



GOVERNMENT OF KERALA

THIRTEENTH FIVE-YEAR PLAN  
(2017-2022)

WORKING GROUP ON

# AGRICULTURE

REPORT

AGRICULTURE DIVISION  
STATE PLANNING BOARD  
THIRUVANANTHAPURAM  
MARCH 2017

## *PREFACE*

In Kerala, the process of a Five-Year Plan is an exercise in people's participation. At the end of September 2016, the Kerala State Planning Board began an effort to conduct the widest possible consultations before formulating the Plan. The Planning Board formed 43 Working Groups, with a total of more than 700 members – scholars, administrators, social and political activists and other experts. Although the Reports do not represent the official position of the Government of Kerala, their content will help in the formulation of the Thirteenth Five-Year Plan document.

This document is the report of the Working Group on Agricultural in Agriculture. The Chairpersons of the Working Group were Dr Raju Narayanaswamy IAS and Professor Venkatesh Athreya. The Member of the Planning Board who coordinated the activities of the Working Group was Professor R Ramakumar. The concerned Chief of Division was Dr P Rajasekharan.

Member Secretary

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**CHAPTER 1**  
**INTRODUCTION**

1. The global economy is yet to see a revival as indicated by the downward revision of world gross product to 2.4 per cent in 2015 from the 2.8 per cent forecast in mid-2015. Similarly, the growth performance of agriculture sector in India also suffered a setback in the recent years and the slowdown had several structural consequences including agrarian distress. The sector grew only by 1.6 percent per annum in the first four years of the ongoing Five-Year Plan as against the targeted 4 per cent annual growth. Although the liberalization regime ensured around 7 per cent growth rate in the overall GDP, it has miserably failed in the agriculture sector with the deceleration of growth rate. Hence, it is evident that the economic growth experienced has not translated into real per capita income growth for the bulk of the workforce employed in agriculture.

*Growth in Agriculture*

2. In order to develop a perspective approach for agricultural development in the 13th plan, an analysis of the performance of the sector in the immediately preceding plan periods is attempted in the following pages:
3. There has been a gradual decline in the area, production and productivity of a majority of crops during the previous plan periods commencing from the 10th plan as illustrated in Fig.1-3.

Figure 1 Area of major crops in Kerala, 10thFive-Year Plan to 12thFive-Year Plan in ha

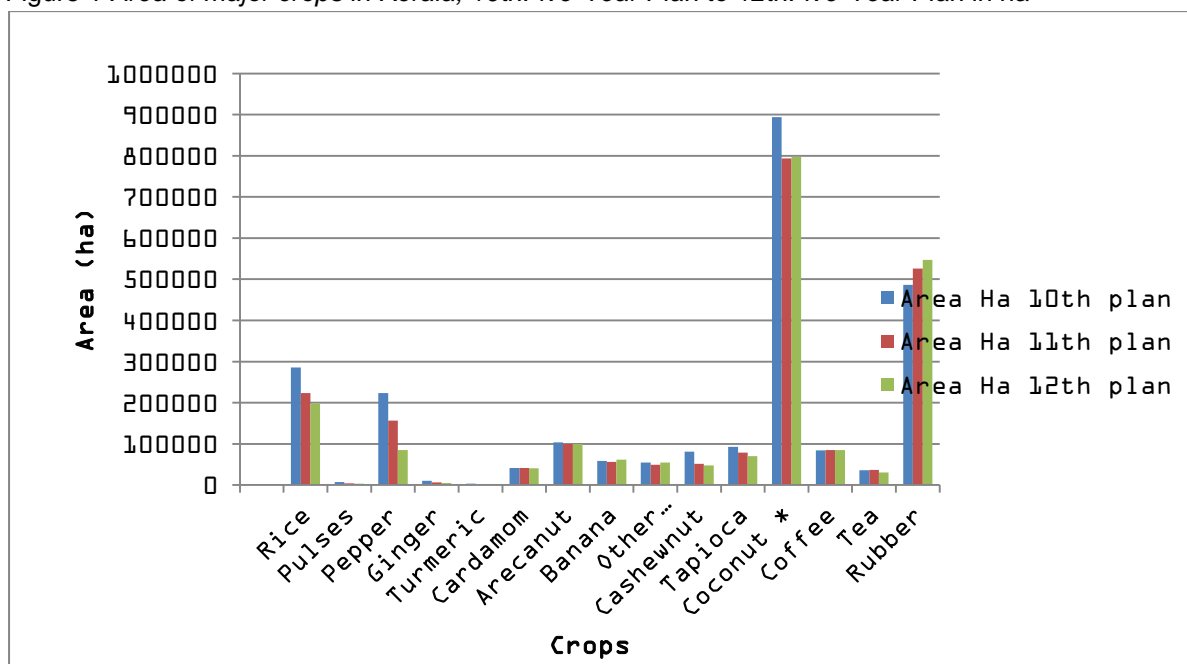


Figure 2 Production of major crops in Kerala, 10th Five-Year Plan to 12th Five-Year Plan in million tones

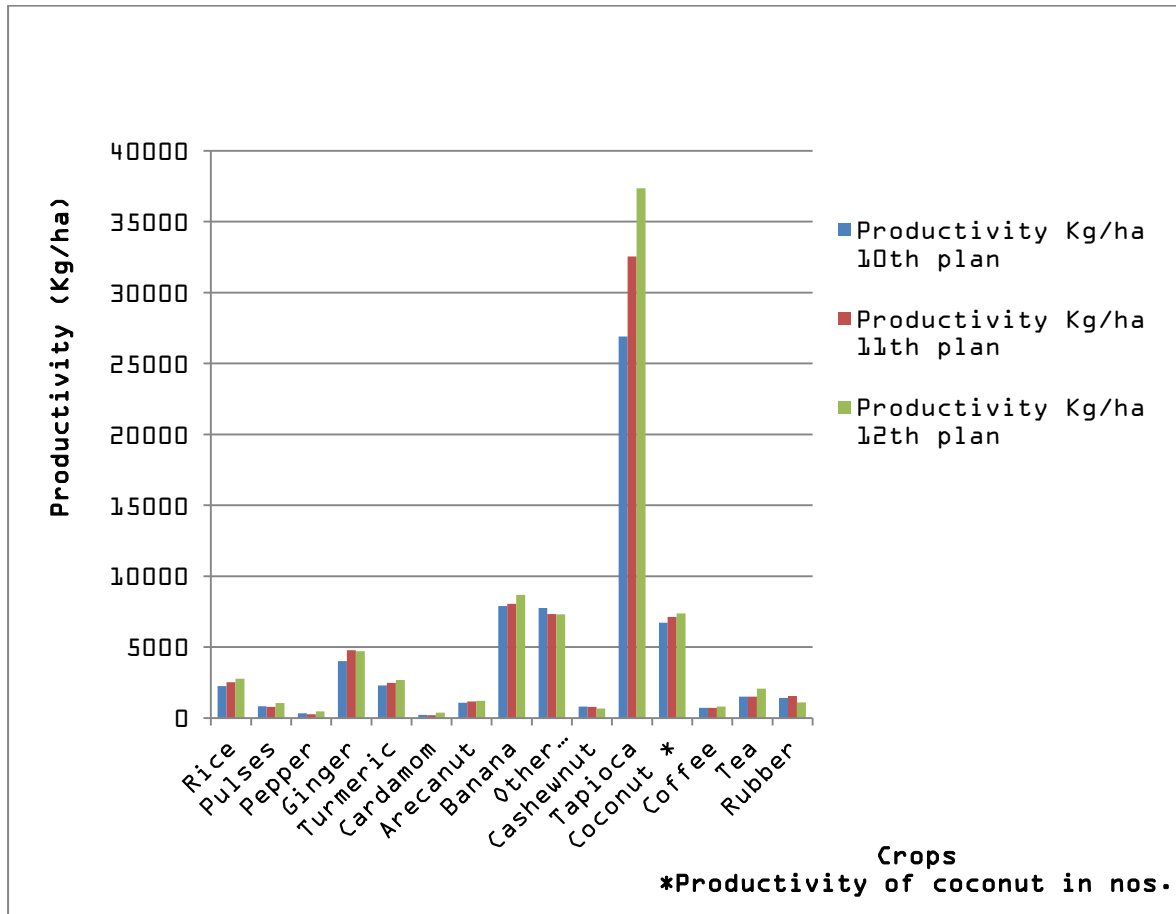
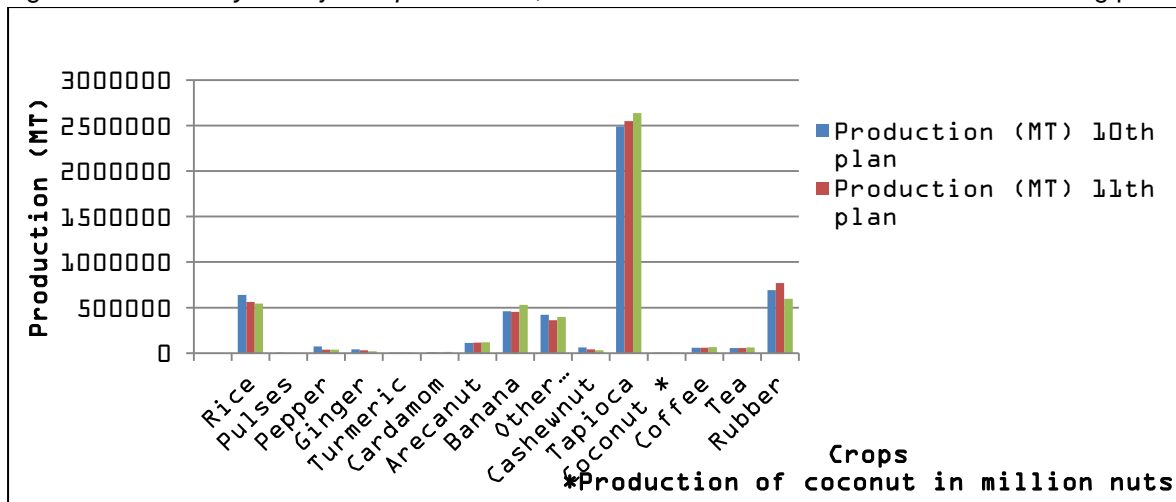


Figure 3 Productivity of major crops in Kerala, 10th Five-Year Plan to 12th Five-Year Plan in kg per ha



4. The Five-Year Plans implemented in the state had given considerable importance to the subsector Agriculture for accelerating growth of the economy. Under Agriculture & Allied sectors, the subsector Agriculture including Crop Husbandry, Marketing, Storage & Ware housing and Other Agriculture programmes accounts the largest share over the plan periods. During 12th plan in order to revive the agrarian economy of the Wayanad district a package of schemes were initiated under Wayanad package and included in the sector Special Programme for Area Development. The share

of expenditure for Agriculture under Agriculture & allied sectors was around 43 % in the 10th plan, subsequently increased to 46.7% in the 11th plan and 48.7% in the 12th plan. The share of expenditure for Agriculture to total plan expenditure is 2.4% in the 10th plan and it was increased to 2.9% in 11th plan and 3.5% during 12th plan. The details are given in Table 1.

**Table 1 Outlay and expenditure under agriculture from 10th plan to 12th plan in rupees crore**

Period	Outlay (Crop husbandry, Marketing, storage and other programmes, Wayanad package)	Expenditure	% of expenditure	% expenditure to Agriculture allied sectors	% expenditure to total state plan
10th Plan	355.47	499.86	149	43	2.4
11th Plan	1337.09	1260.23	94	46.71	2.9
12th Plan (anticipated)	3413.91	3007.98	88	48.7	3.5

*Note:* Percentage expenditure to total State Plan is excluding soil and water conservation.

5. Apart from state plan support considerable support was given through the plans of Local Self Governments for the development of Agriculture from Ninth plan onwards. The approach and strategies of the previous plans focused on area expansion under paddy, coconut, cashew, fruits, vegetables and spices, augmenting productivity of these crops and diversification of product base for maximizing income from unit area.

**CHAPTER 2**  
**ELEVENTH FIVE YEAR PLAN – REVIEW**

6. During XI Five-Year Plan, an amount of Rs 1337.09 crore was set apart for the development of Crop Husbandry (including Marketing, Storage and Ware housing) under state plan with 276% increase over the Xth plan outlay of Rs 355.47 crore. The total expenditure during XI plan was Rs 1260.23 crore (94 % of budgeted outlay) with 152 % increase over the Xth plan expenditure of Rs 499.86 crore. Apart from this an amount of Rs 121.95 crore was spent through Centrally Sponsored Schemes during XIth plan (Table.2).

**Table 2 Outlay and Expenditure during XI Five-Year Plan in rupees crore**

Sl. No	Item	Budgeted Outlay	Actual Expenditure	% Expenditure
1	State Plan Schemes	1337.09	1260.23	94
2	Centrally Sponsored Schemes- Central share	187.67	121.95	65
	<b>Total</b>	<b>1524.76</b>	<b>1382.18</b>	<b>91</b>

7. The target and achievement of major crops during eleventh plan is given below.

**Table 3 Target and Achievement of major crops during XI plan**

Major crops	Target	Achievement
Rice (Lakh tons)	9.50	5.69
Coconut (Million nuts)	8000	5941
Pepper ( Lakh tons)	1.04	0.38

*Major Achievements during XI Plan*

8. The major achievements during XI plan are following:
1. A Project on state food security covering rice, milk, and egg production was launched in 2008-09 and an amount of Rs 87.46 crore was utilised. A convergence approach was followed and the local governments also supported the initiative.
  2. The productivity of rice increased from 2308Kg/ha in 2007-08 to 2733 kg/ha in 2011-12. There was increased production of rice from 5.28 lakh tons in 2007-08 to 5.69 lakh tons in 2011-12. Area under rice increased from 2.29 lakh ha in 2007-08 to 2.34 lakh ha in 2008-09 but it declined to 2.08 lakh ha in 2011-12.
  3. In order to conserve paddy lands in the state, Kerala Paddy Land & Wet Land Conservation Act had been passed in 2008. The procurement price of rice increased to Rs12 per kg as part of the initiative to support paddy production in the state.
  4. The Kerala State Farmers Debt Relief Commission had been set up and functioning in the state since April, 2007. A total of 410549 applications were received and of which 263086 applications were settled and an amount of Rs73.22 crore was expended up to March, 2012.
  5. A pepper package was introduced in Wayanad district for the rehabilitation of pepper through a combination of technological and institutional frame work.
  6. A network of markets and associated infrastructures like godowns, cold storage facilities including processing infrastructure were setup during the period.

*Critical Gaps during XI Plan*

9. Following points were identified as critical gaps during XI plan period:
  1. Lack of implementation of projects in marketing.
  2. The convergence of state plan schemes with the schemes of Local governments to realize the targets.
  3. Inadequate implementation of schemes to strengthen input production.
  4. Preparation of District and State Agriculture plans.
  5. Inadequate thrust for extension.
  6. Risk Management in Agriculture.
  7. Monitoring Mechanism of trade flows.



**CHAPTER 3**  
**12TH FIVE YEAR PLAN**

10. The approach to agriculture in the 12th Plan focused on raising income of farmers through increasing productivity, subsidiary occupations, better marketing and through promotion of value added products. Emphasis given for strengthening extension activities through ATMA and Krishibhavans by promoting the concept of lead farmer and satellite farmers and by using new tools of Information technology and new technologies like biotechnology and precision farming promoted and encouraged through extension. Special focus for food security initiated targeting to increase rice production by 25 percent and vegetable production by 50 percent from the base level. Risk Management strategies were worked out and projects to address weather and price induced risk were identified. In order to provide service to farmers Agro service centers were setup with the support of LSG Institutions and Co-operatives. Value addition projects were given special focus and cash crops and food crops processing encouraged. Use of micro nutrients based on soil studies and comprehensive soil health management were taken up for agricultural productivity. Strengthened market infrastructure by constructing go downs and cold storages.

*12th Plan Strategies and Thrust Areas in Agriculture*

11. The strategies suggested were listed as following,
1. Revival of coconut based systems and revival of pepper development.
  2. Promotion of Integrated Food crop production.
  3. Natural Resource Management.
  4. Agro Ecology Unit (AEU) wise technology packages.
  5. Augmentation of Productivity of crops.
  6. Revitalization of agricultural extension services.
  7. Institutionalization of service delivery for agriculture.
  8. Strengthening of *Krishibhavans*.
  9. Promotion of New technologies.
  10. Strengthening Organic farming.
  11. Soil and plant health management.
  12. Risk management.
  13. Basic infrastructure for inputs and marketing.
  14. Strengthening of participatory and adaptive research.
  15. Location specific technology development.
  16. Special focus to value addition.
  17. Simplification of procedures of Plan implementation

*Outlay and Expenditure during Twelfth Five Year Plan*

12. In the 12th Five Year Plan period (2012-17) the budgeted outlay for the Agriculture including Crop Husbandry, Marketing storage & warehousing, Other Agriculture programmes and Wayanad package is Rs3413.91crore and the anticipated expenditure is Rs3007.98 crore. On 12th Five Year Plan period the total budgeted outlay for Agriculture has been increased 148% compared to the 11th plan period. The year wise outlay and expenditure during 12th plan is given in Table.4.

