Connecting the Dots

Evolving Practical Strategies for Adaptation to Climate Change

Livestock systems, vulnerability and climate change

– Insights from the grass roots

WOTR

Livestock systems, vulnerability and climate change

Written on behalf of WOTR by:
K. Bhavana Rao and Ramkumar Bendapudi.

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Recommended Citation: Watershed Organisation Trust (2013): Livestock Systems, Vulnerability and Climate Change, Pp 23, December 2013.

ISBN No: 978-81-86748-37-4

Reviewed by:

1. Kamal Kishore, former scientist, Central Sheep and Wool Research Institute (CSWRI), ICAR; currently the coordinator for the Rainfed Livestock Network, supported by the Ford Foundation; also Executive Board Member, Life Network–India.
2. Dr. med. vet. Dr. habil. Ilse Köhler-Rollefson, Projects Coordinator, League for Pastoral Peoples and Endogenous Livestock Development, Pragelato Str. 20, 64372 Ober-Ramstadt, Germany.

Livestock systems, vulnerability and climate change

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Foreword

Climate change is already happening, and its effects, especially on rural communities in India, are particularly adverse. There is a need to highlight key issues and understand the practical challenges that must be addressed, if India is to build the capacities of its rural communities to robustly adapt to climate change and realise the National and State Action Plans on Climate Change (NAPCC and SAPCC).

Since the last four years, WOTR has been implementing a large-scale integrated project on climate change adaptation in rural Maharashtra, Andhra Pradesh, and Madhya Pradesh, in collaboration with NABARD, the Swiss Development Cooperation (SDC), the Indian Meteorological Department (IMD), the Central Research Institute for Dryland Agriculture (CRIDA), the World Agro-Forestry Council (ICRAF), and the State Agricultural University (MPKV).

This experience has catalysed insights, lessons, and experiences from multiple stakeholders, which we have formulated as Position Papers across 12 thematic areas: Watershed Development, Water, Food and Nutrition Security, Agriculture, Livestock, Biodiversity and Ecosystem Services, Disaster Risk Reduction and Risk Prevention, Alternate Energy, Economics and Livelihoods, Health, Gender, and Governance.

These papers assess and analyse the key policy and operational challenges faced in building adaptive capacities across sectors, from the perspective of different key stakeholders. The aim is to contribute towards formulation of enabling policy and operational frameworks that would facilitate effective implementation of the NAPCC and SAPCCs in rural India. They hope to trigger creative dialogues between key stakeholders, with a view to providing effective support to efforts that seek to build the adaptive capacities and resilience of rural communities.

The paper **'Livestock systems, vulnerability, and climate change – Insights from the grass roots'** attempts to explore indications of vulnerability at the grass roots. It attempts to see the impact of the logic of using *technology (crossbreeding)* and *sedenterisation* as a means of poverty alleviation/higher economic returns for livestock keepers and the rural poor. Have the poor really benefitted economically, or have we increased their vulnerability further, especially in the context of climate change? The paper urges the need to clear certain areas of prejudice against indigenous cattle, small ruminants, and poultry breeds, and proposes special policy measures for livestock production in dryland regions of India in the context of climate change, a reality that is here to stay.

Key Messages

- Rearing livestock in dryland regions has been developed by pastoralist communities over centuries as an extensive system of production. Due to its inherent bio-physical vulnerability, 'mobility' is a critical factor. It is a complex social–ecological system (SES) with sub-systemic linkages, knowledge systems, and institutions that maintain the resilience of dryland ecosystems.

- When a system is assessed merely in terms of production, it does not take into account the value provided by the multi-functional nature of livestock through essential services such as transport, credit, landscape conservation, and environmental protection.

- High-yielding breeds have huge resource footprints. Managing the ecosystem sustainably for the various services it provides is more critical than the GHG emissions from indigenous livestock.

- Changes in livestock composition and rearing systems (intensification) have definitely increased the vulnerability of both communities and ecosystems for small and marginal farmers and the landless poor.

- The livestock breeding policy must enable *in situ* conservation by involving pastoralists/livestock keepers through long-term sustained initiatives. This needs to be tailored to traditional dryland farming systems.

- Intensification of animal production threatens the eco-system well-being. It is very risky for small and marginal farmers and the landless in the long-term.

- Small livestock and backyard poultry are essential for the rural poor to cope with the emerging risks of climate change.

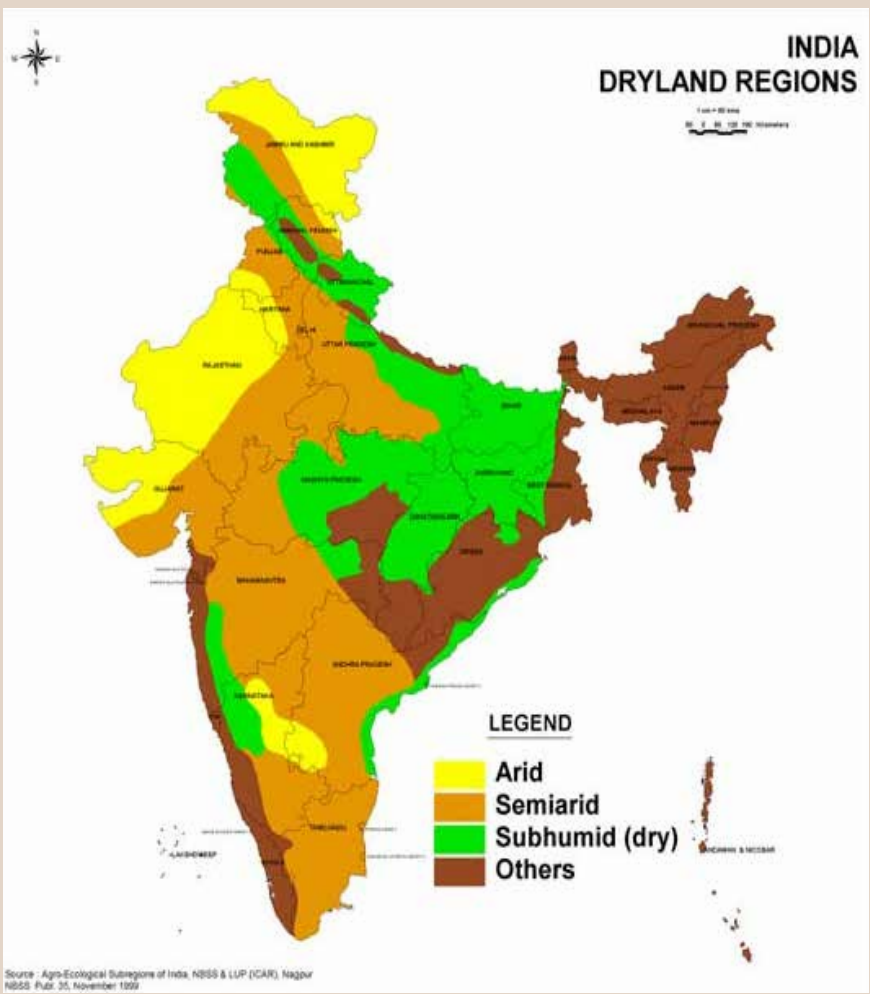
- Programme measures must ensure grazing rights, particularly to pastoralist communities.

