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STATUS AND TRENDS IN AGRICULTURAL DRY LAND CROPS IN INDIA

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ABSTRACT

Historically, economic and agricultural policies in developing countries, including India, have tended to prioritize irrigated farming areas and urban-industrial sectors. This has led to a systematic bias that limited the allocation of resources and technological support to dry land regions, where farmers are typically poorer, politically less influential, and more vulnerable to agricultural risks. As a result, these farmers often bear the disproportionate burden of adverse macro-economic and environmental conditions, despite being primary contributors to food and livelihood security in several states.

Keywords : Agriculture, Dryland, Land farming, Land Crops

INTRODUCTION

Dry land agriculture constitutes one of the most critical subsystems of Indian farming, both in terms of spatial extent and its role in the national food and livelihood economy. A substantial share of India's cultivated land continues to depend primarily on rainfall, with limited or no access to assured irrigation. Estimates based on national land-use statistics indicate that out of about 141–142 million hectares (Mha) of net sown area, roughly 75–86 Mha are cultivated under rainfed or dry land conditions, accounting for around 55–60 per cent of the total net sown area. Even with ongoing expansion of canal, groundwater and micro-irrigation, recent assessments emphasise that approximately 40 per cent of the net sown area is likely to remain rainfed even after realising the full irrigation potential.

Rainfed and dry land areas make a disproportionately large contribution to India's food system. Empirical analyses show that these regions produce about 40 per cent of the country's total foodgrains, including nearly 44 per cent of rice, 87 per cent of coarse cereals, around 85 per cent of pulses, about 72 per cent of oilseeds and nearly 65 per cent of cotton. These areas are also the primary source of almost all minor millets. At the same time, rainfed tracts support roughly two-thirds of India's livestock population and a substantial share of the rural poor, underscoring the fact that dry land agriculture is not merely a production system but a livelihood and social protection system.

Table 1 summarises the significance of rainfed/dry land agriculture in India in terms of area, production and livelihood dependence.

Beyond their quantitative contribution, dry land crops—millets, pulses, oilseeds and coarse cereals—play a strategic role in climate resilience, nutritional security and agro-ecological sustainability. Many of these crops exhibit high tolerance to moisture stress, higher water-use efficiency and greater adaptability to temperature extremes compared with water-intensive cereals such as irrigated rice. With growing concern over climate change, erratic monsoon behaviour and groundwater depletion,

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policy attention has increasingly shifted toward revitalising dry land crops as "climate-smart" and "nutrition-dense" alternatives within India's food systems.

Table – 1 : Significance of rainfed/dry land agriculture in India (selected indicators)

Indicator	Approximate magnitude	Share from rainfed / dry land areas
Net sown area (Mha)	141–142	55–60% under rainfed/dry land
Gross cropped area (Mha)	200	45–50% rainfed
Foodgrain output (million tonnes)	320–330	40% from rainfed regions
Coarse cereals production	–	85–90% rainfed
Pulses production	–	80–85% rainfed
Oilseeds production	–	70–75% rainfed
Cotton production	–	60–65% rainfed
Minor millets production	–	Predominantly (>90%) rainfed
Livestock population supported	–	About two-thirds
Rural population dependent (approx.)	–	40–60% in rainfed tracts

Source: Economic survey of India, 2023

However, dry land agriculture continues to be characterized by pronounced yield gaps and income instability. Longitudinal analyses show that although average productivity of rainfed crops increased from around 0.6 tonnes per hectare in the 1980s to roughly 1.1 tonnes per hectare in recent years, large differences persist between potential yields under improved management and actual farm yields. In contrast, irrigated crops often achieve much higher output per unit area, resulting in a structural productivity divide between irrigated and rainfed regions. Nearly 60 per cent of total agricultural output is estimated to originate from irrigated agriculture, which covers only about 40–45 per cent of cultivated area, thereby highlighting the relatively lower average productivity of dry land farming.

The vulnerability of dry land systems is further accentuated by rainfall variability, soil degradation and climate change. Rainfed agriculture is concentrated in arid, semi-arid and dry sub-humid zones, where annual rainfall is not only low but also highly variable in space and time. Analytical work suggests that nearly 85 Mha of India's 141 Mha net sown area falls within such rainfall regimes; about 74 per cent of annual rainfall occurs during the southwest monsoon, with a declining number of rainy days and an increasing incidence of extreme events. Under these conditions, dry land farmers—often small and marginal holders—face high production risk, limited creditworthiness and constrained capacity to invest in land development or yield-enhancing technologies.