Table 4 *Outlay and expenditure during Twelfth Five-Year Plan* in rupees crore

Year	Outlay	Exp.
2012-13	688.74	660.49
2013-14	781.31	641.29
2014-15	920.32	708.45
2015-16	474.93	449.14
2016-17	548.61	548.61 (anticipated)
<b>Total</b>	<b>3413.91</b>	<b>3007.98</b>

*Key Initiatives and Achievements in 12th Plan Period in Agriculture*

13. The key initiatives and salient achievements during 12th plan were as following:
1. In order to strengthen ATMA model of extension supported by Government of India, new ATMA plus was introduced from 2013-14.
  2. A major project on vegetable development was initiated during 2012-13 to achieve self-sufficiency in vegetable production. During 2012-13 to 2015-16, Rs250.75 crore was budgeted for Vegetable development and the expenditure incurred is Rs233.97 crore (93%). Vegetable production has increased by 64 percent from 8.25 lakh tonnes in 2011-12 to 13.55 lakh tones in 2014-15.
  3. Agro service centres (ASC) established at block level to facilitate integration of services like mechanisation, labor support, biopharmacy and planting materials, soil testing support and other technology based services. The Farmers Service Centers proposed at the block level under the Cooperation Department was linked with the agro-service centres for input delivery. During 2012-13 to 2015-16, 50 Agro service centres through Agriculture department and 60 Farmer Service Centres through cooperation department were established for improved service delivery to farmers.
  4. Karshikakarmasena established in 200 selected panchayats under the supervision of *Krishibhavans*. The farmers enrolled were given training for various agriculture skills and mechanisation.
  5. The multi institutional project on soil health management initiated during the period 2010 was completed and analysed about 2 lakh soil samples and deficient areas in boron, magnesium etc were identified. The major development project on support to soil ameliorants and micronutrients were initiated. Soil test based Health cards were issued to 1.41 lakh farmers. 900 Nutrient Management Plans (NMP) were prepared for various panchayats/ municipalities/ corporations and distributed to krishibhavans. Also 60 Block level Nutrient Management Plans and the District level Nutrient Management Plans of Wayanad, Kozhikode and Kasaragod districts were released.
  6. A new approach on crop health management was initiated during 2013-14 to bring together management of sustainable ecosystems and people's health through good plant protection practices (GPPP). A PG Diploma programme on plant health management has been initiated for the technical officers of the Department of Agriculture in collaboration with the National Institute of Plant Health Management, Hyderabad. Under the scheme Crop Health Management, Plant Health Clinics were established in 118 blocks and referral clinics in 4 districts.
  7. An Electronic fund transfer methodology for payments to the beneficiaries of different schemes of the Agriculture Department from 2012-13 onwards was initiated. As on March, 2014, registration 18.77 lakh farmers were completed, and the subsidy amount distributed through banks in 152 blocks, for all beneficiaries. Subsidies worth Rs 912.33 crore have been successfully transferred to thousands of farmers during 2012-13 to 2014-15.

8. Hi-Tech Agriculture has been given priority in the State during the 12th Plan period and initiated in 2012-13 as part of Vegetable Development programme. A total number of 1200 poly houses was established during 12th plan.
9. Agriculture Development Policy formulated in the state by a committee consisting of experts in Agriculture, peoples/farmers representatives, and after detailed discussion the policy has been approved by the Govt.
10. Coconut development project was restructured and expanded with Kerasamrudhi component to supply dwarf seedlings, Keragramam project for focused coconut development, and production of Neera and procurement of coconut through *KrisshiBhavan*. Procured 70214 Metric Tonnes of copra through Kerafed.
11. SFAC was strengthened for supporting value addition and provided assistance to coconut based and fruit and vegetable based units.

#### *Critical Gaps during 12thPlan*

14. Critical gaps identified during 12th plan were as follows,
  1. Inadequate focus on rice development
  2. Lack of focused implementation of extension scheme
  3. Risk management including human-animal conflict
  4. Poor intervention in fruits, flowers, urban agriculture medicinal plants
  5. Marketing and value addition

#### *The Setting*

15. The foregoing analysis helps in deriving the broad profile features of Kerala agriculture in the current context: The State has witnessed a remarkable transformation in agricultural sector since its formation in 1956. The agro-climatic conditions in the State suit the cultivation of a variety of seasonal crops and perennial crops. Coconut farming constituting almost 39.4 percent of the state's net cropped area is facing severe setback in recent years owing to fall in market price and low productivity due to pest and disease attacks. Kerala's share in area of coconut farming in the country had declined from 69% in 1955-56 to 32.89% in 2014-15. The State had achieved 50 percent self-sufficiency in rice production in 1972-73. But the area and production of paddy have declined at an alarming rate in the later years. The high remittance from abroad boosted the real estate and construction sectors in Kerala weaning away the land under paddy and other crops and labor force involved in cultivation and small land owners to real estate sector. Although Kerala has wide network of rivers, out of the net cropped area of the state, only 19 percent is irrigated. The net area irrigated has slightly increased from 3.93 lakh hectares during 2004-05 to 4.14lakh hectares during 2014-15. Coconut is the major irrigated crop of the state which accounts for 35 per cent of the gross irrigated area followed by paddy with 33 per cent. Kerala, a state which conceived and implemented the progressive Land Reforms Act with the aim of maintaining sustainability of productive land, is now facing the adverse effects of undesirable changes in many facets including in the land use. Cropping intensity decreased by 11per cent and net area sown by five per cent during the same period. Despite the strong demand for food crops, a steady increase in land put on non-agricultural use, cultivable waste and current fallow is also observed. The State is gradually turning into a non-agrarian one with less than 30 per cent and 10 per cent contributions to employment and economy, respectively. The moot question is that can Kerala afford to continue to be so in the long-term interests of the State and its people?

16. The emerging issues of Kerala's agriculture sector is listed below,
  1. The growth performance of the agriculture and allied sectors in Kerala has been fluctuating across the plan periods. It witnessed a positive growth of 1.8% in 10th plan period but a negative growth rate of -1.3% in the 11th Five Year Plan. In 2015-16, the performance of the sector has been bleak, it clocking a negative growth rate of -11% in crop production. The share of public investment in agriculture is also steadily declining.
  2. In a liberalized trade regime involving multi-national and bi-lateral trade agreements, to make agriculture a profitable business activity, productivity enhancement and cost reduction are inevitable. Currently the productivity of crops cultivated in the State remains stagnant and in most cases are palpably below international and national averages reducing the competitiveness of our farmers in the global and domestic markets.
  3. With the changing profile of people in Kerala characterized by the predominance of part-time farming, absentee-landlordism, urban migration etc. imaginative strategies and programmes to attract people including youth to agriculture are wanting at present.
  4. A look at the area and production of crops reveals a worrisome trend, and it is alarming in the case of food crops such as paddy, and cassava and other important crops including coconut. The total area under food crops in the 1970's was around 20 lakh ha. Presently, it is in the around 13 lakh ha. Besides rice, the other crops such as coconut, pepper, cashew and tubers have also recorded sharp decline in area and production in the recent years, particularly after launching of the liberalization policies. Perhaps, banana and vegetable crops alone have registered a positive growth in cultivated area and production in the recent times, besides rubber.
  5. Besides many other reasons, soil related constraints viz. high acidity, deficiency of macro, secondary and micro -nutrients adversely affect crop health and productivity.
  6. Climate related factors such as erratic monsoon, increasing temperatures, floods, drought, salinity etc. play havoc with the livelihoods of farmers. Climate smart agriculture is not now being given due consideration reducing the levels of resilience of the farming community.
  7. Unavailability of skilled labor, high labor cost and low mechanization continue to be serious hurdles to agriculture development.
  8. Availability of quality seeds and planting materials, other agricultural inputs especially bio-inputs, infrastructure facilities for storage and primary processing and service delivery are not matching with the requirement.
  9. The performance of the plantation sector in the state is disheartening and the market instability is unparalleled in the history affecting the livelihood security of the farmers and the plantation laborers numbering 14 lakhs.
  10. The decline in area of food crops is normally compensated by a corresponding expansion in the area of other plantation crops in Kerala. Of late, tendencies like large scale fallowing of land, conversion of farm lands for other purposes nominal or non-intensive cultivation, leasing etc, are increasingly gaining ground. Large scale conversion and filling up of wetland, mainly paddy land, is leading to an ecosystem crisis. The decline in agriculture tends to knock down allied activities such as animal husbandry, poultry, traditional village industries and the rural economy in general. Seventy eight percent of agricultural households in Kerala were indebted with the average amount at Rs 213,600 while the national averages were only 52% and Rs 47,000, respectively.
  11. The average size of an operational holding in the state is 0.21 ha. Marginal farmers accounted for 96.3% of the total number of land holdings. The area covered by these holdings is 58.6% of the aggregate area of operational holdings. The average holding size of the marginal

- farmers group is only 0.13 ha, probably one of the lowest in the world. Farmers' organizations, bolstering social capital development among these marginalized sections, have not evolved substantially in the State.
12. Enterprise diversification, agro-processing and value addition in agriculture which are essential for enhancing the revenue from the farming are at a very low level in the State.
  13. The support for the LSG's from the state and national Governments was also seen lagging with respect to the primary production in different time periods without any continuous and firm commitment from these higher levels of Governments which requires immediate rectification. The integration of transferred departments with the LSGs at various levels has to be reinforced to augment the impact of the process of democratic decentralization in the State.
  14. The role of the co-operative sector in agricultural development has not been realized to the full potential although some success models have emerged here and there.
  15. Collective farming is an important area of Kudumbashree which aims at food security both at household and community level. In this regard, more hand holding support including facilitation with banks and technology support are essential for improving livelihood of the women groups involved in farming.
  16. Fallow land utilization for agricultural production is perceptibly low for a small state like Kerala. Current fallows, fallows other than current fallows and cultivable waste lands are increasing at an alarming rate accounting for around two lakh hectares. In a land-constrained state like Kerala, this luxury is socially unaffordable.
  17. Of late, organic farming and high-tech agricultural practices are gaining momentum in the state and many state interventions are being implemented to promote the same. More often quality and transparency have become the casualties in both of these arenas. Fake labeling of organic products and organic inputs, alleged corruption resulting in sub- standard structures for high-tech agriculture also mar the potential of these emerging arenas of agricultural development.
  18. Demand driven and location-specific projects for agricultural development are a rarity and ritualistic and non – focused projects leading to thin spread of resources and lack of time-bound and visible impact.
  19. Governance issues including lapses in hand-holding, co-ordinating and monitoring of the progress of projects have led to the poor performance of even well-conceived projects.
  20. Over-emphasis on financial targets and absence of social audit of agricultural development projects have resulted in poor impact.
  21. The extension personnel at grass root level are overburdened with routine office work and are unable to deliver the technical and support services to the farmers in time effectively. Use of ICT / social media / hybrid media for enhancing the efficiency of delivery of extension and advisory services is also in a primordial stage in the State.
  22. Most of the phenomenal advances in agricultural development had the backing of breakthrough technologies which are lacking in Kerala agriculture at present despite the presence of a vast network of Research and Development institutions in the State. Besides, the functional linkages with national institutes for utilizing available technologies in Kerala agriculture are also wanting.

#### *The Way Forward*

17. It is heartening to note that, of late, there is an emerging appreciation for farmers and farming in the mindset of Kerala community-thanks to the efforts of the governments, political parties, social activists, media and other sections of the society. The development programs like the vegetable

development program specially focusing on educational institutions, the soil and crop health management program, the agro-ecological zonation program, the ATMAPLUS AND LEADS Project, the electronic payment system etc. implemented in the past have made a mark in Kerala agriculture and hence they have to be further strengthened and scaled up to give effect to the concept of 'continuity with change' in the 13th Plan. Agriculture needs to be made a part of school curriculum to sensitise the young generation about dignity of farming and sustainable use of resources for ensuring food safety and food independence so essential for achieving the ideal of 'one health'. Farm families' livelihood security has to be ensured by making farming remunerative thereby attracting the women and younger generation also to agriculture and agribusiness. Through crop intensification, the cropping intensity in the state has to be enhanced from a meager 128 per cent now to at least 150 per cent during the 13th plan period. Intensified Integrated Farming System (IIFS) approach is inevitable in this context. Special focus projects for rice, coconut, pepper, ethnic fruits and vegetables, floriculture, medicinal plants, apiculture, value addition, social capital development etc. have also to be formulated.

**CHAPTER 4**  
**13TH FIVE YEAR PLAN- APPROACHES, STRATEGIES AND SUGGESTIONS**

*Motto for Agriculture Development in the 13th Plan*

18. The twin objectives of ensuring sustainable use of natural resources and sustainable livelihoods for the people engaged in agriculture are reflected in the following motto for Agriculture Development in the 13th Five Year Plan:

*Responsible Agriculture – Responsive Agriculture*

19. The thrust will be shifted from crops and cropping systems to sustainable integrated farming systems and farmers' welfare. Efforts will have to be made to use the natural resources sustainably and at the same time augmenting farm families' income through scientific technological applications including intensification, value addition and diversification. To realize the above, a comprehensive restructuring of the agriculture sector including the R&D, Extension and Co-operative Institutions and other groups is warranted. The focus will be on the promotion of 'Intensified Integrated Farming Systems (IIFS)' for ensuring maximum food sovereignty and food safety through group-centric innovations, institutions and initiatives and constant campaigning for capacity development of all the stakeholder groups including researchers, extension personnel, farmers, farm women, youth, students and agricultural labourers.
20. To rejuvenate the agricultural sector and to achieve convergence with the flagship programs of the GOK envisaged under the 'HarithaKeralam Mission'(HKM), institutional restructuring in the agriculture and allied departments/agencies is desirable at the levels of compact area groups of farmers and cluster of groups within a ward, cluster of wards, LSG, Block, agro-ecological units, District and State, under the pioneering program of 'Sustainable Intensification Promotion Through Area Group Approach (SIPTAGA)'. Appropriate convergence platforms for HKM at all levels of implementation will have to be created. The technical line Departments of Agriculture, Animal Husbandry, Dairy Development, Fisheries, Irrigation etc. will have to work in tandem with the HKM led by the representatives of the LSGs. This will help in the sustainable and integrated use of natural resources including land, water and enriching soil, root, plant, animal and human health by recycling of agricultural and house- hold waste for enhancing productivity, production, income and profit for the farming community. Specific thrust areas to realize these objectives have to be identified, development programmes designed, implemented, monitored and assessed for impact assiduously in a participatory manner.

*Land Use*

21. Land use planning presents a development approach that contributes to the prevention of land use conflicts, the adaptation of land uses to physical and ecological conditions, the lasting protection of land as a natural resource, lasting productive use of land and a balance use that fulfills all social, ecological and economic requirements. Land evaluation which is a necessity for successful land use planning must consider land capability, land sustainability and production potential. Suggested land use need to be economically viable, technically sound, politically acceptable, maximum benefits, environmentally sound, results must be sustainable and socially acceptable to the people.
22. Since urban spread in Kerala is very active, it needs a dynamic land use planning. Land use planning should be with people's participation, should preserve critical habitats, conserve biodiversity, and

avoid land uses that deplete natural resources. It should promote sustainable resource utilization by regulating degrading activities.

23. Panchayats, the basic unit of planning, preparing spatial database on land and water at micro level on a regular basis, assumes greater significance. Resource based land use planning document should be prepared in consortium mode based on a multi- disciplinary approach and it should be economically viable, environmentally sound and implemented on a sustainable basis. Effective land use planning could be made only by establishing synergy with departments, universities, farmer's forum, NARP centres, R&D extension agencies, etc. Proper Advisory Support Service should be evolved to advice the Local Self Governments on scientific use of soil and land resource data for local application and local development.
24. Decision Support Systems that analyze future land use options for food security, sustainable Natural Resources Management & safe environment, based on present technical knowledge, socio economic constraints & anticipated future objective constraint the need of the hour. This accompanied by a strong planning process, where communities and various stakeholders are involved, can strengthen the decision making process on allocation and utilization of land resources.
25. Food security is a serious issue among the landless, marginal and small land holders of Kerala. A portion of population in our State is not having access to food because of rural poverty. The fertility status of Kerala soil is degrading and the food produced in such soils is deficient in nutrients. Government should bestow more attention on developing the homestead farming systems in the State. Major ecosystem services provided by home gardens are biodiversity conservation, soil and water conservation, nutrient recycling, energy savings and carbons sequestration. Home gardens should be considered as a basic unit of watershed development & suitable models for each agro ecological unit are to be developed, since land use and farmer preferences are different in each unit.
26. Information technology can contribute immensely for successful land use planning. High resolution satellite imageries & GPS could be effectively utilized for assessing and monitoring the activities. Reliable support information including the change in climate, market fluctuations, export, storage, post- harvest, etc. to be provided to farmers through KIOSKS set up with adequate infrastructure and connectivity. This is very important in Kerala where land holdings are small and marginal.
27. It is important to identify the suitable ecological niche for food crops, cash crops, other natural resources etc. in the available land area for the effective land use in Kerala. Suitable intercrops may be introduced in Rubber, Coconut, Cocoa, Arecanut etc., by adjusting the planting geometry for improving the cropping intensity. The current scenario of less attractive prices for rubber and the consequent decrease in replanted area under rubber provides an opportunity for bringing more area under food crops.
28. Kerala, being consumer state, all efforts need to directed towards protection of land under agriculture to cater to the needs of the farmers and address food security. The barren uncultivable lands may be looked for industrialization and infrastructure building and the water bodies, paddy fields and productive agricultural land should be protected to ensure a sustainable agricultural production and land use. Farmers should be given support/royalty for cultivating food crops which are economically not viable.
29. Kerala is a State with rich land resource but without Land Use Policy or statute to regulate its use. It will lead the State into a disastrous situation in land planning. A specific enactment regulating the



non-protected lands is the need of the hour. Land use planning should ensure productive capacity, proper irrigation and fertility of the arable lands and optimum agriculture production. The indiscriminate conversion of land has to be curbed.

30. Good understanding of the resource base of the State is vital for evolving appropriate technologies for natural resource conservation. River basin plan with micro watersheds as basic units of planning for water resource conservation and groundwater recharge is necessary to address the issue of water scarcity especially in the context of climate change.
31. Emphasizing the need for a land use planning, land use pattern in Kerala should be re-assessed and revised to the extent possible to conserve our precious agricultural lands, water bodies, wetlands and biological hotspots.

### *Major Crops*

#### *Food Crops and Spices*

32. Agriculture development experience of Kerala since the last few decades has been characterised by sharp decline in the area under food crops and the substantial expansion in the area under non-food crops. Paddy cultivation in Kerala has witnessed a steady decline since the 1980s. The state needs about 40 lakh tonnes of rice per annum to feed her people. However, it hardly produces 5.62 lakh tonnes. The non-remunerative nature of paddy cultivation as compared to other crops in the State has been a major deterrent in this respect. The sharp fall in the area under paddy cultivation as well as in the quantity of rice produced in the State has had important implications for Kerala's economic, ecological and social development. Tapioca is another important food crop of Kerala which was popularized as a cereal substitute towards the end of 19th century itself in the State. The role of tapioca in the food security of the state is even more prominent today with ever declining area and production under rice. However, the area under tapioca also started declining from 1990-91 onwards and dropped down to 3.39 per cent of the net sown area by 2014-15. The annual consumption of vegetables in the state is 20.78 lakh tonnes, but the state has been producing much less than the requirement resulting in heavy dependence on neighbouring states. However, the area under vegetable cultivation has increased from 42477 ha in 2011-12 to 90533 ha in 2014-15, thanks to the Vegetable Development Program implemented during this period.
33. *The major challenges/issues confronted.* In the case of paddy the major problems are 1) Non availability of good quality certified paddy seed 2) lack of skilled labourers 3) issues of adopting mechanization 4) Inadequate infrastructural facilities 5) irrigation and drainage constraints. The vegetable sector chiefly faces the inherent perishability, fluctuating market prices, lack of scale economies/marketing impediments, and frequent out breaks of pests/diseases. Price fluctuations and subsequent distress sale as well as the scarcity of high quality planting materials are the major issues faced by tuber crops sector. In the case of spices food safety regulations in the export markets and fierce competition in the international trade due to the regional trade agreements are the major worries.

