and in certain cases by state-run agencies. In the United States, 90% of chicken farms and 20% of pig farms were integrated into agro-industrial conglomerates in 1994 (Hamilton 1994). This mode of production is supposed to meet higher quality norms—quality being understood in the narrow context of industrial transformation processes—and to reduce commercialisation costs for the industry.

In India, contract farming is also fast developing. One instance is the Kuppam project initiated in 1997 by an Indian corporation (M/s BHC Agro) with support from the Government of Andhra Pradesh (under the rule of the Telugu Desam Party). Export crops such as potatoes, gerkhins and chillies are grown using expensive imported Israeli technologies for dryland farming. The land is leased from small and medium farmers who are offered work as labourers on the consolidated holding managed by the company. Promoted by the government as a model of modern agriculture, the

pilot project has nonetheless come under heavily criticism based on environmental and social grounds (Chowdry et al. 2000).

The question of social bonds in the context of industrialised agriculture has been a preoccupation of American rural sociologists like Walter Goldschmidt. Although marginalised in the wider literature on agriculture, this work draws important conclusions about the relationship between the structure of agriculture and food production and the social status of farming communities. A study done in the 1950s in California compared communities characterised by very large farms controlled by absentee landowners and integrated into the agro-food industry, with communities where a large number of family farms still remained and where social cohesion and cooperation were also fairly high.[65] It revealed that the former communities had a much lower level of social well-being than the latter.

This finding is of great significance as it allows us to grasp the danger of agricultural policies that directly or indirectly dismantle and eradicate the family farm. This applies not only to Western Europe and North America, but also to Eastern Europe and many Asian, Latin American and African countries.

Property rights over tailored transgenic crops

Third generation genetically modified crops focusing on nutritional value and health-related concerns considerably enlarge the scope for contract production. Many agro-industrial companies are investing in plant breeding research to develop transgenic varieties with certain qualities—such as fruit with a low sugar content or maize with high-oleic content—targeted at niche markets. Seed and agro-food companies then contract growers to produce these value-added or 'identity-preserved' crops. The companies then buy up a pre-determined volume of harvest which they manufacture and market as industrial food products. Companies generally provide seeds to the contract farmers. American agro-industrial firms like DuPont and Archer-Daniels-Midland in the United States are currently developing identity-preserved products (Mooney 1995). These crops are hailed by the agro-food industry as 'the future of agriculture' because of the market opportunities and price premiums they are claimed to provide for North American farmers.

Yet the maximisation of returns for agro-industrial capital is based on the lowest possible price for purchased raw material and the largest possible sale of sophisticated production technologies; two trends which largely go against the interests of agricultural producers. A study of the interplay between contract production and intellectual property rights in agriculture shows that contracts enable companies to (Hamilton 1994):

1. control production technologies and methods and input choices (some of the recommended technologies are often manufactured by the company itself)

65. Unpublished study by Walter Goldschmidt discussed in Hefferman, W., 1998, op. cit., pp. 58-59.

2. set the quantity and the price of crops purchased without any obligation to buy a farmers' entire crop
3. organise marketing channels between processors and consumers and preserve confidentiality over pricing and marketing strategies
4. control the release of specialised crop genetics developed for an added-value trait to ensure maximum returns
5. invest in value-added crop breeding and genetic engineering without having to own and manage land and production facilities

Together, these factors explain why many companies traditionally involved in agricultural sales, such as seed companies, chemical manufacturers and grain traders are now contracting farmers to produce commodities. By controlling the development and use of identity-preserved transgenic crops, firms can prohibit the unauthorised reproduction of the crop. Production contracts thus serve as an additional form of intellectual property right protection.

Economic liberalisation and the decline of family farms

The agricultural policies adopted by industrialised countries since the 1950s have led to the specialisation of regions and farms. Regional specialisation—at the national or international level—favours the establishment of agro-industrial supply and transformation chains and, consequently, the industrial control over the means of production and over decision-making throughout the global agri-food system (Pimbert et al. 2001). It also leads to severe ecological imbalances including the rupture of the biochemical nutrient cycle.

Trade liberalisation only accentuates specialisation, as each region or country is supposed to focus on the areas of production for which it has comparative advantage in terms of growing conditions and means of production (land, labour and capital). The globalisation of trade in food results in the gradual and steady lowering of agricultural prices. It also accelerates the dismantling of local economies and deepens the dependency of farmers on agro-industrial firms. The transportation of agricultural commodities over long distances is an important source of air pollution and has given rise, over the past two decades, to numerous public health problems linked to the deteriorating quality of food (Lucas 2001).

Another outcome of current agricultural policies has been the increase in the size of farms, linked to the uneven adoption of technological progress. Studies of the history of industrialised agriculture show that 'since the beginning of the [20th] century, productivity gains in agriculture and in the industry have led to the progressive elimination of the least equipped and least productive farms. In the end, the only farms that remain in existence are the ones that have had, one generation after

another, the means of adopting the most productive production systems' (Mazoyer and Roudart 1998).

The concentration of farms in the United States is such that in the mid-1990s, 50% of agricultural produce came from 2% of farms (those of 1,000 hectares and above; McMichael 1998). Farming in the United States has become a high-risk activity, and most American farmers rely on off-farm income. Despite the steady increase in the volume of exported agricultural produce between 1965 and 1995, the average revenue for American farmers has stagnated, showing that where agriculture is controlled by agri-business, most farmers do not benefit from rises in productivity and increased sales of agricultural commodities.

In the European Union, more than 500,000 agricultural jobs disappear every year, partly due to the development of new forms of sharecropping arrangements: agro-enterprise farms invest in equipment and cultivate leased land. This farming arrangement became popular in strawberry production in California in the mid-1980s (Wells 1987). Alternatively, contractors owning equipment are called upon by farmers to perform specific tasks (spraying, harvesting…) which decreases—and sometimes completely eliminates—the need for hired agricultural labour. French and British farmers testify to the increasing importance of this practice, often referred to as a step in the process of 'corporatisation' of family farming in Europe.

The decline in farming as a livelihood and as a land management strategy has deep consequences both for society and ecology. In the United Kingdom, 49% of counties no longer have a school, 43% do not have a post office, 75% have been cut off from public transportation systems and 83% no longer have a doctor (Lucas 2001). From an environmental standpoint, the decline of farmlands may be accompanied by a reduction in the local flora and fauna, problems like soil erosion and water runoff in dry regions and drastic change in landscapes.

Disillusionment with trade liberalisation in the developing world

The Agreement on Agriculture (AoA) of the World Trade Organisation (WTO) aims to enhance world trade in agricultural products by lowering tariffs and non-trade barriers. Three areas are targeted in the AoA: enhanced market access, reduced domestic support measures and the elimination of export subsidies. All member countries of the World Trade Organisation have to modify their internal policies in order to comply with the agreement. The AoA contains specific provisions for developing countries in recognition of the structural difficulties they face in agriculture and agricultural policies. In spite of this, the positive impact announced at the signing of the GATT agreement in 1994 has not materialised in developing countries in general and in India in particular.

First, developed countries have retained high levels of export subsidies, leading to trade distortions on the world market. This is a major drawback for developing countries where agriculture is virtually unsubsidised. In India, non-product specific support, which includes subsidies on fertiliser, credit, electricity, irrigation and seed, amounted to 6.5% of total agricultural output in 1999. But subsidies accounted for 49% of total agricultural output in the European Union, 24% in the United States and 65% in Japan that same year.

Secondly, the entry of highly subsidised agricultural products into developing markets and the removal of trade barriers has proved to be a source of instability and risk for Indian farmers. Massive imports of cheap edible oils from Malaysia, Indonesia, the US and Brazil between 1995 and 2000 progressively made oilseed cultivation unremunerative for Indian farmers. This resulted in drastic losses for oilseed cultivators and in the closing down of many oil extraction units (Muralidharan 2001). The self-sufficiency in oilseeds achieved during the previous decade was also annihilated.

Thirdly, the opening up of the agricultural sector to international trade came about during a period of instability. The early 1990s saw the expansion of horticulture and the spread of cash crops (such as cotton and oilseeds) in response to changing patterns of demand and improved price incentives, especially in Southern and Western India. Yet, because of inadequate infrastructure and market facilities and reduced public support and investments in agriculture, the expansion of cash crops has only led to higher cultivation costs and greater risk for farmers. Thus, 'the path of uncritical technological upgradation of small and marginal farmers has proved to be unsustainable, particularly in fragile environments' (Damodaran 2001).

Well aware of these alarming trends, a number of State governments and the Central government made several proposals to alter the WTO Agreement on Agriculture in 2001. These included the creation of a 'Food Security Box' which would reintroduce the right of governments of poor countries to provide domestic support to their agriculture to enhance food security and protect livelihoods. India also demanded that industrialised nations undertake substantial and meaningful reforms to reduce their farming subsidies and to provide adequate market opportunities for exporting countries.

Some researchers argue for a proactive reading and implementation of the AoA based on the needs of agrarian economies of countries like India and on the notion of ecosystemic multifunctionality (Box 33).