- Policies and programmes to protect, conserve, and regenerate common property resources need to accommodate extensive (grazing-based) livestock systems.

1. The proposition

Drylands[1] cover about 41 percent of Earth's land surface and are inhabited by more than two billion people, of which 90 percent are in developing countries.[i] They are characterised by low rainfall and high evaporation, resulting in lack of water and limited soil fertility, limiting agriculture to a single rain-fed crop each year. These factors constrain the production of crops, forage, wood, and other services related to ecosystems in the regions. It is for this reason that livestock production emerged as the main activity that sustains livelihoods in these low productivity and unstable environments.[ii]

Nine states account for over 80 percent of India's dryland regions,[iii] which area hosts 60 percent of its livestock. The Indian livestock sector contributes to 40 percent of the agricultural GDP in the semi-arid regions and 70 percent in the arid regions. The livestock sector contributes eight percent to the country's GDP and employs eight percent of the labour force. [iv] The women in these families carry out some 60 percent of the work related to the care



[1] These include cultivated lands, scrublands, shrub lands, grasslands, savannas, semi-deserts, and true deserts.

and management of livestock in households.[v] Statistics reveal that resource-poor small and marginal farmers and landless labourers own 71 percent of cattle, 63 percent of buffaloes, 66 percent of small ruminants, 70 percent of pigs and 74 percent of poultry in India.[vi] With respect to sheep and goats in India, almost all belong to small-holders who own one hectare of land or less, or are landless,[vii] who depend entirely on Common Property Resources (CPR) for their survival, and rear livestock through the extensive system.

Livestock rearing in dry regions is a complex social-ecological system (SES), which is intertwined with many sectors, communities, and land use in multifarious ways that feed into each other. Overlooking the intricate sub-systemic linkages, knowledge systems, and institutions of traditional livestock production, coupled with the lack of understanding of how extensive livestock rearing systems contribute to maintaining the resilience of dryland ecosystems, has resulted in the promotion of inappropriate policies.

Till today, practically all policies restrict the most important aspect of the production system – 'mobility', and promote 'sedentarisation' with a blinkered focus on increasing production of milk and meat (with the use of technology, cross-breeding with exotics). This approach, which seeks to alleviate rural poverty and to conserve the degrading natural-resource base, now poses serious ecological challenges. The apparent quick gains in productivity often blind us to hidden negative externalities, which erode the medium- and long-term adaptive capacities of the communities because of the stress they create on the ecosystems which are vital to their sustained well-being. In many instances, this approach has weakened the natural systems and increased vulnerability to climate change, particularly in the dryland regions of the country.

With increasing evidence from national and international bodies (like the IPCC, 2007) that climate change is now a grass-roots reality, it is clear that the poorest and most vulnerable people will be the worst affected, particularly in developing countries. The possible effects of climate change are not limited to agriculture and food production. It will also have serious effects on livestock production.[viii] Apart from creating new impacts on livestock production, climate change is expected to exacerbate the impacts of several external drivers and pressures already operational in drylands, thus further increasing the vulnerability of communities inhabiting these fragile regions.

Livestock rearing in dry regions is a complex social-ecological system (SES), which is intertwined with many sectors, communities, and land use in multifarious ways that feed into each other. Overlooking the intricate sub-systemic linkages, knowledge systems, and institutions of traditional livestock production, coupled with the lack of understanding of how extensive livestock rearing systems contribute to maintaining the resilience of dryland ecosystems, has resulted in the promotion of inappropriate policies.

This position paper in progress based on findings from WOTR's project areas brings out a proposition that intensification of livestock production may not be a sustainable option for fragile ecosystems. Having said this, the paper urges the need to clear certain areas of prejudice and to have special policy measures for livestock production in dry land regions of the country as climate change is here to stay.

2. Livestock, livelihoods, and ecosystem resilience: a perspective

2.1 Feed behaviour and traits of animals are critical for resilience of dryland ecosystems and for livelihood

Drylands include cultivated lands, shrub lands, grasslands, savannas, semi-deserts, and true

deserts. They are ecologically fragile, with degraded soils, low availability of water, and drought prone, having short length of growing periods, thus limiting agricultural production. Usage of resources in dry regions beyond their threshold limits can lead to quick groundwater depletion. On the other hand, excessive irrigation with imperfect drainage conditions can lead to spread of surface and subsurface soil salinity and/or sodicity.[2]

It is due to this that rearing livestock in dryland regions has developed as an extensive system of production by pastoralist communities over centuries. This system, widely prevalent in Asian and African countries, is highly suitable, both for the resource-poor communities living there, as also for the fragile ecosystem. It has advantages over crop cultivation as animals are movable and self-replicating assets that can be shifted to areas where there has been some precipitation.