#### *Approaches*

34. *Paddy.* The GOK have issued a hundred- point action plan guidelines as part of the celebration of 2016 as the Rice Year which require to be implemented without delay. Area under paddy cultivation has to be enhanced to 3 lakh ha. During 13th Plan. Productivity has to be enhanced by at least 50

per cent. State support for this endeavor must be substantially enhanced. Following are the approaches that should be adopted for improvement of paddy cultivation,

1. Certified seeds should be made available in time through NSC, KSSDA, and KSSC. Registered Seed production should be enhanced in department farms and through farmers under RSGP. Seed villages have to be developed at GramaPanchayath level to promote paddy seed production in selected padasekharams. Use of certified seed has to be made mandatory among farmers by providing it free of cost.
  2. Popularisation of Community nursery concept is needed to encourage group activity and cut costs. Subsidy provisions should be proportionate to actual cost of cultivation, and in this respect, cost of cultivation should be monitored and documented at District level by PAO on an annual basis.
  3. Potential of Karmasena and kudumbasree to be tapped to address the labor scarcity. Locally suited machineries have to be found out using services of District Agri-engineering wing.
  4. Subsidy provision should be finalized based on actual cost of cultivation incurred. Cess for Rice could also be levied for compensating expenses incurred by farmer.
  5. Agro Service Centres (ASC) have to be established in each block and have to be equipped with spare parts as well. Servicing and maintenance of farm machineries have to be made at block level. The responsibility of monitoring operations of ASC should be given to the Agri. Engineering wing.
  6. A comprehensive survey has to be conducted to identify irrigation/drainage constraints and area that can be brought back to cultivation on solving it. The projects have to be prioritised at panchayath level /block level for preparing suitable projects. Irrigation and production plans have to be co-ordinated to work in tandem. Support from Minor Irrigation division has to be ensured at required places for irrigation and drainage. RIDF funds have to be mobilised for project implementation.
  7. Registered Padasekharasamithies have to be directed to co-operate with *KrishiBhavans* to identify correct area cultivated by farmers, conversion of fallow lands to paddy and providing leadership in each productive operation.
  8. Geo-tagging the existing paddy and wetlands, utilising GIS services for monitoring conversion, community /group surveillance of paddy land conversion, stringent legal action against violators etc are to be taken.
  9. Mini Rural godowns have to be setup in major production centres especially Kuttanad areas for storing paddy.
  10. Check dams, conservation of existing water resources & ponds, stream bank stabilisation projects have to be implemented. Funds from PMKSY, RIDF, and NABARD have to be mobilised.
  11. Pre- season and on season trainings shall be provided to farmers for resorting scientific soil and nutrient management practices, pest and disease management etc.
  12. Paddy farmers have to be arranged easy credit avenues through Kissan Credit cards. Providing Interest free loans through co-operatives can also be planned and implemented. Linkage with procurement scheme would ensure repayment of loans.
  13. Procurement price has to be regulated in such a way that increases in price of paddy does not lead to more than proportionate rise in price of Rice. Managing procurement price at level of MSP, then payment of balance amount as incentive to farmers etc can be followed.
  14. Paddy farm schools have to be implemented in every school which has at least 10 cents to cultivate on the lines of school vegetable garden scheme.
35. *Vegetables*. Capitalising on the conducive mindset of the Kerala community towards poison-free vegetables, at least 50,000 ha. area may be additionally brought under organic vegetable cultivation

during the 13th Plan. Following points were identified as vital for improvement in vegetable sector in Kerala,

1. Seeds have to be provided at GramaPanchayath level through KrishiBhavans/input centres by sourcing from VFPCCK, department farms, KAU etc. Availability and quality has to be ensured throughout the year.
2. Soil analysis has to be done annually to regulate use of manures and fertilizers. Soil analysis has to be made mandatory for issuing assistance.
3. Availability of quality inputs at the correct time has to be ensured through Bio input centres at GramaPanchayath level. This can be done through farmer groups.
4. Good Agricultural Practices (GAP) has to be promoted in vegetable production as a means towards safe to eat vegetables and eventually should lead to organic produce through PGS and NPOP certification.
5. Effective utilisation using micro irrigation has to be popularised. (Drip, wick irrigation, micro sprinklers etc). Water harvesting structures need to be developed with the co-operation of farmers and public.
6. Precision farming technologies suited to our conditions have to be given more focus. Rain shelters and open precision farming can be encouraged. A Knowledge sharing social media Platform has to be created so that experiences of successful farmers, experts and other stakeholders are shared to all.
7. Production has to be stepped up to a larger scale to reduce fixed costs and for ensuring continuous supply. Also assistance has to be provided to famers/groups regardless of any area ceiling.
8. Farmer Retail Outlets have to be created in all potential GramaPanchayaths by organising vegetable clusters and registered groups. Pricing of produce have to be monitored by Agricultural Officers on a weekly basis at these farmer outlets. Service charges can be collected from farmers as a percentage of sale price (eg.10-15%), for managing recurring expenses in the market like salary of staff, stationeries, power charges etc. Block level auction market operating on weekly basis could also be set up under the leadership of ADA's co-ordinating various farmer groups for managing bulk production in potential blocks.
9. Marketing of safe to eat vegetables under common brand name and logo throughout the state would help in fetching good price and ensure faith in quality of the produce.
10. Cold storage facilities should be extended to FRO's at panchayath level through VDP /SHM. Trainings have to be given on Grading and packing of produce and it has to be focused in urban centres for getting premium price. KAU/KVK's can offer support with respect to the value addition. Ketchup, sauce, juice, jams, pickles, papads etc can be made. Scope for exporting also has to be considered after grading /packaging.
11. Production and marketing plan has to be made at each panchayath for managing demand and supply. Agricultural officer at panchayath level and DD at district level and vegetable cell at state level should co-ordinate efforts. IT applications/tools have to be developed for effective management.
12. The targets under current schemes for expanding area under Paddy and Vegetables should be increased to cover additional area as targeted within a span of 5 years. New schemes for area expansion of tubers, spices and medicinal plants have to be put in place. The schemes would be implemented by the Agricultural Officers at Panchayath level based on the working instructions issued. Janakeeyasoothranam scheme can also be utilised for implementation. The progress of the scheme implemented at the panchayath level will be monitored by the concerned Assistant Director of Agriculture. Besides this the working group constituted at gramapanchayath in charge of monitoring schemes implemented in Agriculture and allied

sectors would undertake concurrent evaluation of the scheme. The evaluation of the scheme would be done at the district level by the concerned Deputy Directors.

13. Vegetable producer companies may be established at the major vegetable producing areas for the marketing of the vegetables produced by farmers. These companies can manage procuring, processing and marketing of fruits and vegetables in their area to realise the better price for crop produce. Over a period of 5 years each of the 152 Blocks in the state will have one vegetable producer company to be registered with Agriculture Development & Farmers' Welfare Department/Small Farmers Agribusiness Consortium with registered farmers as members.
  
36. *Tuber crops.* Some of the thrust points for development of tuber crops is as follows,
  1. Good quality planting materials have to be arranged in association with department farms, VFPCCK under the leadership of CTCRI.
  2. Information on new varieties, scientific cultivation, pest and disease management etc has to be given to farmers. Trainings, farm schools, demonstrations etc should be provided at field level. Surveillance machinery has to be put in place for pests and diseases using key farmers.
  3. To combat price fluctuations value addition is the major remedy. Tapioca can be boiled and dried in the conventional manner, or can be made to chips, wafers, powders, starch, papads etc to fetch good price. Producer groups have a role to play on this front. Credit facilities have to be provided to groups for such value added ventures.
  4. A model scheme to expand area under tuber crops covering minor tubers also needs to be taken up by the department. Since there are no schemes for tuber crops for the department, scheme based support would give the necessary impetus for commercial cultivation. Individuals and groups could be given assistance under the scheme. The workforce of MGNREGS can be effectively utilised for undertaking tuber crops in fallow lands.
  
37. *Spices.* Promotion of “clean spices” remains the only option to fetch superior price in national and international markets. Following interventions and facilitations were indentified for betterment of spices production in the state,
  1. Government with the help of Spices Board needs to intervene by providing facilities for scientific processing centres and warehouses in major areas like Idukki and Wayanad. There is a need for a Quality Assurance system/ Cell at the State level for ascertaining and assuring quality of spices produced.
  2. We need to develop the processing sector in spices - Oils and oleoresins which are in great demand –for exploring national and international markets. Branding and securing geographical indications in spice trade especially pepper and cardamom remains an option. Contract farming in association with flavouring, cosmetics, Food processing industries under the leadership of spices board, Assocham, CII etc. could bring benefits to farmers. Union Ministry of commerce should operate a Price Control Cell to monitor the price of spices in international market and convey it to exporters.
  3. We need to train farmers and exporters on the new international food safety regime and quality management system in the international market. The HACCP practices should be enforced in the spices value chain.
  4. A special team to conduct a methodological study on the cultivation and trade of major spice crops in Kerala seems imminent focussing on the new SPS regime imposed by the WTO. The team should have members from IISR, Spices board, KAU, Agricultural department other than representatives of major stakeholders involved in spice cultivation.
  5. Insurance should be made mandatory for all farmers to reduce the risks of natural calamities .It should also cover crop loss due to pest and disease incidence.

6. An international Spice fest has to be hosted in Kerala preferably at Idukki to portray the medicinal and industrial value of indigenous Spice crops to other countries, to promote the scenic beauty of our rich spice growing areas, to open new marketing channels, to promote new business models based on spices and above all to promote spice tourism in Kerala.

#### *Coconut and Plantation Crops*

38. Coconut and plantation crops occupy 80 per cent of the net area cultivated and play a significant role in the agrarian economy of Kerala state. The major plantation crops include coconut, rubber, arecanut, coffee, cashew, tea and cocoa. Plantation crops have been continuously facing the problem of lack of investment and depressed yields and are in great need of modernization. The sector is dominated by millions of small and marginal farmers and mainly confined in the economically and ecologically vulnerable regions, plays a crucial role as far as the issue of sustainability is concerned. Plantation crops sector, in recent times is characterised by selective state intervention and the removal of tariff barriers wherein, its survival depends on international competitiveness. During the import substitution period, the role played by the plantation sector was very crucial in terms of foreign exchange earnings, but of late with a vibrant and dynamic service sector contributing a major chunk of export earnings coupled with a liberalized trade regime the importance of plantation sector has declined.
39. As the crops with long duration and gestation period, plantation crops generally suffer from the disadvantage of low rejuvenation/replanting rate. Hence, majority of the plantations in the state are with senile and unproductive plants leading to low productivity and income. Moreover, predominance of small and marginal holdings adversely affects the adoption of technologies for higher productivity. Scarcity of regular skilled labour, which is expensive, also adversely affects the adoption of labour intensive scientific practices. Majority of the plantation products are export oriented and hence their prices are highly influenced by the fluctuations in the international markets. Hence, the trade policies, especially regional trade agreements with competitive Asian countries had negative impacts in plantation economy of the state, further worsening the farmers' plight. An important strategy of enhancing income of farmers in plantation sector is value addition through product diversification. However, the potential for value addition has not been effectively utilized in the sector. Interventions for plantation crops development have been mainly implemented through the respective commodity boards/ directorates and state sector schemes are limited without effective coordination with the other agencies. Taking into account the unique nature of the crops, strategies should envisage support programmes to sustain the livelihood during the gestation/price crash periods. The fact that programmes and recommendations in the past are not effectively reflected in the development of the sector highlights the importance of long term strategies and implementation without losing its continuity. With this background, crop-wise scenario and strategies are briefed hereunder.

#### *Approaches*

40. *Coconut.* The traditional coconut farming in Kerala is an integral part of life, culture and identity of the people. In contrast to this, the current decade is witnessing mass withdrawal of people from this sector, despite the research outputs generated and extended by the research and developmental institutions. Hence, redemption of the traditional coconut farming and reorientation towards profitable ventures is becoming a necessity. For many years, Kerala ranked first in both area and production of coconut in the country. For instance, in the year 1990, Kerala accounted for 57 percent area and 47 percent production of coconut in the country. However, Kerala's share in area

as well as production of coconut is declining over time (during 2014-15 Kerala accounted for only 32 percent area and 24 percent production in the country), and coconut growers are going through a crisis situation as they find it tough to manage the crop on a remunerative basis.

41. Constraints such as high level of market fluctuation/price crash in coconut, changes in the demographic characteristics of coconut growers with a shift towards absentee landlordism, predominance of senile and unproductive palms, predominance of small and marginal holdings, over populated stands of both coconut and other trees in the homesteads, low level of adoption of crop management practices resulting in low productivity (as of now the productivity in Kerala is 7535 nuts per ha, which is 27 percent lower than the national average), depletion of natural resources in coconut gardens and soil related constraints, inadequate irrigation facilities, lack of availability of quality planting materials, lack of skilled labour and high wage rate, crop loss due to incidence of various pests and diseases, low level of product diversification etc. adversely affects coconut farming in the state. And as such coconut has become a neglected crop in the 'land of coconut' without getting adequate care and management. Following problems have to be dealt during 13th plan period in the coconut sector,
  1. Recent studies conducted in northern Kerala revealed that incidence of pests and diseases in coconut gardens results in considerable economic loss. Thanjavur wilt and general yellowing were observed in many localities besides other pests and diseases.
  2. Competitiveness of coconut oil compared to palm oil in the domestic market gets adversely affected and the excessive import of palm oil would trigger price crash of coconut. During the oil year ended by October 2015 a total of 14.4 million MT of edible oil was imported of which the major item (9.5 million MT) was palm oil. Palm oil seems to be the major competing oil for coconut oil in the domestic market. There is a need to re-calibrate the import duty structure and it is essential that within the framework of permissible limits the tariff rates for the import of palm oil, both crude and refined palm oil are enhanced to protect the interests of coconut growers.
  3. The copra procurement system should be in such a fashion that the Minimum Support Price (MSP) ensures an incentive for processing to the coconut farmers when compared with that of selling fresh coconut. Cost of production of coconut in Kerala is Rs 8.29 per nut, wherein about 58 percent of the total cost is incurred is due to labour charges. This shows the higher per unit labour charges prevailing in Kerala, which can be attributed to higher labour demand and higher cost of labour in Kerala. In addition, lack of availability of sufficient skilled labourers for harvesting of coconut leading to higher cost of cultivation of coconut in Kerala. Currently, wage rate prevailing in Kerala is around Rs 600 per day, which is one of the highest costs prevailing for agricultural labour in India. Cost of production of copra has been estimated as Rs 76/kg, and adding 20 percent margin to this, the MSP should be at least Rs 91/kg. On the other hand the MSP fixed for the current season is only Rs59.50/kg of copra, which is certainly inadequate to support the coconut farmer. Other pertinent factors in this context of discussion are lack of effectiveness and efficiency in copra procurement by the agencies and inadequate infrastructural facilities for the storage of copra. It is noteworthy that, for the most part of the year, copra is traded below MSP. In order to create an impact in the market and for the benefits of MSP to reach the genuine coconut farmers, adequate quantity of copra should be procured. The studies on pattern of distribution of annual yield of coconut indicates that the number of nuts harvested varied from harvest to harvest and 60% of the production of a coconut palm is harvested during the peak production period i.e., the first six months of the calendar year, and hence a stable price during these periods is of utmost importance for achieving profitability in coconut based farming system. Hence, the copra

procurement scheme should be designed keeping view of this important aspect of coconut production in the country.

4. In Kerala, the coconut procurement system through *KrisibiBhavans* in association with KERAFED introduced in 2012-13 as a market intervention by state government has been beneficial to the coconut growers. However, to be effective necessary logistics are to be arranged for procurement of coconuts through all *KrisibiBhavans* along with facilities for safe storage of nuts and also for primary processing of nuts into copra. Steps are also necessary to avoid delay in payment of prices to the coconut growers for the nuts procured.
42. The foremost strategy for improving the coconut production in Kerala is the massive cutting and removal of senile and disease affected coconut palms which are beyond recovery, removal of over aged palms; regulating the palm density and replanting with high yielding planting materials along with adoption of suitable agro-management practices in farmer participatory cluster mode. Other strategies for betterment of coconut sector is listed below,
1. Replacing old palms will require enormous quantity of seedlings. Hence, urgent action should be initiated for replanting such seed gardens with parental lines of new and improved varieties recommended for the respective regions. Further, to increase the capacity for hybrid seedling production, a decentralized production mechanism is to be envisaged by maintaining a centralized pollen storage and supply mechanism.
  2. Formation of third party monitoring/suggestive mechanism for the planting material production by the state department of agriculture.
  3. The early indications from the ongoing multi-institutional network project supported by State Planning Board running at six sites across the state reveals the possibility that alleviation of soil related constraints can regain health and productivity of the coconut palms. Hence, the set of best management practices to alleviate the soil related constraints which include amelioration of surface soil acidity with lime/dolomite and subsoil acidity with gypsum, external fertilizer inputs of not only NPK but also secondary nutrients calcium, magnesium and sulphur and micronutrients copper, zinc, molybdenum and chlorine, and additional input of chlorine through common salt apart from recycling of all the palm wastes to the basin needs to be promoted. Taking into consideration the shift of our society to a largely non-agrarian one, an input delivery model, aiming to make available external inputs at the door step of the coconut farmers also needs to be promoted. These practices have to be scaled up through the ongoing 'Keragramam' scheme with the active involvement of coconut producer societies in a farmer participatory mode.
  4. Systematic coconut based cropping/integrated farming system as a strategy to make coconut farming economically viable in small holdings needs to be highlighted. This strategy is highly relevant since presently coconut growers in Kerala are more exposed to economic risks and uncertainties owing to the high degree of price fluctuations.
  5. Promote more entrepreneurs in coconut sector by establishing 'Coconut Parks' by state government for organized processing for value addition will help coconut farmers to de-link the over dependence on coconut oil in determining coconut price. In Kerala, there is tremendous potential for the development of coconut sector especially in view of the investment friendly ambience due to the organized coconut farmer groups. The state has already formed 7130 coconut producer's societies (CPS), 452 coconut producer federations (CPF) and 29 coconut producer companies (CPCs), and the potential for large scale operations in the coconut value added products is possible through harnessing the synergy of these CPCs. Support may be provided to value addition projects in coconut through the establishment of Coconut Parks.

