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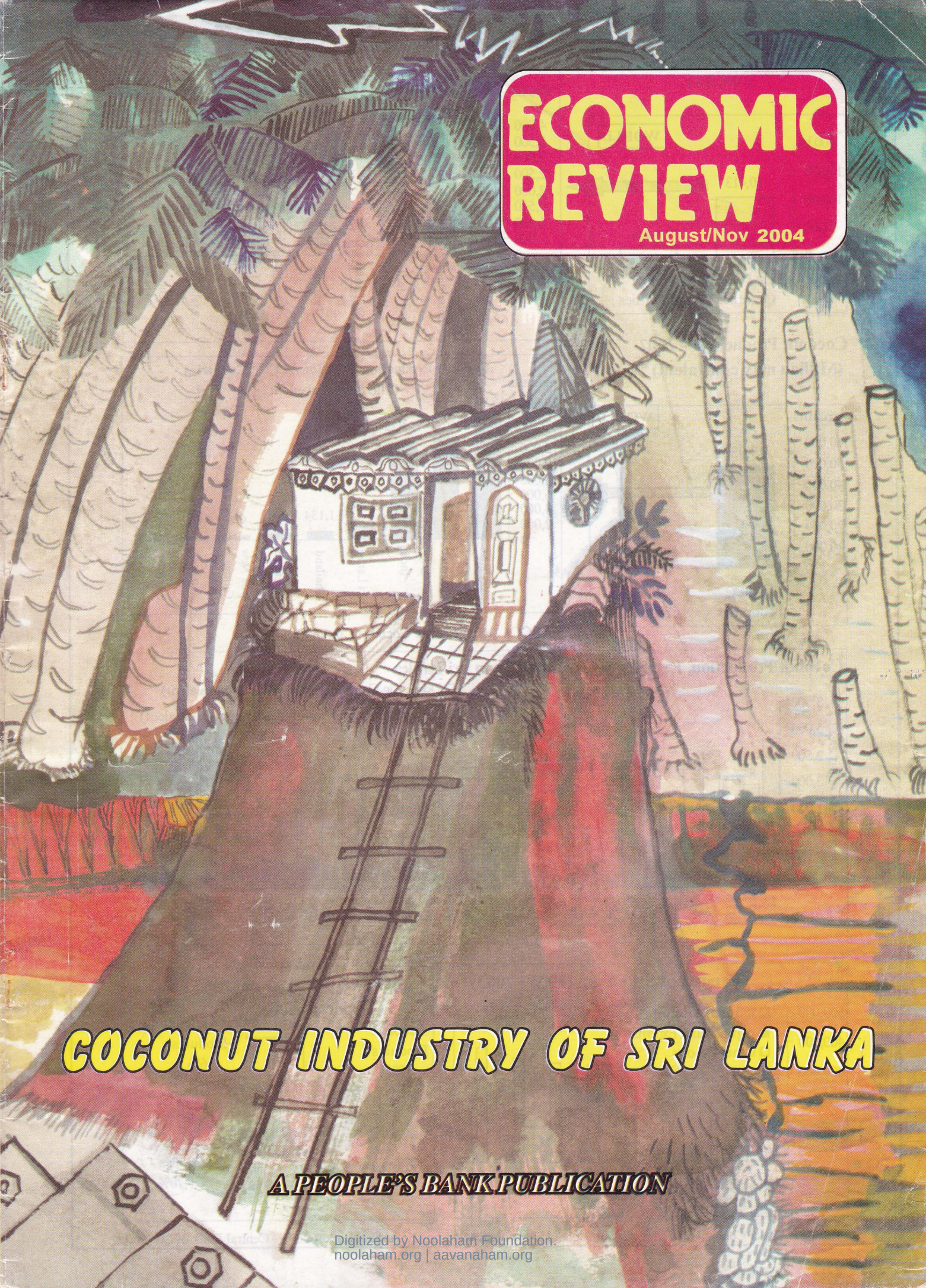

COCONUT INDUSTRY OF SRI LANKA

A PEOPLE'S BANK PUBLICATION

COCONUT INDUSTRY: WORLD & SRI LANKA

Area Under Coconut Cultivation - 2002
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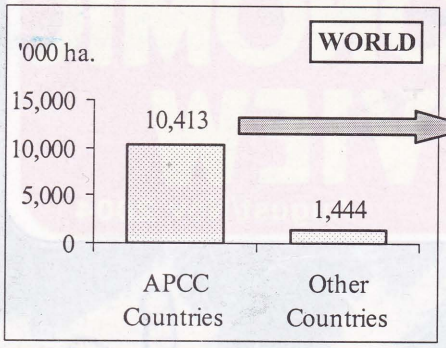
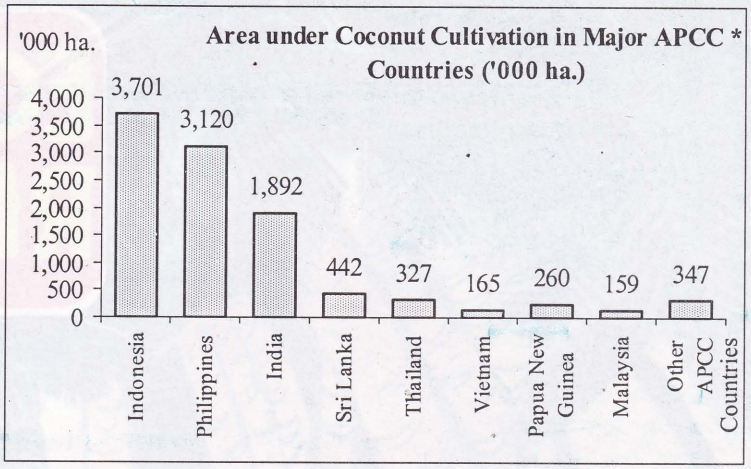
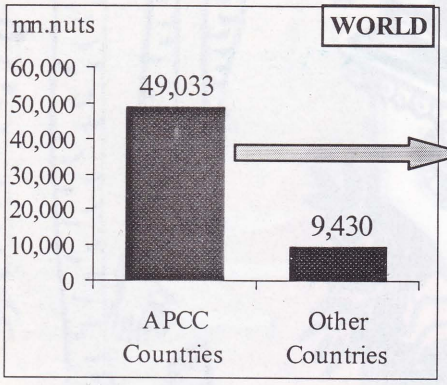
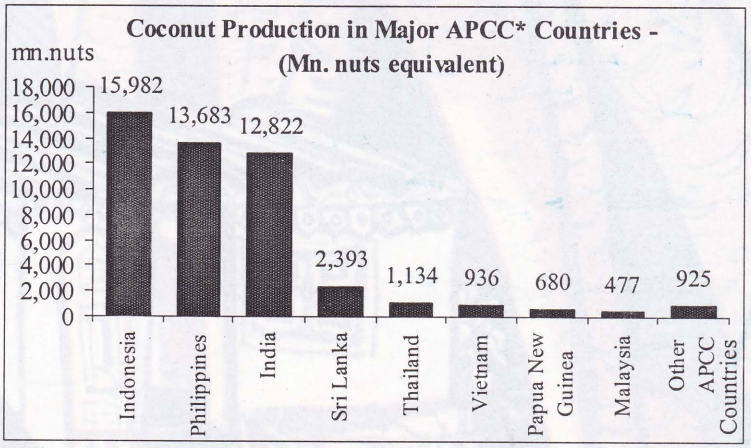


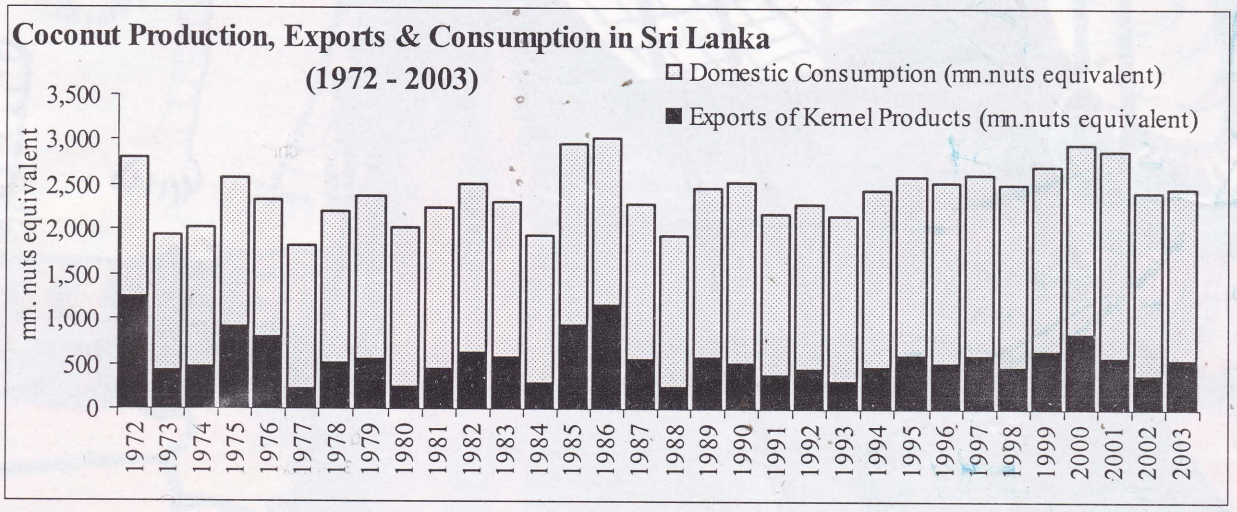


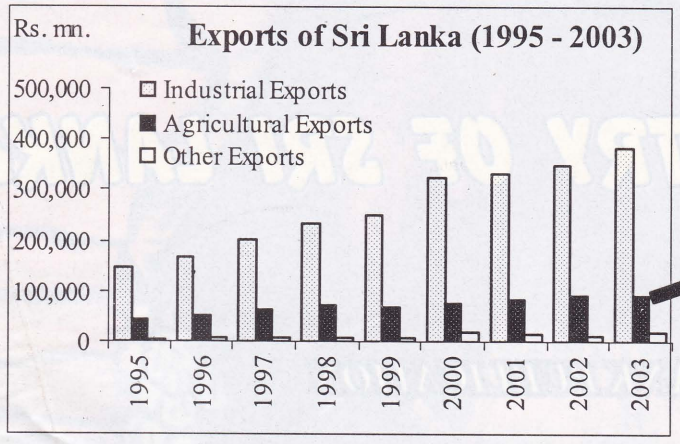
Coconut Production - 2002
(Million nuts equivalent)

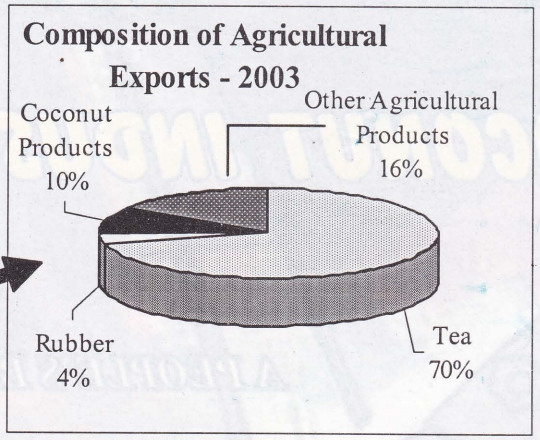




*** APCC - Asian Pacific Coconut Community**







Source : Sri Lanka Coconut Statistics - 2003 Coconut Development Authority, Annual Report 2003 - Central Bank of Sri Lanka

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(We greatfully acknowledge the co-operation extended by Dr. (Mrs) Chitrangani Jayasekara, Director, CRISL and her team of Researchers in compiling this Special Report.)

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OVERVIEW

The coconut popularly known as "Tree of Life" (Kalpavruksha) has been used by human kind from time immemorial. It is used in the form of tender nut and dry fruit as food, drink, oil and milk. For several centuries it has been used as a medicine in Ayurvedic system. As an economically valuable crop coconut plays a significant role in the daily life of people over 80 countries of the tropics. Coconut is grown in more than 80 countries around the world in 12 million hectares and the estimated global production is approximately 57 billion nuts. About 78 percent of world coconut production is contributed by four major coconut growing countries, namely, India, Indonesia, Philippines and Sri Lanka.

In Sri Lanka, wet and intermediate zones of the island remain as the major coconut growing areas and small holdings of less than 20 acres dominate the production. Total extent of land under coconut cultivation is approximately 400,000 hectares and average annual production remains around 2500-3000 million nuts. In terms of total extent of land under cultivation and production Sri Lanka occupies third and fourth places respectively. On the other hand, as far as consumption is concerned, Sri Lanka remains the largest coconut consuming country in the world and approximately 75 percent of its production is utilised for domestic consumption. The per capita consumption of fresh coconuts for house hold consumption is assessed to be over 95 nuts per year.

Coconut while occupying 25 percent of the cultivable land of the country – greater than the total area occupied by tea and rubber – provides livelihood to many thousands of people in Sri Lanka in production, processing and marketing sectors. It also takes a prominent place in the social and religious rituals of large number of Sri Lankans.

Notwithstanding its economic importance in terms employment creation, industrial development and export earnings, over a period of three decades there is a considerable decrease in coconut area, production and productivity in Sri Lanka due to large number of small holdings, old unproductive trees, inadequate water management and input management. In this context the industry faces several challenges and concerted efforts are called for to overcome them and place the industry in a strong footing in the years ahead. The accelerated development of this sector assumes further importance in the context that the estimated demand for coconut in Sri Lanka by 2010 would be in the range of around 4000 million nuts to meet the domestic and industrial requirements. Another aspect the authorities and the stakeholders are required to take into serious consideration in this regard is the mounting competition in the global markets arising from the liberalised trade environment in which the future prospects of the coconut industry lies solely on its overall competitive ability.

At a time when the coconut industry faces severe challenges in various fronts in maintaining a sustained growth and development, the Coconut Research Institute of Sri Lanka to coincide with its 75th anniversary organised an International Conference in Colombo in September 2004 under the theme "Tree of Life – New Trends in the Millennium" with the patronage of the Ministry of Plantation Industries and Asian and Pacific Coconut Community (APCC).

Rich tributes were paid to the CRISL at this conference for the noteworthy role it has played since its inception towards uplifting and sustaining the coconut industry in Sri Lanka. Its outstanding contributions to the industry included development of many high yielding varieties and hybrids, management techniques, coconut based integrated farming systems and processing technologies for developing value added products.

In this issue of Economic Review, in considering the urgent need to focus on the sustained development of the coconut industry, which plays a major role in poverty alleviation in rural communities by providing livelihoods, an effort is taken to take stock of the present status of the industry and steps required to be taken to charter a future road map for the industry.

This Special Report includes articles written by the eminent scientists and researchers attached to the Coconut Research Institute of Sri Lanka who took a proactive role in the deliberations of the International Conference and provides an indepth analysis on the present position and future challenges of the coconut industry. These articles also provide valuable insights to the policy makers who are faced with tremendous tasks in formulating appropriate policies and strategies, in the emerging competitive global environment, to ensure the future growth and prosperity of the industry.

COCONUT INDUSTRY IN SRI LANKA & ITS FUTURE TRENDS

H.D. Jayasinghe
Director
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Coconut Development Authority

Coconut, an important horticultural crop, grown across the globe, especially in coastal eco system occupies an area of 12 million hectare with total production of about 56 billion nuts, of which Asia and Pacific region contributes 90 percent in area and production. Globally India, Indonesia, Philippines and Sri Lanka are four major coconut growing countries, which together contributes 78 percent of world production. Coconut palm being a crop of strategic importance in all the growing countries, in terms of its intimacy with human being, as a social and cultural commodity, has much more significance in socio-economics.

An overview of the coconut industry in Sri Lanka

Coconut is a food crop to a major segment of Sri Lankans and plays a dominant role in their social and religious rituals. It is an important cash crop for more than 700,000 farm families (Land holdings) in the country besides providing job securities direct and indirect to equal number of employees. The coconut industry in Sri Lanka plays a significant role in the economy of the country. Coconut is among the top five export products of the country both interms of traditional and non-traditional products. Coconut cultivation accounts for the second largest land usage and 25% of the total available land in the country.

The total extent of land under coconut cultivation has been 416,091 hectares and the main growing areas are concentrated in the fertile, wet and intermediate wet zones of the island. Except for a few large holdings which are owned by state sector the vast majority of coconut lands are under private ownership and 98% of them are in small holdings of less than 20 acres.

The average annual production of coconut in Sri Lanka is assessed to be around 2,500 – 3,000 million nuts. Out of the total production, a quantity of about 1,750 million nuts or about 60% is used in households mainly, for extraction of coconut milk for use in cooking. The per capita consumption of fresh coconuts for house hold consumption is assessed to be over 95 nuts per year.

Coconut Production

The average annual production of coconut is assessed to be 2,500 – 3,000 million nuts, the current average yields being about 6,250 nuts per hectare per year. There is a considerable degree of variability in annual production of nuts due mainly to :

(a) Greater variability in annual rainfall through out the year, coconut being very responsive to moisture availability.
(b) A fairly high percentage of the palm population is over 70 years old.
(c) Irregular and low rate of usage of fertilizer, due mainly to its escalating costs.

To revive coconut cultivation in the country the Government is launching a massive development programmes which include, distribution of high quality seedlings / planting materials, subsidy for drip irrigation system, management of deceases and pests, development of technologies in the field of product diversification and by product utilization etc.

Coconut Based Industry

About 40% of the annual coconut production is used in industrial processing for the manufacture of a range of kernel and non kernel products such as copra, coconut oil, Desiccated coconut, coconut milk, powder, cream, coir fibre, coir processed products, shell charcoal and activated carbon most of which are meant mainly for export. Coconut products constitute a valuable source of foreign exchange, with an annual earning potential of over Rupees 14 billion (US$ 135 million). The coconut based industrial sector comprises a well organized formal sector and a large informal sector. The formal sector for the most part, comprises the export oriented industries and the small and medium scale processing units. The informal sector is made up mostly of cottage industries, engaged in the manufactures of products and bi-products primarily for the domestic market.

The major coconut processing industries are still dominated to a very great extent, by small and medium scale processing units, which continue to use labour intensive, traditional technology. This situation demonstrates the viability of the small and medium scale operations, continued use of labour intensive, traditional technologies has given rise to a number of issues, particularly in the case of some of the major export oriented products.

The difficulties encountered by the industry are:

(a) increasing difficulties in finding and retaining skilled workers
(b) increasing difficulties in meeting the stringent standards of quality of products.
(c) Escalating costs of production

Further, since most of the major products are still being exported as raw material , (for use in value-addition in importing countries), the prices obtained for these products are fast becoming non remunerative, vis-à-vis their costs of production. This has resulted in most of the small and medium scale industries becoming subsistence level operations, with inadequate returns for re-investment in their development and growth.

The coconut industry in Sri Lanka comes under the supervision and direction of the Ministry of Plantation Industries, which deals with all maters relating to the overall development of coconut plantation, agriculture and associated processing, marketing, research and other related activity.

The Ministry of Plantation Industries implement its development policies through the statutory institutions functioning under its purview, Coconut Development Authority, Coconut Cultivation Board and Coconut Research Institute.

The technological innovations helped in the conversion of coconut in to high quality various value added products according to the international standards and norms and capturing the overseas markets for these products through a well defined marketing strategy are the main gigantic tasks of the Coconut Development Authority.

Export of coconut and coconut based products

Coconut and coconut based products are mainly categorized into 06 sections. They are, Kernel products, fibre products, fibre processed products, shell products, sap products and others. Kernal products are coconut oil, Desiccated coconut, copra, fresh coconut , poonac, coconut cream & milk, coconut milk powder and defatted coconut. Fibre products are mattress, bristle and twisted fibre. Fibre processed products are coir yarn, coir twin, tawashi brushes, coir brooms, brushes, rubberized coir products, husk chips, geo-textiles, moulded coir products for use in horticulture.

Shell products are coconut shell charcoal, shell flour, activated carbon and shell based handicrafts.

Sap products are vinegar, trickles, coconut based arrack and toddy.

Coconut ekels, coconut leave based decoratives, are classified as other products (exports of coconut products for 2003 – 2004 is given in annex i). Sri Lankan coconut products are exported to more than 95 countries in the world.

Coconut production in 2004, was assessed at 2,590 million nuts. The drop in out put was attributed to the lagged effect of reduced rainfall received during the latter half of 2003, especially in the areas in the account triangle and mite attack.

In the wake of a drop in output, the price of nuts increased sharply during the latter part of the year to 17,000/1000 nuts, from Rs. 12,000/ 1000 nuts year ago. Retailed prices of coconuts was unprecedentedly increased by 60% to Rs. 26/= in December 2004 from Rs.15/= corresponding month last year.

Desiccated coconut is the biggest export product both in terms of volume & value. For the year 2004 total DC export volume was 53,615 MT with a value of Rs. 4,636 million. This is higher by 42% form Rs. 3,276 million earnings generated in the same period year-ago. The major importing countries of Sri Lankan DC include India, Egypt, Dubai, France, Germany, Iran , Saudi Arabia and shipments during the year 2004 went to 90 countries. The top 7 destinations which mainly were countries in Asia, Africa, Middle east and the European Union jointly accounted for a combined volume of 43,471 MT . The remaining 10,144 MT or 19% were absorbed by 32 other countries.

Fresh nut exports from Sri Lanka reached 39 million nuts in 2004, up 14% from the 34 million nuts in 2003. The export was worth Rs. 837 million, higher by 21% from Rs. 690 million earnings generated in the same period year ago.

There were 45 country recipients of this product led by UAE which took in 12,115,243 nuts representing 31% of total traded volume.

With a drop in production and an increase in nut prices, coconut oil and edible copra export earnings declined by 7% and 9% to Rs. 189 million and 1,013 million from 204 million and 1,120 million respectively in the same period year-ago.

During the year 2004, coconut cream, milk, and milk powder export earnings increased by 5%, 27% & 571% from Rs. 163 million, 249 million, 147 million earnings generated in the same period year-ago.

The total kernel export was valued Rs. 8,500 million, up by 27% from year-ago at Rs. 6,672 million. Export earnings from Mattress fibre increased by a hefty 67% in 2004 to Rs. 684 million from Rs. 409 million in 2003.

Export of Bristle fibre and Twisted fibre in contrast, sank by 8% and 22% during the period Jan. – Dec. 2004 to 2,917 MT and 15,086 MT from the prior year's 3,196 MT and 19,291 MT respectively.

Coir processed products are gaining world wide acceptance as natural eco-friendly bio-degradable fibre products. Value addition in coir products sector opened exorbitant demand and the industry is blooming to capture new markets. Moulded coir products for use in horticulture, rubberized coir pads and mattress for bedding and geo-textiles are rapidly developing in the coir sector. Coir pith (fibre dust) offer good scope for export as soil conditioner and organic manure. Coir pith has been identified as an ideal soil conditioner for all types of soil.

The total export of coir processed products and by products were worth Rs. Million 4,853 million, higher by 12% from Rs. 4,346 million earnings generated in 2003. The most significant feature is that moulded coir products for use in horticulture are gaining popularity in Japan, China, Korea, UK and EU market as an in-door decorative medium. They are Coir Pots, Coco Poles, Weed Control Mats, Coir baskets liners/ Flat liners, Tree Mats & Pot toppers, Bark Guards, Coco Pets & Moulded products and Multilayer Growing Boards

The export of moulded coir products for use in horticulture was worth Rs. 576 million, higher by 44% from Rs. 399 million earnings generated in 2003.

Coconut shell charcoal finds wide use as a fuel and as a base material for the manufacturer of activated carbon. Activated carbon is the most widely sought product for pollution control and removal of colour and odour of compounds due to its small structure which renders it more effective for these specific applications. This is also extensively used for purifying, refining and bleaching of vegetable oils and chemical solutions and purification of drinking water.

Activated carbon exports grew 6% in 2004 to Rs. 1,557 million from Rs. 1,463 million in 2003. Earnings from Activated carbon represent 9% of total export earnings.