The critical factor in the extensive system of livestock production is 'mobility' which lets the animals forage for themselves. It is more economical and bio-friendly when compared to sedentary systems.[ix] This system gives time for plants to recover from grazing, for seed dispersal and germination, and it fertilises (with manure) the degraded soils, maintaining the resilience of the fragile ecosystem.[x] Kratil,[xi] in his research, brings out that indigenous breeds have the impulse to forage for themselves – which is a learned behaviour, and cannot be passed on among sedenterised animals or other non-nomadic systems. In nomadic systems the animals indicate to their owners when to move in search of new pastures.

Köhler-Rollefson and Mathias[xii] describe that indigenous breeds have special traits which are adapted to very specific eco-systems across the world. These special traits are: the ability to walk long distances, drought resistance, ability to ingest and digest low-quality feed (high cellulose content), thermoregulation, disease resistance, and lastly, fertility and mothering instincts.

These livestock breeds may not be highly productive in terms of milk or meat production, but are highly adaptive to the vagaries of nature and have low resource footprints. These critical aspects are what makes these breeds contribute significantly to food security and livelihood systems of humans who inhabit these regions in various ways without affecting the fragile ecosystem.

2.2 Pastoralists: the custodians of traditional knowledge on livestock production and conservation of dryland ecosystem biodiversity

Over thousands of years, pastoralists and small-holder livestock keepers inhabiting dryland regions benefitted from the ability of local livestock breeds to actively search out and convert natural vegetation into products and services that

[2] Soils vary depending on various chemicals present. Sodic soils are characterised by a disproportionately high concentration of sodium (Na) in their cat-ion exchange complex. They are usually defined as – consisting of an exchangeable sodium percentage greater than 15 percent. These soils tend to occur within arid to semi-arid regions and are innately unstable, exhibiting poor physical and chemical properties, which impede water infiltration, water availability, and, ultimately, plant growth.

support basic human needs: food, fibre, fuel, fertiliser, and draught-power. It is a unique system, a storehouse of unexplained knowledge, built on the relationships between humans, animals, and the ecosystem. They have developed and managed diverse local breeds that are adapted to the feed resources of dryland environment over centuries. In view of this, the pastoralist communities in particular are the *'custodians of traditional knowledge relating to all aspects of animal breeding and management, and vegetation and grazing management'*.[xiii] It is due to the traditional knowledge and institutions of these pastoralists that India has a wide range of livestock breeds of which 140 of them are recognised by the National Bureau of Animal Genetic Resources (NBAGR), with thousands more unrecognised, but which contribute significantly to India's livestock production. Among the milch breeds, the *Sahiwal, Gir, Ongole, Tharparkar* and *Kankrej* have been developed by Indian pastoralist communities and provide a consolidated gene pool that contributes significantly to India's milk production till today. These breeds have been further improved in countries like Brazil.[xiv] Furthermore, it is to be noted that the pastoralists are *'gene keepers'*[xv] and their herds/flocks of animals are the main source from which rural and other communities get their animals for farming, transport, and manure for their fields. This highlights the criticality of their role and knowledge base to the sustainability of the agrarian system in India.

Healthy ecosystems with the right balance help play a crucial role in mitigating as well as adapting to the impact of climate-induced disasters. A critical factor that is often missed is that livestock and biodiversity are closely linked and neither of them will exist without the other. The regeneration and maintenance of the one is dependent on the other. A view that is now gaining ground in recent years is that a complete ban on livestock grazing adversely affects grass bio-diversity and ultimately soil health.[xvi] Studies on biodiversity across the globe have revealed that one should not assume that livestock and ranching operations are necessarily damaging to biodiversity. In fact, grazing does help maintain native plant and aquatic diversity in vernal pools.[3] [xvii] Lack of grazing has shown changes in both floral and faunal species diversity as it disrupts the life cycle. It also results in disappearance of native species and promotes invasions by exotic species. In addition to this, many do not know that several native species of flora need to pass through the gut of the animal to germinate. Apart from affecting germination of certain species, this also reduces seed dispersal, which is essential for maintaining a balance in the floral biodiversity of the different ecosystems. This is most critical in dryland regions, as the main ecosystems are grasslands and tropical forests. In addition, the dung and urine of animals deposited on both common lands and agricultural lands, followed by subsequent trampling by animals, helps regenerate and maintain the ecosystem. A study done in the the Mundanthurai plateau region of the Kalakad-Mundanthurai Tiger Reserve (KMTR), south India,[xviii] showed the practice of burning to enhance forage availability for herbivores in rangelands to be ineffective, compared to the traditional method of grazing by nomadic pastoralists. Hence management strategies aimed at augmenting grazer densities in the reserve were suggested.

Despite these facts, policy environments still show an inherent bias against the extensive system of production, as well as against pastoralists and small-holder livestock keepers (small ruminant keepers in particular). They continue to blame those who use

[3] A seasonal body of standing water that typically forms in the spring from melting snow and other runoff, dries out completely in the hotter months of summer, and often refills in the autumn. Vernal pools range from broad, heavily vegetated lowland bodies to smaller, isolated upland bodies with little permanent vegetation. They are free of fish and provide important breeding habitat for many terrestrial or semi-aquatic species such as frogs, salamanders, and turtles.

dryland resources for grazing, as the main cause for land degradation and a threat to natural resource management (NRM) and conservation programmes. Research, extension, conservation, breeding development programmes, infrastructures and markets, and, in many cases, subsidies, currently favour high-output large-scale livestock systems. These trends contribute to the unfavourable changes in dryland ecosystems, rendering them unsustainable, along with disappearance of valuable local breeds and traditional knowledge (Learning Agricultures 2010).[xix]