6. Potential for production and marketing of neera is a strategic area which has raised lot of expectation. Value added products like coconut palm sugar, palm jaggery, coconut honey and coconut syrup can also be made from neera. Technologies are now available for preserving and packing coconut inflorescence sap as 'neera 'or sweet toddy as non-alcoholic health drink. Many of such federations have started producing and marketing neera. Efforts may be made by state government through Department of Agriculture to assess and refine the technologies made available for neera production so as to standardize the technologies for scaling up neera production on a commercially viable basis.
  7. Farmer participatory initiatives on a compact area basis are to be promoted for the integrated management of diseases like Thanjavur wilt and widespread yellowing of palms observed in northern districts of Kerala state.
  8. Identify the most favourable regions for large scale production and commercial integration and establish farmer participatory coconut parks.
  9. A novel policy initiative shall be chalked out to address the labour scarcity. Here we need to identify the status of traditional climbers, the societal acceptance of new climbers by breaking the cognitive beliefs and thrusting an overall reorientation of this pressing issue. LSGs can play a role in linking trained skilled palm climbers under schemes like Friends of Coconut Trees (FoCT) and coconut farmers by promoting labour bank concept under decentralized people's planning to address the problem of shortage of labour and high wage rate.
  10. Establishing block level/panchayat level hubs with forward and backward integration along with unit level collection centres under the supervision of CPS networks.
  11. Provide the mechanism to reflect trade concerns of Kerala in the forthcoming RPEC Free Trade Agreement.
43. *Natural Rubber.* Kerala contributes 78 per cent of the total rubber production in the country. The state produced 5.07 lakh tonnes of Natural Rubber during 2014-15 which is 21 per cent lower than the previous year. NR sector contributed to around 25% of the agriculture GDP of the State during 2013-14 (43 % during 2010-11). More than one million smallholders depend on rubber plantation for their livelihood. Rubber growers are small/marginal farmers with an average holding size of 0.54 ha and rubber small growers' net income has declined due to fall in price. Skill-gap on technology adoption and negative impact of climate change adversely affected production and productivity of natural rubber. Shift from massive production from estates to production by masses (small holders) necessitates change of the status of rubber cultivation as a standalone activity. Rubber, of late confronted with unprecedented crisis on account of the low level of market prices and subsequent menace.
44. It is striking that for the past six years the rubber prices kept falling continuously. For instance, the average market price per kilogram of rubber in the year 2011-12 was Rs 208 which nose-dived to Rs 90/kg in the year 2016. It is an indubitable fact that the reason for price fall is the erroneous import policy adopted in the regime of trade liberalization and subsequent regional trade agreements. For instance, the quantity of import hovered around 25,000 in the 1990s has reached 1.9 lakh in the year 2010 by the year 2015 reached up to 4.15 lakh tonnes. It is noteworthy that even in the case of synthetic rubber the imports are huge (seven lakh tonnes in the year 2014). It is worthwhile to note that, in India, we produce 95 per cent of the domestic requirement (10 lakh tonnes) of the natural rubber and hence the demand gap is only 0.5 lakh tonnes. Meanwhile the average annual import is more than 4 lakh tonnes. It is evident that there is no short cuts for elevating the natural rubber prices other than the complete ban on rubber imports, which unfortunately not the pragmatic solution in the as we are already embedded in several trade agreements. Timely replanting is another area of concern. The field level insights reveal that whenever the attractive rubber prices are



prevalent, producer tends to explore the maximum product from the tree, by postponing the replanting and in the event of price crash lack of interest in investment keep the replanting in abeyance, there by falling into a vicious cycle, in turn affecting the sustainable natural rubber production. In Kerala, as of now, the ageing plantations with low yielding trees do not hold the promise of a turn around. It is also observed that the rubber cultivation in the recent times shifting to low-cost countries and to non-traditional regions within the major rubber producing country.

45. The potential for ancillary income generation in natural rubber sector for small holder empowerment through cultivating fruits and vegetables in young rubber plantations of Kerala state has to be utilised. Trials of Rubber Research Institute of India has proved that a variety of food crops such as upland rice, banana, pineapple, yam, ginger, turmeric and various vegetables can be successfully intercropped with young rubber plants during the initial 3-4 years. Similarly, feasibility of mixed cropping in mature rubber gardens with compatible crops also has to be explored. There is a need for convergence of schemes implemented by state government for promoting vegetable and fruit production with Rubber Board Schemes to utilize this potential. Following strategies have to be emphasized for improvement of the rubber sector in Kerala,
  1. Homestead rubber processing without required infrastructure and skills leads to inferior quality and heterogeneity of produce/ inconsistency in supply. Efforts are needed for realization of higher price and increasing income of rubber growers through quality up-gradation of produce (Sheet rubber) by renovating/refurbishing the existing Group Processing Centres under Rubber Producer Societies (RPS) as growth centres. Emphasis is also required for skill up-gradation of labour in the tapping job so as to rectify the drawbacks and improve productivity for ensuring availability of superior quality produce (sheet) for manufacturers and better farm gate price realization to growers. Potential for linkage with NSDC/ PMKVY schemes can be utilised to implement such a skill development initiative in harvesting technology in NR sector.
  2. A consortium approach for raw material procurement and sale of output in the block rubber (TSR) and concentrated latex processing sectors is suggested to reap the advantages of scale economies.
  3. A comprehensive insurance programme shall be implemented that covers the price crash regime of the rubber.
  4. Historical trend analysis shows that the rubber prices had been always cyclical in nature and the recovery of price crash regime is imminent. Appropriate programme and schemes in the line of long term market intelligence is necessary to create awareness among stakeholders.
46. *Areca nut*. This industry forms the economic backbone of nearly six million people in India and for many of them it is the sole means of livelihood. India ranks first in both area (49%) and production (49%) of areca nut. The world area and production of areca nut showed a tremendous increase during the last four decades. In India, areca nut is cultivated in an area of 453 thousand ha with an annual production of 632 thousand tonnes. Karnataka, Kerala, Assam and West Bengal are the major producers. Kerala accounts for 22% area and 20% production of areca nut in the country.
47. Though the areca nut is not an export oriented crop, the internal demand has been always remained at higher levels. Stagnating market prices and increasing cost of production, especially the skilled labour charges in the recent times have generated livelihood concerns of areca nut farmers in India. Surging imports, which is around 12 percent of the domestic production, certainly has a significant role in price stickiness. It is a researched fact that more than 75% of the domestic areca nut trade is lies in the hands of private traders, wherein co-operatives have little bargaining position. This eventually results in frequent fluctuations in prices due to poor market intelligence, market hoarding

and imperfect market formation. The price spread analysis of arecanut indicated only a meager share of producer in the consumer price. These indiscriminate expansions of area under arecanut due to the remunerative price prevailed during the period of 1995 to 2000 have resulted in the surplus production of arecanut in the country. Though, alternative uses and medicinal values of arecanut have been reported viable technologies are yet to be developed on an industrial scale for exploiting it economically. The methodologies for alternate uses are available but due to high cost of areca raw material the commercialization has not taken place. Social cost of arecanut promotion is another issue to ponder. Arecanut sector in India is facing a crisis owing to the policy level conflicts of interests and is a matter of concern for the millions of small and marginal farmers who are solely dependent on arecanut farming for their livelihood. On one hand the possible huge social cost of growing arecanut with all the existing institutional support for the crop, and on the other hand the possible marginalization of millions of farming community in the event of threats of partial or complete ban on the cultivation and allied activities of the crop are major issues to contemplate.

48. Following strategies have been suggested for arecanut plantation,
  1. Keeping in view the recommendations of the Paulose Committee and Rathinam Committee and ground realities, further expansion of arecanut in non-traditional areas should be discouraged. Rejuvenation of senile and unproductive areca gardens with high yielding varieties/hybrids released by CPCRI is suggested.
  2. The technological interventions should be implemented through farmer participatory group approach. Clusters of a contiguous area of 25 ha each is to be delineated and Community Based Organizations (CBOs) of farmers are to be formed to implement the interventions.
  3. Soil test based Integrated Nutrient Management practices; organic recycling through vermin composting of arecanut bio-waste etc. are excellent options for sustainable and efficient arecanut production.
  4. To reduce the cost of production and increase the unit level farm return arecanut based intercropping, mixed cropping and mixed farming should be practiced.
  5. Steps are to be taken to streamline the marketing systems by making it much more organized one. In the recent period, the low quality/low grade arecanut is imported to India in huge quantum. Therefore, adequate trade policy measures should be taken in this regard along with enforcing stringent food safety based trade barriers to safe guard the remunerative prices in the domestic sector.
  6. We need to have a futuristic vision to evolve integrated and scientifically planned areca based cropping models in the state which include livestock, fishery component, and staple food components.
  
49. *Coffee*. Coffee in India is largely grown in the southern states of Karnataka (70%), Kerala (22%) and Tamil Nadu (7%). Small growers dominate the coffee sector both in terms of number of holdings and production. Kerala produces 68000 tonnes of coffee (21% of national production) from in 84000 hectares. The productivity of coffee in Kerala in terms of bearing area is 781 kg/ha, which is lower than the national average (799 kg/ha). Internationally coffee has seen its production and export grow rapidly. But India's share in standard compliant global production is only 2% and standard compliant production in India is only 15% of its national production (in Vietnam it is more than 30%). In Kerala Robusta variety of coffee is predominant (96%) while Arabica variety accounts for meagre 4%. It is a matter of concern that Robusta fetches comparatively lower prices and the brewing value is also less. As in the case of other plantation crops price volatility is a pressing issue in the case of coffee. Coffee procurement in Kerala is mostly oligopsonic in nature characterized by large number of small growers with very few buyers. Studies reveal that only 10% of coffee produced in the state is sold through auctions as most of the small growers prefer to sell the

unprocessed crop directly to buyer/agent. Predominance of small growers without effectively organized set up who depend heavily on private coffee buyers due to spot-cash requirement. This, in fact traps the coffee growers into a credit-interlocked dependency with the private buyers. Volatile prices in the liberalized market, a buyer driven-roaster controlled value chain, ineffective cooperative societies, labour scarcity, and credit-interlocked markets are all the issues to contemplate.

50. Following are some strategies to strengthen the coffee production and marketing sector,
  1. Strengthen the existing coffee growers association and increase the number of such groups in the line of coconut producers' societies/federations/companies through availing the ongoing scheme of Coffee Board in this regard.
  2. There has been, of late, a growing coffee consumption culture in the state and we are witnessing successful coffee chains establishing in the state (For instance, Café coffee day, Beans and flavours). We need to ensure the vertical integration (and horizontal through clusters/societies/federations) coffee growers in the state and equip them to form such coffee chains to reap the benefit of the vibrant domestic value chain.
  3. Average yield levels of Kerala are lower than that of the national level. It is also learned that 60-70 per cent increase in yield can be obtained through proper irrigation of Robusta. This has to be further studied and appropriate recommendations have to be chalked out and implemented.
  4. A thorough scrutiny of existing schemes for replanting, water augmentation, quality/processing up-gradation and the extent of usage of these schemes in the state has to be carried out. The growers should be equipped to avail Integrated Coffee Development Project-Sub component- Replanting of the Coffee Board. We also need to motivate/encourage farmers to replant the garden with Arabica variety of coffee.
  5. Encourage the market intelligence and price discovery mechanism through participation in online auction and future trading. In this respect awareness creation and plausible auction plan is required.
  6. Sustaining as a coffee producer and exporter entails production of standard compliant coffee, hence, optimal targets in phased manner has to be fixed for the production of standard compliant coffee.
  
51. *Cardamom*. Small cardamom production in India is largely concentrated in the state of Kerala. The state has about 40,000 hectares of land under cardamom during 2014-15 which accounted for nearly 60 per cent of the total area under small cardamom in India. The contribution of the state in total production of small cardamom was 87.6 per cent. During the last 20 years, the crop has witnessed steady growth both in terms of output and productivity with compound annual growth rates of over 4 per cent. But the area under the crop has witnessed a decline during the last two decades mirroring a similar decline at the national level. The area under cardamom which was 66,000 hectares during 1990-91 has come down to 40,000 hectares. More than 90 per cent of area under cardamom is located in Idukki and Wayanad districts of Kerala. The productivity of the crop has shown a high tendency for instability during the last three decades with a high coefficient of variation. This indicates the occurrence of fluctuation in the farm profits for the producers and the influence of weather parameters in determining production. The small cardamom exports from India earned a value of INR 3,234 million during 2014-15, the bulk of which originated in Kerala. The cardamom produce from the state has a better quality in comparison to the produce from Gautemala, India's major competitor in the cardamom export market. Given the agro-climatic limitations for horizontal expansion as a strategy for enhancing cardamom production, the crop offers good potential for creative utilization and development in supporting the farm livelihood security of cardamom producing regions in Kerala.

52. The following aspects of the crop sector needs to be addressed/focused to strengthen the small cardamom economy of the state,
1. More than 80 per cent of the area under cardamom in Kerala is planted with a single farmer variety, Njallani type. This poses a threat to cardamom biodiversity. Several farmer varieties are available in cardamom which needs to be conserved to enhance varietal diversity. Targeted schemes for incentivizing on farm conservation and in-situ conservation and promotion of varietal diversity need to be implemented.
    1. Alternate varieties for popularization at Idukki- ICRI-2, ICRI-5, ICRI-6, PV 1, PV 2
    2. Alternate varieties for popularization at Wayanad-Appangala-1, Appangala-2, ICRI-2, ICRI-5, ICRI-6, PV 1, PV 2
  2. Identification of strains and crop management practices for inducing synchronized flowering so that harvesting cycles can be reduced leading to saving in labour cost
  3. The farmer variety Njallani is noted for its high input responsiveness. The geographical spread of the crop has lead to predominance of high input intensive practices across the cardamom growing tracts of the state. An alternate system of production need to be made available for those who opt for low input intensive /sustainable practices.
  4. Though seedlings of cardamom can be used as a planting material, suckers from mother plants are more suitable as planting material. The planting material supply system in cardamom needs critical interventions to ensure availability of a wide choice of varieties for cardamom farmers.
  5. Experiments have demonstrated that judicious use of pesticides at the correct time can reduce the need for pesticide sprays in cardamom to 4-6 rounds of spraying. The demonstration of this technology needs to be taken up urgently along with sensitization efforts among farmers and agricultural department personnel to reduce the pesticide load in the cardamom production ecosystems.
  6. At present, Alleppey Green Cardamom is the only Geographical Indication available in cardamom. Considering the limited geographical spread and distinct pockets where cardamom is being grown in Kerala, the possibilities for availing GI registration need to be taken up. This will help in creating a brand identity and provide an opportunity for premium pricing of the produce.
  7. The small cardamom is a labour intensive crop (several rounds of picking/trashing/plant protection operations). Strategic agronomic management for rationalizing labour use need to be implemented.
  8. Targeting development of varieties tolerant to thrips should be given priority in research. In the emerging scenario where environmental pollution arising from pesticide use and pest residues in produce are major concerns, yield parameter alone might not be a suitable indicator for varietal suitability.
  9. Supplementary fertilizer application to supply micronutrients can enhance crop health and enhance productivity. Incentives for promoting adoption of soil test based nutrient application schedule are needed.
  10. Currently, the share of value added products from cardamom in total cardamom exports is less than 10 per cent whereas it is more than 30 per cent in crops like black pepper and cinnamon. This indicates a latent potential for strengthening the cardamom value chain through post harvest processing and value addition.
  11. Since the picked cardamom needs to be processed immediately, availability of processing facility (driers) is critical to ensure production of clean good quality produce. The availability of processing facility in Wayanad and some places in Idukki need to be strengthened through cooperative efforts.

53. *Cashew*. India is the third largest producer of cashew nut in the world and accounts for one-fifth of the total area under cashew cultivation in the world. The productivity of cashew in India is lower than the world average. Till late 1980s, Kerala was the leader in area and production of cashew in the country. Today, although the state is the major processing and export hub, it loses out in terms of total production. Kerala accounts for 11 per cent of cashew production in India and stands fourth in terms of production after Maharashtra, Andhra Pradesh and Odisha. Cashew production in Kerala is low due to the constraints, *viz.*: predominance of senile plantations, planted under degraded lands in neglected conditions; heavy yield loss due to outbreak of tea mosquito bug and absence of dwarf and compact high yielding varieties. At the same time, the processing capacity of cashew industry is much higher than domestic availability and hence we had to depend on imports of raw nuts from overseas. The USA is the major buyer of processed cashew kernels from India (36 percent of Indian export) followed by UAE and Japan. Of late, it has become extremely tough to attract the youngsters into the cashew industry, especially due to the poor working conditions prevailing in the sector. Therefore, the migrant labourers from North and North-Eastern states are trained and recruited in the industry. As a matter of fact, the cashew processing industry in Kerala has to compete with the processing units in other states that offer comparatively lower wages with no commitment on social protection and welfare measures. This in turn affects the cost competitiveness of the state. As of now the cashew sector in the state is faced with several challenges; most importantly, the scarcity of raw material is a menace, especially in the context of very high installed processing capacity in the state. The backwardness of the processing industry in terms of infrastructural facilities, operating environment, hygiene and quality standards are grave concerns in view of the stringent international food safety regime. The value addition and product diversification of cashew apple and cashew kernel is meager in the state that certainly acts as a major hindrance for the value chain up-gradation.
54. Following are the strategies to be encouraged in cashew sector of Kerala,
1. Replace all senile and seedling plantations by high yielding varieties, promote nurseries for raising quality planting materials of recommended varieties to meet the requirement.
  2. Adoption of high density planting system is a major option to increase the productivity of cashew and farmers income. In general, planting density of 384 plants/ ha (6.5 m x 4 m), 400 plants/ ha (5 m x 5 m) and 400 plants/ ha (5 m x 4 m) give two times more yield than normal planting density of 156 plants/ ha (8 m x 8m).
  3. Un-used lands in regions with low soil fertility and hard lateritic areas could be converted to cashew plantations.
  4. With regard to the cashew processing, states other than Kerala have almost completely mechanized their cashew processing. We are backward in this respect mainly due to cost of investment and the apprehensions on broken kernels resulting from machine processing. We need to urgently address this issue and seek possible options for complete mechanization.
  5. It is fact that the public sector player in the cashew industry-Kerala State Cashew Development Corporation (KSDC) has been incurring losses for several years due to the inability in raising sufficient working capital. This issue should be addressed at the earliest to make KSDC as a role model employer in the cashew sector of the state.
  6. Worldwide, Steaming method of cashew processing is considered to be more hygienic than the traditional method that Kerala industry is practicing. Keeping in view the sanitary and phyto-sanitary issues and emerging food safety stringency we need to adopt more hygienic measures at processing node.

