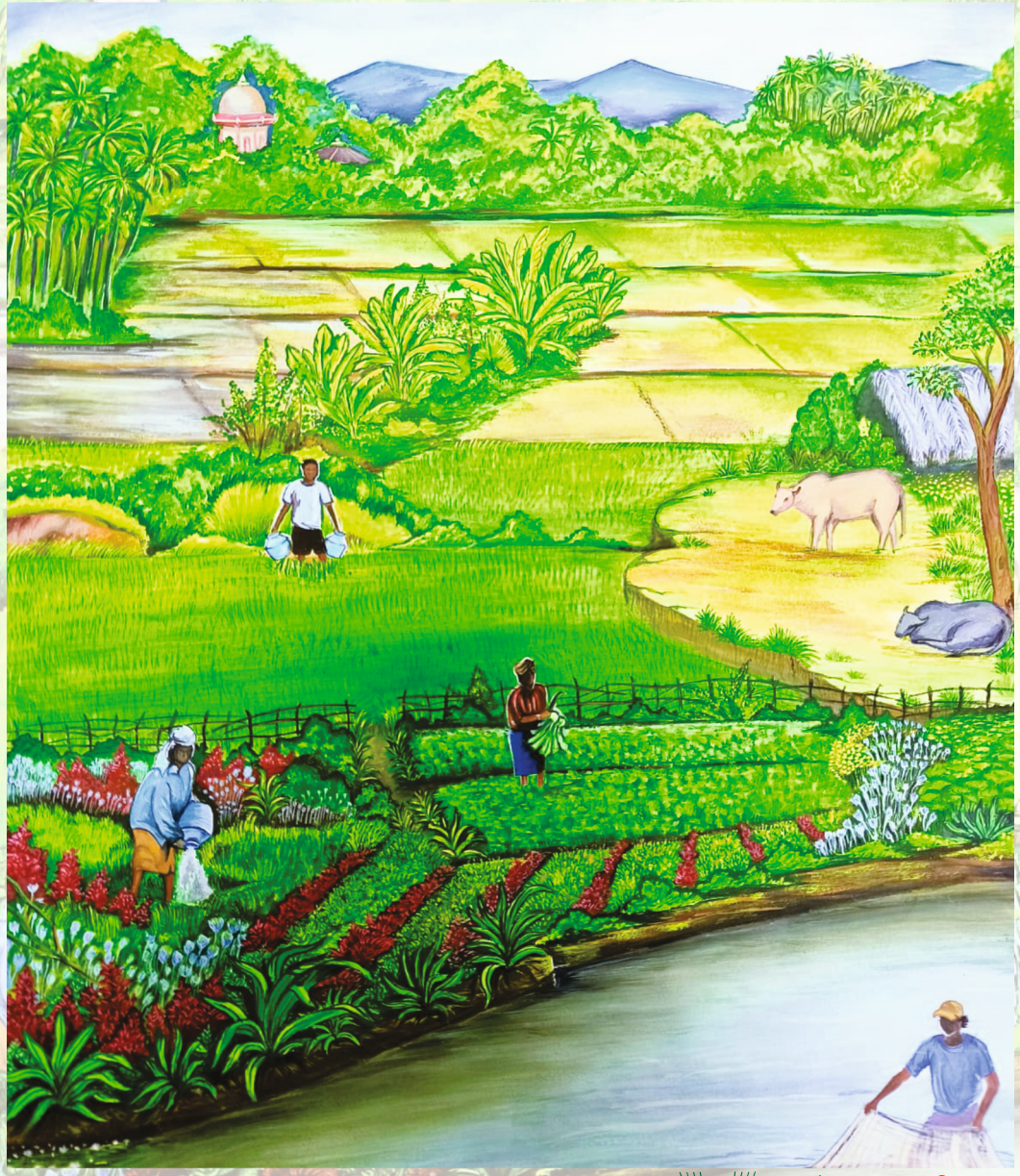
VIKSIT GOA 2047

Revitalising Agriculture and Allied Sectors for Self-Reliant Goa

Policy Paper



ICAR-Central Coastal Agricultural Research Institute
Old Goa-403 402, Goa, India

ICAR-National Academy of Agricultural Research Management
Hyderabad- 500 030, Telangana, India



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Policy Paper

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Gopal Ramdas Mahajan

Tavva Srinivas

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Sreekanth G B

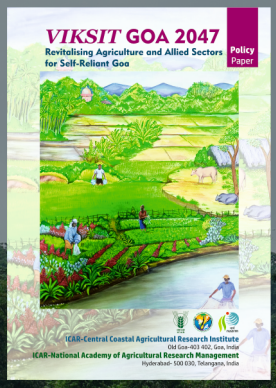
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Viksit *Goa* 2047

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25.11.2024

Foreword

Goa, a state known for its vibrant culture, stunning landscapes, and thriving tourism industry, is now at a critical juncture. As we look towards 2047, the centenary year of India's independence, the need to revitalise Goa's agriculture and allied sectors has never been more pressing. The *"VIKSIT GOA 2047: Revitalising Agriculture and Allied Sectors for Self-Reliant Goa"* policy paper comes at a pivotal moment, charting a comprehensive roadmap to ensure sustainable development and self-reliance for Goa's rural economy.

Historically, agriculture has been the backbone of Goa's economy, supporting livelihoods, ensuring food security, and preserving the state's rich biodiversity. However, in recent years, the sector has faced numerous challenges, including fragmentation of landholdings, declining productivity, climate change impacts, and inadequate infrastructure. In particular, the availability of water during post-monsoon and the accessibility to quality seed and planting materials have collectively hindered the potential of Goa's agriculture.

This policy paper seeks to address these challenges head-on with a forward-looking vision. It advocates for the adoption of innovative farming practices like agro-ecotourism, the integration of modern technology, and the promotion of organic and natural farming methods. A thriving agricultural and allied sectors such as livestock, horticulture, agroforestry and fisheries will contribute significantly to the state's economy, reduce dependency on external food sources, and enhance Goans' overall quality of life. It will also play a crucial role in conserving the state's natural resources and promoting environmental sustainability.

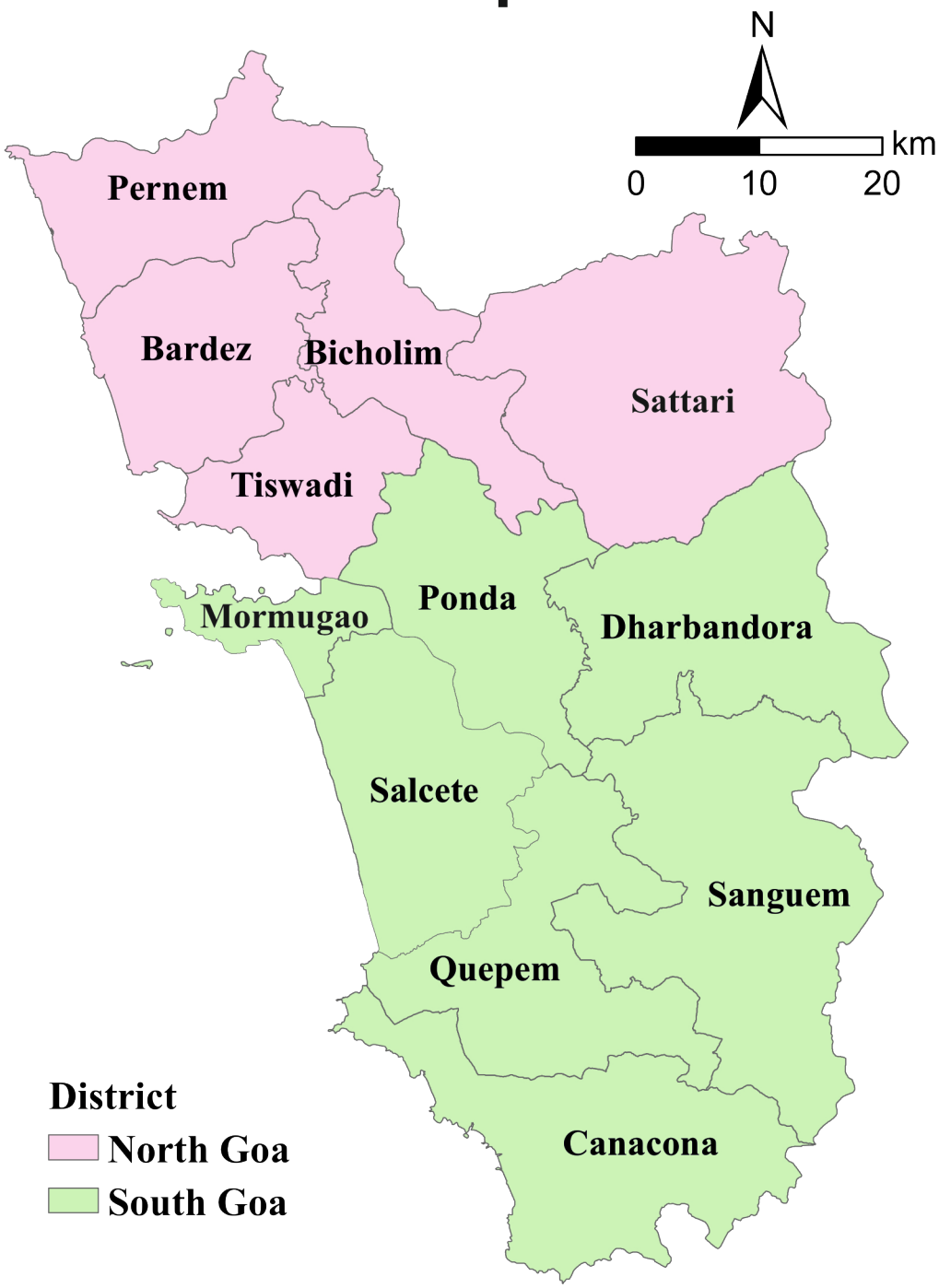
I commend the authors from ICAR-CCARI, Goa and ICAR-NAARM, Hyderabad for their insightful analysis and actionable recommendations. Their work provides a clear and comprehensive blueprint for revitalizing Goa's agriculture and allied sectors.

As we embark on this transformative journey, it is imperative to acknowledge the hard work and dedication of Goan farmers, who are the true custodians of land. I am confident, that the farmer's efforts, coupled with supportive policies and strategic interventions of the Government of Goa and ICAR, will pave the way for a prosperous and self-reliant Goa. The vision of a self-reliant Goa by 2047 is not just a dream but a strategic imperative. Together, let us sow the seeds of progress and nurture the growth of a Visit Goa by 2047.

(S.K. Chaudhari)

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Taluka Map of Goa



Courtesy : Dr. Bappa Das

PREFACE

As we stand at the threshold of the Viksit Bharat@2047, embodied on a century of India's independence covering a wide range of development aspects, including environmental sustainability and economic triumph through agriculture and allied sectors. It is both an honour and a responsibility to present this policy paper on 'VIKSIT GOA 2047-Revitalizing Agriculture and Allied Sectors' for Self-Reliant Goa. The State has long been a place of opportunity and innovation, thanks to its distinctive combination of rich cultural heritage and coastal beauty. However, over time, the country's agricultural and allied sectors have encountered several challenges, including the demands of resources for modern development and shifting climatic trends. This policy paper is born out of a collective vision to transform these challenges into opportunities. It is a comprehensive guide aimed at policymakers, farmers, entrepreneurs, and researchers who are committed to fostering sustainable and resilient agricultural practices in Goa. Through a blend of traditional wisdom and cutting-edge technology, we explore pathways to enhance productivity, ensure food security, and promote economic prosperity for all stakeholders.

In the pages that follow, we delve into the historical context of Goa's agriculture, examining how it has evolved over the decades. We then move on to innovative strategies and success stories that highlight the potential of organic farming, agro-ecotourism and sustainable fisheries. Special attention is given to integrating technology into farming practices, promoting biodiversity and empowering local communities through education and capacity building.

This document is not just about agricultural practices; it is about a holistic approach to rural development. We emphasize the importance of allied sectors such as livestock, dairy, and agro-processing industries, which play a crucial role in creating a vibrant and diversified rural economy. Additionally, we explore policy frameworks and financial instruments that can support and accelerate this transformation.

Our journey towards 2047 is guided by the principles of sustainability, equity and innovation. We believe that by revitalizing Goa's agriculture and its allied sectors, we can contribute to a future, where rural and urban communities thrive together in harmony with nature. We hope that this paper catalyzes change, inspiring action and collaboration among all those who share our vision for a prosperous and sustainable Goa. Let us embark on this journey with optimism and determination, ready to embrace the challenges and opportunities that lie ahead.

Parveen Kumar
R Solomon Rajkumar
Gopal Ramdas Mahajan
Tavva Srinivas
Uthappa A R
Sreekanth G B
Ch Srinivasa Rao

ACRONYMS

- HYV- High-Yielding Variety
- ICAR-CCARI- Indian Council of Agricultural Research - Central Coastal Agricultural Research Institute
- CPCRI- Central Plantation Crops Research Institute
- P- Phosphorus
- K- Potassium
- Ca- Calcium
- Mg- Magnesium
- NBSSLUP- National Bureau of Soil Survey and Land Use Planning
- SRR- Seed Replacement Ratio
- INM- Integrated Nutrient Management
- IPM- Integrated Pest Management
- GI- Geographical Indication
- IFS- Integrated Farming Systems
- NITI Ayog- National Institution for Transforming India
- GROW- Greening and Restoration of Wastelands with Agroforestry
- NGO-Non-Governmental Organization
- AET-Agro-eco-tourism
- DAHVS- Dept. of Animal Husbandry and Veterinary Services
- ICAR-IGFRI- Indian Council of Agricultural Research- Indian Grassland and Fodder Research Institute
- GDP- Gross Domestic product
- GSCST-Goa State Council of Science & Technology
- AGNI-ABI-Agri based Growth opportunities for Nurturing start-ups through Incubation
- NAIF- National Agricultural Innovation Fund
- MoA- Memorandum of Agreement
- a-IDEA- Association for Innovation Development of Entrepreneurship in Agriculture
- NAARM- National Academy of Agricultural Research Management
- CSR- Corporate Social Responsibility
- CSF- Classical Swine Fever
- PPR- Peste des Petits Ruminants
- RKVY- Rashtriya Krishi Vikas Yojana
- NLM- National Livestock Mission
- DPIIT- Department for Promotion of Industry and Internal Trade
- ODOP- One District One Product
- OTOP- One Taluk One Product
- FPOs- Farmer Producer Organizations



1. Introduction

Evolution of Goa's Agriculture

Goan agriculture has a rich history influenced by its unique geographic location, colonial history, and socio-economic changes over the decades. Goa's pre-colonial agriculture was characterized by subsistence farming, with rice as the staple crop. Other important crops included millets, pulses, and vegetables. The agrarian community relied on traditional farming practices, including the use of organic manure and indigenous seeds. During the Portuguese Colonial Period (1510-1961), several new crops were introduced to Goa's agriculture, such as cashew nuts, pineapple, potatoes, and various spices. Cashew and coconut plantations became significant, altering the agricultural landscape. Cashew, in particular, became a major export product. The Portuguese improved irrigation systems, that boosted agricultural productivity.