2.3 Livestock: a critical part of the agriculture production system

Resilience in agriculture production systems is closely linked to livestock, which again is not recognised or given sufficient importance. Right from producing food to manure and draught power, livestock is truly a low-carbon system which is overlooked time and again. Over decades, this critical link has been broken due to the lack of understanding of the role of livestock in dryland farming systems through various policy approaches in the name of better economic development, which has resulted in serious unintended consequences. H. Steinfeld and J. Mäki-Hokkonen[xx] have classified the livestock production system in India as a rain-fed mixed-farming system (MRA). Fifty-one percent of the population in Asia, mainly India, adopts this system. A mixed-farming system with a vegetation growth period of less than 180 days, the main constraint for MRA is low primary productivity of the land due to low rainfall. Livestock rearing in such systems goes much beyond the role of just milk and meat production, supporting rural livelihoods in these harsh and unproductive environments in many ways.[xxi] They play a critical role in providing draught power for agricultural operations, transportation of goods and people, and most importantly, manure for agricultural fields. They provide free manure, living off sparse, low-quality feed resources, which when compared to the manufacture of chemical fertiliser production (a high GHG-emission activity), is a very low carbon system.

3. Changing livestock systems, emerging insights, and vulnerability to climate change

The current section discusses insights from field studies conducted in WOTR's climate change adaptation project villages in Andhra Pradesh and Maharashtra that reveal the following trends and insights on vulnerability of livestock production to climate change.

Livestock is an integral part of dryland farming system – the eroding connect[4]

The WOTR project locations in both Andhra Pradesh and Maharashtra fall in semi-arid regions. Historically, the livestock production system in these areas was mainly an extensive (grazing) system dependent on village common property resources, agricultural

[4] Insights from two studies conducted by WOTR, SA PPLPP (2012), "Watershed Development and Livestock Rearing – Experiences and Learning from the Watershed Organisation Trust in Maharashtra, India" © SA PPLPP (http://sapplpp.org/copyright) and http://www.wotr.org/wp-content/uploads/2012/04/Livestock-Systems.pdf.

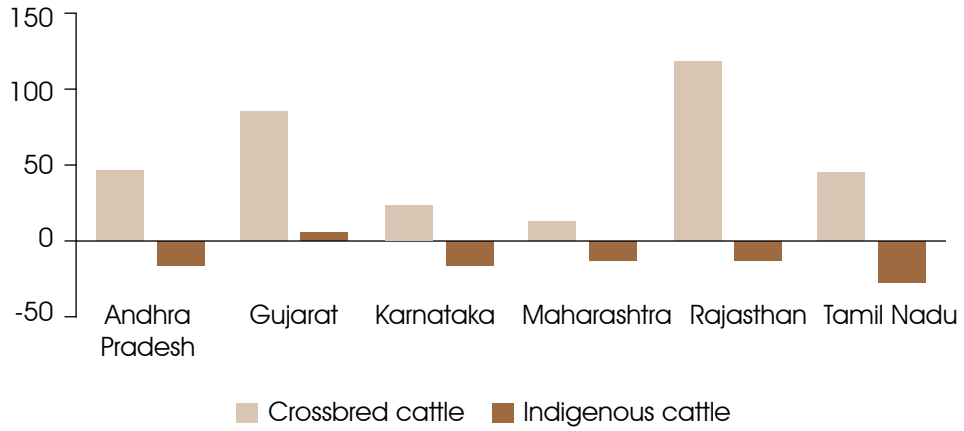
fallows, and grazing lands, for fodder needs. Agriculture was entirely rain-fed. There was a strong link between agriculture and livestock. It was an integral part of the agriculture system as it supported communities in farm operations, enhanced soil fertility (manure), and provided transportation.[xxii] Sale of farm animals was a critical source of income, whereas milk production from indigenous cattle was a secondary livelihood option. Small ruminants, especially goats, played a vital role for poor households for nutritional and financial security and as a buffer in times of need. The diet of the communities was rich in milk, milk products, eggs, and meat. There was no system of fodder production and crop–residues were stored as additional feed for livestock. All households kept cattle, bullocks, goats, and native poultry. The type of livestock and holdings were mainly influenced by the extent of land owned by them. Sheep rearing, however, was restricted to traditional communities like the Kurbas and Gollas of Andhra Pradesh and Karnataka, and the Danghars of Maharashtra.

Over the last twenty-five years, two levels of drivers have emerged as responsible for triggering changes in the livestock production systems. At the national level, the key drivers of change are the animal husbandry policies that promote adoption of high-input-output production systems and animal breeding programmes focussed on increasing productivity (single productive trait). In addition to this, conversion of common property resources (grazing lands in particular) into agriculture lands has been another major change forcing a decline in rearing of cattle. While agriculture production on own lands, as well as in the form of agriculture wage labour at village level has increased, it has led to shortage of availability of labour to manage livestock, impacting livestock rearing yet again. In addition to this, rural literacy programmes have also been a key driver in changing livestock systems – rural youth aspire to better jobs than their traditional occupations. In terms of pressures, communities reported that the ban on grazing in forest areas and natural resource conservation and management programmes have caused reduction in rearing indigenous cattle and other non-dairy livestock, as conservation and management of natural resources puts a direct restriction on grazing. Simultaneously, promotion of dairy cooperatives and related infrastructure, subsidies, poverty-alleviation programmes, and animal husbandry schemes/programmes that promote crossbred cattle for improving economic returns through increased milk production, have accelerated a shift towards rearing crossbred cows. Intensification of animal husbandry with widespread introduction of exotic breeds has led to a perceptible increase in the population of limited specialised breeds and the reduction in total genetic variability and population size of many local breeds. As per the Fourth National Biodiversity report to Convention on Biological Diversity 2009, almost all indigenous breeds of livestock show declining trends in the country. Estimates indicate that 50 percent of indigenous goat, 30 percent of sheep, 20 percent of cattle, and almost all poultry breeds are threatened.