Thus, pressures on agriculture from technological developments, the restructuring of modes of production and market liberalisation have had a two-pronged impact: intensification, specialisation and concentration of farms in the well-endowed regions; and marginalisation and abandonment of farms in the poorly-endowed regions (EC 2000). This scenario applies both to industrialised countries and to developing nations. Indeed, as the President of the UK-based Small and Family

33 An alternative perspective on the Agreement on Agriculture: towards a recognition of agro-ecosystemic multifunctionality

India and other countries with a large rural population have expressed concerns over the likely adverse impact of the Agreement on Agriculture on their food and livelihood systems. Since the agreement emphasises the relevance of 'income support' and 'income diversification', it may be possible for developing countries to develop ways of protecting livelihood systems from damaging imports and to create reduced subsidy regimes for the vulnerable sections of rural society.

Farming systems in India have a distinct pattern of natural resource use based on the dual functioning of agriculture lands as private and common property resources. Large tracts of farmlands have community functions, like the grazing of cattle on harvested fields or the collection of weeds as edible food and fodder plants. In addition, agriculture is a source of livelihood, employment, food and health for millions of farmers. Likewise, livestock have traditionally been 'a means of yielding proteins and energy for India's traditional farming communities and a means of 'survival' and subsistence during natural calamities'.

In view of these facts, India and other developing countries could argue for special treatment of their agrarian economies on the grounds of agro-ecosystemic functionality, which contributes to agro-biodiversity conservation, sustainable livelihoods and employment avenues for the poorer sections of rural communities. This concept thus goes further than the notion of multifunctionality put forward by the European Community to make a case for the protection of its agriculture based on ecological grounds and on the externality principle. Further, India could argue for the AoA to change existing rules on domestic support to achieve the following:

- recognising the important role of common property resources in the income diversification strategy of the rural poor
- adopting more diversified resource generation programmes in wasteland development to improve the income base of resource-poor farmers
- conceiving livestock not just as a 'factor of production' but also as a subsistence asset to be used by poorer sections of farming communities as a livelihood insurance mechanism

Source: Damodaran, A., 2001, "WTO Agriculture Agreement, Common Property Resources and Income Diversification Strategy", Economic and Political Weekly*, September 22.*

Farms Alliance puts it, 'the agricultural crisis is global': it affects Mexican, Indian, Kenyan and Polish farmers alike, albeit with varying degrees of economic, social, political and psychological consequences. The crisis in the farming sector is so pervasive that its existence can no longer be ignored by policymakers. It can only be remedied through global solutions and strategies anchored in the political realm.

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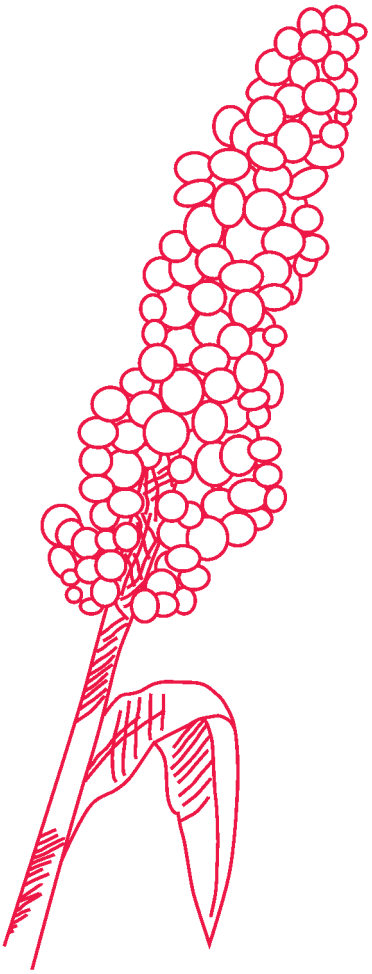

Conclusion: Reclaiming autonomy

Perhaps one of the greatest challenges facing world leaders today is to reverse the present trend of progressive elimination of the least productive and least competitive family farms which provide a livelihood for over a quarter of the world's population. A corollary goal is to develop more sustainable and democratic agri-food systems.

While a section of economists continues to see new technological developments in agriculture as the only way ahead, a growing number of agro-economists argues in favour of a prolonged, steady and significant rise in the price of basic agricultural commodities. The major impacts of this measure would be to substantially increase the revenues of small non-competitive farms and thus to limit the rural exodus (Mazoyer and Roudart 1998). This approach would mean increasing research and policy support to the least productive farming systems. In other words, we need to reverse the current trend of channelling funds and increasingly sophisticated technologies into capitalist export-oriented agriculture, which happens to be the most immediately competitive.

In order to implement such a strategy, some researchers suggest reorganising world trade based on regional groupings of countries with similar levels of agricultural equipment and productivity. More balanced national agricultural policies are also needed, which aim to ensure economic sustainability of less endowed regions and to safeguard the poorest farming economies. Furthermore, 'access to competitive markets for both agricultural inputs and outputs is key to the economic viability of independent farms and maintaining a decentralised—and democratic—food production system' (Pimbert et al. 2001: 15)

Another key component of an alternative food and agriculture scenario would be to relocalise the food economy, to promote linkages between farming communities and urban citizens and to bring farmers into decisions on policies and technologies that structure the food system (Pimbert et al. 2001). Centring food supplies around

produce that is grown locally would limit the amount of energy used for transporting exotic commodities across the world. Relocalising the economy also implies reviving informal exchange networks and promoting non-monetary values.

There are strong reasons why localised, low-input and diversity-based farming systems need to be actively supported. Below, I outline some of these reasons and set out an agenda for building up seed systems that meet the needs of small and marginal farmers.

Guiding principles

Four major objectives underlie the need to support family farms and dryland agriculture in rainfed areas:

1. Preserving the future of small farmers because:
   a) if their natural resource base is protected and regenerated, rural regions can support diversified livelihoods for rural inhabitants
   b) large cities do not offer very hopeful prospects for sustained and well-paid work for rural migrants
   c) human occupation of land is essential in semi-arid areas
   d) the cultural diversity of dryland regions is intimately linked to rural life and to interactions between people and their immediate environment
2. Ensuring economic viability of low-input dryland farming because:
   a) dryland farms could become more productive and less risk-prone with more adequate pricing, subsidies and credit policies
   b) the superiority of dryland agriculture over irrigated agriculture in terms of energetic productivity (i.e. when all inputs including water, energy, biomass, etc… are factored in) is increasingly recognised
   c) dryland farming is at least partly re-oriented towards meeting subsistence needs and not expected to generate profits for the corporate sector
   d) the non-monetary nature of local agrarian economies should be upheld and protected, and re-introduced where the market logic has failed to secure sustainable livelihoods for small farmers.
3. Increasing the participation of women in decision-making because:
   a) women are responsible for ensuring household food security
   b) women are responsible for all reproductive activities, failing to meet their needs reduces the health of their families and ecosystems (Sudarshan 2001)
   c) rural women are experts in biodiversity management

d) the ratio of rural female-headed households is rising, especially in dryland areas where male migrations are increasing

4. Maintaining agrobiodiversity in farmers' fields because:

a) agrobiodiversity is one of the most essential assets of low-input farming systems

b) small farmers' livelihood strategies depend on crop and livestock diversity

c) on-farm conservation of plant diversity (both domesticated, semi-wild and wild species) cannot be replaced by any other mode of resource conservation

d) the preservation of local varieties is a necessary condition for farmers' control over seeds and genetic resources

e) agrobiodiversity must continue to play a vital role in meeting future needs of humanity and in enabling adaptation of societies to environmental changes

Building synergies

Seed being central to farming strategies, it is essential to rethink the development of seed systems in accordance with the principles stated above.

It would be illusory to think that the seed industry can be done away with. Private players in the seed industry are well-established and they are exerting more and more influence on the agenda of the public sector. The fact that most public research institutes now work on the development of genetically engineered crops—despite the multiple layers of risks and dependencies associated with them—is a case in point.

What is possible, however, is to build synergies between the institutional sector and the informal sector as suggested by Ivan Illich. For a balance to emerge between heteronomy and autonomy, the institutional system has to be re-oriented so as to be in synergy with localised systems of innovation, production and exchange of seeds.

1. Farmer-led participatory breeding

The best way of making plant breeding more appropriate to farmers' needs would be through farmer-led participatory breeding programmes in public research institutes. This form of collaborative work between farmers and breeders (or agricultural scientists) entails a change in the dominant research paradigm. The dominant models of transfer of technology and hierarchical relations between specialised and vernacular forms of knowledge need to be completely put aside to allow more flexible and dynamic research approaches, centred around farmers' realities and challenges, to emerge.