7. There is a need to promote the domestic consumption of cashew in the state through elevating the aggregate demand. We need to tap the niche segment in this regard through more aggressive promotional strategies.
  8. To improve/upgrade the working conditions, the state machinery may provide one-time subsidized grant to the employer to modernize the infrastructural facilities and processing practices.
  9. Alternate approaches to develop value added products from the broken kernels (30-40 per cent loss during processing) through linkages CFTRI Mysore wherein they have already developed product lines of this kind.
55. *Tea.* India contributes 1/4<sup>th</sup> of the world tea production. Kerala accounts for 6.3 per cent of total tea production in the country and five per cent of the total area under tea in the country. The market prices of the tea was favourable during early 1990s that hovered around Rs 70/kg but in subsequent years the price went down and reached around RS 50/kg. Thus the prices are lowest levels in the recent period and even the exports came down from 25 per cent of the domestic production to 18 per cent during the year 2014-15. In Kerala, the tea companies have neglected timely replanting and as a consequence, the tea gardens in the state are predominantly old. Low prices and high cost are the major issues confronted in the sector. Besides, archaic labour law, and withdrawal of small holder from the sector are concerns. The studies indicate already around 30 per cent of the small owners have exited the business. Eighty per cent of the domestic market is dominated by Assam tea that priced at Rs 140/kg, Tamil Nadu tea fetches Rs 100/kg and Kerala tea loses out in this aspect. Lack of reinvestment in the tea plantation, and timely replanting when the prices are high have caused irreparable damage to the sector. The companies while reaping benefits when the prices were good had never cared for improving the quality standards or developing a tea brand and eventually we are out of the competition.
56. Strategies for tea sectors is listed as below:
1. Action plans need to be formulated and implemented with optimal yearly targets and a time bound long term strategy to increase the productivity through replanting, rejuvenation, pruning, infilling and shading with trees, and increasing organic content of soil by burial of pruning.
  2. On the production front, alongside replacing old bushes with highly productive new varieties of cloned tea, a plan for targeted replanting subsidy should be formulated.
  3. A comprehensive ‘Munnar package’ should be developed to provide assured reasonable wages to the plantation workers and eliminate the prevailing wage discrimination practices, which also comprising modalities for strict monitoring of the compliance regarding the social security, health, education and welfare of the plantation workers.
  4. Even with the existing senile bushes and prevailing low prices of tea, if productivity can be increased, higher earnings can be ensured to the worker. Considering the tough terrains, mechanization is limited in Kerala, especially Munnar conditions and it is impossible to expect an increase in the daily harvest of the worker. The scenario necessitates an orientation towards innovative marketing strategies by reducing the dependence on auction sales alone.
  5. It is a known fact that some of the gardens in Munnar produce the world’s highest- grown tea and the niche market in this respect is so far unexplored. Keeping view of the possible collective ownership by majority women workers in long run, an action plan to create a new brand through collaboration with the network of Kudumbasree, the women’s’ self-help groups of Kerala should be prepared and implemented.
  6. Chalk out a programme to ensure a rightful share in the earnings of the tourist economy through exploring the potential of agro-eco-tourism in tea growing tracts of Kerala. Here we

need to formulate a self-sustaining project led by women's initiative, youth, tribal people, along with representatives from state machineries, agricultural scientists, and ecologists.

57. *Cocoa*. Across the world, cocoa is grown in 58 countries in around 10 million hectares with an estimated production of 4.36 million tonnes. Among the major countries, Côte d'Ivoire has the highest productivity of 660 kg/ha, while the world productivity is 504 kg/ha. The four West African countries viz., Côte d'Ivoire, Ghana, Cameroon and Nigeria contributed for 73.3% of worldwide cocoa production. In India, cocoa is cultivated mainly in the states of Tamil Nadu, Andhra Pradesh, Kerala, and Karnataka. India produced 15,133 tonnes of cocoa from an area of 71,245 hectares in 2014-15. Tamil Nadu has the highest area under cocoa (33.6%), followed by Andhra Pradesh (31.1%), and in the case of cocoa production, Kerala has the major share (41.8%) followed by Andhra Pradesh (37.0%). The cocoa industry in the country had expanded to a considerable extent in recent years. At present more than 15 industrial entrepreneurs and firms existing in the field demanding nearly 30,000 tonnes of cocoa beans of which the present domestic availability is only about 40 percent. Considering the market growth in the chocolate segment In India, which is about 20 percent per annum, cocoa has a great potential to develop in future years.
58. On the other hand, there are emerging and evolving hurdles to cross, in the forms of highly fluctuating international prices for the commodity, ever increasing mergers and acquisitions in the cocoa industry, lack of high-level technical competence and entrepreneurship in the domestic sector. To make cocoa farming more profitable, farmers need to produce more cocoa. Average productivity increases when entrepreneurial farmers are trained to use inputs such as fertilizer and better cocoa varieties. Domestic supply chain of cocoa in India is still in rudimentary stages. CAMPCO and Cadbury India Ltd (now Mondelez India) are the major procuring agencies in India, who are directly procuring the cocoa beans from farmers. The value share of the producer/farmer is a meager 32% because most of the farmers sell the produce as wet beans, even without doing minimal processing. Drying yards, primary processing facilities, and storage facilities are lacking in the case of most of the cocoa farmers. Since the stringent food safety standards and trace back systems are evolving in international arena, it is a real challenge to establish robust procuring system in the upstream end of the cocoa value chain in the country.
59. Strategies to be followed for cocoa development is as follows,
  1. Cocoa is an important commodity traded in the international stock exchanges. In the domestic level also we may formulate a producer consortium to facilitate the future trading and stock investment of cocoa beans, and there by combat the speculative price movements to a large extent. Risk aversion mechanisms should be adequately taken while advising the area expansion programmes on cocoa wherein we should discourage the monocropping of cocoa.
  2. Urgent steps should be taken to establish village level primary processing units and capacity building for fermentation and drying of cocoa beans with the formation of strong farmer aggregates, women SHG's and rural youths. Development of exclusive market yards and assembling places for cocoa beans along with the adoption of high quality food safety standards would be a pro-active step for better realization of bean prices.
  3. Assured buy-back systems developed in the frame of contract farming under the stake of government (tripartite arrangement) can help the growth of the sector. State machinery should go for Memorandum of Understanding with the leading chocolate manufacturers for appropriate marketing arrangements and supply chain development.
  4. Sustainable cocoa production wherein cocoa is produced without chemicals and devoid of child labour is gaining popularity all over the world. We may explore this opportunity because India is one among the few countries where cocoa is produced without engaging child labour

and moreover, a major cocoa growing district in Kerala (Kasaragod) is declared as an organic district. On a pilot basis, we may explore this opportunity by popularizing the organic cocoa and may endeavour for organic/sustainable certification.

### *Fruits*

60. Major fruits cultivated in the state are Banana, Mango, Pine apple, Jack fruit and papaya and the cumulative area under cultivation of these crops is 3.09 lakh ha. As compared to national productivity, the state average yield is very low reflecting the poor attention given to these crops. Crop-wise opportunities and challenges are summarised below.
61. *Banana*. Availability of unique varieties like Nendran and shade tolerant homestead varieties and rich varietal diversity are the strengths of the crop in addition to its scope in processing industry by way of utilization of wafers and fibre from pseudostem. Some of the challenges of growing the crop include non-availability of quality suckers and virus free tissue cultured planting materials leading to wide use of diseased suckers from Tamil Nadu; Low productivity; and high yield loss due to pests and diseases and other natural calamities coupled with lack of crop insurance programmes.
62. *Mango*. Commercial Mango orchards are confined to Muthalamada of Palakkad district. Rich varietal diversity and popularisation of Mango fest promoted by KTDC are the positives to be tapped and strengthened in the future. Non-availability of quality grafts; under-exploitation of pickle type varieties in social forestry planting programmes; Non- scientific use of chemicals for artificial ripening; and irregular bearing are the challenges to be addressed.
63. *Pineapple*. Pine apple has the advantage of high productivity as compared to other fruit crops. It is preferred due to varietal diversity, including export oriented Mauritius variety; and low pest and disease. It can be cultivated anywhere in the state (from low land to upland). Some of the constraints in pine apple cultivation includes lack of support for planting in rubber plantations; and indiscriminate use of ethrel as flowering agent.
64. *Jack fruit*. Jack fruit is an integral component of homesteads. Rich diversity and highly remunerative timber value are the attractions. Heavy post -harvest loss, maturing late after the onset of monsoon resulting in reduced fruit quality; and non- availability of quality grafts are the challenges.
65. *Papaya*. Papaya is restricted to homesteads and kitchen gardens without any major commercial orchards in the state. Heavy incidence of mosaic and mealy bugs, lack of quality seeds of dwarf types are the problems faced by farmers.
66. *Exotic fruits*. Scope for mangostein, rambutan, pulasan, durian and avocado and Strawberry (in high ranges) as fresh fruits in domestic and export market and in processing industry are to be explored. Making quality grafts and air layers available is a challenge.
67. *Strategies*. Following are the identified strategies for fruit sector in Kerala,
  1. Considering the issues and challenges of the fruit sector in the state, following strategies are suggested for the future.
  2. Expanding fruit cultivation to the low and mid hill region in commercial scale; Promotion of minor hardy fruits in homesteads; and identifying the blocks for growing appropriate fruit crops and ensure planting material supply, Production infrastructure, Technical know –how; and supply of inputs.



3. Updating progeny gardens of DOA and KAU farms with HYV. Open jail at Cheemeni, Kasaragod district can be entrusted with task of establishing largest field gene bank and progeny mango orchards in South India.
4. Implementing Schemes for 'Fruits for eco-restoration'; replacing eucalyptus and acacia with Jack fruits and minor fruit trees for afforestation, along with apiculture promotion to address man – animal conflict and ensure income for state and tribal population.
5. Setting up model fruit and vegetable villages under KVK and developing farmer markets for fruits attached to KVK of each District.
6. Creation of proper storage facilities (low cost storages & Cold stores) for judicious utilization of the harvested produce and smooth running of the processing units and strengthening marketing channels.
7. Value addition of Jack fruit and minor fruits; and extracting high value products from garcinia, kokum and tamarind for revenue and ensuring employment to women and upgradation of processing units.
8. Formation of Growers' cooperatives or growers' companies, strengthening Public-Private Partnership models for enhancing commercial cultivation and contract farming.

#### *Medicinal Plants*

68. The National Medicinal Plants Board take up programmes for conservation, proper harvest management, cost effective cultivation, research and development, processing and marketing of raw materials of medicinal plants. In Kerala, schemes for scientific cultivation, processing and marketing of medicinal plants on commercial basis were undertaken since 2009. Some of the interventions include empowerment of Schedule Tribes; cultivation of medicinal plants in Jails; and establishment of model nurseries in research institutes and agricultural farms with 100% assistance. For commercial cultivation of medicinal plants, a subsidy rate of 30%, 50% and 75% to crops of high demand, endangered and highly endangered species, respectively and till now a total of 533.26 ha of area has been cultivated on cluster basis with assistance of Rs 14.24crores. To ensure market for the produce, MoUs have been signed with the major Ayurvedic Pharmaceutical Companies.
69. Major challenges in the sector include lack of facilities for collection and transportation of the raw material produced by the farmer clusters; difficulty in setting up of processing units based on SPV mode as prescribed in the NMPB guidelines; lack of support for crops those are in demand by the Kerala Ayurveda Industry; Lack of technical knowledge on GAP of medicinal plants; bureaucratic procedural delays; and low private sector participation in the schemes.
70. *Strategies.* Following points should be emphasized for improvement of medicinal plant sector in Kerala,
  1. Assistance should be provided to additional crops that have demand in the Kerala Ayurveda Industry like *Vetiveriazizanioides*, *Kaempferia rotunda*, *Pseudarthriaviscida*, *Cycleapeltata*, *Justiciaadathoda*, *Trichosanthes sp.*
  2. Reforming the norms for setting up PHM units apart from SPV mode as prescribed in the NMPB guidelines.
  3. Conduct awareness programmes at various levels.
  4. Setting up Collection centres & transportation facility (*viz.* mobile vending cart) at cluster level for easy marketing of raw materials.
  5. A campaign on the theme of "back to nature" should be initiated to popularise medicinal plants cultivation in homesteads through KrishiBhavans and KAU farms.

6. Since there is no established marketing channels locally, district level procurement arrangements through selected agencies in association with National Horticultural Board/Department of Ayurveda (Ayush)/Oushadi should be implemented.
7. Marketing channels for procuring raw, dried herbs for traditional, alternate and modern medicine streams needs to be explored at the state level.
8. With support of KAU and KVKs, training on medicinal value of these plants, scientific cultivation, pest and disease management, processing techniques have to be given to farmers by the Agricultural department.

### *Floriculture*

71. In India, floriculture comprises flower trade, production of nursery plants and potted plants, seed and bulb production, micro propagation and extraction of essential oils. Though the annual domestic demand for the flowers is growing at a rate of over 25% and international demand at around Rs 90,000 crores, India's share in international market of flowers is negligible (0.61%). However, India is having a better scope in the future as there is a shift in trend towards tropical flowers and this can be gainfully exploited by country like India with high amount of diversity in indigenous flora.
72. The agro-climatic situations in Kerala are ideal for production of flower crops, especially around homesteads in open and under protected conditions. The important flowers traded in our state are marigold, chrysanthemum, jasmine, lily, lotus, vadamulla, anthurium, and orchids. Out of the 61389 quintals of flowers traded in the state, 5.07% is chrysanthemum, 1.74% ixora, 22.84% jasmine, 2.67% lily, 15.18% marigold, 3.99% vadamulla and 47.65% other flowers. About 96% of flowers are distributed by agents of which 33.18% is from within the state and rest is from outside. Kerala has lessons to learn from the small state Sikkim in how to flourish in terms of employment and income generation through introduction and export-oriented cultivation of just one single flower crop, the orchids, as a lucrative livelihood for rural women. Having recently recognized the potential of its orchid industry, the state government has identified orchid industry as the priority area in their agricultural policy planning and maximum funds are allocated for promoting commercial cultivation of orchids. Given its orchid-growing potential, Kerala can be at the forefront of the international orchid trade. Cultivation of flowers will not only generate employment opportunities and bring high return for the farmers but also reduce the import and save foreign currency. High ranges of Kerala, the most ideal region for commercializing flowers, remain as a potential zone still to be exploited. Strategies have to be streamlined to ensure dissemination of technological ideas about flower farming in already existing plantations as a profitable intercrop. Side by side, innovation of ways and means for further expansion of floriculture as a profitable venture can be developed. All that it requires is addressing a few structural issues. A booming floriculture industry would not only do wonders for the local economy but also add another dimension to the State's efforts on women empowerment.
73. *Strategies.* Strategies for floriculture is listed below,
  1. Sensible crop diversification to accommodate high value crops in existing plantations as well as in every homestead becomes a promising solution if applied logically. The high ranges of Kerala, especially the hill districts, Wayanad and Idukki represent the most potential agricultural zone in the state for promoting agri-tourism and floriculture as lucrative enterprise to generate employment and income.
  2. Floriculture has a vital role to play in the socio-economic uplift of the rural folks of the state because of its capacity for income generation and employment generation, particularly for

rural women, leading to poverty reduction. Developing a strategy for rural development through floriculture-based hi-tech farming for netting a strong platform around the concept of rural tourism will be the most ideal. In this context, commercial floriculture under hi-tech mode in a flori-Village format through KVKs and research centres has relevance.

3. Strengthen homestead - based floriculture of both conventional and cut-flowers especially gerbera, gladiolus, irish lily, orchids, anthurium, marigold and chrysanthemums
4. Capacity building for small/youth entrepreneurs and women in scientific flower production and utilization.
5. Implementation of the floriculture development programme in the state will help to meet the season- bound requirement of flowers in the state and save state revenue through import substitution. Additional income generation through sale of planting materials can also be strengthened.

#### *Organic Farming and Good Agricultural Practices*

74. Organic agriculture generally implies alternate modes of agricultural production, which denounce the use of synthetic fertilizers and pesticides, plant growth regulators, and livestock feed additives. It is essential that the virtues attributed to organic farming need to be rechecked before promoting it as the only policy option or as a complementary option. Although increased attention is paid to organic components, particularly in soil fertility management and pest control, integration is the key in sustainable agriculture. Integrated nutrient management, integrated pest management, integrated weed management, integrated watershed management, and better land husbandry are some of such concepts. Along with the changes in farming styles, steps should also be taken to improve food distribution system, reduce food wastage, close the yield gaps, shift diets away from meat, and use resources much more efficiently. These strategies, if implemented based on sustainable principles, could double food production while greatly reducing the environmental impacts of agriculture. With a growing population and precarious food situation, we cannot afford to take risk with organic farming alone. A holistic approach involving integrated nutrient management, integrated pest management, enhanced input use efficiency and adoption of region-specific promising cropping systems would be the best farming strategy. Good practices related to soil include maintaining or improving soil organic matter through the use of soil carbon-build up by appropriate crop rotations, manure application, pasture management and other land use practices; rational mechanical and/or conservation tillage practices; maintaining soil cover to provide a conducive habitat for soil biota, minimizing erosion losses by wind and/or water; and application of organic and mineral fertilizers and other agro-chemicals in amounts and timing and by methods appropriate to agronomic, environmental and human health requirements. Careful management of water resources and efficient use of water are needed for both rain fed and irrigated crops. Good practices related to crop production begin by selecting cultivars of crops based on their characteristics including response to sowing or planting time, productivity, quality, market acceptability and nutritional value; disease and stress resistance; edaphic and climatic adaptability; and response to fertilizers and agrochemicals. Crop sequences must be devised to optimize use of labour and equipment and maximize the biological benefits of weed control by competition, mechanical, biological, and herbicide options. Provision must be given by using non-host crops to minimize diseases. Wherever appropriate, include legumes to provide a biological source of nitrogen. Regarding fertilizers, use organic and inorganic sources in a balanced way with appropriate methods and equipment and at adequate intervals to replace nutrients extracted by harvest or lost during production. Such a practice will maximize the benefits to soil and nutrient stability by re-cycling crop and other organic residues. Integrate livestock into crop rotations and utilize the nutrient cycling provided by grazing or housed livestock to benefit the fertility of the entire farm. Rotating livestock on pastures allow for healthy

re-growth of pasture. Adhere to safety regulations and observe established safety standards for the operation of equipment and machinery for crop and fodder production.