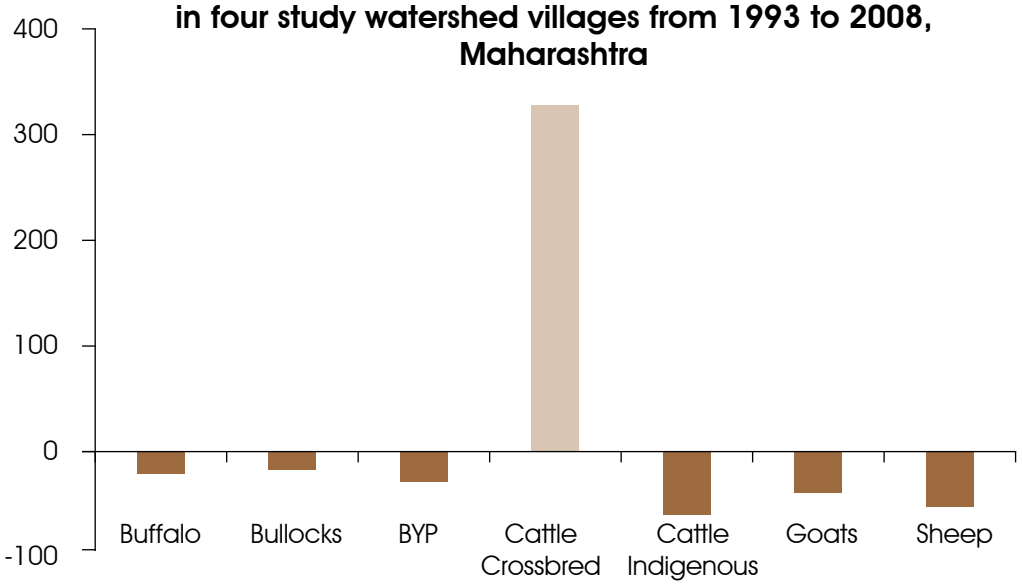
The crossbred cattle population in the country has increased by 22.8 percent and the indigenous cattle declined by 10.2 percent between 1997 and 2003. Following this is an increasing trend in buffalo rearing for milk production. Graph 1 indicates the rate of growth of both crossbred cattle in comparison to indigenous cattle across the dryland states in India (according to the 17th Livestock Census report). The same is seen in sheep where fast-growing meat breeds are promoted rather than the local sheep breeds such as *Deccani* sheep that are more suited to the agro-ecological zone. Further, a recent study[xxiii] done in four sample watershed villages from different agro-ecological zones of Maharashtra shows percentage change in livestock holdings over

Graph 1: Growth rate of crossbred cattle vs indigenous cattle across dryland state of India for the period 1997–2013

Source : 17th Livestock Census



Graph 2: Percentage change in livestock holdings in four study watershed villages from 1993 to 2008, Maharashtra