Developing farmer-led breeding approaches involves:

- working with local germplasm: farmers' varieties become the starting point in varietal selection

- identifying local capacities in terms of seed selection and breeding
- allowing farmers to define breeding goals based on their own criteria
- accepting a change of breeding criteria from conventional issues of productivity and pest resistance to broader notions of low-input, yield stability and fodder quality
- making such collaborations more accessible to women

2. Decentralisation of the seed sector

Decentralising the seed sector requires a commitment by researchers, public seed agencies and policymakers to community-based actions. Practical steps to achieve this centre around two main areas:

a) Strengthening local seed systems

- recognise women's knowledge and expertise in seed selection, production and storage and a commitment to sustain this knowledge
- provide training for landless women to take part in village seed production (for local food crops but also for tree crops and medicinal plants)
- extend support for community gene banks which improve farmers' access to seed for local varieties, reduce small farmers' dependence on large farmers and act as seed insurance systems in the event of large-scale crop losses
- encourage the circulation of seeds at the regional level
- help farmers to develop certification schemes based on local criteria to guarantee seed quality

b) Reinforcing diversity-based farming systems:

- document local practices which conserve biodiversity
- increase the viability of such practices through incentives such as adequate pricing systems and subsidised access to organic manure
- provide low-cost methods for long-term grain storage as well as processing technologies for local dryland crops
- increase the resilience of dryland agro-ecosystems to environmental change (through research on climate change and its impact on plant biodiversity, for instance)
- limit the adoption of costly technologies and inputs that generate dependence (like pesticides that lead to resistance among pests)
- democratise local institutions and introduce the goal of gender equity in regimes of access and control over productive resources

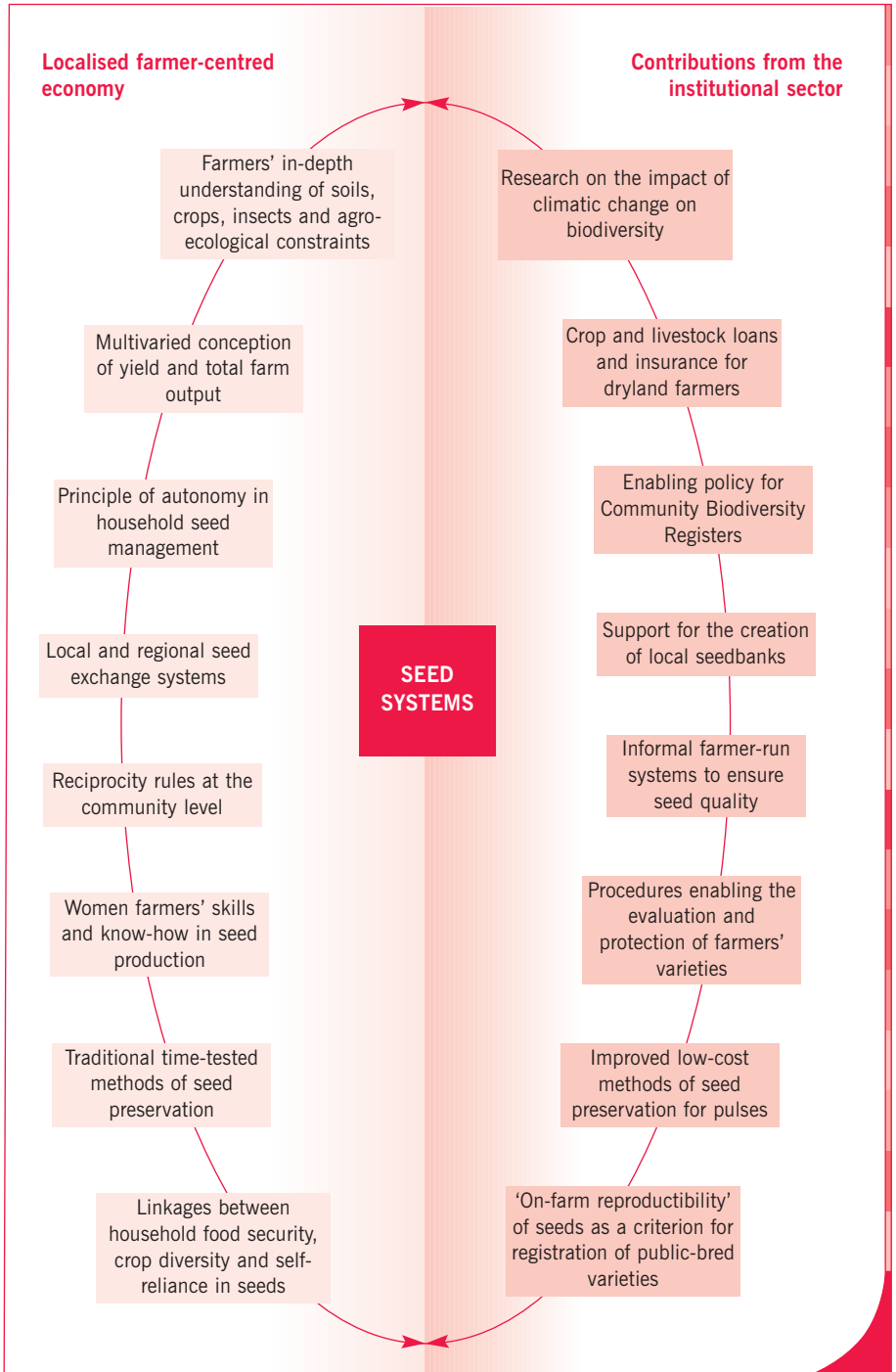

Figure 9: Synergy between the informal and formal seed systems

3. Institutional and legal changes

Recent studies show that in risk-prone and marginalised environments, the informal seed sector is more efficient at meeting farmers' seed needs than the organised sector (both public and private sector). Scientists from the International Plant Genetic Resources Institute write: 'In view of the dual agricultural structure in many developing countries and the one-sided concentration on high yields as a primary breeding goal, the responsibility for the public/formal sector for the promotion of a seed multiplication programme for food crops which is geared to the requirements and structure of the informal sector cannot be emphasized sufficiently' (Franzen et al. 1996).

In our view, an institutional strategy aimed at supporting the farming sector should be based on two principles:

(1) Farmers' seeds should not come under the same regime as commercial seeds; instead a specific support system has to be thought out in order to accommodate the needs and vulnerabilities of an autonomy-based seed system. There has to be a reversal of current trends where the development of the industrial system is encouraged through indirect subsidies, incentives and regulations. This tacit support to the private commercial seed sector on the part of public institutions undermines localised seed systems and needs to be rethought.

(2) In the defence of public interest, the public sector has to take responsibility for monitoring and corporate activities and imposing controls on activities that pose a threat on the environment, health, society, and human dignity.

These principles can be implemented through the following changes:

a) Greater focus on localised seed systems and farmers' rights:

- institutionalise participation in public breeding programmes
- institutionalise processes of consultation with farmers (including women farmers) when creating seed and agricultural policies
- ensure that all new varieties developed by public breeding institutes can be reproduced on-farm
- protect non-monetary seed exchange systems (by relaxing registration, certification and protection rules that limit local breeding initiatives or seed exchange amongst farmers, for example)
- strengthen farmers' rights on local crop varieties and penalise Indian and foreign breeders violating these rights

b) Surveillance of corporate practices:

- undertake systematic evaluation of the environmental impact of new technologies (farmers, independent observers and public servants should form joint evaluation committees)
- monitor the commercial seed, agro-chemical and biotech sectors to avoid technologies, propaganda and commercial arrangements (contracts, technology-user agreements…) that directly or indirectly threaten the cultivation, production and exchange of farmers' local varieties
- make private corporations accountable for any damage caused to farmers (intentionally or unintentionally) through genetic pollution, spurious seeds, false propaganda about pesticides, etc.
- impose limits on the royalties claimed by breeders and adopt a clear position that there should be no patenting of plant and animal life

Rethinking power relations and political action

The idea of rethinking power relations is consistent with the goals of political ecology, feminist scholarship and participatory democracy (see Chapter 1). All three approaches aim to: a) empower marginalised groups; b) include marginalised groups in policymaking processes; c) develop a political debate conceived and shaped by the people who directly depend on the sustainable use of natural resources.

One of the main prerequisites for the empowerment of small women farmers is a change in power relations at three levels: in the household, between men and women; at the community level, between field extension workers and women farmers; and at the national level, between researchers and farmers on the one hand, and between policymakers and women farmers on the other. A number of feminist researchers have shown that in India women are in a better position to play an active part in community decision-making when they have already formed themselves into groups. In other words, political education is a major dimension of empowerment.

The participation of marginalised groups in policy arenas is illustrated by the development of citizens' juries focusing either on given technologies (like genetically modified organisms) or on broader development agendas, as in the case of *Prajateerpu* – a citizen's jury held in Zaheerabad in 2001—which addressed food and farming futures for Andhra Pradesh (Pimbert and Wakeford 2002).

What is most striking about such processes is that they often lead to the emergence of sharp and pointed critiques of technological development. For instance, *Prajateerpu* provided a forum for a collective and grounded critical analysis of the failures of specific technologies and policies but also of the ways in which they inhibit people's capacities to use local resources and knowledge. When empowered

to speak for themselves, small women farmers can, perhaps better than anyone else, make a case for the counter-productivity of a whole array of 'development schemes' that adversely affect their livelihoods and freedom.

Farmers can speak from their own realities and steer a debate with scientists or policymakers towards central livelihood issues. Women farmers often bring forward their perceptions of the natural world to express the need for posing limits to technological development. For example, after hearing about gene transfers from a salmon to a tomato, Deevanama, one of the women jurors in *Prajateerpu*, vehemently declared to a scientist defending the merits of genetic engineering: 'You can take your knowledge and throw it to the bottom of the sea so that it never comes back again.'

