

Technology prioritization for improving coconut productivity in India

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Abstract

Indian coconut sector faces daunting challenges in the present era of trade liberalization and globalization. Competitiveness through higher productivity is the theme of the strategies often suggested by researchers, planners and policy makers for overcoming the problems arising from the Agreement of Agriculture on WTO. For achieving the desirable level of productivity, the role of technology is crucial in the production, processing and marketing sectors of coconut industry. Though India is one of the largest producers of coconut in the world, with an average productivity of around 6800 nuts/ha, it is also the largest consumer of coconut and its products. Due to increasing population and domestic demand for vegetable oils in India, the demand for coconut and its products is estimated to be double by 2025 AD. Strenuous research efforts for more than three decades by the Central Plantation Crops Research Institute as well as the State Agricultural Universities in the major coconut producing States of India have led to evolution of many technologies which are expected to increase the productivity in the production and processing sectors to the desired level. At the same time, for sustained growth of production and productivity at micro level, efforts are also being taken by the Transfer of Technology Network consisting of the State Department of Agriculture/Horticulture in coordination with Development Boards and Institutional Credit Agencies. In spite of all these efforts, the growth in coconut productivity has not been sustained at the desired level. One of the major reasons for this could be the lack of prioritization of technologies to be transferred and their implementation. This paper reviews the existing scenario of coconut production in major producing zones and highlights the major problems in each of the zones and prioritizes the technologies for transferring and effective implementation at micro level for achieving sustained development in coconut production sector.

Key words: Coconut productivity, Prioritization of technologies, Value addition

Introduction

India is the third largest producer of coconut in the World, producing 12827.1 million nuts from 1.892 million hectares. The average productivity of 6776 nuts/ha is the highest realized in the world. The Agreements on Agriculture (AoA) of the World Trade Organization (WTO) is posing serious challenges to Indian agriculture and to an even greater extent in perennial crops due to their inherent characteristics. The farmers cultivating perennial crops like coconut cannot undertake short-term adjustments as foreseen in the Agreement on Agriculture (AOA). Planners and policy makers suggest "Competitiveness through higher productivity" in the production, processing and marketing sectors as the key solution to achieve a sustainable growth in plantation crop sector in the long run. For achieving sustainable high productivity, the role of technology is very crucial. It is also necessary to prioritize the technologies to be

employed, considering agro-climatic, biotic, abiotic and socio-economic factors. In this background, this paper is presented with the following objectives. The overall objective of this paper is to highlight the need for prioritization of technologies for achieving sustainable development in Indian coconut sector. The specific objectives are i) to perform a scenario analysis of coconut production in India and ii) to highlight the concept of technology prioritization for various coconut production zones in India.

Research Methodology

The study is based on the analyses of secondary data on area, production and productivity of coconut and other information on the pest and disease incidence in coconut from authoritative sources such as Food and Agricultural Organization, Directorate of Economics and Statistics, Government of India, Annual Reports and

other major publications of the Central Plantation Crops Research Institute (CPCRI), India etc.

Compound Growth Rate (%) was estimated for analyzing the trend in production sector, For studying the share of area and productivity on production, a decomposition model of the form $\Delta p = \Delta a + \Delta y + (\Delta a \times \Delta y)$, where in the Δp refers to incremental change in production, Δa is the incremental change in area, Δy is the incremental change in productivity and $\Delta a \times \Delta y$ is the interaction between area and productivity, was used. Time Series Analysis was performed for estimating the projected demand for coconut and its products. For assessing the economic worthiness of coconut cultivation using the required level of technology adoption, investment analysis using economic indicators such as Benefit Cost Ratio (BCR), Net Present Worth (NPW), Internal Rate of Return (IRR) and Pay Back Period (PBP) was carried out.

Scientists from the Division of Social Science, CPCRI as well from the State Agricultural Universities (SAU's) have conducted various field surveys and analyzed the major constraints and yield loss caused due to various factors of production. Based on their reports and other major publications from CPCRI, Annual Reports of SAU's and All India Coordinating Research Centres for Palms (AICRPP) etc., the extent of economic loss were assessed. For prioritization of technologies, the same were synthesized and polarized with the present status of production in various zones.

