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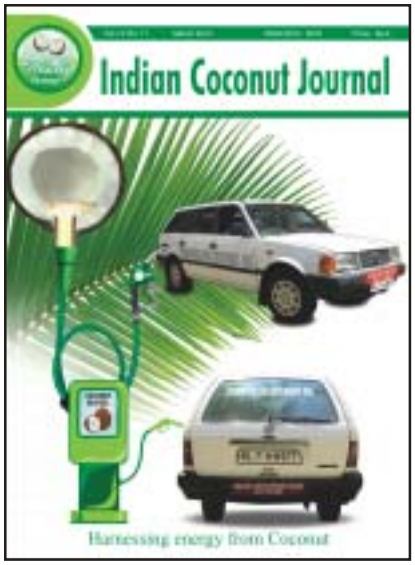
THEME

Harnessing energy from Coconut



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Let us pin hopes on coconut as a biofuel source

Dear Coconut Farmers,

Union budget for 2013-14 offers great scope for the coconut farmers. The budget has made provision for extending the pilot project on replanting and rejuvenation of coconut gardens which was being implemented in three selected districts in Kerala and Andaman & Nicobar Islands to the remaining districts of Kerala. Through the concerted efforts of the Board for the last two years, we could bring together the coconut farmers into a three tier Farmer Producer Organizations (FPOs) comprising of Coconut Producers Society at grass roots level, their Federations at meso level and Producer Companies at district level. All over the four South Indian states, we have now 2258 CPSs and 118 Federations. Twenty Producer Companies are in the offing. Within next two months the legal formalities for the registration of these Producer Companies would be completed. Honourable Union Finance Minister earmarked Rs. 50 Cr for Farmers Producers Organizations (FPOs) as equity grant in the budget. Federations and Coconut Producer Companies are now eligible for accessing this special grant. In the first year itself 500 FPOs across the country can avail themselves this resource. The importance given to the coconut sector and earmarking budget provision for helping the farmer groups are expected to bring in creative changes in the coconut sector. In their state budget, Government of Kerala made budgetary provision for replanting and rejuvenation programme to complement the central funds. Apart from this, Rs. 15 Cr is earmarked for establishing 10 neera processing units in the state.

This issue of the journal is intended to focus on futuristic technologies in coconut sector. It is high time to think seriously about the future prospects of coconut and its products, especially coconut oil. The first idea emerging is using coconut oil as 'bio fuel' instead of petroleum products, especially diesel. Coconut oil as bio fuel has great prospects since the price of diesel is on the increasing trend, commensurate with international price. The petrol price is now decontrolled and it is announced that diesel price would also follow the same path within two years.

Earlier when research studies were undertaken on using coconut oil in lieu of diesel, the apprehension was that diesel can be substituted with coconut oil, only if the price of coconut oil is below Rs.35/- per Kg. At that time, the price of coconut oil was Rs.75 per Kg and that of diesel was only Rs.24/- per litre. Now the price of coconut oil and price of diesel, without subsidy are at par. Oil companies are selling diesel at non-subsidized rates to bulk consumers. Now that a time has come when both the prices of diesel and coconut oil are matching and hence we have to expedite the process of making 'bio fuel' from coconut oil. This is the apt time to relook into the earlier research in association with institutions like IITs, NITs, prominent engineering colleges and other fuel research institutions. Board has already expressed its willingness to collaborate with the research of the School of Engineering and Technology, Institute of Bio-sciences and Biotechnology of the School of Communication and Management Studies (SCMS), Kochi. They have already successfully conducted pilot testing of automobile engines running with coconut oil in lieu of diesel. Further studies are in progress. Revolutionary changes are possible in this sector, if 10 to 20% coconut oil is used in diesel vehicles or 20% of the diesel vehicles start using coconut oil as fuel.

Mechanical engineering department of IIT Chennai has also made advancements on research in bio fuels. Senior Officials of the Board had a meeting with teachers and scientists of IIT Chennai and held discussions on the possibilities of including coconut oil in the bio fuel research studies. Through the tie -ups with academic and research institutions, Board is trying to explore the possibilities of using coconut oil as fuel in a big way. Now it is time to move from pilot to commercial production.

Major coconut growing countries like Philippines, Indonesia, Vietnam, Solomon Islands, Fiji, Federated state of Micronesia, Papua New Guinea and Mauritius are successfully using coconut oil as fuel in vehicles, generators, pump sets and tractors. In India too when the price of coconut oil is almost at par with the price of diesel, we must seriously think of coconut oil replacing diesel.

One of the major issues faced by our country is Current Account Deficit (CAD). In the export-import scenario, mounting trade deficit is a major concern now. Since the trade deficit is a threat to our economic development, coconut oil can play its role in minimizing the trade deficit of the country. Last year India could export only 8,500 MT of coconut oil whereas a small country like Papua New Guinea which is having much less area under coconut than that of a small district of Kerala could export 65,000 MT of coconut oil. Philippines exported 33 lakh MT of coconut oil. India's

share in the global export basket of coconut oil is only 0.33%. We should remember that Philippines is at the third position in production of coconut after India and Indonesia. India with its highest coconut productivity in the world has much scope for increasing its exports of coconut oil. Thus coconut oil can offer a small support in bringing down the trade deficit of the country. India is spending a great deal on importing petroleum products. By using coconut oil in lieu of diesel, the imports of petroleum products can be reduced to a certain extent and thereby reduce the foreign exchange outgo.

There is a potential for increasing the production of coconut in the country to manifold through increasing productivity by extending the replanting & rejuvenation programme to the entire country and through area expansion programme. Apart from this, producing hybrid seedlings of those varieties with high potential for per hectare coconut oil yield on a large scale and making it available through farmer collectives to farmers need to be taken up. While the productivity of common tall varieties is 1.5 MT coconut oil per ha per annum, the high yielding hybrid varieties of coconut palms have shown in Tamil Nadu that they can yield upto 5.9 MT of coconut oil per ha per annum. In such a situation we must plan a programme for producing millions of such high yielding hybrid variety seedlings for increasing the productivity by the next five years. We must consider coconut farming as a more serious business venture as it can bring down the trade deficit of our country and can help in export earnings.

Many studies and researches are going on across the globe on using vegetable oils as energy source. Coconut holds the prime position as a sustainable source of vegetable oil. Among the available vegetable oils in the country, highest per hctare yield is possible in coconut. Also coconut oil is not used as edible oil outside Kerala. This demonstrates the bright prospects of this crop for fuel purpose and there is a need for considering this more seriously. Coconut farming can definitely be made a profitable business when we consider it as a crop which is a regular provider of energy or fuel. We should work for transforming this crop to the real 'Kalpavriksha' which can extend a helping hand to resolve the energy crisis in our country. This can not only put off the foreign exchange outgo, but also will add to the foreign exchange earnings of the country. Over dependence on the diminishing fossil fuel can be reduced to a certain extent. This can be realized through an intensive coconut replanting and rejuvenation programme supported by both the state as well as the central governments.

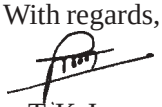
Majority of the states in India are facing power shortage. Even though electricity is now being produced through various sources, there is a possibility of using coconut oil for power generation. The cost of fuel generated from coconut oil can be made on par with the present electricity charges if subsidy from Ministry of Renewable Energy Sources is properly accessed to power generation units using coconut oil. International assistance through carbon credit under Clean Development Mechanism (CDM) is another opportunity. So let us consider coconut farming for power generation as an emerging opportunity. If we can access the opportunities of support from national, international and state level programmes for this, coconut farming no doubt will have bright prospects.

So far we were thinking of producing value added coconut products through the CPS, Federations and Producer Companies. Now we may dream of the Producer Companies setting up power plants using coconut oil which can feed the local power grid. This won't be an unfeasible task with the cooperation and assistance of the central as well as the state governments.

This issue of the journal is attempting to educate the farmers on these possibilities, on the research and development studies undertaken by various institutions and about the advancements made in this sector in foreign countries. Coconut needs a reinstatement as a crop capable of producing energy, which doesn't pollute the environment. The oil reserve across the world is drying up and the available stock is drastically getting depleted. Fuel produced from coconut oil is a steady source of energy as it can be cultivated and yield is available on a monthly basis. Let us think of a ten hectare well managed coconut garden keep on producing fuel for a life span of 50–60 years uninterruptedly, that too with least investment and without polluting the environment. No doubt, a time will come when 'owners of well managed coconut gardens' are respected like 'owners of oil wells'. Once this knowledge is brought lime to light, our coconut gardens, no doubt can be fields in which energy is cultivated.

I request Coconut Producers' Federations and Producer Companies to think differently towards this goal.

With regards,



T K Jose
Chairman

Industrialisation of coconut oil industry – opportunities

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Coconut plays a vital role in the agrarian economy of many regions in the world and provides livelihood to millions of families either directly or indirectly. Systematic research conducted during the last few decades has yielded a substantial number of viable technologies related to crop production, protection and processing. However, farmers are not able to exploit the production potential from these technologies to the extent desirable. Low efficacy of transfer of technology and feedback system is an important constraint in improving technology utilisaiton for productivity improvement, product diversification and value addition to create more wealth from coconut farming.

Regardless of the multitude opportunities for product diversification and value addition to cater to food, beverage, pharmaceutical and other industrial applications the value of coconut in most of the coconut growing countries is regarded mostly in terms of its potential to produce oil in comparison to other oil seed crops. Due to this, the unique features of coconut palm offering multiple benefits have not received consideration to the desired level. Further, in the case of coconut as an oil yielding crop the productivity is low compared to other oil crops which have undergone genetic improvement to raise the yield of oil manifold. Combined with mechanization, especially the annual crop such as soya, sunflower, maize etc, these competing oils could also bring about huge reduction in the cost of production. Coconut is naturally not highly productive because selection and breeding are slow and it is produced mostly by small families in fragmented holdings, unlike most competitors. But now with the release of high yielding varieties and hybrids, it is not at all a constraint and coconut oil yields upto 5-6 MT per hectare have been recorded in farmers field in Tamil nadu.

Despite, there has been a rising awareness of the traditional roles that coconut has taken as food, drink and medication throughout the coconut world. While the main impetus for the downfall of coconut as food was the propaganda by USA, it is significant to note that much of the research findings and the advocacy

for embracing coconut once more have also emerged from USA. There is now a body of sound scientific evidence on the virtues of coconut and most prominent among the products that will benefit from growing demand for its virtues is virgin coconut oil. USA also has emerged as the largest importer of coconut oil especially for use in baby foods.

Global Coconut Scenario

Coconut is grown in the world over an area of 12.26 million hectares producing 64327 million nuts. In production and productivity India has the number one status, with a production of 16943 million nuts (26.34%) followed by Indonesia with 15249 million nuts (23.71%) and Philippines with 15245 million nuts (23.70%) which altogether accounts for a major share of 77.96% of the total production by the three countries along with Sri lanka as per APCC statistics. In productivity also India leads among the major coconut growing countries with 8936 nuts per hectare.

Table-1.Area, Production & Productivity of Coconut in Major Growing Countries (2011)

Country	Area ('000) ha	Production (Million nuts)	Productivity (Nuts/ha)
Indonesia	3808	15249.00	4004
Philippines	3562	15245.00	4280
India	1896	16943.00	8936
Sri Lanka	395	2707.00	6853
Tanzania	310	427.50	1379
Brazil	273	3450.00	12637
Thailand	216	845.00	3912
Papua New Guinea	221	1101.00	4982
Mexico	179	1385.00	7737
Vietnam	155	940.38	6067
Malaysia	109	577.00	5294
Samoa	99	267.00	2697
Others	1041	5190.70	4986
Total	**12264**	**64327.58**	**5245**

Even though India is way ahead in production and productivity of coconut compared to Philippines, Thailand, Brazil, Indonesia, Malaysia and Sri Lanka and with the third position in area under coconut we lag far behind them in processing, value addition and exports. Export of value added coconut products from small nations like Sri Lanka, Vietnam and Papua New Guinea are manifold than that of India. Hence it is high time to focus on these areas in future.

Opportunities for the coconut oil industry

The world coconut oil production remains at more or less same level in the last decade. The highest recorded production was in 2010 at 3.60 million MT. World production of coconut oil in 2011 is 2.99 million tons (Oil World annual 2011). Coconut oil competes with other sources of fats and oils in the world market. In 2011-12 the total volume of major vegetable oils was 153.17 million MT. Contribution of coconut oil was only 2% which was the least among the major nine vegetable oils traded in the world. Palm oil with 51.49 million tons, Soyabean 41.72 million tons, rape seed 23.64 million tons and sunflower seed oil with 14.63 million tons were the major contributors to the vegetable oil market.

Table-2. World Production of Coconut oil, 2007- 2011

Production	Year
2007	3205
2008	3184
2009	3247
2010	3616
2011	2990
TOTAL	**16242**

Table - 3.World Production and Utilisation of Major Vegetable Oils, 2007 -11 (in Million MT)

Commodity	2007	2008	2009	2010	2011
Soyabean Oil	37.67	36.01	38.89	41.38	41.72
Palm Oil	42.88	44.39	46.06	49.12	51.49
Sunflower seed Oil	10.12	12.87	12.62	12.45	14.63
Rapeseed Oil	19.55	21.34	23.75	23.62	23.64
Cottonseed Oil	5.14	4.82	4.44	4.75	5.13
Peanut oil	4.27	4.25	4.08	4.01	4.03
Coconut Oil	3.25	3.11	3.63	3.10	3.12
Olive oil	2.88	2.89	3.29	3.35	3.59
Palm Kernel Oil	4.94	5.12	5.29	5.51	5.82
Total	**130.70**	**134.78**	**142.04**	**147.29**	**153.17**

Total world coconut oil exports ranged between 1.78 to 2.55 million metric tons during 2007 to 2011. The total export for 2010 was 2.55 million MT and came down to 1.86 million metric ton during 2011.Countries in the Asia Pacific regions account for up to around 90 % of world coconut oil exports. The Philippines, Indonesia, Malaysia and Papua New Guinea are the

major coconut oil exporting countries. Other countries in America, such as Mexico and Venezuela and Mozambique in Africa are also the main players in their regions. The Philippines and Indonesia dominate the export of coconut oil in the world market.

Table 4 WORLD: Exports of Coconut oil, 2007-2011(in MT)

Country	2007	2008	2009	2010	2011
APCC Countries	1848245	1731860	1591934	2236400	1544776
Europe	258507	269230	139956	268700	260900
America	11600	14400	20155	20200	36900
Africa	15200	16200	10677	12900	11528
Asia	8900	10300	12849	8000	7700
Pacifics	8200	8200	4793	5003	
TOTAL	**2150652**	**2050190**	**1780363**	**2551203**	**1861804**

Total world import of coconut oil in 2010 was 2.11 million MT, Europe (Germany and Netherland) America (USA) and the Asian countries (China and Malaysia) are the major importers of coconut oil. The import of coconut oil by USA is around 5.18 lakh MT in 2011.

Table 5. World Imports of Coconut oil, 2007-2011 (in MT)

Country	2007	2008	2009	2010	2011
Europe	1091100	1001700	843321	1191700	998500
America	484000	523900	504177	618900	517600
Africa	16400	13300	11932	16000	25200
Asia	535683	556812	508062	742900	548600
Pacifics	17600	15700	14366	14800	15400
TOTAL	**2144783**	**2111412**	**1881858**	**2584300**	**2105300**

Of late increasing demand of coconut oil, especially virgin coconut oil has been seen not only for food uses but also in the lauric oil market for oleo chemical and biofuel industry. In this market coconut oil competes largely with palm kernel oil and VCO with olive oil. In the last two decades, the production of lauric oil has been on the rise, largely driven by the growth in palm kernel oil. Only three countries significantly contribute to the world lauric oil trade i.e., the Philippines in the form of Coconut oil, Malaysia with palm kernel oil whereas Indonesia is seen as a major player in the Lauric oil industry and trade with its increasing production of palm kernel oil and coconut oil. Papua New Guinea also produces both coconut oil and palm oil. The coconut oil industry in India has to undertake a deliberate shift to value added products like virgin coconut oil, coconut milk powder, desiccated coconut, coconut methyl ester, coir and coir based products, coconut shell charcoal, activated carbon, oleochemicals etc to increase the export income.

Emerging applications of coconut oil

Various applications like organic foods, functional foods, pharmaceuticals, cosmeceuticals, oleochemicals, bio lubricants, bio fuels etc. offer vast scope for value addition and increased market demand for coconut oil.

Organic market offers potential both for coconut oil and other edible coconut products considering the premium price. Nearly 90% of the coconut in Asia and almost all the coconuts in pacific islands are grown without any chemical fertilizer or pesticides and are clearly organic, but for the certifications.

Functional Foods

The functional foods, are defined as one which provide health benefit over and above the basic nutrients. The fatty acids in coconut products like Desiccated coconut powder, coconut milk etc. provide both energy (nutrients) and raw material for antimicrobial monoglycerides (functional components). About 48-50% of fatty acid in coconut fat are lauric acid. Lauric acid is a medium chain fatty acid which has additional functional benefit of being formed into monolaurin in the human body. Monolaurin is antiviral, antibactirial, antiprotozoal, monoglycerides which can supress viruses such as HIV, Hepatitis, Influenza, various pathogenic bacteria and Protozoa. Approximate 6.7% of the fatty acids in coconut fats are capric acid which is another medium chain fatty acid which has a similar beneficial functions. It forms into mono caprin in the

Global Functional Foods Market by Region, 2007-2011

	2007* (USD, millions)	2011* (USD, millions)	% change 2007-2011	% share 2011
Japan	7,125	9,750	36.8	38.6
US	6,215	7,850	26.3	31.0
Europe	5,590	7,290	30.4	28.8
Australia	310	410	32.3	1.6
Total	19,240	25,300	31.5	100.0

human body. It is reported that conventional food sector has growth rate of 1-3% whereas the functional food sector had a growth of about 32% over the last five years, with Japan, USA, Europe and Australia accounting for majority of the world functional food market.

