



**FACETS OF NATURAL RESOURCES
MANAGEMENT FOR RAINFED AGRICULTURE:
A PARADIGM SHIFT IS IMPERATIVE**

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Abstract:

Spanning several agro-ecological regions constituting 60% of total cropped area. The rain fed areas represent the geography with the largest concentration of poverty and backwardness. The cumulative neglect of the rainfed areas over the earlier plan periods in terms of institutional development, support systems, availability of appropriate inputs, credit, market access, agricultural research and extension has caused widespread desperation amongst farming community. Rain fed agriculture supports an estimated 40% of population (484 million) and has a large share of cropped area under rice (42%), pulses (77%), oilseeds (66%) and coarse cereals (85%). Harboring about 78% of cattle, 64% of sheep and 75% of goats rain fed areas cater to most part of the meat market in the country. In the light of the above, this paper made an attempt to briefly review the performance of Rain fed agriculture and critically examine the role of Livestock, Fisheries and Horticulture as a key component of rural livelihoods in rain fed regions and finally it also strongly advocates the hidden potential of Management of Common Pool Resources (CPRs) is an essential part of natural resource management in rain fed areas.

Keywords: rain fed agriculture, natural resources, livestock, common pool resources

1. Introduction

The natural resources base of a region includes the elements of climate, land, water, soil and biodiversity. They dictate the opportunities for livelihoods and incomes for the people of the region. In India, the prime natural resource is 328.73 million hectares of land of which 143 million ha are arable lands, 14.81 million ha are fallows and 37.16 million ha common lands and 69.63 million ha are forests, with the rest accounting for 43.22 million ha. (ASI, 2007). The next, water, is critical for agriculture. Agriculture which uses 80

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percent of the fresh water resources in the country depends critically on maintaining the quantity and quality of the 1869.35 km³/year of water available (MoWR). India is also considered a biodiversity hotspot; agriculture in many ways draws from and maintains the diversity of flora and fauna in the country, including the diversity of many collected (non-cultivated) foods obtained from common lands and forests.

Widespread, serious and continuing degradation of India's natural resource base is now reflected in increasing difficulties in achieving growth rates in agriculture. Over 120 million ha have been declared degraded or problem soils (NAAS, 2010). But this seems to be a minor problem in the face of the massive and prolonged loss of organic matter and C in most of the arable lands in India, which have been under the plough for 2000 years or more (Royal Commission on Agriculture in India, 1928). Given that for the country in general, crop response or incremental yield per unit of nutrients tends to be lower with increasing fertilizer use per hectare, the evidence for soil organic matter depletion being a prime cause for declining soil health and soil productivity is mounting (Sharda et al, 2010). In addition, the water resources primarily groundwater is declining at a greater pace threatening the sustainability of Indian agriculture. The latest reports from the GRACE Mission of NASA (Rodell et al., 2010) show decline at a mean rate of 4.0+/- 1.0 cm/yr, equivalent height of water (17.764.5 km³/yr) over the Indian states of Rajasthan, Punjab, Haryana and Delhi. During the study period of August 2002 to October 2008, groundwater depletion was equivalent to a net loss of 109 km³ of water in northwest India. Such high rates of groundwater exploitation increased the percentage of 'unsafe' districts from 9% to 30% in a span of 9 years (1995-2004) (Vijay Shankar and Kulkarni, 2011). Other forms of loss include water lost due to salinity and alkalinity, and due to overdraft from groundwater sources, way beyond the recharge capacities of the aquifers (Planning Commission, 2010; Shah et al., 2009). Globally, there is compelling evidence about agri-environmental degradation, and consequent reinforcement of poverty and hunger by some of the policies and inputs that are designed to increase production but result in resource depletion and degradation.