Results and Discussion

The results and discussion include the scenario analysis of Indian coconut production sector, the demand and supply projections, major technologies and their impact for achieving higher productivity and the prioritization of these technologies for various agro-climatic zones.

A. Scenario analysis

Coconut research in India is carried out mainly by the Central Plantation Crops Research Institute (CPCRI) under the Indian Council of Agricultural Research and the State Agricultural Universities (SAU's) located in major coconut producing states. Though coconut is cultivated in more than 18 States and Union Territories, the four southern states viz., Kerala, Tamil Nadu, Karnataka and Andhra Pradesh are the major producers accounting for more than 90 percent in both area and production.

Table 1. Compound growth rate of area, production and productivity of coconut in India

Years	Area	Production	Productivity
1950-51 to 2000-01	2.29*	2.47*	0.17*
1951-52 to 1960-61	1.54*	3.11*	1.54*
1961-62 to 1970-71	4.03*	3.01*	-0.98*
1971-72 to 1980-81	-0.35*	-0.67*	-0.33*
1981-82 to 1990-91	3.75*	5.70*	1.87*
1991-92 to 2000-01	2.00*	1.61*	-0.38*

* Significant at 5% level.

The long term growth in coconut production sector exhibits a mixed trend in area, production and productivity (Table 1). In the case of area and production, from 1950 to 2001, barring the seventies, the growth was positive. However, in the case of productivity, there was negative growth during the sixties, seventies and nineties, indicating that the overall contribution of area to production is higher than that of productivity.

This statement was further confirmed through the decomposition analysis performed with the time series data on area, production and productivity. The realized results $\Delta p = 22.13 + 5.69 \Delta a + 0.99 \Delta y + (0.0005 \Delta a \times \Delta y)$ indicated that for unit increase in production, the area had to increase by 5.69 units and that of productivity by only 0.99 units. It is pertinent to observe here that the exponential growth rate projections indicated that the domestic demand for coconut, copra and coconut oil in India by 2025 AD would be 21971 million nuts, 1241 ('00 mt copra) and 745 ('00 mt oil). To meet the domestic requirements of coconut and its products, the country needs to further augment its productivity through better adoption of technologies in its production, processing and marketing sectors.

There is a considerable variance in the present level of productivity in the production zones in India, due to varying agro-climatic, edaphic, biotic, abiotic and socio-economic factors (Table 2). It is evident that Kerala has the largest area and production of coconut in India. However, the productivity level is much less than in Andhra Pradesh and Tamil Nadu. This is due to the inherent characters of coconut cultivation in Kerala such as predominance of small and marginal farmers, rainfed cultivation, low marketable surpluses, low income and less investment. This vicious cycle continues to act as a barrier for further augmenting the growth in coconut sector of Kerala state.

Table 2. Comparative status of coconut production in major zones in India

Particulars	Kerala	Tamil Nadu	Karnataka	Andhra Pradesh
Climate	Humid Tropic	Tropic	Tropic	Tropic
Land Holdings	Predominance of small and marginal	Predominance of small	Predominance of small	Predominance of small
Average holding size	< 0.2 ha	0. 4 to 0.8 ha	0. 4 to 0.8 ha	> 1 ha
Type	Predominantly Rainfed	Predominantly Irrigated	Predominantly Irrigated	Irrigated
Major Cultivar	West Coast Tall	East Coast Tall	Tall	East Coast Tall
Area under coconut (lakh ha)	9.39	3.35	3.73	1.04
Production (million nuts)	5744	3294	1523	1129
Yield (nuts/ha)	6114	9808	4077	10857
Average Estimated of Cost of Production*	2150	1610	1450	1340
Coconut Processing	Maximum	Minimum	Moderate	Minimum
Value Addition	Just commenced	Tender nut water based	Moderate	Minimum
Strengths	Largest producer. Fulcrum of Indian coconut market	Better managed gardens, higher productivity, irrigated gardens	Varied agro-climatic zones, value addition is better as compared to other states, enterprising farmers	Better Economies of Scale in production, Grown under irrigated conditions. Highly enterprising farmers and highest productivity
Weaknesses	Predominance of small and marginal holdings, rainfed system of cultivation, lower level of technology adoption, lesser dependence on coconut	Prone for drought. No assured water sources. Over exploitation of ground water resources, Predominance of mono-cropping	Risk due to drought and Predominance of mono-cropping in Maidan Tracts. Predominance of small and marginal holdings and rainfed cultivation in coastal belt.	Suitable for cultivation in limited number of districts, Less emphasis on mixed cropping.
Opportunities	Categorization of technologies before implementing developmental programmes. Soil and water conservation, More emphasis on Post Harvest Technology and value addition.	Water management techniques. Adoption of coconut-based cropping systems	Water management techniques and coconut-based cropping system for Maidan tract, Better adoption of management practices and more emphasis on Post Harvest Technology for coastal belt.	Adoption of coconut-based farming system
Threats	Root (wilt) disease, Price fluctuations, Pest problems Older and senile plantations	Water scarcity, Over exploitation of ground water in western and east coast	Water scarcity, Pest problems	Cyclone

