Policy Brief

Transforming Tropical Tuber Crops: Scientific Advances, Emerging Challenges and Future Directions for India

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Executive Summary

Tropical tuber crops - cassava, sweet potato, yams, taro, elephant foot yam and a few others - are vital yet underexploited resources for food, nutrition, and livelihood security in India. Cultivated on 0.4 million hectares, they generate an annual value of ₹130 billion and sustain over 200 million people. These crops are climate-resilient, high-yielding, and adaptable to marginal soils, offering a pathway for diversification and import substitution in starch and processed food sectors.

Over six decades, ICAR–CTCRI has led pioneering research in germplasm conservation, varietal development, production and protection technologies, post-harvest innovations, and entrepreneurship promotion. Productivity gains, particularly in cassava (403% increase since 1963), reflect major scientific advances in seed systems, nutrient management, mechanization, and climate-smart practices. However, challenges persist - declining area, regional concentration, long crop durations, weak seed and market systems, high post-harvest losses, and emerging pest-disease threats under climate change.

The paper proposes a 'National Mission on Tuber Crops (NMTC)' to mainstream these crops into India's food, nutrition, and climate agendas. The mission envisions certified seed hubs, decentralized processing units, FPO-led market linkages, inclusion of biofortified sweet potato in nutrition programs, and integration with national schemes like MIDH, PM-FME, and PM-POSHAN.

By 2031, the NTM targets 25% higher productivity, 50% higher farmer income, 30% reduction in post-harvest losses, and 1 lakh new rural livelihoods. Through research-policy convergence and inclusive value-chain development, tropical tuber crops can transform into climate-smart, nutrition-sensitive, and value-driven commodities vital for India's sustainable agricultural future.

Tropical tuber crops including cassava, sweet potato, yams, taro, elephant foot yam and a few other crops represent a strategic yet underutilized component of India's food and nutrition landscape (Edison et al., 2006). They support 200 million Indians for food and livelihoods, generating an annual market value of around ₹130 billion. These crops are hardy, climate resilient and high yielding per unit area, thriving on marginal soils with minimal inputs while providing a dependable source of calories, dietary fibre, vitamins and minerals (Lila and Chatterjee, 1999; Byju et al., 2022; Jyothi, 2024). In the face of climate variability, the need for nutritional security, enhanced rural livelihoods and crop diversification, tropical tuber crops offer a unique opportunity to strengthen India's agricultural resilience, reduce import dependence for starch and processed foods, and empower smallholder, tribal and other nature dependent farmers (Nayar, 2014).

The figures 1&2 highlight that, alongside cereals, tropical tuber crops such as cassava, sweet potato, and yams figure among the world's ten most important carbohydrate-rich foods (https://www.fao.org/faostat/en/#data/QCL, Suja et al. 2025). Cassava ranks fifth globally and provide a vital calorie source in sub-Saharan Africa, south and south-east Asia, and Latin America. In India, the three tropical tuber crops, cassava, sweet potato, and elephant foot yam, are among the top ten carbohydrate-rich foods with cassava ranking sixth. The presence of tropical tubers among the leading carbohydrate-rich crops underscores their strategic role in food and nutrition security, particularly in tropical and subtropical regions where they thrive under marginal conditions and serve as climate-resilient, calorie-rich, non-cereal alternatives for the future.

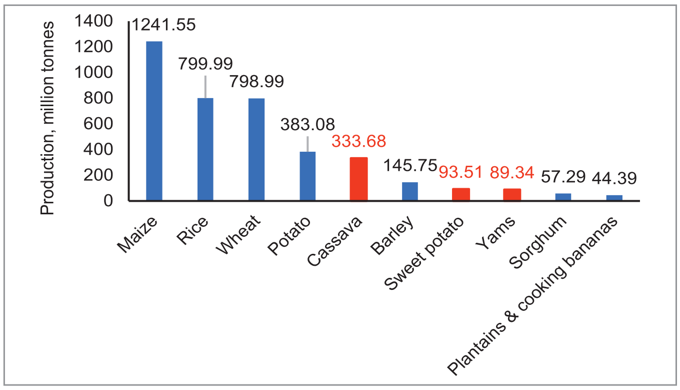


Figure 1. Ten most produced carbohydrate-rich food crops in the world

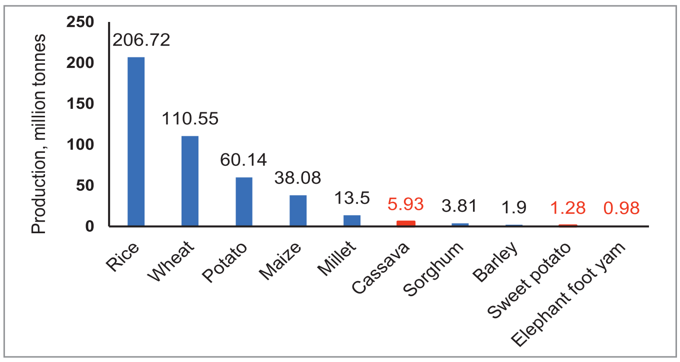


Figure 2. Ten most produced carbohydrate-rich food crops in India

Table 1 presents the area, production, and productivity of tropical tuber crops in the world vis-à-vis India for 2023 (https://www.fao.org/faostat/en/#data/QCL, Suja et al., 2025). In India, tropical tuber crops were cultivated in 0.406 million ha, accounting for 0.75% of the global area, with a total production of 10.11 million tonnes (1.85% of global production). The five major tropical tuber crops produced are cassava, sweet potato, elephant foot yam, yams, and taro, with an average productivity of 24.90 t/ha - well above the global average of 10.17 t/ha.

Table 1. Area, production and productivity of tropical tuber crops in the world vis-à-vis India in 2023

Crop	Area (million ha)		Production (million tonnes)		Productivity (t/ha)	
	World	India	World	India	World	India
Cassava	32.21	0.166	333.68	5.93	10.35	35.77
Sweet potato	7.57	0.110	93.51	1.28	12.35	11.71
Elephant foot yam	-	0.040	-	0.98	-	24.74
Yams	10.60	0.030	89.34	0.81	8.42	27.00
Taro	2.40	0.040	18.07	0.61	7.52	15.30
Other crops	0.75	0.020	10.02	0.40	13.36	20.00
Total	53.53	0.406	544.62	10.11	10.17*	24.90*

*- Average of all crops

This paper analyses the major scientific advances spearheaded by ICAR–CTCRI, examines the key challenges currently confronting the tropical tuber crops sector in India, and offers recommendations for the way forward.

Scientific Advances

The ICAR–Central Tuber Crops Research Institute (CTCRI) under the Ministry of Agriculture and Farmers Welfare, Government of India, was established on 1 July 1963 at Thiruvananthapuram, Kerala, with a regional station set up in 1976 at Bhubaneswar, Odisha. The institute serves as the national leader in research on tropical tuber crops, spearheading scientific advancements in this vital sector (Jaganathan and Suja, 2023; Laxminarayana et al., 2024).

A major milestone in strengthening research came with the launch of the All India Coordinated Research Project on Tuber Crops (AICRPTC) in 1968, which provided strong impetus for the development and evaluation of improved varieties as well as production and processing technologies tailored to India's diverse agro climatic regions and regionally adaptive agri-food systems (Sunitha et al., 2020). At present, the AICRPTC network encompasses 11 state agricultural universities (SAUs) (13 centres), 3 central agricultural universities (CAUs) and 3 ICAR institutes (5 centres), together covering 11 out of 15 agro climatic zones in the country (Khanna, S.S., 1989). Complementing the efforts of ICAR-CTCRI and the AICRP on Tuber Crops network, the Kerala Agricultural University (KAU) and a few other agricultural universities also have contributed substantially to research advancements and the dissemination of technologies related to tropical tuber crops.

Over six decades, ICAR-CTCRI has repositioned crops once seen as 'food of the poor' - cassava, sweet potato, yams, taro, elephant foot yam, and several minor species - into climate-resilient, nutritionally rich, and economically important crops. Its work spans germplasm conservation, crop improvement, production and protection technologies, post-harvest innovations, entrepreneurship promotion, and farmer-centric outreach (Asha et al., 2023; Jeeva et al., 2023 a; Nedunchezhyan et al., 2023; Suja et al., 2023; Sunitha et al., 2023; Susan John et al., 2023).

Agrobiodiversity conservation and crop improvement

ICAR-CTCRI functions as the National Active Germplasm Site (NAGS) for tropical tuber crops, serving as the country's primary centre for the collection, characterization, conservation, documentation and utilization of genetic diversity in these crops. Emphasizing both indigenous germplasm and exotic introductions from Africa, Latin America, and the Pacific, the institute conserves a total of 5234 accessions, including 1216 of cassava, 905 of sweet potato, 801 of yams, 655 of edible aroids, and 387 of minor tuber crops, which also comprise 1270 accessions maintained at the Regional Station, Bhubaneswar, Odisha (113 of cassava, 380 of sweet potato, 51 of yams, 554 of edible aroids, and 172 of minor tuber crops), ensuring the long-term preservation and availability of genetic resources for crop improvement and sustainable utilization (Biradar et al., 1978; Venkateswarlu, 1978; Jos et al., 1985; Naskar and Srinivasan, 1985; Abraham et al., 1987; Jos et al., 1987; Unnikrishnan et al., 1987; Vimala et al., 1988; Archana et al., 1989; Nayar et al., 1989; Singh and Naskar, 1991; Rajendran et al., 1993; Santha Pillai et al., 1993; Thankamma Pillai and Unnikrishnan, 1993; Sheela et al., 2000; Asha et al., 2021; Koundinya et al., 2023; Murugesan et al., 2023; Asha and Asha, 2025; ICAR-CTCRI, 2025; Pati et al., 2025; Rahana et al., 2025; Shirly et al., 2025).

Over the past 55 years, India has released a remarkable range of tropical tuber crop varieties – over 163 across cassava (38), sweet potato (49), greater yam (19), lesser yam (3), white yam (6), aerial yam (2), taro (25), dasheen taro (2), Xanthosoma (2), elephant foot yam (7), Chinese potato (4), west Indian arrowroot (3), east Indian arrowroot (1) and yam bean (4). Institutions like ICAR-CTCRI, KAU, TNAU, IGKV, BCKV, Dr.YSRHU, RAU, APHU, Dr.BSKKV, NDUAT, IGKV, NAU, AAU, ICAR RCNEH, CAU and RPCAU have led this effort. These varieties exhibit superior traits such as high yield, disease resistance, nutrient efficiency, excellent cooking quality etc. Recent releases like Sree Kaveri, Sree Annam, and Sree Manna emphasize nutrient-use efficiency and climate resilience, reflecting the shift toward sustainable and farmer-friendly technologies. Collectively, these varieties have transformed tuber crops into profitable, nutritious, and climate-smart sources of food and industrial raw materials across India.

ICAR-CTCRI began releasing improved varieties in 1971 with three cassava hybrids (H-97, H-165 and H-226) and two sweet potato hybrids (H-41 and H-42), and since then it has developed and released 79 improved varieties across the major tropical tuber crops. In cassava, 22 varieties have been developed for traits such as high yield, industrial relevance (high starch and high yield), cooking quality, short duration, nutrient use efficiency, drought tolerance and resistance to cassava mosaic disease (Nair et al., 1988; Easwari Amma et al., 1993; Rajendran et al., 1995; Nair et al., 1998 a, b; Sreekumari et al., 1999; Edison et al., 2006; Krishna Radhika et al., 2014; Sahoo et al., 2024).

In sweet potato, 22 varieties have been released with attributes like high yield, good cooking quality, early bulking, drought and salinity tolerance, biofortification with β-carotene and anthocyanins, suitability for processing, and diverse plant types including spreading, semi-spreading, semi-erect and semi-compact. In yams, 18 varieties have been developed - 10 in greater yam, six in white yam and two in lesser yam - addressing traits such as high yield, cooking quality, short duration, dwarf or bushy stature, desirable tuber shape, pest and disease resistance, drought tolerance and anthocyanin enrichment. For elephant foot yam, two varieties have been released for traits such as high yield, low acridity, cooking quality and disease tolerance. In taro, 10 varieties have been developed for traits like high yield, low acridity, desirable cormel shape, tolerance to drought, tolerance/resistance to diseases, and longer shelf life. Three varieties of arrowroot have been released for traits like high yield and starch content, while in Chinese potato, one variety has been released with high yield and round tuber shape. One yam bean variety has also been released recently (Vijaya Bai et al., 1975; Hrishi and Vijaya Bai, 1977; Srinivasan, 1977; Kamalam et al., 1978; Abraham and Nair, 1979; Lakshmi and Easwari Amma, 1980; Vasudevan and Jos, 1982; Nayar et al., 1984; Thankamma Pillai and Easwari Amma, 1987; Nair et al., 1998 a, b; Mohan et al., 2013; Archana et al., 2019; Asha Devi et al., 2022; Visalakshi et al., 2023; Sahoo et al., 2024; Bharathi et al., 2025; Chauhan et al., 2025; Gowda et al., 2025).