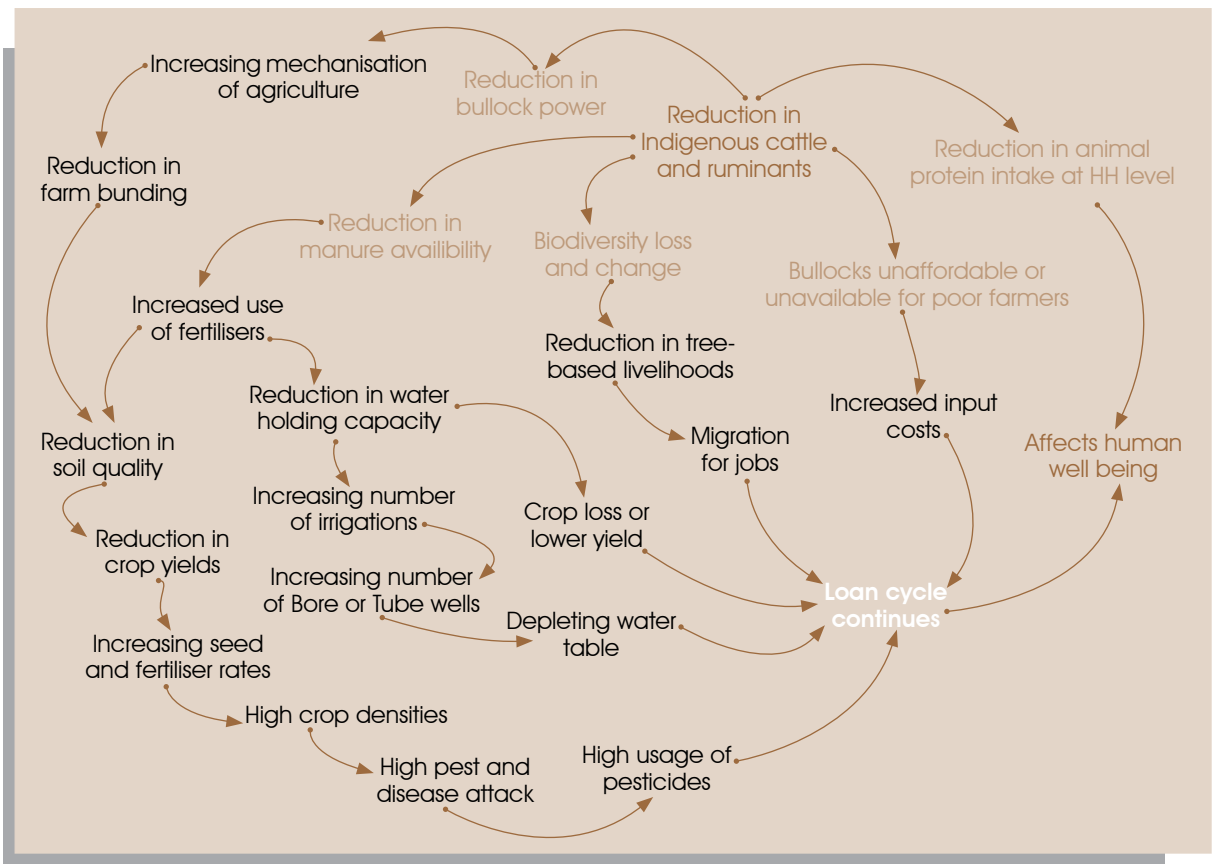


a period of 15 years (refer to Graph 2). The key trend seen is a major shift from extensive mixed livestock farming to water-intensive sedentary livestock production, i.e. increase in crossbred cattle farming and a decline in rearing of small ruminants, back yard poultry (BYP), and indigenous cattle at household level. Such changes/trends in livestock rearing are not restricted to just Maharashtra. It can be seen across WOTR's project villages in the states of Andhra Pradesh and Rajasthan (WOTR data base), as well as other dryland states of India.

These drivers and pressures induce a clear shift from a low-input farming system to a high-input-output, water intensive, cash crop and dairy based farming system. The main trigger was found to be the significant reduction in both the number of indigenous cattle and in the rearing of non-dairy livestock (small ruminants, backyard poultry) by households over time. This has triggered a chain of events impacting agricultural production adversely, particularly of small holder producers. The main impacts seen due to this are increased depletion of ground water, decreasing soil quality and fertility, biodiversity loss, reducing crop yields, and increasing input costs in agriculture. Reduction in small stock, especially goats and backyard poultry, has led to reduced nutritional and financial security for women and children. In the context of human well-being, high-input-output crop-livestock production systems have made the lives of rural women more difficult, as these production systems are highly labour-intensive. (Please refer to diagram below.)

Ecosystem services, high-input-output livestock (crossbreds/exotics) production, and its viability in dryland ecosystems

The profitability/viability of dairy farming with crossbred cows is explored further as field interactions with farmers reveal that rearing crossbred cows for milk production has become a key secondary source of income. It is an adaptation response embraced by the farmers to safeguard themselves from agricultural market price fluctuations and crop loss. However, in-depth interviews, and basic calculations on livestock economics[5] with respect to crossbred



[5] Data was collected from a sample of 10 farmers who belong to the small and marginal farmer category only. Large, progressive farmers were totally excluded from the survey/interviews as the data generated was showing a large difference in all parameters and it was obvious that the two categories were not comparable.

Table 1: Resource requirements per day for different dairy animals

Resource requirement	Cattle		Buffalo	
	Indigenous	Crossbred	Indige nous	Murrah
Drinking water (lt/day/animal)	35–40	70–80	40–45	60–70
Water for maintenance (lts/week/animal)	5	10–20	10	10
Feed concentrate (kg/day/animal)	0–2	6	2	5
Dry fodder (kg/day/animal)	10	45	18–20	20
Cultivated green fodder (kg/day/animal)	5	40–60	20	60–70

Source: Farmer Interactions

cows revealed a different picture altogether, raising issues of concern, especially in the context of climate change and sustainability of dryland ecosystems.

The crossbreds deliver significantly higher milk yields, generating better economic returns; but are at higher risk during the increased dry spells, droughts, and high temperatures during summers, as they are resource-intensive when compared to indigenous cattle (Table 1). As a consequence of this shift to crossbred cattle, the effects on the ecosystem will felt as a greater burden: reduction/loss of fodder production in range lands, lowered buffering abilities of ecosystems, increased desertification processes, scarcity of water resources, and lower production of grain/crop residues. Crossbreds have significantly lower disease resistance as compared to indigenous cattle[xxiv,xxv] and are prone to heat distress, causing poor performance growth, thereby giving reduced yields. Higher temperatures and changes in rainfall patterns will aggravate the spread of existing vector-borne diseases and macro-parasites of animals, as well as the emergence and spread of new diseases. Preliminary analysis of the Rainfed Livestock Network (RLN), a WOTR 2012 study, reveals that loss due to morbidity is significantly higher in crossbreds when compared to indigenous cattle, thus impacting small-holder producers far more than large land holders, due to their limited capacity to invest in health care. Farmers reported that a minimum expense of Rs.3500 per annum goes for health care per animal. This differs depending on the disease and the number of times it re-occurs per year. Data presented in Table 2 from an ongoing study on animal health[6] clearly shows that crossbred cows are more susceptible to diseases when compared indigenous cattle and buffaloes.

Table 2: Morbidity in cattle and buffaloes

State	Indigenous Cow	Crossbred Cow	Indigenous Buffalo	Graded Murrah
Andhra Pradesh	6%	44%	2.8%	13.5%
Maharashtra	11%	27%	25%	NA
Tamil Nadu	10%	28%	12%	NA
Rajasthan	17.5%	30.8%	21.2%	24%

Source: 100 animal survey (WOTR & Rainfed Livestock Network Study)

[6] A study being lead by WOTR, supported by the Rainfed Livestock Network and the Ford Foundation.

In addition to this, crossbred animals are reported to show reduction in hybrid vigour due to which their productive years are reduced significantly (Indian Express, 2009[xxvi]). They also show a higher incidence of reproductive disorders[xxvii] when compared to indigenous cows. Western countries are already facing the brunt of the tremendous increase in the lactation cycle, as it has a huge impact on the vitality and fertility of the animals.[xxviii] Rearing crossbred cattle is more labour-intensive and with increasing farm labour costs, it is a critical problem today. Having more than two crossbred animals per household would require hired labour, making the venture unviable.

The numbers indicate that even though the average milk output per animal per day for indigenous cattle is significantly lower as compared to crossbred cattle, milk from indigenous cattle is still a more sustainable option for the rural poor in dryland regions. Given that the average cost of each animal is Rs.50,000 for a Holstein-Frisian, Rs.35,000 for a Jersey, and Rs.20,000 for an indigenous cow, the viability of crossbreds is questionable.