This shows that women farmers do not hesitate to act on inner feelings and intuitions to dismiss the options proposed by 'experts'. Similarly, when women farmers speak of the diversity of crops on their farms, they raise the fact that this diversity ensures their families a balanced nutrition, reduces the risk of harvest failure and limits cultivation costs. But beyond these more or less pragmatic concerns, crop diversity clearly resonates with their beliefs and appeals to their aesthetic and culinary senses.

It is time, perhaps, that such perceptions entered into the political domain, which has until now remained too closely associated with the ideology of progress and too closely tied up with concerns of power and command in the global economy. Shiv Viswanathan speaks of the need for a 'democratic imagination' in order to do away with 'the politics of control [that] still speaks the language of science and management' (Viswanathan 2002).

There is an urgent need for policymakers and technocrats to be more attentive to this democratic imagination and to surrender control by allowing dissenting views to inform political debates. Indeed, no number of development schemes or food, agricultural and seed policies developed by external agents can replace the multitude of ideas that germinate in the minds of rural people when they are empowered to find their own solutions.

Bibliography

Adolph, B., Butterworth, J., Satheesh, PV. et al. (2002) *Soil Fertility Management in Semi-arid India: Its role in agricultural systems and the livelihoods of poor people.* Natural Resources Institute, Chatham, Deccan Development Society, Hyderabad and BAIF Institute of Rural Development, Bangalore.

Agarwal, A. (1997) 'Dying wisdom: rise and fall of traditional water harvesting systems in India', *Down to Earth*, March 15, pp. 27-39.

Agarwal, B. (1994) *A Field of One's Own. Gender and land rights in South Asia*, Cambridge University Press, Cambridge.

Agarwal, B. (1997) 'Bargaining power and gender relations: within and beyond the household', *Feminist Economics* 3 (1): 1-51.

Agarwal, B. (1998) 'Disinherited peasants, disadvantaged workers. A gender perspective on land and livelihood', *Economic and Political Weekly*, 28 March, pp. A2-A15.

Agarwal, B. (1999) 'The gender and environment debate: lessons from India', in N. Menon (ed.), *Gender and Politics in India*, Oxford University Press, New Delhi, pp. 96-142.

Agarwal, B. (2002) *Are We Not Peasants Too? Land Rights and Women's Claims in India*, Seeds No. 21, The Population Council, New York.

Almekinders, CJM., NP. Louwaars and GH. De Bruijn (1994) 'Local seed systems and their importance for an improved seed supply in developing countries', *Euphytica* 78: 207-216.

Altieri, MA., MK. Anderson and LC. Merrick (1987) 'Peasant agriculture and the conservation of crop and wild plant resources', *Conservation Biology* 1: 49-58.

Amin, S. (2002) 'La nouvelle question agraire: trois milliards de paysans menacés', in S. Amin and F. Houtart (eds), *Mondialisation des Résistances. Etat des luttes*, Editions L'Harmattan, Paris.

Appu, PS. (1996) *Land Reforms in India*, Vikas Publishing House, New Delhi.

Batra, SK. (1995) *Indian Agriculture and New Economic Policy: Impact of agro-industry*, Indian Social Institute, New Delhi.

Baumann, P., R. Ramakrishna, M. Dubey, R. Raman. and J. Farrington (2003) *Institutional Alternatives and Options for Decentralised Natural Resource Management in India*, Working Paper 230, ODI, London.

Beck, T. (1989) 'Survival strategies and power among the poor in a West Bengal village', *IDS Bulletin*, 20(2): 23-32.

Bellon, MR. (1996) 'The dynamics of crop intraspecific diversity: a conceptual framework at the farmer level', *Economic Botany*, 50(1): 26-39.

Bellon, M. and J. Risopoulos (2001) 'Small-scale farmers expand the benefits of improved mazie germplasm: A case study from Chiapas, Mexico', *World Development*, 29(5): 799-811.

Berlan, J-P. and R. Lewontin (1998) 'La menace du complexe génético-industriel', *Le Monde Diplomatique*, No. 537, Décembre.

Beytes, C. (2001) 'The anatomy of technology', *Seed Trade News International*, March, pp. 18-20.

Bonnano, A., L. Busch, W. Friedland, L. Gouveia and E. Mingione (eds.) (1995) *From Columbus to ConAgra : The globalization of agriculture and food*, University of Kansas Press, Lawrence.

Boster, JS. (1996) 'Exchange of varieties and information between Aguaruna manioc cultivators', *American Anthropologist* 88: 428-436.

Brac de la Perrière, R. and Seuret, F. (1999) *Brave New Seeds*, Zed Books, London.

Butterworth, J., B. Adolph. and SB. Reddy (2003) *How Farmers Manage Soil Fertility: A guide to support innovation and livelihoods*, Andhra Pradesh Rural Livelihoods Programme, Hyderabad and Natural Resources Institute, Chatham.

Ceccarelli, S. and Grando, S. (2000) 'Barley landraces from the Fertile Crescent: a lesson for plant breeders', in SB. Brush (ed.), *Genes in the Field: On-farm conservation of crop diversity*, International Plant Genetic Resources Institute and International Development Research Centre, Lewis Publishers, USA.

Chambers, R. (1992) 'Rural appraisal: rapid, relaxed and participatory', *Discussion Paper 311*, Institute of Development Studies, University of Sussex, Brighton.

Chambers, R. (1995) 'Paradigm shifts and the practice of participatory research and development', in N. Nelson and S. Wright (eds.), *Power and Participatory Development*, Intermediate Technology Publications, London, pp. 30-42.

Chambers, R. and Conway, G. (1992), 'Sustainable rural livelihoods: practical concepts for the 21st century', *Discussion Paper* 296, Institute of Development Studies, University of Sussex, Brighton.

Chambers, R., A. Pacey, and LA Thrupp (eds.) (1989) *Farmer First. Farmer innovation and agricultural research*, Intermediate Technology Publications, London.

Chowdry, KR., A. Prasad Rao, D. Venkat, and U. Shankari (2000) *Contract Farming at Kuppam*, Andhra Pradesh Coalition in Defence of Diversity, Hyderabad.

Citizens' Report (1998), *Gathering Agrarian Crisis: Farmers' Suicides in Warangal District*, AP, Warangal (unpublished report).

Clawson, D. (1985) 'Harvest security and intraspecific diversity in traditional tropical agriculture', *Economic Botany*, 39(1): 56-67.

Cleveland, DA., D. Soleri and SE. Smith (1994) 'Do folk varieties have a role in sustainable agriculture?', *BioScience*, 44: 740-51.

Colfer, C. (1991) 'Indigenous rice production and the subtleties of culture change: an example from Borneo', *Agriculture and Human Values* 8 (1 & 2): 67-84.

Conroy, C., S. Iyengar, V. Lobo, GB. Rao and U. Rani (2001) *Livelihood and Coping Strategies in Semi-arid India: A synthesis of macro-and micro-level research findings*, Natural Resources Institute, Chatham, UK.

Crouch, M. (1998) *How the Terminator terminates: An explanation for the non-scientist of a remarkable patent for killing second generation seeds of crop plants*, Occasional Paper, Edmonds Institute, Edmonds.

Damodaran, A. (2001) 'WTO Agriculture Agreement, common property resources and income diversification strategy', *Economic and Political Weekly*, September 22, pp. 3633-3642.

Davuluri, V. and K. Srinivas (2000) *Debt and Deep Well*, Care AP, ICNGO Programme AP, Mari, Hyderabad.

Dayakar, R., B. Ravishankar, A. Radha and S. Raju (1999) *The Role and Importance of Sorghum to the Livelihoods of the Poor: Implications for improved utilization*, National Research Centre on Sorghum, Hyderabad.

Dhar, B. and S. Chaturvedi (1998) 'India's biotechnology plans for the next five years', *Biotechnology and Development Monitor*, No. 35, pp. 16-19.

Dirks, N. (2001) *Castes of Mind. Colonialism and the making of modern India*, Princeton University Press, Princeton.

Dogra, B. (1993) *Seed Industry of India: Seeds of plenty or seeds of discontent*, Navdanya, New Delhi.

Dumont, L. (1970) *Homo Hierarchicus*, Vikas Publications, New Delhi.

Duvvury, N. (1998) 'Women and agriculture in the new economic regime', in M. Krishnaraj, R. Sudarshan and A. Shariff (eds.), *Gender, Population and Development*, Oxford University Press, Delhi, pp. 223-244.

Ertug, F. (2003) 'Gendering the tradition of plant gathering in Central Anatolia (Turkey)', in P. Howard (ed.), *Women and Plants*, Zed Books, London, pp. 183-196.

EC (European Community) (2000) *Agriculture's Contribution to Rural Development*, Discussion Paper 3. Paper presented at the International Conference on Non-Trade Concerns in Agriculture, Ullensvag, Norway, 2-4 July 2000.