Seed systems and quality planting material

While seeds of most crops can multiply exponentially (often 100 times or more), vegetative planting materials such as that of tropical tuber crops multiply at a much slower rate (4-12 times), thereby restricting the rapid dissemination of improved varieties. This inherently low multiplication ratio, coupled with the bulkiness and perishability of planting materials, pose major challenges to the seed sector. To overcome this constraint, the institute initiated experiments in the latter part of 1980s that eventually led to the development and perfection of minisett technology across most tropical tuber crops. Protocols for development of virus free plants were also standardised (James George, 1990; James George and Suja, 1995; James George et al., 2004, Muthuraj et al., 2016; Muthuraj et al., 2018; Muthuraj et al., 2025).

Between 2005-06 and 2024-25, the institute produced and distributed 15.67 lakh cassava stems, 128.17 lakh sweet potato vine cuttings, 392 tonnes of elephant foot yam corms, 326 tonnes of greater yam tuber, 44.2 tonnes of taro cormels, and 2.37 lakh Chinese potato vine cuttings. Recently, minisett protocols for quality planting material production have been further refined by standardising their production in protrays. Additionally, innovative soilless cultivation methods such as 'recirculatory dripponics' have also been developed to further enhance propagation efficiency (Suja et al., 2024 b; ICAR-CTCRI, 2025).

To strengthen the seed system further, in 2014 ICAR–CTCRI conceptualised a novel 'seed village programme (SVP)' aimed at ensuring large-scale, localised availability of quality planting materials and facilitating rapid area expansion under improved varieties. During 2014-15 to 2024-25, the institute identified 323 cassava farmers as planting material producers. As a further refinement, since 2021, the institute has introduced the recognition of decentralised seed multipliers (DSMs) by certifying farmers who successfully sustain quality seed production. During 2021-22 to 2024-25, a total of 256 tuber crop farmers cultivating improved varieties over 59 hectares were certified as DSMs (Muthuraj et al., 2023).

Building on these progressive models, the institute convened a 'National brainstorming workshop on the formalisation of seed system of tropical tuber crops' on 03 December 2024 (Sunilkumar et al., 2025). Subsequently, a five-year roadmap and seed rolling plan for 2025-2030 has been prepared to guide the systematic strengthening of the tuber crop seed sector.

Regenerative, climate smart and precision production practices

Agroecological zone/region/unit-specific agro-techniques, customised cropping systems (13.5-15% higher yield; 45-54% higher profit), integrated farming systems (up to 26% higher yield), and regenerative/low-carbon farming practices such as organic farming (10-20% higher yield; 20-40% higher profit), natural farming (22-24% reduction in production cost) and conservation agriculture (13% higher yield) have significantly enhanced farmer productivity and profitability besides providing many ecosystem services (Nair et al., 1976; Thomas et al., 1982; Potty, 1990; Nayar et al., 1993; Varma et al., 1996, 1997; Mohankumar et al., 1998; Nair et al., 2004; Ravindran, 2006; Nedunchezhiyan et al., 2008; Suja et al., 2015; Suja and Nedunchezhiyan, 2018; Byju et al., 2021; Ravi et al., 2021; Suja et al., 2021; Nedunchezhiyan et al., 2022 b; Suja et al., 2024 a, b). These advancements have been strongly supported by the knowledge base generated in crop physiology (Indira et al., 1972; Ramanujam, 1985; Roy Chowdhury and Ravi, 1990; Ravi and Indira, 1999; Saravanan et al., 2025). Similarly, integrated weed management (15-20% higher yield and 40-50% labour saving) and innovative water-saving methods (50% saving of water, 23-35% higher yield) and precision water management under 'per drop more crop (PDMC)' initiatives (40-50% higher yield, 70-80% water saving), not only boosted yields but also reduced the overall carbon footprint (Srinivasan and Maheswarappa, 1993; Sunitha et al., 2024, Sureshkumar et al., 2025). Development of cassava harvester also helped enabling less drudgery and more profit (Krishnakumar et al., 2025).

Soil fertility management in tuber crops has evolved considerably over the past four decades. The blanket fertilizer recommendations developed during 1970s followed by their soil test based adjustments developed during the 1980s provided a substantial yield advantage in the initial phase (Mandal et al., 1973; Nair et al., 1980; Mohankumar and Nair, 1983). Insights from long-term fertility experiments improved understanding of nutrient dynamics, paving the way for the development of integrated plant nutrient management systems (IPNMS) (Pillai et al., 1985; Prabhakar and Nair, 1987; Kabeerathumma et al., 1990; Susan John et al., 2005; Susan John et al., 2006; Susan John et al., 2016; Susan John et al., 2019). Later, more knowledge-intensive approaches such as site-specific nutrient management (SSNM) using modified QUEFTS models (2000s, 17-23% higher yield), drip fertigation (2010s, 25-33% nutrient saving), and sensor-, and crop-model–based e-Crop based smart farming (ECBSF) (2020s, 25-50% saving of water and nutrients) revolutionised nutrient management (Byju et al., 2010; Byju et al., 2015; Mithra, 2019; Byju and Suja, 2020). These approaches substantially improved input-use efficiency, reduced dependence on external chemical fertilizers, lowered the carbon footprint, and enhanced farm profitability. To address micronutrient imbalances across tuber crop regions, multi-micronutrient formulations developed and commercialised by the Institute have proven highly effective (5-9% higher yield). Furthermore, customised fertilizers designed using modified QUEFTS-based recommendations and related findings have consistently delivered significant yield gains (Byju and Suja, 2020; Raji and Byju, 2022; Susan John and Anju, 2023).

Climate modeling using tools like ECOCROP, WOFOST, MaxEnt and AquaCrop predicts crop suitability under future climates, guiding area expansion and risk mitigation (Raji et al., 2022). Institute also pioneered research on stress responsive genes and impact of change in climatic parameters on crop physiology (Senthilkumar et al., 2023; Ravi et al., 2024). Micronutrient-enriched fertilizers and climate-resilient practices further prepare farmers for drought, salinity, and heat stress (Sanket et al., 2023).

Pest and disease management

ICAR-CTCRI's integrated pest management initiatives have effectively addressed key pest challenges, including mealy bugs and red spider mite in cassava, sweet potato weevil, and nematodes (Pillai and Hrishi, 1975; Rajamma, 1980; Mohandas and Palaniswami, 1990; Palaniswami, 1994; Shivalingaswamy and Misra, 2001; Korada et al., 2010; Harish et al., 2023; Kesava Kumar et al., 2024; Sangeetha et al., 2025). Its integrated disease management programs have been pivotal in combating major diseases such as cassava mosaic virus and *Fusarium* stem and root rot in cassava, *Phytophthora* leaf blight of taro, collar rot in elephant foot yam and anthracnose in yams (Thankappan and Govindaswamy, 1979; Malathi and Shanta, 1981; Shanta et al., 1984; Nair and Malathi, 1987; Sriram et al., 2001; Misra et al., 2003; Govindankutty, 2004; Nair et al., 2004; Jeeva et al., 2020; Veena et al., 2021; Jeeva et al., 2023 b; Makeshkumar et al., 2024; Arutselvan et al., 2025).

Achievements include 70 rapid diagnostic tools for 14 diseases, DNA barcoding of key insect pests, and identification of 25 resistant sources for breeding programmes. Bioformulations such as Sree Pragathi, Sree Jala, and Sree Syama provide eco-friendly disease and nematode management. Transgenic cassava resistant to mosaic virus and full genome sequencing of key viruses and pathogens strengthen future biotechnological interventions

Secondary agriculture and value addition

ICAR-CTCRI turned tropical tuber crops into industrial and functional products, driving rural entrepreneurship (Maini and Balagopalan, 1978; Prasad et al., 1981; Ghosh, 1984; Balagopalan et al., 1988; Padmaja et al., 1992; Nanda and Kurup, 1994; Mathew George et al., 1995; Lila and Chatterjee, 1999; Moorthy, 2001; Premkumar et al., 2001; Sundaresan, 2001; Ray and Sivakumar, 2009; Bala Nambisan, 2011; Padmaja et al., 2012; Moorthy et al., 2018; Bansode et al., 2020; Giri and Sajeev, 2020; Sajeev et al., 2023; Jyothi et al., 2024; Pradeepika et al., 2025). Food innovations include snack foods, nutribars, vacuum-fried chips, noodles, bakery products, rice analogues and functional sago. Industrial breakthroughs include modified starches, resistant starch, biodegradable plastics, bioethanol, adhesives, superabsorbent polymers, thermoplastic starch sheets, biofilms and biodegradable disposable articles and wax coating for enhanced shelf life (Shanti, 1995; Vimala et al., 2011; Saravanan et al., 2015; Sajeev et al., 2021). The techno-incubation centre (TIC) provides entrepreneurship training and capacity building for youth, women, start-ups, farmer producer companies (FPCs), and other groups interested in tuber crop-based food enterprises.

In post-harvest engineering, ICAR-CTCRI created cassava peelers, chipping machines, mobile starch extraction unit, feed granulator, Chinese potato harvester and Chinese potato size based grader, reducing drudgery and losses. Waste utilization technologies include biochar and thippi compost from cassava starch residues and bioactive molecules Nanma, Menma, and Shreya from crop wastes (Nanda and Kurup, 1994; Kurup et al., 1995; Sheriff et al., 1995; Hemasankari et al., 2002; Nanda et al., 2005 a, b; Jayaprakas and Harish, 2020; Krishnakumar et al., 2025).

Outreach, capacity building and livelihood impact

ICAR-CTCRI's farmer-centric approach has been transformative. Leading to major advances in technology assessment, refinement, gender mainstreaming, market intelligence, and digital innovation for enhancing tuber crop productivity and profitability across India (Ramanathan et al., 1982; Pal et al., 1987; Anantharaman et al., 2001; Sheriff et al., 2005; Prakash et al., 2022; Sheela et al., 2022; Prakash et al., 2025; Sheela et al., 2025 a, b). Between 2018 and 2024, 450 training programs and 2600 on-farm demonstrations benefitted nearly 40000 farmers. Sustainable entrepreneurship and value-chain based models were developed for technology validation and commercialization, supported by comprehensive export-import analyses and AI-driven price forecasting tools such as seasonal auto regressive integrated moving average (SARIMA), exponential smoothing, and time delay neural network (TDNN) models.

Nutrition-oriented initiatives like the 'Rainbow Diet Campaign (RDC)' and 'Nutriseed Village (NV)' models, built on a biofortification priority index, integrated tubers and millets into healthy diets. Gender inclusion was strengthened through the Women's Empowerment in Agriculture Index, collaborations with the Kerala state Kudumbashree mission, and promotion of micro-enterprises and startups. Seed villages and special plan demonstrations (scheduled caste sub-plan-SCSP, tribal sub-plan-TSP and north-east hill (NEH) sub-plan) further improved adoption among marginalized communities (Ramanathan et al., 1982; Anantharaman et al., 2001; Sivakumar et al., 2019; Nedunchezhiyan et al., 2022 a; Jaganathan et al., 2023; Nedunchezhiyan et al., 2024; Sivakumar et al., 2024; Sheela et al., 2024; Jaganathan et al., 2025; Ramesh et al., 2025; Sheela et al., 2025 a, b).

Digital innovations at ICAR-CTCRI have been pioneering, with the development of multiple smart farming apps, the Agrianalytics@R web platform for agricultural data analytics, and machine learning-based predictive tools for plant-pathogen interactions, all supported by SNP and miRNA genomic databases. These initiatives collectively integrate AI, multi-omics, and ICT-driven solutions for sustainable and inclusive tuber crop development. The institute's technology transfer mechanism is robust, strengthened by the Agri-Business Incubator (ABI), which actively supports entrepreneurs in establishing start-ups and enterprises based on ICAR-CTCRI technologies. Between 2007 and 2025, 30 technologies were commercialized, 80 licenses granted, and 24 contract research and contract manufacturing projects executed, generating ₹145.7 lakh in revenue. Notably, there has been a sharp surge in commercialization and revenue generation since 2023, driven by enhanced incubation support, expanded consultancy services, and strengthened industry partnerships in contract research and manufacturing (Byju et al., 2016; Sreekumar et al., 2022; Sivakumar et al., 2023).

Economic impact studies show exceptional returns: cassava and sweet potato technologies yield a benefit-cost ratio up to 39.9 and internal rates of return of 44 to 54 %. Productivity in India rose from 3 million tonnes in 1963 to 9.66 million tonnes in 2023, with value increasing from ₹40 billion to ₹130 billion.

Tuber crop-based value chains create 75 million man-days employment annually and add about ₹1.4 billion social benefits each year. A recent study by Prakash et al. (2025) assessing the impact of improved cassava varieties revealed that these cultivars now occupy nearly 30% of India's cassava area, generating a net present value (NPV) of ₹714 crore, with a remarkable benefit-cost ratio of 29.8:1 and an internal rate of return (IRR) of 44% on research investment. Improved varieties such as Sree Athulya, Sree Reksha, H-226, and Sree Kaveri contributed substantially to the additional income realized by farmers (Srinivas et al., 2007; Byju et al., 2020; Prakash et al., 2025).

The adoption of improved varieties and technologies has significantly enhanced household welfare by promoting reinvestment in farming, education, and health, creating additional employment opportunities, increasing women's participation, improving market access, and reducing pesticide dependence. Collectively, these outcomes underline the transformative role of improved tropical tuber crop technologies in fostering sustainable, profitable, and climate-resilient farming systems in India.