EXPORTS OF COCONUT PRODUCTS JANUARY / DECEMBER 2003/2004
COMPARATIVE STATISTICS

	PRODUCT CATEGORY	VOLUME (MT) Jan.-Dec. 2003	*Jan.-Dec. 2004	% Change	VALUE (RS. MIL) Jan.-Dec. 2003	*Jan.-Dec. 2004	% Change
1	Coconut Oil	2,473	2,115	-14	204.61	189.64	-7
2	Desiccated Coconut	42,234	53,615	27	3,275.81	4,636.40	42
3	Copra	17,546	14,651	-16	1,120.58	1,013.54	-10
4	Fresh Nuts & Seed Nuts (Nos.'000)	34,527	39,236	14	690.75	837.89	21
5	Coconut Poonac	340	11,006	-	5.75	177.60	-
6	Coconut Cream	1,435	1,332	-7	163.81	172.20	5
7	Coconut Milk	3,272	4,056	24	249.42	317.27	27
8	Defatted Coconut	1,818	2,340	29	115.04	168.23	46
9	Milk Powder	3,152	3,604	14	847.17	988.20	17
10	***Sub Total Kernel Products (in Mil. Nut Equivalent)***				**6,672.94**	**8,500.97**	27
11	Mattress Fibre	23,793	37,209	56	409.43	684.44	67
12	Bristle Fibre	3,196	2,917	-9	146.61	142.38	-3
13	Twisted Fibre	19,291	15,086	-22	489.03	472.69	-3
14	Coir Yarn	1,224	1,284	5	68.96	77.44	12
15	Coir Twine / Rope	3,446	3,173	-8	256.48	272.62	6
16	***Sub Total Fibre Products***	**50,950**	**59,669**	17	**1,370.51**	**1,649.57**	20
17	Coconut Shell Charcoal	2,852	5,110	79	73.37	126.53	72
18	Coconut Shell & Shell flour	1,104	1,273	15	25.85	32.50	26
19	Coconut Shell Activated Carbon	16,000	15,319	-4	1,463.17	1,556.96	6
20	***Sub Total Shell Products***	**19,956**	**21,702**	9	**1,562.39**	**1,715.99**	10
21	Coconut Ekels	5,114	5,019	-2	72.27	74.32	3
22	Finished Products (Coir Fibre)						
	(a) Tawashi Brushes (Nos.)	31,393,558	30,265,780	-4	327.26	359.06	10
	(b) Brooms & Brushes (Nos.) (Other than Tawashi)	19,060,104	16,927,327	-11	735.02	763.97	4
	(c) Coir Mats & Rugs - Pcs.	210,093	1,507,872	618	808.45	842.54	4
	(d) Coir Mattings (M^2)	9,873	2,048	-79	12.67	1.27	-90
	(e) Rubberised Coir Pads & Mattress for Bedding (Nos.)	96,284	435,479	352	81.68	94.29	15
	(f) Geo Textiles (MT)	1,686	2,153	28	105.46	132.36	26
	(g) Moulded Coir Products for use in Horticulture (MT)	6,777	25,356	274	399.49	576.02	44
	(h) Fibre Dust (MT)	91,059	81,681	-10	1,514.74	1,662.79	10
	(I) Husk Chips (MT)	1,334	2,597	95	40.04	73.56	84
	(j) Coconut Based Arrack (l)	92,223	76,945	-17	25.31	22.04	-13
	(k) Vinegar (l)	79,647	21,002	-74	2.35	1.70	-28
	(l) Others (MT)	-	-	-	-	-	-
23	***Sub Total (Non - Kernel Products)***				***7,057.64***	***7,969.48***	13
24	***TOTAL VALUE OF ALL PRODUCTS***				***13,730.58***	***16,470.45***	20

2003 - Actual
2004 - Jan.-Nov.-Actual, Dec. - Provisional

Source : Customs Returns & CUSDEC Forms

Coconut Industry in Sri Lanka

Everard Jayamanne

Deputy Director (Research)
Coconut Research Institute, Lunuwila.

Coconut palm or *Cocos nucifera* L, the most economically valued cultivated palm in the world plays a significant role in the daily life of people over 80 countries of the tropics. The origin and dispersal of coconut was lengthily debated until recent DNA analyses provided substantial evidence for its origin as atolls in the far-east or Pacific. Coconuts have a great genetic diversity due to man assisted selection over generations for numerous economically useful characters of the palm. However, there is still a clear distinction in the structure of far-east/Pacific and Indo-Atlantic coconuts. The predominately cultivated tall (*typica*) coconut in Sri Lanka resembles Indo-Atlantic coconuts while dwarfs including king coconut and San Ramon (introduction to Sri Lanka from Philippines) resemble far-east/Pacific coconuts. Coconut palm extends over coasts of tropical islands and a few places outside. Coconut dispersed from its origin to many different parts of the world by floating in ocean currents and by man as a source of food and drink on sea voyages.

The earliest record of coconut in Sri Lanka was from an ambassador to the Indian King, Chandraguptha in India (300 BC). More references of coconut including the presence of arrack come from the 5th century AD. The first reference of a coconut plantation is cited in Mahawansa at the time of King Aggabodi (AD 589). Dutch, who occupied Sri Lanka in 1658 showed a distinct interest in coconut and extended coconut cultivation along the coast up to Chilaw from Matara. British, who took over from Dutch in 1670 began plantations in the coast as well as inland of Western and North Western Provinces. They increased coconut acreage from 250,000 in 1860 to 850,000 in 1902. Nuts, copra, oil, DC, coir and arrack were the main export commodities during those eras. Sri Lanka enjoyed a monopoly in coconut export products from 1880s until Philippines came into competition in around 1927.

Coconut provides livelihood for many thousands of people in Sri Lanka in production, processing and marketing sectors. Production is the largest sector while processing sector comprises sub sectors, manufacturing of coconut products and by products for export and producing and processing sap products for domestic use. Country produces 2-3 billion nuts/year occupying an area of 0.44 million ha with 74% being smallholdings (<less than 20 ac). Coconut is the major source of edible oils and fats providing 22% of the daily caloric requirement of an average adult making Sri Lanka the highest per capita consumer in the world with 109 fresh nuts/annum. Processing and marketing sector accounts for Rs. 11.9 billion export earnings (2% of country's total export earnings) contributing 1.3% to GNP (42% of total plantation GNP and 9% of total agriculture GNP). Coconut provides employment for nearly 100,000 people in production and 35,000 in processing and another 265,000 indirect. The total value of the industry is Rs. 27 billion. Coconut was recognized by the International Plant Genetic Resources Institute (IPGRI) as the most valuable tree crop in the world for alleviating poverty among rural farmer communities in the tropics.

Coconut occupies 25% of the cultivable land behind only to rice the staple food in Sri Lanka. This is greater than the total area occupied by tea and rubber together. Total extent under coconut in Sri Lanka increased from 57,000 ha in 1800 to 263,000 ha in 1893 and to 332,000 ha by 1921. In the last decade constancy was seen in the area under coconut in spite of the progressive decline from 1962-1992 due to urbanization and industrialization. The area remained stagnant at 443,000 ha in the last five years. National coconut replanting programme (NRP) assisted by various incentives for growers, expansion of coconut into non-traditional coconut growing areas and home gardens have helped in maintaining this stability. The age structure of the coconut palm population in the country is 12% young, 70% productive palms and 18% senile (>60 years) palms.

Around 65-70% coconut lands are confined to the coconut triangle encompassing Kurunegala, Puttalam, Gampaha and Colombo districts (Table 1). Nearly 12% are found in the coconut mini triangle (thin stretch of land extending along the southern coast in three districts, Kalutara, Galle and Matara. Kurunegala with 36% accounts for highest as a district with Gampaha (13%) and Puttalam (12%) in 2nd and 3rd positions. The recent 550-hectare plantation that established in Mahaweli system C was a significant addition to country's coconut palm pool.

Coconut lands less than 0.8 ha considered as home gardens while those above 0.8 ha < 8 ha as smallholdings, those between 8 to 20 ha as estates and above 20 ha as plantations. Smallholdings dominate coconut production sector with a 50% share. (Table 2).

Table 1. Districtwise distribution of coconut in Sri Lanka

District	Area under Coconut (ha)	% from total area
Kurunegala	159,829	36.17
Kandy	8,363	1.89
Gampaha	56,703	12.83
Moneragala	6,401	1.45
Puttalam	51,781	11.72
Anuradhapura	5,728	1.30
Hambantota	23,173	5.24
Batticaloa	4,090	0.93
Kegalle	21,458	4.86
Amparai	3,886	0.88
Ratnapura	16,777	3.80
Polonnaruwa	3,003	0.68
Matara	16,179	3.66
Mulathivu	2,205	0.50
Galle	12,879	2.91
Trincomalee	1,807	0.41
Kalutara	12,716	2.88
Badulla	1,212	0.27
Matale	11,880	2.69
Mannar	1,181	0.27
Jaffna[1]	10,027	2.27
Nuwara Eliya	1,037	0.23
Colombo	9,121	2.06
Vavuniya	425	0.10
Total	**441,861**	**100.00**

Table 2. Distribution of coconut lands by size and holdings in Sri Lanka

Size class (s)	Holding	Number of holdings	Total area (ha)	Percentage by holdings	Percentage by area
s < 0.8 ha (2 ac)	Home garden	405,289	96,255	57.53	23.65
0.8 ha < s < 8 ha (20 ac)	Small holding	292,879	204,551	41.57	50.25
8 ha < s < 20 ha (50 ac)	Estate	4,012	39,594	0.56	9.72
20 ha (50 ac) < s	Plantation	2,268	66,586	0.32	16.36
Total		**704,448**	**406,986**		

[1] Including Kilinochchi

Table 3 : Requirement of labour per unit land in coconut, tea and rubber

Crop	Labour requirement/ha	Total men workforce in the Cultivation sector
Coconut	0.25	100,000
Tea	3.12	580,000
Rubber	0.87	140,000

Coconut cultivation is less labour intensive than other main plantation crops. It is estimated to be 0.25 workers per ha making the total work force engaged in coconut production approximately 100,000 (Table 3).

Among coconut varieties cultivated, Sri Lanka tall (var. *typica*) is the most extensively grown coconut in the country for its wide adaptability. King coconut (var. *aurantiaca*) known for its potential as a nourishing beverage is found widespread in the country though not at plantation scale. Various colour forms of dwarf coconuts known as great combiners in coconut hybrid development are found scattered in home gardens. CRI has so far released three improved cultivars of coconut, CRIC60, CRIC65 and CRISL98 for extensive planting (Table 4). Besides these there are selected mother palms (plus palm tall) in large estates for collection of seed coconuts.

The annual production of coconut in Sri Lanka averaged 2.51 ± 0.074 billion nuts during the 20-year period, 1983-2002. The best year being 2000 with a crop of 3.1 billion nuts and the worst being 1988 with a crop of 1.9 billion. The average productivity of coconut was 6094 ± 161 nuts/ha with 1986 being the most productive 7607 nuts/ha (Table 5). Coconut being a rain-fed crop the yield is highly dependent on intensity and distribution of rainfall. Nevertheless five-year averages showed a slow positive trend in the production from 1991 onwards. This progress however, is inadequate for sustainability of coconut because the demand for domestic consumption increases more rapidly with the swift population growth.

Table 4. Economic characteristics of improved coconut cultivars

Cultivar Character	PPT (plus palm tall)	Moorock (selected tall)	CRIC 60 (tall x tall)	CRIC 65 (dwarf x tall)	CRISL 98 (tall x San Ramon)
Age at flowering (yr.)	6-7	6-7	6-7	3-4	6-7
Yield stabilizing age (yr.)	10	10	10	8	10
Yield (nuts/palm/yr.).	80	80	100	120	100
Yield (nuts/ha)	13,000	13,000	16,000	20,000	14,500
Copra Mt/ha	200 - 225	250 - 260	225 - 250	200	290
Copra (kg)/nut	2.8	3.3	3.8	4	4.2
Susceptibility to pests	Low	Moderate	Moderate	High	Low
Adaptability	Wide	Specific	Wide	Specific	Wide

The estimated total area under coconut in the world in 2001 was 11.8 million ha of which 10.4 million are in APCC countries. Indonesia had the highest extent of coconut (3.7 million ha) while Philippines and India followed with extents 3.1 and 1.8 million ha respectively. Sri Lanka was the fourth with an extent of 0.44 ha. The world's coconut production in 2001 was 56.4 billion (Table 6) with Indonesia recording highest with 15.16 billion. Philippines and India followed with yields 113.2 and 12.6 billion nuts respectively. Sri Lanka occupied the fourth place with 2.77 billion. Among the best four countries the best productivity was seen in India while Sri Lanka was equally good as India comparing to topmost producers, Indonesia and Philippines. The coconut productivity in Brazil and Mexico were astonishing despite being the first countries to hit by the coconut mite, the most serious coconut pest in the world today.

Coconut consumption in Sri Lanka is unique as coconut is the main source of edible fat in the diet irrespective of income class or origin. In 2002 approximately 1.8 billion nuts were consumed domestically with a per capita consumption of 126 nuts per person. The last 20-year average has been 109 nuts/person/year. The average household is believed to spend around 9% of its food expenditure on fresh coconut and oil. Coconut provides about 22% of daily caloric requirement. This is only second to rice, which provides about 54%. In addition to fat coconut is also a source of carbohydrates, proteins, fibre and minerals (Table 8). Besides direct consumption as dietary constituents, toddy, arrack, treacle and jaggary are also domestic uses of coconut in Sri Lanka. The average domestic consumption over the last two decades (1980-2002) was approximately 1.9 billion (78% of the total nut production) nuts per year leaving 0.6 billion (22%) for the industry. This is an extremely high rate of domestic consumption comparing to other countries. The actual percentage of domestic consumption in APCC countries was 64% in 2001. Apart from India who uses almost all of its coconut production as tender nuts in the domestic market, Sri Lanka is the highest per capita consumer of coconut in the world.

Sap based products is an important industry in coconut that predominantly cater to the domestic market. Total extent of toddy in 2002 was estimated to be around 4685 ac. Toddy tapping is mainly confined to the coastal belt of the Kalutara district. It is also carried out in Gamapaha, Hambantota, Puttalam, Kurnegala,

Table 5. Coconut production and productivity in Sri Lanka in the past 20 years (1983-2002)

Year	Yield '000,000 nuts	Average Yield nuts/ha
1983	2,312	5,618
1984	1,942	4,766
1985	2,958	7,331
1986	3,039	7,607
1987	2,292	5,795
1988	1,937	4,948
1989	2,484	6,410
1990	2,532	6,602
1991	2,184	5,755
1992	2,296	6,115
1993	2,164	5,436
1994	2,622	6,302
1995	2,755	6,406
1996	2,546	6,120
1997	2,631	5,952
1998	2,504	5,660
1999	2,828	6,392
2000	3,096	6,998
2001	2,769	6,259
2002	2,392	5,407
Mean	**2,514**	**6,094**

Table 6: World coconut production and productivity (2001) in main coconut growing countries

Country	Nuts '000,000	Percentage from the total production	Productivity Nuts/ha
Indonesia	15,160	27	4,107
Philippines	13,208	23	4,233
India	12,597	22	6,846
Sri Lanka	2,769	5	6,265
Brazil	2,498	4	9,498
Mexico	1,453	3	8,497
Thailand	1,117	2	3,426
Vietnam	936	2	5,673
Malaysia	563	1	2,491
Total	**56,390**	**100**	

Gamapaha and Kegalle to a lessor extent. This industry provides employment for many although an estimate for the number is not available. Employment opportunities that arise form the industry are direct employment such as tapping and collecting toddy, bottling of toddy, vinegar producing, treacle and jaggery making and trading of all these. Industry also provides indirect employment for making clay pots, coir ropes, tapping utensils and vats. Total toddy tax revenue to the government in 2002 was Rs. 34.2 million. Toddy tapping is more profitable than nut production and provides a daily income for the producer. Demand for toddy is in the increase assuring better prospects for the industry. Coconut arrack industry is dependent on toddy as a raw material. Cost and returns of toddy tapping as at raw material (coir yarn, fertilizer etc.,) and labour costs in 2002 gives a net return of Rs. 2313.00 per/palm/year.

Despite the limited share of nuts available for industry, Sri Lanka still offers a wide range of coconut products for the international market. Export value of coconut products in 2002 was Rs. 12.46 billion (US$ 130 million). Kernel products, earning Rs.5.5 billion (US $ 57 million) i.e. 44% of the total were the highest category of exports. Finished fibre products followed with 29% (Rs. 3.6 billion or US $ 38 million) while Fibre and shell products accounted for 12% and 14% respectively (Table 7).

DC is Sri Lanka's major coconut export product for over 25 years. Main uses of DC are, filling chocolates, candies, biscuits and cakes, decorating cakes, biscuits and ice cream and preparation of snacks. Export earnings from DC varied between Rs. 1.5 - 5.0 billion per annum during the last 10-year period (1993-2002). DC accounted for more than 70% of export earnings from coconut kernel based products and more than 35% from all coconut product exports. DC dominated export earnings during the period 1991 - 2001 but since then percentage reduced due to increase in exports of fiber finished products.

The Philippines and Sri Lanka have dominated world's DC market for a long time. Indonesia has also emerged as an important supplier in the recent years. World DC exports in the five period (1997-2001) averaged 75,661 MT with a major share (72.2%) going for APCC countries. Philippines and Sri Lanka almost equally accounted for about 53% of the total DC exports. The share of Sri Lanka in the five-year period was 24.08%. It is interesting to note that Sri Lanka had exported more DC than Philippines in 2000. Major importing countries of DC are USA, Canada, Europe, South Africa, Middle East and Australia (Table 8).

[2] Source: Dr. M.T.N. Fernando, CRI

Table 8. Desiccated coconut (MT) exports in major coconut producing countries (1997-2001)

	1997	1998	1999	2000	2001	Average
Philippines	76,792	71,896	76,219	73,725	79,671	75,661
Sri Lanka	63,739	45,235	62,949	82,735	49,874	60,906
Indonesia	26,748	22,391	23,533	31,373	34,820	27,773
Other	96,960	82,955	93,664	90,676	78,528	88,557
Total	264,239	222,477	256,365	278,509	242,893	252,897
APCC share (%)	73.72	71.92	71.39	72.29	71.47	72.20
Sri Lanka (%)	**24.12**	**20.33**	**24.55**	**29.71**	**20.53**	**24.08**
Philippines (%)	29.06	32.32	29.73	26.47	32.80	29.91

International price of DC varied widely around US $ 952.00 per MT in the last decade. The average price in January - July 2003 was US $ 895.00 per MT. Cost of production for DC at the rate of current nut price; i.e. Rs. 9.50/nut amounts to about Rs. 80,000/MT[2]. At this rate running a DC mill is not profitable without the additional income from by products such as shells, pairings and red oil. Fluctuation of the international price of DC and local nut prices determine the viability of the DC industry as they often fluctuate within critical regions.

In spite of the heavy competition from various other sources of vegetable oil the main industrial use of coconut in the world is still the production of copra from which coconut oil is derived. Production of copra ranged between 2440 MT to 15,037 MT at an average of 8,420 MT per annum in the last 20 years. Oil production had shown a drastic decline since 1991. The average export value in last six years has been US $ 3 million. Highest export earning from copra, US $ 9.8 million was recorded in 2002 while the average earnings in last six years has been US $ 8.1 million. In the world market still oil production is more than the copra production. Indonesia was the main copra exporter followed by PNG and Sri Lanka. The Philippines followed by Indonesia took a huge share (74%) of oil exports. (Table 9).

The international price of copra varied between US $ 455 and 798 per MT (average price, US $ 675 per MT) in the last decade. The current local market price is Rs. 41,339 at the rate of Rs. 10,500 per candy (254 kg). Similarly the oil prices varied between US$ 627 and 966 at an average of US $ 872 per MT. The current local market price of coconut oil is Rs 75,000

Table 7. Export volumes and values of coconut products in 2002

	Volume MT	Value Rs '000	Value US $	% Value from total
1. Kernel Products				
Coconut oil	2,585	221,977	2,318	1.78
DC	28,557	2,791,256	29,145	**22.40**
Copra	13,281	944,314	9,860	**7.58**
Fresh nuts (Nos.)	23,679,323	523,516	5,466	4.20
Poonac	1	14	0	0.00
Coconut cream	1,255	156,565	1,635	1.26
Milk powder	2,809	754,959	7,883	**6.06**
Defatted coconut	2,066	135,449	1,414	1.09
Sub Total	***5,528,050***	***57,721***	***44.37***	
2. Fibre Products				
Mattress fibre	33,802	502,139	5,243	**4.03**
Bristle fibre	3,263	168,034	1,755	1.35
Twisted fibre	18,453	518,179	5,411	**4.16**
Coir yarn	796	45,318	473	0.36
Coir twine	4,294	319,468	3,336	2.56
Sub Total Fibre Products	***1,553,138***	***16,218***	***12.47***	
3. Shell Products				
Coconut shell charcoal	3,280	76,318	797	0.61
Coconut shell and flour	1,598	36,250	379	0.29
Activated carbon	18,037	1,588,536	16,587	**12.75**
Sub Total	***1,701,104***	***17,763***	***13.65***	
4. Finished Products				
Tawashi brushes (pcs)	35,190,628	356,938	3,727	2.86
Coir brooms, brushes (pcs)	21,471,366	726,576	7,587	**5.83**
Rubberized coir- beds(pcs)	197,542	76,346	797	0.61
Coir mats and rugs	169,216	668,354	6,979	**5.36**
Coir mattings (Sq. M)	36,359	35,692	373	0.29
Coir dust (MT)	79,891	1,427,939	14,916	**11.46**
Huskchips (MT)	1,077	31,349	327	0.25
Coir geo textiles (MT)	1,865	100,405	1,048	0.81
Coir pots (MT)	1,651	169,087	1,762	1.35
Arrack	84,139	22,539	235	0.18
Vinegar (lt.)	156	670	7	0.01
Sub Total		***3,615,895***	***37,758***	***29.02***
5. Other Products				
Coconut ekel (MT)	5,630	61,427	641	0.49
Total Value - All Products		**12,459,614**	**130,101**	**100.00**

Table 9. World exports of copra and coconut oil in 2001				
	Copra MT	Copra share (%)	Coconut oil	Coconut oil share (%)
Indonesia	23,884	22.39	395,019	20.52
Kiribati	7,171	6.72		0
Papua New Guinea	21,800	20.44	27,100	1.41
Philippines	14,587	13.68	1,417,974	73.67
Solomon Islands	6,281	5.89		0
Sri Lanka	15,037	14.1	3,436	0.18
Vanuatu	14,258	13.37		0
Other	3,641	0	81,139	4
Total	106,659	100	1,924,668	100

per MT. The total cost of producing coconut oil at the above rate of copra is around Rs. 93.095.00 including the 15% VAT[3]. The industry however, becomes profitable even at this rate of copra price if 15% VAT is removed and incomes generated by products such as poonac are taken into account.

The biggest threat to the coconut industry is the competition from other cheaper edible oils. Production of vegetable oils has increased from 20 million MT to 72 million MT in the last four decades with soybean and palm oil making the bulk. Contribution of coconut oil declined over the period from a share of 9.58% to 4.29% in spite of the increase in the production volume from 1.99 million MT to 3.1 million MT. Share of palm kernel oil (very similar in properties to coconut oil) increased from 1.87% to 2.61%. Consequently world exports of vegetable oils have also increased from 3.8 million MT to 25 million MT in the same period (1960-1999). The share of soybean in world vegetable exports fluctuated around 20% throughout the period while the share of palm oil dramatically increased from 17.13% - 43.43% during the period.