In this Working Group report, were addressed two specific challenges of this overall deterioration of the natural resource base of Indian agriculture. The first is that of sustainable natural resource management (NRM) of rain fed areas to enhance capacities to revive and manage our natural capital in a sustainable manner. The second is to stabilize the production systems of rain fed agriculture, currently being practiced in over 80 million hectares of sown area of the country. The Working Group feels that it is imperative that the XII FYP devote special attention to the issues of natural resource management and rain fed agriculture as part of its comprehensive strategy for more inclusive growth. In fact, this report strongly argues that sustainable and inclusive growth is not possible unless the processes contributing to resource degradation and vulnerability of rain fed agriculture and production systems are squarely addressed and reversed. It strongly advocates a paradigm shift in agricultural policy that ensures sustainable and equitable development of rain fed areas over the next plan periods.

The Working Group noted some of the major changes in development policy and planning in the country. First, there is a welcome trend towards decentralization of development schemes, especially through the Rashtriya Krishi Vikas Yojana (RKVY) which bestows upon the states the function of preparing district level agricultural development plans taking into account local priorities and needs and further devolves central support to the tune of 18.3% for implementation of these decentralized plans (Planning Commission, 2010). Second, there is a welcome attempt within the Central Ministry of Agriculture to re-structure and re-order the numerous schemes with tiny allocations under the Department of Agriculture and Co-operation by merging them into larger programmes to ensure effectiveness and enhanced development outcomes (Planning Commission, Note Circulated to the Working Group, 2011). Third, the Ministry of Agriculture and the Planning Commission have made the demand that adequate agricultural research funds are devoted to address the natural resources degradation especially in rainfed areas (Planning Commission, 2010; GoI, 2008). Fourth, the Approach Paper to the XIIth plan articulates a strong case in favor of breaking the isolation and exclusion of rainfed agriculture within the agricultural policy mechanisms, research and extension systems, and credit and market support. Finally, there has been a continuous and pro-active engagement of several NGOs and CBOs with issues related to crops, land use, input management, animal husbandry, inland fisheries, horticulture, agro-processing, market access, nutrition and gender in India's drylands. Some state governments have acknowledged and encouraged these civil society groups as critical support systems for the effective functioning of the state's own delivery mechanisms. There is the need to foster more such effective, location-specific and locally accountable partnerships between the formal and informal actors in agriculture.

The Working Group report builds on such encouraging policy developments and feels that they should be further strengthened to open up a path of equitable and people-centered development in rainfed areas of India.

2. Methods and Materials

A descriptive and explorative methodology is followed. The secondary data based on various reports from Govt depts and other research institutions. The published sources such as Web sites, periodicals and Reports are liberally used for the preparation of the paper.

2.1 Cumulative Neglect: Natural Resources and Rain fed Agriculture

Rain fed agriculture (crop and animal husbandry) is now emerging as a major opportunity in raising overall agricultural growth. Even after achieving the full irrigation potential, nearly 50% of the net cultivated area will remain dependent on rainfall. Rain-fed agriculture supports nearly 40% of India's estimated population of 1210 million in 2011. India ranks first among the rainfed countries in the world in terms of rainfed area but ranks among the lowest in rainfed yields (<1t/ha).

Spanning several agro-ecological regions, the rainfed areas represent the geography with the largest concentration of poverty and backwardness. The key thrust in agricultural policy till now has been to extend technologies to these areas that have evolved to enhance productivity in well endowed areas. This has not led to achieve significant gains while resource degradation problems, such as loss in soil fertility, groundwater depletion, loss of biodiversity and increase in climate associated vulnerabilities etc. have continued to exacerbate. At the same time, inadequate support for rainfed agriculture in terms of support price, availability of appropriate inputs, credit, market access and agricultural research and extension has caused widespread desperation among farmers.

A brief overview of the current features of rainfed farming reveals some of the underlying relationships between natural resources and production systems. Even with this policy neglect, the contribution of rainfed agriculture to the national economy is by no means small. The most striking feature of rainfed farming is the diversity of agricultural activities. With the cultivation of over 34 crops in a year as compared to 4 or 5 as in case of irrigated system and where livestock, horticulture, agro forestry, seed spices, medicinal & aromatic plants, fishery (in high rainfall areas), bee keeping, etc., farmers and farming systems in rainfed areas reveal a portfolio of survival and production options.