India: the world leader in cassava yield

Among tropical tuber crops, the productivities of cassava (2nd highest globally), yams (2nd), taro (9th), and elephant foot yam (likely the highest in the world) are ranked within the top ten among producing countries. A remarkable achievement is the more than 403% increase in cassava productivity, from 7.11 t/ha in 1963 to 35.77 t/ha in 2023, corresponding to an annual growth rate of 6.6%-a feat unmatched by any other food crop in India (Figure 3).

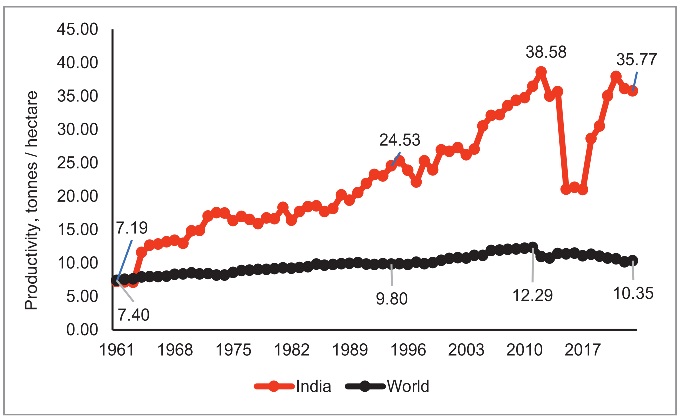


Figure 3. Long term trend in productivity of cassava in India vis-à-vis world

Key Challenges

1.Declining area under cultivation

Due to the unavailability of long-term data for several tuber crops, this analysis focuses on cassava and sweet potato, which together constitute about 71% of tropical tuber crop production in India. Figure 4 illustrates the long-term trends in area, production, and productivity of these two crops combined. It is noteworthy - and rather alarming - that the area under cultivation has declined by more than 50% since 1973. Nevertheless, total production has remained steady at around 7 million tonnes, largely owing to the remarkable gains in cassava productivity.

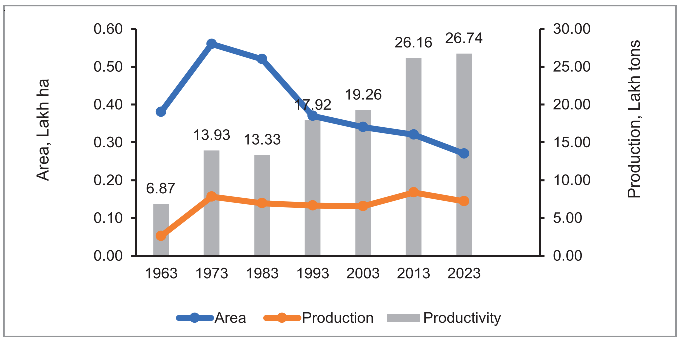


Figure 4. Trends in tropical tuber crops (cassava, sweet potato) cultivation in India (1963-2023)

Cassava occupied 274000 ha in 1961, expanded to a peak of 392000 ha in 1976, and has since steadily declined to 166000 ha in 2023 – representing only 42% of the area cultivated in 1976 (Figure 4; Ramasundaram and Byju, 1994). Despite this substantial contraction in area, remarkable improvements in productivity have enabled India to increase cassava production from 1.96 million tonnes in 1961 to 5.93 million tonnes in 2023 (Figure 5). Notably, the 2023 production level is almost identical to that of 1976, even though the cultivated area in 1976 was about 2.4 times higher than at present.

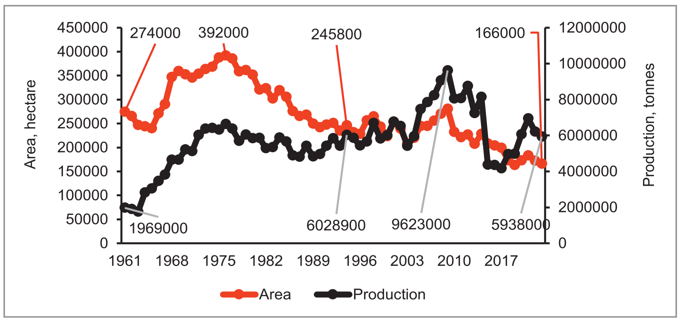


Figure 5. Long term trend in area and production of cassava in India

The area under sweet potato cultivation has remained largely stagnant over the past six decades - 163000 ha in 1963 compared to 110000 ha in 2023. During this period, production increased by only about 1.5 times, primarily due to a modest rise in productivity from 7.74 t/ha in 1961 to 11.72 t/ha in 2023. This corresponds to an overall yield increase of just 83% in six decades, translating to an average annual yield growth rate of only 1.36%. A matter of concern is that India's current sweet potato yield still falls below the global average of 12.35 t/ha, placing the country 40th among 114 producing countries Figures 6 and 7).

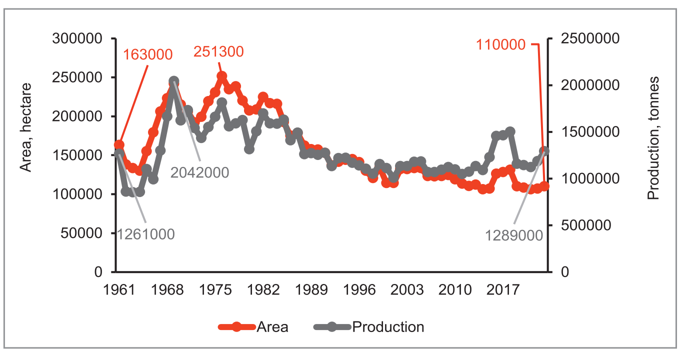


Figure 6. Long term trend in area and production of sweet potato in India

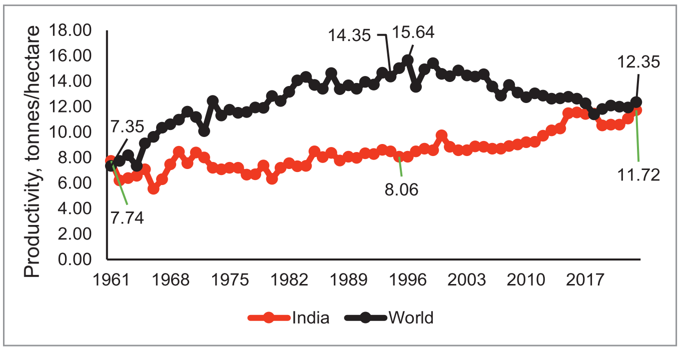


Figure 7. Long term trend in productivity of sweet potato in India vis-à-vis world

2. Geographic concentration and varietal gap

Cassava cultivation in India is highly localized, with production confined to a few specific regions. About 87% of the total cassava area and 95% of national output are concentrated in Tamil Nadu and Kerala, although the crop is reported from nine states with more than 500 hectares under cultivation (Table 2). Cassava is grown in around 150 districts across 13 states, yet 60% of the total area and 68% of production come from just 10 districts - five each in Tamil Nadu and Kerala (Annexure 1). Furthermore, nearly half of India's cassava area (47%) and production (51%) are derived from only six districts (four in Tamil Nadu and two in Kerala). The three contiguous districts of Tamil Nadu - Namakkal, Kallakurichi, and Dharmapuri - alone account for 26% of the national area and 29% of production, clearly demonstrating the extreme geographic concentration of cassava cultivation in a few pockets of southern India. This high geographic concentration of cultivation in the two southernmost states heightens regional vulnerability to pests, diseases and climatic stresses.

Table 2. Area, production and productivity of cassava in major growing states in India in 2023-24

Sl. No.	State	Area		Production		Productivity
		Hectare	Per cent of country's total	Tonnes	Per cent of country's total	Tonnes / hectare
1	Tamil Nadu	98430	55.30	3592730	57.27	36.50
2	Kerala	56550	31.77	2329850	37.14	41.20
3	Meghalaya	5480	3.08	36780	0.59	6.71
4	Andhra Pradesh	5200	2.92	129880	2.07	25.00
5	Nagaland	4880	2.74	76190	1.21	15.60
6	Assam	3390	1.90	33560	0.53	9.90
7	Odisha	1530	0.86	23460	0.37	15.33
8	Madhya Pradesh	700	0.39	11400	0.18	16.21
9	Karnataka	500	0.28	6080	0.10	12.25

Sweet potato displays a spatial distribution distinct from that of cassava, although it also shows marked regional concentration. Nearly 70% of India's sweet potato area and 68% of its total production are confined to five major states - Odisha, Uttar Pradesh, West Bengal, Madhya Pradesh, and Karnataka - despite 16 states reporting more than 500 hectares under the crop (Table 3). The crop is cultivated in about 350 districts across 22 states, yet 68% of the total area and 58% of production are concentrated in only 52 districts spanning six states, highlighting the pronounced regional clustering of sweet potato cultivation in India, (Annexure 2).

Table 3. Area, production and productivity of sweet potato in major growing states in India in 2023-24

Sl. No.	State	Area		Production		Productivity
		Hectare	Per cent of country's total	Tonnes	Per cent of country's total	Tonnes / hectare
1	Odisha	34550	31.41	335450	26.02	9.71
2	Uttar Pradesh	19300	17.55	262470	20.36	13.6
3	West Bengal	16310	14.83	175390	13.61	10.76
4	Madhya Pradesh	7110	6.46	111820	8.67	15.72
5	Karnataka	6520	5.93	102930	7.99	15.78
6	Assam	5000	4.55	28280	2.19	5.66
7	Meghalaya	4970	4.52	17980	1.39	3.62
8	Chhattisgarh	4550	4.14	53550	4.15	11.77
9	Jharkhand	3210	2.92	58860	4.57	18.31
10	Bihar	2400	2.18	44770	3.47	18.68
11	Maharashtra	1450	1.32	12570	0.98	8.67
12	Jammu & Kashmir	1370	1.25	41110	3.19	30.1
13	Nagaland	1010	0.92	11660	0.90	11.6
14	Tripura	650	0.59	6640	0.52	10.28
15	Tamil Nadu	590	0.54	10590	0.82	17.95
16	Rajasthan	510	0.46	11340	0.88	22.37

Although nine states cultivate elephant foot yam in areas exceeding 500 hectares, nearly 88% of the total area and 89% of production are concentrated in just six states - West Bengal, Tamil Nadu, Kerala, Chhattisgarh, Bihar, and Andhra Pradesh (Table 4). Among these, West Bengal alone accounts for about 40% of the national area and 34% of total production. In Chhattisgarh, the crop is mainly confined to the northern and central plains and parts of the Bastar region, particularly in the districts of Durg, Rajnandgaon, Bilaspur, Raipur, Kawardha, Bastar, Kanker, and Dhamtari. In northern Bihar, its cultivation is concentrated in the districts of Muzaffarpur, Samastipur, Vaishali, East Champaran, Madhubani, Sitamarhi, Begusarai, and Bhagalpur. In Andhra Pradesh, major growing areas include Krishna, Bapatla, East Godavari, Guntur, Dr. B.R. Ambedkar Konaseema and Parvathipuram Manyam districts.

Table 4. Area, production and productivity of elephant foot yam in major growing states in India in 2023-24

Sl. No.	State	Area		Production		productivity
		Hectare	Per cent of country's total	Tonnes	Per cent of country's total	Tonnes / hectare
1	West Bengal	16330	40.83	339360	34.63	20.78
2	Tamil Nadu	4520	11.30	143210	14.61	31.71
3	Kerala	4330	10.83	180040	18.37	41.56
4	Chhattisgarh	3550	8.88	41690	4.25	11.75
5	Bihar	3330	8.33	58270	5.95	17.50
6	Andhra Pradesh	3010	7.53	112070	11.44	37.28
7	Jharkhand	2060	5.15	58180	5.94	28.22
8	Madhya Pradesh	1390	3.48	19050	1.94	13.69
9	Tripura	570	1.43	10620	1.08	18.74

Taro is primarily grown in West Bengal, Odisha, Chhattisgarh, Assam, Kerala, Bihar, Uttar Pradesh, Tamil Nadu and Andhra Pradesh, which together account for the majority of the national area and production (Table 5).

Table 5. Area, production and productivity of taro in major growing states in India in 2023-24

Sl. No.	State	Area Hectare	Production Tonnes	productivity
				Tonnes/ hectare
1	West Bengal	8100	64684	8.0
2	Odisha	7500	58500	7.8
3	Chhattisgarh	7344	105254	14.3
4	Assam	5300	44512	8.4
5	Kerala	3200	26400	8.3
6	Bihar	1600	12800	8.0
7	Uttar Pradesh	1500	11250	7.5
8	Tamil Nadu	1200	8400	7.0
9	Andhra Pradesh	1000	7000	7.0

Yams are primarily concentrated in the eastern, southern, and north-eastern states, notably Odisha, West Bengal, Kerala, Tamil Nadu, Chhattisgarh, Bihar, Assam, and Andhra Pradesh, with smaller areas in Jharkhand, Madhya Pradesh, and Tripura.

Despite the release of several improved varieties of tropical tuber crops by research institutions, adoption rates vary widely - from 30% to 80% across crops - thereby influencing the extent of productivity gains and resilience achieved. Moreover, dependence on a narrow genetic base, particularly in cassava and sweet potato, constrains yield potential and increases vulnerability to pest and disease outbreaks, market fluctuations, and climate stresses.