### *Organic Farming Options for Kerala*

75. Organic farming policy, strategy, and detailed action plan for Kerala State was declared during 2010 with a vision to make Kerala's farming sustainable, rewarding, and competitive, ensuring toxin-free water, soil, and food to every citizen. The general approach for implementing the strategies and action plan emphasized that the mission to convert Kerala into an organic State is to be achieved focusing on potential crops and areas in a phased and compact manner with the aim of converting a minimum of 10 per cent of the cultivable land into fully organic every year and thus achieving the target within five to ten years.
76. Kasargod, the northern most district of the state was declared as a fully organic farming district in 2012-13. The programme in the district is being implemented through the formation of farmer's clusters. Financial assistance is provided for registration of new clusters and strengthening of old clusters. Financial assistance is also provided for organic cultivation, on farm production of organic inputs, opening of eco-shops, and for organic certification. The Participatory Guarantee System (PGS) of certification was introduced in the district in 2014 and the Vegetable and Fruit Promotion Council of Kerala (VFPCCK) was declared as the implementing agency of the programme with the mandate of bringing all the vegetable crops under certification. In the other 13 districts of the state, 'Good Agricultural Practices (GAP) and 'Safe to Eat Food Production' programme was implemented from 2015 onwards directly by the Department of Agriculture. In parallel to GAP and safe to eat food production, PGS is also adopted for organic certification in these 13 districts directly by the Department of Agriculture.
77. The organic farming policy (2010) envisaged that on completion of the third year of implementation of the organic farming policy, a committee of experts comprising representatives of farmers and scientists should make a comprehensive assessment of the farmer's well-being, economy, and environment; and only after rectifying the drawbacks, if any, can the policy be implemented in rest of the areas. However, such an evaluation has not been undertaken so far.
78. The suggested measures for regulating the distribution and use of pesticides are not implemented and as such farmers get whatever pesticides available from the dealers without any prescriptions/recommendations of Agricultural Officers. Lack of proper technical support, especially in the changing climatic situations, has resulted in a dip in the confidence level of farmers in pursuing organic mode of farming practices. Constraints experienced by the farmers due to yield reduction during the conversion period and problems in marketing of organic produce could not be addressed by the Department of Agriculture because of non-implementation of the envisaged project activities.
79. Transition to organic farming is a continuous process and mechanism to provide technical support and financial incentives has to be in place on a continuous basis rather than certain disconnected activities. If the conversion phase is not guided on a regular continuous manner the whole process has to start afresh. Delay in proper implementation of project activities has adversely affected the sustainability of the initiatives to promote organic farming.
80. A positive outcome is that after the commencement of the organic farming initiatives by the government, there is increased awareness among farmers regarding the ill effects of indiscriminate

and unscientific use of chemical pesticides and the need to shift towards eco-friendly organic practices. However, majority of farmers are not properly educated about the appropriate farming practices to be adopted for raising different crops. Further, the inputs recommended for crop and soil health management under organic system are not available in required quality and quantity. This situation has given opportunities for unscrupulous elements to flood the market with products of questionable properties. Most often, organic inputs supplied by various agencies are of inferior quality. A continuous and intensive quality control mechanism is needed to prevent exploitation by such elements.

81. Some farmers from Kasaragod procure chemical pesticides from neighbouring districts when their crops are threatened with pests and diseases. They are forced to resort to this practice as there are no viable substitutes to manage pests and diseases to save the crops in the organic way, especially when the incidence is severe. Moreover, farmers find it difficult to get the promised “premium price” for the produce and not in a position to compete with the farmers following conventional farming methods. For managing sudden outbreak of pests and diseases in crops, there are no viable organic methods. Since chemical options are not permitted, farmers suffer economic losses. Although only red and yellow categories of pesticides are banned in the district, farmers are unable to use other less toxic pesticides since the Department of Agriculture is not giving any support to the farmers for such uses, resulting in large scale crop damage and economic loss.
82. Efficacy of the recommended organic methods of pest and disease management have not been properly tested under the different agro-ecological situations of the state. Although Kerala Agricultural University (KAU) has come up with an *ad hoc* Package of Practices for organic agriculture, most of them still remain *ad hoc*, and adequate experiments have not been conducted to prove their efficacy in farmer’s fields through systematic technology assessment and refinement. Hence, there is an urgent need to intensify research for evolving appropriate organic farming technologies for the management of pests and diseases of crops and to validate their field efficacy.
83. Low fertility status of soils in the district adversely affect the productivity of crops besides increasing pest and disease incidence problems due to nutritional deficiency, which are expressed as various signs and symptoms in plants. Economically viable organic substitutes for plant nutrients are yet to be worked out and freely available. Nutrition of plants has substantial impacts on the predisposition of plants to attack by pests and diseases. For example, one of the factors attributed to the widespread incidence of bud rot in the hilly terrains of Kerala is deficiency of calcium, potassium, and boron. Similarly, in banana, sigatoka disease incidence is increased by the deficiency of Ca, K and Mg. Therefore, application of these nutrients as chemical fertilizers cannot be withdrawn abruptly. Otherwise yield reduction will be substantial resulting in huge economic losses to the farmers. The present status of production of organic inputs clearly indicates the non- availability of the above inputs in sufficient quantity.
84. It is better to start organic farming with low volume high value crops like spices, medicinal plants, and aromatic crops. There will also be scope for practicing organic farming on case-to-case basis in traditional strongholds like hilly areas, rain fed and dry land farming system to cater to the demands of organic produces in urban areas who would pay premium prices for such commodities.
85. If somebody wants to go in for organic farming, primarily on commercial consideration or profits motive or to take advantage of the unusually higher prices of organic food, they must be encouraged to do so. In Kerala, traditional organic farming may prevail in certain areas where modern methods are consciously avoided, for example, Pokkali rice, scented rice, and medicinal plants.

86. Along with organic farming, GAP must also be promoted as an alternative to conventional agriculture.

*Strategies for 13th Five Year Plan*

87. Following are the recommended strategies regarding organic agriculture and GAP in Kerala,
1. Instead of spending the available resources to bring all cultivated area in the state under organic farming programme, the approach should be to focus on potential crops and areas in a phased and compact manner, for example, with low volume high value crops like spices, medicinal plants, and aromatic crops.
  2. Specific programmes may be chalked out in traditional organic farming sectors where modern methods are consciously avoided, for example, Pokkali rice, Kaipad rice, Njavara, scented rice, and medicinal plants.
  3. All support and encouragement shall be given to organic farming based on National Programme for Organic Production (NPOP) standards and third party certification intended mainly for export. Certification agencies accredited under NPOP issue the third party organic certificates. The certified produces can cater to the domestic market also for those who can afford to pay premium prices.
  4. Participatory Guarantee System (PGS) is an alternate and complimentary tool to third party certification. Most farmers in the state are small holders, therefore, the PGS is highly suited for spreading organic cultivation and certification in the state. PGS certification is mainly intended for domestic markets. The quality assurance standards are harmonised by the PGS Organic Council, which permits the use of its PGS label on a product as a mark of quality.
  5. A method of certification for GAP, which is both farmer-friendly and eco-friendly is essential for spreading the message of sustainable and eco-friendly farming among the farmers and for getting better prices for their produces. Certification based on 'Good Agricultural Practices (GAP)' is the ideal choice in this context. The benefits of organic agriculture can be achieved, even without complete conversion to organic methods by following GAP. A more reasonable and hopeful way forward is a sort of middle ground, where more and more farmers adopt the principle of organic farming even if they do not follow the organic standards religiously. In this scenario, both the poor farmers and the environment come out way ahead. By periodic revision, the GAP standards can be made more and more eco-friendly or even organic as the farmers gain more experience and easy access to sufficient quantities of quality organic inputs.
88. Programmes suggested:
1. A comprehensive assessment of the impact of interventions on organic farming on the farmer's welfare, economy, and environment in the state as envisaged under the organic farming policy (2010) shall be undertaken to reorient the strategies and to evolve suitable action plan for promoting organic farming or GAP in the state.
  2. Scheme on 'Good Agricultural Practices' (GAP) and 'Safe to Eat Food Production' shall be implemented in all the districts. The aim shall be to bring the entire area of food crops in Kerala under GAP certification during the plan period.
  3. The GAP certification programme shall be implemented in all the districts of the state. An on line software shall be developed for GAP certification.
  4. Parallel to the GAP and 'safe to eat food production', Participatory Guarantee System (PGS) certification will also be adopted. Initially, as in the 12th plan, the Principal Agricultural Officer of the district will function as the 'Regional Council for Organic Farming' and the Directorate of Agriculture as the 'Zonal Council' with the Additional Director of Agriculture

- (CP) as the nodal officer as in the 12th plan. Subsequently, the functions of Regional Council and Zonal Council will be entrusted with autonomous bodies. Assistance will be given during the first year for organic cultivation and for certification as in the 12th plan.
5. Samples of vegetables, fruits and other food products shall be collected from various outlets regularly and tested in the 'Pesticide Residue and Analytical Library, College Agriculture, Vellayanior other approved laboratories for the presence of pesticide residues and results published.
  6. The participatory guarantee system (PGS) of organic certification started in the twelfth plan, with the VFPCCK as the implementing agency shall be continued and PGS certification (and third party certification, wherever possible,) of other food crops and spices shall also be promoted in a phased manner.
  7. Awards shall be given for best performing Legislative Constituencies, GramaPanchayats, and Municipalities in addition to farmers in organic cultivation and GAP.
  8. The state organic farming cell sanctioned in the 12th plan shall continue to function in the 13th plan also.
  9. In all the districts, multi-locational On Farm Testing (OFT) of the ad-hoc organic recommendations for pest and disease management of major crops shall be conducted to assess the efficacy of recommendations. Front Line Demonstrations (FLD) shall be conducted to popularise organic and GAP methods of pests and disease management, which are found to be effective in OFTs. Interventions for OFTs and FLDs shall be included in the action plan of KrishiVinjanKendras (KVKs).
  10. Studies shall be conducted for evolving organic methods for the control of pest/diseases for which the ad-hoc recommendations are ineffective as revealed through OFTs and for which there are no organic recommendations at all.
  11. Until an effective package of organic methods of pest/disease management is evolved, farmers who wish to utilize IPM technologies to avoid crop losses, should be permitted to adopt the same, including the permitted blue and green chemical insecticides, fungicides, and herbicides.
  12. Farmers who resort to only organic methods of pest/disease management and incur crop loss/yield reduction should be adequately supported financially. Funds for the same are to be made available sufficiently in advance based on prior registration of farmers and assessment of crop loss.
  13. Strict measures of quality control are to be insisted for ensuring quality of organic inputs supplied to the farmers.
  14. Decentralized approach shall be promoted for the production and distribution of organic inputs in the required quality and quantity.
  15. In localities where poor fertility status of soil has adversely affected productivity of crops, farmers shall be permitted to resort to Integrated Nutrient Management (INM) practices with financial support from development agencies.
  16. Extension programmes to popularize organic farming and GAP will be field oriented rather than focusing on lecture sessions handled by experts from Government or NGO sectors. Successful experiences of farmers should be scaled up through extension activities.
  17. Support for the management and marketing of organic and GAP products should be provided to farmers on a sustained basis. Marketing support through eco-shops can be strengthened. Financial support for the farmers during the conversion period, assistance for certification and support to facilitate community based organisations (CBO)/Farmer produced organisations (FPO) shall be provided to the farmers.
  18. Guidelines (G.O (MS) No.22/2011/Agriculture dated 17.01.2011) (Appendix 4) for regulating the distribution and use of pesticides in the state shall be implemented.

### *Crop Health Management*

89. Incidence of pests and diseases which adversely affects crop production is a major problem experienced by farmers. Integrated pest/disease management strategies recognising the fact that crop health is an integral part of sustainable agriculture are to be implemented ensuring farmers participation. Studies have shown that the field level of adoption of plant protection technologies is at a low level only due to various reasons. Hence, effective steps are required to facilitate timely diagnosis and adoption of eco-friendly integrated pest management strategies. Available technologies for pest/disease management are to be field validated through on farm testing and effective technologies are to be demonstrated in farmers' field. Wherever required, efforts are to be made to refine the recommended technologies and for evolving appropriate IPM/IDM techniques. Besides, group approach is to be promoted on a contiguous area basis for effectively adopting plant protection measures involving farmer producer organisations, self -help groups and people's representatives. Successful experiences under the recently implemented crop health management scheme can be up scaled to benefit more localities where crop damage is reported due to pest/disease incidence. Analysis of incidence and intensity of pest/disease incidence and crop loss in major crops in the state is also required to formulate and implement appropriate interventions to manage the same. The strategies/programme suggested for crop health management includes the following:

1. Area wide participatory group approach may be promoted for effectively adopting plant protection measures involving farmer producer organisations, self- help groups and people's representatives.
2. Successful experiences of adopting participatory approaches for managing rhinoceros beetle, root (wilt) disease and bud rot disease of coconut under the schemes implemented by CPCRI may be replicated for the management of pests/diseases in other crops/localities from where crop loss are being reported
3. Interventions may be implemented for the management of stem bleeding, Thanjavur wilt and yellowing disease of coconut in selected localities in collaboration with LSGs, KVKs, ICAR institutes and commodity boards like CDB.
4. Assessing the incidence and intensity of pest and disease incidence and crop loss and conducting surveillance of major pests, diseases and weeds and forecasting their outbreak
5. Establishing new plant health clinics/referral clinics and strengthening the existing plant health clinics for enhancing their efficiency. The plant clinics facility has to be extended to at least 100 krishibhavans in each year so as to cover all Krishibhavans of the State in five years.
6. Continuously monitoring pesticide residue in imported fruits, vegetables etc. from neighbouring states and taking action to reduce it by intervening at the production level through collaborative programmes with the neighbouring states.
7. Continuous monitoring of invasive alien species of weeds and pests.
8. Research is to be initiated for testing newer molecules for the management of major pests and diseases of crops and for the use of nanotechnology in pesticide application.
9. KCPM has to be elevated as the Kerala Institute for Plant Health Management (KIPHM).

### *Soil and Root Health Management*

90. Studies have clearly revealed that soil related constraints including soil (surface and sub-surface) acidity, deficiency of major, secondary and micronutrients adversely affect the productivity of crops in Kerala. Typical laterite soils, the predominant soil type in Kerala state, have low N, medium P, low K and Ca, extremely low Mg, medium S, low Boron, Zinc etc. It is a highly weathered tropical soil with kaolinite as its clay with low nutrient holding capacity and CEC value. Because of high



temperature, the mineralization rate is high resulting in low organic matter status. Because of its laterite origin, the soil is with low alkaline elemental status and high in acidic elemental status such as Fe and Aluminium. In addition, the undulating topography and high rainfall leads to leaching resulting in high soil acidity. The highly weathered tropical soil with deficiency and imbalance of major, secondary and micronutrients leads to reduced crop health. High soil acidity induced fungal diseases is very rampant in the state. Plant disorders resulting from nutrient deficiencies and imbalances is quiet common all over the state which are very acute in shallow rooted and fibrous rooted crops. In the eastern high hills with steep slopes, there are reports of heavy crop loss in black pepper, arecanut and coconut and farmers are abandoning cultivation and are in search of other livelihood options. Best management practices for improving soil health suitable for different agro-ecological units in the state are also lacking. Due to various factors, soil test based nutrient management practices are adopted by very few farmers only. Of late, cost of fertilizers is also escalating which is a constraint faced by farmers to adopt scientific nutrient management in crops.

91. Under these circumstances strategies to facilitate amelioration of soil related constraints to crop production are to be implemented in the state which may include the following:
  1. Facilitate soil testing, issuance of soil and root health cards and application of soil ameliorants for correcting soil acidity and deficiency of nutrients. Promote use of concentrated organic manures, naturally available nutrient resources and chemical fertilizers when there are extensive nutrient deficiency symptoms.
  2. Facilitate providing different physical, chemical and biological conditions to rhizosphere of the crop to have a better root health and its continuous monitoring. Regular monitoring of soil pH, cation exchange capacity of soil, amelioration of soils with natural resources/chemicals, protection of roots with endophytes, prevention of subsoil hard pan etc. to have an ideal physical, chemical and biological niche to root. Need-based use of VAM, silica, boron etc. has also to be promoted.
  3. Taking into consideration the shift of our society to a largely non-agrarian one, an input delivery model aiming to make available external inputs at the door step of the farmers may be promoted.
  4. Develop best management practices for ameliorating soil related constraints in the major crops/cropping systems in different agro-ecological units in the state as being done under the ongoing multi-institutional project supported by State Planning Board on 'Enhancing the economic viability of Coconut based land use systems for Land Use Planning in Kerala State'
  5. The set of best management practices may be scaled up through the ongoing 'Keragramam' scheme with the active involvement of coconut producer societies in a farmer participatory mode.
  6. Studies may be taken up to assess the extent and intensity of subsoil acidity and its impact on different cropping systems in different agro-ecological units in the state. Similarly, studies to analyse the health of roots in relation to soil characteristics are also needed.