Virgin coconut oil as functional food

The production of virgin coconut oil, extra virgin coconut oil and organic virgin coconut oil is the largest move by coconut producing countries into high value product diversification. The coconut oil produced through wet method is known as virgin coconut oil. It is obtained from fresh matured coconut kernel by mechanical or natural means with or without the use of heat and without undergoing chemical refining. Virgin coconut oil is marketed in the world as a functional oil.

Virgin coconut oil is now being intensively researched for its effects on preventing and in many cases reversing the effects of various nervous system diseases including alzheimer's, parkinson, epilepsy, dementia, psychophesia and autism. Philippines is the pioneer producer of sizeable quantities of virgin coconut oil commercially. Fiji, Indonesia, Micronesia, Samoa, Srilanka, Thailand, Vietnam and India are also making virgin coconut oil. Besides good domestic demand, developed countries like USA, Europe, Australia, Canada, Denmark, France, Japan and Korea have a huge demand for virgin coconut oil. The use of virgin coconut oil in pharmaceuticals, neutraceuticals and cosmeceuticals is going up and will command a premium market price.

Cosmesceuticals

With urbanization and increased purchasing power, production of cosmetic and personal care products

market is developing fast with the emerging popularity of whitening products. The growth rate for cosmetics and personal care products is about 10% and for soaps it is nearly 20%. Coconut oil based products are said to be good for the skin in reducing cellular aging and for the growth of hair and in removing dandruffs.

Oleo chemicals

Coco chemicals belongs to a group of natural oleochemicals or high value product from natural raw materials like coconut oil and palm kernel oil. They include fatty alcohol, fatty acid, methyl esters and glycerin. When further processed into downstream products they can be used as surfactants (substances that exhibits cleaning power or detergency).This in turn serve as building blocks for consumer products like soaps, detergents, creams, shampoo and toothpaste formulation. Other industrial application includes production and processing of lubricant, paint etc. Coconut oil is a major source of oleo chemicals. The formation of basic oleo chemical substances like fatty acids, fatty acid methyl esters (FAME), fatty alcohols, fatty amines, and glycerol are done by various chemical and enzymatic reactions. Intermediate chemical substances produced from these basic oleochemicals are ethyl ethoxylates, alcohol sulfates, alcohol ether sulfates, monoacylglycerols (MAG), diacyglycerols (DAG), structured triacyglycerols (TAG) and sugar esters. The long term trend of oleo chemicals is favorable with world capacity expected to increase manifold. The Philippines is the largest producer of oleo chemicals from coconut oil.

Oleo chemicals and surfactants are important ingredients for soaps and detergents and other growing specialty downstream applications. The chemical industry recognize a trend towards using organic and renewable materials as alternative to petrochemical feedstocks. Coconut oil typically makes up 90% of all oleochemicals. The sub sector provides the coconut industry a dependable and value added market making it less dependent on direct exports of crude coconut oil.

The expanding market for coco chemicals will be in tune with the growth and changes in soaps, detergents and personal care products which in turn is driven by population growth sophisticated life styles, higher awareness about environmentally friendly product and globalizing of markets. With its bio degradability and cost efficiency, coco chemicals have an important role in satisfying the global demand.

Bio lubricants

Lubricants based on mineral base oils have been used in all kinds of applications since the beginning of industrialization, nearly 95% of these materials are at present based on mineral oil. These lubricants have certain disadvantage like they are not easily biodegradable and are made from non-renewable sources. Today most of the lubricants sold world-wide end up in the environment via total loss applications, volatility, spills or major accidents. In view of their high eco-toxicity and low biodegradability they constitute a considerable threat to the environment.

Recently vegetable oils are getting a renewed interest as lubricants due to the concern of environmental pollution and ecological damage caused by the mineral oil based lubricants and their additives. Many countries including Austria, Canada, Hungary, Japan, Poland, Scandinavia, Switzerland, the USA and EU are either in the process of formulating or had already passed legislation to regulate the use of mineral oil based lubricants in environmentally sensitive areas.

Europe is said to be at least ten years ahead of the world in terms of plant-based lubricant sales and acceptance. The major biodegradable lubricants sold in the European market are hydraulic fluids (67%), Chainsaw oils (14%), cutting oils and gear oils (12%) and other oils(7%). Germany holds the largest share of the biodegradable lubricants market in Europe and are based on rapeseed oil. The plant-based lubricant industry particularly in India is very new, as there are no federal regulations specifically pertaining to the production and usage of biodegradable lubricants in place of petroleum oils.

Bio lubricants are functional fluids made from vegetable oil and downstream esters. Vegetable oils by virtue of their properties like high viscosity index, high solvency and low volatibility, excellent bio degradability and low toxicity, have become primary choice as base oils for lubricant applications. Studies have shown the possibility of using coconut oil as a lubricant in two and four stroke engine by chemically modifying them into suitable derivatives to meet the refueled specifications. Coconut oil has been tried as a two stroke engine lubricants (2T oil) in auto rickshaws and scooters and reported to improve mileage, better pick up, smoother engine operations and reduced smoke in comparison to the conventional lubricants. Recently metal working fluids have been developed using coconut oil by the Indian Institute of Science, Bangalore through a sponsored programme of the Coconut Development Board. Thus there is immense scope for conversion of low molecular weight fatty acid fractions of coconut oil in formulating new generation lubricant for value addition and environmental sensitive applications

Bio fuel

The fuel delivered from biological sources can be generalised as bio fuels and have a history of more than hundred years as the engine developed by the Mr. Diesel (1900) was tested by using a vegetable oil itself .Bio diesel is a renewable and biodegradable fuel produced from plant oil. It is a natural hydrocarbon with negligible sulphur content which can substantially reduce emission from any diesel-fed engines. In its simple term, it may be defined as a chemically modified vegetable oil which exhibits properties that is very similar to diesel fuel. It is normally produced by reacting the vegetable oil with alcohol (methanol or ethanol) in the presence of a suitable catalyst under a specified temperature and

pressure. In chemical jargon, bio diesel is actually a methyl ester with a name of the specific vegetable oil added to it e.g. coco methyl ester or rapeseed methyl ester etc. can be used as 100% pure or blended with diesel fuel up to 20%. It can also be used as a diesel fuel quality enhancer/additive ranging from 1-5%.

In the coconut producing countries of the Asia Pacific bio diesel has traditionally been made using coconut oils as feedstock as coconuts are the most abundant renewable resource. However, there is no widespread production of coco bio diesel due to high production costs. Coco diesel has also been regarded as a superior additive when blended with non edible oil such as jatropha and moringa oils. Coconut oil and oil

derivatives are excellent alternative fuel source for vehicles. Coconut oil is now widely used as a fuel substitute for motor vehicles. Coconut methyl esters are produced by treating coconut oil with methanol in presence of NaOH/ KOH as catalyst. Coconut oil can thus emerge as an eco friendly transport fuel which does not cause atmospheric pollution. Despite there was a strong move to use coconut oil as transport fuel, the comparatively higher price of coconut oil than diesel was a set back. At present scenario the prices of diesel and coconut oil have reached on a comparable position. It was predicted that cost of diesel will still continue to increase in near future so much so that using coconut oil as a substitute to diesel could be advantageous considering the present price situation.

The Philippines is the first nation to produce and use coconut bio diesel. As engine fuel coconut bio diesel can be used as a direct substitute for petroleum diesel, or as an additive to petroleum or bio diesel or as a base ingredient to bio diesel. Even though studies on bio diesel development have been initiated in India, coconut oil has yet to be adopted on a large scale for bio diesel production. Coconut Development Board sponsored research studies undertaken by Indian Institute of Petroleum (2007) reveal that coconut oil has suitable characteristics for trans esterification and methods were also developed for continuous production of coconut bio diesel.

Issues related to use of coconut oil as biodiesel

- All vegetable oils will burn and as such have the ability to be used as a diesel fuel alternative. Different types of vegetable oil, however, display very different properties and this lends some vegetable oils to being more suited to replacing diesel fuel than others. In that sense coconut oil can be considered one of the best vegetable oils to be used as a diesel fuel alternative. This is because it is made up of medium length, saturated hydrogen and carbon chains, making it chemically stable and less likely to react or polymerise. It also means coconut oil has better combustion properties than all other vegetable oils.
- For untreated coconut oil to burn completely a minimum temperature of 500^{o}C must be achieved in the combustor chamber compared to 250^{o}C for diesel. If not burnt, fuel will form carbon deposit at injector nozzle, cylinder walls and through out the combusting system.
- Coconut oil is about 10 times more viscous than diesel fuel at room temperature (25^{o}C) and hence it reduces altered spray pattern of injected fuel and creates additional stresses on injection pump and distribution pump.
- Coconut oil solidify within the temperature range of 20-25^{o}C. At this range the same solidified or solidified oil can have caestrastrophic impact on the injection and distribution pump.
- Using coconut oil as fuel can cause filter blockages, putting stress on the pumps potentially leading to failure of injection and distribution pump.
- When un burn coconut oil gets into the engine pump deterioration of lubricant oil can occur causing wear on bearings and other moving engine plants.
- Distribution pumps can suffer a reduced design life due to the higher viscosity of coconut oil.

India is one of the fastest growing economies in the world. For socio economic development energy is the critical input. Fossil fuels would continue to play a dominant role in meeting the countries energy needs well into the future. Attention to the bio fuels takes into account the environmental challenges posed by the conventional fuels, threat of global warming, climate change and global political pressure to reduce Co2 emissions in addition to escalated prices of crude oil. In the context of international prospective and national imperatives, the national policy on bio fuels was announced on 11th September 2008 and approved by Govt. of India during December 2009 to facilitate and bring about optional development and utilization of indigenous bio mass, feed stocks for production of bio fuel and also development of the next generation of more efficient bio fuel conversion technologies. The salient features of the national bio fuel policy includes an indicative target of 20% blending of bio fuel- bio ethanol and bio diesel by 2017.Another important aspect is that the policy is based solely on production of non food feed stock to be raised on the degraded or waste land that are not suited for agriculture.

Conclusion

The Asia Pacific region which accounts for nearly 90% of the total coconut production also accounts for nearly 60% of the world population with a fast growing economy. This population will require a large quantity of coconut oil for health, nutrition as well as for alternative energy sources in addition to export earnings. Product diversification and expansion of coconut kernel based products, high end applications of lauric oils in the edible as well as oleo chemicals sector is indicative of a promising future for coconut oil industry.

Harnessing the Green fuel: Prospects for Coconut Oil as Bio-diesel

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Bio diesel as the name indicates is a clean burning alternative fuel produced from domestic renewable resources, which is non toxic. Biodiesel are liquid or gaseous fuels produced from biomass resources and used in place of, or in addition to, diesel, petrol or other fossil fuels for transport, stationary, portable and other applications. Biomass resources are the biodegradable fraction of products, wastes and residues from agriculture, forestry and related industries as well as the biodegradable fraction of industrial and municipal wastes. Bio diesel derived out of vegetable oils has drawn considerable attention with increasing environmental consciousness. The growth of bio fuels around the world is spurred largely by energy security, environmental concerns and the fluctuations in crude oil price in the world market. The global biofuel demand is growing at 5-10% per annum.

The international government policies towards emission reductions have also created a guaranteed demand for biodiesel. Developing countries support biofuel as a potential means to stimulate rural development and create employment opportunities. Studies are also being taken up on the possibilities of using vegetable oil as an effective alternative for fuel and have been utilized in many countries like France, USA, Italy,

Malaysia, Spain, Sweden, Greece, Nicaragua and Australia.

India is the fifth largest primary energy consumer and the fourth largest petroleum consumer in the world. A growing population, increasing per capita income, infrastructural development and rapid socio economic development has spurred an increase in energy consumption across all major sectors of the Indian economy. Expenditure on the import of petroleum products in 2010-11 is estimated at $110 billion. Consequently petroleum consumption has also gone to 138 million tons. The on- road vehicle population in India is expected to cross 120 million by 2015 assuming motor vehicle population grows at 8 to 10 percent per year. The current growth in transport activity and the consequent increase in expenditure and consumption of petroleum products are posing serious concerns for the environment. India is also the fourth largest global contributor to carbon emissions. The Govt of India transport policy is targeting EURO-III and IV norms for vehicles, which in turn would require adoption of clean and green fuel. With an aim to meet the objectives, the Union Cabinet had approved the National Policy on biofuels on December 24, 2009.

The Indian approach to biofuels is based mainly on non food feedstocks to be raised on degraded lands not suited for agriculture. The domestic crude oil production in India is able to meet only 23% of demand. Our energy security can be vulnerable until alternative fuels to supplement petro based fuels are developed based on indigenously produced feedstocks.

The National Biofuel policy aims at mainstreaming of biofuels and to

ensure that a minimum level of biofuels become readily available in market to meet the demand at any given time. The Policy is expected to bring about accelerated development and promotion of the cultivation, production and use of biofuels to increasingly substitute petrol and diesel for transport and be used in stationary and other applications, while contributing to energy security, climate change mitigation, apart from creating new employment opportunities and leading to environmentally sustainable development. An indicative target of 20% blending of biofuels, both for bio-diesel and bio-ethanol, by 2017 is proposed. The policy would enable setting up of processing units by industry for bio-oil expelling/ extraction and transesterification for production of bio-diesel. Gram /Intermediate Panchayats would also be encouraged to create facilities at the village level for extraction of bio-oil, which could then be sold to bio-diesel processing units. The prescribed blending levels will be reviewed and moderated periodically as per the availability of bio-diesel and bio-ethanol. The blending would have to follow a protocol and certification process, and conform to BIS specification and standards. Section 52 of the Motor Vehicles Act already allows conversion of an existing engine of a vehicle to use biofuels and the engine manufacturers would need to suitably modify the engines to ensure compatibility with biofuels, wherever necessary. A major thrust would be given through this Policy to Innovation, Research & Development and Demonstration in the field of biofuels. Research and Development will focus on plantations, biofuel processing and production technologies, as well as on maximizing efficiencies of different end-use applications and utilization of by-products.

Biodiesel can be produced from several sources such as soyabean oil, canola oil, sunflower oil, corn oil, mustard oil etc. Apart from being edible oil, coconut oil also has great potential to be used as a bio-diesel. In Pacific Islands, coconut oil is increasingly used in both transport and electricity generation through its lower local cost. Countries like Philippines are already moving ahead to use coconut oil biodiesel

in the transport sector (Tan et al., 2004).

In the coconut producing countries of Asia Pacific region biodiesel has traditionally been made using coconut oil as feedstock, as coconuts are most abundant renewable resource. However there is no widespread production of coco biodiesel due to high production costs and the resulting loss of income from coconut sales and exports.

The Philippines is the first nation to produce and use coconut-derived biodiesel. The U.S. Department of Energy and its National Renewable Energy Laboratory (NREL), along with the U.S. Agency for International Development, have teamed up with the Philippine Department of Energy to conduct experiments intended to validate and expand upon existing coconut-to-biodiesel research. The Asian Institute of Petroleum Studies (AIPS) has made a plea for oil-fired power plants to look at using coconut methyl ester (CME) in a move to become more environment friendly.

There are a number of ways in which vegetable oils such as coconut oil can be used in compression engines. As engine fuel, coconut oil can be used in three ways: as a direct substitute for petroleum diesel, as an additive to petroleum diesel or bio-diesel, as the base ingredient of bio-diesel.

Trans-esterification of vegetable oils is currently regarded as the most important means to process vegetable oils as the products show superior engine performance with reduced emission (Gupta, 2001). Coconut has an oil content of about 70%, and has a yield of about 2500 liters per hectare. The Cetane Number (60) and Iodine Value (10) of coconut oil/copra oil are within acceptable limits for use in diesel engines. Its viscosity after trans-esterification is also in the acceptable range. It thus appears to be a good candidate for biodiesel. Coconut oil can be blended with diesel and under certain conditions totally replace it. Using pure coconut oil in standard engines is very attractive through its low cost. However, it requires special technical supervision and may shorten engine life. As the coconut oil has up to 30 times higher viscosity than the regular diesel at

the same temperature, most engine modifications include a fuel heater. As heat is exchanged between the engine coolant and the fuel, the oil viscosity approximates that of diesel. As the coconut oil solidifies below temperatures of 25°C, often an electrical heater is incorporated in the fuel tank.

Studies involving the use of vegetable oils such as coconut oil in automobile engines were conducted even from early 80s.

The use of coconut oil in adapted engines has been studied by Kopial.*et. al.* (2004). Systems have been developed to adapt the fuel system of an engine to start and stop on pure coconut oil. Feasibility studies have shown favorable opportunities for both electricity generation and taxis in Vanuatu [Leplus, A. (2003), Ribier, V. et al (2004)].

The use of dual fuel systems especially in automotive applications is slowly developing in European countries and the United States. The main advantage of adapted engines is their fuel flexibility and relatively low additional cost.