3. Yield gap

India demonstrates strong performance in tropical tuber crop productivity compared with global averages. Cassava productivity (35.77 t/ha) is over three times the world average, placing India as having world's second highest productivity (Table 6). Yams (27 t/ha), elephant foot yam (24.74 t/ha) and taro (15.30 t/ha) also record productivities far above global levels. In contrast, sweet potato (11.71 t/ha) remain below world average indicating substantial scope for improvement. Overall, India's yield advantage in cassava, yams, elephant foot yam and taro underscores technological progress, though substantial potential remains for enhancing productivity of all crops especially sweet potato.

Table 6. India's performance in tropical tuber crop yields

Crop	India	World	Average of world's five highest productivities	Average of world's five highest productivities (excluding Guyana)	World's highest productivity	Realisable potential yield in India	World's highest yielder
	(Tonnes/hectare)						
Cassava	35.77	10.35	32.91	29.42	41.41	80	Guyana
Sweet Potato	11.71	12.35	50.97	36.45	101.63	40	Guyana
Elephant foot yam	24.74	NA	NA	NA	NA	80	NA
Yams	27.00	8.42	32.49	20.04	79.98	60	Guyana
Taro	15.30	7.52	39.79	29.89	65.85	50	Guyana

4. High cost of production

Among the crops compared, tuber crops show markedly higher profitability than cereals. Elephant foot yam gives the highest net return (₹8.13 lakh/ha) followed by yams (₹4.04 lakh/ha) and cassava (₹1.92 lakh/ha), despite their varying input costs (Table 7). Taro and sweet potato also yield moderate profits, whereas rice and wheat provide relatively low returns, even under rotation. Thus, tuber crops, particularly elephant foot yam and yams, are far more remunerative than conventional cereals. Their high yield, better price realization, and efficient use of land and labour make them economically superior options for diversification and enhancing farmers' income in suitable regions. Compared to other crops, tuber crops have higher cultivation costs, making them hard for value-added products from tubers to compete with analogous products from other crops in the market.

Table 7. Comparative economics of tropical tuber crops and major staple crops

Crop	Production Cost (Cost A2+FL*)		Value of Produce (main + byproducts) (Rs/hectare)		Profit	
	(Rs / hectare)	(Rs / tonne)	(Rs / hectare)	(Rs / tonne of main product)	(Rs / hectare)	(Rs / tonne of main product)
Cassava	159989	6216	352463	13695	192474	7478
Sweet potato	88757	8109	147757	13500	59001	5388
Sweet potato (two seasons)	177514	8109	295514	13500	118002	5388
Elephant foot yam	989571	24458	1803059	44564	813488	20106
Yams	176000	8800	580000	29000	404000	20200
Taro	117827	9120	271320	21000	153493	11880
Rice	58431	15230	84069	20324	25638	6208
Wheat	42288	15480	74282	24228	31994	10435
Rice + Wheat rotation	100719	15355	158351	22276	57632	8321

Source: P. Prakash, Personal Communication; *Cost A2 -all paid-out costs actually incurred by the farmer, FL-family labour (imputed value of family labour)

5. Long crop duration

Table 8 shows that most tropical tuber crops have long crop durations, generally ranging from 5 - 11 months, which increases the cost of cultivation, exposure to climate risks, and leads to reduced cropping intensity as well as greater pest and disease build up. In contrast, sweet potato with its short duration of 2.5–4.5 months, is better suited for short-season cultivation and offers quicker economic returns. The prolonged duration of most tuber crops restricts crop rotation flexibility and necessitates higher management inputs.

Table 8. Duration of tropical tuber crop varieties released in India

Crop	Minimum duration (months)	Maximum duration (months)
Cassava	5	11
Sweet potato	2.5	4.5
Elephant foot yam	6	8
Yams	5	9
Taro	5	9
Arrowroot	9	10
Chinese potato	5	6
Yam bean	4	5

6. Constrained seed and planting material systems

Most tropical tuber crops are propagated vegetatively rather than through true seeds. For instance, a single cassava plant produces only about 12 stem cuttings (stakes) suitable for replanting, compared to the thousands of seeds that a seed-propagated crop can yield. Consequently, the multiplication ratio of tropical tuber crops is generally very low, usually ranging from 3 to 12. This inherently restricts the rapid multiplication and dissemination of newly developed high-yielding varieties.

Vegetative propagules are typically bulky, perishable, and heavy (Table 9), making their transport, handling, and storage costly and logistically challenging. Such characteristics also constrain off-season planting and the establishment of large-scale, organized seed systems. Moreover, because these crops are propagated from vegetative parts, the planting material often harbours bacteria, fungi, viruses, and nematodes, posing a significant risk of pathogen transmission.

With successive vegetative cycles, the planting material tends to degenerate over time due to the cumulative build-up of pathogens and physiological ageing. The absence of formal certification and organized seed systems for tropical tuber crops further compounds the problem, resulting in limited availability and uneven distribution of disease-free, quality planting material.

Table 9. Average weight and volume of planting materials required per hectare: tropical root crops vs rice and wheat

Crop	Type of planting material	Weight (tonnes)	Volume (m^3)
Cassava	Stem cuttings	1.5	2
Sweet potato	Vine cuttings	1.0	6
Elephant foot yam	Whole corm or corm pieces	10	12
Yam	Tuber pieces	3	3.5
Taro	Cormels	2	5
Rice	Seed	0.06	0.1
Wheat	Seed	0.10	0.12

7. Emerging pest and disease threats under changing climate

One major cause of recent concern in the production of tropical tuber crops is the increasing incidence and severity of pests and diseases, often associated with changing climatic conditions. A notable example is the first report of the cassava mealy bug *(Phenacoccus manihoti)* in India, from Thrissur, Kerala, in 2020 (Sampathkumar et al., 2021). In cassava, a new stem and root rot disease, first detected in Kerala in 2018, has rapidly become a serious production threat, often destroying tubers completely before any visible aboveground symptoms appear. The red spider mite, once considered a minor pest, has also intensified in recent years, likely due to warmer and drier conditions. Similarly, in elephant foot yam, leaf and pseudostem rot has emerged as another major biotic constraint, significantly affecting plant vigour and yield. Together, these outbreaks underscore the need for strengthened pest surveillance, resistant varieties, and integrated management strategies under changing climatic scenarios.

8. Nutrition scaling gap: challenges in mainstreaming biofortified orange-fleshed and purple-fleshed sweet potato

Biofortified orange-fleshed and purple-fleshed sweet potatoes (OFSP and PFSP) have demonstrated proven nutritional and health benefits, particularly in alleviating vitamin A deficiency among vulnerable groups such as children and women. Since 2019-20, ICAR–CTCRI has undertaken several initiatives in the north eastern hill (NEH) region (Meghalaya, Tripura and Arunachal Pradesh), including awareness programmes in schools, tuber crop food festivals, nutriseed villages, demonstrations, and establishment satellite incubation centres to promote biofortified varieties (Sivakumar et al., 2024). Despite the release of about 15 biofortified sweet potato varieties in India, their scaling and integration into food systems remain limited due to several constraints - primarily, the lack of quality planting material and organized vine multiplication systems. Additionally, consumer acceptance barriers, weak value chains, and limited storage, processing and market linkages continue to impede the widespread adoption of these nutritionally superior varieties.

9. Post-harvest losses and inadequate storage facilities

Post-harvest losses in tropical tuber crops are substantial, often ranging from 15 to 40 percent, depending on the crop, storage period, and handling conditions. These losses occur at multiple stages - harvesting, transportation, storage, processing, and marketing - and are largely due to the perishable nature of vegetatively propagated roots and tubers. Physiological losses arise from moisture loss, respiration, and sprouting during storage, leading to weight reduction and shrinkage. Pathological losses are caused by microbial infections - particularly fungi and bacteria - that induce rotting during humid or warm storage conditions. Mechanical injuries, incurred during harvest and handling, accelerate deterioration and pathogen entry. In cassava, the roots deteriorate physiologically within 48-72 hours after harvest, while in yam and elephant foot yam, improper curing and ventilation result in rot and significant storage losses. Sweet potato and taro suffer from bruising and fungal infection if not handled carefully. The absence of improved decentralised storage infrastructure, processing and value addition facilities, and organized market chains further exacerbates these losses.

10. Market linkages and farmer organization

Several market linkage models exist across India, though their benefits to farmers vary considerably. In Tamil Nadu, cassava cooperative, SAGOSERVE (http://www.sagoserve.co.in) primarily serve the starch and sago industries, facilitating bulk procuring of tubers and marketing of sago and starch but offering limited price protection or bargaining power to smallholders. Contract farming arrangements in Andhra Pradesh and Telangana ensure assured procurement for industries but often lack transparent pricing. In contrast, cluster-based farmer producer organisations (FPOs) for sweet potato and elephant foot yam in Odisha, Jharkhand, and Chhattisgarh have improved aggregation, local processing, and farmer share in consumer prices. ICAR-CTCRI's Rainbow Diet Campaign initiatives in the NEH region, Kallakuruchi in Tamil Nadu and Attappady in Kerala integrate biofortified tuber crops with nutrition and community markets, promoting inclusive, nutrition-oriented value chains.

Despite some of these successes, tropical tuber crops sector continues to face weak and fragmented market linkages that limit farmer profitability and the overall value chain efficiency. Marketing is largely unorganized and localized, with produce often sold directly at farm gate or in village markets through intermediaries. The absence of effective aggregation mechanisms and organized farmer groups results in poor bargaining power and inconsistent supply volumes for processors and traders.

Most tuber crops are marketed as raw, unprocessed produce, lacking standardization, grading, and value addition, which severely restricts entry into institutional or export markets. Price realization is further constrained by the absence of price discovery mechanisms, limited access to cold storage or processing hubs, and seasonal gluts that depress farm gate prices.

11. Research-to-policy gap

The tropical tuber crops sector benefits from strong research and development (R&D) support, led by institutions such as ICAR–CTCRI, State Agricultural Universities, international collaborations with CGIAR partners such as CIP, CIAT and IITA and public-private partnership (PPP). These efforts have resulted in significant advances in varietal development, biofortification, crop management, pest and disease management, processing, and value addition technologies.

However, the translation of research outputs into policy and large-scale developmental programs remains slow and fragmented. Unlike cereals or pulses, tuber crops seldom feature in national food, nutrition, or procurement missions, resulting in weak institutional support for scaling. The absence of clear policy integration between agriculture, nutrition, and industry sectors limits investment in seed systems, processing clusters, and market infrastructure. Bridging this gap requires stronger research-policy-industry interfaces, evidence-based advocacy, and the inclusion of tropical tuber crops in mainstream agricultural and nutrition security strategies.

Priority Policy Recommendations

1. National Mission on Tuber Crops - a focussed program

To bridge the research-to-policy gap, there is an urgent need to institutionalize a National Mission on Tuber Crops (NMTC).

Such an initiative should have ring-fenced funding for R&D, quality seed systems, processing infrastructure, and market development, ensuring sustained support to the sector. A proposal for Rs. 1200 crores is appended. The mission may initially prioritize high-potential states along with tribal and rainfed districts, focusing on biofortified and climate-resilient tuber crops to enhance both nutrition and livelihood security. This targeted approach would enable faster scaling, better resource convergence, and stronger national visibility for tropical tuber crops in India's agricultural and nutritional development agenda.

2. Area expansion

Expanding the varietal portfolio and promoting region-specific varietal diversification are essential to enhance the stability, resilience, and sustainability of tuber crops production in India. Diversified varietal use can buffer against pest and disease outbreaks and environmental stresses while meeting diverse market and consumer preferences. Equally important is the regular replacement with disease-free, quality planting materials covering 15-20% of cultivated area each year. However, this practice is often neglected, leading to gradual degeneration of planting material and increased risk of pest and disease buildup in farmers' fields. Scaling the successful model of seed villages and decentralized seed multiplier (DSM) programme is therefore crucial to maintain varietal purity, field health, and yield stability. ICAR-CTCRI has prepared a seed rolling plan for next five years in this direction.

Table 10 presents the total requirement of planting materials for major tropical tuber crops in India under two scenarios - 100% and 20% annual replacement. To meet future demand and ensure varietal replacement, it is proposed to expand the area under tuber crops by 125% of the present level by 2030.

Although cassava is cultivated across about 140 districts, the crop is concentrated in a few major production centres. Six districts have more than 10,000 ha, three districts between 5000 and 10000 ha, 17 districts between 1000 and 5000 ha, and 12 districts between 500 and 1000 ha (Annexure 1). These 38 districts merit special attention for systematic varietal replacement, planned area expansion based on local adaptability and market needs and development of locally adaptable agrifood systems. In other districts, area expansion should be guided by climate-analogue assessments to identify regions with suitable agro-ecological conditions.

In the case of sweet potato, one district has an area in between 5000-10000 ha, 25 districts have 1000-5000 ha, and 26 districts have 500–1000 ha (Annexure 2). These 52 districts, out of about 325 sweet potato growing districts, should be prioritized for development of locally adaptable agrifood systems, while in the remaining regions, future growth should follow climate-suitability mapping and regional demand potential.