Poonac (copra meal or cake) is the solid remaining after the oil is extracted. This is used as an animal feed to enhance quality and level of the milk productivity. This is a very profitable industry because it is a by-product. Sri Lanka has been exporting poonac since 1981 but due to decline in the oil production poonac exports also suffered. Highest poonac export (40,080 MT worth US $ 3.9 million) was recorded in 1986. Since then the industry has virtually collapsed. In 2002 only 21 MT (=US $ 13,000) of poonac was exported. International trade in poonac grew impressively from about 453,000 MT in 1960's to 1.12 Million MT in 2001. Philippine was the largest supplier of poonac with 753,000 MT while Indonesia's supplied 259,000 MT in 2001.

Coir products comprising fibre and yarn and finished products and shell products mainly constitute non-kernel-based products of coconut with great export potential. In 2002 the export values of these accounted for nearly 41% of the total coconut export value. Export of non-kernel products increased rapidly and consistently in the last decade. Most promising export in the recent has been coir finished products such as coir fibre dust, coir brooms and brushes and coir mats and rugs. These three commodities earned US $ 14.9, 0.76 and 0.70 million respectively in 2002 accounting for 12.5% of the total coconut export value. Among raw fibre products twisted fibre, mattress fibre and coir twine earned US $ 5.4, 5.2 and 3.3 million respectively in 2002. Among shell products coconut shell activated carbon earned US $ 16.5 million in 2002. Export of coconut ekels earned US $ 0.64 million in 2002. Percentage share in export value of non-kernel based products in 2002 was 55.6%. The coir fibre and other coconut husk based products did not vary much during the five-year period (1997-2001) with Sri Lanka and India taking the lead and Indonesia gradually entering the market (Figure 5). Sri Lanka and India both averaged around 52,000 MT during the period. Sri Lanka predominantly exported raw coir products such as mattress, bristle and twisted fibre while India mostly exported processed products such as coir yarns, mats and mattings.

The export volume of coconut shell products in 2002 was 22,915 MT with coconut charcoal activated carbon, coconut shell charcoal and shell flour accounting for 79%, 14% and 7% respectively. The total export value was US $ 17.763 million with coconut charcoal activated carbon, coconut shell charcoal and shell flour accounting for 93%, 5% and 2% respectively. The main commercial product of coconut shell in the past was charcoal with Philippines and Indonesia as the lead suppliers. The average coconut charcoal export in the five-year period (1997-2001) was 55,536 MT. Processing of activated carbon from coconut charcoal began to increase from mid 1970's. The average export of activated carbon during the five-year period (1997-2001) was 71,441 MT, which was a significant increase comparing to production volumes in 1960's and 70's which were 6,700 MT and 14,580 MT respectively. Philippines was the main exporter while Sri Lanka, Malaysia, Indonesia and Thailand being other exporters.

Progress and sustenance of the Coconut Industry in Sri Lanka is indeed vital for economic stability of the country. In order ensure the viability of the coconut industry three statutory organizations exist under the ministry of Plantation Industries; Coconut Development Authority CDA), mainly to deal with policy matters, industry aspects and marketing, Coconut Research Institute (CRI) for development of technology and Coconut Cultivation Board (CCB) for dissemination of technology.

CRI has progressed for 75 years and over this period the research progressed in five main domains, genetic improvement, soil and fertilizer studies, agronomic practices, crop protection and product technology.

Initial studies on mass selection and genetic co-relations lead to development of mother and plus palm criteria for identification of seed palms The first coconut seed garden (ISG) for mass production of improved planting material was established in 1955 at Ambakelle, Chilaw. Three varieties of coconut, *typica* (tall), *nana* (dwarf) and *aurantiaca* (king coconut) were tested by hybridization and released Sri Lanka Green Dwarf x Sri Lanka Tall (CRIC65) as a promising hybrid. *San Ramon* a tall coconut of Philippine origin was tested and a new variety, *Sri Lanka Tall* x *San Ramon* was released as a better copra producer. A new seed garden was established at Pallama in 1999 for mass production of CRISL98. Two more hybrids *Sri Lanka Dwarf Green* x *San Ramon* and *Sri Lanka Brown Dwarf* x *San Ramon* are now in the pipeline for release. A courageous effort was made to develop a protocol for *in-vitro* propagation of coconut to overcome the problem of non-uniformity of planting material. The results are promising but further refining of the protocols is necessary for mass scale application. Coconut breeding suffered badly because of the narrow genetic base. Cross country movement of germplasm was restricted due to strict quarantine regulations imposed as a concern of Sri Lanka being a country free of all known lethal diseases of coconut. However, development of techniques for embryo rescue facilitated safe movement of germplasm and hence CRI was able to enrich the genetic base by addition of 14 exotic germplasm accessions (four from India and 10 from PNG) in 2002/ 2003 leaving more opportunities for testing of new hybrids.

Soils suitable for coconut and fertilizer requirements for coconut were investigated and beneficial effects of fertilizer on coconut were

[3] Source: Dr. M.T.N. Fernando, CRI

well established. Fertilizer recommendations for young and adult palms were made and improved over time especially giving prominence to magnesium as an essential element for increasing coconut production. Development of a range of organic manure application procedures for increasing yield and conditioning of coconut lands is also noteworthy. Introduction of a differential fertilizer recommendation package for different levels of nutrients in leaf tissues and surveying, mapping of coconut lands based on soil suitability and determining drip irrigation requirements are significant achievements in the last decade.

Studies on agronomic practices of coconut are manifold. Earlier studies on planting practices lead to recommendations on size of planting hole, planting systems and densities. Developing methods for conservation of moisture in coconut lands was a high priority. Pasture and legume research made possible to recommend introduced specific pastures to grow in coconut land of varying different agro-ecological conditions. Introduction of shrub legumes such as gliricidia has progressed a long way. Location specific recommendations for inter-cropping, live stock keeping and development of farming models helped growers immensely to sustain their coconut lands. Socio-economic studies to assess the impact of technology adoption, policy matters, cost effectiveness of coconut products etc. are also noteworthy.

Crop protection research in CRI began by identification and cataloguing of all coconut pests. Due to difficulties in spraying coconut palms special emphasis was given for studying natural enemies of coconut. CRI has proven the effectiveness of biological control by successfully controlling the coconut caterpillar using a pupal parasite and coconut leaf minor that invaded 30,000 ac of the coconut in 1970s. Promising results have been obtained with the use of a virus and fungus for the control of the black beetle. Control measures developed for control of the deadly pest, Red Weevil was also effective in managing the pest. The biggest challenge the CRI is facing now is the coconut mite that emerged recently and developed into epidemic proportions in most parts of the country. The research efforts of CRI towards developing a biological control mechanism against the coconut mite to date are unparalleled to that of other countries that face the same problem.

CRI's efforts on coconut product development started as early as 1930's with efforts on development of sap based products and copra processing. Early research work on copra making, copra kiln and other concomitant problems were very successful. Development of a viable technique for conversion of toddy into vinegar, preparation of treacle, jaggery and sugar at domestic level are also noteworthy. Research on coconut product diversification in more recent times have resulted in developing technologies for production of value added coconut oil, virgin oil and value added oil, milk based products such as coconut paste, yogurt, spread cheese, skim milk based beverages and coconut jam, sap based products such as golden syrup and mild alcohol beverages etc.

In spite of coconut being the major plantation crop in Sri Lanka with tremendous monetary value its sustainability is challenged in all sectors due to high cost of production affecting both grower and the processor. Poor profitability for growers seriously affects on adoption of technology for maximizing coconut productivity. Price coupled with limited share for industry due to high per capita use affect the growth of industry. Further the export industry suffer from competition by large coconut growing countries whose cost of production low and availability of nuts for the industry are in excess. In addition substitution of coconut oil by much cheaper palm kernel oil, palm oil and other vegetable oils also forces to lower cost of production of coconut if the industry is to sustain.

Although national yields are far below potential of improved cultivars still production of new cultivars with better adaptability is a strong need for site and management specific recommendations. Although there is considerable genetic variation in coconuts worldwide the genetic base of coconut in Sri Lanka is limited to just three genetically distinct populations. Countries like Indonesia, India and Ivory Coast have massive collections of coconut germplasm from diverse geographical locations for testing new hybrids. Sri Lanka has limited opportunities for offering a range of improved cultivars of coconut, especially high yielding hybrids. The current requirement of seed coconuts, 2.5 million per annum can not be solely met by improved cultivars. The production potential of CRIC60 seeds is about 1-1.5 million seeds/year while CRIC65 is about 0.2-0.3 million seeds/year. CRISL98 is yet to be produced at mass scale. Hence only about 45-55% of the national requirement could be met by improved varieties. Coconut seed production requires large extents of land, skilled personnel and heavy cost for maintenance. Heavy investment period for over 15 years discourages private sector participation in coconut seed production. On the other hand when a new variety of coconut is bred it requires over 15 years multi-locational testing and again a similar period of time for establish a mass production capacity as artificial pollination for seed production is not cost effective.

About 18.5% of the coconut stand in the country are over 60 years and considered economically unworthy. Taking the economic life span of coconut as 60 years and even age distribution, replanting 2% of the population (app. 2 million per annum) was expected to sustain the population. Growers however, show reluctance for replanting as they can not afford and wish for under planting, which is not economical in the long run and this too is achievable only through subsidy assistance.

Cost of coconut production under standard management gives only a return of around Rs. 11,200 per acre when nuts are sold at Rs. 7.00 per nut, the price that allow the processing sector to sustain. At this rate even a grower with 3 acres will still be rated below the poverty line (daily income < US $). Around 57% of the coconut holdings accounting for about 24% of coconut land are less than 2 acres. Therefore, maximization of coconut productivity is seriously constrained, as growers can not afford to apply fertilizer and attend cultural practices.

Limitation of land suitable for coconut is a serious concern as a large proportion of highly productive coconut land in the coconut triangle are getting fragmented for housing. As a result new planting programmes had to be diverted to non-traditional coconut growing areas where the production potential of coconut could be attained only by high input management including irrigation and soil improvement. Escalation of land prices also affect on replanting and expansion coconut lands. Scarcity of skilled labour for picking coconuts is a growing problem in all coconut growing areas, especially outside the coconut triangle where mostly climbers are employed for picking. Unskilled labour is also serious constraint in the coconut production sector because the wages currently paid are non-competitive with rates paid in other sectors. Basic practices in coconut lands such as weeding, mulching, husk burying get unattended due to unaffordable labour wages.

Coconut requires a minimum of 40 liters of water per day. This is a substantial volume because coconut is mainly distributed in dry intermediate and dry zones that frequently experience rain free periods. Coconut lands are mostly productive in deep moderately drained soils while in other soils the coconuts yield far below their potential unless irrigated. Coconut being a rain-fed crop fluctuation in the production is inevitable. In poor yielding years growers ignore all basic practices and allow palms to suffer. Casualties of drought are also increasing in dry and dry intermediate zones due to more frequent occurrence of droughts. This also seriously affects replanting programmes due to heavy rate of casualties in seedling populations.

High rates of fertilizer and application costs have resulted in poor application of manure in coconut. In 2002 fertilizer was applied for only 17% of the coconut palms in the country in spite of the subsidies provided.

In spite of numerous recommendations for management of pests and diseases of coconut, Red Weevil still account for high rate of mortality in young plantations. Black beetles also account for a fair proportion of seedling deaths every year. Control or prevention of attacks by both these pests could only be minimized proper caring. Lack of proper sanitation in most coconut lands cause black beetle outbreaks and consequently more dangerous Red Weevil. Mite although not lethal causes severe crop loss in heavily infested areas. Biggest obstacle for management of coconut pests is the lack of consorted efforts for preventing, treating and arresting the spread.

Technology is lacking for high input coconut farming as well as in potential areas for mechanization such as manuring, weeding, harvesting, collecting, dehusking and pest control operations.

Main reason for the wide gap between the production potential of coconut varieties (>10,000 per ha) and the actual production (6000 nuts/ ha) at national level is due to poor adoption of technology. Lapses in technology transfer and extension services often lead to growers ignorance on making correct decisions for new/ re/underplanting, choice of planting material, size of planting hole, planting distances and density appropriate for the location and cropping system, proper selection of seedlings, culling of weak seedlings and supplying vacancies at correct age, early care and attending to standard cultural practices such as manuring, weeding, mulching, pest control, maximizing land profitability by intercropping and livestock keeping etc.,

The current demand of coconut for the processing sector is about 500 million nuts annually for production of DC, 500-550 million nuts for copra/coconut oil milling and 100 million nuts for manufacture of milk powder and cream. Therefore, the total annual demand for coconuts is about 3 billion nuts for the two major industries, DC and oil industries to remain in production at economically viable levels. The coconut production however, had remained more or less static with marginal increases and domestic consumption had increased with increasing population posing a serious challenge for the industry. Uncertainty of raw material (nuts) for the industry, high price of raw material (nuts), Shortage of skilled labour, lack of modern technology, professional management, quality control practices, capitol for modernization and expansion, strong marketing channels for small scale producers, strategic marketing, arrangements for market promotion, product/market information and quality control systems have been identified as main constraints for development of processing and marketing sectors.

In order meet these challenges to the coconut industry following targets and directions were set forth in the Coconut sector development plan for the period 2004 -2006.

Targets

1. Achieve and sustain coconut production at 3 billion nuts per annum
2. Achieve a target of 70,000 MT of desiccated coconut per annum.
3. Achieve a target of 70,000 - 80, 000 MT of coconut oil per annum.
4. Achieve a target of 70,000 MT of coir production and exports per annum.
5. Build up processing capacity to 70,000 MT of other kernel based products

In order to ensure the achievement of above targets, promotion of hybrid cultivation in home gardens, popularization of scientific cultivation practices, extensive adoption of coconut based farming systems for increasing productivity and profitability of coconut lands, development and introduction of new value added coconut products, modernization of processing technologies and development of new machinery through consorted effort of CCB, CRI and CDA were identified as key strategies. Creating public awareness to eliminate waste of household coconut use by promoting coconut paste and processed milk and cream in household cooking was another key strategy for saving more coconut for the industry. Ensuring fair price for growers, industry and consumers by maintaining adequate industrial processing capacity and export demand of products and judicious import tariffs on edible oils, assisting DC, coir and oil mills to modernize milling facilities to ensure quality, promoting manufacture of white coconut oil and consumer packaging of edible oils, assisting private and cooperative sector entrepreneurs to manufacture value added kernel and sap products, coir products such as geo textiles, rubberized products and shell products, facilitating marketing channels by providing up to date information to obtain best export price for coconut products are also key concerns in sustaining and developing the coconut industry.

Some of the long and medium term research strategies identified are -

Production and testing of new coconut hybrids; introduction, maintenance, characterization and evaluation of germplasm for future breeding programs; development of cryopreservation technology for conservation of germplasm; mapping coconut genome for marker assisted selection; maintenance of basic planting material source, refinement of *in-vitro* regeneration for effective mass propagation of elite genotypes; development of technologies and applying biochemical and molecular techniques for in depth understanding of physiological processes of tolerance to drought, resistance to pests and diseases for gene introgression.

Development of IPM strategies for coconut mite and black beetle, improvement of red weevil management strategy, development of management strategies for minor pests, further investigation of coconut disorders of unknown etiology, establishment of a surveillance mechanism for early detection of newly emerging pests and diseases.

Development of kernel, water and sap based value added products; production and value addition to virgin coconut oil; improving the shell life of tender coconuts for export; identification of natural ferments of toddy, yield stimulation and sequential tapping of toddy.

Assessment and management of soil quality and nutrients; improvement of soil moisture conservation package; designing appropriate drip irrigation; identification of low cost eco-friendly fertilizers; development of site specific fertilizer recommendations based on soil analysis; development of fertilizer mixtures for tapping palms and king coconut; assessment of future climatic changes; conduct socio-economic market surveys; development and usage of bio-energy in coconut industry; efficacy of coconut based interventions in poverty reduction; adaptive research programs.[4]

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Changes in Land Extent under Coconuts within Two Decades 1982-2002

Evidence from Fifteen Districts in Sri Lanka

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Following the latest Agriculture Census in 2002, the Department of Census and Statistics (DCS) has so far (as on 9 December 2004) published the completed reports on status of coconut cultivation for 15 districts, as shown in Table 1. The previous Census of Agriculture was carried out in 1982, two decades ago the latest census. This paper first compares the district-wise changes in land extent under coconut in 2002 in relation to 1982. The paper then extends the same comparison, disaggregated by smallholder and estate sectors.

Colombo District

Irrespective of land size class, 1 449 ha of coconuts was lost in Colombo district during the two decades, representing almost 16% area reduction (Table 1). Land area under coconuts in both smallholdings and estate sector has reduced in 2002 in relation to 1982, the percentage reduction being greater in estate's sector whereas the absolute reduction being greater in smallholder sector (see Table 2).

Coconut area under smallholders has reduced by 804 ha during the two decades, representing almost 10% reduction whereas the corresponding figures with respect to estate sector are 645 ha and 60% (Table 2). This implies that more coconut extent was lost from the smallholder sector than the estate sector. The possible causes for loosing of coconut lands may include fragmentation for residential purposes, converting into industrial pursuits, urbanization etc.

Irrespective of land size classes, the rate of loosing coconut lands in Colombo district during the past two decades was 72.45 ha (179 ac) per year.

Table 1: Total extent under coconuts as revealed by 1982 & 2002 Agriculture Census

	District	1982 Total (ha)	2002 Total (ha)	Change in 2002 in relation to 1982(ha)
1	Colombo	9 222	7 773	-1 449 (-15.71%)
2	Matara	14 370	14 039	-331 (-2.30%)
3	Galle	13 244	13 214	-30 (-0.22%)
4	Puttalam	51 784	4 8 725	-3 059 (-6%)
5	Polonnaruwa	3 002	7 096	4 094 (136%)
6	Moneragala	4 172	12 675	8 503 (204%)
7	Kegalle	20 420	16 484.9	-3 935 (-19.27%)
8	Mannar	1 181	1 098.8	-82.2 (-6.96%)
9	Badulla	885	3 607.9	2 722.9 (308%)
10	Kalutara	12 358	11 132.8	-1 225.2 (-9.91%)
11	Matale	9 296	10 978.2	1 682.2 (18%)
12	Hambantota	20 430	21 463.5	1 033.5 (5.1%)
13	Vavuniya	425	736.8	311.8 (73.3%)
14	Kurunegala	149 106	143 002	-6 104 (-4.1%)
15	Gampaha	57 049	43 189.7	-13 859.3 (-24.3%)
	Total	**366 944**	**355 216.6**	**-11 727.4 (-3.2%)**

Source: Separate reports on Status of Coconut Cultivation in each of the above 15 districts (2002). Department of Census & Statistics, Colombo.

Matara District

Total area under coconuts in 1982 was 14 370 ha which has reduced by 331 ha to 14 039 ha in 2002, representing 2.3% reduction (Table 1). As Table 2 shows, the area under smallholder sector has increased by 996 ha (8.34%) whereas the area under estate sector has witnessed a reduction by 1 327 ha (55%). Various reasons may be postulated for the observed trend. The increase in area under smallholders may either be due to converting of lands under other crops into coconuts or due to inter-generational succession of larger holdings among several descendents in terms of several smaller parcels. The reduction of estates may be due to the fragmentation for residential parcels, converting into industrial pursuits etc. However, Matara district has exhibited an insignificant reduction of 331 ha (-2.3%) of coconut lands during the two decades, the annual rate of loss being only 16.55 ha (41 ac).

Galle District

This district had 13 244 ha of coconuts in 1982 which has marginally reduced by 30 ha during the two decades, leaving 13 214 ha in 2002 (Table 1). The annual rate of loosing of coconut lands is therefore as small as 1.5 ha.

Area under smallholdings has increased by 670 ha from 11 669 ha in 1982 to 12 339 ha in 2002, which is about 6% increase. Meanwhile, the estate sector has witnessed a reduction in coconut area from 1 575 ha in 1982 to 875 ha in 2002, representing 700 ha (44%) decrease (Table 2).

Although various reasons may be postulated for this observed trend in smallholdings, and estates, the definite causes are not known. As the reduction of lands under estates sector is nearly equal to the increase in lands in smallholder sector, we are prone to think that fragmentation of bigger lands of parents for succession onto following generations would be the cause.

Puttalam District

This district had 51 784 ha in 1982 which has reduced by 3 059 ha (6%) during the two decades, resulting in 48 725 ha in 2002 (Table 1). The equivalent annual rate of reduction of coconut area is therefore 153 ha (378 ac). Disaggregation of this trend by smallholdings and estates suggests the followings. Smallholdings area has increased by 2 370 ha (8%), from 29 187 ha in 1982 to 31 557 ha in 2002. Whereas the area under estates has decreased by 5 429 ha (24%) from 22 597 ha in 1982 to 17 168 ha in 2002 (Table 2). Reduction of area under estates is greater than the gain in area under smallholdings, implying that the district is a net looser.

Polonnaruwa District

Unlike in other districts analysed so far, total area under coconuts in Polonnaruwa district has more than doubled during the two decades (Table 1). The area has increased) by 4 094 ha (136%), from 3 002 ha in 1982 to 7 096 ha in 2002. This substantial increase was contributed by the area increase of both smallholdings and estates (Table 2). Smallholding area has increased by 3,343 ha (114%) from 2,928 in

Table 2: Extent under coconuts by smallholdings & estates as revealed by 1982 & 2002 Agriculture Census

District	Exrent under coconuts (ha)* 1982 Small holding (i.e <20 ac)	1982 Estate (i.e >20 ac)	2002 Small holding (i.e <20 ac)	2002 Estate (i.e >20 ac)	Change in 2002 in relation to 1982 (ha) Small holding	Estate
1. Colombo	8 153	1 069	7 349	424	-804(-9.86%)	-645 (-60%)
2. Matara	11 940	2 430	12 936	1103	996 (8.34%)	-1327 (-54.61%)
3. Galle	11 669	1 575	12 339	875	670 (5.74%)	-700 (-44.44%)
4. Puttalam	29 187	22 597	31 557	17 168	2 370 (8.12%)	-5 429 (-24.03%)
5. Polonnaruwa	2 928	74	6271	825	3 343 (114.17%)	751 (1015%)
6. Moneragala	4 139	33	12 580	95	8 441 (203.93%)	62 (187%)
7. Kegalle	18 656	1 764	15 619.8	865.1	- 3 036.2 (-16.27%)	-898.9 (-50.96%)
8. Mannar	976	205	1 098.8	0**	122.8 (12.58%	-205 (-100%)
9. Badulla	847	38	3 574.7	33.2	2 727.7 (322%)	-4.8 (-12.63%)
10. Kalutara	11 439	919	10 538.9	593.9	-900.1 (-7.87%)	-325.1 (-35.38%)
11. Matale	6 880	2 416	8 996.1	1 982.1	2 116.1 (30.76%)	-433.9 (-17.96)
12. Hambantota	18 273	2 157	20 190.9	1 272.6	1 917.9 (10.5%)	-884.4 (-41%)
13. Vavuniya	407	18	736.8	0**	329.8 (81%)	-18 (-100%)
14. Kurunegala	103 240	45 866	105 083.2	37 918.8	1 843.2 (1.79%)	-7 947.2 (-17.33)
15. Gampaha	45 187	11 862	37 029.1	6 160.6	-8 157.9 (-18.05)	-5 701.4 (-48%)
Total	273 921	93 023	285 899.6	69 315.9	11 978.6 (4.4%)	-23 707.1 (-25.49%)

Note: *** Including the estimated area covered by scattered coconut trees & excluding king coconuts.**
Source: Separate reports on Status of Coconut Cultivation in each of the above 15 districts (2002). Department of Census & Statistics, Colombo.

1982 to 6 271 ha in 2002. The increase in area under estate sector was also substantial in that it has increased by 751 ha (1015%), from 74 ha in 1982 to 825 ha in 2002. The coconut plantation of Mahaweli Coconut Plantation Ltd (MCPL) which is 545.5 ha is also come under this district. In sum, these trends suggest that the new lands have been converted into coconuts at an annual rate of 205 ha (506 ac) in Polonnaruwa district.