Table 1: Share of Rainfed Area in Total Area under Crops

Crop	Area	% Under Rainfed	Area Under Rainfed
	M.HA	%	M.HA
Rice	45.54	42%	19.13
Coarse cereals	27.45	85%	23.33
Jowar	7.53	91%	6.85
Bajra	8.75	91%	7.96
Maize	8.17	75%	6.13
Pulses	22.09	77%	17.01
Redgram	3.38	96%	3.24
Bengal gram	7.89	67%	5.29
Oilseeds	27.56	66%	18.19
Groundnut	6.16	79%	4.87
Rapeseed & Mustard	6.3	27%	1.70
Soybean	9.51	99%	9.41
Sunflower	1.81	69%	1.25
Cotton	9.41	65%	6.12
Total	191.55	68%	130.48

Source: Indian Agricultural Statistics, 2010.

Rainfed agriculture accounts for 60 % of total cropped area, 48% of the area under food crops and 68% of that under non-food crops. In terms of crop groups, 77% of pulses, 66% of oilseeds and 45% of cereals are grown under rainfed conditions (Table 1). Foodgrain production in India grew at a rate of 1.26% per annum between 1990-93 and 2003-06. Meeting the future demand for food grains (estimated at 280 million tones by 2020) would

require a step up in the rate of growth of food production where rainfed agriculture has to play an important role. As estimated by the Technical Committee on Watershed Development (2006), even in the best possible scenario of irrigation development, about 40% of the additional supply of food grains needed to match future rise in demand will have to come from the rainfed agriculture. Therefore, a breakthrough in rainfed agriculture is an imperative for poverty alleviation, livelihood promotion and food security in India.

The rainfed crops have shown more impressive growth rates in recent years as compared to irrigated crops like rice and wheat as seen in Table 2. The compound growth rates for the period 1998-99 to 2008-09 reveal that production of coarse cereals increased at a rate of 2.73%; production of pulses continued to be an area of concern. Both area and yield didn't show any significant growth and remained stagnant and as a result the production also increased at a mere 1.08% per annum. As far as oilseeds are concerned, faster yield growth was observed in groundnut (2.29%), sunflower (2.25%) and rapeseed and mustard (2.22%) and slower growth in soybean (1.15%) and castor (1.21%). Finally, in case of cotton, the yield increased at a significant rate of about 9.60 percent per annum and led to a production growth rate of over 10 percent per annum. Growth rate in yield of coarse cereals, pulses and oilseeds taken together (2.18%) was much higher than that of rice (1.40%) and much higher than wheat (0.46%). Therefore, these crop groups, whose production is largely rainfed, witnessed significant production and productivity growth during the last decade and compared favorably with that of rice and wheat.

Table 2: Growth Rate in Area, Production and Yield of Major Crops in India, 1998-99 to 2008-09

Crop/ crop group	Compound Annual Growth Rate (%)		
	Area	Production	Yield
Sorghum	-2.82	-1.19	1.77
Pearl millet	0.07	4.11	4.04
Maize	3.00	5.60	2.52
Coarse cereals	-0.52	2.73	3.26
Chickpea	1.69	2.24	0.54
Pigeon pea	0.34	0.16	-0.17
Pulses	0.61	1.08	0.47
Coarse cereals + Pulses	-0.03	2.24	2.27
Groundnut	-1.32	0.93	2.29
Castor*	0.22	1.44	1.21
Sunflower	4.94	7.32	2.25
Soybean	4.39	5.59	1.15
Rapeseed and mustard	1.97	4.24	2.22
Oilseeds	1.60	3.65	2.02
Coarse Cereals + Pulses + Oilseeds	0.51	2.70	2.18
Cotton	0.54	10.20	9.60
Rice	-0.12	1.28	1.40
Wheat	0.39	0.85	0.46

*Data used for castor refer to 1997-98 to 2007-08

Source: CRIDA (Adapted from ASI).