Nakpong and Woot-thikanokkhan (2010) has studied the use of coconut oil as a prospective feedstock for biodiesel production in Thailand. The viscosity of coconut biodiesel product was very close to that of Thai petroleum diesel and other measured properties met the Thai biodiesel (B100) specification.

In the Philippines, the primary feedstock for biodiesel production is coconut wherein the extracted coconut oil is trans-esterified using methanol and sodium hydroxide as catalyst to form the coconut methyl ester and a by-product glycerol. Methanol was chosen instead of ethanol due to its availability, less expensive as compared to ethanol but provides same process efficiencies (Sheehan *et. al,*1998)

Alamu *et. al* (2010) has investigated the potential for use of coconut oil for the production of alternative renewable and environmental friendly diesel fuel (biodiesel) and characterized as alternative diesel fuel.

Studies undertaken by James Cook university of North Queensland, Australia (1983) concluded that coconut oil has the best characteristics as a fuel of all the common vegetable oils Conclusions from their trials suggested that the only short term, problem with coconut oil is the possible clogging of the engine fuel filter. This problem is easily remedied by changing the filter element; the rate at which the engine filter clogs may be minimized by efficient pre-filtration (or settling) of the coconut oil fuel.

The widespread use of coconut oil to replace diesel has a range of potential environmental benefits too. Mainly, there is a drastic reduction in the emission of poisonous gases and particulate matter as compared to diesel, through the higher oxygen content of coconut oil. Secondly, the use of coconut oil can be considered CO_2 neutral. The CO_2 stored in the coconuts, husks and shells are used in the process of oil production (husk and shells for drying the copra) and burning of the oil. This CO_2 is again sequestrated during the growing of new trees and nuts.(Cloin, 2005)

Indian Institute of Petroleum, Dehradun was assigned a study "Batch/continuous trans-esterification process for utilization of coconut oil for bio-diesel production" by the Coconut Development Board in 2007. The results of the study revealed that coconut oil has suitable characteristics for transesterification and the method developed is suitable for continuous production of biodiesel.

At the National Technological Congress, held at Thirvananthapuram, Bovas *et. al* (2011) presented the paper "Coconut Oil Biodiesel: Possibilities as A Green Fuel for Ecological Hot Spot Areas in Kerala" wherein the results indicated that coconut oil biodiesel is a better fuel than diesel for CI engines, except for its high specific fuel consumption. Blending coconut oil biodiesel even at low proportions (20%) resulted in a considerable reduction in pollution caused by diesel engines. Even if the current situations preclude its wide use, its potential as an anti pollutant additive for diesel is noteworthy, especially in the ecological hot spots in Kerala.

The various organisations doing bio fuel research in india are the following:

1.Bio Diesel Association of India B-14 RNA Arcade, Lokhandwala, Andheri (W) Mumbai - 400053, Maharashtra: The BDAI is non profit national association representing the biofuels sector more specifically biodiesel industry as the coordinating body for marketing, research and development in INDIA, encourage Bio fuels specially Biodiesel and

assure sustainable Agricultural growth, Rural development, Energy security and equal opportunity for the masses with overall environmental protection..

2. Petroleum Conservation Research Association, Sanrakshan Bhavan,10, Bhikaji Cama Place, New Delhi -110066:One of the major objectives of PCRA is "To promote Research, Development and Deployment efforts aimed at petroleum conservation and environment protection, support and facilitate efforts aimed at petroleum conservation and environment protection, support and facilitate efforts for adoption and dissemination of fuel efficient technologies and substitution of petroleum products with alternate fuels, and renewable. Also to establish synergistic institutional linkages at the national & international levels in the areas of petroleum conservation and environment protection".

3.Institute of Chemical Technology, Nathalal Parikh Marg, Matunga, Mumbai -400 019. In addition to bioethanol, the centre is also poised to look at alternative sources of second, third and fourth generation biofuels. With the aim of developing efficient biodiesel production technologies, work is being carried out to develop strains that produce lipases with desirable characteristics of specificity and stability, immobilizing enzymes, building reactors and developing technologies for recovery of high value products from vegetable oil/s before subjecting to enzyme action.

4. Centre of Excellence in Biofuels, Agricultural Engineering College and Research

Institute,Tamil Nadu Agricultural University,Coimbatore-3: Centre has been taking up research from 1992 on tree based oilseeds for production of biofuels.

5. Indian Council of Agricultural Research, Pusa, New Delhi 110 012: Has identified new varieties of Jatropha for biofuel

6.BARC,Mumbai: Mutation of Jatropha for increased biodiesel yield

7.IIT Madras – Department of Biotechnology, Department of Mechanical Engineering: Research on the use of Jatropha oil as a fuel for engines

8.NIT Warangal – Chemical Engineering Department,Andhra Pradesh: Techniques for extracting oil from jatropha are developed

9. IIT Guwahati: Biodiesel extraction technologies and Jatropha micropropagation methods are taken up.

10. The International Crops Research Institute forthe Semi-Arid Tropics (ICRISAT) Hyderabad: Wide range of research activities in Biodiesel are being undertaken.

Even though studies on biodiesel development have been initiated in India, coconut oil has yet to be adopted on a large scale for biodiesel production in our country. India's total biodiesel requirement is projected to grow to 3.6 Million Metric Tons in 2011-12, with the positive performance of the domestic automobile industry. Analysis from Frost & Sullivan, Strategic Analysis of the Indian Biofuels Industry, reveals that the market is an emerging one and has a long way to go before it catches up with global competitors. The government is currently implementing an ethanol-blending program and considering initiatives in the form of mandates for biodiesel. Due to these strategies, the rising population, and the growing energy demand from the transport sector, biofuels can be assured of a significant market in India. Studies conclude that even though there has evidence of environmental benefits in using vegetable oils as fuel, it is the local cost of fuel that determines biodiesel economics.

Widespread utilisation of alternative fuels will require active involvement of oil manufacturing companies, engine manufacturers and trained mechanics.For coconut oil fuel to be a sustainable alternative to diesel fuel, restructuring of the coconut industry, along with supportive governmental policies are required.

Can Energy be Cultivated?

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Energy demand in the world, in all its forms, is skyrocketing. Rising crude oil prices coupled with the global warming compels the nations to search for alternative sources of energy. In the Indian context, the energy demand is expected to grow as the country moves on its growth trajectory. Plant biomass has been an important source of energy ever since people first began burning wood to cook food. The Energy Information Administration (EIA) projected that by 2017, biomass is expected to be twice as expensive as natural gas, slightly more expensive than nucleus power, and much less expensive than solar panels. Plant parts store solar energy through the process of photosynthesis and therefore biomass derived from living plants is a renewable energy source. When the biomass is burnt, it releases solar energy they contain. Plant biomass thus functions as a sort of natural battery for storing solar energy. There are two main approaches for using plants for energy production. One is growing plants specifically for energy use and the other is using the residues from plants, which have other utility values. Plant wood is still the most common source of biomass energy. Other source of biomass energy include food crops, grasses and other plants, agriculture and forestry waste and residue, organic components from wastes etc. Biomass can also be effectively used to produce electricity and as fuel for transportation. This article discusses the potential of utilizing coconut biomass as a source of energy and coconut oil as an alternative transport fuel to meet the fast growing fuel requirement of the future.

Coconut as a renewable source of energy

Renewable energy is the energy that comes from resources which are continuously replenished such as sunlight, wind, rain, waves and geothermal heat. About 16% of global energy consumption comes from renewable resources with 10% from traditional biomass, mainly used for heating. The share of renewable energy in electricity generation is around 19 % with 16% from hydroelectricity and 3% from the new renewable sources.

Biomass derived from plant material is a renewable energy resource. The International Renewal Energy Agency (IRENA), an intergovernmental organization for promoting the adoption of renewable energy worldwide, is looking for every alternate sources of renewable energy to balance the fuel requirement. Developing countries are really in need of renewable energy, as the fossil fuels are getting depleted day by day. Therefore producing renewable energy locally is a viable alternative to transform any nation to economic prosperity.

'Renewable Energy has the ability to lift the poorest nations to new levels of prosperity'.
Ban Ki Moon, Secretary General, United Nations

Coconut tree as a whole and its voluminous biomass are alternative source of renewable energy. The dried palm parts available on a regular basis were source of fuel wood for the people before cooking gas become popular. Studies in this direction revealed that 35-40 coconut trees could satisfy the cooking fuel requirement of a farm family of 4-5 members with a daily consumption of 7-10 kg of coconut biomass. The biomass production of a palm under good management giving fronds, bunch, stalk, spathe, husk and shell is estimated at 135.677 kg per year as shown in Table 1 (Thampan, PK 1991). Evidently the removal of biomass from 1 ha coconut garden having 175 trees is estimated at around 24 MT per year. This would be much more in a coconut based farming system where many seasonal and perennial intercrops are integrated.

The dried material could be used and burnt to generate heat and produce electricity. Solid, liquid and gaseous fuels also could be produced by heating the biomass in the absence of oxygen. The output of biomass from the coconut palm is substantial for profitable

conversion to different energy forms. Coconut shell, pith and wood are converted into charcoal and other forms of fuels and chemicals. The chopped coconut biomass during decomposition generates producer gas, which after cleansing become good fuel for internal combustion engines such as gasoline and diesel engine. The gaseous product derived from coconut biomass on gasification produce methanol after purification, compression and distillation. Methanol is an alternative fuel for transport vehicles with converted engines (Thampan, PK 1991). It has been reported that this fuel is less polluting with reduced emissions.

Coir pith and coir briquettes also liberate energy on combustion. Coconut shell charcoal is another efficient fuel source, especially charcoal is prepared in **pyrolysis** plants. Studies conducted at College of Agricultural Engineering and Technology, Tavanur, Kerala, paved way for utilization of coconut shell as matrix for cell immobilization in bioreactors. The shells needed only simple pretreatments to use it as media in bioreactors.

Coconut in White House - A Blue Print for "An America – Built to Last"

Arun Subramony with the team in the White House

Mr. Arun Subramony, the founder Chairman & CEO of Empereal Inc., a Singapore based Corporation engaged in producing power and desalinated water from renewable energy sources, is an youngster from the land of coconut. Mr. Arun was invited by White House Economic Council to be a part of the Asian American and Pacific Islander (AAPI) forum, to participate in a very special round table discussion with senior government officials to discuss on a **Blue print for "An America - built to last".** The Blue Print for an 'American economy that is built to last' was laid out by President Barak Obama in his State of Union address. The Blue print also envisaged an economy built on American manufacturing, American energy, skills for American workers and renewal of American values. The Administration sought the counsel of Mr. Arun on the best course of action to be taken, in order to further stimulate business and job growth in the US. Mr. Arun and his fellow invitees focused on the driving growth through technology innovation and R&D in targeted industries like IT, clean energy, healthcare, and education sectors.

The President intends to keep moving forward and rebuild an economy where hard work pays off and responsibility is rewarded-**an economy rebuilt to last.** Under the Agenda 'Make the most of Americas Energy resources", responsible development of the near 100 year supply of natural gas, supporting more than 6,00,000 jobs while ensuring public health and safety, incentivize manufactures to make energy upgrades, saving $100 billion over the next decades, creating clean energy jobs in the US are the targeted areas.

A happy note - the round table set in motion a series of efforts, initiatives and programmes that will be continuously monitored and managed over the next 6 months. The team will meet Obama's Advisor regularly to chart the course of action for the next 4 years. Mr. Arun will be taking coconut from his home land of Kerala to White House as a source of energy. **He will be presenting the potential of coconut oil as a cultivable source of energy as a measure to boost the Energy resources of America.**

The key areas where Empereal Inc.,will be associating are leveraging policies and incentives to export biodiesel, Waste to Energy solutions and other Bio Energy products in India, Middle East and South Asia.

Coconut trunk is also amenable to carbonization. Charcoal types of both coconut wood and shell are equally efficient. Coconut oil and oil derivatives are also excellent alternative fuel source for vehicles. **Thus all harvestable biomass from coconut constitute a very valuable renewable energy resource. No other tree can contribute biomass in this much quantity or on such periodicity**.

Mean annual production of byproducts by one coconut palm (sun dry basis) under good management

Name of byproduct	Dry Weight (kg) of each byproduct	Number of each by product tree^{-1} yr^{-1}	Dry weight (kg) of each by product tree^{-1} yr^{-1}
Frond (petiole, leaves and stipules)	4.998	12	59.976
Spadix (bunch stalk and spathe)	1.003	12	12.036
Husk	0.438	107	46.866
Shell	0.157	107	16.799
Total			**135.677**

Source: Meerabai et al. (1991)

Coconut oil as Source of Biofuel for Transport vehicles

India is one of the largest petroleum consuming and importing countries and the present annual consumption of diesel touches around 50 million tonnes. Considering the growth rate in petroleum product consumption over the past decade, finding alternative sources of energy in the world over has become imperative. Three per cent of the worlds transport fuel requirement in 2010 was met by Biofuels. According to IRENA, by 2050, biofuels will have the potential to meet more than a quarter of world demand for transportation fuels.

Biodiesel is a promising alternative fuel for substituting petroleum in diesel engine because of the similarities in properties. It has been reported from various countries that Ethanol derived from coconut sap and other biomass is good substitute for gasoline as transport fuel. The coconut biomass could be pre-treated and fermented to produce ethanol. Alcohol is then separated by fractional distillation. In terms of volume, ethanol is proved to be almost as efficient as petrol by releasing 23, 000 kilojoules of energy 1^{-1} against 25,000 kilojoules 1^{-1} of petrol. Ethanol causes less pollution and emits less smog unlike the leaded petrol. Blending of ethanol with diesel has been tried and put in practice in many countries like Australia, Brazil, Philippines, Micronesia and Pacific countries. The US and Brazil are the two largest producers of Ethanol. Brazil occupies the monopoly of world's largest exporter of ethanol also. In their Ethanol fuel program (EFP) they uses modern equipment and cheap sugarcane as feed stock and the residual cane waste (bagasse) is used to produce heat and power. There are no longer light vehicles in Brazil running on pure gasoline.

In Brazil around 40 lakh cars are running on ethanol and another 10 lakh use mixture of 20 per cent ethanol and 80 percent petrol.

Coconut oil is now widely used as a substitute for diesel in motor vehicles. Methyl Ester formed from coconut oil emits not much sulphur dioxide. Coconut methyl esters are produced by treating coconut oil with methanol in presence of NaOH/KoH as catalyst. There are great opportunities to utilise coconut oil as a fuel with decreased emission. Coconut oil can be blended with diesel fuel and under certain conditions it can totally replace diesel. Pacific Islands are increasingly using coconut oil in both transport and electricity generation.

There have been many exhaustive studies done on coconut oil as a biofuel in various countries and many reports published. In the Philippines during the Second World War the armies used coconut oil to run diesel engines. This marked the beginning of the continuous use of coconut oil as a direct substitute for diesel. Pacific Islands like Papua New Guinea, Vanuatu, Solomon Islands and Fiji had diesel generators and trucks run on locally produced coconut oil. In Vanuatu reports on the use of coconut oil reveals that they initially mixes 20 parts coconut oil with one part kerosene and this blend is then mixed 2:1 with diesel to give an effective 64% coconut oil bio-fuel. The Mechanical Engineering Department of the University of Wollongong in Australia has done extensive tests on blends of coconut oil with diesel, kerosene and ethanol. Petrol, kerosene oil substitutes and

heavy oils can be generated from coconut oil. It has been reported that coconut oil when cracked at 356-388°C under 3.2 kg/ cm^2 pressure, motorfuel and diesel oil are obtained. The yield of motor fuel increases when high pressure is applied. When ethyl alcohol is added to coconut oil in presence of sulphuric acid or hydrogen chloride ethyl esters and glycerol are produced. Ethyl esters are considered to be excellent substitute for kerosene also. Coconut palm can contribute substantially to the fuel needs of rural house holds and coconut biomass and coconut oil are dependable sources of renewable energy. Coconut palm thus helps in conserving natural resources and preventing depletion of non–renewable energy resources. **Despite there was a strong move to use coconut oil as transport fuel, due to the comparatively higher price of coconut oil than diesel, this move was not pursued vigorously. Now the prices of diesel and coconut oil have reached on a comparable position and hence it is high time to think of using coconut oil as a substitute to diesel as switch over to coconut oil fuel is advantageous. This represents a double economic advantage for a developing country like India through reducing the import of petroleum as well as lowering the cost of fuel switch.**

Coconut Palm vs Oil Palm – as source of energy/biofuel

Oil palm was considered as the richest source of vegetable oil. In Malaysia the average annual productivity ranges between 2.5 and 4.0 tonnes of oil per ha per year. The oil palm plantations of Oil Palm India Ltd. in Kerala give an average yield of 2.5 tonnes of oil per hectare per year. However yield potential of 4.5–5.0 tonnes of oil per ha annually was also reported in the case of oil palm. The yield record of the best hybrid combinations in coconut has not exceeded 3 to 3.5 tonnes of oil per ha. But now hybrids yielding oil upto 6 tonnes per ha is reported from state like Tamil Nadu. Therefore the apprehension on higher yield potential of oil palm has become out of place. Moreover, coconut is more adaptive to adverse agro-climatic situations without much variations in productivity whereas oil palm is grown under strictly favourable conditions such as well drained deep sandy loam soils. Coconut can be grown successfully beyond the traditional coastal belts. Now the crop has made inroads in the non traditional areas of east and north-eastern region of the country. The productivity of some coconut palms grown in West Bengal and Assam under sub-optimal conditions is comparable with high yielding palms grown in better locations.