Table 10. Planting material requirements of tropical tuber crops in India

Crop	Unit	Total requirement	Nursery area for 100% replacement	Nursery area for 20% replacement	Nursery area for 1000 ha new planting	Nursery area for 20% replacement in 1000 ha area
			(hectare)			
Cassava	Million stems (1.2 m long)	342	13833	2767	83	17
Sweet potato	Million plants (3 m vines / plant)	917	11011	2202	100	20
Elephant foot yam	Million kg corm	370	14956	2991	374	75
Greater yam	Million kg tuber	93	3766	753	114	23
Taro	Million kg cormel	67	4500	889	113	23

3. Strengthen seed and planting material systems

A robust and efficient seed system is critical for the large-scale dissemination of improved tuber crop varieties. Establishing certified tuber seed hubs under public–private partnerships will ensure a structured pathway from breeder seed → foundation seed → certified seed multipliers. Priority should be given to the production and distribution of clean, disease-free planting material using tissue culture and rapid multiplication to maintain varietal purity and phytosanitary standards.

Supportive policies such as targeted subsidies, concessional credit lines, and start-up assistance for seed entrepreneurs, farmer producer organizations (FPOs), and community seed banks (seed villages) will enhance seed availability and accessibility. Integrating these hubs within a national seed certification and quality assurance framework will help standardize production protocols, ensure traceability, and build farmer confidence in improved planting material.

New innovations in quality planting material production must be an integral part of the research portfolio. ICAR-CTCRI has already initiated studies on advanced techniques for planting material production, including the tunnel system and portray nursery for all tuber crops, single-node cuttings with leaves in cassava, bioreactor-based tissue culture in cassava, soilless recirculatory dripponics in sweet potato, and sprout bud culture in elephant foot yam.

4. Nutrition-sensitive tuber crops-based agrifood systems

Sweet potato has been gaining prominence as a 'super food' due to the development of nutrient dense and climate resilient varieties. ICAR-CTCRI has successfully developed and promoted biofortified orange- and purple-fleshed sweet potato (OFSP and PFSP) rich in beta-carotene and anthocyanins respectively, and is now focusing on developing biofortified yams, cassava, and taro with enhanced beta-carotene, anthocyanin, iron and zinc contents.

The institute launched the 'Rainbow Diet Campaign' project, aimed at mainstreaming diversified, nutrition-sensitive food choices through the promotion of biofortified and underutilized tuber crops such as OFSP, PFSP, purple fleshed taro (PFT), and purple fleshed yam (PFY). The initiative emphasizes community-level nutrition education, culinary demonstrations, and the linkage of farmers, SHGs, and mid-day meal programs to ensure regular inclusion of coloured, nutrient-rich tubers in daily diets.

Bridging this nutrition scaling gap requires an integrated approach that combines decentralized seed multiplication, nutrition awareness campaigns, culinary integration, and market incentives. Stronger convergence among research, nutrition, and extension systems is essential to translate biofortified tuber crop innovations into widespread dietary and public health impact.

Building on its proven success at the pilot scale, there is an urgent need to upscale the promotion of biofortified tubers especially sweet potato through integration with national nutrition and food security programs such as Anganwadi / ICDS, Mid-Day Meal (PM-POSHAN), and public procurement systems under FCI and State Nutrition Missions. Over the next five years (2026–2031), a phased strategy should aim to expand biofortified sweet potato cultivation from the current pilot area to about 50000 hectares, representing nearly 40% of India's total sweet potato area, with priority given to nutritionally vulnerable districts in Odisha, Uttar Pradesh, West Bengal, Madhya Pradesh, Karnataka and north-eastern states. This will be aimed to cover at least 20% of Anganwadi centres and government schools in nutritionally vulnerable districts in these states, where malnutrition rates remain high.

Bridging this nutrition scaling gap calls for an integrated and multi-sectoral approach that combines (i) decentralized seed multiplication units linked with Krishi Vigyan Kendras (KVKs) and women's SHGs and progressive farmers to ensure local availability of planting materials, (ii) nutrition awareness and behaviour change campaigns, emphasising the health benefits of biofortified tuber crops, (iii) culinary integration and recipe standardisation for Mid-Day Meal and Anganwadi feeding programs, and (iv) market linkages and procurement incentives through convergence with DoA&FW, FSSAI and State Horticulture Missions.

By 2031, the goal should be to achieve about five lakh tonnes of biofortified sweet potato production annually, contributing significantly to dietary vitamin A intake among children and women. Strong institutional convergence among research (ICAR-CTCRI, SAUs), nutrition (MoWCD, FSSAI), and extension systems (KVKs, ATMA) will be crucial to translate this innovation into measurable public health and livelihood outcomes.

5. Climate smart agriculture

Building on ICAR-CTCRI's achievements in climate-smart agriculture (CSA), there is an urgent need to integrate research outputs with national programs on food, nutrition, and climate resilience. By 2031, the goal should be to bring about two lakh hectares of tropical tuber crops under climate-smart production systems, including nearly one lakh hectares under biofortified and climate-resilient varieties. This would represent close to one-third of India's tuber crops area and will be supported through the establishment of 100 seed villages across major tuber crop growing regions such as Kerala, Tamil Nadu, Andhra Pradesh, Odisha, Bihar, Uttar Pradesh, and the North-Eastern states.

Efforts will focus on conserving and characterizing germplasm accessions for resilience to drought, heat, salinity, and pest and disease challenges. At least 20 next-generation multi-trait varieties will be developed that combine high yield, processing quality, stress tolerance, and enhanced nutrition through higher levels of beta-carotene, anthocyanins, iron and zinc. Advanced breeding tools such as genomic selection, gene editing using CRISPR-Cas9, and precision phenotyping will be deployed to shorten varietal development time.

Climate-smart and regenerative production systems will be expanded through modules that integrate nutrient-, water-, carbon-, and energy-efficient practices, covering around one lakh farm units by 2031. Climate suitability maps will be generated for major tuber crops to guide area diversification and adaptive cultivation under future climatic conditions. Organic, natural, and conservation agriculture practices will be promoted across 25 percent of the total tuber crop area, while efforts to enhance nutrient-use efficiency and residue recycling will reduce the carbon footprint of production systems by 15-20 percent.

Digital, mechanization, and innovation ecosystems will be strengthened through the development and commercialization of at least 10 affordable mechanization prototypes for planting, harvesting, and grading, designed to suit smallholder and rainfed conditions. Artificial intelligence, internet of things, and drone-based technologies will be deployed for real-time crop monitoring, pest and disease forecasting, and input optimization across 50 pilot districts. A National Digital Tuber Crop Observatory (NDTCO) will be established by integrating satellite, sensor, and farmer-generated data for dynamic monitoring of crop area, productivity, and health status.

Nutrition and market integration will be pursued by incorporating biofortified cassava and sweet potato into key government programs such as Anganwadi, ICDS, PM-POSHAN, and state-level public distribution systems, targeting at least 100 nutritionally vulnerable districts by 2031. The aim will be to achieve 5 lakh tonnes of biofortified sweet potato production and about 15 lakh tonnes of tuber crop based industrial products annually. Value addition will be accelerated through the development of 20 premier product prototypes including flours, extruded foods, bakery products, bioethanol feedstocks, and starch based products in collaboration with industry and start-up incubators.

Enabling policies will focus on promoting biofortified and climate-resilient varieties by including them under the Seed Act Schedule, the Mission for Integrated Development of Horticulture (MIDH), Farmer Producer Organizations (PM-FPO), and State Nutrition and Climate Missions, thus linking tuber crops with public procurement, food security, and national nutrition initiatives. Strengthened investment in research and development, seed systems, mechanization, and digital infrastructure will ensure that tropical tuber crops contribute substantially to India's goals of sustainable growth, nutrition security, and climate smart agriculture by 2031.

6. Tuber crops in urban and peri-urban agriculture

India's urban population is projected to exceed 600 million (over 40%) by 2030, creating major challenges for food production, distribution, and sustainability. Tuber crops offer strong potential for integration into urban and peri-urban agriculture through circular, zero-waste food system approaches. By 2031, at least 50 model urban and peri-urban clusters should be established across major cities to demonstrate protected, soilless, and vertical farming systems using rooftop and community nutri-gardens. Fifty such clusters, each covering 5-10 hectares and producing 600-900 tonnes of fresh tubers and roots annually through efficient resource use, could together generate 30000-45000 tonnes of nutrient-rich produce while advancing circular and climate-resilient urban food systems. Collectively, these initiatives could recycle about 1 lakh tonnes of organic waste into compost, reuse greywater for irrigation, and employ solar-powered drip systems to reduce freshwater use by 40% and emissions by 25%. Linking these models with programs such as Poshan Abhiyaan, ICDS, and the Smart Cities Mission will enable inclusion of biofortified tuber crops in 50 city nutrition schemes. Such measurable actions will position tropical tuber crops as key components of sustainable, zero-waste, and nutrition-sensitive urban food systems.

7. Decentralised processing and cold chain

Decentralized, small-scale processing and efficient post-harvest management are essential to enhance value addition and reduce losses in tropical tuber crops. By 2031, at least 500 village- or cluster-level processing units should be established across major tuber crop growing regions for producing various value added products. Each unit, with a capacity of 1-2 tonnes per day, can generate local employment for 10-15 people and collectively process nearly 3-4 lakh tonnes of raw tubers annually, stabilizing farm gate prices and ensuring steady market supply. Development of 100 mobile cold storage units and 200 tuber crop specific packhouses will further reduce post-harvest losses - currently estimated at 15-20% - and extend shelf life, particularly for perishable crops such as cassava, sweet potato, elephant foot yam, and taro.

Public-private partnerships and women Self Help Group (SHG) networks, modelled after successful initiatives like the Kudumbashree Mission in Kerala, can effectively promote entrepreneurship, local brand development, and equitable benefit sharing. At least 25% of the proposed processing units should be managed by SHG or FPO-led enterprises with technical support from ICAR-CTCRI and State Departments. Recent MoUs between ICAR–CTCRI, industries, and community organizations have demonstrated the scalability of such decentralized enterprise models. Strengthening these linkages through incubation, training, and financial facilitation could transform the tuber crop sector into a vibrant, inclusive, and value-driven rural economy, ensuring year-round product availability, income diversification, and a reduction of post-harvest losses by at least 10-12% nationwide by 2031.

8. Value chain and market interventions

Developing efficient and inclusive value chains is essential to transform tropical tuber crops from subsistence staples into profitable, market-oriented commodities. By 2031, at least 200 Farmer Producer Organizations (FPOs) should be strengthened or newly formed in major tuber crop growing regions to facilitate aggregation, collective marketing, and contract farming with processors. These FPOs could together cover about 2 lakh farming households, improving bargaining power and ensuring consistent, quality supply to industries. Establishing 50 processing and packaging clusters, each with low-cost curing and storage facilities and linked to nearby industrial units, can reduce post-harvest losses - currently around 15-20% - by at least 10-12% percentage while improving profitability.

For commercialization, 10-12 processing-grade and industry-specific varieties should be developed and deployed, supported by cluster-based value chains targeting major end uses such as starch, bakery, snack, feed, nutraceutical industries etc. Public-private partnerships and digital platforms for real-time price dissemination, branding, and traceability should be promoted in at least 100 districts to ensure transparency and fair farmer returns.

Policy interventions are needed to support tuber crop based industrial uses such as baby foods, starch extraction, animal feed formulation, and bio-ethanol production, with a goal of achieving a 25% increase in industrial utilization of tuber crops by 2031. The introduction of quality grading standards, contract farming frameworks, and digital marketplaces under schemes like MIDH and e-NAM can further strengthen commercialization.

By linking producers, processors, and markets through these organized value chains, the tropical tuber crop sector can evolve into a vibrant, enterprise-driven ecosystem generating over 2 lakh rural jobs, enhancing farmer income by 30-40%, and contributing significantly to rural industrial growth and national nutrition security.

9. Finance, insurance and trade facilitation

Strengthening financial and trade support mechanisms is essential for accelerating investment and ensuring risk resilience in the tropical tuber crop sector. By 2031, at least ₹1,000 crore in targeted credit should be mobilized through dedicated and customized Kisan Credit Card (KCC) variants and priority lending schemes for tuber crop cultivation, mechanization, processing, and storage. Simplified access to institutional finance for 500 FPOs, SHGs, and rural entrepreneurs will enable the establishment of 300 cluster-based enterprises and promote decentralized value addition across major producing states.

Crop insurance modules tailored to the 5-11 month crop cycles of tuber crops must be developed and piloted in 25 high-risk districts to protect farmers from yield losses due to droughts, floods, or pest outbreaks. These schemes should integrate index-based and weather-linked insurance instruments to ensure transparent and timely compensation, targeting coverage for at least 2 lakh farmers by 2031.

To enhance market diversification, export-oriented promotion of processed tuber products - including starch, flour, chips, dehydrated cubes etc. - should aim to achieve an annual export turnover of ₹500 crore by 2031, supported through quality certification, branding, and trade facilitation under APEDA and the India Brand Equity Foundation (IBEF). Aligning agricultural credit, insurance, and trade policy will strengthen the sector's financial inclusion, stabilize farm incomes, and establish tropical tuber crops as a globally competitive agri-industrial segment contributing to India's export and rural development goals.

10. Institutional and capacity building

Strengthening institutional frameworks and human resource capacity is fundamental to accelerating innovation and adoption in the tropical tuber crops sector. By 2031, capacity development should be undertaken in at least 200 Krishi Vigyan Kendras (KVKs) across major tuber crop growing districts to support seed system development, climate-resilient production, and value chain interventions. Infrastructure and scientific manpower at ICAR-CTCRI and 10 SAUs should be upgraded with advanced facilities for genomics, phenomics, mechanization, and processing research, ensuring comprehensive support for technology generation and field application.