Changing livestock systems and vulnerability to climate change

Based on projected impacts of climate change in dryland regions, changes in livestock composition and rearing systems (intensification) have definitely seemed to increase the vulnerability of both communities and the ecosystems. Intensification of livestock during the past couple of decades (or more) has been a high-resource (water), high-input-output production system that brings in short-term gains, but which erodes the medium- and long-term adaptive capabilities of communities due to the stress imposed on the ecosystems. Findings indicate that communities continuously search for better options to reduce their vulnerability to climate change. However, the majority of responses adopted are short-term fixes that reduce vulnerability temporarily, but decrease the resilience of the ecosystem, particularly in the face of varying weather patterns. This increases the community's vulnerability in the long term.[xxix] The most vulnerable groups identified in this context are small and marginal farmers, women, the aged, and children. When there is a high dependence on high-risk crossbred cow farming, with a significant reduction of small livestock which acts as a buffer in times of emergency, the vulnerability of the small-holder producers is greatly aggravated. This is particularly noticed in Maharashtra, where the small ruminant population has drastically fallen. There is an increasing investment cost in farming due to loss of the multiple advantages provided by indigenous cattle (manure, draught power, etc). Besides this, there is loss of financial and nutritional security for women and children with the reduction in backyard poultry (BYP) and small ruminants at household level.

In the agriculture sector, maximum GHG emissions are from enteric fermentation in livestock, amounting to 59 percent, followed by paddy cultivation at 23 percent, manure management at five percent, and burning of agriculture crop residue at one percent. With India having the highest population of livestock[xxx] reared under the extensive system of livestock production, it is said that poorly-fed livestock, i.e. fed on inadequate rations or less digestible crop by-products or grazing on poor quality rangelands, results in release of high levels of methane via enteric fermentation.[xxxi] However, among the different livestock categories, female crossbred cows emit higher emissions than indigenous cattle due to their higher body weight, while indigenous cattle have better capacity to digest low-quality feeds. Various studies indicate that enteric emissions from livestock depend on the interactions between a variety of factors[7] of which the feed characteristics and feed rates

[7] Such as the physical and chemical characteristics of the feed (feed quality), the feeding level and schedule, the use of feed additives to promote production efficiency, and the activity and health of the animal, etc.

have the most influence. Inferences from Table 1 above and from discussions with farmers groups indicate that only farmers with large land holdings can produce adequate quantities of green fodder. They buy higher quantities of concentrate feed; invest in better health care and management for the high-yielding crossbred cows. But many poorer farmers also keep crossbred cattle, but cannot feed or manage them adequately, causing the cattle to produce high levels of methane; therefore, one may conclude that methane emissions in high yielding crossbreds, considered in totality, will be much higher when compared to indigenous cows. However further research is required on this.

4. Current trajectories and areas of prejudice: the Positions for Policy Change

The following recommendations/positions throw light on the areas of blindness, given that the main effects of climate change will be on livestock production. These are suggested for policy change.

4.1 Livestock breeding policy must enable *in situ* conservation by involving pastoralists/livestock keepers in long-term sustained initiatives

As per the Fourth National Biodiversity report to CBD, 2009, almost all indigenous breeds of livestock are showing declining trends in the country. Estimates indicate that 50 percent of indigenous goat, 30 percent of sheep, 20 percent of cattle, and almost all poultry breeds are threatened. Rapid structural changes occurring globally in the livestock industry try to industrialise livestock production to provide cheaper livestock products, to make it more accessible to the poor. However, these possess many dangers apart from losing the diversity of animal genetic resources. Hence changes in policy are required to accommodate the following:

- Protect small-holder producers, who are a majority in India, so they do not get excluded, as they are unable to compete with larger players. More than 40 million households in India partially depend on milk production. Development in the dairy sector will have significant repercussions on their livelihoods.[xxxii]

- Support traditional extensive livestock production systems and reduce the risk of pandemics (swine flu, bird flu, mad cow disease, etc.) which are high in industrially produced livestock. This will be exacerbated with climate change.

- Protect the pastoralist communities, the nomadic groups in particular, who are the main 'livestock gene keepers' as they supply the best animals to other sedentary farmers across drylands, ensuring sustainability of agricultural production systems and increasing the resilience of food supply systems. They are also the custodians of a store of traditional knowledge that needs to be protected, relating to all aspects of animal breeding and management, and vegetation and grazing management.

State/national livestock breeding policy and development strategies need to be designed taking into consideration the different agro-ecological zones and livestock production

systems specific to the region. In addition to this, for dry regions, genetic improvement of breeds needs to focus on identifying high-performance *local* breeds and the optimisation of their potential for multiple functions, rather than on a single productive trait such as meat or milk production. Since *ex situ* conservation efforts have failed miserably over the years, our policy must enable *in situ* conservation through long-term sustained initiatives, where local livestock keepers can participate and improve locally adapted livestock under different production systems. This ensures focus on conservation and development of indigenous breeds, along with protection of pastoralists communities who are the custodians of this valuable knowledge base.

4.2 Livestock schemes need to be more suited to dryland farming systems

Facts from the grass roots conclude that high-input water-intensive production is a high-risk option in dryland regions and needs to be balanced. Given the high resource footprints, it may not profitable in the long run with the increasing impacts of climate change. Crossbreds deliver high milk yields, generating better economic returns in the short run; however, given the inherent vulnerabilities of dryland regions and the impacts of climate change, such as increased dry spells, droughts, high temperatures during summers, and the various insights listed earlier, crossbred dairy farming does not seem to be a viable option beyond a point.

In this scenario, there is a need to clear the prejudice that indigenous breeds are not productive and shift the approach from high economic returns to more ecosystem-friendly sustainable modes of production. Various animal husbandry and rural development programmes must support conservation and development of indigenous breeds by providing subsidies/ incentives or loan schemes to encourage farmers to maintain them.