* Per 1000 nuts under optimum management conditions

Tamil Nadu is the second largest producer of coconut in India. The crop is mainly cultivated under irrigated conditions and the land holdings size is comparatively bigger than that of Kerala. Though the farmers are enterprising, unprecedented drought for three consecutive years has ruined the coconut industry in the State. The State always faced with scarcity of water for agricultural and non agricultural purposes needs to reorient its strategies on water management in agriculture.

Karnataka State has the second largest area under coconut. However, the productivity is the lowest among

the four states. Coconut is mainly cultivated under irrigated conditions and land holdings are predominantly small. As in the case of Tamil Nadu, drought is the major threat for coconut cultivation in this State.

Andhra Pradesh plantations are in a fertile area and coconut is cultivated more scientifically with better adoption of technologies. The land holdings are also comparatively large and the marketable surplus is fairly high.

B. Production constraints

Field surveys conducted by CPCRI, SAU's and AICRPP indicated that coconut farmers in major

production zones are facing several constraints for technology adoption. Low productivity due to senile and unproductive palms, heavy incidence of pest like Eriophyid mite and diseases like Root (Wilt), pro-longed dry spell in North Kerala, increasing cost for labour and other factors of production are the major constraints faced by the farmers in Kerala. In the case of Western Tamil Nadu and maidan tract of Karnataka, drought is the major problem, followed by the incidence of pests and diseases. Risk to natural calamities such as cyclones is the prime constraint for the coconut farmers at Andhra Pradesh (Arulraj *et al.*, 2001).

Though Research and Developmental agencies are well aware of these constraints, they are not categorizing the technologies and prioritizing them for achieving higher productivity on a sustained basis. There are several developmental programmes by the Commodity Board at the respective State Governments, which are giving same emphasis to all the problems in all the production zones. They need to understand that unless the crux of the basic problem is solved or minimized, the probability of achieving success on a sustained basis is less. Hence prioritization of technologies is very much essential for achieving sustained growth in Indian coconut sector.

C. Prioritization of technologies

Strenuous research efforts over three decades by CPCRI as well as the SAU's of the major coconut producing states have led to the evolution of many production, protection and processing technologies for coconut. However, some of them are of much relevance only to specific areas. But there are certain other technologies which need prime attention in all the major coconut growing tracts. The following paragraphs highlight those technologies, which need to be adopted in all the zones.

C.1. Technologies to be adopted in all the zones

1.1. Replanting of senile and diseased palms

Under-planting / replanting of senile / diseased palms with seedlings of high yielding varieties / hybrids

is an important technology to be adopted for sustaining the productivity and profitability of coconut farming. On an average, 10 percent of the palms are either non-bearing or senile/unproductive (Muralidharan *et al.*, 2003). This may extend upto 30 percent in disease endemic areas such as Southern Kerala. The investment analysis of coconut in Kerala, which is the major coconut producing State in India, indicated that under the present level of input-output prices, the Benefit-Cost Ratio (BCR), Net Present Worth (NPW), the Internal Rate of Return (IRR) and the Pay Back Period (PBP) are favourable to the coconut farmers only if they could get additional income through intercropping in the initial stage of pre-bearing phase (Table 3).