To enhance global and national collaboration, at least 10 formal partnerships should be established with international centres such as CIP, IITA, and CIAT, and with 15 SAUs and private sector innovators for joint R&D, technology validation, and capacity building. A network of five regional skill-based training hubs and three incubation centres focused on youth, women-led enterprises, and agri-startups should be created to train 10000 stakeholders annually in climate-smart production, value addition, and entrepreneurship.

Such targeted institutional strengthening and capacity enhancement will accelerate technology diffusion, foster innovation-led rural transformation, and position tropical tuber crops as a driver of sustainable growth and employment generation in India's agri-food sector.

National Mission on Tuber Crops

(A flagship initiative for climate-smart, nutrition-sensitive and value-driven tuber crop development in India)

Vision

To transform tropical tuber crops into climate-resilient, nutrition-rich, and income-enhancing commodities through science-led innovation, sustainable production systems, and inclusive value-chain development.

Mission Objectives

1. Strengthen seed and planting material systems through certified hubs and decentralized multipliers.
2. Promote biofortified and climate-resilient varieties for nutrition and livelihood security.
3. Establish cluster-based processing and cold chain infrastructure to minimize post-harvest losses.
4. Foster entrepreneurship and market integration through FPOs, SHGs, and start-ups.
5. Integrate tuber crops into national nutrition, climate, and livelihood programs.

Five-year implementation framework

The proposed 'National Mission on Tuber Crops (NMTC)' will adopt a phased, convergence-based approach over five years, ensuring alignment with ongoing national initiatives such as the Mission for Integrated Development of Horticulture (MIDH), Pradhan Mantri Formalisation of Micro Food Processing Enterprises (PM-FME), Pradhan Mantri Poshan Shakti Nirman (PM-POSHAN), National Food Security Mission (NFSM), and PM-PRANAM. The implementation framework emphasizes institution building, technology integration, capacity enhancement, and measurable impact across productivity, nutrition, income, and climate resilience.

Phase I (Year 1) – Establishment and pilot implementation (10 districts)

A National Mission Directorate will be constituted under the Ministry of Agriculture and Farmers Welfare (MoA&FW), with ICAR–CTCRI serving as the Technical Support Unit (TSU). Ten pilot districts across five states (Tamil Nadu, Kerala, Odisha, Chhattisgarh and Meghalaya) will be identified for integrated interventions focusing on:

1. Establishment of 10 certified seed hubs and decentralized nurseries.
2. Setting up of 10 cluster-level processing and value-addition units (1-2 tonnes/day) through FPOs and women SHGs.
3. Inclusion of biofortified sweet potato and other nutritious tubers in ICDS and mid-day meal schemes in pilot districts.
4. Baseline mapping of area, production, productivity, post-harvest loss, and farmer income using geo-tagged data systems.

Phase II (Years 2–3) – Expansion and convergence

The mission will expand to 50 districts across 10 states, integrating activities under MIDH, PM-FME, and PM-POSHAN. Key components will include:

1. Establishment of State Mission Units (SMUs) and District Implementation Cells for coordinated action.
2. Roll-out of 50 certified seed hubs and 500 decentralised seed multipliers, targeting 20% annual replacement of planting material.
3. Operationalization of digital seed traceability and market platforms linked with e-NAM and FPO marketplaces.
4. Expansion of climate-smart production clusters with micro-irrigation, fertigation, and regenerative farming modules in one lakh farm units.
5. Launch of five Tuber Entrepreneurship and Innovation Hubs at ICAR–CTCRI and selected SAUs to train 10000 youth and women annually.
6. Introduction of crop-specific insurance modules in 25 high risk districts covering two lakh farmers, integrated with KCC credit lines for enterprises.

Phase III (Years 4–5) – Consolidation, scaling and sustainability

During the final phase, NMTC will achieve full-scale national coverage with emphasis on sustainability, institutionalization, and export competitiveness. Key actions will include:

1. Integration of tuber crops into national nutrition and procurement programs such as ICDS, PM-POSHAN, and State Nutrition Missions in 100 districts, reaching one million children.
2. Establishment of 50 export-oriented processing clusters and branding initiatives for producing 3-4 lakh tonnes of processed tubers annually.
3. Achieve a 25% increase in industrial utilization (starch, bakery, feed, ethanol etc.).
4. Carbon-smart certification and incentive schemes for low-carbon and regenerative tuber crop farming systems across 25% of total tuber crops area.
5. Operationalize a National Digital Tuber Crop Observatory for real-time monitoring using AI, IoT, and GIS tools.
6. Establish the National Tuber Innovation and Entrepreneurship Hub (NTIEH) at ICAR–CTCRI as a nodal centre for R&D–industry linkages and PPP facilitation.

Monitoring, evaluation and key performance indicators (KPIs)

Domain	Target by 2031	Baseline Reference (2024-25)
Area expansion	Increase total tuber crops area from 4 lakh ha to 5 lakh ha.	4 lakh ha
Seed systems	100 seed villages, 500 decentralised seed multipliers ensuring 20% annual variety replacement	10-15% coverage
Production and productivity	25% increase in productivity, national output to reach 12.5 million tonnes	10 million tonnes
Processing and value addition	500 cluster-level processing units, 100 mobile cold storages, 200 packhouses	Below 50 units
Biofortified nutrition reach	One million children through ICDS and MDM by year 5	Pilot scale study
Farmer income	50% increase in average tuber crop-based income by year 5	Rs. 1.0 lakh/ha average
Employment generation	One lakh rural jobs (25% women and youth) through decentralised enterprises)	Not tracked
Climate efficiency	20% reduction in water and nutrient use per tonne of produce, 15-20% reduction in GHG footprint.	Not tracked
Export revenue	Processed tuber products to reach Rs. 500 crore nnual export turnover	Below 100 crores

Institutional mechanism and stakeholder roles

Level	Key institutions	Primary roles
National	MoA&FW, NITI Aayog, ICAR	Policy, convergence, funding, national dashboard
Technical	ICAR-CTCRI (TSU), SAUs, ICAR institutes	R&D, technology development, capacity building
State	State agriculture / horticulture departments, KVKs	Implementation, extension, monitoring
Private / NGO	FPOs, SHGs, MSMEs, industry partners	Seed multiplication, processing, marketing
International	CIP, IITA, CIAT, FAO	Technical collaboration, germplasm, capacity development

Indicative financial outlay: Rs. 1200 crores over 5 years

Component	Description	Proposed Allocation (Rs. Crores)
Seed / Planting Material Network	Establishment of certified seed hubs, decentralized nurseries, tissue culture and rapid multiplication facilities across states.	300
Decentralized Processing & Cold Chain Grants	500 processing units, 100 mobile cold storage, 200 packhouses	300
R&D, Extension, and Capacity Building	Research on biofortified and climate-resilient varieties, training of 200 KVKs, and farmer capacity building through ICAR-CTCRI and SAUs, incubation.	200
Market Development & Digital Platforms	Establishment of digital traceability, e-trade systems, branding and export facilitation initiatives.	200
Climate-smart Infrastructure & Mechanization	Promotion of regenerative, organic and precision systems including micro-irrigation, renewable energy-powered units, mechanization for planting and harvesting.	200
Total Estimated Allocation (Convergent funding through MoA&FW+PPP+CSR)		1200

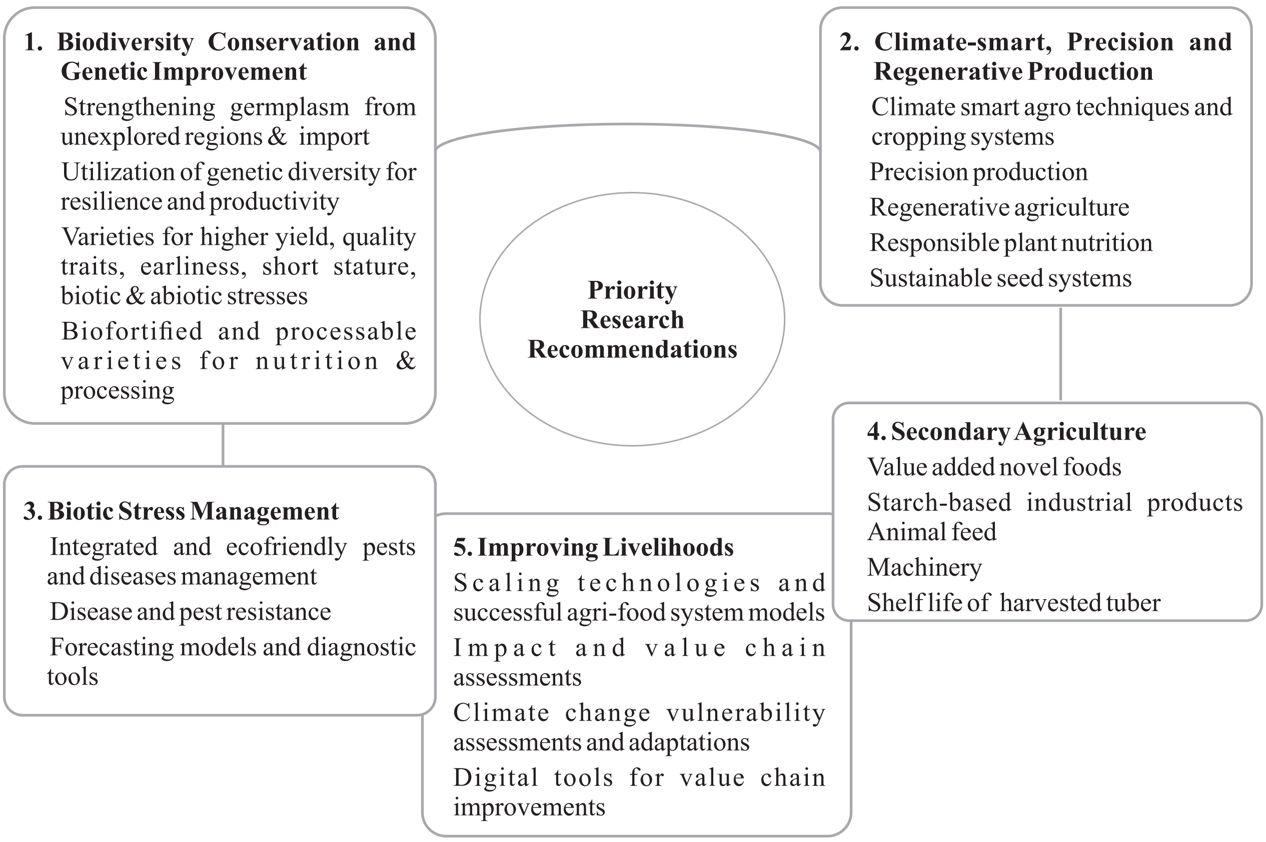
Risk mitigation and sustainability

1. Market volatility: Strengthen institutional procurement and contract farming with public agencies and industry partners.
2. Adoption lag: Promote intensive demonstrations, field schools, and nutrition awareness campaigns.
3. Climate shocks: Diversify species portfolio and promote adaptive CSA modules.
4. Financial sustainability: Blend central funds with PPP, CSR, and state share (60:40 mode).

Expected outcomes

1. Expand tropical tuber crops area from 0.4 million to 0.5 million ha by 2031 with a potential to reach 0.6 million ha by 2035.
2. 25% higher productivity and 50% higher farmer income in mission districts.
3. Five lakh tonnes of biofortified sweet potato and 15 lakh tonnes of tuber crop based industrial products annually.
4. Reduced post-harvest losses by 30% and GHG emissions by 20%.
5. Enhanced nutritional security for children and vulnerable populations.
6. Creation of 1 lakh rural and peri-urban livelihoods, including women and youth.
7. Strengthened contribution to SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption), and SDG 13 (Climate Action).

The priority research recommendations to meet above targets are given below.