#### *Soil Survey and Soil Conservation*

92. Co-ordination among different agencies viz., Department of Agriculture, Land Use Board, Department of Soil Survey and Soil Conservation should be ensured while planning and implementing interventions pertaining to soil survey and soil conservation. The following activities may be taken up on priority basis.

#### *Conservation of Natural Resources through Watershed Approach*

93. Planning and implementation of natural resource management activities in a watershed perspective is essential for the holistic and sustainable development of the area. Integrated Watershed Management Plans especially for the ground water vulnerable Blocks in the State have to be developed and implemented.

*Protection of Catchments of Reservoirs of Water Supply / Irrigation Projects*

94. Proposes to conserve the catchments of the reservoirs of Irrigation projects/ Water supply projects like Peechi dam in Thrissur, Malampuzha dam in Palakkad & Peruvannamoozhi dam in Kozhikkode and other reservoirs on a pilot basis. This will help to check siltation in the reservoirs of irrigation/water supply projects and to maintain the capacity of the reservoir by protecting the catchment area.

*Strengthening the Training Infrastructure*

95. The State level institute of the Department, Institute of Watershed Development and Management-Kerala (IWDM-K) providing trainings on natural resources management to various stakeholders would be strengthened by providing adequate infrastructure and manpower.

*Completion of Detailed Soil Survey in the State*

96. The Department will complete Detailed Soil Survey in the remaining areas of the state by 2020.

*Upgradation of the Soil Museum to International Standards*

97. During this Plan period, the Department intends to upgrade the Soil Museum established at Thiruvananthapuram to international standards.

*Frontier Agricultural Technologies*

98. New technologies available for better crop health/soil health management are to be effectively utilised for sustainable development of agriculture sector in the state. Few of the relevant technologies are listed below. Farmers/farmer producer organisations may be facilitated to adopt the technologies by providing incentives. It is also necessary to conduct awareness-cum-training programmes on the selected technologies to benefit the farming community.

*Use of Efficient Root Endophytes for Better Adaptation and Performance of the Plant Even under Extreme Biotic and Abiotic Stress Conditions*

99. Easily colonizing root endophytes that can perform as bioregulator, biofertilizer, bioprotector, biocontrol and biodegrading (pesticides) agents may be used for both seed and seedling priming. Root health of major crops may be improved with the efficient colonization of root endophytes and the use of other soil ameliorant. This leads to better root health with high quality root architecture and root metabolomics / rootonics which improve the efficient absorption of water and nutrients from the soil. Moreover, the root endophytes should be able to degrade residual effect of pesticides used especially in vegetable and fruit crops. Addressing the problem of sub-soil acidity must be accorded the top priority.

*Use of Crop Friendly Geo-Textiles which Ensure Slow Release of Water and Nutrients to Crop Plants and Finally to their Decomposition*

100. The geotextiles (coirpith, perlite, peat materials etc.) should be impregnated with nutrient solutions. Water and nutrients should be made available to plants in a slow releasing manner to minimize the loss of water and nutrients. At their critical stages of the crop growth, the efficient microbes should decompose / mineralize the geotextiles / slow releasing nutrient mix in a faster rate.

*Use of Quality Agriculture Production Inputs*

101. Seeds, seedlings and planting materials should be high yielding, true-to-type and free from pests and diseases, primed with efficient root endophytes. Organic matter and manures used should be devoid of all contaminants including mycotoxins, heavy metals, soil borne pathogenic fungi, bacteria, nematodes etc. and it should contain minimum level of primary, secondary and micro nutrients and also humus. Fertilizers and pesticides especially derived from the natural resources should be used for the agricultural production. Sachets or capsule of concentrated nutrients/pesticides should be made available to farmers at reasonable price in order to reduce their losses and residual effects.

*Use of Quality Irrigation Water*

102. Water used for the irrigation water should not contain any toxic materials, heavy metals, effluents, phytopathogens etc. and should have optimum level of cat-ions that harness the soil conditions, rhizosphere development and easy absorption of water by root hairs. If possible, all the essential primary, secondary and micronutrients should be made available to the plant in their critical stages of growth through fertigation, micro-irrigation and drip irrigation.

*Development of Model Integrated Farming/ Cropping Systems*

103. Integrate an ideal crop, animal husbandry, fisheries, microbe cafeteria in order to recycle all natural inputs available in the farming area.

*Processing and Handling of Harvested Produce to Minimize the Post- Harvest Loss and To Market Safe-To-Eat Food*

104. The crops should be harvested, processed and stored hygienically in order to reduce the loss of harvested produce (Irradiation energy / Radio-frequency energy / Solar energy technology).

*Value Addition of Harvested Produce*

105. The technology incubation centres may be equipped to initiate start-up centres on different chain of value added and processed food produces.

*Precision Agriculture*

106. Precision agriculture techniques may be commercialized in special agricultural zones.

*Vertical Farming*

107. Vertical farming in high value vegetables and fruits may be explored.

*Harnessing the Natural Resource Conservation Technologies at Production Level*

108. For water harvesting, micro-irrigation, drip irrigation, fertigation, recycling of agricultural inputs, laser land levelling and zero/reduced tillage in undulated topography.

*Use of Nanotechnology in Different Agricultural Inputs Use Especially in Manures/Fertilizers/Pesticides*

109. Nanotechnology can be used to increase their efficiency for crop production and protection with very low level of environmental risk.

*Integrated Land Use Planning, Use of Remote Sensing and Micro-Processor Based Decision Support Systems*

110. These methods can be used in crops grown in 'special agricultural zones' for better crop production and protection.

*Quality planting material*

111. Making available good quality planting material is an essential pre-requisite for higher productivity of crops. Various farms under the State Department of Agriculture, agencies like VFPCK and Kerala Agricultural University are the major sources of supply of quality planting material in the public sector, apart from the farms of commodity boards and ICAR institutes functioning in the state. Farmer Producer organisations like Coconut Producer Federations (CPFs) also produce and market seedlings of crops like coconut. There is huge gap between the availability and requirement of seeds and planting materials in our state (Table5).

**Table 5 Availability and requirement of planting materials in Kerala**

Sl. No.	Crop	Estimated annual requirement of seeds/ planting materials	Estimated availability of seeds/ planting materials	Shortage/gap
1	Rice	12000 tonnes/year	5400 tonnes	6600 tonnes
2	Coconut	40 lakhs	20 lakhs	20 lakhs
3	Pepper	5 crore cuttings	50 lakhs	4.5 crores
4	T.C. Banana	40 lakhs plants	15 lakhs	25 lakhs
5	Coffee	8.5 lakhs seedlings	4 lakhs	4.5 lakhs
6	Nutmeg	5 lakhs	2 lakhs	3 lakhs
7	Clove	5 lakhs	1 lakh	4 lakhs

112. Since, the production from various agencies is unable to meet the demand private sector players also has a significant role in supplying planting materials. Regulatory measures to ensure quality of the planting materials supplied by private sector agencies are quite inadequate and some unscrupulous elements exploit the situation causing loss to the growers and adversely affecting the sustainable farming.

113. The strategies suggested for improving the planting material supply situation include:

1. Strengthening quality control mechanisms.
2. State/District perspective plans may be prepared for planting material production and marketing involving/linking various agencies.

3. Functioning of farms under State Department of Agriculture may be improved through purchase of newly evolved nucleus planting materials, increasing the area under progeny orchards, development of tissue culture facilities, establishment of processing units, establishment of on-farm production units of bio fertilizer and bio pesticides, establishing integrated farming systems and strengthening seed production programme, improving infrastructure facilities of the farms/nurseries for enhancing quantity and quality of planting materials etc.
4. Establishing high density progeny gardens with updated/latest high yielding and promising varieties in every farm of the department of Agriculture and the KAU institutions including KrishiVigyanKendras.
5. Capacity building to impart plant propagations skills and technology – local self- help groups and Kudumbasree units, local youth etc. can be imparted propagation skills and later engaged in the activities on profit sharing. Production and popularisation of grafted vegetable seedlings have to be given a boost.
6. Seed multiplication and popularization of new varieties of vegetables released by KAU.
7. Creating facilities for transgenic seed identification at High-tech seed testing lab attached to Department of Olericulture, College of Horticulture, Vellanikkara
8. Strengthening tissue culture labs and biocontrol labs under DoA and KAU involving SHGs/ participatory mode.
9. Establishment of a state level seed certification agency as envisaged in Seed Act.

*Agro Service Centre and Service Delivery*

114. Low level of mechanisation and lack of skilled labour adversely affect crop production in the state. Hence, it is necessary to strengthen the existing Agro service centres (ASC) established at block level and Farmer Service Centres to facilitate integration of services like mechanisation, labour support, biopharmacy and planting materials, soil testing support and other technology based services and to establish new agro service centres for improved service delivery to farmers. Interventions to be implemented during 13th plan period through Department of Agriculture may include establishing new Agro Service centres, formation of apex body for effective functioning of Agro Service centres, provide usage subsidy for machineries to model ASCs, maintenance of custom hiring centres, establishment of one Agro machinery Service Centres in all districts, skill development of members of Agro Service centre and karshika karma Sena on machinery, production of bio inputs etc., and software development for rationalisation of use of equipment of Agro Service Centre/Karshika Karma Sena.

*Delineating Special Agriculture Zones under the Overall Frame Work of Agro Ecological Units*

115. Realising wide agro Climatic variability of Kerala, the National Bureau of Soil Survey and Land Use Planning (ICAR), Regional Centre, Nagpur was entrusted with the delineation of the State into different Agro Ecological Units (AEU). Accordingly after extensive field visit, review of studies, analysis of database and after analysing soil, climate and topography, the State has been spatially delineated into 23 AEUs. Taking the AEZ delineation as base work, a number of AEZ projects were completed covering different sectors. The yield gap of various crops on Agro ecological unit wise were also worked out.

116. It is expected that dividing targets and resource allocation on Agro Ecological Approach, identifying the potentials at the local and regional level, constraints and possibilities of each AEU would result in realization of higher outputs in a time- bound manner. In order to further streamline

implementation of projects, 23 AEUs were further regrouped into 20 AEUs taking blocks as the basic unit. In order to implement area based or crop based interventions, the concept of Special Agriculture Zones under the overall frame work of AEU also could be considered.

117. Special Agricultural Development Zones (SAZ) are to be delineated for formulating and implementing convergence based result oriented schemes in selected crops on an autonomous and project based approach. Single window system for providing all incentives and for all needs through special offices as in the case of Special Economic Zones. 1-5 blocks in contiguous areas based on minimum area under the selected crop, potential for production, soil and climatic conditions etc have to be used to develop criteria for the selection of zones in each district. The facilities suggested to create in the SAZs include Agro Service Centres including soil testing labs and call centre, plant health clinics, weather stations and advisories, bio-pharmacy including on farm production units, planting materials production units, farmers markets supported by LSGIs, processing and value addition units, irrigation support, need based interest free loan, extension support including ICT based initiatives, community radio, procurement system for surplus production, promotion of Farmer Technology Development and training to farmers. During the 13th plan SAZs may be initiated for rice, vegetables, banana, coconut, mango, pineapple, jack, tribal agriculture, medicinal plants, floriculture and for sesamum in selected districts/blocks/localities.

#### *Agriculture Marketing*

118. As part of strengthening marketing infrastructure for agricultural produce and to ensure reasonable price for the growers weekly markets may be established at Grama Panchayat level. Besides, a chain of agro super bazars and eco shops can also be facilitated. Creating an E-portal and linking farmer collectives with states following GAP can also be taken up. Efforts may be made for the required software development networking for the effective management of the portal.

#### *Post-Harvest Management and Value Addition*

119. Value addition through product diversification is an important strategy for enhancing income from farming which is highly relevant in the present day context of price fluctuation/price crash in most of the crops cultivated in the state. However, the level of post-harvest processing and value addition is quite low at present which necessitates meaningful interventions to support our farming community to utilise the vast potential for value addition in different crops. Hence, support may be provided to value addition projects in coconut and other crops through establishment of Agro Parks. It is also necessary that capacity development programmes on various aspects of technologies and entrepreneurship development related to production and marketing of value added products are conducted to benefit farmer producer organisations. Technology Incubation Centres and Business Incubation Centres by reputed Institutions have to be fostered. Support also may be provided for the Honey Mission, Pineapple Mission and SFAC.

#### *Biodiversity and Local Germplasm Conservation and Promotion*

120. Design of sustainable farming systems and appropriate technologies aimed at enhancing food production for self-sufficiency should incorporate locally adapted, native crops. Hence, conservation and utilisation of biodiversity and indigenous germplasm assume much significance. Initiatives to conserve the traditional and indigenous varieties available in different crops especially in tribal habitats may be implemented ensuring active participation of local farming community. The local farming community should be adequately supported for maintaining their crop heritage and

persevere in conducting the crop management practices for nurturing these plants. Assistance may be provided for cultivation and multiplication of local germplasm by tribal, local farmer clusters, NGOs and other organizations.

#### *Promotion of Agriculture in Tribal Hamlets*

121. Efforts for biodiversity and local germplasm conservation and promotion may also be linked with specific interventions to promote crop production activities in tribal lands so as to ensure food and nutritional security to the tribal population.

#### *Establishment of Integrated Farming Models*

122. In Kerala, marginal farmers accounted for 96.3% of the total number of land holdings. It is a challenge to make farming remunerative in these fragmented holdings. Cultivation of a single crop in these holdings does not generate sufficient income to meet the family requirement. Moreover, presently farmers in Kerala are more exposed to economic risks and uncertainties owing to the rapid price fluctuations/price crash in most of the cultivated crops. In these circumstances it is needless to emphasize the importance of integrated farming which comprise of components from agriculture, animal husbandry, poultry and fisheries coexisting in a mutually complementary and self -sustainable manner yielding diversity and quality in production and maximum land use efficiency. The agronomic feasibility and economic viability of adoption of integrated farming systems have been amply demonstrated in research stations and farmers' fields. In spite of the obvious benefits of integrated farming system over the traditional monoculture, the extent of adoption of the integrated systems is not at a satisfactory level. Hence, interventions may be formulated and implemented to popularise integrated farming system models suitable to different agro-ecological units in the state.

#### *Risk Management*

123. Crop Insurance, compensating crop loss due to natural calamities, human-animal conflict
1. For restructuring of existing crop insurance scheme with nominal increase in premium and major increase in the rate of compensation for crop loss under consideration of Government of Kerala.
  2. For meeting the crop loss compensation claim of natural calamity affected farmers
  3. Over and above the SDRF norms of assistance.
  4. Other existing components to continue
  5. Hi-tech Agriculture :Restructuring and strengthening
  6. Apart from the ongoing components, construction of mini polyhouses in condominiums and small households are also to be proposed.
  7. Construction of Mini polyhouses for flowers and vegetable cultivation in condominiums and in small households
  8. Improved technical marketing support
  9. Establishment of Micro Irrigation units – Drip and sprinkler irrigation under PMKSY
  10. In situ water conservation methods (in situ moisture trench, husk burial/mulching ), water harvesting structures like ponds, community water harvesting structures with command area of 10 ha, irrigation units like pump sets and solar pump sets
  11. Water and waste recycling in condominiums /house holds

#### *Urban Agriculture*

124. Urban agriculture is evolving in the state. A comprehensive project covering technical, input and service delivery could be implemented in the 13th Five-Year Plan in corporations and municipalities.

#### *Lease land farming*

125. In Kerala, there are people who are interested in farming (young farmers/agricultural labourers/SHGs/JLGs) but they do not own land. At the same time people who are not interested in farming or those who are too busy to be in farming own land. So, concealed tenancy is widely prevalent. The system, as of now, has several inherent constraints including threat to land ownership, degradation of the land due to exploitative farming etc.
126. The social situation in the state demands promotion of lease land farming by strengthening the regulatory measures in support of the land owners as well as the cultivators through a licensing mechanism. There should be advisory/monitoring/supervisory mechanism at Grama Panchayat level for prescribing rent rates/licensing conditions/management practices and dispute resolution. The sustainability of the production practices also needs to be ensured. The system may also facilitate the utilization of public lands by such measures.

#### *Agricultural Water Management*

127. One of the major impacts of Climate change in Asian Subcontinent is projected as water scarcity. The demographic forces, rapid urbanization and industrialization cause serious pressures on water resources. The percapita availability of water is showing a declining trend over the years and is projected to be further low, as per the estimates for 2050. The conflicting interests of major water users, i.e., agriculture, industries and domestic sector may lead to a situation of growing water markets and rising prices. Naturally this situation can lead to serious health issues, social frictions and economic burden to the households and resource poor farmers may be at the risk of leaving farming. To face these challenges, the proposed interventions are:
1. There should be a relook on the existing subsidy policies (especially energy subsidy) in agriculture.
  2. The existing privately owned open wells/bore wells and other water bodies are to be registered.
  3. There should be a programme for natural resource accounting by the local self governments and a register of the natural assets and its status to be maintained by the officials (like stock register in offices) and its accountability to be specified.
  4. The licensing for bore well digging is to be enforced.

#### *Unique Selling Products*

128. Kerala has the diverse ecosystems and products which are known for its uniqueness. These products are to be specifically addressed for its promotion through scientific management. For instance, the mangoes of Muthalamada panchayat have very high market potential in the national and international markets as it is the first harvest across the country. Presently, the management of the mango orchards is mainly by the lessee traders who have only short term profit motive and the pesticide /chemical use is reported to be very high. The existing trade practices are also against the interest of producers and the full commercial potential is not realized. There should be a special package for the scientific management and product promotion/market promotion and value addition of mangoes of Muthalamada. The project should include, research, extension and development aspects that should aim at the overall development of the area. The participation of



local self governments and the stake holders in mango farming and trade may also be ensured. Similar approach has to be adopted in the case of other unique selling products of the State also.