Under optimum management conditions, assuming a medium price of Rs.3.50/nut, the suggested period for removing the senile and unproductive / older palms is those in which, the realized annual yield is consistently less than 40 nuts/palm. However, the past experience indicates that farmers prefer to under-plant a new seedling instead of replanting. Replanting/ under-planting of coconut seedlings can be undertaken with High Yielding varieties (HYV)/ Hybrids. Several HYV/ hybrids have been released through concerted efforts of CPCRI and various SAU's and their yield potential under well managed conditions are significantly higher than that of the local cultivars. At present, these HYV/hybrids are hardly adopted by the farmers due to two major reasons viz., a) lack of awareness and b) lack of adequate production of planting materials (Towards Helping Farming Community Arulraj *et al.*, 2003). To overcome these problems, Developmental agencies should actively involve progressive farmers from the major production zones on a cooperative basis, for production and marketing of elite planting materials of various HYV/ hybrids. They should also create awareness about the advantages of cultivating HYV/hybrids among the farmers.

1.2. Coconut - Based Cropping/Farming Systems

Coconut, being a crop planted with wider spacing and having an ideal rooting pattern and canopy coverage,

Table 3. Investment analysis of coconut cultivation under optimum management conditions in Kerala State

Particulars	60 nuts/palm/year				80nuts/palm/year				100nuts/palm/year			
	BCR	NPW (Rs.)	IRR (%)	PBP	BCR	NPW (Rs.)	IRR (%)	PBP	BCR	NPW (Rs.)	IRR (%)	PBP
Without intercrops	1.01	2905	-	12	1.20	58827	03	12	1.29	83810	03	12
With intercrops*	1.28	91510	10	12	1.44	128355	13	12	1.74	243674	15	12

Discount rate - 8% p.a. PBP is in years, * During pre-bearing phase
The calculations are based on market prices for 2001-02

offers much scope for integrating a variety of crop combinations in the interspaces. Under farmers' field conditions, mono cropping conditions are widely prevalent and even if inter/mixed cropping practices are there, they are not practiced scientifically. Various multiple cropping systems such as intercropping, mixed cropping, multi-storied cropping, mixed farming and High Density Multi-Species Cropping Systems are studied by different researchers under various agro-climatic, edaphic and biotic conditions and have proved the technical feasibility and economic viability of those systems (Nelliat *et al.*, 1974, Bavappa, 1991; Rethinam and Venugopal, 1994, Thampan, 1996, Sairam *et al.*, 1999). Hammed Khan and Upadhyay (2002) have stressed the need for low external input agriculture through integrated nutrient management in coconut-based cropping / farming systems in India. Maheshwarappa *et al.*, (2000) proved that integration of dairying, poultry rearing, cultivation of fodder and pisi-culture in coconut gardens is technically feasible and economically viable.

Economic returns from various coconut - based cropping/farming systems are furnished in Table 4. It could be inferred from the table that the returns over coconut monocrop ranged from Rs.14,800/ha in the case of coconut +elephant foot yam to as high as Rs.56,000/ha in the case of coconut based high density multi-species cropping system. The significance of income from the inter/mixed crops or other enterprises could be better realized if the price of coconut and its products are less. The realized Marginal Rate of Return (%) was the highest in coconut + tapioca system, followed by coconut - based high density multi-species cropping system. Studies conducted in farmers' fields in various parts of the country indicated that they do practice coconut - based cropping/farming systems. However, due to non-

scientific farming, the resource use efficiency as well as income generation per unit area is far below the potential level. Hence research and developmental agencies should make concerted efforts for implementing appropriate programmes to encourage the farmers to practice coconut - based cropping/farming system models in different agro-climatic zones.

1.3. Product diversification and value addition

Though India is one of the largest producers of coconut in the world, its relative share in the international trade arena is non-significant as compared to the other major coconut producing countries such as the Philippines and Indonesia. The prime reason for this is the lack of organized marketing having vertical integration with the agro-processing. Technologies are available for individual processing for the production of edible oil, DC powder, vinegar, coconut chips, shell powder, industrial oil and cakes. However, due to their small scale operation, the economies of scale and their relative profitability is low as compared to the desirable level, which could be achieved through scientific integration.

CPCRI has evolved economically viable technologies for production of value added coconut products such as Snow Ball Tender Nut and Coconut Chips. Market surveys indicated a positive response among the consumers for these products, which are expected to have a higher domestic demand in future. This not only fetches additional returns to the farmers, but also provides additional employment for the rural youths.