The Green Revolution of the 1960s and 70s brought significant changes with the introduction of High Yielding Variety (HYV) seeds, chemical fertilizers, and pesticides. However, the impact in Goa was less pronounced compared to other Indian states due to its small size and diverse cropping pattern. There was a gradual shift towards horticulture and floriculture, with an emphasis on cash crops like cashew, coconut, and arecanut. Spices like black pepper, nutmeg, and cinnamon also gained importance. Various government schemes aimed at improving irrigation, providing subsidies for fertilizers, and promoting modern agricultural techniques helped in transforming agriculture. The salient data representing the overview of Goan agriculture and allied sectors are illustrated in the below table 1 and 2. The comparison of productivity of horticulture crops in Goa with the national average and percent deviation of crop productivity with the national average are given in Fig. 1 and 2.



Table 1. Production and productivity of agriculture and horticulture crops in Goa

Sectors	Area (ha)	Production (t)	Productivity (t/ha)	National Average (t/ha)	Deviation %
Agriculture (2020-21)					
Rice	32,680	87,340	2.67	2.72	-1.8
Pulses	3,840	3,750	0.98	0.89	10.1
Sugarcane	550	35,630	65.39	83.57	-21.8
Horticulture (2021 - 22 provisional data)					
Vegetables	8,110	86,160	10.62	18.05	-41.2
Fruits	11,800	77,950	6.61	15.2	-56.5
Banana	2,470	29,680	12.02	36.52	-67.1
Mango	5,060	10,280	2.03	8.84	-77.0
Pineapple	340	5,550	16.32	16.51	-1.2
Major Spices	1,120	420	0.38	2.41	-84.2
Black Pepper	860	400	0.47	0.34	38.2
Cashewnut	59,020	24,820	0.421	0.635	-33.7
Coconut (million nuts)	26,630	165	6196*	9430*	-34.3
Arecanut	2,070	4,140	2.0	1.80	11.1

*Indicates nuts/ha;

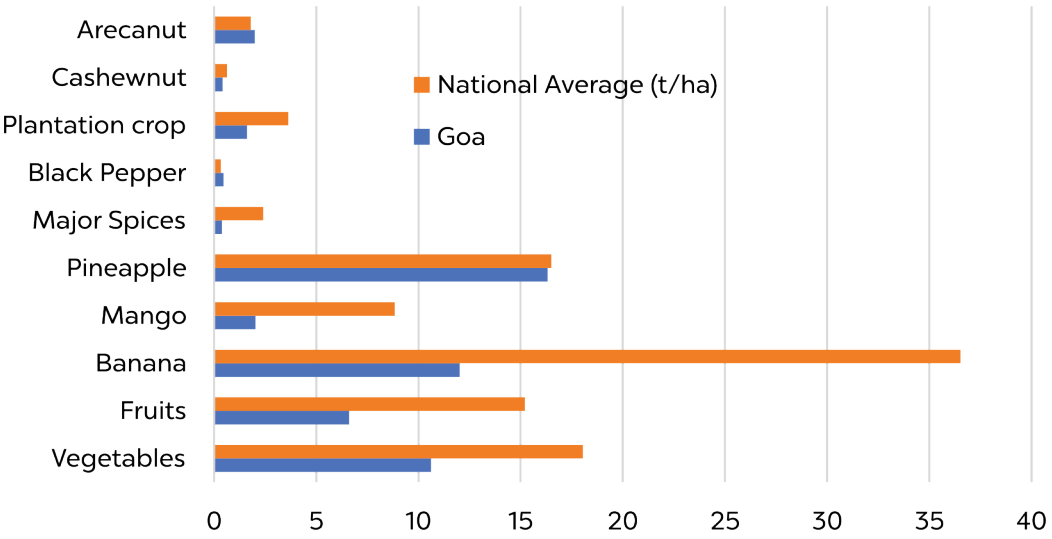


Fig. 1. Productivity of horticulture crops in Goa *vs.* national average

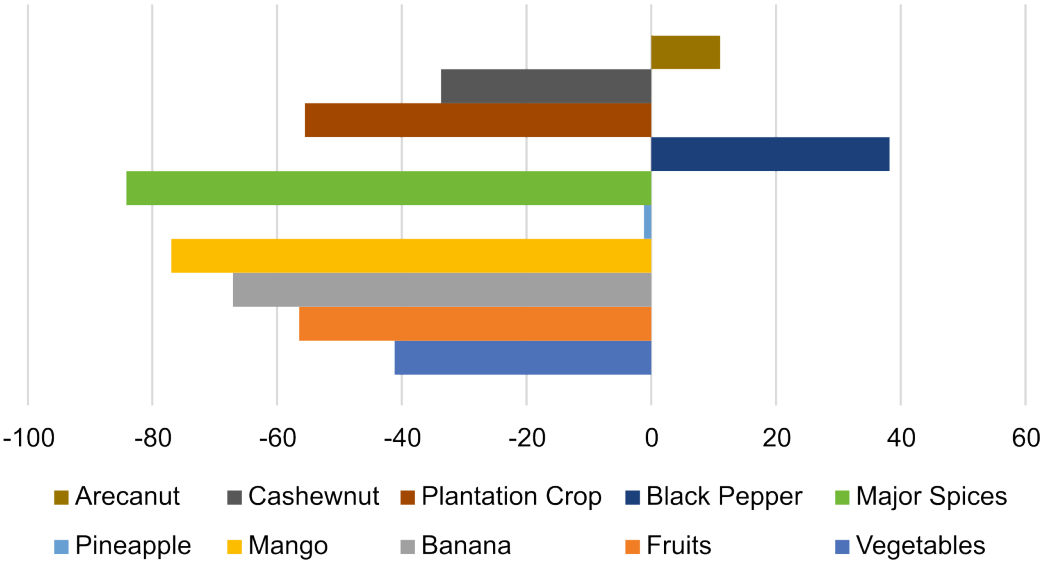


Fig. 2. Percent deviation of crop productivity *vs.* national average

Table 2. Changes in agriculture and forest area between 1987-88 to 2021-22

Parameter	Goa		
	1987-88#	2021-22	Times increased over the initial year
Net sown area (ha)	1,22,182	1,26,000	1.03
Gross sown area (ha)	1,30,575	1,40,500	1.08
Cropping intensity (%)	106.9	115	1.08
Net irrigated area (ha)	16,206	30,000	1.85
Forest area (m ha)	1,24,000	2,24,000	1.81

#at the time of attaining statehood

In recent years, there has been a growing emphasis on organic farming, driven by both government initiatives and market demand for organic produce. Modern techniques like drip irrigation, greenhouse farming, and mechanization have been adopted by progressive farmers. The booming tourism industry in Goa has both positive and negative impacts on agriculture. While it provides a market for local produce, it also leads to the conversion of agricultural land for commercial and residential purposes. There is a growing awareness about sustainable agricultural practices. Farmers are increasingly focusing on crop diversification, soil health management, and water conservation. Women play a crucial role in Goa's agriculture, often involved in various farming activities, especially in the cultivation of vegetables and spices.

Agro-eco-tourism is emerging as a potential area for growth, providing farmers with an additional source of income. Continued research and innovation in crop varieties, pest management, and sustainable practices are essential for the future growth of agriculture in Goa. Enhanced policy support from the government, including better infrastructure, financial aid, and training programs, is crucial for the sustainable development of agriculture in the region. Goan agriculture has thus evolved from traditional subsistence farming to a more diversified and modern sector, facing both opportunities and challenges in the current socio-economic landscape.

Role of ICAR-CCARI in the progress of agriculture & allied sectors in the state of Goa

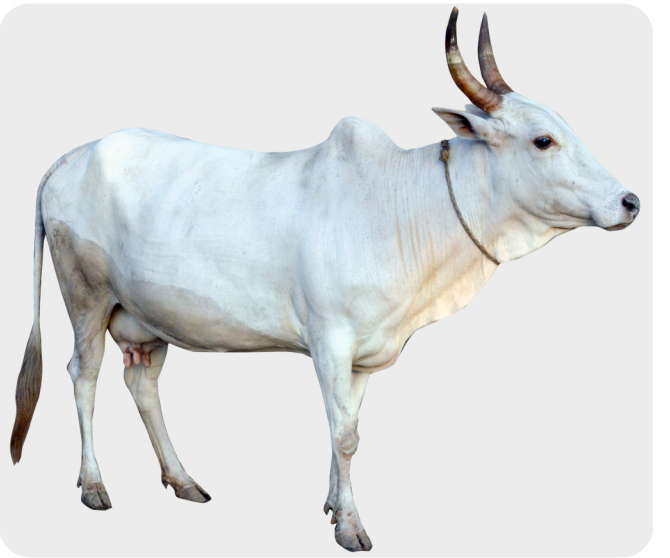
The Indian Council of Agricultural Research - Central Coastal Agricultural Research Institute (ICAR-CCARI) has played a significant role in advancing agricultural research and development in the coastal regions of India, particularly in Goa. ICAR-CCARI was established in 1976 as a regional station of CPCRI, Kasargod and later upgraded as an independent institute 'ICAR Research Complex for Goa' in 1989. It was set up to address the specific agricultural challenges and potentials of the state of Goa. In the year 2014 the institute was rechristened as ICAR-Central Coastal Agricultural Research Institute and the institute's mandate included research on field crops, horticulture, livestock, and fisheries, focusing on the unique agro-climatic conditions of the coastal belt.

In the early years, the institute focused on building its infrastructure, including research farms, laboratories, and administrative buildings. This provided a solid foundation for its research activities. ICAR-CCARI initiated various research programs to improve the productivity and sustainability of coastal agriculture. These programs covered areas such as crop improvement, pest management, soil fertility, and water management. The institute developed and released 28 crop varieties suited to the coastal climate. Notable examples include improved varieties of rice (Goa Dhan 1 to 4), cashew (Goa Cashew 1 to 6), and brinjal (Goa brinjal 1 to 6) which are staple crops in the region. Also, the research on livestock and fisheries aimed at improving the health, productivity, and management practices for coastal breeds of cattle, goats, poultry, and fish.

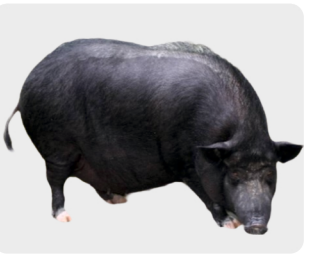
ICAR-CCARI made significant strides in cashew research, developing high-yielding and disease-resistant varieties. The institute also worked on improving post-harvest processing and value addition of cashew products. The institute promoted organic farming practices, developing protocols and guidelines for the organic cultivation of various crops. This included research on organic fertilizers, pest management, and certification processes. The institute provided extension services to farmers, disseminating knowledge and technologies developed through its research and also generated in other institutes/organizations situated in coastal region. This included training programs, workshops, and field demonstrations.

The institute is exploring the potential of agro-ecotourism and value addition to agricultural products as means to enhance farmers' incomes and promote rural development. ICAR-CCARI has made substantial contributions to the development of Goa's agriculture in last 3-4 decades. Its research and extension efforts have helped improve crop yields, livestock productivity, and sustainable farming practices in the region. The institute continues to play a crucial role in addressing emerging agricultural challenges and promoting the overall development of the agricultural sector in coastal areas. To recognize the outstanding contributions of ICAR-CCARI, Govt. of Goa honoured institute with citation on its 35th Statehood Day on 30-05-2022 in Raj Bhawan.

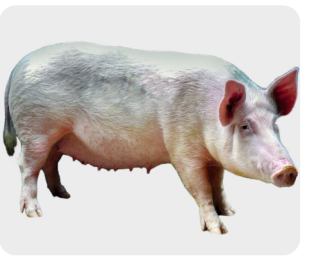
Breeds developed / registered



Shwet Kapila



Agonda Goan



Goya

Varieties developed - 28 nos.



Rice - 4 nos.
Goa Dhan 1
Goa Dhan 2
Goa Dhan 3
Goa Dhan 4



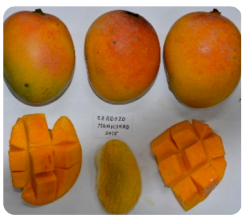
Cowpea - 1 no.
Goa Cowpea - 3



Cashew - 6 nos.
Goa Cashew 1
Goa Cashew 2
Goa Cashew 3
Goa Cashew 4
Goa Cashew 5
Goa Cashew 6



Brinjal - 6 nos.
Goa Brinjal 1
Goa Brinjal 2
Goa Brinjal 3
Goa Brinjal 4
Goa Brinjal 5
Goa Brinjal 6



Mango - 1 no.
Cardozo Mankurad



Nutmeg - 3 nos.
Goa Jayphal - 1
Goa Jayphal - 2
Goa Jayphal - 3



Cinnamon - 1 no.
Goa Dalchini-1



Kokum - 3 nos.
Goa Kokum - 1
Goa Kokum - 2
Goa Kokum - 3



Arecanut - 1 no.
Goa Butki Supari 1



Okra - 1 no.
Goa Bhendi 1



Red Amaranthus - 1 no.
Goa Tambdi Bhaji 1

Background and conceptualization of the policy paper

Hon'ble Chief Minister, Government of Goa, Dr. Pramod Sawant has expressed a need for a policy paper on agriculture and allied sectors for improving production, productivity and income. During June 2023, the Goa government conducted a two-day *"Chintan Shivir"* chaired by the Hon'ble Chief Minister with the active participation of all members of his cabinet to draw an agenda for the state's vision for 2047. The Director, ICAR-CCARI presented a road map for the Goan agricultural and allied sectors for Viksit Goa 2047. This presentation and interactions thereafter laid the foundation for the conceptualization of this policy paper. Subsequently, ICAR-CCARI, Goa conducted a special session on "Revitalizing Goan Agriculture and Allied Sectors for doubling Farmer's Income" during the three-day XXII Biennial National Symposium on "Climate Smart Agronomy for Resilient Production Systems and Livelihood Security" in November 2023 to further delve into drawing a road map for the Goa's agriculture in consultation with various stakeholders. Further periodic interface meetings were conducted with the line departments, farmer organizations and other institutions to brainstorm strategies for the relevant research needs. Based on the recommendations and outcomes of the above deliberations, the present document is compiled. The base documents developed by ICAR-CCARI, Old Goa, Goa on *'Doubling Farmers Income of State of Goa' and 'Roadmap for development of agriculture and allied sectors in the state of Goa: a way towards making Goa self-sufficient'* have been considered while developing this policy paper.