Eyzaguirre, P. and M. Iwanaga (1996) 'Farmers' contribution to maintaining genetic diversity in crops and its role within the total genetic resources system', in P. Eyzaguirre & M. Iwanaga (eds.), *Participatory Plant Breeding*, IPGRI, Rome, pp. 9-18.

FAO (Food and Agricultural Organization) (1997), *The State of the World's Plant Genetic Resources for Food and Agriculture*, FAO, Rome.

Fowler, C. (1994), *Unnatural Selection: Technology, politics and plant evolution*, Gordon and Breach Science Publishers, Yverdon.

Franzen, H. et al. (1996) 'Variety improvement in the informal sector: aspects of a new strategy', in P. Eyzaguirre, and M. Iwanaga (eds.), *Participatory Plant Breeding*, Proceedings of a Workshop on Participatory Plant Breeding, 26-29 July 1995, Wageningen, IPGRI, Rome.

Freeman, JD. (1955), *Iban Agriculture: A report on the shifting cultivation of hill rice of the Iban of Sarawak*, Colonial Research Station Paper No. 18, Her Majesty's Stationary Office, London.

Friedberg, C. (1997), 'Diversité, ordre et unité du vivant dans les savoirs populaires', *Nature, Sciences, Société*, 5(1): 10-22.

Gadgil, M. and Guha, R. (1992) *This Fissured Land: An Ecological History of India*, Oxford University Press, New Delhi and Melbourne.

Goland, C. (1993) 'Agricultural risk management through diversity: Field scattering in Cuyo Cuyo, Peru', *Culture and Agriculture* 45-46: 8-13.

Gollain, F. (2004) *A Critique of Work: Between ecology and socialism*, International Institute for Environment and Development, London.

Gopalam, C., BV. Rama Sastri, and SC. Balasubramanian (1989) *Nutritive Value of Indian Foods*, National Institute of Nutrition, Hyderabad.

Gramsci. A. (1971) *Selections from the Prison Notebooks of Antonio Gramsci*, edited and translated by Q. Hoare and G. Nowell Smith, Lawrence & Wishart, London.

Granié, AM. (2002) 'Relations de genre dans la société marocaine', Paper presented at the *Troisième Colloque International des Recherches Féministes Francophones, «Ruptures, Resistances et Utopies»*, Toulouse (France), 17-22 septembre 2002.

Guérin, M. (2001) 'Essartage et riziculture humide: Complémentarités des écosystèmes agraires à Stung Treng au début du XXième siècle', *Asèanie*, No.8, Décembre, pp. 35-56.

Gulati, A. and Kelley, T. (1999) *Trade Liberalisation and Indian Agriculture*, Oxford University Press, New Delhi.

Hall, AJ. and Yoganand, B., eds. (2000) *Sorghum Utilisation and the Livelihoods of the Poor in India: Summary Proceedings of a Workshop*, 4-5 February 1999, ICRISAT, Patancheru, Socio-Economic and Policy Program, ICRISAT.

Hamilton, N. (1994) 'Why own the farm if you can own the farmer (and the crop)? Contract production and intellectual property protection of grain crops', *Nebraska Law Review* 73: 48-103.

Hanumantha Rao, CH. (2001) 'WTO and Viability of Indian Agriculture', *Economic and Political Weekly*, September 8, pp. 3453-3457.

Harding, S. (1992) 'Subjectivity, experience and knowledge: an epistemology from/for rainbow coalition politics', *Development and Change*, 23 (3): 175-193.

Harlan, JR. (1992) *Crops and Man*, American Society of Agronomy, Madison, Wisconsin.

Haugerud, A. (1989) 'Land tenure and Agrarian Change in Kenya', *Africa*, 59 (1): 61-90.

Holton, R. and Turner, B. (1989) *Max Weber on Economy and Society*, Routledge, London.

Howard, P. (2003) 'Women and the plant world: an exploration', in Howard, P. (ed), *Women and Plants: Gender Relations in Biodiversity Management and Conservation*, Zed Books, London, pp. 1-48.

Howard-Borjas, P. (1999) 'Some implications of gender relations for plant genetic resources management', *Biotechnology and Development Monitor*, No. 37, March, pp. 2-5.

Ilaiah, K. (1996) *Why I am not a Hindu. A Sudra critique of Hindutva philosophy, culture and political economy*, Samya, Calcutta.

Illich, I. (1996) *The Right to Useful Unemployment and its Professional Enemies*, Marion Boyars, London.

Illich, I. (1976) *Limits to Medicine. Medical nemesis: the expropriation of health*, Penguin Books, Middlesex.

IPCC (2001) *Third Assessment Report: Summary of Policy Makers*, Intergovernmental Panel on Climatic Change, Climate Change Secretariat, Bonn.

Jaffé, W. and van Wijk, J. (1995) *The Impact of Plant Breeders' Rights in Developing Countries*, Inter-American Institute for Cooperation on Agriculture, University of Amsterdam, Amsterdam.

Jiggins, J. (1986) *Gender-related Impacts and the Work of the International Agricutlural Research Centers*, CGIAR Study Paper 17, The World Bank, New York.

Jodha, NS. (1986) 'Common property resources and rural poor', *Economic and Political Weekly*, 5 July, pp. 1169-1181.

Joshi, PK., BS. Chandel, SM.Virmani, and JC. Katyal (2001) 'Agricultural performance in semi-arid tropics of India', *Indian Journal of Agricultural Economics*, 56 (1): 71-88.

Kabeer, N. (1995) *Reversed Realities: Gender hierarchies in development thought*, Kali for Women, New Delhi.

Kanji, N. (2003) *Mind the Gap: Mainstreaming gender and participation in development*, Institutionalising Participation Series, IIED, London and IDS, Brighton.

Kerr, JM. (ed.) (1991) *Farmers' Practices and Soil and Water Conservation Programmes: Summary proceedings of a workshop*, ICRISAT, Patancheru, Andhra Pradesh.

Kerr, J., D., Marothia, K. Singh., C. Ramaswamy and W. Bentley (eds) (1997) *Natural Resource Economics, Theory and Application in India*, Oxford and IBH Publishing CO. PVT. Ltd., New Delhi.

Khanna, M. (2000) 'The ritual capsule of Durga Puja: an ecological perspective', in CK. Chapple and ME. Tucker (eds), *Hinduism and Ecology*, Oxford University Press, New Delhi, pp. 469-498.

Klass, M. (1980) *Caste: The emergence of the South Asian Social System*, Institute for the Study of Human Issues, Philadelphia.

Kneen, B. (1999) *Farmageddon. Food and the culture of biotechnology*, New Society Publishers, Gabriola Island, B.C., Canada.

Kothari, A. (1997) *Understanding Biodiversity: Life, sustainability and equity*, Orient Longman, New Delhi.

Krishna, S. (2004) 'A genderscape of community rights in natural resource management', in S. Krishna (ed.), *Livelihood and Gender: Equity in community resource management*, Sage Publications, New Delhi, pp. 17-63.

Leimer Price, L. (2003) 'Farm women's rights and roles in wild plant food gathering and management in North-East Thailand', in P. Howard (ed.), *Women and Plants*, Zed Books, London, pp. 101-114.

Louette, D. and Smale, M. (2000) 'Farmers' seed selection practices and traditional maize varieties in Cuzalapa, Mexico', *Euphytica* 113: 25-41.

Louette, D., A. Charrier and J. Berthaud (1997) '*In situ* conservation of maize in Mexico: Genetic diversity and maize seed management in a traditional community', *Economic Botany*, 51 (1): 20-38.

Louwaars, N. (2000) 'Seed regulations and local seed systems', *Biotechnology and Development Monitor*, No.42, pp. 12-14.

Louwaars, N. and Minderhoud, M. (2001) 'When a law is not enough: biotechnology patents in practice', *Biotechnology and Development Monitor*, No. 46, June, pp. 16-19.

Lucas, C. (2001) *Stopping the Great Food Swap: Relocalising Europe's food supply*, The Greens/Europe Free Alliance, European Parliament, Brussels.

Luxereau, A. (1994) 'Usages, representations, évolution de la biodiversité végétale chez les Haoussa du Niger', *Journal d'Agriculture Traditionelle et de Botanique Appliquée*, 36(2): 67-85.

Majumdar, GP. and Banerji, SC. (1962) 'Krsi-Parasara', *Bibliotheca Indica*, Vol. 285, no. 1579, The Asiatic Society, Calcutta, p. ix.

Manicad, G. (1999) 'CGIAR and the private sector: Public good versus proprietary technology in agricultural research', *Biotechnology and Development Monitor*, No. 37, March, pp. 8-13.

Manicad, G. and McGuire, S. (2000) 'Supporting farmer-led plant breeding', *Biotechnology and Development Monitor*, No. 42, June, pp. 2-7.

Mazoyer, M. and Roudart, L. (1998) *Histoire des Agricultures du Monde*, Editions du Seuil, Paris.

McMichael, P. (1998) 'Global food politics', *Monthly Review* 50 (3), July/August, pp. 14-31.

Mehta, M. (1996) 'Our lives are no different from that of our buffaloes'. Agricultural change and gendered spaces in a Central Himalayan valley', in D. Rocheleau, B. Thomas-Slayter and E. Wangari (eds), *Feminist Political Ecology*, Routledge, London, pp. 3-23.