To intensify the process of product diversification and value addition, at micro level, rural women - based Self Help Groups need to be trained on various aspects of value addition in coconut including quality

Table 4. Economics of coconut - based farming systems and product diversification (Rs./ha)

System	Gross cost	Gross return	Net return	Return monocrop	Marginal above Rate of Return (%)	Additional employment generated (mandays/ year/ha)
Coconut monocrop	17000	56000	39000	-	-	-
Coconut + Elephant Foot Yam	64100	117900	53800	14800	46.03	131
Coconut + Ginger	74500	149000	74500	35500	79.71	500
Coconut + Tapioca	34700	107400	72700	33700	222.66	130
Coconut + bhendi	33000	90000	57000	18000	136.11	125
Coconut + Clove *	47880	100000	52120	13120	58.32	150
Coconut + Banana *	59680	137150	77470	38470	111.26	230
Coconut based HDMSCS*	52000	147000	95000	56000	188.89	191
Coconut based mixed farming *	172000	265000	93000	54000	49.82	600

Source: For employment generation Gopalasundaram, *et. al* (1993). Estimated figures for 2002-03 * under irrigated conditions

parameters and initially they need to be given support for marketing their products. This method of on farm processing and value addition for coconut products needs to be effectively implemented in all the major coconut growing zones of the country. The investment requirements for producing various coconut - based value added products are furnished in Table 5. Though the requirements given are for medium to large scale plants, the average production capacity could be scaled down to the level of rural co-operatives, retaining the economic viability of the project.

Table 5. Estimated Investment requirement for the coconut - based industries

S.No	Industry	Capacity (No. of nut/day)	Quantity of products	Investment (US \$ in thousand)
1.	Desiccated coconut	10000	1000 kg	70
2.	Coconut chips	10000	1000 kg	70
3.	Cream	10000	2500 kg	300
4.	Coconut milk powder	20000	1000 kg	600
5.	White copra production	10000	1500 kg	15
6.	Oil mill	10000	750 kg	15
7.	Packed tender coconut water	12500	2500 lit.	80
8.	Vinegar	10000	1000 lit.	20
9.	Nata de coco	10000	200 kg	20
10.	Shell powder	10000	1000 kg	30
11.	Shell charcoal	35000	1150 kg	30

At macro level, technology needs to be refined for integrating production and marketing of various coconut based value added products. Commercial viability of coconut processing can be further enhanced through the integrated processing of coconut and its by-products. Investment requirement for different models of the integrated coconut processing complexes are given in Table 6. However, due to their small scale operation, the economies of scale and their relative profitability is low as compared to those which could be achieved through scientific integration. Establishment of these units in those areas with lower labour costs will prove to be more beneficial. Since integration of various agro processing units of coconut involves high investment, entrepreneurs who are willing to invest in a few of these low or high intensive models, need to undertake an ex-

ante assessment of the demand and supply pattern of the inputs required for the production and the possible domestic and international demand.

C.2. Technology prioritization for Kerala State

As stated earlier in this paper, Kerala is the largest producer of coconut in India. However, predominance of small and marginal holdings, rainfed nature of cultivation as well as prevalence of diseases such as root(wilt) are the major barriers for the sustained development of coconut in Kerala. Geographically the State is classified as Northern, Mid and Southern zones and also based on the topography; the same is classified as coastal, mid land and high ranges. Though coconut is cultivated throughout the Kerala state, it is mostly confined to the coastal and mid land areas. Prevalence of six months of continuous dry weather is a common problem in the Northern zone, while widespread prevalence of root (wilt) disease is the major problem in Southern Kerala. The Mid zone has a medium level of both these problems. Considering the overall scenario in this state, the technologies which need more emphasis are given in Table 7. It could be inferred from the table that soil and water conservation measures such as drip irrigation system, use of bio-engineering methods for moisture and soil conservation need to be adopted on a larger scale and they need to receive more attention in the relatively disease free zone of Northern Kerala. Integrated Disease Management needs prime focus in the Southern zone of the State especially for management of the root (wilt) disease. At the same time the Research Institutions should continue to strive hard for tackling the problem of Eriophyid mite infestation, which is not only prevalent in Kerala, but also in all the major coconut growing tracts of the country.