Moneragala District

The total area under coconuts in this district has almost tribled during the two decades. It had totally 4 172 ha in 1982 which has increased by 8 503 (204%) to 12 675 ha in 2002 (Table 1). The equivalent annual increase in area is therefore 425 ha (1050 ac). Of the analysed districts so far, this is the district which has shown the biggest absolute as well as percentage increase in area.

Although Pollonnaruwa district has also shown an increase in area under coconuts, the pattern of increase in this district is different from Polonnaruwa, in that the percentage increase in area under smallholdings is higher than that of the estates in this district whereas the opposite is the case in Polonnaruwa district. This means that the new lands coming under the smallholder sector is widespread in Moneragala district.

Kegalle District

As shown in Table 1, the coconut area in this district has declined by almost one fifth during the two decades. Some 3 935 ha of coconuts have lost from 20 420 ha in 1982 to 16 485 ha in 2002. So, the annual rate of loss is 196.75 ha (486 ac). The absolute reduction of lands is greater in smallholdings (3 036 ha) than in estates (899 ha), but the percentage change is in reverse order, as evidenced by Table 2.

Mannar District

Operators are reported to be absent on the holdings (> 20 ac) at the time of Census of Agriculture 2002 due to unsettled conditions, and most of these holdings are reported to be non-functioning estates. So, the extent of estate category is not available in this district in 2002 (see Table 2.) Subject to this data limitation, Mannar district has shown an almost 7% (82 ha) decline of coconut lands during the two decades (Table 1). So, the annual rate of loosing of coconut lands is 4.1 ha (10.13 ac). However, as evidenced by Table 2, extent under smallholdings has increased by about 123 ha, from 976 ha to 1 099 ha during the two decades, representing about 13% increase. Comparison of estate sector extent is precluded due to dearth of data.

Badulla District

This district had fairly a small extent of coconuts (885 ha) in 1982, but it has increased approximately by about four times in 2002, with an equivalent absolute increase of 2 723 ha, representing 308%. This increase in land extent is exclusively contributed by the increase in smallholdings (Table 2). The annual rate of coconut area increase is 136 ha (336 ac).

Kalutara District

Coconut land extent has reduced by about 10% (1 225 ha) during the two decades (Table 1). So, the annual rate of reduction is 61.3 ha (151.3 ac). As shown in Table 2, the above coconut land reduction is constituted both by smallholdings and estates, 900 ha and 325 ha respectively.

Figure 1: Absolute change in extent (ha) under coconuts in 2002 in relation to 1982

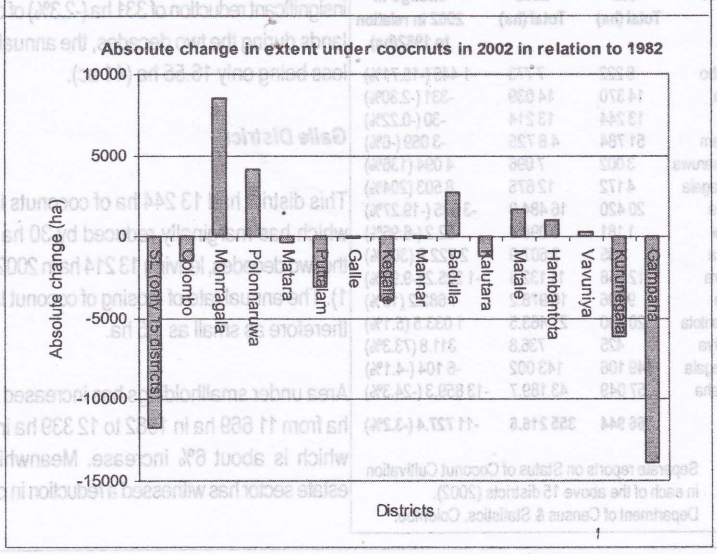
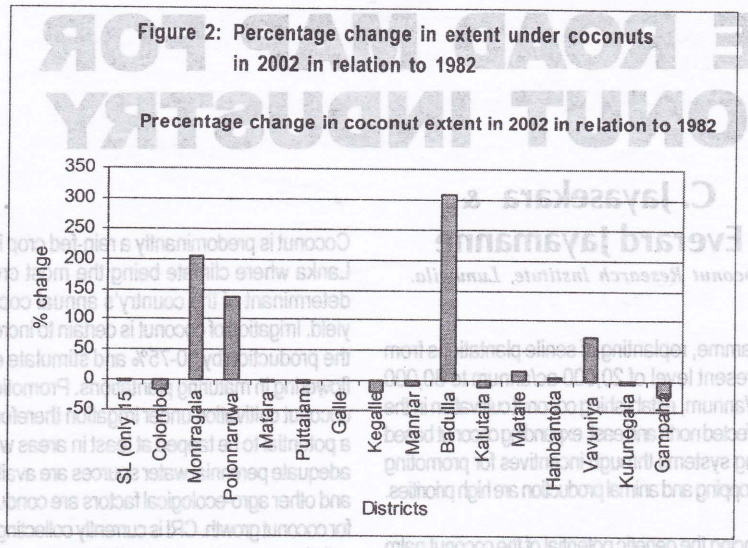


Figure 2: Percentage change in extent under coconuts in 2002 in relation to 1982



Matale District

Coconut extent has increased by 1 682 ha (Table 1), about 18 per cent increase in relation to the extent in 1982. The equivalent annual rate of increase is therefore 84 ha (207 ac). As evidenced by Table 2, coconut extent under estates has reduced while the extent under smallholdings has increased, the latter being greater than the former, implying that new smallholdings must also have emerged in the district in addition to the smallholdings fragmented by larger estates.

Hambantota District

The district has shown an increase in coconut area by 1 033 ha, a 5% increase as compared with the area in 1982. So, the equivalent rate of increase is 51.6 ha (127.6 ac) per annum. The above change in coconut area is comprised by 1 918 ha increase in smallholdings and 884 ha reduction in estates.

Vauniya District

This district also suffers from the same data limitation as in Mannar district, i.e. operators are reported not found in estates at the time of Census of Agriculture 2002 due to unsettled conditions and the estates were also in defunct state. So, estate sector data are missing. Subject to this data limitation, the land extent in Vauniya district has increased by 312 ha, a 73% increase in relation to 1982 land extent (Table 1). However, the available data show that the smallholder area has increased by 330 ha, some 81% increase as compared with the 1982 smallholder area (Table 2).

Kurunegala District

The district is a net looser of 6 104 ha of coconut lands during the two decades, a 4 per cent decrease. The equivalent annual rate of reduction would therefore 305 ha or 754 ac (Table 1). As shown in Table 2, the estate sector has reduced by almost 8 000 ha while the smallholder sector has expanded by 1 843 ha. The reduction of estate sector is nearly four times higher than the increase in smallholder extent, which means that a substantial extent of bigger estates have been definitely converted into non-coconut uses such as industrial pursuits.

Gampaha District

The highest loss of coconut lands is reported in Gampaha (Table 1) which is 13 859 ha, a 24% reduction in relation to the coconut extent in 1982. The equivalent annual rate of land loss is therefore 693 ha or 1 711.6 ac. Although the loss of smallholdings is higher than the estates, both of these land categories significantly contributed to the land loss (Table 2). A notable feature is that the reduction of estates is almost 50 per cent of the estate extent in 1982, implying that the bigger coconut estates are rapidly disappearing in the Gampaha district.

National Picture

The following aggregated picture would be discerned by about 11 727 ha (28 967 ac) in 2002 in relation to the extent in 1982 (Table 1 and Figure 1), representing 3.2% reduction (Figure 2). The equivalent annual rate of loss of coconut lands is therefore 586 ha (1 448 ac).

The above loss of land is contributed by a reduction of area under estates by 23 707 ha and increase in area under smallholdings by 11 979 ha, respectively 25% and 4% in relation to the 1982 extents.

Summary and Conclusions

- Of the analysed 15 districts, 9 districts, namely Gampaha, Kegalle, Colombo, Kalutara, Mannar, Puttalam, Kurunegala, Matara and Galle were net loosers while the remaining 6 districts, i.e. Badulla, Moneragala, Polonnaruwa, Vavuniya, Matale and Hambantota were net gainers. The biggest looser in terms of absolute hectareage was Gampaha (13 859 ha), followed by Kurunegala (6 104 ha) and Kegalle (3 935 ha) while the smallest looser was Galle (30 ha). The biggest net gainer in terms of absolute hectareage was Moneragala (8 503 ha). The highest percentage increase was observed in Badulla.
- Lands under coconuts both in estate and smallholder sectors have reduced in Colombo, Kegalle, Kalutara and Gampaha districts whereas only the estate sector has reduced in Matara, Galle, Puttalam, Mannar, Badulla, Matale, Hambantota, Vavuniya and Kurunegala districts.
- Land area under coconuts both in smallholder as well as estate sector has simultaneously increased in Polonnaruwa and Moneragala districts.
- Estate sector significantly shrinked in Matara, Puttalam, Kurunegala and Gampaha districts.
- In 1982, Gampaha district was the second largest coconut district, but in 2002 this district has shifted to the third place, the first two districts being Kurunegala and Puttalm respectively.
- The aggregate area under coconuts constitute by the analysed fifteen districts has shown a net reduction of 11 724 ha (3.2%), from 366 944 ha in 1982 to 355 217 ha in 2002.

A FUTURE ROAD MAP FOR THE COCONUT INDUSTRY

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Coconut is one of the most important plantation crops in Sri Lanka, providing livelihood for nearly 500,000 people in three main sectors, production, processing and marketing. Its extent covers over 430,000 hectares, equivalent to 20% of the cultivable area of land in the country. Coconut being predominantly a smallholder's crop, approximately 75% of the extent comes under holdings with an area less than 8 ha. The total hectarage of small holdings is approximately 272,000 (Agricultural survey in 1982). Coconut benefits people of all socio economic strata in numerous ways by its multitude of uses. However, the area under coconut is reducing at a substantial rate, 5,000 ha/annum in the coconut triangle due to urbanization and industrialization.

Sri Lanka's annual coconut production varies from 2,500-3,000 million nuts and of which approximately 70% is consumed for culinary purposes leaving only 30% for the coconut industry. Coconut is a rich source of edible fats and proteins providing 22% of the daily caloric requirement of an average Sri Lankan. Coconut industry in Sri Lanka plays a vital role in sustaining a viable economy at village, district and regional levels. Coconut kernel (meat) based industries such as desiccated coconut, copra, oil, cream and milk powder and non-kernel based products such as fibre and shell with value addition accounts for export earnings around Rs. 11.9 billion per annum which is equivalent to 1.3% of the GNP.

According to Asia-Pacific Coconut Community (APCC) reports the predicted global demand for value added coconut products is, desiccated coconut (DC) 9%, fresh coconut 5%, coconut milk, 45% and activated carbon 40%. This novel trend in the international demand has a profound effect on repositioning the coconut sector in Sri Lanka. Emphasis is now laid on improvement, value addition and promotion of a variety of coconut based products, kernel based and non-kernel based in order to ensure sustainability and progress of the coconut industry, which is essential for upholding the lives of many thousands of people who depend on this traditional crop.

The most important strategy for next ten years would be to increase the coconut production to cater the dietary needs of the increasing population and supply additional raw material for coconut based industries. Therefore, strengthening of the home gardening programme, replanting of senile plantations from the present level of 20,000 ac/annum to 30,000 acres/annum, establishing coconut cultivation in the war affected north and east, expanding coconut based farming systems through incentives for promoting intercropping and animal production are high priorities.

Enhancing the genetic potential of the coconut palm to thrive in a wider range of environments is an important strategy towards increasing the coconut production. This could be attained through effective application of breeding technologies by infusion of new genetic material into the breeder's collection. Genetic diversity of coconut in Sri Lanka is limited and has already being utilized to the near maximum for developing improved coconut cultivars. Coconut Research Institute has already taken measures by importing coconut varieties from India, Papua New Guinea and Ivory Coast during the years, 2003 and 2004. These new introductions can either be used as varieties by themselves for extensive planting depending on their ability to adjust to conditions in Sri Lanka or can be used in crossing programmes for development of new hybrid cultivars. In the past coconut breeding programme has given more emphasis on increasing production potential of nut number, yield of copra, and oil content. Future breeding programs of the CRI would also focus on traits such as high fibre content, shell thickness, taste of nut water, dwarf ness, high yield of sap etc., to increase diverse values of the palm and thereby upbringing the income status of farmers and those engaged in coconut based small and medium scale industries.

Adoption of appropriate coconut cultivation practices among coconut small holders is far below expectations. Poor coconut yields in majority of small coconut lands account for inadequate or no caring of palms by growers either by negligence or lack of knowledge on proper cultivation practices. Application of fertilizer, management of soil and moisture, management of weeds, sanitation and management of pests are practices hardly attended by growers. Though beneficial effects of inter-cropping and live stock keeping on coconut and enhancement of the profitability of coconut lands by attending to cultural practices have been well established the growers show no or little keenness to reap these benefits. More consorted efforts on dissemination of technology is needed and in this regard the functions of CCB and CRI need to be appropriately defined and implemented with an effective linkage mechanism.

Coconut is predominantly a rain-fed crop in Sri Lanka where climate being the most crucial determinant of the country's annual coconut yield. Irrigation of coconut is certain to increase the production by 50-75% and stimulate early flowering in maturing plantations. Promotion of coconut cultivation under irrigation therefore, is a potential to be tapped at least in areas where adequate perennial water sources are available and other agro-ecological factors are conducive for coconut growth. CRI is currently collecting and collating enormous amount of information on soils, ground water availability, irrigation technologies, fertigation etc, for the benefit of growers who wish to opt for intensive coconut cultivation.

Minimizing the wastage of coconut kernel is another important strategy for preserving coconut for the industry. The traditional method of extracting coconut milk (scarping and squeezing by hand) leaves 30% of the fat in the kernel residue. This residue is supposed to have properties for reducing blood cholesterol and remedying gastrointestinal problems. Discarding an important residue still rich in fat, proteins and more importantly dietary fibre is a serious loss to the country's economy. The annual wastage of coconut kernel by discarding this residue is equivalent to approximately 500 million nuts as Sri Lanka being the highest per capita consumer of coconut in the world, approximately 110 coconuts per annum. To consume coconut kernel with zero wastage, introducing processed coconut kernel as coconut cream or coconut paste, especially for urban communities is considered a priority. Technologies have been developed for coconut paste and coconut cream at CRI and entrepreneurs are encouraged to develop and market such products. Extensive extension programme to promote coconut paste is also recognized as important to change the consumption pattern of coconut as a finished product instead of the fresh kernel.

Virgin coconut oil is another new product that gradually gaining demand in the western world. At present the Philippines produce virgin coconut oil in large amounts and supply to the USA market at a price of US $ 7 per litre. As an organic coconut product, virgin coconut oil has a niche market with very high prizes. CRI is promoting virgin coconut oil and value added

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Short-term Projections for Coconut Industry in Sri Lanka

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Coconut is an important crop for Sri Lanka both as a source of food and export earning. It provides about 22% of the daily calorie intake of the Sri Lankan population, being second only to rice. The annual per capita consumption of coconut is the highest in Sri Lanka compared with other coconut growing countries. During 1950 to 2003, the mean annual national coconut production (ANCP) in Sri Lanka was around 2500 million nuts (Peiris, 2004a). The average percentage contribution to the GDP by coconut industry during 2000 to 2003 was 1.225 as against 1.250 from tea industry (Central Bank, 2003). In this article, number of nuts required for local consumption and for various kernel products are estimated for 2005 and 2006 for the benefit of national planners.

Position of the Sri Lankan Coconut Industry in the World Scenario

Coconut is a high value commercial crop grown in 92 countries within the humid tropical region in the world. The world annual coconut production is around 50 billion nuts. About 85% of the world production is contributed by the countries of the Asian Pacific Coconut Community (APCC). The coconut extent of the APCC countries is around 11300 million hectares which is about 90% of the world coconut extent. Of the APCC countries, Sri Lanka (SL) ranks 4th place (Peiris, 2004a) with respect to both coconut extent and production (Fig. 1).

Change of Bearing Extent of Coconut

Coconuts are grown mainly in six agro-ecological regions (traditional areas) as a plantation crops as shown in Fig. 2.

The coconut extent has been steadily increased since 1860 up to 1970 and thereafter reached to platue (Fig. 3) indicating the trend can be modeled by Mitscherlich function ($y = a + b^{*}e^{gt}$) . It indicates in spite of coconut lands are being used for urbanization during recent past, the total extent of coconut (including scattered palms) has been stagnated.. This may be due to the increase of coconut growing in home gardens and new plantings especially in the non-traditional areas outside the coconut triangle. Thus it can be assumed that the bearing extent of coconut would be around 0.42 million hectares for few years.

Annual National Coconut Production (ANCP)

During the last 54 year period (1950-2003) ANCP has fluctuated from 1821 million nuts in 1977 to 3039 million nuts in 1986 with the mean of 2422 (± 295) million nuts. The target of 3000 million nuts has been achieved only in two years (1986 and 2000) in spite of all efforts by the coconut industry. The national coconut production has never reached according to the potential productivity of coconut lands based on land suitability classes for coconut (Somasiri, *et al*, 2000). This is due to the fact that most of coconut lands are unproductive because of the absentee land owners and not practicing recommended cultural practices.

The ANCP will be decided by the climate variability in coconut growing areas, use of fertilizer and other recommended agronomic practices, intensity of pest and disease control, and bearing extent of coconut. Unlike at the farm level, the statistics on last three factors is not available either in national or regional scale, but the impact from fertilizer, pest and disease control, and improved technology can be considered as impact due to technology effect. Based on those assumptions an integrated statistical model which captures both rainfall and technology effects (R^2 = 0.92) was developed by Peiris (2004a). The predicted values for 2005 and 2006 are 2710 and 2850 million nuts respectively (Fig. 4). The two horizontal lines are the lower and upper quartile based on data from 1950 to 2003. The prediction for 2006 was done using time-series model. Further, Peiris, *et al.* (2004) have shown that due to the increase of temperature and decrease of intensity of effective rain (>5 mm) in almost all coconut growing areas, an major increase of national coconut production can not be expected in near future.

Pattern of Nut Utilisation

Major proportion of nuts are used for domestic consumption. The main use is for culinary purpose as fresh nuts by the householders.

Figure 2. The agro-ecological regions in the main coconut growing areas

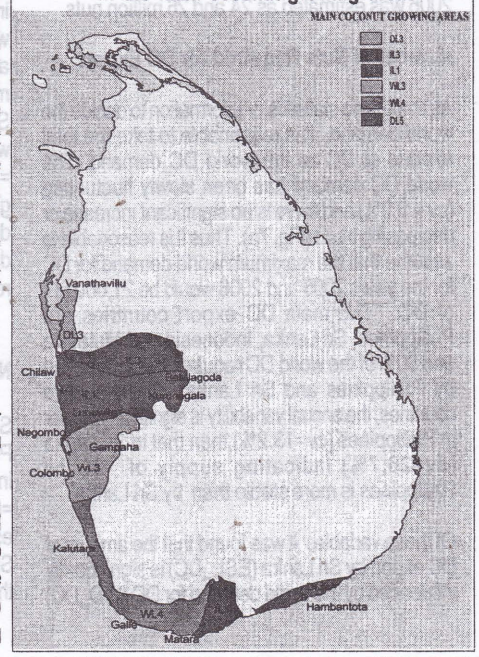


Figure 1. The percentage contribution from major coconut growing countries towards the world production

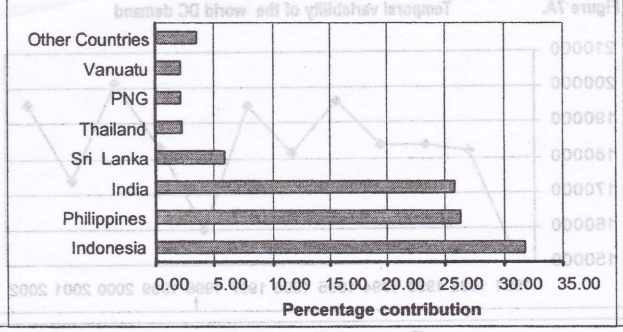


Figure 3. Temporal change of land area under coconut (plantation + scattered)

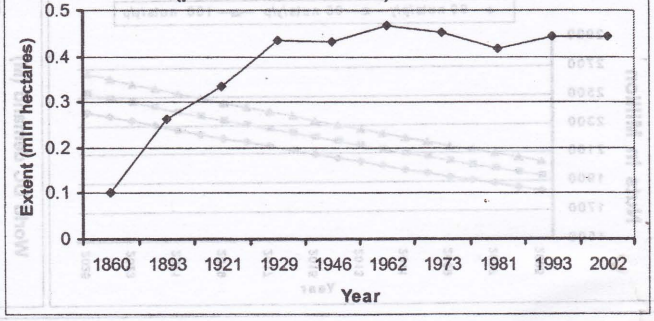


Figure 4. Annual national coconut production (ANCP) from 1985 to 2003 and the predicted ANCP for 2004 – 2006 (two horizontal lines represent the first and third quartile values based on 1950-2003)

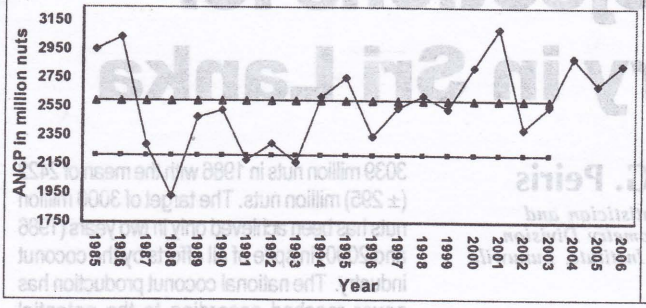
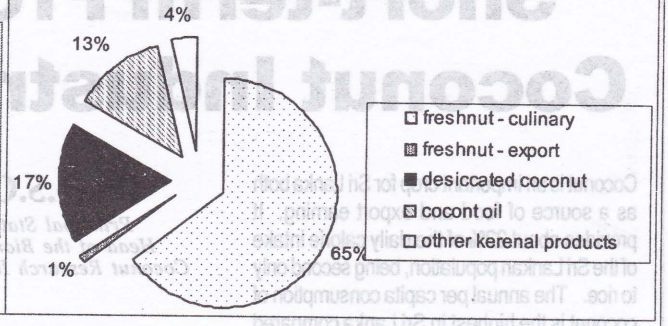


Figure 5. The pattern of nut utilization by various stake holders based on 1999-2003



The average fresh nut consumption per person per year is around 95 fresh nuts (excluding for the use of coconut oil, soap, etc.). The balance nuts are used for various kernel products such as desiccated coconut (DC), copra, coconut cream and coconut milk powder and about two million nuts are exported annually (Fig. 5). Of these activities the internal consumption will increase with the increase of population while the use between coconut oil/copra and desiccated coconut manufacturing will change depending on nut availability and the relative competitiveness of the prices by these two processing industries to growers.

Nut Requirement for Culinary Usage

In Sri Lanka the main use of coconuts (@95 nuts/person/year) is to extract coconut milk directly from the unprocessed kernel for culinary preparation and to use as 'pol sambola' for meals. Thus the expected requirement for domestic consumption (@ 95±5) as fresh nut alone was estimated by projecting the population (Peiris, *et al*, 2004) as depicted in Figure 6.

Nut Requirement for Coconut Oil (CNO) for Local Use and Export of CNO

During the recent past the major portion of the oil requirement was met through the importation of substitute oil The rate of use of coconut oil has highly varied from 1.66 to 4.29 kg per person per year (0.65 kg = 1 bottle and 1 MT of coconut oil = 8800 nuts) (Peiris, 2004b). In 2003, the amount of imported coconut oil alone was 64086 MT (Coconut Statistics, 2003). The production of coconut oil is mainly depend on the government policies on importation of substitute oil. During recant years, the total amount of substitute oil imports was higher than the amount of coconut oil produced in Sri Lanka (Peiris, 2004b). Thus the number of nuts required for local consumption was estimated under two scenarios based on the per capita consumption of coconut oil use: (a) at the rate 2.6 Kg (4 bottles per person per ear), if no coconut oil importation and (b) at the rate of 1.3 Kg (2 bottles per person per year), if coconut oil importation is allowed (Table 1).