AGRO-CLIMATIC ZONES AND DISTRIBUTION OF DRY LAND AREAS IN INDIA

A proper appreciation of dry land agriculture in India requires an understanding of the country's agro-climatic diversity. Agro-climatic zonation provides a scientific basis for planning agricultural development by grouping districts and regions that share broadly similar climate, soil, physiography and cropping pattern characteristics. The erstwhile Planning Commission (now NITI Aayog), drawing upon agro-meteorological and soil data, delineated India into **15 major agro-climatic regions** and about **72 agro-climatic sub-zones**, later further refined in agro-ecological and agro-ecoregion frameworks.

An agro-climatic zone is generally defined as a land unit or region that is relatively homogeneous in terms of long-term climate (particularly rainfall and temperature), length of growing period, and associated soil and landform characteristics, such that it is broadly suitable for a certain range of crops and cultivars. This zonation is especially relevant for dry land agriculture because arid and semi-arid

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conditions are concentrated in particular regions, and crop planning as well as resource management strategies need to reflect these climatic constraints.

Table 2 summarizes the **15 agro-climatic regions of India**, their broad locational coverage and their dominant dry land features.

Table-2: Agro-climatic regions of India and relevance for dry land agriculture

Agro-climatic region	Major states/areas covered	Broad rainfall regime & climate	Relevance for dry land crops
Western Himalayan Region	J&K, Himachal Pradesh, Uttarakhand	Cool temperate to humid; moderate rainfall	Limited dry land; temperate cereals and pulses
Eastern Himalayan Region	NE states, parts of West Bengal (hills)	High rainfall; humid–perhumid	Mostly humid; dry pockets in rain-shadow zones
Lower Gangetic Plains Region	West Bengal (plains)	Humid subtropical; high rainfall	Rice–based systems; some pulses/oilseeds rainfed
Middle Gangetic Plains Region	East UP, Bihar	Sub-humid; 1000–1400 mm	Rainfed rice–wheat, pulses in uplands
Upper Gangetic Plains Region	West UP	Sub-humid; canal irrigation	Some rainfed pulses, oilseeds
Trans-Gangetic Plains Region	Punjab, Haryana, Delhi, parts of Rajasthan	Semi-arid to sub-humid; high irrigation	Predominantly irrigated; residual rainfed pockets
Eastern Plateau and Hills Region	Odisha, Chhattisgarh, Jharkhand, parts of MP	Sub-humid; 1000–1600 mm; undulating terrain	Large tribal rainfed areas; millets, pulses, oilseeds
Central Plateau and Hills Region	MP, parts of Rajasthan, UP	Semi-arid to dry sub-humid; 500–1000 mm	Important rainfed zone: sorghum, pulses, oilseeds
Western Plateau and Hills Region	Maharashtra (non-coastal), parts of MP and Rajasthan	Semi-arid; 500–900 mm	Major dry land zone; coarse cereals, pulses, oilseeds
Southern Plateau and Hills Region	Karnataka, Telangana, parts of Tamil Nadu & Andhra	Semi-arid; 600–1000 mm	High share of dry land; millets, pulses, oilseeds
East Coast Plains and Hills Region	Coastal AP, Tamil Nadu, Odisha	Sub-humid to semi-arid; monsoonal	Rainfed millets and pulses in interior tracts
West Coast Plains and Ghat Region	Coastal Karnataka, Kerala, Konkan	Humid–perhumid; high rainfall	Mainly irrigated/plantation; some upland rainfed
Gujarat Plains and Hills Region	Gujarat, parts of Rajasthan	Arid to semi-arid; 300–800 mm	Severe dry land conditions; cotton, groundnut, millets
Western Dry Region	Western Rajasthan (Thar)	Arid; <300 mm; high evapotranspiration	Extreme dry land; pearl millet, pulses, fodder crops
Islands Region	Andaman & Nicobar, Lakshadweep	Humid maritime climate	Limited relevance for dry land crops

Source: Extracted from various reports Indican Council Agriculture Research

While not all agro-climatic regions are dominated by dry land agriculture, semi-arid and arid regions—including the Western Dry Region, Gujarat Plains and Hills, Western Plateau and Hills, Central Plateau and Hills, Southern Plateau and Hills, and parts of the Eastern Plateau and Hills—collectively account for a substantial proportion of India's dryland/rainfed cropped area. Analytical work on rainfed systems notes that dryland farming is concentrated where annual rainfall generally falls below 750–800 mm and the effective crop growing period is shorter than about 180–200 days.