Coconut has got many other advantages over oil palm. The oil palm fruits are highly perishable in nature and have to be processed within 24 hours after harvest failing which the quality of oil extracted deteriorates. Oil palm is not amenable to homestead plantings as in case of coconut. On the other hand coconut is amenable to any cropping system from homestead units to commercial plantations, as a monocrop or as a component crop in the multi cropping system. As such, coconut which is small holders crop cannot be replaced by oil palm. Further, oil palm has to be replanted after a period of 25-30 years whereas in the case of coconut the economic life of a palm is about 60 years. The holdings under coconut are safeguarded against soil degradation by resorting to appropriate cropping pattern in the interspaces to further increase income from a unit area.

Both coconut and oil palm bio mass and also coconut oil and palm oil are tried as prospective sources of biofuel by many countries. In countries like Thailand using coconut and oil palm biomass are considered as most prospective for bio diesel production. Studies were conducted on the properties of bio diesel blends and the exhaust emissions. In a study conducted at the Joint Graduate School of Energy and Environment, King Mongkut's University of Technology, Bangkok, Thailand, coconut methyl ester and palm oil methyl ester 20 % blend showed lower emissions when compare to petroleum diesel (2004). The most promising blend they found is the B-20 blend ie., a mixture of 20 per cent biodiesel and 80 per cent petroleum diesel by volume. B-20 blend represent a good compromise between increased nitrogen oxides and reduction of all other emissions. The National Biodiesel Board, US and the US Environmental protection Agency reported their analytical and experimental work on various biodiesel blends on diesel engines reported that B 20 formulae significantly cut combustion exhausts.

Conclusion

Energy security is a matter of strategic concern for all countries around the world. Plant biomass has been an important source of energy in the context of depleting fossil fuel. Biofuel is a clean burning fuel as it is produced from renewable resources, and it is better for environment as a sustainable option. Coconut is an important source of renewable energy. All its parts can be effectively put to use in energy production. Apart from biomass coconut oil is also emerged as an ecofriendly transport fuel which does not causes atmospheric pollution. Coconut oil as biofuel is ideal for improving the air quality through pollution control. This represents a double economic advantage for a developing country like India through reducing the import of petroleum as well as lowering the cost of fuel switch. Rising crude oil prices coupled with the global warming make it compelling case for the need for the development of alternative sources of energy. In the Indian context, the dependence is only expected to grow as the country proceeds on its growth trajectory. Development of bio-diesel as a substitute for fossil fuel will not only help the country attain energy security and protect the environment, but also generate rural employment. Energy is essential for fuelling the ambitious growth rate of our country. While energy security is important, ecological security is equally important. Coconut Oil is a sustainable resource. Moreover, it emits less toxic fumes than fossil fuel. Coconut oil runs smoother and reduces engine knock.

Coconut tree and its most important commercial product, coconut oil are environment friendly alternate source of renewable energy. The present production of coconut oil in the country does not offer much scope for diverting to biofuel purposes. Coconut oil production in the country at present is around 4.5 lakh metric tonnes which is entirely consumed domestically for edible, toiletary and industrial purposes. The country has therefore to initiate stringent steps to enhance the area under coconut especially with high yielders and to target for a manifold increase in the production of coconut oil for energy security and ecological security.

The author is grateful to Mr. Arun Subramony, founder Chairman & CEO of Empereal Inc., Singapore

Coconut oil in lieu of diesel, CDB explores the possibilities

Coconut Development Board is trying to explore the possibilities of using coconut oil as fuel in future. Senior officials of the Board had discussion with the scientists of IIT Chennai on 23rd March 2013 at Chennai on including coconut oil in the bio fuel research of the institute. Since the price of diesel is likely to rise above the price of coconut oil, coconut oil can be used an alternative bio fuel for petroleum products. The Board suggested IIT, Chennai to initiate detailed studies on the techno-economic aspects of coco biodiesel as a part of their ongoing research on biofuels.

Board has already expressed its willingness to collaborate with the research of the School of Engineering and Technology, Institute of Bio-sciences and Biotechnology of the School of Communication and Management Studies (SCMS), Kochi. They have successfully conducted pilot testing of automobile engines running with coconut oil in lieu of diesel. Further studies are in progress. Revolutionary changes are possible in this sector, if 10 to 20% coconut oil is used in diesel vehicles or 20% of the diesel vehicles start using coconut oil as fuel.

Officials of CDB under the chairmanship of Shri. T.K.Jose IAS in discussion with scientists of IIT, Chennai

Technology for conversion of diesel engine to run on cocodiesel

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In the recent times, the world has been facing problems with energy crisis due to depletion of conventional energy sources and the increasing environmental problems. This situation has led to the search for an alternative energy resource, which is not only inexhaustible but also less harmful to environment. Recent developments have seen the price of petrol and diesel rising continuously over the years and there are indications that this trend will continue in the coming years.

Coconut biodiesel used in trucks operated by the Philippine Department of Agriculture

Coconut oil has been used to run engines periodically throughout the South Pacific for decades. It was used as fuel extensively in the Philippines during the Second World War when diesel was in short supply. Since then, the wide availability of diesel throughout the world and difficulties in running engines on coconut oil in cooler weather virtually ended its use in this way. In recent years, however, there has been a revival of interest. This is due to the growing demand for fuel, frequent shortages, and increasing energy prices. There are also concerns about environmental pollution caused by the use of petroleum products. The main drawback with using coconut oil is that it solidifies at temperatures below 24°C. When it becomes solid it can't flow through the fuel lines and filters. This is a definite problem in temperate climates and even in many places in the tropics where temperatures can drop below this point at night. In the tropics coconut oil can be mixed with up to about 20% diesel without any modifications to the engine. Pure coconut oil or a coconut oil/ diesel mix over 20% needs some modification to the fuel system. This problem is overcome by using either a twin tank system or a pre-heater fitted to the fuel line. In the twin tank system one tank is used for diesel and another for coconut oil. The engine is started and stopped on diesel. The exhaust or coolant hoses run through the coconut oil tank to heat it. When the oil reaches a safe operating temperature an automatic switchover device changes the supply from diesel to coconut oil. An advantage of this system is that no coconut oil is left in the engine which might solidify in the injectors when the engine is stopped and cooled down. With a pre-heater on the fuel line, pure coconut oil or a coconut oil/diesel mix can be fed from a single tank.

Most vegetable oils, however, needs to be converted into biodiesel to be of any practical use. Unaltered polyunsaturated vegetable oils like soybean and linseed oils undergo chemical changes in the engine forming tough epoxy-like deposits that can clog valves, injectors, and pistons and cause loss of power and excessive wear.

Coconut oil on the other hand is chemically more stable than other oils and has better burning properties that makes it the best oil for diesel use. Unlike most other vegetable oils, diesel engines can run on 100% coconut oil or a mixture of coconut oil and diesel or coconut bio diesel. Bio diesel is produced through a process called transesterification in which coconut oil is made to react with alcohol, forming an ester-coconut methyl ester or coconut biodiesel.

EPC service truck in Samoa running on coconut oil fuel blend

Advantages of coconut oil

Using domestically produced coconut oil as fuel may help to reduce the import of costly petroleum products. Development of the bio-diesel industry would strengthen the country's rural and agricultural economy. Coconut oil is biodegradable and non-toxic. Unlike fossil fuel it is a renewable fuel that can be produced by regular cultivation and or other feed stocks that are considered as waste. It contains low aromatics and has a reasonable cetane number and hence possesses less knocking tendency. Coconut oil has low sulphur content and hence is environment friendly.

Coconut oil could be used as an excellent diesel substitute in one of the three ways

- It can be burned in a diesel engine either on its own or by blending with diesel. Despite physical and chemical differences between diesel and coconut oil such as the latter's high viscosity, there are reports of pure coconut oil being used in South Pacific countries like Fiji, Papua New Guinea, Samoa, Solomon Islands etc without apparent ill effects. However it is generally considered that the long term use of fuel blends containing over 20% coconut oil is liable to result in very high maintenance costs due to problems such as sticking of fuel injectors and clogging of filters.
- It can be burned in a specifically designed diesel engine with provision of a device that preheats the fuel to increase its viscosity prior to injection. An alternative is the use of a dual fuel engine which starts up using diesel and coconut oil can be introduced once the engine has reached a high temperature.
- Coconut oil can be converted into bio diesel suitable for use in ordinary diesel engine by reacting with methanol and sodium hydroxide as catalyst

Modifications in Diesel Engine for running with 100% coconut oil

Any diesel engine can be modified to run on straight coconut oil. This modification requires the addition of a solenoid operated fuel valve plus the installation of a custom-made metal fuel tank and modifications to the engine coolant hoses. These modifications are done in order to heat the coconut oil so that it has a similar viscosity to diesel fuel. An engine modified to run on 100 per cent coconut oil can still run on diesel fuel.

There are two reliable ways to fuel a diesel engine with coconut oil: make the coconut oil into biodiesel or heat the coconut oil with engine coolant. Hot coconut oil flows easily through diesel engine fuel lines, fuel injector pumps, and fuel injectors. Injectors can spray hot coconut oil as efficiently as they spray diesel fuel. If used with caution, coconut oil can be a reliable diesel engine fuel. The key to fueling a diesel engine with coconut oil is to reduce its viscosity. As the temperature of coconut oil increases, its viscosity decreases. Once the temperature of coconut oil reaches 70°C, its viscosity drops below 20 centistrokes. Although most diesel engine manufacturers specify a maximum fuel viscosity of 10 or 15 centistrokes, most diesel engines can conveniently run on coconut oil with a viscosity of 20 centistroke. When temperature of coconut oil reaches 80°C, its viscosity drops below 10 centistokes, making it reliable for use in all diesel engine fuel systems. An engine running on coconut oil which has been heated to 80° C will have similar injector coking and engine wear to an engine running on diesel. In addition, an engine running on heated coconut oil will experience significantly lower emissions than an engine running on diesel.

Running a diesel engine on straight coconut oil can choke the injectors and cause engine damage. After injector choking occurs, the injectors will begin to spray

incorrect quantities and patterns of fuel. This can result in damage to cylinder walls and piston rings. Since most of the choking occurs when an engine is started on coconut oil under cold conditions, diesel engines running on coconut oil must be started on diesel fuel or biodiesel fuel, then switched to hot coconut oil for the majority of the running time, and then idled for a short time on diesel or biodiesel fuel before being shut off. Idling the engine on diesel or biodiesel before shutting the engine off ensures that the fuel injector pump, injectors and all the fuel lines are clear of any coconut oil.

Parts for modifying a diesel engine to run on coconut oil

The 3-Port Solenoid Valve

Either the 3-port or the 6-port solenoid operated fuel valve can be used for this modification. The only difference between the units is that the 3-port valve comes with 3 of the 6 nozzles capped with rubber caps. To use the 6-port valve for this modification, blocking off or ignoring of the 3 smaller fuel nozzles is suggested.

The Fuel Return Loop

Instead of returning fuel to the diesel tank, the modified diesel engine will pump fuel from the return side of the injector pump into the feed side of the injector pump. The return fuel line will be cut at 60 cm after it leaves the injector pump. After the fuel return line is cut, it will be looped around and connected to the feed line on the injector pump with a tee connector. The injector pump will then pump fuel through the return line, into the feed line, and back into the pump. There will be a circulation of fuel from the injector pump, to the return line, to the feed line and to the injector pump. Meanwhile, more fuel will flow into the feed line. Re-routing the fuel return line into the injector pump eliminates the need to heat a fuel return line to the coconut oil tank.

The Custom-Made Heated Tank

In order to run a diesel engine on coconut oil, it is necessary to build a heated, metal fuel tank. It is possible to build the fuel tank from sheet metal. However, aluminum is preferable because it does not rust. The aluminum tank will he installed in the vehicle and used as a second fuel tank. When the bottom and sides of the aluminum tank have been assembled, a loop of copper pipe is laid in a zig-zag pattern along the bottom of the tank. Two holes are drilled in the bottom of the front wall of the tank. This is the tank wall which will face the front of the car. The ends of the copper pipe are then inserted into the holes so that the ends protrude through the wall of the tank. The ends of the copper pipe are soldered to the aluminum tank. A fuel pickup pipe will bring coconut oil from the bottom of the tank near the copper pipe up to the feed nozzle on top of the tank. The fuel pickup pipe and feed nozzle will be welded or bolted into the top of the tank. An extra option that the tank builder can install in the top of the tank is a fuel tank sender unit and float. The sender unit and float can be wired to the fuel gauge in the dashboard of the vehicle. The last step of the fuel tank building process involves welding the top of the tank, fuel pickup pipe, and feed nozzle to the aluminum tank. The aluminum tank looks like a normal fuel tank when it is finished, except for the two short pieces of copper pipe protruding through the bottom of the front wall of the tank. The ends of the copper pipe that is inside the tank will be connected to coolant hoses from the diesel engine. Coolant from the engine flows through the copper pipe inside the tank. As the engine and coolant heat up, the copper pipe inside the coconut oil tank also heats up. The hot copper pipe heats the coconut oil inside the tank.

The coconut oil tank must have regular automotive fuel cap. This is the cap that you unscrew before filling a car with fuel at a service station. This cap has a small vent in it that allows air to slowly enter the tank as fuel is consumed by the engine. If the coconut oil tank has a tight sealing cap instead of an automotive fuel cap, the tank could collapse in upon itself.

The Hose Within a Hose

The hose within a hose is a length of translucent polyethylene hose inside a larger diameter black hi-temp heater hose. Coconut oil flows in the polyethylene hose and coolant flows in the heater hose, but the two liquids never mix. The purpose of the hose within a hose is to heat the coconut oil from the coconut oil tank to the engine compartment. Since the coconut oil is surrounded by hot coolant, the coconut oil heats quickly and evenly. The two ends of the hose within a hose are identical. One end of the hose within a hose goes in the engine compartment near the solenoid valve. The other end of the hose within a hose reaches next to the coconut oil tank. At each end of the hose within a hose, the

coconut oil line passes through an adapter which is attached to the coolant hose. An o-ring is slid down the coconut oil line until it meets the adapter. A compression nut is then slid down the coconut oil line and screwed onto the adapter, clamping the o-ring around the coconut oil line and making a tight seal between the coolant hose and the coconut oil line. Before the coconut oil line is inserted into the coolant hose, a tee connector is spliced into the hose near each end. At the end of the hose within a hose in the engine compartment, the tee connector connects to one of the car's two heater hoses. A separate coolant hose is attached between the other end of the copper heating pipe and the other heater hose in the engine compartment.

Once the coconut oil heating system is complete, there will be a circulation of engine coolant from the heater hoses in the engine compartment, through the hose within a hose, to the coconut oil tank, and back to the heater hoses. Coolant will flow through the system in the following order:

- From the hot engine
- Through one of the car's heater hoses
- Into the tee connector on the hose within a hose
- Through the hose within a hose
- Out of the tee connector on the other end of the hose within a hose
- Into one end of the copper heating pipe in the coconut oil tank
- Out of the other end of the copper heating pipe in the coconut oil tank
- Into another coolant hose called the coolant return hose
- Into the other heater hose in the engine compartment
- Back into the engine

Coconut oil Filter

A Diesel engine will run on coconut oil that is passed through a 40 micron filter. The coconut oil does not need a filter pre-heater for a 40 micron filter as long as it has been heated at the coconut oil tank and has been flowing in the hose within a hose. 40 micron filters are available for engine oil, hydraulic oil, and farming equipment.

Although a diesel engine will run on coconut oil which is passed through only a 40 micron filter, it is advisable to pass the coconut oil though a 25 or 15, or even 10 micron oil filter before the coconut oil is injected into the engine.

The Fuel Filter Pre-Heater

There are a number of fuel filter pre-heaters which are designed to heat diesel fuel right before it enters the fuel filter. These heaters can heat coconut oil enough to pass through a small micron fuel filter. Fuel filter pre-heaters are either coolant operated or electric. In general, coolant operated heaters will bring coconut oil to a higher temperature than electric heaters.

The Thermo switch (Optional)

A thermo switch also called a thermostat switch is a temperature activated switch. Most automobile radiators have a thermo switch mounted on them. When the radiator gets hot, the thermo switch turns on a fan to cool the radiator. Good thermo switches are adjustable. Adjustable thermo switches are available at automotive parts stores. The use of the thermo switch is not for a radiator, but for the coconut oil tank. The switching of the coconut oil fuel system can be automated by adding a thermo switch to the coolant hose near the coconut oil tank. When the thermo switch senses that the coolant has reached the selected temperature, it will activate the solenoid valve which will switch the fuel from diesel fuel to coconut oil. Even if a thermo switch is installed, switching the automobile back to diesel fuel before shutting the engine off will still have to be done manually. The thermo switch can be installed inside one of the coolant hoses near the coconut oil tank. Adjusting the thermo switch is done by measuring the temperature in the coconut oil tank with a thermometer and comparing it to the temperature in the coolant hose. When the temperature in the coconut oil tank is 70° C, the thermo switch would activate the solenoid operated valve.

Conclusion

Even though there are lot of environmental benefits by using coconut oil biodiesel as as fuel in automobile diesel engines, it is the availability and local cost of coconut oil that would be the driving force behind these developments in the Indian economy. If coconut oil as a fuel for automobile engines has to be a sustainable alternative to diesel, restructuring and replanting of coconut plantations would be required. Also widespread utilization of alternative fuels will require active involvement of engine manufacturers and local mechanics.