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Annexures

Annexure 1. District wise area, production and productivity of cassava in India in 2023-24 (Ranked by area under cultivation)

Sl. No.	State	District	Area (Hectare)	Production (Tonnes)	Productivity (t/ha)
1	Tamil Nadu	Namakkal	17755	656937	37.00
2	Tamil Nadu	Kallakurichi	15604	779691	49.97
3	Tamil Nadu	Dharmapuri	13860	405052	29.22
4	Kerala	Thiruvananthapuram	13244	473604	35.76
5	Tamil Nadu	Salem	13117	538936	41.09
6	Kerala	Kollam	10489	399123	38.05
7	Kerala	Kottayam	6640	336523	50.68
8	Tamil Nadu	Erode	6021	190318	31.61
9	Kerala	Ernakulam	5475	273915	50.03
10	Kerala	Idukki	4989	248505	49.81
11	Tamil Nadu	Cuddalore	4727	120589	25.51
12	Tamil Nadu	Tiruchirappalli	4142	166685	40.24
13	Kerala	Pathanamthitta	3933	198254	50.41
14	Tamil Nadu	Tiruvannamalai	3605	131695	36.53
15	Kerala	Malappuram	3345	141836	42.40
16	Andhra Pradesh	Kakinada	2316	27453	11.85
17	Tamil Nadu	Perambalur	1986	75722	38.13
18	Kerala	Alappuzha	1939	80419	41.47
19	Tamil Nadu	Karur	1450	32942	22.72
20	Meghalaya	East Garo hills	1282	7295	5.69
21	Tamil Nadu	Villupuram	1195	28941	24.22
22	Meghalaya	West Garo Hills	1166	6731	5.77
23	Kerala	Palakkad	1135	51059	44.97
24	Kerala	Kannur	1066	43915	41.19
25	Kerala	Kozhikode	1021	32914	32.23
26	Kerala	Wayanad	1015	45286	44.62
27	Kerala	Thrissur	937	45120	48.17
28	Tamil Nadu	Kanniyakumari	919	31372	34.14
29	Andhra Pradesh	East Godavari	840	14023	16.69
30	Tamil Nadu	Tiruppur	797	29930	37.55
31	Meghalaya	North Garo Hills	725	4259	5.87
32	Tamil Nadu	Coimbatore	644	34025	52.83
33	Tamil Nadu	Thanjavur	597	22419	37.55
34	Tamil Nadu	Pudukkottai	586	22006	37.55
35	Tamil Nadu	Dindigul	574	21556	37.55
36	Meghalaya	West Khasi Hills	568	4341	7.64
37	Meghalaya	East Khasi Hills	567	4118	7.26

38	Andhra Pradesh	Alluri Sitharama Raju	509	4714	9.26
39	Kerala	Kasaragod	484	19921	41.16
40	Meghalaya	South West Garo Hills	451	3132	6.94
41	Assam	Kokrajhar	387	4306	11.13
42	Assam	Dima hasao	380	2679	7.05
43	Assam	Baksa	352	4511	12.82
44	Meghalaya	South Garo Hills	344	3029	8.81
45	Nagaland	Mon	318	6836	21.5
46	Nagaland	Peren	314	7441	23.7
47	Nagaland	Mokokchung	306	7073	23.11
48	Nagaland	Tuensang	285	6287	22.06
49	Assam	Udalguri	279	3219	11.54
50	Assam	Karbi Anglong	275	3131	11.39
51	Nagaland	Noklak	256	5744	22.44
52	Meghalaya	South West Khasi Hills	253	2253	8.91
53	Assam	Goalpara	248	2111	8.51
54	Tamil Nadu	Ariyalur	223	8412	37.72
55	Nagaland	Longleng	221	4801	21.72
56	Karnataka	Mysore	194	2014	10.38
57	Tamil Nadu	Krishnagiri	186	6947	37.35
58	Assam	Chirang	179	1497	8.36
59	Assam	Sonitpur	176	2067	11.74
60	Tamil Nadu	Thiruvarur	175	6572	37.55
61	Nagaland	Shamator	167	3693	22.11
62	Nagaland	Phek	151	3355	22.22
63	Mizoram	Lawngtlai	145	523	3.61
64	Pondicherry	Pondicherry	144	3470	24.10
65	Nagaland	Kohima	137	3046	22.23
66	Nagaland	Kiphire	133	3033	22.8
67	Nagaland	Zunheboto	128	2828	22.09
68	Assam	Biswanath	121	2016	16.66
69	Nagaland	Wokha	115	2547	22.15
70	Tamil Nadu	Theni	101	3793	37.55
71	Assam	Bongaigaon	90	882	9.8
72	Assam	West Karbi Anglong	88	869	9.88
73	Tamil Nadu	Sivaganga	86	3230	37.56
74	Karnataka	Gulbarga	84	1064	12.67
75	Tamil Nadu	Mayiladuthurai	83	3117	37.55
76	Karnataka	Kodagu	81	1220	15.06
77	Meghalaya	Ri Bhoi	73	461	6.32
78	Tamil Nadu	Thenkasi	64	2403	37.55
79	Nagaland	Nuiland	64	1437	22.45
80	Nagaland	Tseminyu	64	1422	22.22

81	Nagaland	Chumoukedima	59	1325	22.46
82	Nagaland	Dimapur	52	1167	22.44
83	Karnataka	Hassan	44	536	12.18
84	Assam	Dhubri	40	338	8.45
85	Assam	Hojai	40	386	9.65
86	Assam	Tinsukia	40	370	9.25
87	Tamil Nadu	Madurai	38	1427	37.55
88	Karnataka	Gadag	37	447	12.08
89	Tamil Nadu	The nilgiris	36	1352	37.56
90	Tamil Nadu	Tirupathur	36	1352	37.56
91	Karnataka	Dharwad	36	324	9.00
92	Assam	Lakhimpur	35	336	9.60
93	Meghalaya	West Jaintia Hills	27	298	11.04
94	Assam	Dhemaji	27	189	7.00
95	Tamil Nadu	Thiruvallur	25	939	37.56
96	Karnataka	Tumkur	25	254	10.16
97	Andhra Pradesh	Tirupati	24	303	12.63
98	Karnataka	Belgaum	24	278	11.58
99	Assam	Cachar	21	215	10.24
100	Karnataka	Koppal	19	217	11.42
101	Tamil Nadu	Tirunelveli	17	638	37.53
102	Tamil Nadu	Virudhunagar	16	601	37.56
103	Andhra Pradesh	Anakapalli	16	202	12.63
104	Mizoram	Saitual	15	22	1.47
105	Andhra Pradesh	Konaseema	14	176	12.57
106	Karnataka	Bagalkot	14	160	11.43
107	Mizoram	Lunglei	13	28	2.15
108	Mizoram	Hnahthial	12	81	6.75
109	Andhra Pradesh	Vizianagaram	11	139	12.64
110	Assam	Barpeta	10	106	10.6
111	Assam	Dibrugarh	10	105	10.5
112	Assam	Kamrup	10	91	9.1
113	Tamil Nadu	Vellore	9	338	37.56
114	Assam	Charaideo	8	72	9.00
115	Assam	Sivasagar	8	72	9.00
116	Meghalaya	East Jaintia Hills	7	62	8.86
117	Assam	Nagaon	7	72	10.29
118	Assam	South Salmara Mancachar	7	73	10.43
119	Karnataka	Chamarajanagar	7	82	11.71
120	Assam	Golaghat	6	52	8.67
121	Tamil Nadu	Chengalpattu	5	188	37.6
122	Andhra Pradesh	Parvathipuram Manyam	5	63	12.6
123	Tamil Nadu	Ranipet	4	150	37.5

124	Assam	Jorhat	4	42	10.5
125	Assam	Marigaon	4	38	9.5
126	Pondicherry	Mahe	4	120	30.00
127	Andhra Pradesh	Visakhapatanam	3	38	12.67
128	Assam	Kamrup Metro	3	27	9
129	Karnataka	Dakshin kannad	3	36	12
130	Karnataka	Chikmagalur	2	23	11.5
131	Karnataka	Chikmagalur	2	14	7
132	Karnataka	Kolar	2	23	11.5
133	Karnataka	Ramanagara	2	11	5.5
134	Andhra Pradesh	Palnadu	1	13	13
135	Assam	Darrang	1	12	12
136	Assam	Majuli	1	10	10
137	Assam	Nalbari	1	12	12
138	Karnataka	Bangalore rural	1	20	20

Source: P. Prakash, Personal Communication

Annexure 2. District wise area, production and productivity of sweet potato in India in 2023-24 (Ranked by area under cultivation)

Sl. No.	State	District	Area (Hectare)	Production (Tonnes)	Productivity (t/ha)
1	Odisha	Ganjam	7510	73360	9.77
2	Karnataka	Belgaum	4928	50713	10.29
3	Odisha	Sundargarh	3260	32570	9.99
4	Odisha	Koraput	3140	32310	10.29
5	West Bengal	24-Pgs (S)	3025	39125	12.93
6	Uttar Pradesh	Kasganj	2972	34404	11.58
7	Odisha	Keonjhar	2900	29580	10.20
8	Odisha	Mayurbhanj	2810	27750	9.88
9	Odisha	Sambalpur	2080	19740	9.49
10	Odisha	Gajapati	2040	16280	7.98
11	Odisha	Dhenkanal	2020	17770	8.80
12	Odisha	Rayagada	1850	14820	8.01
13	Odisha	Malkangiri	1600	14880	9.30
14	Odisha	Bargarh	1510	13580	8.99
15	West Bengal	Hooghly	1476	14109	9.56
16	Odisha	Nabarangpur	1470	14010	9.53
17	Uttar Pradesh	Fatehpur	1422	16461	11.58
18	Meghalaya	West Khasi Hills	1384	5355	3.87
19	West Bengal	Murshidabad	1331	14001	10.52
20	Madhya Pradesh	Katni	1322	13404	10.14
21	Odisha	Kandhamal	1260	11800	9.37
22	West Bengal	Dakshin Dinajpore	1120	11212	10.01
23	Odisha	Nuapada	1100	9570	8.70
24	Meghalaya	West Jaintia Hills	1026	3225	3.14
25	Uttar Pradesh	Budaun	1017	11773	11.58
26	West Bengal	Coochbehar	1012	10250	10.13
27	West Bengal	Purulia	945	8551	9.05
28	Uttar Pradesh	Etah	939	10870	11.58
29	Uttar Pradesh	Amethi	919	10638	11.58
30	West Bengal	Midanapore (E)	910	8925	9.81
31	Uttar Pradesh	Shahjahanpur	845	9782	11.58
32	Uttar Pradesh	Sultanpur	821	9504	11.58
33	West Bengal	Birbhum	801	8420	10.51
34	Odisha	Bolangir	800	7370	9.21
35	West Bengal	Midnapore (W)	793	7620	9.61
36	Uttar Pradesh	Farrukhabad	764	8844	11.58
37	Odisha	Subarnapur	760	6430	8.46
38	West Bengal	Nadia	751	9370	12.48
39	Meghalaya	East Khasi Hills	749	1113	1.49
40	Madhya Pradesh	Tikamgarh	746	11190	15
41	West Bengal	Bankura	688	7175	10.43
42	Odisha	Cuttack	670	5730	8.55
43	Uttar Pradesh	Hardoi	642	7432	11.58
44	West Bengal	Uttar Dinajpore	627	7460	11.90

45	Karnataka	Hassan	607	7097	11.69
46	West Bengal	Purba Bardhaman	603	5651	9.37
47	West Bengal	Alipurduar	600	6711	11.19
48	Uttar Pradesh	Kaushambi	545	6309	11.58
49	West Bengal	Malda	538	4653	8.65
50	Uttar Pradesh	Unnao	532	6158	11.58
51	West Bengal	24-Pgs (N)	523	5456	10.43
52	Odisha	Deogarh	500	4730	9.46
53	Uttar Pradesh	Mainpuri	481	5568	11.58
54	Odisha	Angul	470	3920	8.34
55	Assam	Barpeta	438	1826	4.17
56	Uttar Pradesh	Pratapgarh	422	4885	11.58
57	Meghalaya	West Garo Hills	410	1510	3.68
58	Uttar Pradesh	Kanpur Nagar	394	4561	11.58
59	Odisha	Kalahandi	390	3380	8.67
60	West Bengal	Jalpaiguri	384	4880	12.71
61	Odisha	Boudh	360	3200	8.89
62	Assam	Udalguri	348	2354	6.76
63	Assam	Karbi Anglong	336	1896	5.64
64	Meghalaya	South West Khasi Hills	328	1086	3.31
65	Karnataka	Kodagu	324	3893	12.02
66	Odisha	Nayagarh	320	2940	9.19
67	Assam	Nagaon	316	3081	9.75
68	Assam	Sonitpur	305	1817	5.96
69	Madhya Pradesh	Shivpuri	305	5900	19.34
70	Uttar Pradesh	Sitapur	304	3519	11.58
71	Uttar Pradesh	Kannauj	303	3507	11.57
72	Uttar Pradesh	Kanpur Dehat	266	3079	11.58
73	Madhya Pradesh	Shahdol	265	3530	13.32
74	Odisha	Kendrapara	260	2150	8.27
75	Odisha	Bhadrak	250	2160	8.64
76	Odisha	Jajpur	250	2090	8.36
77	Madhya Pradesh	Datia	243	3645	15
78	Madhya Pradesh	Sagar	239	7049	29.53
79	Chhattisgarh	Jashpur	236	1365	5.78
80	Andhra Pradesh	Alluri Sitharama Raju	236	4433	18.78
81	Rajasthan	Sikar	232	6952	29.97
82	Meghalaya	East Garo Hills	232	849	3.66
83	Uttar Pradesh	Faizabad	232	2686	11.58
84	Odisha	Jagatsingpur	230	2000	8.70
85	Assam	Dhubri	229	1178	5.14
86	Madhya Pradesh	Ratlam	228	1689	7.41
87	Assam	Kamrup	225	1045	4.64
88	Madhya Pradesh	Barwani	220	3413	15.51
89	Madhya Pradesh	Umaria	220	2200	10
90	Madhya Pradesh	Rajgarh	218	5450	25
91	Meghalaya	South West Garo Hills	204	801	3.93