Several attempts have been made to estimate the extent and distribution of dry land areas across India. A widely cited estimate suggests that about 80–85 Mha of India's 141–142 Mha net sown area is

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under dry land or rainfed farming, spread over roughly 170–180 districts. These areas are predominantly located in:

i. The Deccan Plateau (Maharashtra, Karnataka, Telangana, parts of Andhra Pradesh and Tamil Nadu)

ii. Central and western Madhya Pradesh and adjoining Bundelkhand/Baghelkhand tracts

iii. Western and southern Rajasthan and parts of Gujarat

iv. Rain-shadow and upland zones of Odisha, Jharkhand and Chhattisgarh

In addition, a separate classification of drought-prone areas identifies about 51 Mha of land as chronically drought-prone, distributed over 13 states, many of which coincide with the semi-arid and dry sub-humid agro-climatic regions mentioned above. These regions tend to experience frequent rainfall failures, high inter-annual variability, soil erosion and land degradation, making them highly vulnerable to climatic shocks.

Table 3 presents an indicative distribution of rainfed/dry land agriculture across broad agro-climatic groupings, highlighting the dominance of semi-arid and dry sub-humid areas.

Table-3: Indicative distribution of rainfed/dry land agriculture by broad climatic group

Climatic group	Typical annual rainfall (mm)	Major regions/states (illustrative)	Approximate dry land characteristics
Arid	< 300	Western Rajasthan, parts of Gujarat	Sparse cropping; pearl millet, pulses, fodder
Semi-arid (tropical)	300–750	Deccan Plateau (Maharashtra, Karnataka, Telangana), MP, Gujarat	Dominant dry land crops: sorghum, millets, pulses, oilseeds
Dry sub-humid	750–1100	Eastern MP, parts of UP, Bihar, Odisha, Chhattisgarh, Jharkhand	Mixed rainfed rice–pulses–oilseeds systems
Moist sub-humid/humid	> 1100	Eastern India, coastal and hill zones	Mostly irrigated or high-rainfall systems; limited dry pockets

Source: Extracted from various reports Indican Council Agriculture Research

From the perspective of the present study, the Southern Plateau and Hills Region (covering much of Karnataka) and adjoining parts of the Western and Central Plateau and Hills Regions are particularly important. In these regions, dry land agriculture is the predominant land-use system, millets, pulses and oilseeds are core components of local cropping systems, and watershed development has emerged as a major policy strategy for stabilising production.

STATUS OF DRY LAND AGRICULTURE

Dry land (rainfed) agriculture continues to constitute the backbone of Indian farming, both in terms of spatial coverage and in terms of its contribution to food and livelihood security. Even after decades of investment in major and medium irrigation projects, a substantial share of India's cropped area remains dependent on rainfall, and this share has declined only marginally over time. Analysing trends in area, production, and productivity, together with state-wise comparisons, is therefore essential for understanding the current status of dry land agriculture and for situating the experience of Karnataka within the broader national context.

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GROWTH PERFORMANCE OF DRY LAND CROPS

Growth performance of dry land crops in India is generally assessed in terms of changes in area, production and yield over time, using indicators such as the compound annual growth rate (CAGR). For most empirical studies, CAGRs are estimated by fitting semi-logarithmic time trends to long time-series data and interpreting the regression coefficient as the approximate annual percentage change (Raju & Rao, 2010; Suresh, Raju, Chauhan, & Chaudhary, 2014).

Because dry land agriculture is not separately reported in official statistics, researchers typically focus on major rainfed crop groups—coarse cereals (bajra, jowar, other nutri-cereals), pulses, oilseeds and cotton—and examine their growth performance at the national and state levels. This section synthesises the available evidence on CAGRs of area, production and yield for key dry land crops and discusses their contribution to aggregate agricultural output, with particular reference to rainfed-dominant states such as Karnataka.