Coconut oil as bio fuel - Getting equipped to meet the demand

Deepthi Nair S.
Marketing Officer, Coconut Development Board, Kochi

The talk in vogue is the potential of exploiting futuristic technologies in coconut for the upliftment and sustainability of the sector. And the new entrant is coconut oil as biodiesel. It is not new knowledge as such. Many countries experimented it and undertook commercial production and utilization of coconut oil as biodiesel, either straight or in differing blends. In the coconut sector, though the crop can be put into varied uses, we, in India are still revolving around fresh coconuts, copra and coconut oil. Industry based on coconut has been initiated in form of packed tender coconut water, desiccated coconut, coconut milk powder etc but the number of units are very few to make an impact. The oil industry is the only traditional industry on coconut in existence in our country today. Coconut farmers and the small and medium scale oil industrialists are confident in production of coconut oil than taking the leap to produce other innovative products. It is in this context the use of coconut oil as bio fuel gains importance.

Coconut oil is used as cooking oil in Kerala and neighbouring parts of Tamilnadu and Karnataka. It is used solely as hair oil and body oil in other parts of the country. Increasing demand for coconut oil as cooking oil in other areas is a slow process which needs an attitudinal change in society. The scope for stimulational marketing for creating demand for coconut oil is limited. But there is potential for remarketing of coconut oil ie., creating new uses for the product and thus revitalize demand. And what better utility for coconut oil than its use as bio fuel. Much research was undertaken during the past decade, by CDB and other research institutes to exploit the prospects of coconut oil as bio fuel, but the difference in cost of diesel and coconut oil prevented the prospects of use of coconut oil as bio fuel. Now a time has come when diesel prices and coconut oil prices are comparable. Also fossil fuels are being subject to demarketing since the phenomenon of over demand prevails. The demand for fuels which do not add to the carbon dioxide emission is preferred these days owing to the issues of global warming. Burning of vegetable oils is carbon neutral and it is hoped that the large scale utilization of coconut oil as bio fuel will merge as the futuristic technology for engine fuels. Going by the way the technological advances happen, it is time that we think of equipping our coconut sector to cater to the huge demand that may arise if this revitalization of market demand takes place for coconut oil. CDB is spearheading research on coconut oil as biofuel in coordination with IIT and other research institutes. A replicable model for the use of coconut oil as biofuel is under way.

The scenario of coconut oil production in the country needs to be analysed in this context. The estimation of coconut oil production in the country is to the tune of 5 lakh tonnes per annum. Milling copra is produced predominantly in Kerala and Tamilnadu and to a minor extent in Karnataka, Andhra Pradesh, Lakshadeep and Andaman and Nicobar islands. The average recovery of coconut oil from milling copra is around 62.5%. Coconut oil goes in to cater to the demand of coconut oil as cooking oil and hair and body oil in different parts of the country. In case of an additional demand arising for coconut oil as bio fuel, there is an urgent need for revamping the coconut plantations in the country to cater to the demands.

An estimation was undertaken on the increase in area under coconut necessary for enabling the additional demand generated owing to the use of coconut oil as biofuel. The estimations were made considering that on an average around 7500 nuts go in for the production of one MT of copra.

Increased demand of coconut oil for use directly or as blends in bio fuel: The current productivity of coconut is estimated at 51 nuts/palm/year. If there is an increased demand for 25000 MT of coconut oil for use as bio fuel, the enhancement in area under coconut is to the tune of 33613 ha, i.e., an additional area of 33,613 ha (around 2%) is to be brought under coconut cultivation for catering to this additional demand. This demand for increase in area becomes 1,34,454 ha (7%) if the demand is 1,00,000 MT of coconut oil and 1,68,067 ha

Estimated demand of coconut oil as biofuel MT	Copra to be produced MT	Area under coconut to be increased in ha at different productivity levels expressed in nuts/palm/year			
		51	100	200	300
125000	200000	168067	85714	42857	28571
100000	160000	134454	68571	34286	22857
50000	80000	67227	34286	17143	11429
25000	40000	33613	17143	8571	5714

(9%) if the estimated demand is 1,25,000 MT of coconut oil for use as biofuel.

Increasing area is one way of catering to the increase in demand for coconut oil. Most of the old plantations in the traditional coconut growing states have become senile with low yielding palms and increased incidence of diseased palms. Replanting and rejuvenation of the existing plantations with high yielding varieties will pave the way to catering to the demand for coconut oil as biofuel. There are high yielding hybrids with yield as high as 300 nuts/ palm/ year. Rejuvenation of around 2% of the existing area with hybrids with high yield will be ample to produce around 1,25,000 MT of coconut oil for use as biofuel.

Increasing area under coconut and production of coconut oil for biofuel should be followed up with stimulational marketing for creating demand for the product. Acceptance of petroleum products as fuel for automobiles became popular only after different marketing strategies like stimulational marketing to create demand, developmental marketing to develop demand and maintenance marketing to maintain demand were used in the logical sequence. Now petroleum products are over full in demand. Efforts are made to reduce its demand or demarketing is propagated. Advertisements call for saving every drop of oil that goes waste. Similar market developmental programmes are vital for coconut oil to make an entry, establish and sustain its demand as bio fuel. It is the right time for revitalizing demand for coconut oil as bio fuel. Instead of being late, as always, in knowing, in experimenting, in accepting and in implementing, let us work together towards utilizing this opportunity and make ourselves and the sector equipped for providing coconut oil as biofuel.

Statement of ownership and other particulars about the INDIAN COCONUT JOURNAL

FORM IV

(See Rule 8)

1.	Place of Publication	:	Kochi - 11
2.	Periodicity of Publication	:	Monthly
3.	Printer's Name	:	Sugata Ghose
	Nationality	:	Indian
	Address	:	Chief Coconut Development Officer Coconut Development Board, Kochi - 11, Kerala.
4.	Publisher's Name	:	Sugata Ghose
	Nationality	:	Indian
	Address	:	Chief Coconut Development Officer Coconut Development Board, Kochi - 11, Kerala
5.	Editor's Name	:	Dr. Remany Gopalakrishnan
	Nationality	:	Indian
	Address	:	Deputy Director Coconut Development Board, Kochi - 11, Kerala
6.	Names and addresses of individuals who own the newspaper and partners or shareholders holding more than one percent of the total capital	:	The periodical is owned by the Coconut Development Board which is a body corporate set up by the Government of India under the Coconut Development Board Act, 1979.

I, Sugata Ghose, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd/

Date : 01-03-2013

(Sugata Ghose)

Coconut Oil -Source of Energy that can be cultivated

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Statistical Investigator, CDB, Kochi

"The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in the course of time as important as the petroleum and coal tar products of the present time"
Rudolf Diesel, 1912

Electricity occupies a prime position in the present day life as it is an integral part of day to day life. Kerala state depends mainly on hydroelectric projects since it is blessed with the richness of rivers, lakes and other water resources. Kerala, a state with surplus electricity until recently, now depends on the share from central pool to meet it's domestic demand. Kerala State Electricity Board, the body responsible for the generation and distribution of electricity in the state is equipped with 23 hydroprojects (12 big and 11 small), two diesel power plants and a wind mill. Total installed capacity of all these units comes to 2234.4 MW. Of these Brahmapuram in Ernakulam district and Nallalam in Kozhikode district is running on diesel generators. The wind farm located at Kanjikode in Palakkad district with an installed capacity of 2.025 MW is the only one utilising non-conventional energy source.

Diesel Engine – History

The diesel engine is named after Rudolf Diesel, who presented the prototype at the 1900 World Exhibition in Paris. By running the engine on peanut oil, Diesel proved that the engine could run on a variety of liquid fuels like vegetable oils, animal fats and gasoline. The engines were built strong and robust in early days to handle the broad range of crude oil. As fuel quality and standards improved day by day, especially during the last twenty years, engines have been optimised to run on a specific grade of diesel.

Fuel	Specific Energy (MJ/Kg)	Density (Kg/m^3)	Cetane Number	Viscosity (cST 40^0 C)	Kinetic Solidification Temp(^{0}C)	Flash point (^{0}C)
Diesel	44.0	828	45 – 55	4	-9	>62
Coconut Oil	35.8	925	60 – 70	27	22 – 25	200 – 285
Rapeseed	35.0	915	38 – 42	38	-5 - 0	290 -330
Palm oil	39.6	890	42 - 50	37	35	162
Soyabean Oil	39.6	924	37.9	33	-16	324
Linsed Oil	39.7	929	34.6	29	-24	222

Diesel and Coconut: a comparison as engine fuel

When diesel and coconut oil are compared, it is easy to understand that there are various properties between these two. The most important of these is that coconut oil is much more viscous than diesel and this factor is the main problem in using coconut oil as a fuel. Another important difference between these two is their combustion properties. To be more specific, coconut oil has a higher ignition temperature than diesel. Key physical properties of important vegetable oils are listed in the table below. Rapeseed oil, a very popular vegetable oil fuel used in Europe, is also listed in the table.

From the table, it may be noted that coconut oil stands closer to diesel in characteristics than other vegetable oils.

Chances of getting approval to more hydel power projects are bleak. Water scarcity owing to climatic changes coupled with other environmental problems together form the obstacles in approving more hydel projects. The sky rocketing price rise and scarcity and problems related with the transportation of other fuels like NAFTA and coal force us to depend on other non conventional sources for generation of power. The average price of diesel which stood at Rs.4.57 per litre in 1990 rocketed to Rs.43.60 per litre in 2012. Approximately an increase of 10 times is noticed in the price of diesel. It was during the period in which price fixation of diesel was under the sole control of Government of India. In the near future, once the right to fix the price of diesel is transferred to oil companies, chances of a sharp price increase in diesel is expected.

Studies over the years have proved that the total energy content in one litre of coconut oil almost

Generating power using coconut oil

matches with that of one litre of diesel. Kerala State Electricity Board has 5 generators with 21.32 MW capacity each at Brahmapuram and 8 generators with 16 MW capacity each at Nallalam diesel plants for power generation. These generators are started and initially run over on diesel and subsequently shifted over to LSHS (Low Sulpher Heavy Stock), which is a by product from petroleum. The present cost of which is approximately Rs.41,550/- per MT. It is estimated that around two and a half to three units of power can be generated by using one litre of diesel as fuel in power generators. In other words, the cost of generating one unit of power using diesel alone as fuel is between fourteen and fifteen rupees, where as if coconut oils is used as fuel, the cost goes between eighteen and nineteen rupees. But when we watch the price trend in diesel from 1990 it is observed that by around 2017 the price of both these commodities would be more or less the same and later on the price of diesel may rule above the price of coconut oil. Apart from this, as coconut oil is a green fuel, it will not create environment pollution. It is estimated that one litre of diesel contains 0.67 Kg of carbon, which in turn produce approximately 2.45 Kg of carbon die oxide while burning.

Feasibility studies were conducted to assess the possibilities on the use of coconut oil as substitute to diesel to generate electricity in the Pacific countries like Papua New Guinea, Fiji and Solomon Islands. Similar studies were done in Agalega Islands in Mauritius during 2010-11. Indiaoil (Mouritius) Limited was one of the partners of the studies done in Agalega Islands. The Indian oil companies are also looking for green options for the future.

It is a fact only 30% of the domestic requirements of petroleum products is produced in India and the rest 70% is being imported from eight foreign countries. The main outflow of foreign currency from India is through import of petro products. If a situation comes where diesel can be substituted with coconut oil, atleast for generation of power, obviously it is not only a boon to the country's foreign currency reserve, but also will be the first step put forward to make the coconut cultivation and the farmers of the country prosperous.

Coconut Gets Celebrity Status at the Oscars

Coconut is kicking 2013 off with a smash at the Oscars. Backstage and in the dressing rooms at this year's Academy Awards, Hollywood elite enjoyed Blue Monkey's 100% pure, not-from-concentrate coconut water and new coconut chips. A family-owned company formed in response to the demand for quality, not-from-concentrate coconut water and all-natural juice and coconut blends, the Blue Monkey Coconut Collection makes its coconut water preservative free with nothing added. Naturally a great source of minerals and electrolytes, coconut water is also characteristically low in fat and calories; free of cholesterol and contains a natural balance of sodium, potassium, calcium and magnesium - making it a very healthy beverage. It's no wonder coconut water has received such solid celebrity recognition over the years.

Blue Monkey also premiered new product coconut chips, a delicious combination of salty and sweet. Blue Monkey's Coconut Chips are 100% natural, baked free of preservatives and lightly sweetened with coconut nectar sugar and non-GMO cane sugar. Blue Monkey Coconut Collection, founded in 2010 by the husband and wife team of Simon and Mary-Jane Ginsberg. The Blue Monkey Coconut Collection is a full beverage line including juice blends and instant coconut water. Visit www.bluemonkeydrinks.com for more information.

Coconut oil as a substitute for diesel

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Rudolf Diesel, who presented his prototype engine at the 1900 World Exhibition in Paris was using vegetable oils produced in his own garden as its fuel. The reason was the high price prevailing for petroleum products. Apart from this he also took into consideration the marketing prospects of these environment friendly vegetable oils as well as the financial upliftment of farmers. Later on the abundance of cheap diesel fuel ultimately caused the decline of use of vegetable oils.

Over time the diesel engine has evolved to efficiently burn the fossil fuel powering it. In the early days they were built strong and robust to handle the broad range of crude distillate being produced. As fuel quality and standards have improved, particularly in the past 20 years or so, engines have been optimised to run on a specific grade of diesel. The greatest attraction of today's diesel engine is its highest fuel efficiency.

Vegetable oils have huge scope as bio fuels in the wake of the decreasing crude oil deposits, the expected price hike and the pollution it causes to the environment. Vegetable oils as bio fuels can bring down the carbon deficit from 40 to 60%. The pollution due to the burning of sulpher which is used as lubricants for diesel engines can also be brought down. The usage of vegetable oils can also ensure the financial security of the farmers.

Cars running on recycled vegetable oil in America

Bio diesel

Many chemicals are added to vegetable oils to make the same viscosity as of diesel. There are chances for the rubber, plastic parts and fuel injection pumps of the vehicles to be damaged as the bio diesel passes through it. Another method is mixing kerosene, diesel or petrol with vegetable oils. But if we use these oils directly in the diesel engines, it will affect its efficiency. Producing bio diesel with the same qualities of the present day diesel is very expensive. Compared to bio diesel, coconut oil is non toxic, bio degradable and cost effective. Coconut oil has better combustion properties than other vegetable oils.

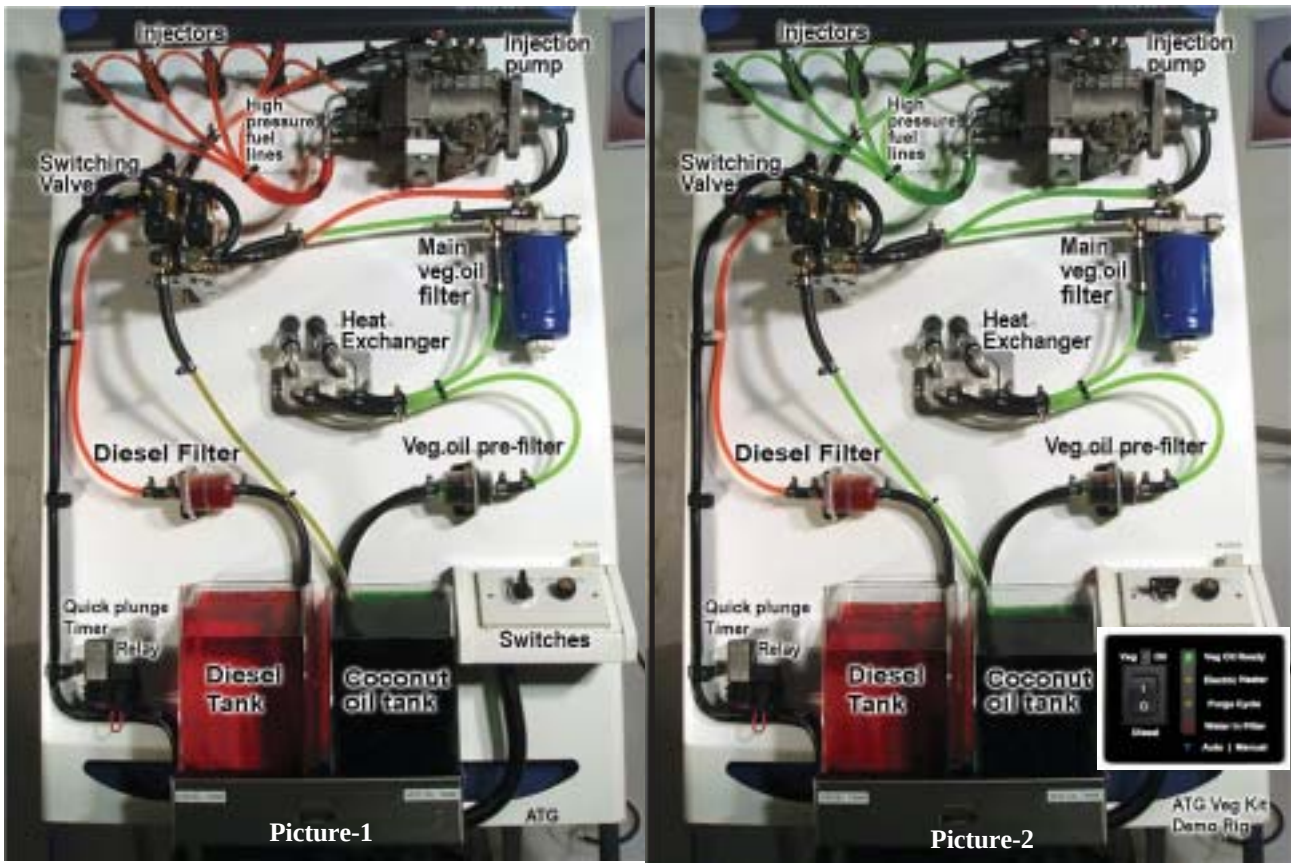
Differences between Diesel and Coconut Oil

Coconut oil like other vegetable oils are 11 times more viscous than diesel fuel. There is also difference in the flash point temperature of coconut oil and diesel. Diesel gets fired when it is 62° C or more hot, while coconut oil and other vegetable oils like rapeseed oil get fired, when it is 200°C and 290°C or more hot respectively. Diesel solidifies at -9°C where as coconut oil at 25°C. Since coconut oil is having this problem the fuel tank also need to be heated when coconut oil is used as fuel in places where the temperature is low.