After 1995, the amount of coconut oil exported has been varied from 2500 MT to 4000 MT with a mean of 3250. Based on the trend of past data the number of nuts required for oil export for 2005 and 2006 was estimated as 24 and 26 million nuts.

Number of Nuts Required for DC Export

As there is no statistics or information to decide the world demand, it is reasonable to take the total exports of DC as the world DC demand. The world DC demand has been slowly fluctuating (cv = 6.9%) and there is no significant increase or decreasing trend (Fig. 7a). Thus it is reasonable to assume that the maximum world demand for DC for the years 2005 and 2006 would be 21,000 MT of DC. The main DC export countries are Philippines, Sri Lanka, Indonesia and Malaysia and 80% of the world DC requirement is supplied by Philippines and Sri Lanka. Of these two countries, the annual variability is significantly lower in Philippines (cv=13.2%) than that in Sri Lanka (cv=26.7%) indicating supply of DC by Philippines is more stable than by Sri Lanka.

Of these variables it was found that the amount of DC export by Sri Lanka (ESL_DC) is significantly influenced by the world demand for DC (WD_DC) and the amount of DC export by Philippine (EPL_DC) using regression technique and the relationship is ESL_DC = 47281 + 0.53488*WD_DC – 1.13125*EPL_DC (R^2 = 0.83, $p < 0.0004$). Also no significant correlation was found between WD_DC and EPL_DC.

The export amount of DC by Malaysia showed a very sharp significant decline, particularly after 1995 (Fig. 7b). The decline trend in Malaysia is mainly due to their promoting of oil palm industry. Further, the export amount of DC by Indonesia has been significantly increasing, at the rate of 2438 MT/year. Thus the amount of DC export by Indonesia was forcefully included in to the above model. and a sensitive analysis was carried out to estimate the exportable amount of DC for the next two years. The model estimated that the export demand for the Sri Lankan DC during the years 2005 and 2006 would be around 50,000 – 55000 MT (1MT DC = 8000 nuts). If an allowance (say 1%) was given assuming the nut size would be smaller due to expected temperature increase and mite damage, it can be taken that the number of nuts required per 1MT of DC would be 8800 nuts.

Nut Requirement for Copra Export

Sri Lanka has been exporting copra mainly to Pakistan and the amount of exports has been increasing since 1996 as shown in Fig.8 (R^2 =0.79, p = 0.0013). The figure for 2004 was estimated based on data up to August 2004. Single exponential smoothing method predicted that the demand for copra for 2005 and 2006

Figure 6. The expected nut requirement for local consumption as fresh nuts

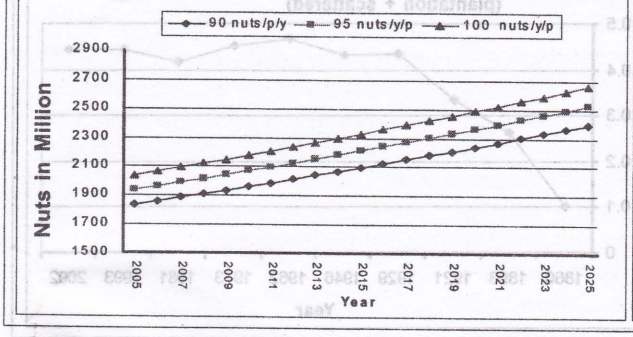
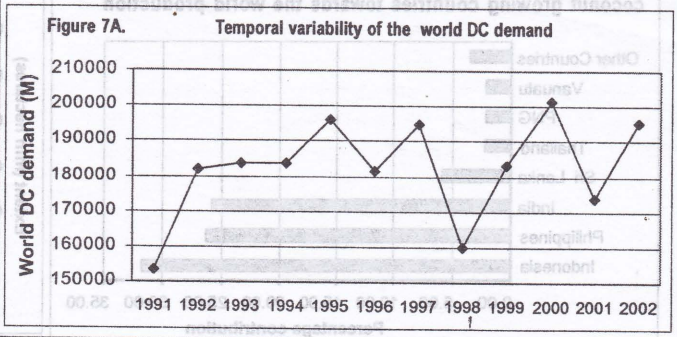
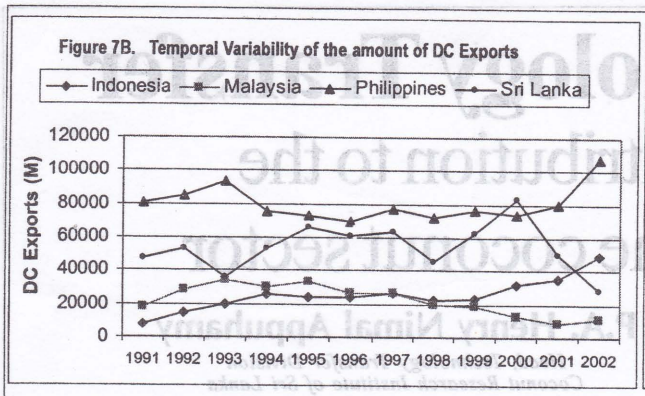
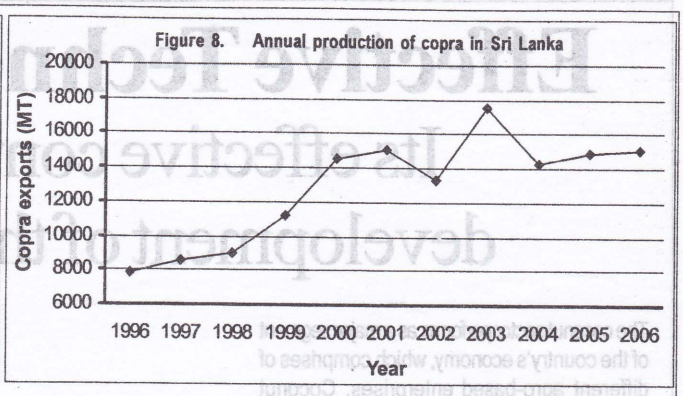


Figure 7A. Temporal variability of the world DC demand







would be as 14888 and 15096 MT (1MT copra = 5775). Thus the number of nuts required to produce copra would be 82 and 86 million nuts during 2005 and 2006 respectively.

Nut Demand for Other Kernel Products

In addition to local consumption (fresh nut + coconut oil) and DC, the nuts are used to manufacture coconut cream (CC) and coconut milk powder (CMP) for both export and local market. The number of nuts used for CC and CMP during 2002 and 2003 are 33 and 63 million nuts (Coconut Statistics, 2003) and there was marginal increase of nut usage for CMP in 2003. Using exponential smoothing techniques the number of nuts required to manufacture both CC and CMP was predicted as 55 and 50 million nuts for 2005 and 2006 respectively.

Demand of Nuts for Export as Fresh Nut and Local Seed Nut Requirement

Based on single exponential smoothing the estimated number of nuts for export during 2005 and 2006 would be 27 and 30 million nuts. As the seed nut requirement has been increasing annually, the expected amount for seednuts for the 2005 and 2006 could be taken as 4 and 5 million respectively. The majority of the seed nuts are supplied by the Coconut Research Institute (CRI) and Coconut Cultivation Board (CCB).

Conclusion

The expected number of nuts for different stake holders in the coconut industry during 2005 and 2006 is shown in Table 1.

Table 1. Number of coconut nuts required for various stake holders (in million nuts)

Type of stake holder	Scenario I 1.3 Kg of CNO /p/year Year		Scenario II 2.6 Kg of CNO /p/year Year	
	2005	2006	2005	2006
Local consumption (fresh nuts)	1937	1963	1937	1963
Desiccated coconut (DC)	440	440	440	440
Coconut oil - local	212	215	424	430
Coconut oil - export	24	26	24	26
Copra	86	88	86	88
CC and CMP	55	50	55	50
Fresh nut export	27	30	27	30
Seed nut requirement	4	5	4	5
Total	**2785**	**2817**	**2997**	**3032**
Predicted yield	**2710**	**2850**	**2710**	**2850**

(CC = coconut cream and CMP = coconut milk powder)

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virgin coconut oil in addition to various other food products made out of the residue or the press cake remaining after extracting the oil from the kernel. Development and introduction of processing technology, machinery and strengthening of promotional activities as well as marketing channels are important strategies that need to be implemented properly through collaboration with the Coconut Development Authority and the Ministry of Plantation Industries.

A current world market price of vegetable oils is a serious threat for the coconut oil industry. Coconut as an edible oil can not compete with Soya or Palm oil because of the high production cost. Nevertheless coconut industry is not challenged by the competition in the oil market because of its multitude of uses. Most coconut producing countries for instance India, Malaysia, Indonesia and Thailand, coconut is largely cultivated for drinking purposes. Thembili (king coconut) is well known as a drinking coconut in Sri Lanka and in addition there are many dwarf varieties with the potential for use as beverage coconuts. Screening of these dwarf varieties and promoting the cultivation of prospective forms for local consumption or exporting as tender coconuts is worthwhile. The tourism industry is gaining prominence in Sri Lanka and along with that and the tendency in the world for moving towards natural beverages the prospects of the tender or beverage coconut industry is likely to bloom. Tender coconut water could also be value added, preserved and bottled as a natural drink to replace aerated artificial drinks that currently flooded in the market country wide. In addition coconut skim milk, sweat meats made of coconut kernel are also becoming popular among tourists.

In order to reap the maximum potential of coconut products an integrated approach for processing and marketing is vital. Organization of farming communities and promotion of integrated processors of coconut as small and medium scale enterprises, ensuring quality, durability, and marketability by way of training were seen as vital in sustaining and promoting the coconut industry.

Effective Technology Transfer

Its effective contribution to the development of the coconut sector

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The coconut sector performs as a major segment of the country's economy, which comprises of different agro-based enterprises. Coconut growers, processors, millers, dealers, brokers and exporters play major role in the sector as sub-sectors. The internal and external environment of sub-sectors determines the performance of the sector. The Ministry of Plantation Industries, Coconut Development Authority (CDA), Coconut Cultivation Board (CCB) and Coconut Research Institution (CRI) are responsible for high performance and profitability of sub-sectors. Research and extension institutions are responsible to generate, develop and transfer new technologies based on the problems and needs of sub-sectors. It is now widely accepted that the agricultural development drive must operate with synergy having two-way flow between scientific, extension and clientele sub-systems. It could be seen that the inadequate performance of the sector is due to lack of interaction among the sub-sectors. Strengthening the linkage mainly among research, extension and grower activities could be seen as the major focus in technology transfer activities of the sector.

During last two decades coconut production has improved only marginally despite substantial advances in production technologies. Resource limitations and poor technology delivery are the key causes. In addition other constraints in the coconut sector at present are the low nut production, high cost of production, soil degradation, and inadequate income generation from coconut lands. As a result, most coconut growers are reluctant to invest for the development of their coconut lands. Coconut lands have a wide potential for high-income generation through the adoption of crop and animal based farming systems. But the overall income generation from most coconut lands is rather poor. Sustainable technologies should be developed and disseminated to growers in order to make the coconut cultivation profitable and uplift the economic standard of them.

The coconut sector comes within the purview of the Ministry of Plantation Industries. The Ministry direct and supervise the activities of the Coconut Development Authority (CDA), Coconut Cultivation Board (CCB) and the Coconut Research Institute (CRI). CDA is responsible on policy formation and coordination of different agencies in the sector. Quality control of different coconut products and advice and guidance in respect of coconut processing and marketing are also some responsibilities of CDA. Controlling and monitoring the internal and external marketing of coconut products and the coordination of programmes which supported by CESS fund, are also major responsibilities of CDA.

The Coconut Cultivation Board (CCB) is the mandated organization responsible for extension and advisory services of the sector. The extension activities of (CCB) are carried out in 17 Regional Stations located in major coconut growing areas. In each region a Manager, one or two Assistant Managers, Coconut Development Officers (CDOO) and Field Assistants are assigned to implement extension activities. The number of CDOO and Field Assistants assigned to each region is depending on the total number of coconut growers in a region.

The Coconut Research Institute is responsible to generate and develop technologies to uplift the productivity of the coconut sector. In 1929 the Coconut Research Scheme of Ceylon was established at Bandirippuwa Estate to attend research and advisory needs of the coconut plantation sector. Only three Technical Divisions named as, Soil Chemistry Division, Chemistry Division and Botany Division were in operation at the initial stage. In 1948 it was identified that one-seventh of the area under coconut was beyond the economic life span of 70 years. It was also estimated in 1949, that about 15,000 acres be replanted, with financial allocation from the Department of Agriculture. Advisory Field officers were appointed under the Planting Division to supervise the selection and the issue of seedlings for replanting programmes. These officers were also expected to monitor and advice on the maintenance of seedlings after planting. With the expansion of advisory activities, more Field Advisory Officers were recruited and the Planting Division was renamed as Planting and Advisory Division. Regular educational and training programmes were conducted to improve the technical knowledge and skills of Field Advisory Officers. Regular discussions were conducted at CRI between the technical Staff and the Field Advisory Officers appointed to different areas to assess the progress of research and advisory activities. Frequent seminars and field demonstrations were also conducted for coconut planters and the researchers were directly involved in these activities. Advisory Circulars were issued in simple language with illustrations on each recommendation. A series of publications were issued with the objective of improving the knowledge of coconut growers.

In 1971, the government introduced a subsidy programme to rehabilitate the coconut sector. As it was expected to operate island wide, Coconut Cultivation Board(CCB) was formed under the Coconut Development Act. No 46 of 1971 to provide subsidies to coconut growers and assist them to get the best benefits from it. All the functions and the staff of the Planting and Advisory Division of CRI were absorbed by the CCB. The activities of CCB were implemented through Regional Offices established in major coconut growing areas. Coconut Development officers were appointed to operate under each regional station. Coconut Development Officers (CDOO) is expected not only to administer subsidy schemes but also to provide technical guidance and inputs to growers.

The ultimate objective of both research and extension subsystems of the coconut sector is to increase the productivity of the coconut lands. Their role of generating and transferring technology is complementary. Coconut researchers need to have information on growers field problems and technology needs to formulate research agenda and to set priorities. Formulation of research agenda based on the requirements of stakeholders result in technologies that will be acceptable to end users. The extension organization can provide research institute with information on research requirements and play a mediatory role between growers and researchers. Extension organization requires a continuous flow of information from research institution on new and improved practices. Therefore, an efficient two-way communication process is essential for

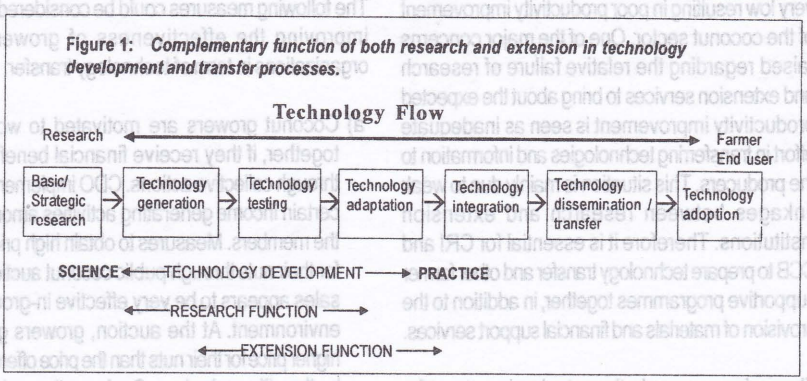

Figure 1: ***Complementary function of both research and extension in technology development and transfer processes.***

generating and transferring technologies effectively. The success of two way communication is determined mainly by the effectiveness of linkages between research and extension institutions. In the coconut sector, research and extension functions are carried out by two different organizations.

In the coconut sector, three major state institutions (CRI, CCB and CDA) are expected to maintain an effective linkage in planning and implementing development activities. The level of interaction among these institutions is inadequate resulting in poor impact at the stakeholder level. When the technology generation, development and transfer activities are concerned, it is essential to maintain formal linkage between research and extension programmes. The Coconut Cultivation Board is the main responsible organization to provide technical support services and promote effective management to improve the productivity of coconut lands. The existing organizational structure and human resources could effectively be used to fulfill the above objectives with proper planning.

Linkages for Technology Generation, Development and transfer

During Green Revolution period, the performance of national agriculture research systems in all Asian countries was relatively high. However, in recent years, the technical capabilities of national agriculture research systems have declined resulting in poor performance and lack of technical advances. Increasing demands for high performance and accountability are new challenges in the present agriculture research systems in Sri Lanka.

The Coconut Research Institute as a component in the national research system faces the same challenges in respect of performance, productivity and relevance. To improve the performance in modern more complex environment, CRI has to develop strategies, which respond the clients' needs. In the agricultural development efforts, research and extension are considered as complementary functions to achieve high performance at the stakeholder level. Technology generated at the research station flows through a series of processes, which convert them into more acceptable form by the end users. Technology flow involves sequential processes along the science–practice continuum. They are; technology generation, technology testing, technology adaptation, technology integration, dissemination, diffusion and adoption. (Roling, 1989).

Research activities could be identified as basic research, strategic research, technology generation, technology testing, and technology adaptation. Extension functions include technology testing, technology adaptation, technology interaction and technology dissemination. It could be observed that these functions are not properly performed due to lack of research and extension linkages. In the coconut sector, research and extension systems function under separate organizations. Therefore, a mechanism for effective linkage is vital for high performance of these functions.

To ensure high performance in the coconut sector, it is essential to maintain effective linkage among the active partners in the sector. For effective technology generation, development and transfer, CRI has to play a vital role in maintaining linkage among other institutions and partners. The following four stages could be identified as essential steps in strengthening the linkage among research, extension and client subsystems.

Formal and Informal linkages

Formal linkages refer to linkages that are specified and agreed by organizations. Informal linkages are direct person-to-person contact based on needs for collaboration between individuals. As informal linkage is effective, it should be encouraged along with formal linkages. At present formal linkages between the institutions in the coconut sector are inadequate. All the organizations should agree as a policy to establish joint reviews of research and extension activities of the coconut sector.

Top-down and Bottom – up linkages

In top-down linkage information on research findings and new technologies flow from CRI to extension personnel, growers and other clients. Bottom – up linkages refer to the flow of information from growers, and clients to research personnel. Information from growers and other clients is based on their practical knowledge and related problems, which would help CRI to improve the effectiveness of research programmes. The bottom – up linkage should be strengthened in the process of research planning and prioritization.

Internal and External Linkages

Internal linkages refer to linkages among scientist working different disciplines within CRI. Due to compartmentalization of research activities as Divisions, the internal linkages appear to be inadequate. Therefore, CRI need to promote internal linkage in developing research strategies, which would generate technologies to solve the problems of clients. External linkage refers as linkage with major clients such as extension staff, growers, processors, dealers, etc. The external linkages help to identify technology gaps and assess the utility of the technologies developed.

Downstream and Upper-stream linkages

In the technology development and transfer process, upper- stream linkages occur between CRI and large plantations managed by private and state companies. The aim here is to address the needs and problems of estate sector. Downstream linkages occur between CRI and small and medium scale clients who need technical advice and information specific to them.

Technology Transfer Activities in the coconut sector

The Coconut Cultivation Board is the main responsible organization to provide technical support services and promote effective management to improve the productivity of coconut lands. The existing organizational structure and human resources could effectively be used to fulfill the above objectives with proper planning. CCB as an independent organization design and implement its extension programmes with proper consultation with research and grower sub-systems. However, the present interaction in their planning appears to be inadequate.

The Coconut Development Officers (CDO)should be adequately knowledgeable to assist their clients, not only on coconut cultivation but also on processing and cost effective estate management. CCB should give high priority for the improvement of their knowledge and skills.

Short and medium term programmes are required for technology transfer activities. Short-

term programmes mainly focus on the productivity increase from existing mature plantations. Medium term programmes include measures for obtaining high nut yield, maximize the land use, increase the profit by reducing the cost of production and the expansion of coconut acreage in both traditional and non-traditional areas.

Short Term Programmes

(1) Promotional programmes to encourage growers to use fertilizer for coconut at the correct time.
(2) Encourage growers to adopt correct measures to reduce soil degradation and to rehabilitate low yielding coconut lands.
(3) Promote the use of dolomite for every palm each year.
(4) Promote the use of organic manure and green manure for coconut estates at least once in every fourth year.
(5) Encourage medium and large scale coconut growers to adopt DFR for effective nutrient management.
(6) Promote mulching, husk burial, contour drains, contour live hedges and cover cropping as cost effective management practices.

Medium Term Programme

(1) Production and distribution of superior planting materials.
(2) Irrigation for higher productivity
(3) Encourage growers to replant or under plant senile plantations.
(4) Animal and crop integrated farming systems for coconut lands.
(5) Measures to reduce soil degradation in coconut lands.
(6) Mechanization to reduce cost of production.
(7) Skill development on coconut estate management.
(8) Promotional programmes to expand coconut cultivation in non-traditional areas.
(9) Encourage setting up coconut processing plants in non-traditional coconut growing areas.
(10) Promotional programmes for small and medium level coconut based industries

For effective implementation of the above programmes, the technology generation, development and transfer activities must be strengthened. Fairly large number of technologies such as improved planting materials, crop fertility management measures, irrigation practices, soil and moisture conservation measures and integrated pest management measures has been introduced. However, the rate of adoption of these technologies at the field level is found to by very low resulting in poor productivity improvement of the coconut sector. One of the major concerns raised regarding the relative failure of research and extension services to bring about the expected productivity improvement is seen as inadequate effort in transferring technologies and information to the producers. This situation is mainly due to weak linkages between research and extension institutions. Therefore it is essential for CRI and CCB to prepare technology transfer and other farmer supportive programmes together, in addition to the provision of materials and financial support services.

The major concern in these technology transfer programmes would be -

1. Transfer of coconut cultivation and processing technologies and information to CDOO, coconut growers, related commercial enterprises and general public. This involves training, seminars, workshops and field days in order to update technical knowledge and skills of CDOO, growers and other stakeholders.
2. Persuasion of coconut growers to adopt new technologies to improve the productivity of their plantations. Educational programmes, field demonstrations, farmer field schools, media programmes, publications and farmer participatory field activities are used effectively to fulfill these objectives.
3. Assist coconut growers to solve their field problems and technology related problems through field inspections and consultancy services.

Group approach for technology transfer

Group approach is the most effective way to transfer technology to coconut growers. When coconut growers in a village are considered as a group, their problems and needs regarding coconut cultivation are mostly same. They prefer to act together as a group as long as they are personally benefited. Formation of coconut growers' groups enhances the power to fulfill their needs and create an encouraging environment to adopt new technologies for their own benefits.

The Coconut Development Officer (CDO) could act as a facilitator to encourage growers to form their own organizations. Technology transfer activities could be organized with the participation of these organizations. It is the skill of CDO how he could encourage the members of these organizations to make the highest benefit from the services available. In addition to technical matters, CDOO also be provided with special training on the formation and handling farmer groups in the village environment. The Regional Staff with the assistance of CDOO could monitor the progress achieved by these organizations and assist them to provide the best services to their members.

The following measures could be considered in improving the effectiveness of growers' organizations in term of technology transfer:

a) Coconut growers are motivated to work together, if they receive financial benefits through collective actions. CDO implements certain income generating activities among the members. Measures to obtain high price for their nuts through public coconut auction sales appears to be very effective in-group environment. At the auction, growers get higher price for their nuts than the price offered by the village dealers. Such auction sales could also be arranged for other estate products too. In order to make this system more effective, CDO could build up marketing network by linking growers' organizations in other villages.
b) Formation of growers' organizations could be encouraged by providing CCB services and inputs only through these organizations. As these organizations are seen as receiving mechanisms through which inputs, information, advice and training can be provided to a large number of growers. CDOO could use these organizations for their technology transfer programmes more effectively.
c) With the guidance of CDO, members could organize themselves to implement measures to reduce the cost of production.
   - ❒ CCB could assist them to purchase machinery (tractors, weed slashers, harrowers, sprayers) with low interest bank loans for the benefit of members.
   - ❒ Maintain a separate group of trained coconut pickers.
   - ❒ Maintain a trained labour force that is available for estate activities on contract basis for the benefit of members.

d) As an effective technology transfer method, one coconut land in each village could be developed as a model farm with the assistance of farmer organizations.