4.3 Making agriculture sustainable; bringing back the livestock connect

Dryland regions are inherently vulnerable, bio-physically, and the enormous environmental stress created by the high resource footprint of crossbred dairy farming on an already fragile ecosystem often goes unnoticed due to the high gains from productivity. When productivity is assessed in terms of production, it does not take into account the value provided by the multi-functional nature of indigenous livestock to keepers/farmers through essential services such as transport, credit, landscape conservation, and environmental protection, thereby resulting in biased evaluations.[xxxiii]

Mixed farming systems which existed earlier need to be promoted, ensuring the development and conservation of cattle in optimal numbers, coupled with conservation and development of CPRs to support the extensive system of livestock husbandry that is required.

4.4 Small livestock is essential for the rural poor to cope with the emerging risks caused by climate change

a) Need for a special programme for backyard poultry[8] (BYP)

Policy-makers and programmes have overlooked these traditional backyard poultry systems in favour of industrial-production systems using exotic and cross-breeds. Backyard poultry provides important subsidiary income for women, nutrition for

[8] 'Backyard poultry' (BYP) for native birds, practised under the traditional system of free-range scavenging. These native birds are characterised by their ability to thrive under local climatic conditions for which they are well adapted. They require low or almost no external inputs for production. These native birds are resistant to diseases and possess an innate capacity to protect themselves from predators. They also do not require extra labour, specially allocated land or external supply-support systems for production.

poor households, and plays an important role in traditional rituals and cultural activities in rural India. Without additional inputs and with improved practices, BYP gives an annual income of around Rs.2000, which is equivalent to the income generated from agriculture on one acre of dryland. Evidence from initiatives documented by the South Asia Pro Poor Livestock Policy Programme (SAPPLPP) and various research-based studies across India clearly highlight the positive impact of regular healthcare service delivery, continued supply of vaccines and improved management practices, which result in improved economic gains for households raising backyard poultry. In addition, projects implemented by NGOs like Anthra – Andhra Pradesh, the Bastar Integrated Livelihoods Development Programme (BILDP) in Chhattisgarh, and the DANIDA initiative indicate that net income from BYP can go up by 200 percent per household (Rs. 4000 to 5500 per annum).

The absence of sustained programmes promoting BYP is proving counter-productive to the nutritional and financial security of poor households and hence, a strong need for a separate programme for BYP is essential.

b) Sustainable intensification of small ruminants yields higher returns and has less impact on the ecosystem

Sheep and goats in India belong mainly to smallholders who own one hectare of land or less, or are landless, and who depend entirely on common property resources for their survival. Emphasis needs to be on accommodating small-ruminant rearing systems, which are purely extensive, in watershed development programmes. Priority should be given to the provision of grazing rights, particularly to pastoralist communities, and to accommodate extensive (grazing-based) livestock production systems, in initiatives to protect, conserve, and regenerate common property resources.

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About WOTR

Aware of the fragility of ecosystems and our symbiotic link with it, WOTR has historically applied a systems-based approach to watershed development, focussing on people-centric participatory interventions. With more-than-normal weather variations now being experienced, WOTR has moved into **Ecosystem-Based Adaptation (EBA)** – an emerging approach that helps vulnerable communities build the resilience of their degraded ecosystems and livelihoods threatened by climate change impacts. This approach also generates significant multiple benefits – social, economic, and cultural.

Since 2008, WOTR has been reorienting, re-organising and equipping itself with respect to focus, strategy, and interventions in order to specifically address the challenges (and opportunities) posed by climate change to vulnerable rural communities. In the process, WOTR has introduced a bottom–up, holistic, and integrated approach with appropriate interventions, towards **Adaptation and Resilience Building.**

Constantly learning from experience, we have been **rethinking conventional development.** We have introduced **Systems Thinking and Complexity Analysis** in programme design and are developing strategies to incorporate these into action plans, leading to new **tools and frameworks** while adapting the existing ones. This helps us move to **Framework-Based Management**, in contrast to activity-based project design and management.

Applied Research is a constant companion. The WOTR team, guided by experts, helps local communities become researchers – observing, measuring, and assessing for themselves not only problems but also the improvements that a project brings about. And having tested methodologies, WOTR disseminates the learning through **Capacity-Building Events** to reach implementers and donors, far and wide, so as to benefit rural communities across India and countries in the South.

As of now, WOTR's Climate Change Adaptation project is currently being implemented in 65 villages of Maharashtra, Madhya Pradesh, and Andhra Pradesh, covering an area of approximately 41,000 ha (410 km^2), directly benefitting over 63,000 people from around 12,000 households.

Since its inception in 1993, WOTR has carried out developmental work in over 2,500 villages in six states – Maharashtra, Andhra Pradesh, Madhya Pradesh, Rajasthan, Jharkhand, and Odisha (Orissa). It has organised over 1,100 watershed development (which are also climate adaptation projects), covering nearly 7 00,000 hectares and impacting over 1,000,000 people. Its involvement in over 8,300 women's Self Help Groups (SHGs), micro-finance, trainings and other initiatives have benefitted over 100,000 women. Similarly, over 320,000 people from 27 states in India and 35 countries have participated in WOTR's training and capacity-building programmes.

Today, the WOTR Group consists of four not-for-profit institutions – the Watershed Organisation Trust (WOTR); the Sampada Trust (ST) for women's empowerment and micro-finance; Sanjeevani Institute for Empowerment and Development (SIED), which is the implementation wing of WOTR; and Sampada Entrepreneurship and Livelihoods Foundation (SELF) that has recently been set up to promote social enterprises and livelihoods.

For more information visit us at www.wotr.org

Watershed Organisation Trust
'The Forum', S. No. 63/2B, Padmavati Corner,
Pune–Satara Road, Parvati, Pune 411009
Tel: +91-20-24226211
Email: info@wotr.org website: http://wotr.org

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