Eventhough coconut oil is having all these draw backs, when it is heated at 80°C, it is having the same viscosity as that of diesel. Studies have shown that coconut oil burn better than all other vegetable oils in the diesel engines. It is also to be noted that, no change is observed in fuel efficiency also.

Straight Vegetable Oil (SVO) Kits

Certain adaptations have to be made in the modern diesel engines



Demonstration of SVO Kit by M/s. ATG, a Britain based company

for using coconut oil and other vegetable oils as fuel. Diesel conversion kits for using vegetable oils directly in the diesel engines are available in Germany, USA and Britain. Since there is very less demand for this product, the product is not available in Indian markets. Kits suiting to various models of diesel engines and fuel injectors are available today. Kits for car, lorry and generators with different horse power are also available. In foreign countries, oil used for frying in hotels is available on cheaper rates which is used in vehicles and generators after filtration.

Working Method

Diesel and coconut oil is stored in two separate tanks. Engine will be started by using diesel and when it gets heated, it will run on coconut oil. The engine will be stopped again on diesel. Thus the vegetable oil will be fully removed from the engine and it will be ready to be started on diesel again. Only filtered coconut oil shall be used as fuel. SVO kits comprise of oil filters, heat exchanger, switching valve, fuel tank, valve, hose and the electric system. The cost of this kit is above Rs.50,000/- in the foreign market.

Single tank SVO Kit

Single tank SVO Kits using vegetable oils in diesel engine are also available. In this system, engines can be started with vegetable oils. This kit consist of a fuel tank which can be heated, specially made injector pump and fuel injector. The cost of this kit is comparatively higher.

Drawbacks

If SVO Kits are installed in new vehicles, vehicle manufactures may lessen the engine warranty. Vegetable oils with its higher viscosity shall be heated at 80°C or above to obtain the same fuel injection of diesel. Periodical maintenance of the vehicle also shall be ensured. These kits are to be imported to India. Manuals and videos on installing these kits are available. The advantages and disadvantages of these kits are available in various internet discussion forums.

Power generation from coconut oil in Tamil Nadu

Sasi Kumar. C
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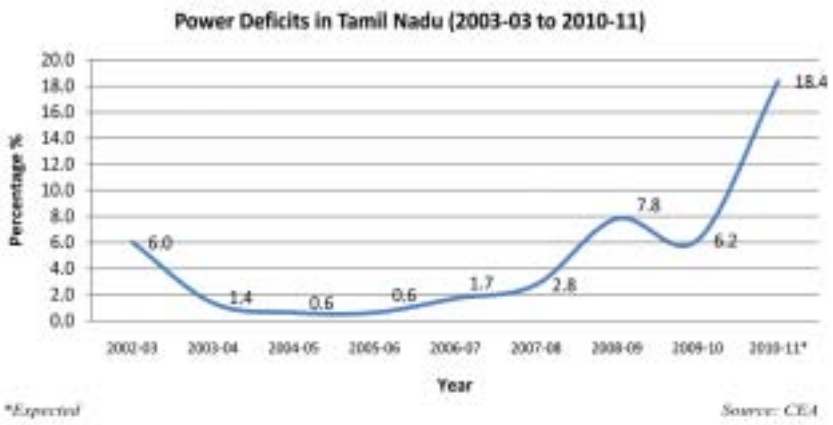
Tamil Nadu, the fifth largest contributor to India's GDP is the most urbanized state in the country with the highest number of business enterprises. Even with its huge power crisis, Tamil Nadu is the second most industrialized state in India. Over the last few years, Tamil Nadu has been facing accute power deficits. According to the Central Electricity Authority (CEA), the state was expected to have a power deficit of around 18% in 2010-11. As a result, the state is now facing huge power cuts. On an average, 6-8 hours of power cuts are being experienced by consumers in the state. The impact of this power shortage is badly affecting the industries, leading to a loss in their efficiency and production.

Power status:

An analysis of the future power scenario in the state and estimation of the power deficit/surplus in 2015-16 was done. The total installed capacity in Tamil Nadu increased from around 13,000 MW at the end of the 10th plan to around 14,700 MW in 2010-11, representing an increase of around 12%.

Coconut oil has been proven to be a very clean fuel with excellent combustion properties. Tamil Nadu is the second largest producer of coconut in the country with an area of 4,10,149 Ha under coconut cultivation and a production of 59656 lakh nuts (2010-11). Considering the crisis, it is high time to think of generating power using coconut oil which is environment friendly.



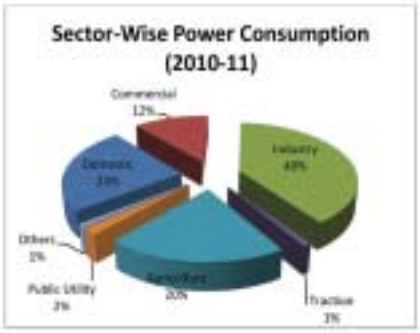
Demand:

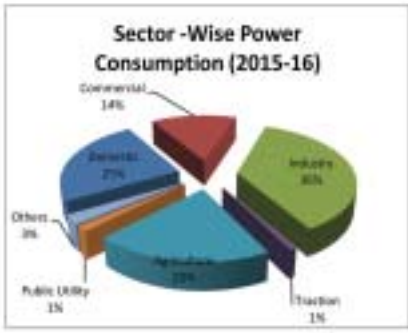
It is estimated that 75,816 MU (million units) is the required demand of power during the current year, 81,122 MU is for next year and 86,796 MU for the subsequent year. To meet such a huge demand, the available source of hydro, thermal, nuclear and wind mill are not sufficient. The sector wise projected energy demand is given in the table.

Demand – Supply Gap

The demand and supply projections have been compared in order to estimate power deficits/ surplus in the state in the next five year.

The above figure shows a deficit of around 13% in the year 2010-11, which is lower than the 18% deficit estimated by the CEA. As is expected, supply of power increases after 2011-12 and levels off after 2013-14. Due to the capacity additions in 2011-12, the state is expected to become power





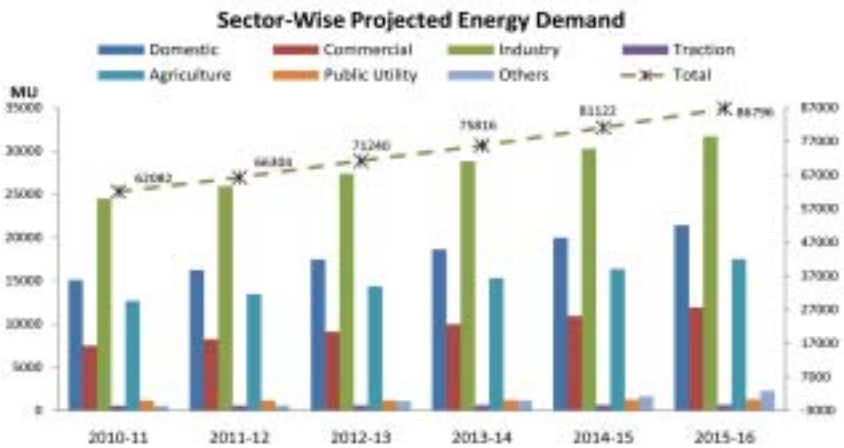
surplus in 2012-13. However, as can be seen from the figure, the lack of capacity addition after 2013-14, can again lead to power deficit. In 2015-16, it is estimated that Tamil Nadu will have a power deficit of around 11%.

Advantage:

It is estimated that 3.73 lakh MT nuts are produced in the state which can produce 2.33 lakh MT coconut oil. Coconut cultivation is considered to be one of the major livelihood support to 3.15 lakh farmers in the state. Biomass power generating units produce a significant economic benefit to the area surrounding the plant. A 10 MW biomass power project can create employment for nearly 100 workers. It is estimated that around 9.45 million tonne dry biomass per year can be generated from the coconut gardens in Tamil Nadu. There are several banks including Indian Renewable Energy Development Agency (IREDA) willing to give loans at reasonable interest rate. Although debt financing is the most common approach, there are several equity investors looking for good projects to invest.

Environmental benefits:

The growing global concern about environmental issues like global warming and climate change, air pollution and public health in the 90's (i.e. Clean Air Act) has increased the interest in alternative fuels, and more importantly the steady rise in the cost of fossil fuel, have altogether received rapidly growing interest in the use of renewable fuels (biofuels).



The increasing amount of greenhouse gases (ghg) such as CO_2 which is causing global warming and climate change, as well as the declining reserves of fossil fuels, and more importantly and the high fuel prices have strongly increased the interest in the use of bio-oils and bio diesel for land transport and power generation.

Carbon benefit:

Diesel engines running on coconut oil as alternative fuel contains insignificant levels of PAH, whereas petroleum based diesel fuel has 1-4% PAHs. Seed oils (soybean, safflower, rapeseed, palm, coconut oil and their esters), which are renewable, non-toxic, biodegradable and their physicochemical properties are comparable with ordinary diesel (OD) fuel are considered as viable bio fuels for diesel engines.

Government benefits:

Medium speed diesel engines can operate well with the use of straight and unprocessed vegetable oil such as coconut oil. Fuel cost is often the largest part of the operating cost of transport operators and diesel power plants. Governments will, however, benefit from renewable fuels in terms of displacement of fuel imports.

Conclusion

While the use of pure coconut oil is certainly feasible to run diesel engines especially if when one is not very discriminating on its effect to engines, its use can be better maximized if it is converted to coco biodiesel. Clean Air is more extensively addressed in coco biodiesel. Coconut oil is currently still more expensive than diesel fuel and there is very small production in relation to the annual demand for diesel fuel.

Courtesy: Athena Infonomics India Pvt. Ltd

Commercialisation of production technology - a success story

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Introduction

Coconut is a perennial palm having a longer life span. Hence the selection and use of planting material of high intrinsic value assumes considerable importance in coconut planting. The quality and excellence of the planting material is detrimental in deciding the future yield. Even when we observe strict adherence to the quality of the soil, irrigation and scientific cultivation practices, if the genetic make up of the planting material is ignored, the productivity will definitely be affected adversely.

Tall varieties are commonly cultivated while dwarf and hybrid cultivars cover less than 1% area. Dwarf and hybrid varieties are known for their early bearing and high yielding characters. Breeders exploited high yielding characters of hybrids in early twenties and released many varieties. Tall x Dwarf and Dwarf x Tall combination are identified for their superior high yielding characteristics. Non availability of dwarf parent varieties is one of the major constrains in hybrid seedling production. Eventhough CPCRI and Agricultural Universities played a major role in identifying many hybrid varieties but could not produce seedlings in the desired quantity. Deejay is the largest producer of hybrid seedlings in India which follows scientific method of hybridization program in its breeding gardens.

A high yielding Malayan Green Dwarf in Magudapathi's garden

A Successful farmer

Shri.P. Magudapathi, is a renowned coconut farmer hailing from Kulathupalayam village in Dharapuram town in Erode District of Tamil Nadu. He started planting Deejay hybrid coconut varieties during the nineties itself. In Dee jay's profile Magudapath is credited as one of the old customers and is facilitated every year. His farm is a referral model farm of his locality. Shri. Magudapathi bought 70 acres of barren land in dry area of Dharapuram belt. He has spent about one lakh rupees per acre for developing a good coconut garden before bearing starts in the third year of planting. He planted 4000 Deejay hybrid seedlings in the entire area. The farm is developed with all basic infrastructures like tractor, tiller,chopper, two open wells, five bore wells, farm house etc in the farm. Water from all the bore wells is being brought to one common well for accumulation in the night hours and pumped to drip system in the day time.

Source of planting materials

Being a lay man, it was his blind faith in the deejay hybrids and his determination that prompted him to plant deejay hybrids alone. His dream came true when his plants started yielding from three and a half years onwards. Heavily bunched coconut trees in his garden attract all. According to Magudapath, Malayan Dwarf variety with heavy bunches performs best among Deejay hybrids. The company claims that their hybrid yields 250 nuts per palm per annum, i.e. 45,000 nuts per ha compared to 14, 000 nut per ha with the per palm yield of 80 nuts of the ordinary tall variety. Deejay hybrids start bearing in 24 months, yields 68% oils, gives 600 ml water as tender nut, higher copra turnout of 8750 kg and highest oil yield of 5950 kg.

Organic farming in coconut

The farm is being maintained as organic for the past seven years. Organic recycling is being adopted in the farm. All the leaves and husks are being cut in to small pieces by a tractor operated chopper and is applied to basins up to two meter radius for soil and water conservation to maintain optimum soil temperature and to facilitate more microbial activities. Goat rearing is being done inside the farm since the past fifteen years by allowing the sheep and goats for direct incorporation of excreta and urine in to coconut basins. Sixty kilogramme of cow dung mixed with cow urine after decomposition is applied to coconut basins per annum in two split doses. One kilogramme neem cake and poultry manure are applied once in three months to every palm. Neem based pesticides are used for controlling pests. Department of Seed Certification, Govt of Tamil Nadu recognised this farm as organically managed farm in all respects and issued a certificate of appreciation. The conversion to organic management leads to a crop lose of up to 40 % in the initial period But it will increase slowly and will pick up fully by the fourth year. The plantation is having better drought resistance after the conversion. The trees are still healthy despite the long spell of drought during the current year.

Cultural practices

The farm is well maintained. Individual palms are taken care off. Each and every coconut basins are covered with coconut leaves and husk powder. A tractor drawn chopper machine is used for making organic recycling of farm waste. The machine chops five tone farm wastes every hour. Cow dung, cow urine, goat excreta and neem cake are the main inputs to the soil. Conservation of soil and moisture plays major role in the cultivation practise. Subabul and glaricidia are being grown in the garden as leguminous crops. All the palms are healthy and does not show any symptom of pest and diseases. Each and every bunch has minimum 25-30 nuts irrespective of its stage. In each harvest not less than one lakh nuts are harvested. The average yield of one palm is more than 250 nuts , thanks to Deejay. Because of its bigger size and high copra content, the coconut from this farm fetches 10-20% higher price.

Mixed farming System

All inter-related activities are followed in the farm. Goat farm with 100 goats, 2000 poultry and a dairy farm with 50 milch animals are maintained for feeding coconut palms. Goats are allowed inside the farm for gracing for in-situ mixing of excreta and urine directly to the basins. Cow-dung along with its urine are allowed to decompose in the pit and applied at the rate of 30 kg once in six months. Thus the nutrient requirement of the palms are met by adopting mixed farming. The experts in TNAU are frequently consulted for proper maintenance of different farming. The units are maintained with high hygienic conditions with all modern facilities.

A model farm

Magudapathi farm is not only a model farm with Deejay hybrid seedlings, it is also a model farm for organic coconut farm for its optimally spaced cultivation system, well managed soil and moisture conservation, good nutrient management, precise irrigation management and mixed farming system.

There is a need for production of high yielding hybrid seedling in our country. Adoption of hybridisation technology in large scale production of hybrids is restricted by limited availability of dwarf palms. Coconut Development Board is supporting farmers/ societies of coconut farmers/ NGOs/ educational institution who are all interested in production of hybrid seedling in large scale for planting atleast 25% hybrid seedlings. Financial assistance up to Rs 35 lakh is given for the project under the scheme Technology Mission on Coconut. As a pioneer M/s Maithri, an NGO made the maiden attempt to produce hybrid seedlings by artificial pollination with the assistance of Coconut Board. In order to bring more area under dwarf plantation, CDB is facilitating for arrangement for procuring dwarf seed nuts for raising dwarf seedling with the financial assistance under nursery programme.

In India there is scope for increasing the production of coconut into manifold provided hybrid seedlings are made available in bulk quantity. Shri.Murugan in Theni, Shri.Umapathi in Udumalpet, Vasanth Velusamy in Anthiyur and Shri Venugopal are few educated farmers who have already initiated hybridisation programme. Regional Research Station Aliarnagar under TNAU has also initiated a massive hybridisation programme in farmer's garden for production of hybrid seedlings.

How to contain Indian current account deficit and achieve trade surplus

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Can we contain our current account deficit by increasing our exports and bring down our imports without affecting the economic growth and momentum of trade reforms over a five-year period through strenuous skillful planning? Is it possible? Is it highly improbable? Our current account deficit Year-on-Year added to our problems on our reserves. The only year when our trade account remained positive was in the financial year 1973-74. It is not possible to bring down the trade deficit to trade credit in the short to medium term. The least we can accomplish is to bring down the trade deficit to appreciable low levels. Even advanced and highly developed nations have deficits in their trading accounts. According to experts, in a situation of a normal country's growth of 13%, the sustainable current account deficit to GDP can at best be around 2.3%. In the case of slower growth, the percentage can go up to 2.5%. That is an ideal scenario.