Development programmes in the coconut sector include strategies to increase productivity, profitability, employments, and global competitiveness. The organizational models and approaches that were effective at the time of Green Revolution are no longer adequate in today's more complex environment. The research and extension institutions, which play a role in the development process, need strategies to face challenges in the fields of cultivation, processing and trade. The major challenges being sustainable increase in production and productivity of coconut lands with low cost management practices.

RESEARCH CONTRIBUTION TO THE DEVELOPMENT OF COCONUT INDUSTRY

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The coconut palm could be introduced as an essential food crop most closely associated with the life of Sri Lankan community among the three main plantation crops namely, tea, rubber and coconut grown in Sri Lanka. The Coconut Research Institute (CRI) marked its 75th Anniversary in April 2004. During the period it has rendered a valuable technological service to this industry.

Traditionally, the primary research projects required for the development of coconut cultivation undertaken in the maritime areas of Sri Lanka were originally implemented in association with the Department of Agriculture. However, the request of coconut growers at that time was that if the intention is to develop coconut cultivation in Sri Lanka, there was the need to introduce the appropriate technology and as such coconut research needed a special research programme. The early part of 19th century where there was high demand for coconut products, especially desiccated coconut, the plain need of the coconut growers was to identify new technological methods for the improvement of coconut production. Scientific investigation about the coconut palm and its cultivation commenced in1912 under the guidance of the then Director of Agriculture. The first fertilizer and soil researches were conducted in 1918 in Hunupitiya Estate, Kurunegala by R. Leen and in Alexandra Estate, Ja-Ela by late Mudliar P.E. Rajapakse, under the supervision of the Department of Agriculture. As a result of the discussions held with the authorities for years, it was decided to start for the first time, a coconut research project under Coconut Research Ordinance No: 29 of 1928. The first meeting of the Board of Control of the Coconut Research Project was held at the Chambers of the Legislative Council in Colombo on 27th April 1929. Although research activities of this project expanded under the Department of Agriculture, efficient implementation of these activities began after Bandirippuwa Estate, where the present research station is located, was acquired for this project on 07th January 1931. Construction of laboratory and administrative buildings on Bandirippuwa Estate commenced during this period.

After independence, with the objective of expanding the coconut development activities of the country, the Coconut Research Project was named Coconut Research Institute under Coconut Research Act No: 37 of 1950. Under this, the activities of the institute were developed very extensively. By identifying the problems that lie in the field inhibiting development of cultivation, an extensive range of research activities was implemented to find solutions for them. Efficient scientists and research assistants contributed to this effort. The institute introduced improved technology to planters, appointed trained instructors throughout the island to increase productivity of their lands and special programmes were conducted periodically to increase the knowledge and skills of the instructors. In addition, on 23rd April 1955, world's first solitary coconut seeds garden was started in Ambakele Forest for the production of highbred coconut seeds that provide a higher yield to the growers.

With the enactment of Coconut Development Act No: 46 of 1971, in addition to the Coconut Research Institute, several boards including the Coconut Cultivation Board were set up with the objective of developing the industry further. The advisory services and nurseries along with the respective staff hitherto attached to the Coconut Research Institute were attached to the Coconut Cultivation Board. The fundamental responsibility of the Coconut Research Institute was to develop new technology for the development of coconut cultivation and to introduce them to growers. Further, the primary responsibility of the institute was to identify their problems and recommend appropriate technological methods to growers by developing a close relationship with them.

When we consider the food habits of the people of Sri Lanka, coconut remains second only to rice. Considering the multifarious uses and its food value, it is absolutely correct when our ancients called the coconut palm "Kalpa Vruksha" (Tree of Eternity). Among the plants of the world that are useful to man, coconut palm could be defined as the plant that contributes most to the satisfaction of human needs. Although it can be grown successfully in different areas of Sri Lanka, we cannot be content with the present predicament of the coconut palm that provides an essential food item of the Sri Lankans. It is therefore necessary to investigate the reasons for this predicament and to implement short term and long term plans with the objective of improving the cultivation and the coconut industry which is the life blood of the people of Sri Lanka.

Although it is the crop that is grown in the largest acreage for any plantation crop in Sri Lanka, it is mainly a small holders' cultivation. Kurunegala (35.6%), Gampaha (15.5%), Puttalam (12.9%), Hambantota (4.9%) and Kegalle (4.9%) are the leading coconut growing districts of Sri Lanka. When we consider the present extent of lands where coconut is grown, 57% are less than 2 acres. Lands less than 5 acres in extent are 86% and those less than 10 acres in extent comprise about 96%. This illustrates that the major contribution in the coconut industry comes from small holders. In the process of transferring lands to children by parents, these lands become further fragmented into smaller land holdings.

When considering the socio-economic condition of coconut land owners of our country, it is observed that in respect of the majority of the people, the main source of income is not coconut cultivation. The income generated by coconut cultivation is treated as a supplementary income. In view of the income, even though small, received in the long run from the coconut land the rapidly rising value of coconut lands, many coconut land owners continue with their holdings under minimum maintenance. Some coconut land owners however, have increased the productivity of their lands very satisfactorily, by the utilization of resources available in the land and by adopting technological management systems. However, due to attempts made by the majority of land owners to reap higher returns in the long run by spending less as far as possible, a large number of coconut lands have faced rapid deterioration. These lands are rendered unsuitable for a successful re-plantation due to soil erosion and severe loss of soil fertility due to long term non-application of fertilizers. On lands in this condition, it is observed that there is a rapid drop in coconut yield and that even if replanting is commenced where trees are ageing. Such re-plantation remains in a poor condition. Owners of such lands always attempt to sell them and invest the proceeds in a profitable venture. In the main coconut growing districts where there is high population growth, a high demand exists for lands. Consequent to this, lands that are being fragmented for house construction are on the increase.

Although the general condition of the coconut cultivation is as described, since of late, there have been many people who have shown increased interest and effort to cultivate coconut methodically. It can be pointed out that the reasons for this upsurge are the prevalence of a satisfactory price for coconuts and the increase in yield due to the adoption of technological methods and the cultivation of high yield-

ing varieties of coconut. To obtain a good yield from all agricultural crops including coconut, it is essential that every plant that is planted should be a high yielding highbred one. In respect of long term income yielding permanent crops such as coconut, it is essential to pay due attention to the quality of the plant. In addition, a good knowledge is required regarding the appropriate soil and climatic conditions required for the successful growth of plants with high yield potential. The growers should be well aware of the nutritional and water requirements according to the conditions prevalent in different regions where planting is undertaken. As the result of laboratory and field experiments conducted by the Coconut Research Institute during the last 75 years, a number of technological recommendations have been introduced to coconut growers. Different technological recommendations have been introduced by identifying the problems and limitations existing in different coconut growing areas of the island.

The Coconut Research Institute has made its recommendations regarding the procedure that should be followed by a grower to improve an old coconut land yielding a low income. Clear recommendations have been made in details as to how high yielding plants could be planted in place of the old cultivation. These recommendations include clear instructions regarding under planting while the old cultivation remains as it is and managing it, how the old cultivation should be completely removed and a re-plantation commenced, and the problems existing in such plantations. CRIC 60 or tall X tall improved coconut variety that has been recommended for all the cultivable regions are being produced by means of nuts produced through pollination of selected high yielding mother and father palms of the tall variety. Although the maternal and paternal plants of these seed nuts are high yielding plants and the seed nuts generated by them are invariably potent high yielder, in order to realize the anticipated yield from these high-brid coconut variety, these plants should be planted in a suitable soil and their management level too should be high. In addition to this tall x tall variety of coconut, 'Kundira' and CRIC 65 variety that is a cross breed of tall varieties are recommended for lands with deep soil which can be maintained at a high management level under irrigated water supply. This variety commences flowering earlier than the variety mentioned earlier and a higher yield of nuts could be obtained from a well grown palm. The cross bred CRIC 65 variety is most suitable for home gardening. Even if a few plants are successfully grown in small urban lands, the household will be able to obtain from its own land the quantity of coconuts required for daily household consumption.

Although many coconut growers show greater keenness to plant coconut seedlings as a step towards improving their lands, the interest shown by them in maintaining those plants until such time they give a yield is very low. The result would be the deformed growth of the plant, more time taken for flowering and the very small number of nuts per palm once the crop starts yielding. In this situation, growers should always attempt to make every plant grow well for a period of about 5 years until it starts bearing. If the growers wish to reach this condition, Coconut Research Institute has given clear recommendations that they should follow. Growers have been introduced to methodical planting of saplings, use of dampness conservation methods, application of chemicals and carbonic fertilizers, watering and pest and disease control methods. By following these recommendations, growers will be able to ensure the growth of a healthy plantation. The main problem faced by growers in maintaining cultivated plants is the damage caused to the plants by the black beetle and the red weevil. From the day a sapling is planted, it can be subject to the damage caused by the black beetle. It is a problem when the frond of plants at very young age are destroyed by the black beetles activities resulting on most instances, in the death of the plant or stunted or deformed growth of the plant. Hence Coconut Research Institute has introduced methods by which the black beetle can be successfully controlled. Similarly, an insect that inflicts deadly damages to plant cultivations, especially from the time the trunk forms upto the time of bearing is the red weevil. It is reported that a great number of well grown young trees are facing destruction daily due to damages caused by the red weevil. The special feature of the damage caused by the weevil is that it cannot be identified at the beginning. The larva of the red weevil that enter the trunk of the coconut plant eat the tissues inside the trunk and destroy and the ultimate result will be that within a few days the crown breaks down and is destroyed. This is a tremendous economic loss to growers who nurture the growth of coconut plants with the greatest difficulty and at a considerable expenditure upto this stage. If growers however, closely and continuously examine their cultivation and detect the damages caused by weevils early, Coconut Research Institute has introduced to growers, successful methods of controlling them. It is a necessary condition that there is a lesion (wound) in the plant due to natural or exogenous reasons for the female of the red weevil to lay eggs on it.

In a few days, the eggs laid on the lesion hatch and tiny larva enter soft parts of the trunk and gradually grow and destroy tissues of the palm on a large scale. Due to this, holes occur in the trunk and sap flowing through them can be seen. In most instances, since the stem are of plants of this age are covered with dry coconut leaflets and petioles, the sap flow and the holes cannot be detected easily. The result will be that when the damage is detected late, the fibre inside the trunk would have been severely damaged. Even if pests are controlled by application of chemicals due to the decline of the trunk's strength it can breakdown later. But, this weevil damage can be controlled successfully by keeping the palms clean, frequent inspection of palms to detect the damage early, injection of a chemical such as monocrotophos if the damage is discovered at the early stages. It is essential that growers possess a good knowledge of these methods of control.

The main reason for low nut yield in many plantations is the inadequacy of nutrients and the water that the palm receives. The cultivation that is presently existing in these lands may be the secondary or the tertiary plantation on the same land. A nutrient deficiency in many coconut lands can be seen due to the removal from the land every part of the palm for man's use. Due to this reason, it is essential that fertilizer be applied to the cultivation to obtain a good yield from coconut lands. As a result of long term research regarding the fertilizer that should be used according to the nutrient requirement of the palm and the nature of the soil by the Institute, fertilizer mixtures required for coconut cultivation have been recommended. These recommendation include the method of application of the mixture, quantity and the frequency. The Institute has provided to the growers, the way different nutrient deficiencies can be identified and the methods that should be followed to ameliorate them.

Today, there is a fast growing demand for products of cultivations using natural fertilizer completely free of artificial fertilizer. There is also a good demand for carbonic coconut and coconut products. The Coconut Research Institute has made clear recommendations for growers to follow, if they are to reach this position. Clear instructions have been given to growers regarding correct and methodical planting of seedlings, watering and control of pests. By following these instructions, growers will be successful in establishing a healthy plant cultivation. But due to not following suitable land management systems a severe soil deterioration caused by erosion of top soil and greater exposure of the soil to sunlight can be observed. Under no circumstances can a good yield be expected from a coconut cultivation so deteriorated.

Hence, the Coconut Research Institute has issued clear instructions regarding methods by which soil and soil dampness conservation and their advantages. Laying of contour drains on sloppy lands and thereby reducing soil erosion, increasing the quality of soil by growing leguminous cover plants are considered important management methods. The CRI has provided information including clear instructions regarding the practice of these methods.

There is a clear relationship between the coconut yield and the nature of the soil of that land.

HYBRID COCONUT VARIETIES TO INCREASE PRODUCTION

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For the National Replanting Programme (NRP) of coconut in Sri Lanka, there are mainly two recommended coconut cultivars; the improved tall cultivar CRIC60 (tall x tall) and the hybrid CRIC65 (dwarf x tall). The balance seed nut requirement for the NRP is supplied to the growers from a pool of seed palms selected in high yielding estates. In addition to all above, there are two other newly released hybrids, namely CRISL98 (tall x san ramon) and Kapruwana (dwarf green x san ramon), but their seed nut availability for the NRP is limited.

Experimental evidence confirmed that under average management conditions, hybrid (CRIC65) was capable of producing 20,000 nuts/ha/year (100 nuts/palm/year), when CRIC60 was producing 14,400 nuts/ha/year (72 nuts/palm/year) under same conditions. Though hybrid tends to show a yield reduction at an increased rate compared to tall cultivars in response to drought, hybrid has always been the highest total nut and copra producer among other cultivars when yearly total nut and copra yield was considered. Under high input managements system, hybrid could produce even up to 24,000 nuts/ha/year (120 nuts/palm/year) and under micro-irrigation systems with fertigation even more than that. Hence, though hybrid was in the past considered severely affected by drought, hybrid is now considered for recommending in an extended area with optimum input of fertilizer and management and with more emphasis on high input cultivation for maximizing the productivity and profitability.

Nearly 70% of the total coconut production in Sri Lanka is locally consumed and hence only 30% of the production is available for desiccated coconut (DC) and copra, which are major agricultural avenues for foreign exchange earning. Thus a programme is now under way to promote planting three to five hybrid coconut palms per household in the home gardens, especially in and around Colombo and other town areas with the intension of meeting the fresh nut coconut requirement of the household. Application of organic waste from the kitchen with little amount of inorganic supplements and utilized water from the house through out the year could keep the palms under optimum management conditions to bear enough nuts for household consumption. As hybrids are profuse bearers, short in stature and come into bearing in 3 to 3 1/2 years after planting, planting hybrids in home gardens is an appropriate approach to increase the coconut production in the country without going for area expansion. Similarly, as adequate information on soil suitability information is now available at CRI, diversion of hybrid seedlings in class one and two soils could boost the production level within a comparatively shorter period than planting traditional tall cultivars. The national production can significantly be increased by this way and thereby spare coconut production from large estates for the DC and copra industry.

CRI has conducted an extensive study in this regard and has identified a number of grades of suitability of lands for coconut cultivation. The most suitable soil grade for coconut cultivation has been identified as S1 and less suitable ones as S2, S3, S4, S5 and those unsuitable for coconut cultivation have been graded N1 and N2. CRI has issued maps depicting suitable areas in the Coconut Triangle and the Southern Region. These maps titled Land Suitability for Coconut Cultivation could be bought from the Institute according to the various regions. A grower will be able to identify the main suitability grade in reference to these maps and descriptions. Even in the same land soil categories with different suitabilities can occur and these grade descriptions clearly indicate in which feature of the soil lies the suitability of the land. Hence, the growers will be able to identify the extent to which their lands are suitable for coconut cultivation. Similarly an idea could be obtained as to what limitations the land is facing and what methods have been recommended to improve them. Besides, one should decide on the purchase of a land for coconut cultivation only after studying these features. An important factor seen in the feature characteristics of the soil on which coconut is cultivated is that deep loamy soil and sandy loamy soil categories that can retain a greater quantity of water are most suitable for coconut cultivation. The roots of palms planted on such soils run deep and are capable of absorbing water present even in deep soil. As such, at a time when there is low rainfall, even though the top soil gets dried up, the coconut palm remains healthier and capable of yielding a higher crop due to its ability to absorb deep water. But the situation is quite different in lands with a shallow soil with gravel clay. As the clay is less deep the ability of this soil to retain rain water is less and even during a short dry spell coconut palms face water deficiency. Signs of water deficiency are slow growth of plants, less number of nuts produced and fall off of immature nuts. Further, reduction in the size of the nut and thickness of the kernel are also signs of water deficiency.

All these information points to the fact that the productivity of the coconut palm cultivated depends on the amount of water that can be retained in the land wherever coconut is grown.

Hence, it is very important that methods of dampness conservation on coconut lands are implemented. The CRI has clearly demonstrated that coconut yield can be increased by implementing the recommended dampness conservation methods especially on lands with clay, sand and shallow soil.

Of these methods, the method that can be implemented by the growers quickly and at a less cost is covering with dry coconut leaves, leaves and branches or coconut husks, the fertilizer circle at the base of the coconut palm. This reduces the drying up of the fertilizer circle where the most active roots are located and as it prevents hot sun rays falling on the root area it controls its rising temperature. If the temperature of this are with the active roots rises, their action weakens and renders them inactive. Furthermore, when plant parts used as cover decay, carbonic particles enter the fertilizer circle. The most effective method recommended for retention of dampness is the burying of coconut husks between roars of coconut palms. By burying layers of coconut husks in pits with length, breadth and depth of 8x4x3 between two coconut palms in the roar will result in a clear increase in the coconut yield in a matter of few years. Although the total rainfall received by many coconut growing areas is quite adequate, a drought condition exists between the Yala and Maha season for a couple of months.

In certain years, it could be observed owing to the elongation of this drought condition, coconut cultivation in many areas faced severe drought damages.

When coconut husks are buried on the land, a considerable amount of water that is received during the rainy season are absorbed by those husks and the roots of the palm during the dry season extend into the damp husks to satisfy the water requirement of the plant. Due to this, even under

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Product Diversification & Value Addition to Generate Income from Coconut

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Coconut *(Cocos nusifera* L) is a very important crop in the plantation sector of Sri Lanka. Because of its food value, coconut plays an important role in the lives of Sri Lankans. The primary food products of coconut are kernel, coconut sap and coconut water. These items can be used to produce many food items such as copra, coconut oil, desiccated coconut, toddy, vinegar, beverages and so on. However, in recent times coconut industry in Sri Lanka showed recession. Law productivity of coconut lands due to recurrent drought and land fragmentation are some of the reasons for the decline of coconut production in Sri Lanka. Due to the less productivity of coconut lands, farmers get very low income. Therefore, they tend to sell their coconut lands for housing construction and other industrial development purposes. In order to halt the decline of coconut sector, product diversification has been advocated as a strategy. Value addition is a key for product diversification. Therefore, primary products of coconut have to be used for product diversification purposes under this program.

Reduction in the wastage of coconut during home consumption could help to enhance income. In the traditional way of pressing coconut for milk is found to lose one third of the money value of coconut. Therefore, coconut paste was suggested as an alternative product of high nutritional value out of the kernel. It is time now to educate the general public to use coconut paste instead of coconut milk. If the demand for this product increases, small scale entrepreneurs can capitalize the situation. The initial investment needed for this kind of venture is very small.

Virgin coconut oil is another innovative product which could be used for enhancing income generation. When coconut kernel is subject to screw press expelling under control temperature conditions a very clear oil of high quality is obtained. Due to its premium quality it can fetch a high price in the developed countries. Using virgin coconut oil as a base material further value addition also could be possible. Carotene-enriched coconut oil and chili-enriched coconut oil are two examples of this category. The monetary value could be further increased if the oil is used for the production of medium chain fatty acid enriched products. The importance of medium chain fatty acids in human nutrition has now been realized. The medium chain enriched oils could be used to prepare high energy biscuits, sports food etc.

From production of virgin coconut oil a high quality refused which is low in oil content but high in dietary fiber could be obtained as a byproduct. It is called defatted coconut powder. Use of this byproduct in food could enhance the income of virgin coconut oil industry. Having been rich in dietary fiber this byproduct finds many applications in bakery products. In addition to this, it could be also used for the preparation of sweetened fruit bars, spread cheese, instant coconut 'sambol' etc.

Coconut milk could serve as a base material for value addition to increase income in the coconut sector. Skim milk beverages could be prepared using skim milk obtained by cream separation of coconut milk. This can be further improved by the addition of mango or pineapple flavors. Coconut yoghurt and coconut jelly are two other products which are produced using skim milk.

Small scale industries can embark on a variety of sweet meats which can be prepared from young and mature kernels. Sugar coated dried coconut chips and 'penipol' are products made out of mature coconut kernel. Coconut chip could be packeted under vacuum to market as a snack food. In the case of 'penipol', it could be used as filler for bakery products such as bun. If an attractive packaging material is used, this kind of bakery products can be marketed as breakfast items. The kernel of the nine to ten months older coconut is lower in oil content and has a soft texture due to low amount of dietary fiber. Crushing of this kernel can be used for preparation of jam. 'Deekiri' coconut is another option for product development. It is a special type of coconut variety which produces kernel with a gel like texture. Preparation of jam using 'deekiri' coconut was sucessful. It was also found out that a smaller proportion of pineapple addition to this jam will enhance the flavour.

Coconut water is another valuable component of coconut. Despite its nutrient content, it is the component mostly wasted during the industrial processing of coconut. In fact, voluminous amounts of coconut water are released from copra and desiccated coconut manufacture. If nut water is properly collected, it can be converted into a sport drink or vinegar. Eventually, it can become an additional source of income for kernel based industries.

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drought conditions, it is possible to reduce the water deficiency of the coconut palm. Many growers show greater interest in implementing this method in their lands due to its distinct advantages. In a coconut land, not only coconut, but a number of other crops also can be grown. CRI has provided information containing recommendations on suitable subsidiary crops for different coconut growing areas and on planting and maintaining them methodically. Growers show greater interest in growing crops like plantains, pineapples, ginger, papaya, pepper and passion fruit.

There is also the possibility of successful animal husbandry in coconut plantations. Further, by applying carbonic fertilizer obtained from the animals of the farm on coconut palms, the cost of chemical fertilizer can be reduced substantially. Leaves and grass required by the animals could be successfully grown on the lands themselves and it can be pointed out that animal husbandry is a profitable farm activity. Many land owners who cultivate only coconut on their lands spread annually a large sum of money for weed control. These weeds can be effectively controlled by rearing cattle, goats and sheep and the carbonic manure they produce can be usefully applied to coconut palms. In a way, since weed control takes place due to animal husbandry, cost of weed control can be reduced. The special attention of the Institute has also been focused on the promotion of other products of the palm besides increasing the nut yield of the coconut palm. New techniques of toddy tapping have been introduced and thereby the quantity of toddy obtained from a palm has been increased. Further, different new by products of toddy have been introduced. The special focus of research programmes has been to improve the quality of different coconut products and to introduce value added new coconut products. The Institute has already introduced a number of new products and they are gaining popularity among consumers.

This institute that was established solely for the development of coconut growers and it has performed a very special service for the industry during the past 75 years.

If growers had applied the technology generated by the Institute in its proper form to the development of their lands, the current level of productivity in the field of coconut cultivation would have been very high. It is a necessity that this Institute that works for the development of coconut growers and industrialists maintains a close relationship with them. Without them, this organization will not exist. It is essential that a suitable institutional structure exists within the coconut industry for this purpose. Future research activities have been planned to be implemented to identify the basic problems prevalent among coconut growers and the industry and to find effective solutions for them.