FACTORS AFFECTING DRY LAND CROP PRODUCTIVITY

Productivity of dry land crops is shaped by a complex interaction of biophysical, technological and institutional determinants. While climatic conditions and soil characteristics define the basic production environment, farmers' access to inputs, technology, markets and institutional support systems strongly influence actual yield outcomes. In India's semi-arid and dry sub-humid regions, these factors interact under conditions of high climate risk and resource scarcity, making productivity enhancement both a technical and a socio-economic challenge (Rao & Lal, 2015; Wani, Rockström, & Oweis, 2009).

Against this backdrop, the following subsections examine four broad sets of factors affecting dry land crop productivity: climate change and rainfall variability, input use, technology adoption, and institutional support.

POLICY AND MARKET ENVIRONMENT FOR DRY LAND CROPS

Public policy and market conditions play a decisive role in shaping the production, profitability and stability of dry land crops. In India, the core instruments influencing farmers' incentives include **minimum support prices (MSP)**, **public procurement mechanisms**, and **trade policy (export–import regulations and tariffs)**. While irrigated staples such as rice and wheat have historically benefitted from strong MSP-procurement backing, the policy environment for coarse cereals, pulses and oilseeds has been more mixed, with recent attempts to strengthen support in light of nutritional security and climate resilience concerns (Suresh, Raju, Chauhan, & Chaudhary, 2014; Rao & Lal, 2015).

For dry land farmers in states like Karnataka, these policy and market signals critically influence cropping decisions, input use, technology adoption and overall viability of rainfed agriculture. The following subsections discuss the MSP structure, procurement mechanisms, and external trade policy relevance for major dry land crops.

CHALLENGES OF DRY LAND AGRICULTURE IN INDIA

Despite its large spatial extent and critical role in supporting food, fodder and rural livelihoods, dry land agriculture in India continues to face multiple, interlinked challenges. These challenges are rooted in biophysical constraints such as soil degradation and water scarcity, and are reinforced by market and institutional weaknesses that limit farmers' ability to secure remunerative prices and invest in productivity-enhancing technologies (Rao & Lal, 2015; Wani, Rockström, & Oweis, 2009).

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For semi-arid states like Karnataka—where a majority of the cultivated area is rainfed and dry land crops dominate the cropping pattern—these constraints are particularly acute. The following subsections discuss three major sets of challenges: soil degradation, water scarcity, and low market penetration/value-chain integration.

FUTURE PROSPECTS OF DRY LAND FARMING

The medium- to long-term prospects of dry land agriculture in India are increasingly being reframed from a narrative of distress to one of strategic opportunity, particularly in the context of climate change, nutritional security and sustainable rural livelihoods. Policy discourse has gradually shifted from viewing dry land crops as "orphan crops" to recognising them as "Shree Anna" (nutri-cereals) with high potential for climate resilience and value addition (Government of India, 2023; Ministry of Agriculture & Farmers Welfare, 2023).

Within this broader shift, millets and associated dry land crops occupy a central place. Their agronomic robustness under water stress, rich nutritional profile and compatibility with low-input systems make them promising anchors for sustainable intensification in semi-arid regions such as Karnataka's dry zones (CRIDA, 2020; Chand, 2023).

SUMMARY

This article has provided a comprehensive macro-level analysis of the status and trends of agricultural dry land crops in India, with particular reference to the policy and institutional context that frames dry land farming in states such as Karnataka.

The discussion began with an overview of India's agro-climatic and agro-ecological diversity, highlighting that large extents of arid, semi-arid and dry sub-humid regions continue to depend predominantly on rainfall. Within this setting, major dry land crops—coarse cereals (jowar, bajra, ragi), pulses (red gram, green gram and others) and oilseeds (groundnut, sunflower, mustard)—were profiled in terms of their spatial distribution, production shares and significance for food, fodder and livelihood security.

Subsequent sections examined area, production and productivity trends of dry land crops, including decadal patterns and state-wise comparisons. The evidence suggests that while there have been notable yield improvements in some crops and regions, rainfed systems still lag behind irrigated staples, and instability in output remains pronounced in drought-prone areas. Analysis of growth performance using CAGR and contribution to total agricultural output underscored the continuing importance of dry land crops in India's food basket, even as their relative shares have fluctuated in response to policy incentives and market dynamics.

Three interlinked challenges—soil degradation, water scarcity and low market penetration—were identified as major constraints on the sustainability and profitability of dry land agriculture. Extensive land degradation, limited and variable water availability, and weak value chains for millets, pulses and oilseeds collectively reduce returns to investment and reinforce vulnerability among small and marginal farmers in dry zones.

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