Integration with world Economy

With greater exposure to the world economy due to integration with global economy, India was able to out-stretch its volume of external trade and financial transaction resulting in several benefits accruing to the country.

Balance of Payment position

What exactly is Balance of Payments (BoP)? It is our transaction with the rest of the world. But how do we pace the increase of our exports? We need to promote productivity based export competitiveness while improving domestic fundamentals that are supportive to the growth of the economy. Our priority should be to reduce imports and boost merchandise exports.

Our basket of products in the import basket includes petroleum, edible oil, crude oil, and gold which by themselves aggregate 2% of the Gross Domestic Product of India. In the beginning years of our independence, our trade deficit was 0.5% to the GDP (1951-1955). It slowly accelerated to 8.7% during 2007-12. Any downswings in the global business cycle or rise in the international prices affect our trade balance.

We need to be reminded that the structure of the economy has changed in a fundamental way with flexible exchange rate and greater depth in financial markets besides much larger foreign investment than in 1991. The only way to sustain capital account deficit levels is to accelerate efforts towards structural reforms for boosting competitiveness, raise growth potential, and bring in more stable inflows into the economy.

Our country is beset with an economic divide that is wide. There is a robust middle class, who in spite of scorching price hike, create real demand backed by increasing purchasing power. As exports slow down, manufacturing contracts, output declines and growth enters a slow yet still pace. Rupee has been eroding its value in the domestic market. Growth in imports has been clogging the available foreign exchange in the country, and how can the country, without doubling its exports and curtailing the import bill, equilibrium the Balance of Payments or India's capital account which has been steadfastly turning negative.

External sector do not behave the way, we want it to, and the patterns of economic behaviour are no longer the outcome of domestic policies but the whims and caprices of international trade. Domestic policies work in a stable external environment to trade; demand has dried up in Europe, US still weak in its recovery, and Euro Zone is ineffectively sliding into recession. Advanced economies shape our export fortunes, but they are vulnerable.

Revisiting Exports

Can we curtail the basket of items in our imports? Are they imperative? Can we reduce the dependence of petroleum products by going in for alternative fuels, or non conventional sources of energy? It must be a continued policy. Can we reduce the import of edible oil by expanding

production, increasing productivity, increasing yield of our oil seeds over a period of time? Can we produce to our optimum capacity, and increase production which will pave for surplus which we can export? Can we reduce production of electricity; reduce oil demand, back up generation system through bio-fuels? Can we change our direction, a little, and bring about a change, so that there will be eventual success. We need to go in for Research and Development. Innovation needs to be cultivated. Coconut Development Board should have an independent R&D lab to enable it experiment with new coconut products which would serve as alternatives to our important import items. Industry-Institute linkages with funding from industry can be part and parcel of Board's R&D Centre.

We always look for instant solutions. There is a mismatch in production; hence, we need to meet consumption with production by going for outright import. When there is lot of inflow of imported oil without License (Import is under Open General license) the enormous supply creates demand artificially in markets fuelling inflation. In order to bring down inflation, we opt for soft measures like decreasing revenue, bringing down duty, which eats into our revenue base. What about our domestic oil seeds or edible oil industry? They continue to suffer because there is no scientific methodology evolved to increase their productivity, production, yield and better returns. Over the plans, our share of outlay for agriculture in the Five year Plans seeing a decline, a pattern difficult to digest when we have a huge farm labour. First Five Year Plan allotted 15.4% to agriculture while in the XII Plan, a modest outlay of 5.2% has been ear-marked. Agricultural growth target of 4% was planned while achievement was 3.2% actual, we still don't get into emergency mode to get agricultural growth to double figures. Water is scarce even in rain fed areas. Water table is empty. Land is arid. Kharif and Rabi crop does not get adequate rain fall. Monsoon has played truant, again and again. Oil seed production shrinks and conversion to edible oil is failing. A serious set of measures need to be initiated to bring the oil seed industry into higher yield, productivity and larger acreage under cultivation. This is the scenario at Ground Zero.

India's Balance of Payment Position (BoT) which is Export minus Imports over the last 22years is given in Table- 1. Even though, India's exports were $ 52 billion in 2003-04, in a span of 5 years, it could grow to US $ 116 billion and $ 303 billion by 2011-12. This is very impressive. However, India's imports during the same period rose up from $ 62 billion to $ 489 billion, creating an alarming current account deficit of US $ 184.8 billion. May be, India had to import capital equipment, accessories for substitution and state-of-the-art machinery, as India was in a growing stage. But the time has come to look at import and export items, and go in for higher export of value added products, reducing exporting raw materials, while curtailing imports which can be manufactured locally or developed locally. This shift must be gradual.

If we would like to take our growth rate to 9% from the present

Table-1. Balance of Payment Position [Last two and half decades]

Sl No.	Year	Exports (US$ million)	Imports (US$ million)	Trade Balance (US$ million)
1.	1989-90	16,612.50	21,219.20	(–)4,606.70
2.	1990-91	18,145.20	24,072.50	(–)5,297.30
3.	1991-92	17,865.40	19,410.50	(–)1,545.10
4.	1992-93	18,537.20	21,881.60	(–)3,344.40
5.	1993-94	22,238.30	23,306.20	(–)1,067.90
6.	1994-95	26,330.50	28,654.40	(–)2323.80
7.	1995-96	31,749.90	36,675.30	(–)4880.40
8.	1996-97	33,469.70	39,132.40	(–)5662.70
9.	1997-98	35,006.40	41,484.50	(–)6478.10
10.	1998-99	33,218.70	42,338.70	(–)9170.00
11.	1999-2000	36,822.40	49,670.70	(–)12,848.30
12.	2000-01	44,560.30	50,536.50	(–)5,976.20
13.	2001-02	43,826.70	51,413.30	(–)7,586.60
14.	2002-03	52,719.40	61,412.10	(–)8,962.70
15.	2003-04	63,842.60	78,149.10	(–)14,306.50
16.	2004-05	83,535.90	1,11,517.40	(–)27,981.50
17.	2005-06	1,03,090.50	1,49,165.70	(–)46,075.20
18.	2006-07	1,26,414.10	1,85,735.20	(–)59,321.20
19.	2007-08	1,62,904.20	2,51,439.20	(–)88,535.00
20.	2008-09	1,85,295.00	3,03,696.30	(–)1,18,401.30
21.	2009-10	1,78,751.40	2,88,372.90	(–)1,09,621.50
22.	2010-11	2,51,136.20	3,69,769.10	(–)1,18,632.90
23.	2011-12	3,04,623.50	4,89,417.40	(–)1,84,733.90

6%, we need to increase our GDP. We need to progressively increase our exports substantially, reduce our imports drastically, bring down our fiscal deficit, and make our current account deficit to around 2 to 2.5% to attain trade stability, economic growth and increase our Foreign Exchange reserves.

In 2011-12, India's exports touched US $ 306 in spite of global grim uncertainties and slowdown in emerging markets. This year, Commerce Ministry of Govt of India, has predicted a gloomy growth, with the export expectations remaining at US $ 280 billion much below US $ 350 billion target. Shrinkage in export trade is expected to catapult trade deficit to $ 193 billion as import trade is expected to reach $ 473 billion in the current fiscal due to high import prices of petroleum, larger volumes of edible oil, gold and other luxury items and products. According to Ministry sources, financial year 2013 will see the trade deficit boom. Lesser exports, higher imports, necessarily produce high trade deficits becoming a challenge to the growing economy as current account deficit will put pressure on the rupee. A weak rupee would also not help Indian exporters as importers who will feel the pinch will look for more discount. The huge deficit will put India's economy on crisis mode.

Explanation

If we have to level the export trade with imports and realize positive balance, we need to skillfully plan higher exports and bringing down certain percentage of import, thus leveraging the BoT/ BoP positions. If we intend to reduce the Balance of Payment position (current account deficit), let us assume that Indian exports is growing on an annualized basis at 25%. We target 10% compulsory growth when we fix the targets, and we should carefully monitor the export growth. When it comes to imports, we are assuming that the imports are growing approximately at 30% annually. We have to clamp a 10% cut on imports compulsorily, so as to slowly make deficit to surplus. We can progressively bring down petroleum product import by considerably lessening the import of diesel by increasing our portfolio of non-conventional sources of energy, reducing the edible oil import, and reducing our import exposure on gold. We need to necessarily curb certain unnecessary imports which have a luxury tag. If this is done, as the table shows, we will become positive in our Trade Balance from 2016-17. [See Table-2.]

Table-2. Suggested action plan to decrease Trade Deficit

Year	Exports (In US$ billion)				Imports (In US$ billion)				Current account surplus/ deficit (US$billion)
	Annual Exports (in US$ billion)	Targeted Growth +25%	% of difference Planned (plus 10%)	Total	Annual Imports (in US$ billion)	Anticipated Growth +30%	% of difference Planned (minus10 %)	Total	
	A	B	C=10% of (A+B)	D=(A+B+C)	W	X	Y=10% of (W+X)	Z=(W+X+Y)	(D)-(Z)
2012-13	280			280	473			473	(-)193
2013-14	280	70	35	385	473	140	60	553	(-)168
2014-15	385	96	48	529	553	166	72	647	(-)118
2015-16	529	132	66	728	647	194	84	838	(-)110
2016-17	728	182	91	1001	838	251	109	980	(+)21
2017-18	1001	250	125	1376	980	294	128	1126	(+)250
2018-19	1376	344	172	1892	1126	338	146	1318	(+)574

In oil importing countries, high petroleum prices can affect output, inflation and the balance of payments in several ways. First, high oil prices can exert downward pressure on income and demand, since for a given exchange rate, more income is needed to pay for the same volume of oil imports. Furthermore, if the exchange rate depreciates to address balance of payments deficits, this leads to further increase in the domestic price of oil, which can trigger inflation.

In addition, higher oil prices can affect aggregate supply. As input costs increase, output may fall, or as profits decline, investment spending may be reduced. If the costs of higher oil prices are passed

on to consumers, this may result in higher wage costs, which may exert further inflationary pressures on the economy.

Finally, if fuel prices are subsidized, as oil prices rise, government expenditures on subsidies will grow, thereby potentially compromising the sustainability of a government's fiscal position.

Diesel prices have been found to be on the increase. Oil companies want diesel price de-regulation. If the prices of diesel and/ or petrol hurl, then, people who will be going in for motor cars will stop their buying spree, which will hit the motor car industry along with that the ancillary industries, auto spare parts original equipment manufacturer, tyre manufacturers, and so on. It will create a devastating effect on the economy as manufacturing growth (automobile sector) will take a hit. Secondly, public transport and railways will be hit by the massive price rise which will result in hike in prices, affecting the common man. These will leave a scar on India's economy.

Administrative Price Mechanism for petroleum products has been done away with. If government de-regulates diesel price, the oil companies which are private sector companies, may be government owned but not having the status of the government, are commercial companies with a profit making motive. There are private sector companies too, supplying diesel to public for a price. They strictly come under Monopoly Trade Restricted Practices Commission rules. The monopoly companies, for every Rupee depreciation, dollar appreciation (and not vice versa), every cost increase in the Petroleum prices in the international market (not for every decrease for the international market), raise prices without looking whether economy is favourable, inflation is rather high, etc.

Reducing trade deficit

How can we reduce our Current account deficit? We need to plan like Fiji. We need to reduce and weed out unnecessary imports. We need to chalk out an action plan to trim our imports. In order to the arrest Fiji's mounting trade deficit, the country started substituting imported diesel for domestically produced coconut oil .In the first half of the third millennium, Fiji produced approx. 9 million liters of coconut oil. In addition, Fiji has programmed to replant and revive 6 million coconut trees. By 2025, Fiji has planned a potential to produce 27.3 million liters of coconut oil thereby replacing 23.7 million liters of imported fuel.

Coconut Oil as an Alternative to Diesel

Coconut oil is a widely used liquid biofuel that is clean, relatively cheap, easy to extract, non-toxic and aromatic. It can also be used for cooking, in spreads, in health food products and cosmetics, and as a medication vector. The leftover coconut meal can be used to make flour, biscuits, chicken pellets and fish food while the husks and shells with their high heating value are an efficient dry fuel, making the common coconut one of the most useful nuts. Energy can be harnessed from coconut oil as done by some Pacific countries. Coconut oil can substitute diesel in which case, production of power from generators will be cost effective. Coconut oil biofuel will decrease the incidence of higher import and steady the Balance of Trade-Balance of Payment Position. When current account deficit gets lower, GDP enlarges. In the past, countries have adopted import substitution policies as a means of reducing dependence on imports, addressing trade imbalances and conserving foreign exchange reserves, by replacing imports with domestically produced goods.

Conclusion

If India needs to come out of negative current account deficit, it needs to structurally change and frame policies which have a long term effect which will sustain growth, increase GDP, manufacturing sector will become buoyant, exports growth will gather pace on higher value addition, imports will decrease, trade deficit will dim, and the fiscal deficit will come down. All these prospects hold bright future for the country.

Year-on-Year, starting from 2013-14 onwards, increase exports by compulsory 25% growth with an incremental target of 10% and the sector that achieves it will get the benefit of additional incentive from Appendix 37 of the Hand book of Procedures, Vol I. The Imports will grow at a pace of 30%, but clamp 10% minus growth, by bringing down import percentage of certain bulk commodities and some who could be eliminated from the import basket. For those industrial sectors

which had reduced imports, support will be given to augment its manufacture or supply through domestic production by giving them Bank Credits at lesser interest. .

Promote productivity based export competitiveness and improving domestic fundamentals that support growth in trade;

We need to concentrate on export promotion, import substitution, and try to check our imports;

We should try to go in for alternate technology so as to convert coconut oil as a biofuel and slowly bring down the import volume of petroleum products. This will decrease emission levels.

Carbon Credits will compensate us for any investment for producing new form of energy.[Kyoto Protocol]

Reduce use of Diesel in Generators instead use bio-fuels; reduce consumption in use of diesels in generators used by industry during power shut downs.

Increase acreage of yield of Oil seeds through time bound specific programme so that edible oil production can be increased by 30% and the deficit be reduced to 20% annually.

In order to reduce gold imports, create 'inflation indexed bonds, interest for special deposits with rate of inflation added for senior citizens, long term interest bearing Bonds (inflation rate added) for long term bonds; (People buy Gold as investment to combat inflation).

In addition to the usual CAGR in exports, an additional 10% growth should be compulsorily fixed and in the case of imports, a 10% cut in imports be made fixed so that by 2015-16, the current account deficit will become positive.

All Commodity related exports should grow by 100% by 2017-18. Coconut exports which is slated to touch Rs 1000 Cr during 2012-13 is targeted to attain Rs 5,000 Cr worth of exports by 2017-18.

Karnataka state buses running on bio fuel

Karnataka State Road Transport Corporation which is having 7000 buses is using 181.56 million liter high speed diesel annually. The State Transport Corporation started using Ethanol diesel mixture with bio fuel with the objective of reducing environment pollution, increasing the fuel efficiency and for reducing the carbon emission. Initially buses with bio fuels started service from Doddaballapur and later on from 10 depots from Mandya, Mysore and Kolar. Karnataka State Transport corporation could make a profit of Rs.14.94 crore through the use of bio fuels. Karnataka is now having around 500 buses running on bio fuels. Corporation is getting ready for running all its buses on bio fuel energy.

This is a good model that can be followed by Kerala and Tamil Nadu. By using coconut oil as bio fuel, both the transport corporations and the coconut farmers can have better prospects. The Kerala State Road Transport Corporation is having 6143 buses which requires 4.3 lakh liter high speed diesel per day. Since the price of diesel has increased manifold, KSTRC is forced to meet the additional expenditure of Rs. 15 crore per month.

We have never dreamt of coconut oil as a bio fuel source saving our transport corporations. Since the oil companies are now selling diesel at non-subsidized rates to bulk consumers like KSRTC,this is the right time to think of alternatives like coconut oil as bio fuel source to save the Road Transport Corporation which is already running on heavy loss.

Value added products from Coconut oil

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Coconut palm belongs to the family of *arecaceae* and is essentially found throughout the tropic area as high humidity, abundant sunlight, regular rainfall and sandy soil favors it growth. Coconut crop is less susceptible to abnormal climatic conditions in comparison to other oil crops. Philippines, Indonesia, India, Sri Lanka, Thailand, Vietnam, Papua New Guinea and Malaysia are the major coconut producing countries. In India cultivation of coconut is spread over the coastal belt and in some interior areas of the southern states.

Coconut oil is extracted from wet coconuts (virgin oil), dry coconuts (unrefined grade) and also by solvent extraction method (refined grade). Use of primitive chekkus as well as rotary ghanis is the oldest method of extraction of the oil which is still in use in some parts of India and Sri Lanka. Copra processing by continuous pressing is another method where extraction of the oil is done with the help of expellers. Hydraulic presses based extraction is done in large installations, which is generally followed by refining. Virgin coconut oil is typically produced by centrifuging freshly extracted milk from wet coconuts to get a concentrated cream, followed by heating up to 80°C before centrifuging again to obtain the oil.

Coconut oil- Industrial applications

Coconut oil is an important source of basic oleochemicals as it has the unique advantage of having its fatty acid composition that is highly desired by the industry, the C12–C18 fatty acid fractions are the primary raw materials for detergent-grade fatty alcohols and the low molecular weight fatty acid fractions comprising of caproic to capric fatty acids used as starting materials for plasticizer range alcohol and for polyol esters, which are also used in formulating new generation of lubricants.