Two-day "*Chintan Shivir*"
Organized by
Government of Goa



Special session on
"Revitalizing Goan Agriculture &
Allied Sectors for doubling Farmer's Income"

2. Agriculture

I. Soils

Acid Soils

Status

By and large, the soils of the State of Goa, India are acidic in soil reaction. It is evident by the fact that of the total 1194 soil samples collected and analyzed for the soil pH, 93.47% were below 6.0 and 98.91% below 7.0. Liming the soil is one of the most effective ways to correct soil acidity. Soils with pH less than or equal to 6.0 are required to manage by lime application and the lime requirement. Heavy rainfall washes away essential nutrients from the soil, leading to deficiencies.

Constraints

Soil acidity is one of the important abiotic stresses which pose serious limitations to crop production. It affects the soil's chemical processes and imbalances the availability of the essential nutrients to the crop plants. Acidic soils often have elevated levels of hydrogen ions that can disrupt the availability of essential nutrients such as phosphorus, calcium, and magnesium. The acid soils of Goa are deficient in soil available P, K, Ca, Mg, etc. Soil acidity impacts agricultural productivity by causing nutrient deficiencies, which in turn leads to poor plant growth and yield loss.

Way Forward

Effective management practices, such as liming to neutralize soil acidity and soil testing, are crucial to mitigate these effects and enhance soil fertility, ultimately improving crop performance and yield. Based on the systematic analysis, lime requirement maps of the State of Goa have been prepared by ICAR-CCARI, Goa. As per the estimates, the soils of the State of Goa require from 2 to 20 t/ha of lime for different regions with varying soils and crops. To manage the acidity-related problems, apply ground limestone up to 11 t/ha or dolomite 10.5 t/ha once in 5 years (NBSSLUP, 2018). The assessed lime requirements can be utilized by farmers, extension officers, and agricultural advisors to provide tailored recommendations on lime application, including the appropriate amounts, timing, & methods for effective use. The recommendations could also be prescribed by the soil testing laboratories of the state while issuing the Soil Health Cards (SHCs).

Coastal Saline Soils (*Khazan* Lands)

Status

Salt-affected coastal soils of the state of Goa are locally called *Khazan* lands. The extent of these lands in the state is 18,000 ha of *Khazan* lands, of which, nearly 40-50% of this area is cultivated with rice, and the rest is kept fallow during *kharif*, and it is largely fallow during the *rabi* season.

Constraints

The soils in this region uniquely combine acidity with high levels of sodium chlorides and sulphates. They are rich in essential nutrients like phosphorus, potassium, calcium, sulphur, iron, manganese, copper, and zinc. Salinity varies seasonally, with monsoon rains leaching salts and making the land suitable for rice cultivation. However, as the monsoon recedes, salinity increases, peaking during the summer. Additionally, seasonal waterlogging severely restricts crop production. Despite their fertility, the high salinity limits productivity. To maximize the land's potential and ensure year-round usability, a holistic approach incorporating advanced technologies is essential.

Way Forward

The promotion of improved salt-tolerant rice varieties, such as Goa Dhan 1, Goa Dhan 2, Goa Dhan 3, and Goa Dhan 4, is recommended for these lands. Along with these varieties, a comprehensive crop production technology package (PoP) should be adopted to enhance productivity and income in salt-affected soils of the West Coast. The product 'Goa Bio-1,' a talc-based bio-formulation designed to promote plant growth in salt-affected paddy fields, is advised for use as either a seed or nursery treatment.

For effective land reclamation, a land shaping method is proposed, involving 65% of the original low-lying lands, 10% allocated for farm ponds, and 25% for bunds. This method prepares the land for various components of integrated farming systems, including crops, vegetables, coconuts, fruit crops, fodders, and pisci culture. It helps rapidly reduce soil salinity and creates optimal conditions for cultivation. Promoting this approach within farmer clusters will maximize rainwater harvesting, replenish ponds, and recharge groundwater with fresh water.

Land Degradation

Status

The area under very slight (5 t/ha/yr) soil loss is located in a part of Salcete, and Canacona talukas and accounts for 9.6% of the total area of the state. Slight (5-10 t/ha/yr) potential soil loss was noted in Satari, Salcete, Sanguem, Quepem and parts Canacona talukas, covering 15.5% area of the state. Moderate (10-15 t/ha/yr) and moderately severe (15-20 t/ha/yr) potential soil losses were observed in other parts of Satari, Salcete, Sanguem, Quepem and Canacona talukas, accounting for 8.8 and 8.9% area respectively in the state. Severe (20-40 t/ha/yr) & very severe (40-80 t/ha/yr) potential soil losses were reported from Pernem, Bardez, Bicholim, Satari, Tiswadi, Ponda, Quepem and Sanguem talukas, holding an area of 26.9 and 22.0% respectively in the state. Extremely severe (>80 t/ha/yr) potential soil loss was observed mainly in Pernem and Bicholim talukas, representing an area (NBSSLUP, 2018).

Constraints

Soil erosion is a critical issue in the hilly regions of Goa, particularly in the talukas of Satari, Sanguem, and Canacona, which are part of the Western Ghats. This region, with its fragile ecosystem, serves as the watershed for major rivers in the state but faces significant challenges due to biotic pressures and inappropriate land use practices. Despite the presence of substantial forest cover, much of the area suffers from soil erosion. The steep gradients and lateritic soils lead to rapid surface runoff, exacerbating soil erosion and hindering water infiltration into the subsoil. Coastal erosion also poses a major concern for Goa. The erosion of topsoil depletes essential nutrients, leading to diminished crop growth and reduced yields. Implementing effective soil and water conservation measures is crucial to optimizing agricultural production and mitigating these adverse effects.

Way Forward

Different management practices and soil and water management practices suitable for different land uses of the state of Goa are enlisted below:

General Soil and Water Conservation Measures

- Construct staggered trench-and-bund systems; plant pasture grasses and legumes on the bunds.

- Create percolation pits according to the slope and runoff intensity.

Measures for Sloped Lands

- Build contour bunds or contour trench-and-bund systems to manage runoff and erosion.
- Grow pasture grasses and legumes on bunds to stabilize them and provide feed for dairy animals.
- Staggered contour trenches with vegetative barriers

Measures for Agricultural Lands

- Implement grassed waterways and stone bunds with vegetative barriers.
- Use contour bunding with stone pitching downstream, including an outlet or field bund-and-trench systems with an outlet.

These measures are tailored to enhance soil and water conservation across various land uses and topographies in Goa.

ii. Crops and Farming Systems

Rice

Status

In the 2022-2023 season, rice cultivation in Goa covered a total area of 31,519 hectares, with 22,569 hectares in the Kharif season and 8,950 hectares in the Rabi season. The state produced 88,400 tonnes of rice, with 62,956 tonnes from *kharif* and 25,444 tonnes from *rabi*. The productivity was recorded at 2.79 t/ha for *kharif* and 2,843 kg/ha for *rabi,* resulting in an overall average productivity of 2.80 t/ha, which is close to the national average of 2.72 t/ha. This performance, while commendable, highlights the potential for further improvement.

Constraints

Paddy production in Goa faces several constraints, including small and fragmented land holdings that hinder large-scale mechanization and efficient farm management. Increasing urbanization and alternative employment opportunities result in a labour shortage, driving up labour costs. Inconsistent rainfall patterns affect water availability and crop yields, while soil salinity in coastal regions negatively impacts paddy growth. Farmers often rely on traditional practices, with poor availability and access to high-quality seeds and insufficient knowledge and resources for effective pest and disease management, leading to significant crop losses.

Way Forward

To enhance pulse production in Goa, strategies include expanding pulse cultivation on paddy fallow lands specially for cowpea, green gram, and groundnut cultivation. Promoting the use of soil moisture residue for pulses in areas unsuitable for second rabi crops will be encouraged. Adoption of high-yielding pulse varieties aims to boost productivity, while branding and promoting the local Goa Cowpea-3 variety for its bold, brown colour, nutritional qualities, and local appeal will further support these efforts.

Millets

Status

Cultivation of millets in the state of Goa is currently minimal (less than 100 ha), resulting in insignificant overall production. Among millets, only ragi (finger millet) is cultivated during the *rabi* season. Additionally, there have been initial initiatives to cultivate ragi in the interspaces of crops such as cashew during *kharif* (upland conditions) during the early stages of orchard development.

Constraints

Several constraints limit the expansion and production of millets, including small and marginal land holdings, labour shortages, competition from crops like rice with assured minimum support prices, and limited awareness among farmers.

Way Forward

Promoting millet-based agroforestry systems in Goa, especially in the interspaces of crops like cashew, coconut, etc., presents a promising and innovative approach to boost expansion and production of millets for grain and fodder purposes. Adopting millet-based agroforestry systems in coastal regions not only would enhance farmers' income and nutritional security but also will address environmental challenges, contributing to sustainable development goals. Given the nutritional value of millets and the minimal use of chemical fertilizers by farmers, there is huge potential for the production and marketing of organically produced millets. Additionally, adding value-addition and processing of millets can further supplement farmers' incomes and build entrepreneurship.

Way Forward

- Adoption and cultivation high-yielding paddy varieties to enhance overall productivity in different ecologies e.g. Goa Dhan 1, Goa Dhan 2, Goa Dhan 3, Goa Dhan 4, Sahbhagi Dhan, etc.
- Increasing the Seed Replacement Ratio (SRR) of existing popular and improved varieties to ensure the use of superior seeds for better crop yields.
- Development and promotion of the production of certified HYV seeds to ensure quality and availability.
- To maximize income and enhance the economic viability of rice cultivation in this region, the development of a value chain and processing of the rice through establishment of rice mills and value addition should be initiated. This strategic move will not only improve the marketability of rice but also create job opportunities, reduce post-harvest losses, and increase the overall income for farmers. By investing in modern rice milling facilities, the region can capitalize on its agricultural productivity, ensuring a more sustainable and profitable future for the local farming community.

Pulses

Status

In the 2022-2023 agricultural year, the state of Goa reported a total area of 3,600 hectares under pulses (mainly cowpea) cultivation during the *rabi* season. This effort resulted in a production of 3,188 tonnes, achieving a productivity rate of 886 kg/ha against a national productivity of 902 kg/ha.

Constraints

Constraints contributing to poor production and productivity of pulses in Goa include limited availability of high-yielding pulse crop varieties and inadequate irrigation facilities hindering pulse production during the rabi season.

Horticulture

a. Plantation crops

Status

The status of crop production in Goa shows significant variation across different sectors. Cashewnut is cultivated on 56,934 hectares, yielding 25,800 tonnes with a productivity of 453 kg/ha, which is below the national average of 684 kg/ha. Coconut occupies 26,683 hectares, producing 163 million nuts with a productivity of 6,113 nuts/ha, also below the national average of 9,430 nuts/ha. Arecanut is grown on 2,081 hectares, yielding 3,963 tonnes with a productivity of 1.9 t/ha, surpassing the national average of 1.8 t/ha. (Source: DoSP, 2020-21).

Constraints

Constraints affecting crop productivity in Goa include several factors for each major crop are given below:

- **Cashew:** Senile orchards, poor nutrient and insect-pest management, inadequate irrigation facilities, and climatic aberrations are significant setbacks for cashew productivity.
- **Coconut:** Senile orchards, poor nutrient and insect-pest management, insufficient irrigation facilities, lack of harvesters and advanced technologies for harvesting, and challenges in crown management constrain coconut productivity.
- **Arecanut:** Nutrient deficiencies and disease management are key constraints impacting arecanut production in Goa.

Poor availability of the quality planting material of the improved varieties contributes to poor productivity of these crops.

Way Forward

- **Cashew:** To boost cashew production and productivity, it is essential to replace old and unproductive plantations with High Yielding Varieties (HYV) in staggered manner to balance income and expenditure. Implementing Integrated Nutrient Management (INM) and Integrated

Pest Management (IPM) will improve nutrient management and pest control, with a specific focus on managing the cashew stem and root borer. Additionally, leveraging the brand and Geographical Indication (GI) of Goan cashew can significantly enhance the promotion, marketing, and value addition of cashew cultivation.

- **Coconut:** To boost coconut productivity, a way forward includes to replace old and unproductive plantations with dwarf HYV in staggered manner, Implementing INM and IPM, and implementing intercropping management practices with forage, spices, fruits, and floriculture. To boost coconut productivity, the introduction of improved harvesting technologies, establishing harvesting squads, and develop entrepreneurship services to provide or outsource efficient and timely coconut harvesting could be promising.
- **Arecanut:** Introduction of dwarf arecanut varieties and enhancing disease management are essential to boost productivity. Additionally, promoting suitable mechanization for all agricultural activities, from farm tilling to arecanut peeling, is crucial.

In general, enhancing the availability of high-quality planting materials for plantation crops can greatly boost productivity.





b. Fruit Crops

Status

Major fruit crops in Goa include mango and banana, alongside other fruits such as sapota, papaya, jackfruit, lemon, and more. Mango cultivation spans 5,071 hectares, yielding 10,188 tonnes with a productivity of just 2.01 t/ha, compared to the national average of 8.84 t/ha. Banana occupies 2,480 hectares, producing 29,267 tonnes at a productivity of 11.80 t/ha, much below the national average of 36.52 t/ha. Pineapple, cultivated on 334 hectares, yields 5,533 tonnes with a productivity of 16.56 t/ha, at par with the national average of 16.51 t/ha.

Constraints

The fruit production in the State of Goa faces several constraints. Limited availability of the quality planting materials of the fruit crops also causes poor productivity. Most fruit crops are highly sensitive to climatic variations such as extreme heat, irregular rainfall patterns, and humidity levels, which can adversely affect flowering, fruit set, and overall yield. Additionally, limited irrigation facilities restrict consistent water supply, essential for optimal growth and fruit development, particularly during dry periods. Soil nutrient management necessitates careful attention to fertilization and soil health practices to maintain crop vigor and fruit quality. Moreover, inadequate post-harvest infrastructure and practices contribute to significant losses, reducing the quantity and quality of fruit crops like mangoes and bananas available for market distribution.

Way Forward

Ensuring the availability of high-quality planting materials for fruit crops can greatly enhance productivity and expand cultivation areas. Establishing new orchards with improved local varieties of mangoes and initiating value addition through processing, particularly in preserving mango pulp of local varieties like Mankurad, can significantly enhance income and the mango value chain. Similarly, promoting value addition and processing initiatives for jackfruit and other minor fruit crops such as kokum will further diversify product offerings and increase economic opportunities in

Goa's fruit sector. Implementing climate-resilient farming practices tailored to mitigate climate variability's impact on mango and banana crops, alongside robust integrated pest and disease management strategies, will be critical. Enhancing irrigation infrastructure to ensure reliable water supply during post-monsoon season is crucial for consistent fruit development. Promoting soil health management through balanced fertilization and organic practices will improve nutrient availability and crop resilience.



c. Vegetable Crops

Status

Vegetables are cultivated generally on hill slopes during monsoon and coastal sandy soils during *rabi* season starting from November to March. Although local varieties of vegetables are cultivated in Goa, improved varieties and hybrids are not adopted at a commercial scale in farmers' field. In Goa, vegetable production spans 8,374 hectares, yielding 97,817 tonnes with a productivity of 9.95 t/ha (Dept of Agriculture, Govt of Goa, 2022-23). This productivity figure is far lower than the national average of 18.05 t/ha. Majority of the vegetables are imported from the neighbouring states. Local vegetables are highly preferred by consumers for their specific quality traits and taste, despite their lower yield levels.