Rainfed areas have recorded high growth in terms of yield and production. Much of this is cultivated in multiple cropping systems. There are crop sequences and combinations tuned to undulating terrains, soil moisture, availability and use of farm yard manure (FYM) or other bio-mass and fertilizers, traditional pest management practices at times integrated with modern pesticides, and emerging markets (as evident in the case of sorghum, soyabean, cotton, etc.). Contrary to the irrigated production systems that focus on individual crops/commodities, the key feature of rainfed cropping is the attention paid to the entire farming system and what can be harvested best.

3. Livestock, Fisheries and Horticulture

Livestock production forms a key component of rural livelihoods in rainfed regions. The rainfed areas account for almost 80 percent of all small ruminants in the country. Estimates suggest that 70% of agricultural GDP in arid areas and 40% in semi-arid areas come from rearing of livestock- accounting for around 55% of the total livestock population, estimated to be 350 million in 2003. Livestock contributes over 20% of the annual income of rural households; the share rising to nearly 30% percentage for households with less than 1 hectare of land (CAZRI). There is evidence that livestock development and most importantly risk mitigation in this sub-sector is supported by investments in water harvesting, soil conservation, regeneration of grasslands, assured access to common lands and availability of local germplasm as well as nurturing of local breeds.

Presently, fisheries and aquaculture contribute 1.04% of the national GDP of the country and 5.34% of agriculture and allied activities (DAHD, 2009). India is now the third largest producer of fish and the second largest producer of fresh water fish in the world. Fisheries sector contributes significantly to the national economy while providing livelihood to approximately 14.49 million people in the country (Handbook on fishery statistics, 2006). The poor inland fishing communities depend for their livelihood and food security on these indigenous species. India has vast inland fishery resources in the form of rivers and canals (195210 km), reservoirs (2-94 million ha), tanks and ponds (2.41 million ha), floodplain (DAHD, 2009).

In dryland livestock as well as inland fisheries production, the two common concerns arise from (i) the acute dependence of the poorest population groups on these two sub-sectors, and (ii) the rapid rate at which the natural resources-grazing lands, commons, diversity of crop residue available, grass and local medicinal plants, common water bodies, diversity of local species of animals and fish - are getting degraded. The limited public sector support that the rainfed areas receive either add to the problem (by subsidized tube wells withdrawing water, or tractors and deep tillage eroding and denuding the precious top soil) or are oblivious of the existence of the massive potential for inclusive growth. For instance, in Orissa, a State where marginal and small farmers, together with rural landless households own 60 percent of the milch animals, 55 percent of draught animals, 75 percent of the poultry, over 80 percent of the goat and almost all

the sheep and pig population, the focus is on improving the genetic stock of cows and buffaloes. There is an emphasis on cattle and buffalo as the only livestock worth technological support and production inputs. Besides, there are consistent attempts to blame goats for natural resource degradation and deforestation. The dry lands are also terrains where regular battles are fought between villagers and forest officials over grazing rights. The neglect of livestock-based livelihoods, resource constraints and deprivation in India's economic decision-making forums, is evident from the fact that till date, the CSO reports fodder value from forests in 17 major states as 'nil or negligible'.

4. Common Pool Resources

Common Pool Resources (CPRs) or "commons" are an important component of the rainfed production systems, which is also one of the most neglected even in the schemes and programmes that purport to explicitly focus on physical resources. Though a common definition of common pools does not exist, broadly all land, water (including groundwater), seeds, breeds and diverse species of plants, which are collectively used and held, can be categorized as commons. The Committee on State Agrarian Relations and Unfinished task of land Reforms defined rural common pool resources as "*resources to which all members of an identifiable community have inalienable use rights. In the Indian context CPRs include community pastures, community forests, Government Wastelands, common dumping and threshing grounds, river beds, watershed drainages, village ponds and rivers etc.*".