THE PLAIN TRUTH ABOUT COCONUT OIL

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Asian & Pacific Coconut Community

(Quoted from the Jakarta Post, June 18, 2003)

On March 19, 2003 the Jakarta Post published an article entitled "The simple truth about cholesterol" written by Melissa Southern-Garcia. While the article tries to enlighten readers about cholesterol, it is sad to note that the author gave inaccurate and misleading information about coconut oil. She implied that since coconut oil belongs to saturated fat it has a negative effect on our health by increasing our blood level of harmful LDL (Low Density Lipoprotein) cholesterol.

This article is meant to give a scientifically proven fact about coconut oil that may be missed out by common people and professionals.

Coconut oil is a colorless to pale brownish yellow oil with a melting point ranging from 23ºC to 26ºC. The glycerides of coconut oil are invariably a mixture of one, two, or three fatty acids. Though coconut oil is known as triglyceride or lipid, it also contains minor proportions of mono and diglycerides and has highest content of glycerol (13.5% to 15.0%). Glycerol is a carbohydrate with chemical composition similar to that of simple sugar. This implies that with coconut oil as a dietary fat, the actual intake of fatty substances is much less than that with same quantity of any other actual intake of any other oil.

A study done in a two groups of community living in New Zealand who consume a large number of coconut oil has proved that they have rare incidents of hypercholesterolemia and heart attack. According to Prior, Davidson et al. two groups of Polynesians from Cook Islands derive 35% and 27% of their calories from coconut oil but their mean cholesterol values are low, i.e. 153 mg% and 195 mg% respectively. Prevalence of heart attacks also is low in these groups compared to the usual New Zealand population.

About 70% Sri Lankans are consuming coconut oil for over 1000 years but the epidemic of hypercholesterolemia and heart disease is of recent origin. Before 1950, heart attacks were not common in Sri Lanka. Hospital admission rate for heart attacks was 57.3 in 1970 to 182 in 1992. On the other hand the Central Bank of Sri Lanka figures out that the coconut consumption has gone down from 132 nuts per person per year in 1952 to 90 per person per year in 1991. It indicates that the increase of heart attacks incidents in Sri Lanka is not due to the increased consumption of coconut.

In a study in the Philippines, 10 medical students tested diets consisting of different levels of animal fat and coconut oil. When the ratio of animal fat and coconut oil at ratio of 1:1, 1:2, 1:3 no significant change in cholesterol but when animal fat level increased total calories reached 40% and blood cholesterol increased. This study indicated that not only did coconut had no effect on cholesterol levels, it even reduced the cholesterol elevating effect of animal fat.

Hashim et al (1953) demonstrated that coconut oil was not a "bad oil" when they compared essential fatty acid-rich safflower oil with an equal mixture of safflower oil and coconut oil on 10 hyper-cholesterolemia males, 8 of whom were survivors of myocardial infarction. They showed that both safflower oil (SFO) and safflower oil-coconut oil (SFO-CNO) caused marked decrease in the serum cholesterol and that the (SFO-CNO) effect was obtained regardless of whether it was fed before or after the safflower oil (Kaunits, 1992).

There were some experiments which concluded that coconut oil caused hypercholesterolemia, but these experiments turned out to be unacceptable due to some reasons. First, these experiments used hydrogenated coconut oil in which the coconut oil became more saturated and its essential fatty acid, linoleic fatty acid, got destroyed. Second, Most of the research work has been done using animals such as rabbits, monkeys, dogs, swine, and rats and the number of animal used are very small. In some experiments only four animals were used. Third, Rabbit model used for most of the research work cannot be compared to man. It has been found that when corn oil is administered to a man it will make his serum cholesterol level come down, while in the rabbit model, corn oil increases serum cholesterol level (Aturokarole, 1996).

The fact that coconut oil belongs to saturated oil cannot be automatically justified to be the cause of increasing LDL cholesterol as coconut oil has its own unique properties. Moreover, people may not know what saturated oil means. Chemically, oil is made up of chains of carbon, hydrogen and oxygen called fatty acid. All fatty acids consist of a chain of carbon atoms with varying amounts of hydrogen atoms attached to them. A molecule that has two hydrogen atoms attached to each carbon is said to be "saturated" with hydrogen because it is holding all the hydrogen atoms it possibly can. A fatty acid that is missing a pair of hydrogen atoms on one of its carbons is called monounsaturated fat. If more than two hydrogen atoms are missing, it is called polyunsaturated fat. (Fife, 2000).

Table 1

Estimated amounts of cholesterol in vegetable oils and animal fats

Oil/fat	Range (Parts per million)
Coconut	5-24
Palm kernel	9-40
Sunflower	8-441
Palm	3-19
Soy	20-35
Cottonseed	28-108
Rapeseed	25-80
Corn	18-95
Beef tallow	800-1400
Butter	2200-4100
Lard	3000-4000

Source: Inform, Vol. 13, 2002

It must be noted that there are different groups of fatty acids contained in major oils and fat. Generally they are grouped into medium chain fatty acids (MCFA), and long chain fatty acids (LCFA). The two fatty acids have different behavior and health effect to human being. Those who equate coconut oil with other saturated fats are not conscious of the existence of subgroups within broad category of saturated fatty acids. The medium fatty acids have a lower melting point, a smaller molecular size and greater solubility in water and biological fluids compared with those of the long chain fatty acids (Thampan, 1998).

Coconut oils is grouped into MCFA as 57% its fatty acids consisting of C8 (capric acid) and C12 (lauric acid). A number of noted scientists have revealed the superiority of MCFA. Coconut oil has approximately 50% lauric acid. Lauric acid has the additional beneficial function of being formed into monolaurin in the human or animal body. Monolaurin is the antiviral, antibacterial, and antiprotozoal monoglyceride used by the human or animal to destroy lipid-coated viruses such as HIV, herpes, cytomegalovirus, influenza, various pathogenic bacteria, including listeria monocytogenes and helicobacter pylori, and protozoa such as giardia lamblia. Some studies have also shown some antimicrobial effects of the free lauric acid. (Enig, 1999).

Coconut oil has also, approximately 6-7% capric acid. Capric acid has a similar beneficial function when it is formed into monocaprin in the human or animal body. Monocaprin has also been shown to have antiviral effects against HIV and is being tested for antiviral effects against herpes simplex and antibacterial effects against chlamydia and other sexually transmitted bacteria. (Reuters, London June 29, 1999).

Garcia who stated in her article that vegetable oils did not have cholesterol is not accurate. The latest research finding concludes that cholesterol can also be found in vegetable oils. INFORM Vol. 13 December 2002 published by American Oil Chemists' Society indicates that vegetable oils contain cholesterol although in small amounts. It is further stated that coconut oil has the lowest cholesterol amounts (5-24 parts per million) compared to palm kernel oil, sunflower oil, palm oil, soy oil, cotton seed oil, rapeseed oil, and corn oil. Please see table 1. (Extracted from the web site **www.coconutoil.com**)

PRIVATISATION IN SRI LANKA

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During the past 2 decades, the concept of privatization appeared in many different forms in many parts of the world. Perestroika in Russia, Economic reforms in China, Modernization in Vietnam, Public Capitalism in Latin America, Social privatization in Spain are some of them. The transmission of world super political power from Soviet Russia to the capitalist countries like USA and UK, the obvious failure in state controlled economies especially in Eastern Europe and the successful experiences in market oriented economies in many part of the world encouraged most of the developing countries to shift from centrally planned economies to more liberalized market economies

In Sri Lanka, privatization was announced as a state policy in 1987 under the UNP government and continued to exist despite the changes in the ruling party. The process was known as "Peopolization" (Janathakaranaya) at the very beginning and gradually found its real term "Privatization".
The aim of this article is to discuss the nature of the privatization process practiced in Sri Lanka, the rationality and its impact on the country's economy.

Introduction

Privatization became a prominent topic discussed in many countries across the world in the latter part of the 20th century. The transmission of world super political power from Soviet Russia to the capitalist countries like USA and UK, the obvious failure in state controlled economies especially in Eastern Europe and the successful experiences in market oriented economies in many part of the world encouraged most of the developing countries to shift from centrally planned economies to more liberalized market economies. Furthermore, the policy recommendations that the World Bank (WB)[1] and the International monetary Fund (IMF) prescribed in the form of Structural Adjustment Programmes (SAP) as recovery measures to the Latin American countries that severely affected from the world debt crisis in 1980s and to some other developing countries in South Asia like India and Sri Lanka that are heavily dependent on IMF and WB for external borrowings accelerated the process of privatization which had been hitherto not significant in such countries.

In economic literature the concept of privatization goes back to the days of Adam Smith (1723-1790), farther of economics. The first shadow of privatization concept can be seen in his famous work; the Wealth of Nation[2] in 1776. Smith estimated the productivity of state owned lands was about 25% of that of private owned lands. He claimed that the selling up the state owned lands would generate huge amount of money to pay off government debts and the land itself would generate as much income as never expected by the government.

During the last 2 decades of the 20th century, the concept of privatization appeared in many different forms and different attractive names in many parts of the world. Perestroika in Russia, Economic reforms in China, Modernization in Vietnam, Public Capitalism in Latin America, Social privatization in Spain are examples for widely used terms. Privatization in India has been carried out in several stages such as deregulation, dereservation, privatization and disinvestments

In Sri Lanka, privatization was announced as a state policy in 1987 under the UNP government and continued to exist despite the changes in the ruling party. The process was known as "Peopolization" (Janathakaranaya) at the very beginning and gradually found its real term "Privatization".

The aim of this article is to discuss the nature of the privatization process practiced in Sri Lanka, the rationality and its impact on the country's economy. The first part of the article is devoted to a brief discussion on the privatization concept and methods of privatization in general. In the second part, I will be discussing the socio-economic background that pushed Sri Lanka towards privatization. The third part outlines the nature and progress of the privatization programme in Sri Lanka and the final part of the article is devoted to identify its socio-economic implications.

Part-I

Concept of privatisation

Privatization, in its purest form, refers to the shifting of the production of goods and services from the government to the private sector, often by selling government-owned assets. The central Bank of Sri Lanka, in a very broad term but most simply, defines privatization as the transfer of the management and or the ownership of a property from the public sector to the private sector. (Anon, 1998)

Privatisation, in its broader sense, stands for policies to reduce the role of the state, assign larger role for the private sector pursuing the logic of the market in all economic decisions. Privatization, however, is most often associated with transfer of public sector enterprises and services to private ownership, management and control (Goyal, 2003). Most definitions of privatization cover virtually any action that involves exposing the operations of government to the pressures of the commercial marketplace. That would include everything from contracting out security services at a public building to selling off countries' much-valued natural resources.

Privatisation may vary within a very broad range, sometimes leaving very little role for the government, and other times creating partnerships between government and private service providers where government is still the dominant player. The broader definition of privatization includes a wide range of public-private partnerships. In USA, even the creation of federal corporations, quasi government organizations and government-sponsored enterprises come under the general category of privatization, though, it is difficult to tell where the role of the government ceases to exist and the private sector begins.

Methods of privatisation

Privatisation process for public enterprises can involve steps ranging from dilution of state-held equity, to adoption of practices like franchising, award of lease and management contracts, sub-contracting of selected activities and tasks, down-sizing of workforce, and changes in the process of decision- making even without change in ownership, so that business decisions are guided by market and commercial principles of profit maximization than vague societal concerns (Goyal, 2003). In this section, we attempt to have a brief account on few of the privatization methods widely used in many parts of the world.

Contracting out or outsourcing- this term is applied when the government competitively contracts with a private organization to provide

[1] International Bank for Reconstruction and Development
[2] An Inquiry into the Nature and Causes of the Wealth of nation

a service or part of a service. For example, a government hospital signs a contract with a private food supplier to provide midday meal for the indoor patients.

Public-Private Competition- this comes into existence when the public services are opened up to the competition of both private and State owned service providers. This is also known as the managed competition or market testing. Providing public transport is a very common area where this method could be successfully applied.

Franchise – when a private firm is given the exclusive right to provide a service within a certain geographical area without State interference, it is termed as franchise.

Internal Markets – Departments are allowed to purchase support services such as printing, maintenance, computer repair and training from in-house providers or outside suppliers. In-house suppliers or service providers who operate as independent business units within the institution are allowed to compete against outside contractors for departments' business. Under such a system, market forces are brought into the organization.

Vouchers – household or individuals are given redeemable certificates to purchase the service form any supplier they prefer in the open market. The Government subsidizes the consumer of the service, but the services are provided by the private sector. This method can be satisfactorily applied in providing welfare services by the government.

Commercialisation or service shedding comes in to existence when the Government entirely stops providing a service and allows the private sector assume the function.

Self-Help - Community groups and neighborhood organizations take over a service or government asset such as children parks, zoos, public libraries, museums, and some recreational facilities like swimming pools and tennis cords. Normally these types of services are undertaken by non-profit oriented organizations seeking reputation or some other non-financial rewards.

Asset Sale or Long-Term Lease- Government sells or enters into long-term leases for assets such as airports, harbors, gas utilities, power generation plants or real estate to private firms. In a sale-leaseback arrangement, government sells the asset to a private firm and then leases it back at a monthly or annual rent. This method can be used to convert physical capital into financial capital that could in tern be reinvested in some other project.

Management contracts – In some cases, as an interim step towards full privatization, the management of a public enterprise is transferred to a private firm enriched with the necessary management and technical expertise required for running the enterprise. There is no change in the ownership but only the transfer of management through a contract for a stipulated period on an agreed management fee. The quantum of management fee usually depends on the profits made by the enterprise during the contract period. Management Contracts are treated as a means of making an unprofitable enterprise profitable before it being privatized. The privatization of the plantation sector in Sri Lanka is a good example for management contracts.

Employee buyout - Existing public managers and employees of a public firm acquire a part of the ownership, typically by purchasing a certain amount of company's stocks. Transferring a part of the ownership to the labour force as a method of privatization has a very strong positive incentive effect that may be reflected in terms of increased productivity.

Private Infrastructure Development and Operation - The private sector finances, builds, and operates public infrastructure such as high ways, harbors and airports, recovering costs through user charges over a period of time. Under this method there are five options that defer from each other depending on the nature of involvement of the private sector. *Build-Operate-Transfer* (BOT), Build-*Operate-Own* (BOO), Build-Own-Operate-transfer (BOOT), Rehabilitate-Operate-Transfer (ROT), Modernize- Operate-Transfer (MOT)

Although all the methods discussed above less or more were tested, privatization in Sri Lanka is usually characterized by either partial divestiture or management contracts, which was the explicit form of privatization the Sri Lankans often experienced. During the first phase of liberalization in Sri Lanka (1977-89), the methods adopted were mainly in the form of partial divestiture, management contracts and franchising. No serious attempt was made to fully privatize public enterprises. However, after 1989, various other methods of privatizing were adopted. The most widely used approach was the sale of a majority of shares (over 50 per cent) to a corporate investor on the basis of open tenders and competitive bidding. Around 87 per cent of the transactions conducted during the 1989-1998 period have adopted this method of privatization. (Salih, 2001)

Widely used methods of privatisation in Sri Lanka

1. Holding of minority shares by the government, while management is under the private sector
2. Transferring both ownership and management exclusively to the private sector
3. Sale of assets of public corporations while the state takes over liabilities e.g. Ceylon Plywood Corporation.
4. Employee buy-out: Under this method a majority of shares is sold to workers of the firm. This method has not been significant in Sri Lanka except for a few small enterprises where the total capital base was limited. E.g. Lanka Ceramics Ltd. Buhari Hotel (80 per cent of shares were sold to the workers, and the balance was kept with the treasury)
5. Negotiated sale of shares: This method of sale may be advantageous in the cases where the private firm taking over the State enterprise has special management or technical expertise to run the enterprise better than it had been, or where the purchaser has a particular forms of market access either locally or abroad, or large volume of capital inflow is needed to make the privatization successful. In Sri Lanka, this method was adopted in the case of Pugoda Textile Mills, when it was sold to an Indian company called 'Lakshmi' that had managed the mill before full privatization, and was known to the government for a reasonable period of time.
6. Sale of less than 50 per cent of shares: The Ministry of Industries, for example, decided to divest up to 40 per cent of shares of companies involved in the mineral sector. E.g. Phosphate Lanka Ltd., Bogala Graphite Lanka Ltd., Mineral Sands Corporation and Lanka Ceramics Ltd.

Part - II

Background of the privatisation Programme in Sri Lanka

Privatization in Sri Lanka was announced as a State policy in 1987 under the regime of UNP[3] government. That cannot be known as an arbitrary decision taken all of a sudden. Background for such a movement had been gradually developing inside the economy as well as in the external environment. This part of the article briefly examines the background in which the necessity for privatization was emerged since regaining independence in 1948.

Minimal State Intervention – 1948-1950

By the time when Sri Lanka regained independence in 1948, Government activities were mainly confined to provision of basic social needs such as public health, free education, infrastructure, and general public administration and attempted to developed non-

[3] United National Party

plantation agriculture especially paddy production by providing subsidies for fertilizer, agricultural equipment, irrigated water etc. Government's share in the economy accounted only for 20% of GDP[4]. The UNP Government in power attempted to make an active contribution to the economy beyond the provision of basic welfare facilities. Government's effort to establish public enterprises under the Six Year Investment Plan (1948-1954) was not successful due to some weaknesses in the programme itself and some external pressure. Hence the government expenditure, on average, remained at 23.4 % of GDP for the period of 1948-1957 (See Table –01)

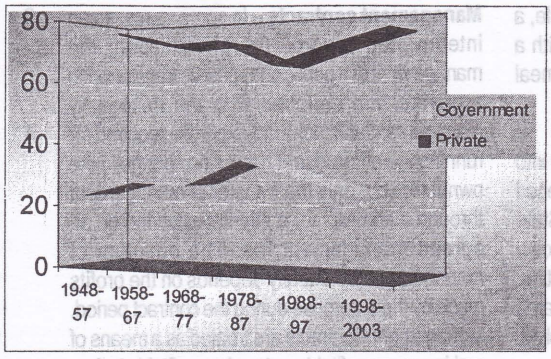


Table- 01Expenditure as percentage of GDP

	1948-57	1958-67	1968-77	1978-87	1988-97	1998-2003
Government	23.4	28	27.1	35.2	29.8	25
Private Sector	76.6	72	72.9	64.8	70.2	75

Source: Central Bank Annual Reports – various years

During the two decades starting from 1958, the state intervention to the economy reported a sharp increase as high as 28 % of GDP. This is mainly due to increased expenditure on social welfare activities across the country such as providing household subsidies, expansion of health facilities, preventive services (Malaria) and health awareness programmes. Furthermore Government took-over a few private schools and setup a large number of new schools across the island with view to extend free education to rural areas.

Meanwhile the Government[5] took steps to establish of a large number of public enterprises catering to industrial sector. This included some large scale manufacturing plants established under foreign financial and technical assistance. Some of the examples are Hardware plant – (assisted by Poland), Steal rolling plant and tyre factory – (assisted by USSR), Timber processing and furniture – (assisted by Romania), Spinning and weaving mill – (assisted by East Germany). In addition, the Government enterprises began to expand its wings in outstations setting up plants for Cement, Milk, mineral sand and sugar, Brick & tile and ceramic products.

During the period under review, especially when left-wing parties were elected to power, Government intervention was increased expanding state monopoly in selected services by means of nationalization of private enterprises[6]. Under this movement private bus companies were nationalized (1958) and Ceylon Transport Board was established. Port service was nationalized (1958) and State Shipping Corporation was established. The State Petroleum Corporation was established in 1960 to undertake import and distribution of petroleum hitherto handled by private sector. Moreover, the government involvement in banking and financial sector also became significant when the Bank of Ceylon was nationalized (1961) and the People's Bank was established in 1960. The National Savings Bank (1972), State mortgage and Investment Bank (1975), Insurance Corporation (1962) were also established as state owned financial intermediaries. In relation to stock and retail trade, the Co-operative Wholesale Establishment (CWE), Building Materials Corporation (BMC), and Paddy Marketing Board (PMB) were set up. Under the Land Reforms Act of 1972, all plantation lands exceeding 20 hectares in extent were nationalized and transferred to two state corporations known as State Plantation Corporation and *Janawasama*[7]

As the overall result of all above activities State intervention into national economy had sharply increased by 1977. Total government expenditure accounted 28 % of GDP in mid 1970s and had been growing at an annual average of 26 % during the two decades ended 1977. Number of public enterprises rose from 28 to 107 during 1958-77 and the Public sector employments increased over six-fold to more than 1.2 million during 1951-79 (11% of total employment). Public sector share in domestic industrial production was 55 % and also the Government controlled at least 51% and 35% of total tea and rubber lands respectively by mid 1970s.

The economic policy of the country shifted from inward-looking policies to outward-looking policies with opening up the economy in 1977. The UNP Government, in contrast to the previous SLFP[8] Government, attempted to reduce its intervention into economic activities relying much on private sector led economic growth. Some of the significant changes brought forward were -

- Upward revision of subsidized prices in public enterprises lightening its burden on government budget
- Rationalizing subsidies and household transfer payments directing only to the needy people
- Expanding small holders contribution in plantation sector
- Dismantling government trading monopolies
- Opening up public transport service, health and education to private sector competition
- Encouraging private sector involvement in banking and financial services

Despite the economic liberalization in 1977, the public sector share in the economy still remained high in the 1980s. The size of the Government increased to 34 % measured by total government expenditure as a percentage of GDP. This is because the Government spent heavily on Infrastructure development to support private sector led economic growth. Substantial capital expenditure incurred on the Accelerated Mahaweli Development Project, power generation and distribution, development of port and transport system, establishment of Export Processing Zones (Katanayake, Biyagama), housing development project (Udagama Concept) are few to note.

Establishment of new financial institutions such as National Development Bank (NDB), Regional Development Banks, Sri Lanka Export Credit Insurance Corporation and expanding operations of existing public enterprises like CWE, Ceylon Electricity Board (CEB) resulted in further increase in capital expenditure.

Government recurrent expenditure too rose up owing to decentralization of administrative system and devolution of political power by introducing Provincial Council System in 1988, introduction of new subsidies such as "Janasaviya movement", School mid-day meal, free school tex books etc. Large-scale recruitments to public sector including military forces too pushed the government recurrent expenditure further up. Public sector share in total employed workforce rose to 14% in 1975 to 21 % in 1985.

By the mid 1980s, the public enterprises were facing many problems. Most of the State enterprises were loss making due to operational inefficiencies and poor management. Managers were paid despite the company running at loss and this resulted in a moral hazard effect in

[4] Gross Domestic Product
[5] During the period under review the ruling party changed 5 times and so did the economic policy. Here we highlight only the general movements of the economy without referring to any specific political party regime.
[6] This movement, after 1970s, was facilitated by the Business Acquisition Act of 1971
[7] Janatha Wathu Sanwardana Mandalaya (National Estate Development Board)
[8] Sri Lanka Freedom Party

keeping them away from profit motive. In some industries State monopoly was guaranteed resulting poor product quality and supply shortages. In absence of renovations for a long time, physical capital of such firms had been obsolete and the enterprises had no way to mobilize resources to meet large investment required for renovations, capacity building or quality improvement other than relying on the government budget. Excessive dependence of State enterprises on capital transfers from the government budget further weakened their competitive position and paralyzed the economy as a whole making the tax payee worse off. Loss making public enterprises had been a heavy burden on the government budget exceeding 30% of total expenditure by 1987 (see Figure – 02).

Labour redundancy[9] was a big problem in State enterprises. Table-2 shows Fiszbein's (1992) estimates on redundancy rates for eight selected state enterprises. According to Fiszbein, the redundancy level was as high as 40 - 50 per cent in 1991 in the public sector except for the plantation sector. For example, the level of redundancy in the Sri Lanka Transport Board (CTB) was estimated at six employees per bus. The ratio of employee per bus was 13:1 in CTB where as the generally accepted ratio is 6.5:1

There were two possible reasons behind the problem of labour redundancy. First, a number of state enterprises have been overstaffed under political patronage embodied in the government recruitment policies. Second, the work norms that prevailed in such firms by no means encouraged for high worker productivity. There was no rewarding system for performers and penalties for non-performers. Also they enjoyed a high sense of job security and treated the public sector employment as an entitlement rather than a career position that had to be secured and developed by efficient performance.