Constraints

The limited and poor availability of quality seeds of improved varieties of vegetable crops, along with inadequate irrigation water and facilities during the post-monsoon season, restricts crop productivity. In the light of tropical humid climate, the incidence of pest and diseases hinders the vegetable production and productivity in the state.

Way Forward

Alongside cultivating local vegetables to meet consumer preferences, adopting new varieties supported by advanced production and protection technologies is crucial to enhance vegetable production and productivity in Goa. Additionally, utilizing rice fallow lands for vegetable cultivation can optimize land use and contribute to increased agricultural output by ensuring need-based irrigation through rainwater harvesting at farm level. Ensuring availability of the quality seed of the vegetables is also key to boost productivity.

d. Spices

Status

The important spice crops of the Goa are black pepper, turmeric, nutmeg & tree spices. In Goa, black pepper is cultivated on 861 ha, yielding 418 tonnes with a productivity rate of 485 kg/ha. This productivity exceeds the national average of 340 kg/ha, highlighting Goa's potential in black pepper cultivation despite its relatively being grown at small scale. The other important spice crops are kokum and tree spices which cover an area of 91 & 266 ha, respectively (Dept. of Agriculture, Govt. of Goa, 2022-23).

Constraints

The production of spice crops faces several constraints in Goa. These include the limited availability of high-quality seeds for improved varieties, which hinders the adoption of more productive crop strains. Additionally, spice crops like black pepper are vulnerable to frequent insect and pest infestations, particularly diseases that can significantly impact yield and quality. Furthermore, there is a lack of adequate infrastructure and technologies for processing and adding value to spice crops, which limits their market potential and overall economic viability.

Way Forward

Enhancing availability of high-quality seeds and planting materials of spice crops and management strategies are essential to increase productivity and quality. Investing in processing infrastructure and value addition will unlock market potential and improve economic returns for spice growers in Goa.



Quality Seed and Planting Material

To enhance agricultural productivity & sustainability in Goa, it is essential to ensure the availability of high-quality seeds and planting materials of both improved & local varieties. The following approaches & recommendations are proposed to achieve this goal:

1 **Establishment of Seed Villages:** Develop seed villages where farmers can collaboratively produce, process, and distribute high-quality seeds of field and vegetable crops. This initiative will ensure a steady supply of locally adapted seeds and reduce dependency on external sources.

2 **Creation of Nurseries for Quality Planting Material:** Set up nurseries dedicated to producing superior and certified quality planting materials of important crops. These nurseries should focus on propagating a variety of plants, including fruit trees, multipurpose trees, fodder, vegetables, spices, etc. tailored to the local agro-climatic conditions.

3 **Formation of a State Seed Certification Body:** Establish a seed certification body for Goa to ensure that all seeds and planting materials meet the required quality standards. This body will oversee the certification process, ensuring the availability of certified, high-quality seeds to farmers.

4 **Promotion of Farmer Participatory Seed Production:** Encourage large-scale farmer participatory seed production programs. By involving farmers in the seed production process, the quality and adaptability of seeds can be improved, leading to increased agricultural productivity.

5 **Development of a Seed Chain:** Create a comprehensive seed chain to ensure that quality seeds are accessible to all farmers. This seed chain should encompass all stages from production to distribution, ensuring timely availability and widespread reach.

Implementing these recommendations will significantly improve the availability and quality of seeds and planting materials in Goa, fostering a more resilient and productive agricultural sector.

e. Integrated farming systems

Status

Monocropping rice prevalent in lowland areas of Goa, is often vulnerable to risks and less remunerative. To address this issue, diversifying the current crop and cropping pattern with new farm enterprises suited to the region is essential. Interventions aimed at enhancing productivity, profitability, and farmers' livelihoods should be implemented, with a focus on soil health and employment generation.

Constraints

The successful implementation of Integrated Farming Systems (IFS) in Goa faces several challenges. The majority of farmers in the state are small and marginal landholders with limited resources, making it difficult for them to adopt and sustain diversified farming practices. These resource-poor farmers require consistent, year-round income to ensure their livelihoods, which traditional farming systems often fail to provide. However, the significant market demand for agricultural produce in Goa presents a valuable opportunity. By promoting local crops and vegetables as part of the IFS, there is potential to boost farmers' incomes and improve their economic resilience. Addressing these constraints is essential for the widespread adoption and success of IFS in Goa.

Way Forward

To enhance agricultural productivity and farmer income in Goa, various IFS models have been developed and tailored to the region's unique conditions:

1. Rice-Based Lowland Integrated Farming System for the West Coast Region of India
2. Plantation Crop-Based Upland Integrated Farming System for the West Coast Region of India
3. Livestock-Fish-Horticulture-Based Integrated Farming System for Improving Farmer Livelihoods
4. Homestead Farming Models Suited for Varied Homestead Areas

These IFS models have proven to be energy-efficient and have been successfully demonstrated across 60 hectares at 35 locations in Goa. The results are promising, with a net income of ₹1.45 lakh per year generated from a 0.5 hectare area and the creation of 325 man-days of employment. Adoption of these IFS models has led to a 53% increase in production, a 58% rise in profitability, a 42% boost in employment, and a 31.2% reduction in production costs compared to the traditional rice-fallow system.

Further improvements in the yield and income of Kulaghar farmers can be achieved through scientific resource assessment and the implementation of need-based enterprises, which will significantly enhance productivity. To ensure widespread adoption and success, policies aimed at popularizing and disseminating the IFS approach across Goa are essential.

f. Kulagar : A traditional integrated farming system of Goa

Status

Farmers in the state of Goa, have inherited a traditional homestead gardening system known as '*Kulagar*'. This system involves multi-storey cultivation of crops such as Arecanut and coconut, along with medicinal plants, plantation crops, spices, local vegetables, and flowers. These plants are meticulously integrated to conserve the natural flora and fauna, soil, and water resources. The *kulagar* system helps to preserve traditional crops and farming technologies. Modern farmers are now incorporating advanced production techniques, expanding the system to include value addition and processing, agro-eco-tourism, and on-farm conservation of genetic resources. Key features of the *kulagar* system include crop diversification, resource recycling, organic production, water harvesting, and soil and water conservation, making it a unique and sustainable horticultural practice. The area under*kulagar* in Goa is around 45 sq. km (unpublished data).

Constraints

The *kulagar* system in the Konkan region, particularly in Goa, faces several constraints despite its sustainable and integrated approach to farming. Farmers often lack adequate knowledge and training on advanced agricultural techniques, limiting the system's potential. The availability of essential inputs is another significant challenge. Market access issues persist, making it difficult for farmers to sell their diverse produce at profitable prices. Infrastructure bottlenecks, including inadequate storage, processing, and transportation facilities, further hinder the system's efficiency. Economic challenges also arise from the high initial investment and maintenance costs, which can be prohibitive for small-scale farmers. Environmental factors, such as changing climate patterns, adversely affect crop productivity. Wild animal invasions due to its rich biodiversity and the proximity to the Western Ghats is another potent challenge. Lastly, insufficient policy support and government subsidies restrict the growth and expansion of the *kulagar* system.

Way Forward

Increasing awareness and training programs for farmers on advanced agricultural techniques can significantly improve productivity and efficiency. Implementing modern irrigation methods and efficient water management practices can address the water scarcity issues faced by *kulagar* plantations. Strengthening market linkages and establishing cooperative societies can help farmers to get better prices for their produce, thereby improving their income. Additionally, incorporating value addition and processing of farm produce can enhance profitability and create new income streams. Promoting agro-eco-tourism and on-farm conservation of genetic resources can further diversify the economic benefits of the *kulagar* system. Policy support and subsidies from the government are crucial to encourage the adoption of sustainable practices and ensure the long-term viability of *kulagar* farming. Finally, fostering community farming initiatives can help share resources, knowledge, and infrastructure, creating a robust support system for farmers practicing the *kulagar* system.



Padma Shri Sanjay Anant Patil

g. Agroforestry

Status

According to the Forest Survey of India report, 2013, Goa has a 280 sq. km area under agroforestry, which constitutes 7.56% of its geographical area. The major agroforestry systems in Goa include several plantation-based and integrated approaches such as coconut-based agroforestry, arecanut- based agroforestry, *kulagar* (traditional arecanut based mixed intercropping system), cashew-based agroforestry and home gardens. These agroforestry systems are crucial for the sustainable development of Goa's agricultural sector, providing a blend of economic viability and environmental conservation.

Constraints

- Lack of Awareness: Many farmers are unaware of the benefits and proper management practices of agroforestry systems.
- There is a shortage of high-quality planting material for tree species.
- Market for Intangible Goods: There is no established market for the intangible benefits provided by agroforestry systems.

Way Forward

According to the NITI Aayog (2024) Greening and Restoration of Wastelands with Agroforestry (G.R.O.W) report, Goa's agroforestry suitability encompasses a total area of 463 sq. km, that is 8.87% of Goa's total geographical area equating to 309.60 sq. km, is classified as "highly" suitable for agroforestry. Additionally, 4.4% of the area, corresponding to 153.64 sq. km, is categorized as "moderately" suitable. North Goa has the highest suitable area, with 178.04 sq. km, while South Goa has 131.55 sq. km suitable for agroforestry. Notably, South Goa contains a substantial portion of land, 82.10 sq. km, under the "moderate" suitability category, compared to 71.54 sq. km in North Goa.

To address agroforestry constraints in Goa, it is essential to implement awareness programs to educate farmers and provide technical and financial support (tree loans and tree insurances) tailored to agroforestry needs. Ensuring the availability of quality planting material, market development for farm-grown wood produce, and creating markets for intangible benefits like carbon credits are also needed. Collaboration between government, research institutions, NGOs, and farmers will enhance resource sharing and knowledge dissemination, fostering a supportive ecosystem for successful agroforestry practices.

h. Organic and natural farming

Status

Organic and natural farming in Goa is gradually gaining traction, with numerous farmers adopting these sustainable practices. Several farmers have transitioned from conventional farming methods to organic and natural farming, highlighting the environmental benefits and improved crop quality. Various initiatives by the government and NGOs have been instrumental in promoting organic practices. The presence of model organic farms and the implementation of organic farming packages for major cropping systems further support this growth.

Constraints

- Limited availability of organic inputs such as seeds and bio-fertilizers
- Lack of adequate market linkages for organic produce
- Insufficient infrastructure for processing and storage of organic produce
- Reduced yield compared to conventional farming
- Economic feasibility issues due to higher costs and lower output
- Limited awareness and training for farmers on organic farming practices

Way Forward

- Strengthen the supply chain for organic inputs and enhance market access for organic produce
- Develop better infrastructure for processing and storage to maintain the quality of organic produce

- Implement more robust certification systems to boost the credibility and marketability of organic products
- Increase investment in research and development to improve organic farming techniques and productivity
- Provide comprehensive training programs for farmers to adopt best practices in organic farming
- Create financial incentives and subsidies to support organic farmers and bridge the economic gap between organic and conventional farming



iii. Agro-eco-tourism



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Status

Goa is often referred to as the ***"Pearl of the Orient"*** and the Beach Capital of India. Its natural beauty, unique heritage and a delectable mix of cultures, along with friendly and hospitable people, make it perhaps the most attractive tourist destination in India. Tourism is the backbone of the Goa's economy, with 40 % of the population directly or indirectly dependent on it. The sector has shown strong growth with total tourist arrivals increasing from 2.3 million in 2005 to 7.2 million in 2022, an annual growth of nearly 11%. Goa falls into three distinct categories in terms of topography, the western ghats, the midlands and the coastal region. However, the coastal region, even though it occupies a very small portion of the total geographical spread of the state, has been the most popular tourist destination, especially for those coming from abroad. As a result, the entire concentration of touristic activities has mainly been confined along beaches. To outspread the benefits of tourism growth to a large section of the people living in interior and hinterland areas of Goa, a perceived paradigm shift from "onshore tourism to 'offshore tourism" would be the key turning point. Nestled in the biodiversity hotspot region of Western Ghats, Goa offers tourists the opportunity to experience this region's diverse agro-ecosystems. The concept of Agro-eco-tourism (AET) will help the state of Goa in creating its own model of barefoot luxury and hip hideaways by exploiting its rich biodiversity, well-endowed agricultural traditions and rich cultural heritage. Currently, more than 22 Agroecotourism units popular as 'Spice farms' are operational in the state of Goa.

Constraints

- The absence of clear policies and regulations supporting agro-eco-tourism can hinder its growth.
- Limited financial incentives and support from the government for farmers and entrepreneurs to invest in agro-eco-tourism.
- Need for better customer service skills and professionalism among those involved in agro-eco-tourism.
- Navigating complex land use regulations and obtaining necessary permits and licenses.
- Ensuring compliance with safety standards and regulations to protect tourists.

Way Forward

The Government of Goa formulated the “Goa Tourism Policy 2020” to harness the full potential of its tourism sector and to address existing challenges in a systematic manner. With the growth of the tourism industry, day by day, tourism product offerings have also evolved and new arenas have emerged in the tourism industry to fulfil the ever-increasing requirements, demands and the thirst of 'Offshore' and hinterland-seeking tourists. With the increasing trend in Agro-ecotourism centres, farm stays and spice gardens in Goa and their potential for transforming the agriculture and tourism economy, it's imperative to have a comprehensive policy for the promotion and regulation of Agro-ecotourism in the state of Goa.

Plastic management

The state of Goa is known for its globally known tourist hotspots such as beaches, heritage sites, biodiversity paradises such as coastal ecosystems and the Western Ghats. The state has been a favourite spot for the domestic and international tourists since the last century. The state attracts about 7 million tourists every year, which is 4.5 times of the residing population size of 1.6 million. However, this enormous anthropogenic pressure releases around 8 metric tonnes of plastic every year, which ultimately reaches the oceans and coastal waters creating an ecological hazard. The per capita plastic waste generated in the state is 8 times higher than the national average of 61.2 g/day. This scenario demands a paradigm shift in the management of plastic waste in the state & strengthening the current management framework.