C.3. Technology prioritization for Tamil Nadu

Tamil Nadu with a relatively higher level of productivity is often facing drought situation and the farmers in this State are overcoming this problem through over exploitation of ground water resources. The State, which receives an average annual rainfall of only 900 mm in the coconut growing tracts, needs to emphasize

Table 6. Estimated Investment requirement for the integrated coconut processing complex

Model number	Main product	Processes to be integrated	Investment(US \$ in thousand)
I	Desiccated coconut	Vinegar and/or Nata de coco + Shell powder + Shell charcoal	120
II	Coconut chips	Vinegar and/or Nata de coco + Shell powder + Shell charcoal	120
III	Cream	Vinegar and/or Nata de coco + Shell powder/ Shell charcoal	350
IV	Coconut milk powder	Vinegar and/or Nata de coco + Shell powder/ Shell charcoal	650
V	White copra production	Oil mill + Vinegar and/or Nata de coco + Shell powder/ Shell charcoal	80

Table 7. Prioritization of technologies to be adopted for Kerala State

Rank	NorthernZone	Central Zone	SouthernZone	Research Institute Developmental Agency
01	Soil and Water Conservation (Huge loss of top soil and water resources)	Pest and Disease Surveillance (Yield loss 30 to 60 %)	Integrated Disease Management especially for root (wilt) disease (Yield and economic loss 37 to 60%)	Proving the technical feasibility and economic viability of these technologies through large scale demonstrations
02	Germplasm conservation in high productive zones (Yield loss due to senile palms – upto 20%)	Germplasm conservation for disease free palms amidst disease infected palms (Yield loss due to senile palms – upto 20 %)	Removal of severely infected root (wilt) palms and planting with disease tolerant varieties / other species of crops. (Yield loss due to diseased and senile palms – 37 %)	Working in coordination for achieving the desired results in these programmes
03	Seedling production with HYV/hybrids (Supply is inadequate)	Seedling production with HYV/hybrids (Supply is inadequate)	Seedling production with HYV/hybrids (Supply of Root (wilt) tolerant planting material is required)	Working in coordination for achieving the desired results in these programmes

water management as the top most priority in all the zones. In those regions like that of the Union Territory of Pondicherry, wherein flood irrigation system is being followed, the probable problem of seepage of sea water into ground water needs to be properly highlighted to the coconut growing farmers. Adoption of drip irrigation system to irrigate coconut gardens would be useful for realizing better water use efficiency (Table 8). In addition to the drought and Eriophyid mite infestation, widespread prevalence of stem bleeding and Ganoderma wilt diseases has also affected the growth in coconut production in Tamil Nadu (Table 9).

Table 8. Economic analysis of investment in drip irrigation (Rs./ha)

Years	Cost	Return	Discounted Margin
Drip Irrigation			
1	47260	51975	4100
2	22260	51975	22469
3-20	400680	935550	137688
BCR		2.02	
Pay Back		2 years	
Basin Irrigation			
1	29060	48825	17187
2	29060	48825	14945
3-20	523080	878850	91584
BCR		1.68	

- discount rate of 15 percent was considered to calculate the discount margin
- Adapted from Dhanapal, et.al. (2000).

C.4. Technology prioritization for Karnataka

Karnataka stands next to Kerala as far as acreage is concerned, but the State's share in total coconut production is much less due to the low level of productivity. The major reasons for low productivity are successive droughts in major growing tracts as well as Eriophyid mite infestation and wide spread attack of leaf eating caterpillar. The State is popular for tender nut water consumption and has medium level of coconut -

based processing industries. Hence, water management, drought management and IPM for major pest attack are the technologies, which need prime focus for improving level of coconut productivity in this State (Table 10).

C.5. Technology prioritization for Andhra Pradesh

Andhra Pradesh has the highest level of productivity for coconut in India. The coconut growing belts are most fertile and farmers are highly progressive and innovative in technology evolution and adoption. However, due to agro-climatic factors, area expansion is possible only to a limited extent in this State and uncontrolled area expansion could lead to imbalance in the agro-ecosystems of the zone. The Coastal districts of this State are also prone for cyclonic storms during North East Monsoon Season and the farmers are yet to systematically practice coconut - based farming/cropping systems on a larger scale. Hence adoption of coconut based farming systems, production and distribution of elite planting materials of HYV/hybrids suitable for this zone and Integrated Pest and Disease Management are the technologies which needs prime attention for this State.