#### *Farm Income Guarantee Scheme*

129. The budget speech of 2016, Government of India introduced the target of doubling of farm income by 2022, which later on was observed by many scientists and policy analysts as unattainable. It was estimated that the sector should register a 12% growth annually (in nominal terms and 20-30 % in real terms) to achieve this target, while the realised rate was marginal only. In Kerala, 30 percent is the farm families' income from cultivation. Though share of wages shows a high 44 %, the proportion shows a decline over the period, indicating a shift towards cultivation, non- farm sector and livestock. This trend signals the importance of improving agricultural income to ensure a higher inclusive growth. Moreover, the consumption expenditure of farm households in the State is the highest making the households to depend on credit, institutional and non- institutional. Thus the indebtedness is also on the higher side. The inability to continue in farming prompts most of the practising farmers leave the profession. In this background, a pilot programme to work out the modalities of the Agricultural Income Guarantee Scheme has to be envisaged with the following broad objectives,

1. To avoid the situation of practising farmers leaving the profession
2. To attract young farmers/new farmers to the profession
3. To improve the social status of farmers
4. To sustain and improve the food production and ensure food safety and security
5. To maintain ecological balance and ecosystem health

130. The scheme will be successful only if the payments are made on time. For this each ADA can estimate the potential level of compensation required based on previous data in their records and make a demand. The State may constitute a separate fund and advance the amount to the respective ADAs, well ahead of the event. The pilot program should help in scientifically delineating the feasible measures to assure a stabilized income from crop enterprises in the event of price fall or crop failure and thus assist the farmers in overcoming potential risks of income loss from agriculture.

#### *Agricultural Extension, Capacity Development and Convergence*

##### *Revitalisation of KrishiBhavans*

131. The network of Krishibhavans across the state continues to be the most important agency providing farm advisory services. However, the major share of office time in Krishibhavans is dedicated to routine office work, reporting, and meetings and hence the quality of implementation of developmental schemes especially which needs field level interactions; and extension activities gets affected. The staff support to Krishibhavans has to be reorganized based on work load and number of farm families in the jurisdiction.

132. For improving the efficiency of the functioning of krishibhavans and for easy monitoring, a centralised MIS-FMS system (paperless automation of the activities) is an alternative. Even, videoconferencing tools like webex can also be utilized in review systems than regular face-to-face meetings along with other web and mobile based ICT tools. Institutionalizing the already existing models of ICT applications can also be attempted (Strengthening the network with high-end computers and high bandwidth connections to Krishibhavans is the precondition).

133. ICT initiatives by various agencies and institutions are available in plenty, spread over many platforms, *viz.* Information Systems (IS) and DSS on various activities in different stages of production; input availability; market intelligence; and forewarnings. Hence, integration of various agencies under one roof for providing vital information on various components of agriculture so that it will act as a one stop solution for the needs of the farmers. In addition, authenticity of information can be ensured, especially in social media, as in case of discussion forums, WhatsApp groups, Face Book forums, YouTube videos by establishing authorised platforms and groups for the users.
134. We depend on sample survey data as the source of production statistics wherein micro level data is not available. Since, a grass root level institutional reach through krishibhavans is well established, collection of basic data as a one-time initiative and then upgradation at regular interval is very much possible especially in this era of IT revolution. Thus, a systematic and centralized data repository on agricultural production, cost of cultivation, pest and disease status, etc. can be prepared. Similarly, information on production of agricultural produces and value added products can also be part of the information collected which can be linked to the data repository on market information for strengthening demand-supply balance.
135. GIS based thematic maps on soil fertility, pest and disease incidence, other natural resources and cropping pattern with holdings as the basic unit could be prepared. This would eventually help us in decentralized planning on crop husbandry. Location specific optimum cropping pattern can be formulated, even at variety level.
136. Soil health cards are issued with two years validity wherein systematic upgradation is so crucial. In this case, development of centralized database on individual holdings on soil health status accessible online will be an efficient alternative.
137. The fact that even though there are many ICT initiatives, their usage is limited, showing the importance of capacity building of extension personnel and farmers on using the apps and also developing easy-to-use applications. Medium of communication should be local language and voice or video based communication in place of text is preferred. Mobile applications are to be given priority than web based as mobile phones are more common nowadays.
138. The Department of Agriculture has to be gradually transformed as a department with specialist support in soil and crop health at Block and District levels as in the state's Directorate of Health services. The agricultural officers should be relieved from the over burdening activities such as report writing, attending frequent meetings and trainings at different levels and should be facilitated for regular field visits and farmer contact. The KrishiBhavan should be made a paper-less office with ISO certification. The Block –level offices of the Department of Agriculture should also be strengthened.
139. The functional linkages at various levels between the Department of Agriculture and other technical departments should be strengthened, especially for implementing interventions on natural resource management through watershed based approach contemplated in the HKM. The convergence mechanisms envisaged in the ATMA scheme have to be revitalized and fostered. At present the extension component is very weak in majority of development schemes implemented through krishibhavans (including centrally sponsored, state sponsored and LSG schemes). Financial target and achievement is given the priority with least concern for the extension efforts for effectively

implementing the interventions in farmers' field. Hence, it should be made mandatory for including the component for extension interventions also for implementing the schemes at krishibhavan level. The involvement of krishibhavan staff in the implementation of ATMA programmes is not at a satisfactory level now. To enhance the level of their participation and to ensure convergence, the formulation and implementation of ATMA programmes will have to take into account the type of agricultural schemes to be implemented in the respective areas.

140. A 'knowledge centre' at the district level has to be developed as a district resource centre for effective farm advisory services. Maintenance of the centre will be through ATMA.
141. The auditing system followed in the department needs to be thoroughly restructured for improving the Departmental Quality Management System. Social Audit becomes inevitable in the current context of transparency in public governance.
142. Strengthening of Agriculture Engineering wing for enabling small farm mechanization in the state is to be urgently attempted.
143. The norms for implementation of schemes and projects under LSGD and DOA must be reviewed and unified.

#### *Capacity Development*

144. In a dynamic science as agriculture, human capacity development is inevitable. Capacity development should encompass aspects of awareness raising, education and training, attitude change, confidence building, participation in decision making and action. The 3500- strong human resources of the Department of Agriculture have to be developed continuously to provide topical and timely technology and service delivery support to the farming community, particularly to the farm women and other weaker and marginalized sections. This will also help in professionalizing the department of agriculture with soil and crop health specialists at Block and District levels. A capacity development policy has to be formulated and implemented for this.
145. International and National level institutions must be identified and networked for providing capacity development assistance for the technical staff of the department through exchange visits, internships, advanced trainings, online courses like MOOC etc.
146. A perspective Capacity Development programme for each technical staff in the DOA has to be chalked out, provided, monitored and evaluated. A matrix depicting the skill sets and the institutional and temporal aspects for each of the personnel in the DOA has to be worked out and executed with impact.
147. The 'Management Development Program' type trainings to the officers at SAMETI will be ideal.
148. Technical Trainings should be located in Research Institutions like KAU, KVASU, KVFOS, ICAR institutions and other national technical training institutions
149. Smart class rooms including Skype/VOIP facilities have to be developed in all the training institutions in agriculture in the state. An exclusive project for the Infrastructure development can be thought of for funding from the Kerala Infrastructure Development Fund Board (KIDFB). Cost-

sharing trainings, sponsored programmes, consultancies, impact studies etc can be taken up for revenue generation and long-term financial viability

150. The farmers training programs which are demand-driven, need- based and location specific have to be conducted by the RATTCS, FTCs, ATMA Training centres at District and Block levels, KVKs, established NGOs etc. Particular emphasis has to be placed on the capacity development of farm women. SAMETI will be the nodal agency for serving as the planning, monitoring and hand holding institution for CD in agriculture and allied sectors at the state level. Training calendars for all these networked institutions of SAMETI will have to be prepared and publicised in advance for ensuring committed participation.
151. Capacity development in frontier areas including IT/BT/NT/agribusiness including value addition, urban and peri-urban agriculture, sun rise fields, HKM etc should also be the focus in these programs besides technical and managerial aspects. Bench marking of Best Practices should be attempted to continuously improve Training Quality Management.
152. Induction and motivation trainings for all newly recruited staff should be given within their probation period warranting successful completion of the training.
153. IIFS, IT including social media networking and Social Capital Development must be the thrust areas in the trainings for the farmers and officers
154. The collaborative post-graduate diploma programmes and Massive Open Online Courses (MOOC) on PHM, AEM, IT/Social media have to be further strengthened as Continuing Agriculture Education (CAE) programs in line with CME in the Health Services.
155. SAMETI should be developed into a National Centre of Excellence in Capacity Development in Tropical Agricultural Management.
156. SAMETI should be elevated as a Deemed University for Extension and Management sciences in agriculture offering post-graduate degree, certificate, and diploma courses.

*Strategies for effectively utilising national research institutes for agricultural development of Kerala state*

157. Various national research organisations are functioning in the state having mandate over major crops cultivated in the state and other sectors like fisheries. They include ICAR institutes like CPCRI, IISR, CTCRI, CIFT, CMFRI, and ICRI under Spices Board, RRII under Rubber Board etc.
158. Unprecedented crisis situation is prevailing in majority of the crops covered by these national research institutes wherein farming community is struggling due to price crash in the market and other constraints.
159. In this era of liberalised trade, apart from pro-farmer government policies to protect the interests of farmers, the other major thrust should be to enhance the efficiency in the respective sectors by enhancing productivity and reducing cost of cultivation. For bringing this efficiency in different crops/sectors, effective utilisation of technologies generated by the above research organisations can play a crucial role.

160. Even though frontline technology transfer initiatives are being conducted by these research institutions, their efficacy and coverage is not at a satisfactory level. Many studies indicate very low level of field level utilisation of these technologies. Hence, efforts are required to make use of the research output of these institutions to address the technology gap/to address the problems experienced in farmers' field in the state.
161. Functional linkages among the national research institutions and state agriculture university and state department of agriculture, commodity boards and other development and extension organisations are rather weak.
162. An effective platform is to be built to bring together the national research institutions and research institutions under the state government like KAU, KVASU, KUFOS to evolve effective and uniform technology recommendations in the respective crops/sectors. A uniform package of practices recommendations for crops suitable to the agro-ecological characteristics of the state is to be evolved integrating the research outputs from national institutes with the state Agriculture University and other research institutions under the state government.
163. A mechanism is to be put in place to ensure that the research projects implemented by the national research institutes functioning in the state address the field problems experienced by the farmers in the respective crops. For this research-extension-farmer interface programs at regular intervals (at least once a year) should be made mandatory as part of the annual research council meetings of the national institutes in which responsible officials from the state agriculture department and other line departments and representatives of farmer producer organisations and commodity boards should participate.
164. Though the KVKs are functioning in all the districts with the responsibility of technology assessment and refinement and conducting frontline demonstration and extension activities, many a times research output relevant for addressing the field problems are not tested/ validated and the feedback for refinement is rarely made available. Hence it is also necessary to bring the KVK system as an important partner in the proposed interface.
165. A state level official body involving higher level officials of the national research institutes, state agriculture universities, commodity boards, state agriculture department and other line departments should be constituted for effectively monitoring the interface programmes.
166. Arrangements are to be made for the participation of scientists from national research institutes in the Monthly Technology Advisory meetings of ATMA and Multi- disciplinary diagnostic teams, especially in those districts where field problems pertaining to the mandate crops of national research institutes are reported. Participation of scientists from national research institutes in the follow up activities including diagnostic field visits and formulation and implementation of on farm testing of recommended technologies followed by front line demonstration should also be ensured. Linkage between the ATMA set up and national research institutes has to be strengthened. In some districts.
167. Linking national research institutes with the implementation of decentralised planning process of LSGs through the effective utilisation of relevant technologies from these institutes is also to be given due consideration. In the capacity development programmes being organised by KILA, sessions on activities/achievements of national research institutes should be included to create awareness among peoples' representatives from LSGs on the potential of making use of available

technologies from these research institutes for effective implementation of decentralised schemes for agricultural development.

168. Functional linkages can be made more effective through promoting participatory research/extension approach as experienced under the NATP project on TAR-IVLP.

*Proposed Outlay for Agriculture in 13th Five Year Plan*

169. The expenditure incurred for Agriculture covering Crop Husbandry, Soil & Water Conservation, Food, storage and Warehousing, Investment in Agricultural Financial Institutions, Agricultural Marketing and Quality Control & Other Programmes implemented by the department of Agriculture, Land Use Board and Soil and Water conservation during Tenth, Eleventh and Twelfth Five year plan periods are shown in Table.6. The expenditure for agriculture sector in total state plan out lay is only about 3 percent for the last three Five-Year Plan periods. Significant increase in resource allocation in agriculture sector is required during 13th Five year plan to improve growth rate as well as productivity of crops. The outlay covering crop husbandry, soil and water conservation, marketing and other programmes implemented by the department of Agriculture and Soil and water conservation has to be enhanced to a minimum of 5 percent of State plan outlay during 13th Five-Year Plan. The outlay for allied sectors to be provided over and above this share with significant increase in the plan period considering the priorities and the share earmarked in previous plan periods.

**Table 6 Expenditure for agriculture during tenth, Eleventh and Twelfth Five year plans**

Sl. No	Plan	Expenditure (Rs Crore)	% share in total state plan
1.	Tenth Plan	629.78	3.06
2.	Eleventh Plan	1387.53	3.2
3.	Twelfth Plan (Anticipated)	3281.23	3.83

*Epilogue*

170. Summarising the foregoing observations, the following guidelines are suggested for revitalising the agriculture sector in the State during the 13th Five Year Plan:
1. Farmer-led development of sustainable, situation-specific and eco-friendly technology.
  2. Quality control of agricultural inputs and outputs.
  3. Effective programs for soil, root and crop health management
  4. Development of efficient small farm machinery and skilled technicians for service delivery.
  5. Development of suitable precision farming techniques.
  6. Risk aversion in agriculture with tools such as drones, geo tagged mobile applications, crop and market modelling etc.
  7. Development and popularisation of climate-smart practices.
  8. Capacity development of all stake holders with innovation focus.
  9. Promotion of farmer based organisations entrenched in social capital development.
  10. Reinforcement of the extension system with ICT enabled services.

171. It is firmly hoped that the State's agricultural sector can be revitalised and farming can be made charming with the committed participation of all stakeholder groups facilitated by a supportive policy environment during the 13th Five-Year Plan period.

ANNEXURE 1

**PROCEEDINGS OF THE MEMBER SECRETARY  
STATE PLANNING BOARD  
(Present: Sri. V. S. Senthil IAS)**

Sub: Formulation of 13<sup>th</sup> Five Year Plan – Constitution of Working Groups – reg.  
Ref: Note No.260/2016/PCD/SPB dated 06.09.2016 of the Chief (i/c), Plan Co-ordination  
Division, State Planning Board

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**Order No. 300/2016/AGRI (W1)/SPB**

**Dated: 19.09.2016**

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As per the reference cited, State Planning Board has constituted Working Group on ‘Agriculture’ to formulate the draft proposals in the sector for inclusion in the Thirteenth Five Year Plan.

The Working Group on “**Agriculture**” is hereby constituted with the following members.

**Co-Chairpersons**

Dr Raju Narayana Swamy IAS, Principal Secretary, Agriculture  
Professor Venkatesh Athreya, MSSRF, Chennai.

**Members**

1. Sri Biju Prabhakar IAS, Director of Agriculture, Thiruvananthapuram
2. Sri J Justin Mohan IFS, Director, Soil Conservation and Survey Department, Thiruvananthapuram
3. Sri A Nizamudin, Land Use Commissioner, Thiruvananthapuram
4. Dr James George, Director, CTCRI, Thiruvananthapuram
5. Dr C Bhaskaran, Former Professor, Kerala Agricultural University, Thiruvananthapuram
6. Dr Ranjan S Karippayi, Director, State Horticulture Mission, Thiruvananthapuram
7. Smt P S Radhamony, Director, SAMETI, Thiruvananthapuram
8. Dr C Thamban, Principal Scientist, CPCRI, Kasaragod
9. Dr P Indira Devi, Professor of Agricultural Economics, College of Horticulture, Vellanikkara, Thrissur
10. Dr T Pradeep Kumar, Professor, Olericulture Department, College of Horticulture, Vellanikkara, Trissur
11. Dr George Thomas, Associate Dean, College of Horticulture, Vellanikkara, Trissur
12. Dr K M Sreekumar, Professor of Entomology, College of Agriculture, Padannakkad, Kasaragod
13. Dr M Joy, Associate Professor, Department of Plant Pathology, College of Agriculture, Vellayani, Thiruvananthapuram
14. Dr Mathewkutty, Director, Coconut Development Board, Kochi
15. Dr Rajendran, Head, RARS, Ambalavayal, Wayanad
16. Dr K P Chandran, CPCRI, Kasaragod
17. Dr Jayasekhar, CPCRI, Kasaragod
18. Sri K V Ramakrishnan, Kannanperiyaram, Kannadi PO, Palakkad – 678701
19. Sri Sathyan Mokeri, State General Secretary, Kissan Sabha (SreeAchutham, Mokeri P.O., Kakkathil (Via), Kozhikkode

**Convener**

Dr P Rajasekharan, Chief (Agriculture), State Planning Board

**Co-Convener**

Smt K B Sreelatha, Assistant Director, State Planning Board



### **Terms of reference**

1. To review the development of the sector with emphasis as to progress, achievements, present status and problems under its jurisdiction during the 11<sup>th</sup> and 12<sup>th</sup> Five Year Plan periods.
2. To evaluate achievements with regard to the plan projects launched in the sector, both by the State Government and by the Central Government in the State during these plan periods.
3. To list the different sources of data in each sector and provide a critical evaluation of these data sources, including measures for improvement.
4. To identify and formulate a set of output and outcome indicators (preferably measurable) for each sector and base the analysis of the previous plans on these indicators.
5. To outline problems pertaining to the potential, issues and the strategies for the development of agricultural production, marketing and the enhancement of farmers income and welfare. It will pay special attention to issues of women and socially oppressed sections of the population.
6. To suggest, in particular, a set of projects that can be undertaken during the 13<sup>th</sup> Plan period in the sector.
7. The Co-Chairperson is authorised to modify terms of reference with approval of State Planning Board. The Co-Chairperson is authorised to invite, on behalf of the Working Group, experts to advise the Group on its subject matter. The non-official members of the Working Group will be entitled to travelling allowances as are applicable to class I officers of the Government of Kerala. The class I officers of GoI will be entitled to travelling allowances as per rules if reimbursement is not allowed from Departments.
8. The working group will submit its draft report by 1<sup>st</sup> December 2016 to the State Planning Board.

*Sd/-*  
**Member Secretary**

To

The Person concerned  
The Sub treasury Officer, Vellayambalam

Copy to:-

The Accountant General, Kerala (A&E) with C/L  
All Divisions, State Planning Board  
PS to VC  
PA to Member Secretary  
Stock file

*Forwarded by order*  
*Sd/-*  
*Chief (Agriculture)*