Way Forward

There are several measures to control the use and dumping of plastic such as establishing plastic waste collection centres, ban on single use-plastic, encouraging people participation in reducing the use of plastic and collection of plastic waste and also amendments in the plastic waste management by-laws. However, there is an urgent need to strengthen the existing plastic waste management system. The strategy can be developing a robust solid waste management system including innovative initiatives, stringent regulations, community engagement and waste to wealth programs. This will lead to a more sustainable and plastic-free state, setting a role model in the solid waste management.

iv. Water

Status

The state of Goa receives abundant rainfall with an annual average of 3,400 mm, but the availability of the rainwater is limited during the post-monsoon period. The poor water availability and soil moisture stress often leads to poor crop and agricultural productivity. Thus, harvesting and storing the rain water is pivotal and a prime necessity. The gravelly nature and poor water holding capacity of laterite soils leads limits the water conservation. Further the nature of the soil causes wear and tear of lining material resulting in reduced durability of water harvesting ponds. There is a need to standardize the methodology for establishing water harvesting ponds with low-cost interventions and increase their durability.

Constraints

- Unavailability of water for irrigation during post-monsoon season
- Lack of water harvesting structures for efficient storage of excess rainwater
- Poor groundwater storage due to steep gradient

Way Forward

To enhance water availability and productivity in Goa, a multifaceted approach should be adopted. Creating awareness among farmers about water conservation, storage and judicious utilization. Site specific soil and water conservation measures need to be implemented to reduce runoff and retain soil moisture. The rainwater harvesting structures (small, medium, and large systems) standardized by ICAR-CCARI can be established through a farmer-participatory approach at farm level/household level. Application of efficient irrigation management practices, coupled with sensor-based irrigation scheduling, will reduce operational costs and increase the crop and water productivity. Additionally, rejuvenating traditional rainwater harvesting structures and integrating with modern irrigation methods will preserve cultural heritage while improving water resources. This comprehensive strategy will foster sustainable water management and agricultural productivity in the state.

3. Livestock

Introduction

The livestock sector is of vital importance in generating additional employment opportunities and supplementing the incomes of small and marginal farmers of the country. Livestock resources are diverse and plenty in number in coastal regions of the country. Goa is located in South-Western India in the coastal region, also known as Konkan. It lies on the slopes of the Western Ghats, blessed with a unique climate of 18-35°C, and 2500-4000 mm annual rainfall with high humidity, it is a biodiversity hot spot and best suited for integrated farming systems including livestock and poultry as a prominent component. The livestock and poultry population (Table 3 and Fig 3) of Goa as per the 20th Livestock Census, 2019 is as detailed below:

Table 3. Livestock and poultry status of Goa

Livestock Census	1987-88#	2019	% increase over the initial year
Total livestock	3,16,193	1,32,406	-58.1
Cattle	1,12,016	60,247	-46.2
Buffalo	40,812	27,207	-33.3
Pigs	85,955	35,480	-58.7
Poultry	6,08,135	3,47,765	-42.8

#at the time of attaining statehood

Table 4. Livestock product status in Goa

Livestock Product	1987-88#	2020-21	Times increased over 1987-88
Milk (t)	25,000	60,139	2.4
Eggs (million nos.)	8.0	37.48	4.7
Meat (t)	2,000**	6060	3.0
Fish (t)	28,640	1,11,484	3.9

**indicates the data for 2006-07; #at the time of attaining statehood

Table 5. Comparison of per capita availability of livestock products

Livestock Products	Goa (per capita)	National Average (per capita)	% Deviation
Milk (g/day)	106	427	-75.2
Eggs (no./year)	26	90	-71.1
Meat (kg/Year)	3.91	6.52	-40.0
Fish (kg/Year)	16	9.0	77.8

The demand for quality livestock products will be increasing in the coastal regions as the purchasing power of the coastal population is on the upswing with the growing economy & continually increasing population of the middle class (Table 4 and 5). However, there is a huge deficit in production of the livestock products like milk, meat and eggs and the state depends on the neighbouring states for its daily demand of livestock products.

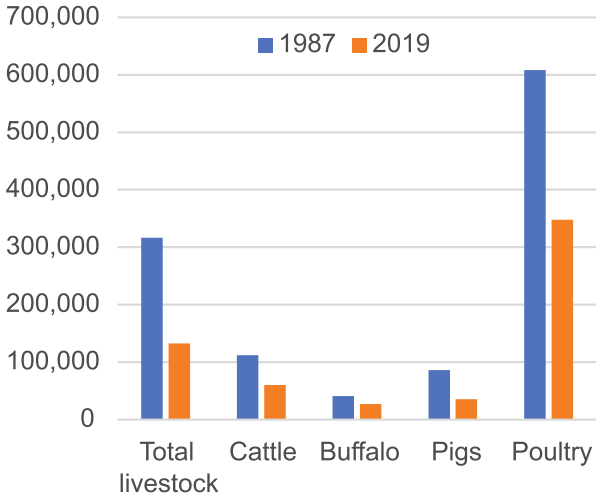


Fig. 3. Trend in Goa Livestock Population

Source: Dept. of Animal Husbandry and Veterinary Services, Govt. of Goa, 2022

Status

a. Dairy

As per the latest livestock census, more than 10,000 households are engaged in livestock rearing in the state of Goa. The total demand for milk in the State is around 3.25 lakh litres per day (Dept. of Animal Husbandry and Veterinary Services (DAHVS), Govt. of Goa, 2022), while the estimated production is 1.5 lakh litres per day. Accordingly, there is a shortage of 1.75 lakh litres per day, which is met by importing from neighbouring states. The state does not recognize breeds of cattle or have an organized cattle market. Nearly, 70% of available cattle are local and non-descript breeds. Goa Dairy is a cooperative federal body of dairy societies, with a processing capacity of 1.10 lakh litres/day. Goa is the breeding tract for the Sweta Kapila breed of cattle which was recognised by the ICAR-National Bureau of Animal Genetics Resources, Karnal as a registered breed. It is a completely white-coloured cattle found in the state of Goa. Daily milk yield ranges from 1.8 to 3.4 kg with an average of 2.8 kg and lactation milk yield varies from 250 to 650 kg. Height ranges from 97 to 137 cm. The population size is estimated approximately at 22,000.Goa has a large milk deficit, yet has considerable potential to meet the required demand through organized milk production and value chain systems in many rural and peri-urban regions.

Buffaloes reared in the region, although potentially excellent for both milk and meat production, still suffer in obscure conditions of poor nutrition, breeding, management and welfare. There is an urgent need to identify and resolve biological, social and economic constraints to the development, adoption and productivity of sustainable smallholder dairy systems involving buffaloes. Buffalo dairying in the region is predominantly unorganized. Buffalo is an important component of the mixed crop-livestock smallholder farming systems in the coastal regions as other than milk, it provides employment, sustainable income and social security. Besides 11 centrally sponsored schemes, the Govt. of Goa is offering the below-mentioned schemes to the dairy farmers of Goa.

- Kamdhenu Scheme (Sudharit) Amended 2021 & its Infrastructure Components
- Revised Scheme for Incentives to Milk Producers
- Pashupalan Scheme (Amended) Modified
- Scheme for incentive to Green Fodder Cultivation for Perennial and Seasonal
- Fodder Development in the State (Amended) 2017-18
- Dairy Equipment Scheme (Amended) Modified
- Dairy Kits Scheme (Scheme for SC/ST Families)
- Revised Modern dairy Scheme and Purchase of dairy Farm Equipments
- Community Dairy Farming Scheme (Amended 2021)
- Purchase of Milch Animals
- Renovation of Cattle Shed
- Gopal Ratna Award Scheme
- The Goa Stray Cattle Management Scheme 2013 (Modified)
- Interest Subsidy on Loans for Agriculture & Allied Activities

b. Piggery and Goat

The traditions and culture influence meat consumption to a great extent in India. The state of Goa on the west coast of India is a former Portuguese colony with a unique westernized culture where pig farming is common in rural areas. Goan population prefers meat in daily food, of which fresh/frozen pork and ethnic Goan pork sausages contribute a major portion. Goan pork sausages are prestigious and highly valued meat products among the Goan population. The demand for these sausages is tremendous,

especially among expatriate Goans living abroad and seafarers. Goan pork sausages are widely available in local markets and retail stores across Goa and a considerable proportion of the population still to the date traditionally make them at the household level. Until recent times there was no availability of branded or packed Goan pork sausages except at very few niche markets. In Goa, majorly the women are actively engaged in handling, preparation, storage and marketing of the Goan pork sausage for their livelihood. These sausages are gaining popularity during social and cultural events, festivals and tourism activities. Therefore, these ethnic meat products have a great socio-economic and entrepreneurial prospect in this region. The pig-rearing units could be seen only in Ponda and Bardez taluks as traditional household activities.

Goat rearing is taken up mainly by landless agricultural labourers, both as a primary and supplementary activity. Recently, goat farming emerged as an enterprise for alternative red meat production to meet the demand for a protein diet in Goa. The ICAR-CCARI introduced promising goat breeds (Konkan Kanyal, Malabari and Black Bengal) suitable for the Goa conditions. The Govt. of Goa is offering Varahpalan Scheme and Goatery Scheme to promote pig and goat production in the state of Goa.

c. Poultry

Poultry activity, especially Layer and Broiler rearing, provides subsidiary income and gainful employment to farmers throughout the year. A total of 6,805 households are involved in backyard poultry in Goa (DAHVS, Govt. of Goa, 2022) and Goa produces approximately only 30% of its requirement of poultry eggs and meat and is solely dependent upon the neighbouring states for the additional demand for chicken meat and the eggs. Poultry farming is a supplementary source of income for rural households and farmers, especially women. The per capita poultry consumption in Goa is estimated at about 80 eggs and 3 kg of meat as against the national average of 55 eggs and 2.2 kg of meat (DAHVS, Govt. of Goa, 2022). This may be mainly due to a large number of tourist inflow. The demand for poultry products is 150,000 broilers per week, and local supply is just one-third of the demand. There are a total of nine commercial poultry farms in Goa.

Though commercial poultry development in the country has taken a quantum leap in the last three decades, the growth has not penetrated the state of Goa due to the unfavourable climatic conditions and the terrain for commercial poultry. Therefore, the rural backyard poultry has been the most suitable

alternative protein source for the Goan population. Even for feeding the poultry birds , feeds and feed ingredients are being imported from the neighbouring states of Karnataka and Maharashtra. There is a huge demand for poultry eggs and meat in Goa (DAHVS, Govt. of Goa, 2022).

Besides other centrally sponsored schemes, the Govt. of Goa is offering the below-mentioned schemes to the poultry farmers of Goa.

- Financial Assistance for Rearing Broilers, Layers & Low Input Technology Poultry Birds (2018).
- Financial Assistance for Infrastructure of Poultry Farm (2018).
- Subsidy for Transportation of Ready Poultry Feed from Outside Goa
- Establishments of Backyard Poultry Unit (For SC/ST).
- Gramshakti – Supply of Low Input Technology Poultry Birds to Rural Farmers (2018).

Veterinary Service Delivery in the state of Goa

The state of Goa has a notable Veterinary Health Cover provided through a network of Veterinary Hospitals, Dispensaries and Sub-Centres. The services are available at the following institutions.

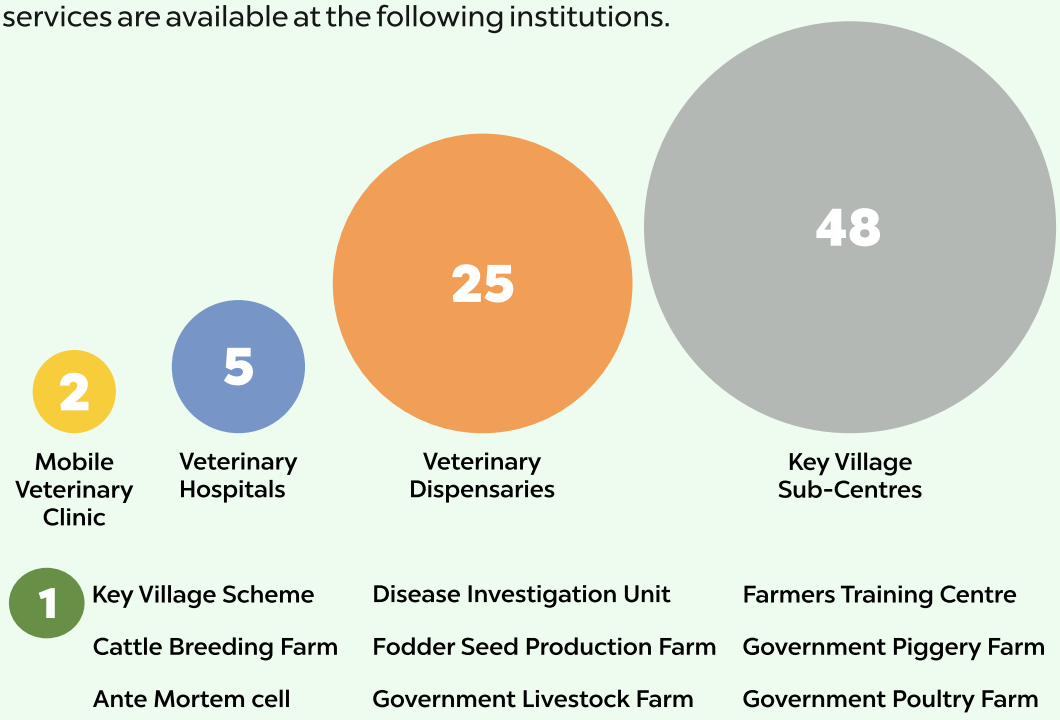


Fig. 4. Veterinary service institutions of Goa

Source: Dept of Animal Husbandry and Veterinary Services, Govt. of Goa, 2022

Constraints

There are some serious challenges too which impede the growth of the livestock and poultry sectors in the state of Goa. Livestock in this state are more susceptible to stress due to climate change. Shrinking of pasture land, lack of availability of good quality fodder and increase in the cost of concentrate feed are equally important hurdles, obstructing the progress of dairy enterprises in the state of Goa. Some of the local germplasm is on the decline due to the lack of scientific conservation practices which need immediate attention. Only a few farmers in the state adopt scientific feeding practices. The high population of underfed, mismanaged and stray animals also result in low average yield of the animal. Some of the other challenges affecting the livestock and poultry sectors in the region include:

- High rate of urbanization, unplanned urbanization, shrinking landmass
- Due to high human population density and influx of floating tourists, there is more threat from the outbreaks of zoonotic diseases
- Recurrence of infectious diseases in farm animals.
- Reduced access to quality veterinary services and artificial insemination in rural areas limits opportunities for enhanced animal performance.
- The coastal region especially the east coast of the country is more prone to the natural disasters like cyclones, tsunamis, sea rise etc.
- Migration of farmers to other occupations and enterprises for better income alternatives/opportunities. The high interest rate on finance affects the viability of dairy farming.
- High cost of poultry feed followed by high labour cost hindering the poultry industry.
- Lack of motivation to the youth in non-tourism-related enterprises especially agriculture and animal husbandry activities.