92	Odisha	Balasore	200	1700	8.50
93	Madhya Pradesh	Singrauli	198	3416	17.25
94	Meghalaya	East Jaintia Hills	193	621	3.22
95	Nagaland	Zunheboto	187	1787	9.56
96	Madhya Pradesh	Chhindwara	183	3294	18
97	Assam	Cachar	182	763	4.19
98	Nagaland	Phek	181	1721	9.51
99	Madhya Pradesh	Chhatarpur	181	2034	11.24
100	Uttar Pradesh	Agra	180	2084	11.58
101	Uttar Pradesh	Aligarh	177	2049	11.58
102	Assam	Goalpara	176	1387	7.88
103	Assam	Bongaigaon	175	775	4.43
104	Uttar Pradesh	Firozabad	171	1979	11.57
105	Nagaland	Mokokchung	169	1610	9.53
106	Meghalaya	Ri Bhoi	168	1142	6.8
107	Nagaland	Mon	159	1504	9.46
108	Chhattisgarh	Balrampur	158	845	5.35
109	Uttar Pradesh	Rae bareli	158	1829	11.58
110	Meghalaya	South Garo Hills	155	608	3.92
111	Chhattisgarh	Surajpur	151	822	5.44
112	Assam	Chirang	150	714	4.76
113	Assam	South Salmara Mancachar	150	753	5.02
114	Madhya Pradesh	Sehore	150	4500	30
115	Nagaland	Wokha	147	1402	9.54
116	Nagaland	Kiphire	146	1402	9.6
117	Chhattisgarh	Surguja	143	804	5.62
118	Karnataka	Mysore	142	1705	12.01
119	Nagaland	Longleng	139	1322	9.51
120	Assam	Lakhimpur	138	644	4.67
121	Assam	Tinsukia	135	630	4.67
122	Madhya Pradesh	Balaghat	130	2770	21.31
123	Madhya Pradesh	Mandsaur	130	2134	16.42
124	Nagaland	Peren	129	1232	9.55
125	Assam	Kokrajhar	121	657	5.43
126	Odisha	Khordha	120	1020	8.50
127	Uttar Pradesh	Moradabad	117	1354	11.57
128	Assam	Biswanath	115	847	7.37
129	Uttar Pradesh	Jaunpur	112	1296	11.57
130	Uttar Pradesh	Bareilly	111	1285	11.58
131	Assam	Karimganj	107	876	8.19
132	Assam	Darrang	105	447	4.26
133	Assam	West Karbi Anglong	103	582	5.65
134	Nagaland	Kohima	103	988	9.59
135	Assam	Dima hasao	102	685	6.72
136	Nagaland	Shamator	96	914	9.52
137	Meghalaya	North Garo Hills	93	344	3.7
138	Uttar Pradesh	Barabanki	92	1065	11.58

139	Uttar Pradesh	Siddharth Nagar	92	1065	11.58
140	Odisha	Jharsuguda	90	770	8.56
141	Odisha	Puri	90	750	8.33
142	Madhya Pradesh	Ujjain	86	1581	18.3
143	Assam	Golaghat	84	454	5.4
144	Nagaland	Tuensang	84	799	9.51
145	Assam	Dibrugarh	83	399	4.81
146	Uttar Pradesh	Hapur	83	961	11.58
147	Uttar Pradesh	Hathras	82	949	11.57
148	Nagaland	Noklak	80	758	9.48
149	Uttar Pradesh	Bahraich	78	903	11.58
150	Chhattisgarh	Kondagaon	77	696	9.04
151	Madhya Pradesh	Jabalpur	77	774	10.1
152	Tamil Nadu	Karur	76	2021	26.59
153	Madhya Pradesh	Hoshangabad	76	913	12.01
154	Uttar Pradesh	Sambhal	72	834	11.58
155	Assam	Dhemaji	70	396	5.66
156	West Bengal	Jhargram	69	576	8.35
157	Assam	Marigaon	67	300	4.48
158	Nagaland	Tseminyu	66	632	9.58
159	Uttar Pradesh	Sant Kabeer Nagar	65	753	11.58
160	Madhya Pradesh	Guna	65	1625	25
161	Uttar Pradesh	Allahabad	63	729	11.57
162	Andhra Pradesh	Annamayya	61	1146	18.79
163	Madhya Pradesh	Agar malwa	61	596	9.77
164	Uttar Pradesh	Amroha	59	683	11.58
165	Uttar Pradesh	Auraiya	59	683	11.58
166	Karnataka	Udupi	58	867	14.95
167	Uttar Pradesh	Bulandshahr	58	671	11.57
168	Madhya Pradesh	Dhar	58	1080	18.62
169	West Bengal	Darjeeling	58	676	11.66
170	Tamil Nadu	Tiruvannamalai	54	1724	31.93
171	Nagaland	Chumoukedima	51	488	9.57
172	Madhya Pradesh	Ashoknagar	51	701	13.75
173	Uttar Pradesh	Etawah	48	556	11.58
174	Uttar Pradesh	Kushi Nagar	45	521	11.58
175	Madhya Pradesh	Betul	45	382	8.49
176	Tamil Nadu	Cuddalore	44	325	7.39
177	Nagaland	Nuiland	44	422	9.59
178	Madhya Pradesh	Alirajpur	44	704	16.12
179	Nagaland	Dimapur	43	410	9.53
180	Madhya Pradesh	Seoni	43	805	18.72
181	West Bengal	Kalimpong	41	440	10.73
182	Assam	Baksa	40	225	5.63
183	Assam	Nalbari	40	296	7.4
184	Kerala	Kasaragod	39.23	737.96	18.81
185	Assam	Jorhat	38	201	5.29

186	Tamil Nadu	Dharmapuri	38	953	25.08
187	Madhya Pradesh	Indore	37	814	22
188	Uttar Pradesh	Mathura	35	405	11.57
189	Madhya Pradesh	Morena	35	760	21.71
190	Uttar Pradesh	Lucknow	34	394	11.59
191	Assam	Sivasagar	33	158	4.79
192	Chhattisgarh	Bastar	33	187	5.67
193	Chhattisgarh	Raigarh	33	178	5.39
194	Karnataka	Kolar	33	398	12.06
195	Karnataka	Ramanagara	33	326	9.88
196	Tamil Nadu	Kanchipuram	33	648	19.64
197	Tamil Nadu	Tirunelveli	33	762	23.09
198	Uttar Pradesh	Kheri	33	382	11.58
199	Kerala	Malappuram	32.89	377.88	11.49
200	Uttar Pradesh	Chitrakoot	32	371	11.59
201	Assam	Charaideo	30	149	4.97
202	Uttar Pradesh	Banda	30	347	11.57
203	Uttar Pradesh	Rampur	30	347	11.57
204	West Bengal	Paschim Bardhaman	30	281	9.37
205	Tamil Nadu	Thiruvallur	29	3554	122.55
206	Madhya Pradesh	Khandwa	29	529	18.24
207	Rajasthan	Nagaur	27	45	1.67
208	Uttar Pradesh	Saharanpur	27	313	11.59
209	Uttar Pradesh	Varanasi	27	313	11.59
210	Kerala	Palakkad	26.42	383.46	14.51
211	Assam	Hailakandi	26	228	8.77
212	Madhya Pradesh	Mandla	26	459	17.73
213	Assam	Hojai	25	245	9.8
214	Assam	Majuli	25	141	5.64
215	Chhattisgarh	Bemetara	25	150	6
216	Rajasthan	Jalore	25	68	2.72
217	Tamil Nadu	Madurai	25	192	7.68
218	Madhya Pradesh	Anuppur	25	625	25
219	Madhya Pradesh	Narsinghpur	25	336	13.44
220	Rajasthan	Jaipur	24	25	1.04
221	Assam	Kamrup Metro	23	124	5.39
222	Uttar Pradesh	Deoria	23	266	11.57
223	Tamil Nadu	Pudukkottai	22	411	18.68
224	Uttar Pradesh	Gonda	21	243	11.57
225	Chhattisgarh	Durg	20	180	9
226	Madhya Pradesh	Gwalior	20	440	22
227	Uttar Pradesh	Shravasti	19	220	11.58
228	Rajasthan	Bundi	18	125	6.94
229	Madhya Pradesh	Vidisha	18	212	11.78
230	Chhattisgarh	Dhamtari	16	104	6.5
231	Chhattisgarh	Korea	16	101	6.31
232	Uttar Pradesh	Muzaffarnagar	16	185	11.56

233	Madhya Pradesh	Dewas	16	478	29.88
234	Uttar Pradesh	Lalitpur	15	174	11.6
235	Chhattisgarh	Sukma	14	74	5.29
236	Chhattisgarh	Dantewada	13	72	5.54
237	Kerala	Kannur	12.22	134.42	11
238	Karnataka	Tumkur	12	141	11.75
239	Rajasthan	Barmer	11	11	1
240	Tamil Nadu	Tirupathur	11	69	6.27
241	Kerala	Thiruvananthapuram	10.55	116.05	11
242	Chhattisgarh	Gaurella-Pendra-Marwahi	10	63	6.3
243	Karnataka	Bangalore Rural	10	211	21.1
244	Andhra Pradesh	Krishna	10	188	18.8
245	Andhra Pradesh	Kadapa	9	169	18.78
246	Uttar Pradesh	Ambedkar Nagar	9	104	11.56
247	West Bengal	Howrah	8	120	15.00
248	Karnataka	Chikballapur	7	86	12.29
249	Uttar Pradesh	Ballia	7	81	11.57
250	Chhattisgarh	Bijapur	6	31	5.17
251	Chhattisgarh	Kanker	6	34	5.67
252	Chhattisgarh	Mahasamund	6	44	7.33
253	Chhattisgarh	Manendragarh Chirimiri Bharatpur	6	35	5.83
254	Tamil Nadu	Virudhunagar	6	518	86.33
255	Andhra Pradesh	Chittoor	6	113	18.83
256	Andhra Pradesh	Vizianagaram	6	113	18.83
257	Uttar Pradesh	Basti	6	69	11.5
258	Uttar Pradesh	Sonbhadra	6	70	11.67
259	Kerala	Idukki	5.72	124.41	21.75
260	Kerala	Ernakulam	5.2	54.08	10.4
261	Chhattisgarh	Raipur	5	25	5
262	Rajasthan	Sirohi	5	75	15
263	Tamil Nadu	Thiruvarur	5	355	71
264	Uttar Pradesh	Gorakhpur	5	58	11.6
265	Chhattisgarh	Mungeli	4	27	6.75
266	Karnataka	Gadag	4	47	11.75
267	Rajasthan	Banswara	4	20	5
268	Uttar Pradesh	Azamgarh	4	46	11.5
269	Uttar Pradesh	Mahoba	4	46	11.5
270	Uttar Pradesh	Mau	4	46	11.5
271	Uttar Pradesh	Shamli	4	46	11.5
272	Kerala	Kozhikode	3.77	57.18	15.17
273	Kerala	Alappuzha	3.59	37.695	10.5
274	Chhattisgarh	Gariyaband	3	17	5.67
275	Chhattisgarh	Sakti	3	27	9
276	Karnataka	Dharwad	3	37	12.33
277	Rajasthan	Jhalawar	3	7	2.33
278	Tamil Nadu	Ariyalur	3	61	20.33
279	Tamil Nadu	Dindigul	3	252	84

280	Tamil Nadu	Salem	3	75	25
281	Andhra Pradesh	Visakhapatanam	3	56	18.67
282	Kerala	Thrissur	2.66	16.85	6.33
283	Kerala	Wayanad	2.35	35.84	15.25
284	Kerala	Kollam	2.04	20.4	10
285	Chhattisgarh	Khairgarh Chhuikhadan Gandai	2	13	6.5
286	Chhattisgarh	Korba	2	13	6.5
287	Chhattisgarh	Narayanpur	2	9	4.5
288	Chhattisgarh	Rajnandgaon	2	13	6.5
289	Karnataka	Chitradurga	2	22	11
290	Karnataka	Gulbarga	2	25	12.5
291	Karnataka	Mandya	2	29	14.5
292	Karnataka	Shimoga	2	24	12
293	Rajasthan	Ajmer	2	3	1.5
294	Rajasthan	Bikaner	2	19	9.5
295	Tamil Nadu	Erode	2	254	127
296	Tamil Nadu	Ranipet	2	64	32
297	Tamil Nadu	Theni	2	19	9.5
298	Tamil Nadu	Villupuram	2	117	58.5
299	Uttar Pradesh	Bijnor	2	23	11.5
300	Uttar Pradesh	Chandauli	2	23	11.5
301	Uttar Pradesh	Ghaziabad	2	23	11.5
302	Uttar Pradesh	Hamirpur	2	23	11.5
303	Uttar Pradesh	Meerut	2	23	11.5
304	Uttar Pradesh	Sant Ravidas Nagar	2	23	11.5
305	Kerala	Kottayam	1.75	19.25	11
306	Kerala	Pathanamthitta	1.46	17.52	12
307	Chhattisgarh	Balod	1	8	8
308	Karnataka	Bijapur	1	12	12
309	Karnataka	Chikmagalur	1	13	13
310	Karnataka	Raichur	1	14	14
311	Karnataka	Uttar Kannad	1	15	15
312	Rajasthan	Bharatpur	1	7	7
313	Rajasthan	Chittorgarh	1	1	1
314	Rajasthan	Jodhpur	1	15	15
315	Rajasthan	Karauli	1	2	2
316	Tamil Nadu	Coimbatore	1	19	19
317	Tamil Nadu	Namakkal	1	93	93
318	Tamil Nadu	Sivaganga	1	33	33
319	Tamil Nadu	Thoothukudi	1	262	262
320	Tamil Nadu	Tiruchirappalli	1	94	94
321	Andhra Pradesh	Nandyal	1	19	19
322	Andhra Pradesh	Tirupati	1	19	19
323	Uttar Pradesh	Maharajganj	1	12	12
324	Uttar Pradesh	Pilibhit	1	11	11

Source: P. Prakash, Personal Communication

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