Conclusion

Indian coconut sector has inherent strengths of varied agro-climatic conditions, huge domestic demand, highest productivity, sound research, developmental and Transfer of Technology systems etc. However, so far, the sector has not effectively utilized the possible linkage between them for increasing the production and marketing efficiencies. The present era of globalization and trade liberalization warrants a sustainable growth in the entire industry to sustain the economic prospects of Indian coconut farmers.

For this long-term, vision oriented strategic plans

Table 9. Prioritization of technologies to be adopted for Tamil Nadu State

Rank	East Coast	Western and Southern	North Western	Research Institute	Developmental Agency
01	Drought Management (Estimated yield loss upto 50%)	Drought Management (Farmers over exploit ground water)	Drought Management (Yield loss upto 30 %)		Technology dissemination and developmental schemes on a larger scale for drip irrigation, husk and leaf burial through large scale demonstrations
02	Awareness creation on over exploitation of ground water (Long run threat). Water management techniques like drip irrigation				Working in coordination for achieving the desired results in these programmes
03	Seedling production with HYV/hybrids. (Supply is inadequate)				Working in coordination for achieving the desired results in these programmes
04	Encouraging coconut – based cropping / farming system subject to water availability.				Technology dissemination and developmental schemes on a larger scale for various cropping/ farming system models.
05	Management of <i>Ganoderma</i> - wilt and Stem Bleeding diseases.(Yield loss upto 30 %)				Integrated Disease Management strategies in the endemic areas.

Table 10. Prioritization of Technologies to be adopted for Karnataka State

Rank	Coastal	Western and Southern	North Western	Research Institute	Developmental Agency
01	Soil and Water Conservation (Huge loss of top soil and water resources)	Drought Management (Yield loss upto 30 to 60%)	Drought Management (Yield loss due upto 40%)		Proving the technical feasibility and economic viability of these technologies like drip irrigation, husk and leaf burial through large scale demonstrations
02	Awareness creation on Integrated Pest Management (Yield loss upto 40%)				Working in coordination for achieving the desired results in these programmes
03	Seedling production with HYV/hybrids				Working in coordination for achieving the desired results in these programmes
04	Integrated Crop Management Strategies (Yield loss upto 50%)	Encouraging cropping system subject to water availability			Proving the technical feasibility and economic viability of various cropping/farming system models.

C.5. Technology prioritization for Andhra Pradesh

Table 11. Prioritization of Technologies to be adopted for Andhra Pradesh State

Rank	Coastal	Other zones	Research Institute	Developmental Agency
01	Production and Distribution of Elite Planting Materials of HYV/Hybrids			Proving the technical feasibility and economic viability of these technologies like drip irrigation, husk and leaf burial through large scale demonstrations
02	Encouraging cropping system.	Encouraging cropping system, subject to water availability		Proving the technical feasibility and economic viability of various cropping/ farming system models.
03	Awareness creation on Integrated Crop Management			Working in coordination for achieving the desired results in the developmental programmes

need to be formulated and effectively implemented involving the research, developmental, extension and co-operative marketing agencies. In the production sector, all the activities of these agencies need to aim towards competitiveness through higher productivity based on a farming systems approach. Area expansion needs to be

discouraged, production zones needs to be categorized as high, medium and low and appropriate technology transfer and development schemes need to be implemented considering their inherent strengths and weaknesses. Categorization of technologies and their prioritization for various production zones should

precede the process of technology transfer. Technologies such as under-planting/replanting with High Yielding Varieties / Hybrids, coconut - based farming/cropping systems and product diversification and value addition need more emphasis in all the major production zones.

In the case of marketing and processing sectors, on-farm processing needs to be encouraged and joint efforts of research, extension, co-operative marketing sector, and developmental agencies are required to test the technical feasibility and economic viability of coconut - based agro-processing complexes in all the major coconut-producing states. The activities of marketing federations need to be revitalized. The Commodity Board may give more emphasis on market promotion schemes for popularizing value added products.

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