Way Forward

There is, indeed, a huge scope for dairy farming and allied activities in the state of Goa. With demand for milk and milk products increasing at a faster rate, coordinated efforts involving state government

departments and dairy cooperatives are required to enhance the overall productivity of the sector. It is also important to timely address the major challenges and bottlenecks hindering the growth of the sector.

Analysis of current farming systems and the assessment of resource levels in the state of Goa indicate a greater scope for dairy and allied farming enterprises in the future. Further, increasing the milk production for the majority of households and overall improvement in dairy farming can be attained through addressing problems of fodder scarcity and feed price, adoption of cost-effective and viable technological interventions and climate resilient dairy farming, other scientific rearing practices, and making full use of veterinary services coupled with seizing of available financial incentives and subsidy opportunities.



4. Fodder

Introduction

Goa faces a severe shortage of green fodder. According to a report, the annual demand for concentrate, green fodder, and dry roughages is approximately 1.23, 10.08, and 1.67 lakh tons, respectively. The supply deficit is most pronounced in concentrates at 93%, followed by 49% in green fodder and 50% in dry roughages (ICAR-IGFRI, 2020). Limited land availability and small land holding: Fragmented land reduces the scope for large-scale fodder cultivation, making it challenging for farmers to allocate sufficient area solely for fodder. Existing agricultural practices only provide about 40% of the green and dry fodder needed by the dairy industry. ICAR-CCARI has identified and recommended Hybrid napier (CO-5, DHN-6), Guinea grass (DGG1, Grazing guinea), Perennial sorghum (COFS-29), tree fodders (*Morus alba, Moringa oleifera, Leucaena leucocephala, Calliandra, Sesbania sp.*) as suitable fodder crops for the state of Goa.

Constraints

- Shortage of water for irrigation in the post monsoon season: With water resources dwindling after the monsoon, sustaining fodder crops becomes difficult, impacting livestock feed availability.
- Farmers often lack access to quality seeds and planting materials, hampering the establishment of high-yielding fodder crops.
- Lack of information, knowledge, and awareness of fodder cultivation and conservation: Many farmers are unaware of modern practices for growing and preserving fodder, leading to inefficiencies and lower productivity.
- Scarcity of Labour: Fodder cultivation and harvesting are labour-intensive, and the shortage of workers, especially during peak agricultural seasons, can hinder timely operations and reduce overall output.



Fodder resources development plan for the state of Goa

A fodder resources development plan for the state of Goa has been formulated by the ICAR-Indian Grassland and Fodder Research Institute, Jhansi (UP) with the following recommendations.

No.	Fodder Resources	Proposed development plan
1.	Cultivated Fodder Resources	Currently, fodder cultivation occupies less than 1000 hectares, providing under 10% of the state's needs. It is recommended to increase this to 5% of the total cultivated area. Promote the cultivation of high-yielding and drought-resistant fodder varieties to ensure a consistent and adequate supply of green fodder
2.	Fodder Production through Horti and Silvi-Pasture Systems	Horticulture crops cover 60.5% of Goa's total cropped area, with cashew (55,672 ha) and coconut (25,608 ha) being the major crops. Due to limited land availability, it's essential to identify fodder crops for large-scale cultivation within existing horticulture and silviculture areas. Integrate fodder crops with horticultural and silvi-pasture systems to maximize land use efficiency and diversify fodder sources.
3.	Fodder Production from Permanent Pasture/Grazing Lands	Implement sustainable management practices to enhance the productivity and carrying capacity of permanent pastures and grazing lands.
4.	Fodder on Non-Competitive Lands	Utilize non-arable and marginal lands for fodder cultivation to increase fodder availability without compromising food crop production.
5.	Alternative Fodder Resources	There is a need for exploring the alternative or non-conventional fodder resources viz., moringa, azolla, hydroponics, crushed areca nut leaves, pineapple wastes, etc.
6.	Crop Residue Quality Enhancement	Enhance the nutritional quality of crop residues through treatment methods like urea treatment and fermentation to make them more suitable as animal feed.
7.	Fodder Conservation Technologies	Adopt and promote fodder conservation technologies such as haymaking, silage production, leaf meal production and feed blocks to ensure year-round availability of quality fodder.

Way Forward

- Utilizing the interspaces of coconut and cashew plantations for fodder cultivation can maximize land use efficiency and provide a continuous supply of green fodder for livestock.
- Constructing rainwater harvesting ponds lined with silpaulin sheets can ensure a reliable water source for irrigation during the lean season, reducing dependency on external water sources and enhancing fodder crop resilience.
- Establishing fodder nurseries in various taluks of Goa, in collaboration with ICAR-CCARI, Goa, and ICAR-IGFRI, RRS, Dharwad. It will facilitate the availability of quality planting materials, ensuring the adoption of high-yielding and resilient fodder varieties.
- Implementing dedicated training programs and extension services is crucial for educating farmers on modern fodder cultivation practices and conservation technologies. This will help bridge the knowledge gap and promote sustainable fodder production.
- Identifying and using wastelands and non-arable lands for fodder cultivation can increase green fodder availability without competing with food crops, thereby supporting livestock feed needs sustainably.
- Encouraging the adoption of fodder conservation technologies, such as silage making, can help preserve surplus fodder during peak production periods for use during lean seasons, ensuring a steady supply of livestock feed throughout the year.



5. Fisheries

Status

Fish is considered a staple diet for more than 90% of the population of Goa. Goa is bestowed with a coastline of 104 km and a continental shelf area of 10,000 km^2 (Table 7). The annual average marine and inland fish production during 2023 is estimated at 1,26,990 and 8,651 tonnes, respectively. Goa shares nearly 2% of the total marine fish production of our country (Table 8). About 600 fish and shellfish species are recorded in the fish landings. The numbers of pelagic, demersal, crustacean and mollusc species identified were 200, 280, 95 and 90 respectively. The fisheries sector contributes to about 3% of the state GDP and 17% of the agricultural GDP (2021). Thus, the fisheries industry plays a vital role in the socio-economic development by contributing substantially towards Net State Domestic Product through export and domestic trade. Approximately 2,823 tonnes of fish worth Rs. 41.82 crores have been exported from Goa in 2022-23. The annual average per capita consumption of fish in Goa was 78 kg as per the data in 2021-22. About 12000 active fishermen earn their livelihood from fishing and allied activities distributed in 39 fishing villages. The harvested fish is distributed through 27 major and medium fish landing points in the state.

Fisheries co-operative societies play a major role in co-ordinating the fisheries activities and a total of 36 societies are active in the state. Altogether about 5-10% of the total population is engaged in fishing and allied activities. Moreover, the fisheries industry forms the second largest industry both in terms of employment and income. Besides the actual fishing process, many ancillary and subsidiary activities like marketing, drying, processing and small-scale vending also create livelihood for a significant section of the inhabitants. However, the fisheries sector of the state faces various challenges like over-exploitation, indiscriminate fishing practices, fish migration barriers, pollution, habitat degradation, invasive species, climate change, and lack of a proper policy framework. The sector also needs a boost in fish seed production and aquaculture diversification to meet the demand for fish from the resident population and tourism sector.

Table 6. General profile of fisheries sector in Goa

Parameters	Particulars
Coastal length	104 km
Inland waterways in Goa	250 km
Inland water tanks (area)	100 ha
No. of Fishing talukas	7
No. of Fishing villages (North) *	16
No. of Fishing villages (South) *	23
Fisheries population (2010)	30,225
Active Fisherman Population (2010)	11944
No. of Mechanized Trawlers in operation	913
No. of Motorized crafts registered	1665
No. of non-motorized crafts registered	911
No. of registered nets	8644
Fish landing centres (Major Jetties)	5
Fish landing centre ramps	22
(a) Fisheries Co-operative Societies (Boat Owners)	08
(b) Fisheries Co-operative Societies/ Association (Canoe Owners)	28

Source (*): Marine Fisheries Census 2016 (Goa) Published by Ministry of Agriculture & CMFRI

Table 7: Landing, value and export of fish and fishery products in Goa

Fisheries	Annual Fish landing 2023 (t)	Value of fish landing 2023 (Rs. Crores)	Export of Fish Products 2022-23 (t)	Value of exported fish products 2022-23 (Rs. crores)
Marine	126990	1728		
Inland	8651	78.8	**2823**	**41.82**
Total	**135641**	**1806.8**		

Source: 1) Directorate of Fisheries, Govt. of Goa, 2024, 2) Department of Fisheries (2023) Handbook of Fisheries Statistics-2022, Statistical report of the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India, and 3) Online dataset from the Marine Products Exports Development Authority (https://mpeda.gov.in/?page_id=438)

Constraints

- Stagnating marine fisheries and limited scope of expansion
- Inadequate database of aquatic resources and fisheries
- Inefficient monitoring, control and surveillance system for illegal, unreported and unregulated fishing activities
- Anthropogenic stressors such as pollution, overfishing, habitat degradation, coastal development and invasion of exotic species
- Inadequate adaptation and alternate livelihood opportunities in the backdrop of climate change and natural calamities

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- Inadequate adaptation and alternate livelihood opportunities in the backdrop of climate change and natural calamities
- Slow growth in the aquaculture sector due to lack of quality seeds,

Way Forward

There is a need for management and developing opportunities for fisheries in Goa to improve the rural livelihoods. The major share of the fish production still comes from the capture fisheries and there is a huge potential for inland water fisheries, coastal aquaculture and mariculture to augment the fish production of the state. To make Goa self-reliant on the fisheries resources, the focus should be on sustaining the marine fisheries sector, exploring the deep sea resources, vertical and horizontal expansion of mariculture, improving ecological health and restoration of inland aquatic resources, developing package of practices for seed production and culture of commercially important aquatic species, utilising the untapped potential of coastal areas for aquaculture following good aquaculture practices and health management, ensuring quality fish for domestic and export markets, and revamping the governance in the fisheries sector. The policy framework should focus on these key areas and strategies to develop the fisheries sector of the state.



Mudushi (Sillago) of Goa
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6. Value addition & Processing

Value addition and Processing of Native foods

Food is an integral part of Goan culture and history. Goan cuisine is a blend of Portuguese, Hindu Saraswat, and indigenous cuisines that feature local ingredients such as fresh seafood, tropical fruits, and spices. This not only enhances the authenticity but also provides tourists with flavours that are unique to the region and not easily found elsewhere. Goa hosts various food festivals and culinary events that highlight local cuisine. Events like the Goa Food and Cultural Festival, Cashew Festival and Fish Festival attract visitors who are eager to sample a variety of traditional dishes and learn more about Goan cooking. Goan beverages such as feni (a local spirit made from cashew apples or coconuts) and various types of traditional Goan wines are unique to the region and can be a major draw for tourists interested in local drinks.

Processing and adding value to Goan foods can create new business opportunities and boost the local farming economy. By processing and adding value to traditional foods, there's an opportunity to preserve and promote Goan culinary heritage. This can lead to job creation in areas such as food processing, packaging, and marketing. Processed and value-added products often have a longer shelf life and can be distributed more widely. This opens up opportunities for Goan foods to reach markets outside the region, potentially even internationally. Effective processing can reduce food waste by utilizing parts of ingredients that might otherwise be discarded. By creating a demand for traditional Goan foods, there is a positive ripple effect on local farmers and artisans who produce the raw materials. This support can help sustain traditional farming practices and local economies.



Geographical Indication tagged foods of Goa

Geographical Indication (GI) tags are instrumental in preserving the unique qualities and traditions of region-specific products. In Goa, the efforts taken by the Goa State Council of Science & Technology (GSCST) and ICAR-CCARI to secure GI tags for 10 local specialities have been a significant milestone and more products are under consideration. These tags validate that products like Goan spices, traditional sweets, and other regional delicacies possess unique attributes directly tied to their geographical and cultural origins. They help protect the genuine nature of Goan products by preventing counterfeiting and misuse of their names, ensuring that consumers receive authentic goods that meet traditional standards. The various GI-tagged native foods are described in the table below:

Table 8. Description of GI tagged foods from Goa

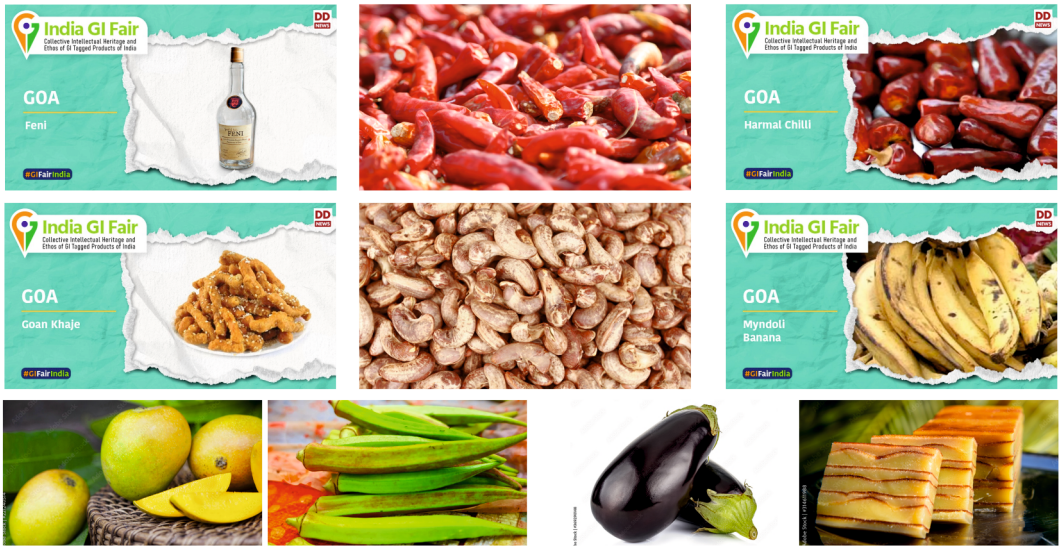
No.	GI Tagged Food	Description	Year of Registration
Technical Support by ICAR - CCARI, Goa			
1.	**Goa Cashew Feni**	It is a traditional spirit produced made out of cashew apple juice. The Government of Goa classified this drink as the 'Heritage Spirit of Goa' further giving it its unique identity.	2009
2.	**Khola Chilli**	It's an organically grown bright red colour and medium spiced chilli grown in the Canacona area of Goa characterised by extended shelf-life as a result of its thick skin	2020
3.	**Harmal Chilli**	This reddish-brown chilli, derives its name from its area of cultivation which is a coastal village in the Pernem taluka in North Goa. The chili is unique in its size, pungency, colour and has a non-wrinkly skin texture.	2020
4.	**Myndoli Banana**	A long tusk-shaped banana believed locally to have medicinal properties that could aid in the prevention of certain illnesses. Also commonly known as Moira Bananas.	2020
5.	**Mankurad Mango**	Goa mankurad mango is rich in taste with small and flat mango stones. Each fruit weighs around 200-250 g and is juicy, and pulpy with a sweet-tangy flavor. This variety is one of the most sought-after mango varieties in Goa during summer.	2020

6.	**Agsechi Vayingim (Agassaim Brinjal)**	This brinjal originated from Agassaim Village of South Goa known for its soft, puffy flesh, deep purple skin, and large size	2021
7.	**Sat Shiro Bheno (Seven-ridged Okra)**	It is a unique Okra that is tender even after it has grown up to one foot in length. In addition, it is sold at a higher price, as this variety is more fibrous.	2021
8.	**Goa Cashew (Kaju or Caju)**	Goa cashews are known for their quality and history and are characterised by their large size, creamy texture, buttery flavour, and fullness. Goa cashews are the most popular souvenir food products among tourists visiting Goa	2023
Other Products			
9.	**Goan Khaje**	Khaje is a finger-shaped fried sweet prepared with chickpea flour, ginger, jaggery and white frosted with sugar and sesame seeds. It is a sweet staple at every temple zatra and church fair across the state and originated centuries ago in Goa.	2020
10.	**Goan Bebinca**	A traditional Indo-Portuguese dessert, Bebinca is a layered pudding made of flour, coconut milk, egg yolks, ghee, palm jaggery and more. Also called as 'Queen of desserts.	2021

Way Forward

Conserving and promoting geographically indicated (GI) food products involve both protecting their unique characteristics and supporting their sustainable development. Enforcing quality standards and maintaining strict adherence to quality and production standards specific to the GI product is of pivotal importance. This can be achieved by training local farmers and producers about best practices for maintaining the quality and authenticity of GI products. The government can run campaigns and offer grants or subsidies to support producers in adopting sustainable practices and improving their infrastructure. In addition to this, clear and attractive labelling with the respective product GI logo would help consumers easily identify GI products and understand their origins. The research should focus on quality grafts related to GI-tagged crops that should be made available to Goan farmers with promotional schemes to further boost the native foods in the global market.