Furthermore, a number of state enterprises faced labour riots demanding higher remuneration packages to be in line with private sector employees.

These problems created a growing need to improve the efficiency of the public enterprises and downsize the scope of the public sector in the economy. As a solution, privatization was announced as a state policy in 1987 in Sri Lanka. The Structural Adjustment Programme (SAP) introduced by the IMF in late 1970s, in which reduction of government expenditure had been prescribed as a basic policy requirement, further encouraged privatization process.

Objectives of Privatisation

The Objectives of Privatisation programme in Sri Lanka were aimed at eliminating the inefficiency problems discussed above. Among them, increasing efficiency and productivity, improving financial viability and profitability, expanding the supply and improving the product quality by attracting more investments, expanding production capacities and employment opportunities with new investments and reducing the burden on the government budget, were important.

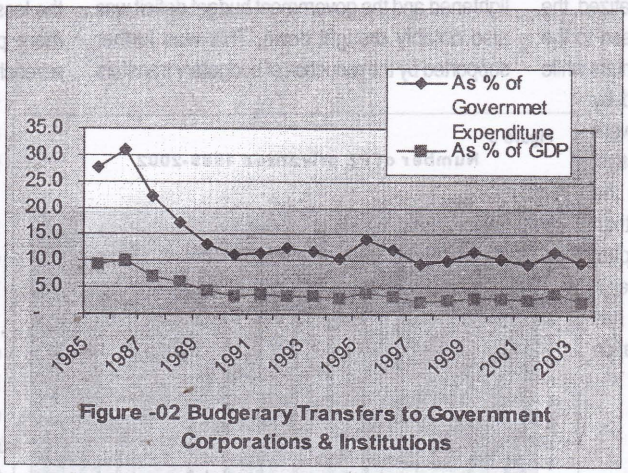


Figure -02 Budgerary Transfers to Government Corporations & Institutions

Legal & Institutional Framework for Privatisation in Sri Lanka

Two legal enactments were passed in Parliament in order to facilitate building up of share capital base, transferring employees to new companies and compensating for retrenchment of excess staff. The Public Corporations Act No 22 of 1987 facilitated the convention of government owned business units into public corporations and the Public Company Act No 23 of 1987 for convention of public corporations into public companies. At the initial stage in 1987, the Presidential Commission on Privatization (PCP) was established to study and prepare general framework for implementation of privatization programme. In 1989, a public Investment Management Board (PIMB) was formed to undertake privatization programme for PCP. PIMB was renamed in 1990 as Public Investment and Management Company and empowered to prepare public enterprises for privatization and manage them until disposal.

In 1989 a special unit was also setup at Ministry of Industries under the World Bank's Public Manufacturing Enterprises Adjustment Credit Fund to undertake privatization of industrial enterprises. Privatization of plantation and transport sectors was treated as a special subject to be studied separately and two institutions, namely Plantation Restructuring Unit (1989) and National Transport Commission (1990), were setup to co-ordinate privatization processes of those tow sectors. However, the institutional commitment towards the success of privatization in general was not satisfactory. The legal power vested with them too was not sufficient to overcome the situational obstacles they faced in the implementation stage. In 1995, the Public Enterprises Reform Commission (PERC) was established and entrusted with the required legal powers under the Public Enterprise Reform Act No 01 of 1996 to undertake privatization programme in a more efficient and transparent manner. PERC is the authorized body now handling privatization programme in Sri Lanka.

Table 2: Redundancy Rates in Selected State Enterprises

Company	Redundancy %	Company	Redundancy %
Ceylon Electricity Board	51	Ceylon Petroleum	40
Lanka Electricity	45	Sri Lanka Cement Co.	46
Railways	48	Lanka Cement Ltd.	63
Sugar Corporation	86	Ceylon Shipping	43
		Average Redundancy	53

Source: Fiszbein (1992).

Part – III

Progress of Privatisation

At the first stage of privatization implemented under the UNP government, poorly performing industrial enterprises such as textile factories (Veyangoda, Tulhiriya, Pugoda), Lanka Oxygen and Lanka Loha Hardware were privatized. But the programme for the second stage (under UNP government) included profit-making enterprises such as Lanka Distilleries, Ruhunu Cement, Lanka Milk Foods, National

[9] Theoretically, a worker is redundant if his marginal productivity is below the received wage

Development Bank and some service providers including hotels. Also management of Regional Plantation companies was transferred to the private sector. The third stage (under PA government) started privatizing large-scale public enterprises like Colombo Gas, Sri Lanka Telecom, and plantation companies.

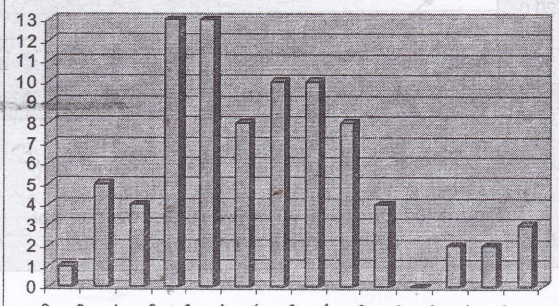
By the end of 2002, under privatization programme 83 public enterprises in all sectors had been privatized. This included 25 enterprises in plantation & agriculture, 37 in manufacturing, 16 in services and 5 in the financial sector. Privatization process had a slow start at the beginning and showed a rapid improvement at mid point. In 1991 there was only 10 privatized enterprises in Sri Lanka but the number increased to 64 by the end of 1996. (See Figure 03)

Out of the 83 enterprises so far privatized, the ownership of 56 entities was passed to the hand of local investors including workers while 12 of them were totally acquired by foreigners. The balance 15 firms were shared by both local and foreign investors. However, foreign participation in the privatization programme is higher than local component in terms of capital investment. As per the Table – 3, foreign capital inflows to the programme has accounted 63% of the total privatisation proceeds realized.

watercourses they have. This is a new phenomenon that never came out prior to privatisation.

According to the Central Bank Annual Report 2002, the divestiture programme during 1989-2002 generated Rs. 61,017 Million to the government. It attracted foreign investments of around Rs 38,203 Million, strengthening domestic liquidity position and country's external asset base (See Table 03). The privatization proceeds also helped to pay off government borrowings and to reduce interest costs. For example, for the first time in Sri Lanka history, government retired Rs 10,000 Million worth of treasury bills in August 1997 with the privatization proceeds received from Sri Lanka Telecom (SLT) deal when 35 % of SLT shares were sold to Japanese Nippon Telegraph and Telephone Company for US $ 225 Million (Damayanthi, 1997). As a result government debt burden was lightened and the government budget deficit was also notably brought down. This was further supported by the reduction of budgetary transfers to loss making State enterprises. The budgetary transfers as a percentage of total government expenditure could be brought down to 10% by the year 1999 as against 30% recorded in 1987 (See Figure 02). It also noteworthy mention that transfer of state enterprises to private ownership not only cut down government subsidies but also generated permanent revenue sources to the government by way of lease rent, corporate income tax, and dividends.

Figure 3
Number of PE privatized 1989-2002



Part - IV

Economic benefits of privatisation

Privatisation has improved the performance of the companies especially in the plantation sector, which had been loss making for a number of years. This is mainly due to technological improvements and the further infusion of capital in the form of equity or reinvested retained profits. For the plantation companies, in general, profits have boosted and workers' welfare too has improved. After privatization, some unproductive marginal tea lands have been put to alternative uses such as cultivation of spices or other crops. Such diversifications have caused the companies to sustain despite fluctuating tea prices in the world market during the past couple of years. In addition, some private owned plantations have taken steps to generate hydropower for own consumption or to sell to the CEB[10] with the help of small

As a result of foreign involvement, some of the privatized companies were able to increase their efficiency with the transfer of international technology. The customers also had access to quality products and better services at more competitive prices than before. When it comes to quality improvement resulted from technology transfer, the Sri Lanka Telecom is a good example that proved the success of privatization. In such companies the workers too were benefited with free transport, medical, housing and other sanitary facilities offered in addition to increased salaries.

Some companies like Lanka Oxygen and Sri Lanka Telecom with their wide expansion after privatisation Increased employment opportunities. The retained workers in most companies were better off and in some companies like Buhari Hotel and SLT the workers became shareholders. Nevertheless, the increase in employment opportunities after privatisation is still subject to criticisms because the rate of labour retrenchment also was very high during this period. Many economists argue that the net employment generation by privatization is negative on the ground that labour retrenchment has been higher than new recruitments. However, in my point of view the lesser number recruited is economically more productive than the bigger number retrenched. Therefore the economy as a whole has been better off even though some unproductive workers individually have been worse off.

Privatisation also contributed to the development of the Colombo Stock Exchange. During the two years ended 1997, privatisation brought in 12 new companies into the stock exchange, increasing the number of listed companies from 226 to 236. It is the privatization that led the plantation sector to the stock exchange. This enabled foreigners to bring portfolio investments into the privatised companies and for the shareholders to make capital gains by resale of shares.

Economic cost of privatisation

Six companies, after privatisation, failed to perform and had to be acquired by the government. These were Colombo Commercial Fertilizer Ltd, Kantale Sugar Industries Ltd., Hingurana Sugar Industries Ltd., Kahatagaha Graphite Lanka Ltd., Lanka Loha Hardware Ltd., and Mattegama Textiles Ltd. This made the privatisation programme as a whole distressed and also disordered the government budgetary programmes.

Privatisation of some service oriented State enterprises of which the sole supplier had been the government led to private sector monopoly. Bitter exploitation by Lanka Sell Gas in terms

[10] Ceylon Electricity Board

Table 03 - Capital Investments in Privatized Public Enterprises

Sector	No. of PEs	Local Capital Rs. Million	%	Foreign Capital Rs. Million	%	Rs. Million
Plantations & Agriculture	25	8193	100%	0%	0%	8193
Manufacturing	37	7028	39%	11040	61%	18068
Financial	5	1761	28%	4455	72%	6216
Services	16	5832	20%	22708	80%	28540
Overall	83	22814	37%	38203	63%	61017

Source: Central Bank Annual Reports, Various years

of excessive price increases after privatisation has been a widely spoken topic in this connection. The government had no control over their monopolistic power and failed to introduce a powerful competitor to attack the monopoly. In the case of Lanka Lubricants too the monopolistic power vested with them was translated into price rises and quantity restraints embarrassing the customers.

Retrenching of excess labour brought many social problems. These problems are of two types, more certainly, the problems pertaining to the very act of retrenchment and the problems that arose after retrenchment. There are lots of complains about discriminations, harassments and sometimes favoritism taken place in the process of labour retrenchment. These problems were very critical in deciding how many workers were in surplus who were actually redundant and how the retiring workers were compensated for their welfare losses. The number of workers retrenched as a result of privatization is in dispute. According to the Labour Department, up to July 1994, nearly 18,000-20,000 workers have been retrenched whilst the Employers' Federation of Ceylon estimates it to be 35,000. On contrary, Jathika Sevaka Sangamaya, the main public sector trade union claims that 50,000 of their members have been retrenched. No body look in to the matter whether the compensations given in terms of money were sufficiently covered the welfare losses. In deed, in Sri Lanka, the framework set out for handling labour issues including labour retrenchment during privatization was extremely poor. When it comes to voluntary retirement scheme used in the pre-privatization scenario, the government gave at least three months notice to workers to decide. In the post-privatization period, the workers were given only 2-3 weeks by the new owners to decide whether they wanted to take the compensation package and leave. However, this is not an inherent weakness of privatization concept but something mistaken in putting it into action.

On the part of the firms, under voluntary retirement scheme, the privatized enterprises happened to loose many skilled workers like mechanical engineers, technicians, and machine operators who otherwise could have been used to increase productivity

As the retrenchment programme was not systematic and were also subject to political influences and rent-seeking trade union powers, in some cases, unreasonably high level of compensation packages were paid to retiring workers at cost to the general public or the tax payers. There are two economic considerations here. One is that paying higher level of compensation to few by taxing many is a problem of social welfare and equality. The other one is whether the lump sum of money they received in the form of compensation has been put into economically productive use. A survey done by the Sri Lanka Business Development Centre (SLBDC) in 1992, for instance, showed that most workers used compensation received to pay debts, rather than investing in income generating activities (Kelegama, 1995).

Favouritism in tendering for sale and under valuation of much valuable public assets under political patronage made a black mark to the privatization progamme and caused to loose public confident as well. For instance, Karbool Lanka, which had been valued US $ 100 million, was soled for just US $ 7 million (Priyantha, 2001). This type of transactions always brought troubles to public finance affaires. Government has to increase short-term borrowings, in most cases from domestic market sources, to finance budget deficit as expected privatization proceeds delayed or not received in time. This cased to widen actual budget deficit far away from the estimated and to impose inflationary pressure on the economy. For example, the Central Bank Annual report-2002 reports the Government received only Rs 5.7 Billion as against the Rs 21 Billion projected from the privatization programme in 2002.

Conclusion

Privatization programme was implemented in many different countries in different ways. Some countries were better off while some were worse off. Therefore it is evident that the success or failure of the concept depends nothing else but on the way it is put into action. In Sri Lanka privatization was introduced and carried out on trial and error basis. As such a number of mistakes were found later on and a lot of miss opportunities were noted. Most of them were due to over powered political influences. It is true that this unnecessary political intervention might see the end after the remaining state enterprises too are privatized. However, we should not forget that not all social needs are attended in a private sector led economy and there are lots of possibilities for market failures. The government has to play a vital role to prevent market failures and smooth functioning of the economy. When all the state enterprises were privatized the government would surrender its competitive powers to regulate the market and has to stick to the old-fashioned rules and regulations.

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Dimensions in Organic Farming & Marketing

An Economic & Environmental Gain for Sri Lanka

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&
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By 'organic farming' we mean a system of farming which uses on synthetic chemical fertilizers or pesticides, and which employs recycled organic materials and particular systems of cropping for the management and enhancement of soil fertility. To a considerable extent, weed and pest management follows from the cultural practices adopted, although a wide variety of substances often of herbal origin- are used for controlling pests. The aim is to 'work with nature' to create a system functioning somewhat like an organism. Organic food will be virtually free of chemical residues but also has other qualities which make it healthier. It has a higher mineral and vitamin content, better flavour and texture and better keeping quality.

Asia can potentially become the largest organic market in the world with its large population and gradually improving living standards. However, organic agricultural production and markets throughout Asia and East remain underdeveloped. The reasons for this include the limited local perception of the advantages of organic production and the slowness of its official recognition. This has meant that organic inspection and certification for in-country consumption often legs behind actual increases in organic production.

Organic certification is a market instrument enabling organic producers to access a particular market sector. At present, inspection for international recognition is mainly from outside Asia and carries with it high cost and even conflict between producers and inspectors. It is necessary and urgent to set up local inspection and certification programs for sustainable development of organic agriculture within Asian countries.

The evaluation of quality for conventional products is based principally on observation and testing of the final product, without regard for the growing and processing procedure. Although comparative quality techniques do exist, in practice the quality evaluation of organic products is guaranteed by a surveillance of the growing and processing procedures. Growing, processing, storing, transporting, and selling organic products has therefore to be inspected and certified on a regular basis. Furthermore, since the inherent value of organic produce in terms of food quality or environmental protection cannot be judged from its final products, there is a need for a trade marking system or logo to distinguish such items from conventional products and indeed from any other products which the grower may wish to claim as having similar benefits. This whole process, including inspection by an authorized certification body, provides a framework within which marketing can be conducted fairly and the consumer's interests protected. As such, the system has been operating successfully in other world regions such as Europe, Australia and New Zealand for more than 20 years.

This article also wishes to point out the strategic advantages for Sri Lanka of a move towards sustainable, ecologically based agriculture and how this might be achieved over the next few years.

Let us begin by posing the question of who actually controls our agriculture and environmental management. It has to be said that the respective government Ministries to the present time have had very limited positive influence on preserving environmental quality- instead the World Trade Organization and multinational corporations have had a powerful influence here as they continue to have throughout the world. Until we come to terms with their influence on governments and farmers, involving corrupt practices at the highest level and a variety of short term inducements at farmer level, there can be little hope for saving our environment or of reversing the current deterioration in our people's health.

This present a worrying situation but on the positive side, organic, ecologically-based agriculture can and should be helping Sri Lanka in various ways if we have the foresight and determination to gain help from it. Let us consider a number of benefits of introducing organic farming.

Water consumption reduced and water pollution eliminated

Organic framing and soil management results in plants growing with less need for water-this applies for all crops. Additionally 'new methods' of maha season much paddy farming now promise to save more than 50% of the water routinely used in flooded paddy systems. This makes possible paddy production in the driest areas yet leaves tanks with a capacity for irrigation in the yala season thus reversing the present perception of water scarcity and the very real hardships which result from a limited annual cropping potential.

The non-use of chemical fertilizers and pesticides means that leaching of soluble chemicals into rivers, tanks and ground water can be virtually eliminated. Pure water in an increasingly scarce national resource while the public health consequences of water contamination will soon reach catastrophic levels without action taken.

Improvement in soils and biodiversity

Organic methods stabilize soils and improve their structure thus reducing risk of erosion-long regarded as a menace in Sri Lanka. Soils are managed by a combination of simple intercropping to alley cropping and 'analogue forests'. Biodiversity promotion is not just an optional extra conservation exercise but a prerequisite framework for natural past management.

Prospect of improved conditions for farmers

Converting to organic farming means eliminating costs of chemical fertilizers and pesticides and opens up the possibility of growing more traditional varieties and saving one's own seed, thereby further reducing costs of inputs. Yields from organic farming do not necessarily fall on conversion as is often claimed. Recent experience with paddy shows yield gains following conversion while the performance of all tropical crops will increase as the natural soil biology recovers from chemicals. Organic farms with greater crop diversity encourage better food security and will perform reliably and economically in drought when chemical farming becomes unprofitable.

Improvement in the health of the nation

There is a high incidence of diseases which were rare or unknown before modern methods of farming were introduced. There is accumulating evidence that this is linked to the chemicals in our food and water supplies and to the deficiencies in mineral nutrition which chemical farming has brought about. Farmers are particularly at risk from chemical poisoning, particularly where water supply for washing is limited but all of us on a daily basis ingest low levels of chemicals for which the body has no defence. We thus find in doctors clinics increasing numbers of people presenting with disorders traceable to defects show particularly in the next generation. Our children's bodies will therefore probably begin weaker than ours did. Fertility problems are now common place

with, for example, male sperm counts down 50% in the last 20 years in Sri Lanka, mirroring a similar picture in Europe. It is time that food, health and environmental issues were being researched and handled in a coordinated way and that these trends receive due priority by those in influential positions.

Economic gains for the nation as a whole

Conventional chemical agriculture incurs huge hidden costs on the environment and our health and the price we pay for its products is a small part of the total which society must bear now and into the future. For profits during our generation it seems the whole of our future must be mortgaged. The only course for the future is an agriculture pledged to support our environment. While low-input systems are anxious to show their environmental credentials organic farming is the only system fully committed to restoring environmental quality. It will support biodiversity and the conservation of genetic resources both of wild species and indigenous cultivars. It will mean a healthier environment and food supply, which will in turn help lessen the future cost of healthcare and hospital provision.

A healthier and preserved environment would also underpin Sri Lanka's constant desire to market itself as an 'island Paradise' for tourists- without a coherent environmental policy such claims amount to hollow and deceptive rhetoric. Organic markets are rapidly expanding worldwide so fresh or processed organic foodstuffs could significantly increase the island's exports-in 2001 this was the only agricultural sector to do so! On the other hand imports of chemical fertilizers and pesticides would clearly be reduced as Sri Lanka does not produce its own supplies.

At a time when Sri Lanka manifestly fails to generate adequate electrical power it is instructive to note that alongside the big water-guzzling Mahaweli Schems linked to irrigated chemical framing and power generation not only can organic framing reduce the country's trading deficit but actually be a leading force in reducing agricultural water use.

What should now happen in order to prioritize and focus the contribution of organic framing? Institutional Banking! The recent appointment of an Expert Committee by the ministry of Environment and natural Resources for the promotion of organic framing and marketing is a most welcome development. It augurs well against a background of solid but sector and regionally- based organic initiatives to date. The main players include NGOs, a few of which have played a lead role in introducing and promoting organic farming yet not on a national scale, the Export Development and a few leading businesses mainly involved in organic tea and processed fruit.

At the initial stages of business development the private sector business houses are assisted by the Export Development Board through their export promotional expertise and other resources and programmes in their export promotional endeavours most of the times. Good work done by the Export Development Board together with the private sector have a repulsive effect on organic farmer development most of the time leading to an export market focused conversion into organics. It was a near similar exercise with the Export Agriculture Department too despite the operation of 'internal politics which may impede the functioning of such an organic promotion temporarily. It should not be forgotten there are governmental organizations such as Tea Research institute who engage in organic research and gaining international recognition also for their initiatives in this direction while the Agricultural Study Faculties of the Universities are also growing an interest in their studies and research in this field.

However it is discouraging to note that a cohesion required for many 'such sporadic' activities is still not seen at national level reflecting a 'sub optimisation' by various interested parties for their own interests without pushing for a nation level programme. For instance the private sector, however much we consider them to be the engine of growth, they could not move forward in organic agriculture beyond certain limits. Undoubtedly NGOs have their own limitations requiring all the stake holders to get together with a good leader's initiative such as the present one of the ministry of Environment and Natural Resources.

These few years saw initiatives in the development of regional standards for Asia. International Federation of organic Agricultural Movements (IFOAM), the apex world body for such activities through its membership in Asia played a dynamic role in this arena. IFOAM-ASIA which is operative in the region set goals among others in this direction for development of national standards for each country in Asia as a single standard cannot encompass the multiple variants in the agricultural systems. National organic movements and networks should try to achieve this goal. Regional standards for Asia are a must as Asian agriculture has many unique features, which require that they be preserved and promoted. Besides, Asian regional standards could emerge as a referral standard for development of national standards in Asian countries.

The regional standards development requires to be done from the perspective of alternative marketing mechanisms, which are emerging in Asia. A trusted system of certification of organic produce within Sri Lanka is now urgently needed; the question is how to achieve this. In our opinion, while the system to be adopted should be free from political interference, the Ministries of Environment, Agriculture, Water Management and possibly the new Ministry of Rural Industries should, in partnership with the Standard institution and Lanka Organic Agricultural Movement (LOAM) examine and hopefully implement a symbol certification system for Sri Lanka organic produce. LOAM draft standards developed over recent years by NGOs and the private sector, provide in our view a satisfactory framework for the development of such a local scheme.

This set of local standards that have been drafted when receive the acceptance of the Environment Ministry initiated Expert Committee could be the basis for the interplay of market forces to bring the organic products to the local market. This will give the necessary push for the development of the international organic market with much vigour. This could partly solve the question of incentives for farmers to convert to organic farming.

LOAM will however require a properly financed administrative structure if it is to fulfill its task. Joint government and non-government action is necessary for a successful outcome. Equally, combined action by government Ministers is much to be preferred over single Ministry involvement which would undoubtedly lead to divisiveness, resentment and ultimately to a loss of prestige for the symbol itself.

So how should we move forward over the next few years?

What is needed is focus and co-ordination of expertise across the island

Thousands of NGOs and several government agencies have the aim of supporting communities, through poverty alleviation, water supply problems and agriculture; a few actively promote organic farming. We could name many who have pioneered in this field. For the most part however there is little awareness of or interactivity between such organizations; organizational capacities are often built up then just through lack of funding or other reasons.

A regime of incentives for framers would include non-discriminatory approach to organic farming through creating a level playing field with chemical framing. Discontinuation of chemical fertilizer subsidy and accompanying loan access arrangements or alternatively direct support for development of local organic fertilizers at village level are some of the step that can be taken even though the former may not look politically desirable. A coupon system for agricultural input purchases by the small farmers could well stand as a desirable move in this direction.

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