Mendras, H. (1984) *La Fin des Paysans*, Actes Sud, Paris.

Menon, U. (1995) 'Evolution of intellectual property rights in plants', in B. Sharma et al. (eds.), *Genetic Research and Education: Current trends and the next fifty years*, Indian Society of Genetics and Plant Breeding, New Delhi.

Mies, M., K. Lalitha, and K. Kumari (1983) 'Landless women organize: A caste study of an organization in Andhra Pradesh', *Manushi*, 3(3): 11-19.

Mooney, PR. (1999) 'The ETC century: erosion, technological transformation and corporate concentration in the 21st century', *Development Dialogue*, 1999: 1-2, Dag Hammarskjöld Foundation, Uppsala, Sweden.

Mortimore, M. (1998) *Roots in the African Dust: Sustaining the drylands*, Cambridge University Press, Cambridge.

Mortimore, M., B. Adams and F. Harris (2000) 'Poverty and systems research in the drylands', *Gatekeeper Series* No 94, IIED, London.

Muralidharan, S. (2001) 'The farming crisis', *Frontline*, February 2.

Myers, N. and Kent, J. (2001) *Perverse Subsidies: How tax dollars can undercut the environment and the economy*, Island Press, Washington DC.

Nagarajan, V. (2000) 'Rituals of embedded ecologies: drawing *kolams*, marrying trees and generating auspiciousness', in CK Chapple and ME Tucker (eds.), *Hinduism and Ecology. The intersection of earth, sky and water*, Oxford University Press, New Delhi, pp. 453-468.

Nanda, M. (1995) 'Transnationalisation of Third World state and undoing of Green Revolution', *Economic and Political Weekly*, January 28, pp. PE20-PE30.

Narayan, D., R. Patel, K. Schafft, A. Rademacher, and S. Koch-Schulte (2000) *Voices of the Poor. Can anyone hear us?* Oxford University Press, New York.

Netting, R. McC. (1993) *Smallholders, Householders. Farm families and the ecology of intensive, sustainable agriculture*, Stanford University Press, Stanford.

O'Riordan, T. (2002) 'Protecting beyond the protected', in T. O'Riordan and S. Stoll-Kleemann (eds.), *Biodiversity, Sustainability and Human Communities*, Cambridge University Press, Cambridge, pp. 3-29.

Orlove, B. and Brush, S. (1996) 'Anthropology and the conservation of biodiversity', *Annual Review of Anthropology*, 25: 329-352.

Pandey, G. (1993) *Hindus and Others: The question of identity in India today*, Viking Publishers, New Delhi.

Pant, M. (2000) 'Intra-household allocation patterns: a study in female autonomy', *Indian Journal of Gender Studies*, 7(1): 93-100.

Parthasarathy, G. and Shameen (1998) 'Suicides of cotton farmers in Andhra Pradesh: an exploratory study', *Economic and Political Weekly*, March 28, pp. 720-726.

Passet, R. (1996) *L'Economique et le Vivant*, Economica, Paris.

Peet, R. and Watts, M. (1996) 'Liberation ecology: development, sustainability, and environment in an age of market triumphalism', in R. Peet. and M. Watts (eds), *Liberation Ecologies: Environment, development, social movements*, Routledge, London, pp. 1-45.

Phillipson, M. (2001) 'Agricultural law: containing the GM revolution', *Biotechnology and Development Monitor*, No. 48, December, pp. 4-6.

Pimbert, M. (1991) *Participatory Research with Women Farmers*. A film by Development Perspectives, ICRISAT and TVE, London and Hyderabad.

Pimbert, M. and Wakeford, T. (2002) *Prajateerpu: A Citizen's Jury/Scenario Workshop on Food and Farming in Andhra Pradesh*, India, IIED, London and IDS, Sussex.

Pimbert, M., Thompson, J., Vorley, WT. et al. (2001) *'Global restructuring, agri-food systems and livelihoods'*, Gatekeeper Series No. 100, IIED, London.

Pionetti, C. (1999) *Perceptions Paysannes de la Diversité Agricole sur le Plateau du Deccan en Inde et Droits des Communautés* (Farmers' Perceptions of agricultural diversity on the Deccan Plateau in India and Community Rights), Masters' Thesis in Environmental Studies, University of Orléans, France (unpublished).

Prasad, SK. and Reddy, PG. (1999) 'Capacity building in the Andhra Pradesh Netherlands biotechnology programme', *Biotechnology and Development Monitor*, No. 39, pp. 6-9.

Pray, C. (1997) *Public Policy, Public Investments, and Private Investments in Seed Supply: Experiences in Turkey and India*, State University of New Jersey (unpublished paper).

Pretty, J., JIL Morrison and R. Hine (2003) Reducing food poverty by increasing agricultural productivity in developing countries, *Agriculture Ecosystems and Environment*, 95: 217-234.

Purdue, D. (1995) 'Hegemonic trips: world trade, intellectual property and biodiversity', *Environmental Politics*, 4(1): 88-107.

Radha, T. (2002) *The Political Economy of Seed in Andhra Pradesh*, PhD Thesis, Acharya N.G. Ranga Agricultural University, Hyderabad.

Ramaswami, B., C. Pray and T. Kelley (2002) 'Dissemination of private hybrids and crop yields in the Semi-Arid Tropics of India', *Indian Journal of Agricultural Economics*, 57(1): 39-51.

Ramdas, S. et al. (2001) 'Changing livelihoods, livestock, and local knowledge systems: Women stake their claim in Andhra Pradesh and Maharashtra', *Indian Journal of Gender Studies* 8 (2): 152-174.

Rao, B. (1996) *Dry Wells and Deserted Women: Gender, ecology and agency in rural India*, Indian Social Trust, New Delhi.

Rao, PR. (1997) *History of Modern Andhra*, Sterling Publishers, New Delhi.

Raynaut, C. (1997) *Sahels. Diversité et dynamiques des relations sociétés-nature*, Editions Karthala, Paris.

Richards, P. (1985) *Indigenous agricultural revolution. Ecology and food production in West Africa*, Hutchinson and Westview press, London and Boulder.

Richards, P. (1983) 'Farming systems and agrarian change in West Africa', *Progress in Human Geography* 7: 1-39.

Rifkin, J. (1998) *The Biotech Century: Harnessing the gene and remaking the world*, Tarcher Inc. Publishers, Putnam.

Rocheleau, D., B. Thomas-Slayter and E.Wangari (1996) 'Gender and environment: A feminist political ecology perspective', in D. Rocheleau, B. Thomas-Slayter and E. Wangari (eds.), *Feminist Political Ecology: Global issues and local experiences*, Routledge, London, pp. 3-23.

Rosset, P. (1999) *The Multiple Functions and Benefits of Small Farm Agriculture*, Policy Brief No.4, Institute for Food and Development Policy, Oakland, CA.

Ryan, JG. and Spencer, DC. (2001) *Future Challenges and Opportunities for Agricultural R &D in the Semi-Arid Tropics*, ICRISAT, Patancheru, Andhra Pradesh.

Sahai, S. (2000) 'Farmers' rights and food security', *Economic and Political Weekly*, 11 March, pp. 878-880.

Sanyal, B. (1999) "Working with watershed elements in the drylands of West Bengal", *The Debacle*, Vol. V, No.1-2, pp. 40-44.

Satheesh, PV. and Pimbert, M. (1999) 'Reclaiming diversity, restoring livelihoods', *Seedling* 16(2): 11-23.

Satheesh, PV. and Reddy, S. (2000) 'Uncultivated food and the poor', in *Proceedings of a South Asian Workshop on Uncultivated Food and Plants*, UBINIG, Dhaka, Bangladesh, pp. 78-92.

Satheesh, PV. (2002) *Crops of Truth: Farmers' perception of agrodiversity in the Deccan region of South India*, International Development Research Centre, Ottawa and Deccan Development Society, Hyderabad.

Schrijvers, J. (1995) 'Participation and power: a transformative feminist research perspective', in N. Nelson and S. Wright (eds.), *Power and Participatory Development*, Intermediate Technology Publications, London, pp. 19-29.

Seetharama, N., T. Shyamala Rani and D. Harshavardhan (2001) 'Will the poor benefit from the agricultural biotechnology revolution?', *Journal of Plant Biology*, 28(2): 139-146.

Selvarajan, S., DC. Joshi and JC. O'Toole (1999) *Agro-Biotechnology Capacity and Demand: The Indian private sector seed industry*, The Rockefeller Foundation, New Delhi.

Sen, A. and Drèze, J. (1989) *Hunger and Public Action*, Oxford University Press, New Delhi.

Shiva, V. (1991) *The Violence of the Green Revolution*, Zed Books, London.

Soil Association (2002) *Seeds of Doubt: North American farmers' experience of GM crops*, available at www.soilassociation.org.

Sperling, L. and Scheidegger, U. (1996) 'Results, methods and issues in participatory selection: the case of beans in Rwanda', *Gatekeeper Series* No. 51, IIED, London.