Management of the Farm and Food waste

Following the circular economy approach in the waste-management sector, farm and food waste management in Goa has gained significant momentum, with various technologies developed and promoted through commercialization and government initiatives.

Farm waste management

Organic waste from agriculture, particularly in Goa's traditional farming systems, is an invaluable resource with tremendous potential for conversion into valuable products like manure and compost to enrich soils and maintain soil health. Proven methods such as composting, vermicomposting, and shredded biomass vermicomposting have been highly beneficial in reducing farmers' dependence on external farm inputs. These practices are especially crucial for promoting organic and natural farming, which aligns with the government's priority initiatives. Wastewater is an invaluable resource, rich in nutrients but often compromised by undesirable qualities. To address water scarcity, treated wastewater presents a viable option, offering both sustainability and resource efficiency. Implementing eco-friendly, low-energy, and cost-effective treatment solutions that comply with government policies and schemes is essential for maximizing the potential of treated wastewater while ensuring environmental and public health safety. JALOPCHAR™ is an innovative, eco-friendly wastewater treatment technology developed by ICAR-IARI, New Delhi, and implemented at ICAR-CCARI under the Swachhta Action Plan (SAP) Program. Designed to treat up to 1,00,000 litres of wastewater per day with minimal land use, this system has been optimized for the high rainfall and humidity conditions of Goa. Some key examples of these advancements by ICAR-CCARI, Goa are detailed below:

Livestock waste management

Livestock waste, such as dung and urine, can be processed, recycled, and value-added through a "waste to wealth" approach. A tailored innovation for the state of Goa has been developed in the form of the Livestock Waste Valorization System (LWVS), offering an efficient solution for managing and utilizing livestock waste. It converts the waste and urine into valuable resources like biogas and Phosphate Rich Organic Manure (PROM). This model not only addresses livestock waste management but also offers farmers economic benefits, such as reduced input costs and improved crop yields, contributing to sustainable agricultural practices.

Food waste management for livestock and fish farming

Feed shares the major operational cost (~50%) in livestock and fish farming. Thus, it is vital to identify low-cost and readily available feed resources to make the farming economically viable and sustainable. The food waste from restaurants, vegetable/fruit shops and slaughter houses can be treated and incorporated as feed for livestock and fish farming. The pig farms of Goa utilises the food waste as a major source of feed, which reduces almost 70% dependence on off farm feed resources. Similarly, the discards from slaughter houses and fish markets serve as an important source of feed for farmed fish types such as Red snapper, Asian seabass, and Pangasius sp. Adopting the strategy of feed from food waste, a progressive farm family from Bicholim, had developed a sustainable integrated farming system (IFS) model including fishery, piggery, poultry, fruit crops, vegetables, vermi-compost, and biogas with technical inputs from scientists of ICAR-CCARI. During the covid-19 pandemic, the institute guided the farmer in developing the IFS, which is more profitable, sustainable, and resource efficient. Considering these sincere efforts, they were awarded with IARI Innovative Farmer Award at national level and Krishi Vibhushan Award by Govt. of Goa.





Nutmeg pericarp taffy



Nutmeg pericarp taffy is a unique and flavourful confection made from the outer fruit of the nutmeg seed, known as the pericarp. This often-underutilized part of the nutmeg is rich in natural sugars and aromatic compounds, making it ideal for creating a delicious, chewy taffy. The product has been commercialized to Goa State Biodiversity Board for livelihood improvement of the women SHGs. Also, the technology is licensed to a young entrepreneur practising agro-eco-tourism.

Cashew apple crunch



Cashew apple crunch is an innovative snack made from the often-discarded cashew apple, offering a sustainable and nutritious alternative. Rich in vitamins and antioxidants, the cashew apple is processed into a crunchy, flavourful snack that helps reduce food waste while promoting the value of this underutilized part of the cashew fruit. This product not only adds economic value to cashew farming but also supports eco-friendly food processing practices in regions like Goa.

Building agri-startups to support innovation for value addition/supply chain

India has seen growing interest in agriculture to agri-entrepreneurship due to interventions of technology and digitization. This shift has strengthened the agriculture start-up culture which helps to eliminate a variety of problems like outdated equipment, infrastructure, poor market connectivity, supply chain, etc. by providing information, techniques, and efficiencies with new ideas and innovations. The state of Goa offers a rich array of opportunities for agri-startups, ranging from organic farming and agri-tech innovations to aquaculture and agri-tourism. By leveraging these opportunities, startups can contribute to the agricultural sector's growth and sustainability while addressing local and global market demands.

To accelerate a strong agri-startup ecosystem in the state of Goa, ICAR-CCARI established Agri based Growth opportunities for nurturing start-ups through Incubation (AGNI) Agri-Business Incubator (ABI) in Goa through Incubation Fund under XII plan scheme of Intellectual Property & Technology Management unit of ICAR, i.e. National Agricultural Innovation Fund (NAIF) component II in the year 2019. AGNI ABI in Goa would serve as a pivotal platform for nurturing viable ideas and building successful business ventures in agriculture & allied sectors for Goa by providing services like infrastructure, business consultancy, capacity building programmes, prototyping and lab testing, business networking, facilitating capital assistance, etc. By providing comprehensive support & resources, it can significantly contribute to the growth and modernization of agriculture in the region.



7. Market Linkages

Market Linkages between Farmers and the Corporate Sector in Goa

Challenges

Goan farmers face several challenges, including limited access to profitable markets, a lack of bargaining power, reliance on traditional and often inefficient supply chains. Hotel industries in Goa are significant consumers of agricultural products, which are sourced through intermediaries and imported from other neighbouring states. This practice escalates costs, reduces produce freshness, and lowers profit margins for farmers and also leads to price volatility and inconsistent demand.

Proposed Market Linkages

- Establishing direct connections between farmers and hotel industries can reduce intermediary involvement, thus increasing profit margins for farmers and reducing procurement costs for hotels. A digital marketplace or mobile apps for direct B2B (Business-to-business) transactions could facilitate this.
- Encouraging hotels and corporates to engage in contract farming agreements can provide farmers with a stable market and fixed income, reducing the uncertainties of selling produce in open markets.
- Leveraging Goa's robust tourism sector to promote agro-ecotourism can create unique farm-to-fork experiences. Hotels can partner with local farms to offer tours and farm-fresh meals, providing an authentic Goan experience to tourists while generating additional revenue for farmers.
- Corporate social responsibility (CSR) initiatives can fund training programs to help farmers adopt modern farming techniques and practices, improving yields and product quality to meet the high standards of corporate buyers and upscale hotels.
- Introducing cold storage facilities and logistics support can help maintain the quality of perishable goods. Investment in such infrastructure can be a collaborative effort between the government, private sector, and farmers.

Way Forward

Improving market linkages between Goa's farmers and the hotel/corporate sector holds the potential to transform the local agricultural landscape. By fostering direct procurement channels, promoting contract farming, leveraging agri-tourism, and investing in capacity building, policymakers can create a more resilient, profitable, and sustainable agricultural sector. Such initiatives will benefit all stakeholders involved and contribute to the broader economic development of Goa.



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8. Platform to implement and monitor the road map

An inter-ministerial platform is proposed to implement and monitor the recommended road map for 'VIKSIT GOA 2047-Revitalising Agriculture and Allied Sectors for self-reliant Goa' as a strategic approach to ensure that agricultural and allied sectors development is effectively managed and that policies are aligned with the state's needs. The inter-ministerial platform may be constituted as follows.

1.	Hon'ble Chief Minister of Goa	Chairman
2.	Hon'ble Minister for Agriculture, Govt. of Goa	Vice-Chairman
3.	The Director, ICAR - Central Coastal Agricultural Research Institute, Goa	Ex Officio Member
4.	Secretary (Agriculture), Govt. of Goa	Ex Officio Member
5.	Secretary (Animal Husbandry & Veterinary Services), Govt. of Goa	Ex Officio Member
6.	Secretary (Fisheries), Govt. of Goa	Ex Officio Member
7.	Three ICAR Scientists from the fields of Agriculture, Livestock, and Fisheries sectors nominated by the Chairman	Members
8.	Three farmers of Goa from the fields of Agriculture, Livestock, and Fisheries sectors nominated by the Chairman	Members
9.	Director of Agriculture, Govt. of Goa	Member Secretary

The proposed inter-ministerial platform may meet regularly (preferably twice a year) to review the effectiveness of the implementation of the roadmap and make necessary adjustments to improve its operations and impact and ensure that the state's agricultural sector is well-supported and sustainable.



9. Policy Suggestions & Recommendations

Agriculture Sector

- Establishment of seed villages and nurseries for the production of seed and planting material and formation of a State Seed Certification Authority to maintain quality standards. Promoting large-scale farmer participatory seed production and developing a comprehensive seed chain will ensure the availability of quality seeds and planting materials to the farmers.
- Implementing farmer-participatory low-cost rainwater harvesting structures at farm level/household level suitable to agro-ecological and soil conditions of the State of Goa is crucial to enhance water availability, increasing cropping intensity, and boosting crop productivity.
- Developing modern rice milling facilities for value addition and processing will not only reduce post-harvest losses but also boost marketability, thus enhancing overall economic viability for farmers.
- Rice fallow lands should be brought under cultivation by emphasizing high-yielding pulse crop varieties (cowpea and green gram (Mung)) to reduce fallowing and to improve area under pulses.
- Promoting millet-based & fodder based agroforestry systems, especially in interspaces of crops like cashew and coconut, is critical for enhancing millet production and making Goa a self-reliant in fodder production.
- Replacement of senile orchards with high high-yielding varieties (HYV) of cashew and coconut with best production management practices is recommended to boost cashew and coconut productivity sustainably.
- Availability of high-quality planting materials and establishing new orchards with improved local varieties like Mankurad mangoes ensures Increase in fruit crop productivity.



- Focus on promoting adoption of improved vegetable varieties and advanced production technologies to increase productivity and meet consumer demands.
- Promote the integrated farming systems models developed.
- Develop markets for the intangible benefits provided by agroforestry systems, such as carbon credits and ecosystem services. This can be achieved through government incentives and partnerships with environmental organizations.
- Need to implement a comprehensive policy for the promotion and regulation of Agro-eco-tourism in the state of Goa.

Livestock & Fodder Sector

- State Animal Husbandry departments should initiate proactive measures for enhancing the availability of quality feed and fodder, and improved fodder varieties in the region. Implementing horti-pastoral systems, which combine horticulture (coconut, mango) and forage crops, can augment forage availability and optimize orchard floor management.
- Coordinated efforts are required to widen the current artificial insemination, cross-breeding and breed up-gradation programs based on respective region-specific breeding policies.
- Scientific feeding practices, and advanced feeding technologies such as bypass fat feeding, hydroponic fodder production, feed blocks and total mixed ration blocks need to be disseminated to the farming community and dairy entrepreneurs to optimize dairy animal productivity.
- Community dairy farming with all the facilities like, basic veterinary services, health management and collection of milk, processing and marketing may be initiated as pilot and later can be expanded if the results are encouraging..
- Promotion of indigenous dairy cows for milk production and as a part of an integrated farming system, as these cows are well adapted to coastal humid climate with minimum inputs.
- Initiatives like organization of cattle markets for better availability of quality dairy animals need to be promoted.
- The introduction of well-structured milk marketing mechanisms, and improved value chain of livestock products can contribute to the viability of dairy farming in the state of Goa.

- Promote goat farming by the introduction of promising goat breeds like Konkan Kanyal, Black Bengal & Malabari which are suitable for Goa state through the relevant Govt. schemes for entrepreneurship development for rural youth.
- Backyard poultry production and introduction of color broilers for increasing meat and egg production.
- Establishment of slaughterhouses/meat processing units for small animals (goats, pigs and poultry) for meat production and value addition.
- Intense vaccination programs particularly for Classical swine fever (CSF) disease in pigs and PPR in goats in addition to vaccination in cattle need to be initiated to boost pork and goat meat production.
- Introduction of exotic germplasm through artificial insemination not exceeding 50% genetic makeup by the Directorate of AHVS (for AI programmes).
- Introduction of indigenous breeds: Gir, Sahiwal and Red Sindhi for supply of indigenous breeds and maintenance of germplasm.
- Introduction and conservation of indigenous and cross-breed pigs (for conservation and multiplication and supply, formulation of schemes).
- Establishment of nucleus breeding units for livestock – Goat, pig, etc. through RKVY, National Dairy Development Board, National Livestock Mission, etc.,
- Establishment of feed manufacturing units through RKVY, National Livestock Mission (NLM).
- The provision of subsidized poultry feed, electricity and water and establishment of a feed mill with subsided equipment, remunerative price for broilers and eggs through co-operative marketing may be initiated.
- Implementation of the fodder resources development plan devised for the state of Goa by the ICAR-IGFRI, Jhansi.