Management of CPRs is an essential part of natural resource management in rainfed areas. Commons are not only a 'refuge' to which vulnerable households and populations can turn to when everything else fails, it is a foundation on which multiple production systems rest in a manner that strengthens their resilience. It is in the commons-livestock-agriculture interface and the larger geo-hydrological functions the commons play that the inter-connectedness of the system and its resilience can be located. Hence, we need to strengthen symbiotic relationships between commons, livestock, soil fertility, pest management, soil moisture management, watershed development and agriculture, especially in rainfed areas. Given the overall policy neglect and limited investments in rainfed areas, the subsidy derived from commons forms a critical contribution to both livestock/fisheries and agricultural production systems.

There have been many estimates of the size and significance of CPRs. The National Sample Survey Organization (NSSO) in the 54th round of survey estimated that commons constituted about 15% of the total geographical area of the country. One fourth of this area is community pasture and grazing lands, 16% is village forests and woodlots, and 61% is attributed to the 'other' category. 'Other' includes the village site, threshing floors, and other barren and wasteland. Chopra and Gulati (2001) reclassified India's Agricultural Land Use Statistics data for 1991 to estimate the extent of common pool resources in 16 major states. Their estimation is based on the 9-fold classification land. Based on this they defined common pool land resources in the country as the sum of

cultivable wastes and fallows other than current fallows, common pastures and grazing land, protected and unclassified forests, and barren, uncultivable and other government lands that are being used as for common purpose. In their estimate, common pool came to around 25.61% of the total geographical area of the country. By this estimate the non-forest common pool resource constitutes around 14.81% of the total geographical area of the country. Including the protected forest and other forest the common lands (Table 3).

Table 3: Estimation of Common Pool Land Resources (Million Ha) in India

Sl. No	Land use type	1990-91
1.	Total Geographical Area (ASI)	328.73
2.	Owned land (AC)	165.51
3.	Net sown area (ASI)	143.00
4.	Current fallows (ASI)	13.70
5.	Private land with common access (2 - 3 - 4)	8.81
6.	Cultivable wastes (ASI)	15.00
7.	Other fallows (ASI)	9.66
8.	Common pastures & grazing land (ASI)	11.40
9.	Land under misc. tree crops (ASI)	3.82
10.	Non-forest common pool resource (5+6+7+8+9)	48.69
11.	As % of total area	14.81%
12.	Protected forest (SFR)	23.30
13.	Other forest (SFR)	12.21
14.	Common pool resource including forests (10+12+13)	84.20
15.	As % of total area	25.61%

Source: Agricultural Statistics of India (ASI, 2002); Agricultural Census (AC, 2002); State of Forest Report (SFR, 1991)

The Working Group accepted the need to have differentiated perspective of commons based on its social-cultural, economic, livelihood and ecological functions. The differentiated perspective would help in defining commons based on its use regimes across different location specific contexts, and devising appropriate strategies and approach for governing common pool resources. Commons are critical for the poor households, plays a crucial role in sustaining eco-system functions, directly and indirectly contributes to agriculture production system, meets substantial proportion of fodder requirement of livestock production systems in rainfed regions, are the dominant source of firewood needs of the poorest and contributes directly and indirectly to the nutritional and food security of rural households. Further, commons play a crucial role in the coping mechanisms of rural households and through livestock and other produce collection plays a critical risk coverage function. N. S. Jodha's (1986) study of 82 villages from 21 districts in the arid and semi-arid zone of the country leads several studies that have now established beyond doubt the relevance of the Commons to India's rural economy at large and its criticality to the livelihoods of the rural poor in particular. Jodha's study shows that around 84-100% of the rural poor depend on the Commons for fuel, fodder and food items. The study estimated that 14-23% of household incomes are

derived from the Commons and they play an important role in reducing income inequalities.

The 54th round of the National Sample Survey Organisation also reports the current status of common pool resources in the country, based on a survey of 78,990 rural households in 5114 villages. Table 4 reports data from the NSSO survey on the use of common pool resources. About half of the surveyed households reported collection from common pool resources, with the major uses being fodder for grazing and fuelwood.