Srinivas, Ch. and Abdul Thaha, S. (2004) *A Study on Alternative Distribution System*, Deccan Development Society, Hyderabad.

Stenson, A. and Gray. T. (1999) 'An autonomy-based justification for intellectual property rights of indigenous communities', *Environmental Ethics*, 21: 177-190.

Stoll-Kleemann, S. and O'Riordan, T. (2002) 'Enhancing biodiversity and humanity', in T. O'Riordan and S. Stoll-Kleemann (eds.), *Biodiversity, Sustainability and Human Communities: Protecting beyond the protected*, Cambridge University Press, Cambridge.

Sudarshan, R. (2001) 'Managing ecosystems for women's health and sustainable development: an illustration from the Kumaon, Uttaranchal', *Indian Journal of Gender Studies*, 8(2): 207-222.

Synnevag, G. (1997) 'Gender differentiated management of local crop genetic resoruces in Bafoulabe Cercle, Kayes region of Mali', *Seminar Proceedings: Plant Genetic Resources in African Savannah*, Bamako, Mali, 24-28 February, IER/BRG/Solagral, Montpellier (France), pp. 85-92.

The Madras Group (1983) 'Indian agriculture at the turn of the century', *Readings from the Patriotic and People-Oriented Science and Technology (PPST) Bulletin*, pp. 56-104.

Torres, F., M. Pineiro, E. Trigo and N. Martinez (2000) *Agriculture in the Early 21st Century: Agrobiodiversity and pluralism as a contribution to address issues on food security, poverty and natural resource conservation*, GFAR, Rome.

Tripp, R. and Pal. S. (2000a) *The Private Delivery of Public Crop Varieties: Rice in Andhra Pradesh*, Overseas Development Institute, London.

Tripp, R. and Pal, S. (2000b) 'Information and agricultural input markets: Pearl millet seed in Rajasthan', *Journal of International Development*, 12: 133-144.

Turner, N. (2003) 'Passing on the news: women's work, traditional knowledge and plant resource management in Indigenous societies of North-western North America', in P. Howard (ed.), *Women and Plants*, Zed Books, London, pp. 133-149.

United Nations Development Programme (1999) *Human Development Report*, Oxford University Press, New York.

United Nations Environment Programme (1995) *Global Biodiversity Assessment*, Cambridge University Press, New York.

Unnithan-Kumar, M. (1997) *Identity, Gender and Poverty: New perspectives on caste and tribe in Rajasthan*, Berghan Books, Oxford.

Vandelac, L. (2001) 'Menace sur l'espèce humaine. Démocratiser le genie génétique', *Futuribles*, 264: 5-26.

Van der Heide, WM., R. Tripp and WS. de Boef (eds.) (1996) *Local Crop Development: An annotated bibliography*, IPGRI, Rome, Italy.

Vasavi, AR. (1999) 'Agrarian distress in Bidar: market, state and suicides', *Economic and Political Weekly*, August 7, pp. 2263-2269.

Vasavi. AR. (1999) *Harbingers of Rain. Land and life in South India*, Oxford University Press, New Delhi.

Vellama, S. (2000) 'Contractual maize seed production', *Biotechnology and Development Monitor*, No. 42, June, pp. 8-11.

Venkateshwarlu, D. and Corta, LD. (2001) 'Transformations in the age and gender of unfree workers on hybrid cottonseed farms in Andhra Pradesh', *The Journal of Peasant Studies*, 28 (3): 1-36.

Venkateshwarlu, D. and K. Srinivas (2000) *Debt and Deep Well*, Care AP, ICNGO Programme and MARI, Hyderabad.

Venkateswaran, S. (1992) *Living on the Edge: Women, environment and development*, Friedrich Ebert Stiftung, New Delhi.

Viswanathan, S. (2002) 'Why is the issue of GMO crucial?', in Satheesh, P.V. (ed.), *Genetic Engineering, Agriculture and Food*, Proceedings of a two-day seminar, July 2-3, 2001, Hyderabad, Deccan Development Society, Andhra Pradesh Coalition in Defence of Diversity, Centre for World Solidarity, Hyderabad, pp. 8-18.

Vom Brocke, K. (2001) *Effects of Farmers' Seed Management on Performance, Adaptation and Genetic Diversity of Pearl Millet Populations in Rajasthan, India*, PhD Dissertation, University of Hohenheim, Germany.

Wangari, E., B. Thomas-Slayter and D. Rocheleau (1996) 'Gendered visions for survival – Semi-arid regions of Kenya', in D. Rocheleau, B. Thomas-Slayter and E. Wandari (eds.), *Feminist Political Ecology: Global issues and local experiences*, Routledge, London, pp. 127-154.

Watts, M. (1990) 'Peasants under contract: agro-food complexes in the Third World', in H. Bernstein, B. Crow, M. Mackintosh and C. Martin (eds), *The Food Question: Profits versus people?*, Monthly Review Press, New York.

Wells, M. (1987) 'Share-cropping in the United States: a political economy perspective', in M. Chibnik (ed.), *Farm Work and Fieldwork: American agriculture in Anthropological perspective*, Cornell University Press, Ithaca, pp. 211-243.

Wright, S. and Nelson, N. (1995) 'Participatory research and participant observation: two incompatible approaches', in N. Nelson and S. Wright (eds.), *Power and Participatory Development*, Intermediate Technology Publications, London, pp. 43-59.

Yapa, L, (1996) 'Improved seeds and constructed scarcity', in R. Peet. and M. Watts (eds), *Liberation Ecologies: Environment, development, social movements*, Routledge, London, pp. 69-85.

Annexes

Annex 1. List of major dryland crops

English	Telugu	Hindi	Botanical name)
CEREALS AND MILLETS			
Foxtail millet	Korra	Kauni, Navane	Setaria italica
Finger millet	Taida	Ragi, Mandua	Eleusine coracana
Little millet	Saama	Gundli, kutki	Panicum miliare
Proso millet	Varigalu	Barri, Cheena	Panicum miliaceum
Kodo millet	Arikelu	Kodra	Paspalum scrobaculatum
Pearl millet	Sajja	Bajra	Pennisetum typhoideum
Sorghum	Jonna	Jowar	Sorghum bicolor
Maize	Makka	Makka	Zea mays
Wheat	Goduma	Gehun	Triticum oestivum
Rice	Wodlu	Dhan	Oryza sativa
Barley	Evalu	Jau	Hordeum vulgare
PULSES			
Pigeonpea (redgram)	Togari, Kanda	Arhar	Cajanus cajan
Blackgram	Minimulu	Urid	Vigna mungo
Greengram	Pesarlu	Moong	Vigna radiata
Cowpea	Bebbarlu	Lobia	Vigna unguiculata
Field bean	Anumulu	Sem	Dolichos lablab
Horsegram	Ulavalu	Kulthi	Dolichos biflorus
Chickpea Senega	Chana	Cicer arietinum	
Field pea Batagalu	Matar	Pisum sativum	
Lentil	Sirisenegalu	Masoor	Lens esculenta
Lathyrus Lankalu	Khesari	Lathyrus sativus	

English	Telugu	Hindi	Botanical name)
OILSEEDS			
Mustard	Avalu	Sarson	Brassica juncea
Groundnut	Biamugulu	Bhuimung	Arachis hypogea
Sesame	Manchi nuvvulu	Til	Sesamum indicum
Niger	Gaddi nuvvulu	Khorasni	Guizotia abyssinica
Linseed	Aviselu	Agasti	Linum usitatissimum
Safflower	Kusumalu	Kusum	Carthamus tinctorius
Sunflower	Nalla kusumalu	Suryaphul	Helianthus annuus
Castor	Amdalu	Arand	Ricinus communis
Soybean	Soyabean	Bhat	Glycine max
GREEN VEGETABLES			
Fenugreek	Menthi koora	Methi	Trigonella foenum-graecum
Amaranth	Thota koora	Chaulai sagh	Amanranthus
Roselle	Pundi	Lal ambadi	Hibiscus sabdariffa
Mesta	Gongura	Ambadi	Hibiscus cannabinus
Spinach	Palak koora	Palak sagh	Spinacia oleacera
Ponnaganti	Ponaganti koora	Saranti sagh	Alternanthera sessilis
Coriander leaves	Kotimera	Dhania pata	Coriandrum sativum
Mint leaves	Pudina	Pudina	Mentha arvensis
OTHER VEGETABLES			
Squash (pumkin)	Erra gumarikaya	Kumra	Cucurbita moschata
Ridge gourd	Birakaya	Torai	Luffa acutangula
Bittergourd	Kakarkaya	Karela	Momordica charantia
Bottlegourd	Anapakaya	Kaddu	Lagenaria siceraria
Cucumber	Dosakaya	Kira	Cucumis sativus
Ladies's fingers	Bendakaya	Bhendi	Hibiscus esculentus
Drumstick	Moliga kaya	Saijanki phalli	Moringa oleifera
Eggplant Onkaya	Beghan, brinjal	Solanum melongena	