Fisheries Sector

- Develop conservation measures, including species-specific and zonal/area-specific management plans, through consultative processes.
- Implement ecosystem-based fisheries management and co-management approaches.
- Prepare a proposal for the development of mariculture, including identifying suitable areas within territorial waters, candidate species, leasing policies, and best practices.
- Promote seaweed farming and integrated multi-trophic aquaculture systems along the coastal region.
- Enhance the ecological health of riverine and wetland ecosystems by limiting pollution from point and non-point sources in coordination with relevant stakeholders.



Velli (White Sardine) of Goa
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- Conserve riverine stretches and associated wetlands to sustain indigenous species by establishing protected areas, enforcing time and area closures, and managing efforts.
- Diversify and expand the species spectrum for freshwater fishes by ensuring the availability of healthy stocking material, suitable technologies, and support services.
- Develop an action plan for seed production, including establishing seed banks.
- Enhance the provisions for quality seed and feed.
- Identify potential areas for aquaculture and ensure their availability and allocation, along with necessary support services.
- Promote species diversification by reviving tiger shrimp and Indian white shrimp, and including candidate finfish species.
- Improve biosecurity and health management by eliminating the use of banned antibiotics, providing additional quarantine facilities, and promoting Good Aquaculture Practices,
- Strengthen R&D linkages in the fisheries sector for the rapid development and dissemination of sustainable fisheries and aquaculture technologies and management practices.
- Develop policy framework that aligns agricultural, livestock, and fisheries goals with environmental conservation and climate change adaptation.

Value addition and Agri-entrepreneurship

- Promote value addition and processing of traditional Goan foods to enhance local culinary heritage, create new business opportunities, support sustainable farming practices, and boost the state's economy through wider market reach and job creation
- Foster agri-startups by leveraging platforms like AGNI-ABI to drive innovation in value addition and supply chain solutions, enhance agricultural sustainability, and support entrepreneurship in agriculture and allied sectors through comprehensive infrastructure, business consultancy, and market access.

One Taluka One Product for the state of Goa

The Government of Goa and the Department for Promotion of Industry and Internal Trade (DPIIT), the Government of India, have been taking various steps to promote exports from the country and boost industrial development and export promotion. One of the major steps towards export promotion is to realise the potential product from each district of the Country, One District One Product (ODOP) program. The Invest India Team under the Ministry of Commerce & Industry has identified two products namely 'Cashew nuts and 'Feni' as ODOPs for the two districts of the Goa.

District	Primary	Secondary
North Goa	Cashew Nuts	Feni
South Goa	Feni	Cashew Nuts

The suggested One Taluka One Product (OTOP) for the state of Goa parallel to ODOP of Govt. of India will be a major step towards the identification and promotion of potential 'OTOP' products from each taluka of Goa which has its unique specialities that need to be explored to convert each taluka into a leading production and processing centre fuelling economic growth, generate employment and rural entrepreneurship for achieving the viksit Goa. The following agriculture products/activities have been proposed for the 12 talukas of Goa.

Table 9. Proposed One Taluka One Product (OTOP) for Goa

No.	Taluka	Primary OTOP
1.	Bardez	Banana
2.	Bicholim	Mango
3.	Pernem	Cashew
4.	Ponda	Kulagar based AET
5.	Sattari	Dairy and fodder
6.	Tiswadi	Rice
7.	Canacona	Chilli
8.	Dharbandora	Honey
9.	Mormugao	Fish Products
10.	Quepem	Indigenous tubers and vegetables
11.	Salcette	Pork/Goan Sausages
12.	Sanguem	Sugarcane

Transforming Goa's Agricultural Future A Pathway to Viksit Goa by 2047

The implementation of the above recommendations would be instrumental in transforming Goa into a developed and prosperous state ('Viksit Goa') by 2047, particularly by revitalizing its agriculture and allied sectors. A focus on sustainable agriculture practices, technological integration, and capacity building would empower farmers to adopt more efficient, data-driven approaches such as precision agriculture, smart irrigation, and automation, significantly improving productivity while promoting environmental stewardship. By fostering public-private partnerships and offering training programs to enhance digital literacy, the agricultural workforce would be better equipped to leverage modern tools like mobile applications, IoT, and blockchain for supply chain transparency. The development of agri-processing units would reduce post-harvest losses and create value-added products, while stronger market linkages and branding strategies would enhance the reach of Goan agricultural products at national and global levels. Strengthening cooperatives and Farmer Producer Organizations (FPOs) would further enhance collective bargaining power, improving market access. With infrastructure development, policy support, and incentives like green certification for sustainable practices, Goa's agricultural sector would become more self-reliant, resilient, and environmentally friendly, contributing to long-term socio-economic growth.



1 Technological Integration

Production Technologies

- Climate resilient and High Yielding varieties / species of crop, livestock and fish
- Package of Practices for Climate-smart Integrated Farming System (IFS) models
- Secondary Agriculture
- Agro-ecotourism

Digital Agriculture

- Data-Driven Farming
- Farm Management Software
- Mobile Applications
- Blockchain Technology
- IoT and Sensor Technologies
- Automation and Mechanization
- Training and Capacity Building
- Digital Literacy Programs
- Extension Services
- Public-Private Partnerships

2 Environmental & Social Considerations

- Promotion of Sustainable Practices
- Community Engagement
- Ecosystem Services Recognition

3 Incentives for Sustainable Practices

- Green Certification Programs
- Financial Incentives
- Market Access Initiatives

4 Collaboration and Research

- Research Initiatives
- Innovation Hubs

5 Monitoring & Evaluation

- Performance Metrics
- Feedback Mechanisms

Expected Growth in Agriculture Sectors in Goa by 2047

Growth Potential

High

Moderate

Low

Horticulture : High
- Increased demand for fresh and organic produce
- Focus on high-value crops and post-harvest management

Aquaculture and Fisheries: High
- Expanding coastal aquaculture
- Emphasis on sustainable practices & resource management

Organic Farming: High
- Rising consumer demand for organic products
- Expansion of organic certification and marketing

Agri-Tourism : High
- Integrating agriculture with tourism
- Promoting local culture and practices

Agri-Tech Innovations: High
- Adoption of modern technologies (IoT, AI)
- Driving innovation and attracting investment

Spices and Condiments: Moderate to High
- Unique climate for spice cultivation
- Opportunities for organic certification and exports

Livestock and Poultry: Moderate
- Improved breeding and veterinary services
- Potential for organic livestock farming

Plantation Crops: Moderate
- Stable market for coconut and areca nut
- Opportunities in product diversification

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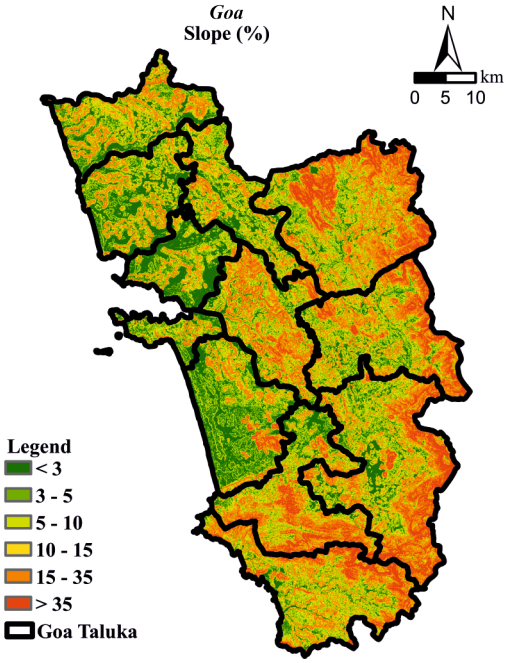
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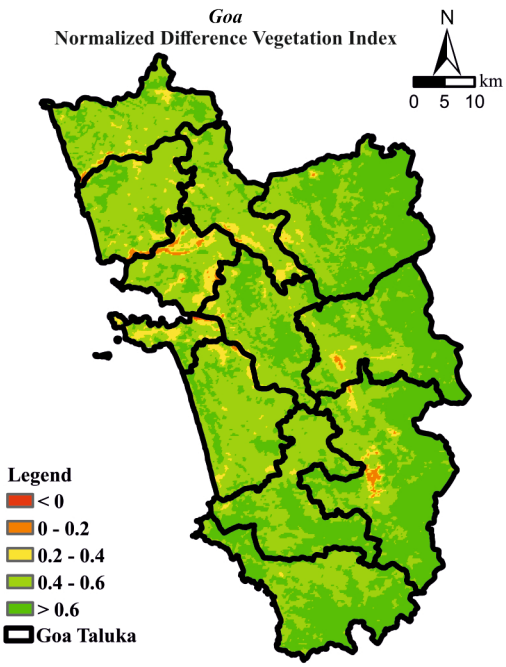


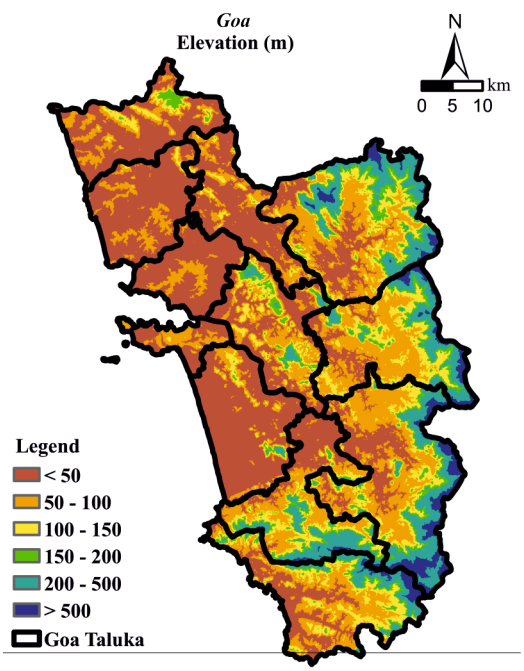
Tarle (Oil Sardine) of Goa

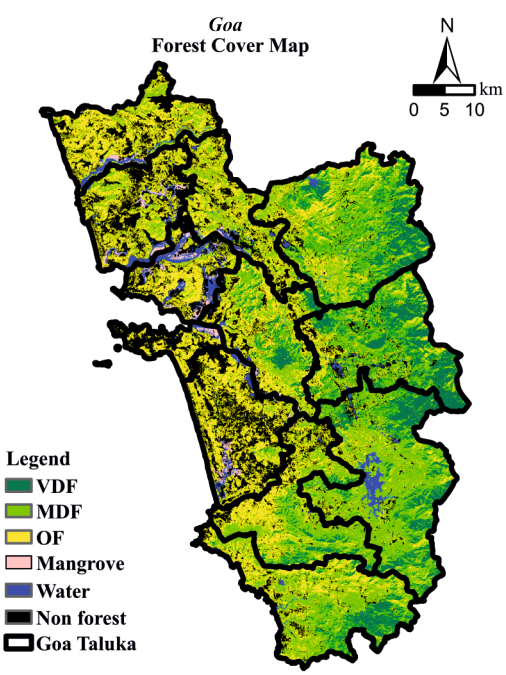
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Maps of Goa





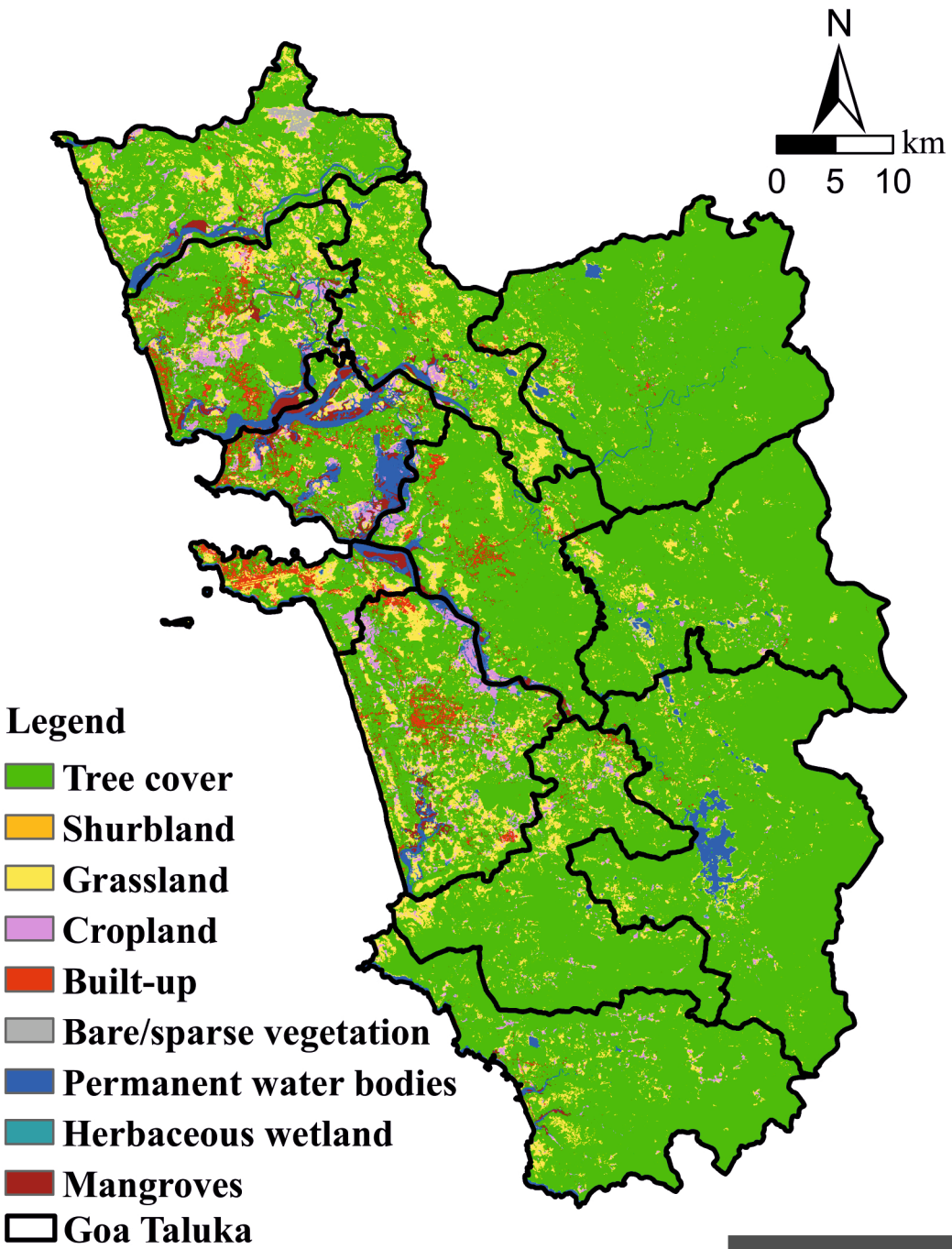




Courtesy : Dr. Bappa Das

Notes

Land Use and Land Cover map of Goa



Courtesy : Dr. Bappa Das

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