Table 4: Extent of Uses of Common Pool Resources (NSSO, 1999)

Sl. No	Uses	Average value	Range
1.	Households Collecting CPR products (%)	48	13-73
2.	Average value of annual collections per household	693	230-1989
3.	Ratio of average value of collection to average consumption expenditure (%)	3.02	.91-4.89
4.	Dependence on CPR for fuelwood		
4.1	Share of fuelwood in collection of CPRs (%)	58	31-79
4.2	Households collecting fuelwood from CPRs (%)	45	10.6-70.7
4.3	Average quantity of fuelwood collected annually from CPR (in Kg)	500	219-1203
5.	Dependence on CPR for fodder		
5.1	Households reporting grazing on CPRs (%)	20	1-42
5.2	Households possessing livestock (%)	56	29-86
5.3	Collecting fodder from CPRs (%)	13	1-36
5.4	Average quantity of fodder collected from CPRs (in kg)	275	26-1743
6.	Dependence on common pool water resources-households (%) reporting usage of common water sources for		
6.1	Irrigation (%)	23	2-45
6.2	Livestock (%)	30	6-70
6.3	Household enterprises (%)	2.8	1-6
6.4	Fisheries (%)	2.5	1.5-34

Source: Dinesh K Marothia, "Technological and Institutional Options for Common Property Resource Management in Rainfed Area", *International Journal of Ecology and Environmental Sciences*, 36 (1), 45-57, 2010)

The 2010 study carried out by Foundation for Ecological Security, covering 3000 households in 100 villages in rainfed regions establishes that majority of the households for one or the other purpose access commonly held land and water resources. The study shows that in villages with gross irrigated area less than 40%, 53% of households collect inputs for agricultural purposes from commons, 69% graze their animals on the commons, 23% collect fodder from the commons, 62% access common water bodies for domestic and livestock purposes, 74% collect fuel-wood from the commons, 37% collect food items for household consumption and 37% are engaged in collection of other non-timber forest produce from the commons. Livestock in these production systems plays a critical role in nutrient transfers and reallocation of fertility both across space and time-dung production is an important livestock production objective. These systems are geared towards increasing complementarities between different production systems and

dynamic usage of available resource. Not only are the small ruminants but also other livestock species, are supported in a grazing system. Even the archetypical stall fed animals, buffaloes and crossbred cattle depend on commons for meeting more than 20% of their fodder requirement (Table 5).

Table 5: Percentage of Annual Fodder Requirement Livestock Species met from Commons

		Indigenous Cattle	Crossbred Cattle	Buffalo	Sheep and Goats	Camel
Arid	33.1	62.94	44.63	65.13	83.78	68.25
Semi-Arid	31.09	40.79	29.82	29.95	51.73	29.23
Sub-Humid	67.83	74.02	11.11	58.24	79.3	0

Source: A Commons Story: In the Rain Shadow of the Green Revolution, Foundation for Ecological Security 2010.

5. Summing up

A comprehensive National Rainfed Farming Programme (NRFP) should be initiated, incorporating various aspects of rainfed area interventions and putting these together as a package. This new NRFP could initially be implemented in 1000 most backward rainfed blocks of the country. Blocks with high levels of poverty, natural resource degradation predominantly rainfed and risk prone cropping systems and high levels of migration would be prioritized for the programme.

In each of the 1000 blocks, about 10,000 hectares would be chosen for implementation of the NRFP under the guidance of a National Rainfed Farming Agency. This Mission would steer the NRFP and converge it with other ongoing NRM programmes like MGNREGA, IWMP, NRLM etc. The Natural Resource Management component of Integrated Watershed Management Programme (IWMP) as well as MGNREGA should be strengthened and linked with interventions in rainfed agriculture for these programmes to realize their full potential. Capacities of local self-governments and community-based people's institutions should be developed to undertake full NRM-based area planning. A National Commons Policy should be drawn up, incorporating recording of community rights over commons, tenurial security of users and decentralized commons governance mechanisms under the overarching direction of Panchayat Raj Institutions.

Conflict of Interest Statement

The author declares no conflicts of interests.

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