English	Telugu	Hindi	Botanical name)
MAIN CASH CROPS			
Turmeric	Paspu	Haldi	Curcuma domestica
Garlic	Vellulipaya	Lasoon	Allium sativum
Ginger	Alam	Adrak	Zingiber officinale
Onion	Ulipaya	Peajh	Allium cepa
Bishop's weed	Omum	Ajwin	Trachyspermum ammi
Chillies	Mirapa kaya	Mirchi	Capsicum annuum
Potato	Alugada	Alu	Solanum tuberosum
Cotton	Patti	Kapas	Gossypium sp.
Sugarcane	Cheruku	Ganna	Sachharum officinarum

Annex 2. Crop genetic diversity in India

Recorded genetic diversity of some of the major crops grown in India

Crop	Number of local varieties	Crop	Number of local varieties
Rice	> 50.000	Pepper	500
Sorghum	5160	Cardamom	226
Cotton	1975	Nutmeg	301
Cassava	701	Clove	150
Sweet potato	495	Cinnamon	4
Yam	305	Ginger	124
Minor tuber crops	78	Turmeric	184
Potato	16	Rubber	103
Groundnut	80	Tea	1607
Sugarcane	48	Mango	> 1000
Coconut	42	Fruits of arid and semi-arid zones	380

Source: Kothari, A. (1997), Understanding Biodiversity, *Orient Longman, New Delhi, p. 135, based on data collected from The Central Potato Research Centre, the Central Rice Research Institute, the Central Institute for Cotton Research, the National Research Centre for Sorghum, the Central Tuber Crops Research Institute, the Central Plantation Crops Research Institute, the All-India Coordinated Project on Arid Zone Fruits, the Central Institute of Horticulture for Northern Plains, the Sugarcane Breeding Institute and the National Research Centre for Groundnut.*

Annex 3. Agronomic and nutritional data on sorghum and other millets

Sorghum, *Sorghum bicolor*, is well adapted to conditions of low rainfall and drought, which makes it the most widely grown dryland cereal. Sorghum has its centre of origin in Africa, like finger millet and pearl millet. It is grown primarily as a food and fodder crop in India and Africa, generally in association with pearl millet, with pulses and oilseeds (groundnut). It is grown as a feed in the United States. Sorghum yields range from 500 t/ha to 2 t/ha and above in the case of hybrids grown as a monocrop.

Pearl millet, *Pennisetum typhoideum*, grows in regions of very low rainfall (200 to 800 mm). The straw is a valuable fodder for cattle, and is also used as thatching material. Bird attack is a major problem for cultivators of pearl millet, especially in African countries. The area under pearl millet and sorghum has been steadily declining in India over the past three decades.

Finger millet, *Eleusine coracana*, is considered to be one of the hardiest millets. It grows on hilly lateritic soils, has a high yielding potential and a good resistance to pests and diseases. Its grain is very nutritious and can be stored for a long period without any risk of pest damage. It is consumed directly and used in beer production.

Foxtail millet, *Setaria italica*, is a drought-resistant millet that can grow at very high altitudes (up to 6000 ft). It is often intercropped with finger millet in India. Its straw is used as green fodder and its grain remains free from storage pests for years at a time.

Little millet, *Panicum miliare*, is related to proso millet, *Panicum miliaceum*. Both are fast-growing crops (under 4 months), with a capacity to withstand both drought and excess of water. They require little care during the growing season, but their yield of grain and fodder are moderately high. Proso millet is grown in the Himalaya at altitudes as high as 10,000 ft (Shiva, V., Ramprasad, V., Hedge, P, Krishnan, O., and Holla-Bhar, R., 1995, *The Seed Keepers*, Navdanya, New Delhi).

Kodo millet, *Paspalum scrobiculatum*, is cultivated on the most degraded and stony lands, where virtually no other crop will grow due to poor fertility and lack of moisture. Its growth cycle of 5 to 6 months is longer than that of other millets. It is generally free from pests and diseases.

Comparative nutritional value of major cereals

Crop	Protein (g)	Minerals (g)	Calcium (mg)	Iron (mg)
Finger millet	7.3	2.7	344	6.4
Pearl millet	11.6	2.3	42	5
Kodo millet	8.3	2.6	27	5.2
Proso millet	12.5	1.9	14	5
Little millet	7.7	1.5	17	10
Sorghum	10.4	1.6	25	5.8
Wheat (whole)	11.8	1.5	23	4.9
Maize (dry)	11.1	1.5	10	2
Rice (milled)	6.8	0.6	10	3.1

Source: Gopalam, C., Rama Sastri, B.V., Balasubramanian, S.C., 1980, Nutritive value of Indian foods*, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad.*

Annex 4. Conversion of Table 11 into kilograms

Table 11. Multiplying seed stocks and loans: the strategy of resource-poor households

Crop (and name of local varieties)	Quantity of seeds produced	Quantity of seeds sown	Quantity of seeds given on loan	Source of seeds – Harvest	– Wage	Number of beneficiaries
Kharif crops						
Kharif sorghum	33kg	9kg	24kg	✓	✓	3
Foxtail millet	9kg	1.5kg	7.5kg	✓	✓	5
Pearl millet	6kg	3kg	3kg	✓		2
Finger millet	3kg	0.75kg	2.25kg	✓		3
Greengram *Pacha pesari* *Tiga pesari*	 36kg 3.75kg	 12kg 0.75kg	 24kg 3kg	 ✓	 ✓	 4 2
Blackgram	36kg	6kg	30kg	✓		5
Pigeonpea	18kg	6kg	12kg	✓	✓	4
Field bean	12kg	3kg	9kg	✓		3
Horsegram	6kg	1.5kg	4.5kg	✓		3
Cowpea	3kg	0.75kg	2.25kg	✓		3
Roselle	3kg	0.75kg	2.25kg	✓		4
Rabi crops						
Rabi sorghum	7.5kg	1.5kg	6kg	✓		2
Chickpea	48kg	18kg	30kg	✓	✓	2
Coriander	20kg	-	20kg		✓	1
Safflower	12kg	1.5kg	10.5kg	✓		4
Linseed	3kg	-	3kg		✓	1
Chillies	0.35kg	0.35kg	-	✓		0
Mustard	0.1kg	0.1kg	-	✓		0
TOTAL	**259.70kg**	**66.45kg**	**193.25kg**			**51**

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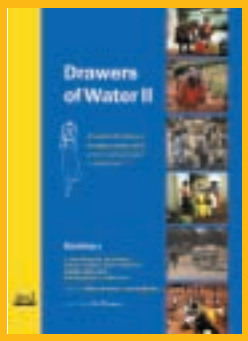

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Women, through their multiple roles as farmers, livestock herders, cooks, gardeners, keepers of culinary traditions, seed custodians and healers, have played a major role in shaping biodiversity important for food and agriculture. The author of this book looks in particular at women's roles in agriculture and especially the important part women play in saving and reproducing seed in the drylands of the Deccan Plateau, in South India.

Detailed farmers' accounts of why seed-saving is essential emphasise the interconnectedness between self-reliance in seed, crop diversity and nutrition. By extension, the realms of food culture and religious rituals (which entail the use of traditional crops) are also linked to seed autonomy. What is most significant about the intertwining of seed-saving, crop diversity and nutrition is that these three realms are largely under women's control. However, the processes of industrialisation and institutionalisation in the seed sector are undermining the very basis of autonomous seed production by:

1. degrading farmers' knowledge systems and innovation capacity
2. destroying an activity that provides a living for marginal and landless farmers, especially in female-headed households
3. undermining solidarity networks on which poor rural households critically rely
4. undermining women's status and intra-household bargaining power as their role in seed and grain management is eroded by market forces
5. destroying localised seed economies: seed regulations hamper farmer-to-farmer seed exchanges that have been shown to reinforce ecological sustainability and to secure livelihood and social assets in rural communities

The author argues that a radical re-orientation in public policies is needed to support autonomous seed production in the drylands of South India. Poverty alleviation and biodiversity conservation both directly depend on a) the strengthening of diversity-based farming systems, b) institutional support for decentralised seed systems, and c) reversals in policies for technological and legal developments.

How – and under what conditions – can diverse, localised food systems be sustained in the twenty-first century? Who gains and who loses when local food systems are strengthened? These are some of the questions examined by the *Sustaining Local Food Systems, Agricultural Biodiversity and Livelihoods* project.

This project combines a political ecology perspective on food systems and livelihoods with action research grounded in local practice. Research is done with, for and by people – rather than on people – to bring together many different ways of knowing and types of knowledge for learning and change. As such this action research seeks to bridge the gap between the academic orientation of political ecology and the largely activist focus of food sovereignty, human rights and environmental justice movements.

The *Reclaiming Diversity and Citizenship* Series publishes lessons from case studies in India, Indonesia, Iran and Peru along with findings from other studies linked with this action research project. Contributors are encouraged to reflect deeply on the ways of working and outcomes of their research, highlighting implications for policy, knowledge, organisations and practice. The *Reclaiming Diversity and Citizenship* Series also seeks to encourage debate outside mainstream policy and conceptual frameworks on the future of food, farming and land use. The opportunities and constraints to regenerating local food systems based on social and ecological diversity, human rights and more inclusive forms of citizenship are actively explored by contributors.

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