Potential new uses of coconut oil in industry

The use of natural products for lubrication has a history of centuries. Discovery of petroleum played major role in transforming the lubricant sector as the majority of the lubricants which are in use today are based on petroleum sources. It has been observed that millions of tonnes of engine, industrial and hydraulic oils leak into the ground and surface water and are disposed off directly to the environment leading to the contamination of water and affecting the flora and fauna. The most important aspects of health hazards by them are their endangering potential due to bioaccumulation and its consequential toxicity. Growing environment awareness has renewed interest in environment friendly lubricants over the last three decades.

Vegetable oils, in general, by virtue of their properties such as high viscosity index, high solvency, low volatility, excellent biodegradability and low toxicity have become primary choice as a base oils for lubricant applications. In addition, they are renewable and also sustainable. Therefore use of vegetable oils in lubricant application will deliver combined environmental benefit and value addition to agriculture. Though vegetable oils offer specific environmental and sustainable benefits over conventional mineral oil-based lubricants, they have certain performance limitations restricting their use which could be overcome if they are meticulously addressed.

Metal Working Fluids

Metal Working Fluid (MWF) play important role in various machining operations as they are used to lubricate, cool the tool and work piece and also to flush away the chips formed during the process. Traditionally mineral oil based formulations are used for this purpose with other functional specific compounds to make the formulation to meet the ever increasing and demanding metal working requirements. Conventional metal cutting oils are not biodegradable leading it to accumulate in the environment with time and are also highly toxic. It was observed that machine operators exposed to conventional MWFs have increased risk of respiratory disorders and various skin disorders. Further to this with

the introduction of various environmental legislations, today's MWF formulators and users find themselves having to abide by the edicts of these new regulations regarding the impact of formulation chemicals on the environment, as well as machine operator health and safety. In this connection there has been an increasing demand for environmentally acceptable products suitable for use as MWFs. Thus, use of products derived from plant sources can be the ultimate solution as they are not only derived from renewable sources but also safe to use.

Coconut oil based MWF have been developed and its performance was evaluated in terms of various parameters. Studies have revealed that coconut oil based emulsion was stable and comparable to conventional mineral oil based MWFs. Further analysis of coconut oil based MWF showed comparable surface roughness and lesser torque during drilling operation than commercial cutting fluids. It was observed that all the commercial MWFs used were highly toxic where as the MWF developed from coconut oil was non toxic.

Greases

Greases are the semi solid colloidal dispersions of a thickening matrix agent in a liquid lubricant and is used to lubricate machine components where conventional lubricants cannot be used due to various physical constraints. Greases are generally used in total loss situations and thus cannot be recycled or disposed of safely. The soaps used in greases provide the body to keep the grease in place while the oil performs the function of lubrication. Conventionally complex soaps of Li and Ca are used as thickening agents and mineral or synthetic oil for the preparation of greases. Though greases based on vegetable oils have been reported as early as the 1940s, use of vegetable oil based greases are getting prominence only in the recent past as the increased interest in the environmental friendly products. However substitution of the traditional thickening agents with more environmentally friendly and biodegradable materials will make the product more acceptable in the environmental sensitive applications.

Biofuel

The fuels derived from biological sources' can be generalized as biofuels and have history of more than 100 years as the engine developed by Mr. Diesel was tested by using a vegetable oil itself. In 2010 worldwide biofuel production reached 105 billion liters accounting for about 2.7% of the world's fuels for road transport. The International Energy Agency has set a goal for biofuels to meet a quarter of world demand for transportation fuels by 2050 to reduce dependence on petroleum sources.

Coconut oil is used as a biofuel in Pacific islands. In a milestone event on 25th February 2008, a Boeing 747 running on jet fuel made from coconut oil was successfully flown from Heathrow London to Schiphol airport in Amsterdam, paving the way for what can be considered as a revolution in environmentally responsible aviation.

Transformer insulation oils

Power transformers play important role in reliable power system, have different kind of insulation, of them transformer liquid insulation is predominantly used where the condition of oil is used to determine the life span of the transformer. In general mineral oil is used as the transformer liquid insulation, however due to their toxic nature; there is an increased attention towards replacing them with environmental friendly products such as vegetable oil. The coconut oil by virtue of high flash and pour point, moderate viscosity and specific gravity has all the desirable properties recommended for transformer insulation oils. The major issue with the use of coconut oil as transformer oil is limited by its higher conductivity values compared to that of mineral oil which could be improved to a satisfactory limit with different processes.

Two and Four stroke engine oil

Mineral or synthetic oil based lubricants are used in Internal Combustion (IC) engines for lubrication and are disposed into environment after use in an unregulated manner causing immense damage. In this context use of vegetable oils for lubrication application gaining importance as it will have impact on the national economy. Studies have showed the possibility of using coconut oil as a lubricant in two and four stroke engines by chemically modifying them into suitable derivatives to meet the required specifications. Coconut oil is widely used as a two-stroke engine lubricant (2T oil) in autorikshaws and scooters in

Kerala, India. It was claimed by the users that use of coconut oil has improved mileage, better pick up, smoother engine operation, reduced smoke and also increased engine wear in comparison to the conventional lubricant. The studies conducted on a four stroke engine also showed reduction in exhaust emission for both coconut oil in terms of oxides of carbon and nitrogen when compared with standard mineral oil based 4-stroke engine oil in addition to the improved fuel efficiency but increased wear which possibly can be addressed by means of suitable chemical modification.

Coconut oil is used in tropical countries in various forms since thousands of years. Coconut oil has a long shelf life due to the presence high content of saturated fatty acids and is used in baking industries, processed foods, infant formulas, pharmaceuticals, cosmetics and also as hair oil. Coconut oil by virtue of presence of high saturated fatty acids has good thermal and oxidative resistance in comparison to other vegetable oils and has become subject of interest for the different lubricant applications. Studies have also proved that coconut oil has great potential for different new industrial applications like metal working fluid, two and four stroke oil, grease, transformer insulation oil and also as a biofuel provided necessary modifications to the coconut oil is carried out with the addition of suitable additives. This value addition will further increase the use of coconut oil and will not only benefit the farmer but will also help in conserving the environment.

Price trend of coconut oil and diesel

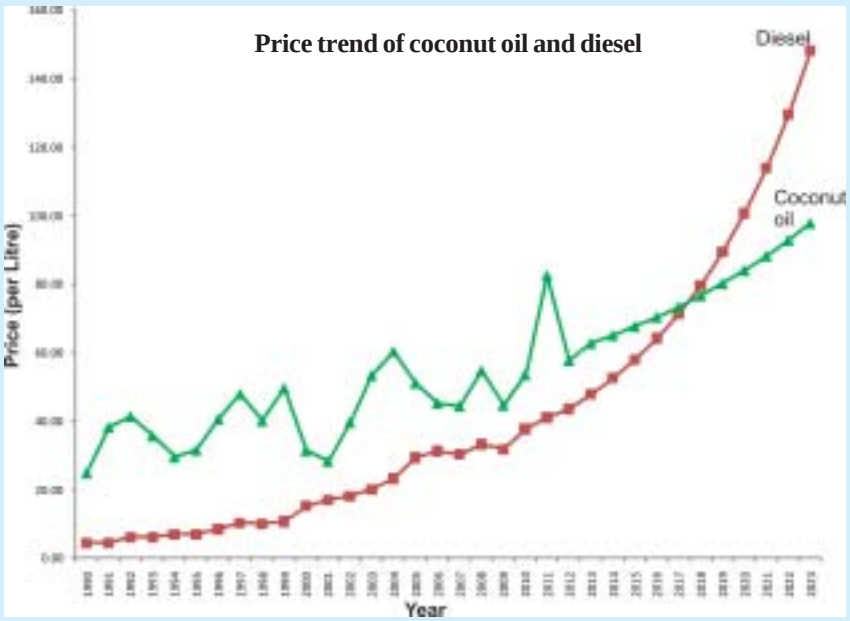
Petroleum products are an integral part of present day life. India with world's second highest population is showing an increasing trend in the consumption of petroleum products. Along with its higher usage, the industry sector of the country is hurdled with its high cost and diminishing resources.

Among petroleum products, diesel is the major produce being imported by the country. The exorbitant usage of diesel is creating environment pollution, global warming and also many health problems. Hence it is high time to think of an alternative that have better qualities than diesel, low production cost, prevalently available and that which does not create environment pollution.

Coconut oil so far used as essential food item is now used as an alternative for diesel. The greatest problem presently faced by the coconut farmers is the low price prevailing for coconut. This sector can be revived if it tap the potential of coconut oil as a source of fuel. Coconut oil as fuel can bring down environmental pollution, unexpected climatic changes and even global warming.

The price of diesel in India during 1990-91 was Rs.4.75 per litre. By 2000-2001 the price increased to 274% and by 2012-13 it reached 949%. If the same growth rate continues in future a growth of 3145% is expected by 2023 which is equivalent to Rs.148 per litre.

The price of one liter coconut oil in 1990-91 was Rs.24.82. Only a growth rate of 13.78% was observed by 2000-01 and by 2012-13 it was only 153%. If the same trend is continued the price of coconut oil will only register 294% increase which is equivalent to Rs.98 per litre. India with world's highest productivity in coconut can no doubt think of producing fuel from coconut oil. This would bring down the import of diesel and coconut will definitely create a new era in the Indian economy.



Preetha Kumari P.V., Statistical Assistant, CDB, Kochi-11

Technology for cheaper and healthier coconut oil blends

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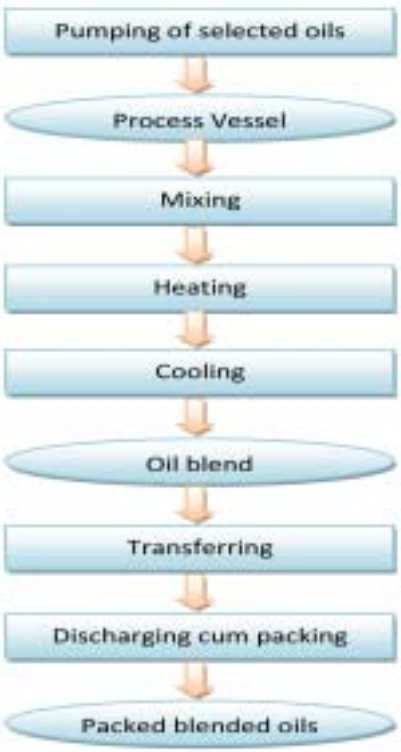
Coconut oil edible oil, has been consumed in tropical countries for thousands of years.Coconut oil is also consumed in the refined form as refined, bleached & deodourized coconut oil (RCNO) and is mainly used in processed foods, ready to eat foods, fried foods such as chips, namkeens etc., for providing mouth-feel, texture and imparting storage stability to cater to the needs of consumers who consume coconut oil based products. Coconut oil is rich in medium chain fatty acids (69.4%), especially lauric acid (50%). Lauric acid and capric acid has been recognized for its unique properties in food use, which are related to its antiviral, antibacterial, and antiprotozoal functions. These fatty acids are found in the largest amounts only in traditional lauric fats, especially from coconut. Also, research has shown that natural coconut fat in the diet leads to a normalization of body lipids, protects against alcohol damage to the liver and improves the immune system's anti-inflammatory response. Clearly, there has been increasing recognition of health-supporting functions of the fatty acids found in coconut oil.

In India, many brands of unrefined coconut oil and refined, bleached and deodourized coconut oil (RCNO) are being traded. The good effect of medium chain fatty acids is that these are easily absorbed and assimilated in the human body, thus making coconut oil a very light and easy to digest oil. However the prolonged use of coconut oil for cooking make the coconut oil consumers deficient in PUFA, MUFA and natural antioxidants which are present in other vegetable oils, while non-coconut oil consumers are deprived from the health benefits of medium chain fatty acids (MCFA) present in coconut oil. Moreover, coconut oil is a costly oil which some of the coconut oil consumers can not afford and thus blending it with other cheaper vegetable oils will therefore produce cheaper coconut oil blends which will be at affordable cost to all the sections of coconut oil consumers. Hence keeping all this in view, an attempt has been made to prepare coconut oil blends with other vegetable oils for both the consumers (coconut and non-coconut) having coconut oil as the major, equal or minor component in the blend.

Figure 1: Blending Process Flow Diagram



Materials

Crude Coconut oil (CNO)- KPM brand, Refined Coconut oil (RCNO)- Cocosilver brand, Refined Sunflower oil (SFO)- Sunpure brand, Refined Safflower oil (SAFO)- Saffola brand, Refined Soybean oil (SBO)- Nutrela brand, Refined Palm oil (PO)- Palm Raja brand, Crude Groundnut oil (GNO)- Diamond brand, Refined Rice bran oil (RBO)- Giva brand, Crude Mustard oil (MO)- Fortune brand, Crude Sesame oil (SESO)- Idhayam brand were procured from the local supermarkets of Mysore. The chemicals and reagents used for analysis were of analytical reagent grade.

LAB SCALE STUDIES

Blending Process for Laboratory Study

A mixture of 100g coconut oil

and other vegetable oils were taken in a 250 ml beaker and were mixed by using a mechanical stirrer for 15 minutes. The mixing speed was kept at 180 rpm (minimum speed of mixing for 100 g blend quantity). Blending of oils was done in this manner under two different conditions i.e. at room temperature (RT: 25-35°C) and optimum temperature for mixing (65°C). Sixty blends were prepared in this manner on lab scale and the physico-chemical characteristics like free fatty acid values, peroxide values, colour values, saponification values and fatty acid composition were done for all the blends prepared on lab scale. The selection of blends for coconut oil consumers was done on the basis of strong CNO flavour in the blends. The blends for non-coconut oil consumers were also prepared in the similar manner by using refined, bleached and deodourized coconut oil (RCNO) and hence the blends were devoid of CNO flavour.

PILOT SCALE STUDIES

Blending Process for Engineering Study

1 Kg each of the selected blends were prepared under various conditions of mixing speed, temperature (RT: 25-35°C) and optimum temperature (65°C) and energy calculations were done and process parameters optimized for production of 500 kg of blend per batch.

Based on the engineering study, about 15.5 litres (14 Kg) batches of the blends were prepared on pilot scale under optimized conditions of speed and temperature and the samples were stored in plastic containers for a day at room temperature. Blending efficiency was studied and the blending process for the large scale production of blends at 500 kg is given in Figure 1. The process yields 3.5tons of the blend of 7 batches per shift of 8hours.

METHODS

Physico-chemical Analysis – conformity with PFA specification

Moisture content, free fatty acid value, peroxide value, saponification value and unsaponifiable matter for the oil samples were determined by using standard methods of AOCS. Colour of the oil samples was determined by using a lovibond tintometer (model-F, Tintometer Ltd, Salisbury, UK.) in the transmittance mode in 1-inch cell. The total tocopherol content in the oil sample was determined by using IUPAC method. Packaging and storage studies were carried out using standard procedures.

Results:

Seven blends for coconut oil consumers have been prepared which have strong coconut oil flavour. Seven blends for non-coconut oil consumers have been prepared which do not have coconut oil flavour and has the flavour of constituent vegetable oil. The blending efficiencies of the oil blends prepared at pilot scale were satisfactory (e”95% efficiency). The prepared oil blends quality characteristics are in agreement with ISI / PFA specifications. The consumer evaluation of the coconut oil blends and vegetable oil blends is satisfactory. The sensory attributes of the coconut oil blends stored in nylon & foil laminate based packaging material remained acceptable during the storage period. Coconut oil is least prone to oxidative rancidity but susceptible to hydrolytic rancidity. Nylon based packaging material adequately preserves the oil blends at room temperature conditions for 5-6 months. Foil laminate based packaging material preserves the oil blends better (10months) than nylon based packaging material (5-6months).

The coconut oil blends for coconut oil consumers are cheaper (10-40%) than coconut oil alone for certain combinations (CNO+SFO, CNO+PO, CNO+RBO). Coconut oil blends have far better antioxidant activity as compared to coconut oil alone. The blends prepared for coconut oil consumers have more health-improving constituents than coconut oil alone. The refined coconut oil blends for non-coconut oil consumers are more stable against oxidation and have increased shelf life and contain healthful medium chain fatty acids of coconut oil. Medium chain fatty acids of coconut oil may impart some health benefits to the oil blends for non-coconut oil consumers while coconut oil consumers will be benefited by incorporation of MUFA, PUFA and natural antioxidants.

SFO is a MUFA & PUFA rich oil while SBO is a PUFA rich oil; individually both SFO & SBO showed good hypocholesterolemic and hypolipidemic effects, but when present in CNO as blend at 50:50 ratio SFO showed marginal effect whereas SBO showed good effect.

Investors' meet held at Hyderabad

The first investors' meet of the coconut processing sector in Andhra Pradesh was held at Hyderabad on 16th March 2013. Smt. Minnie Mathew IAS, Chief Secretary Govt. of Andhra Pradesh and former Chairman, Coconut Development Board inaugurated the programme. The meeting was organised by Coconut Development Board in association with Federation of Andhra Pradesh Chamber of Commerce and Industry (FAPCCI), Hyderabad. In her inaugural address she pointed out that processing and value addition in coconut sector need to be intensified further for further positioning India in the global coconut scenario. Coconut Development Board under its Technology Mission on coconut is extending financial assistance for setting up value added coconut processing units. It is high time to abolish the practice of fixing the price of coconut based upon the price of coconut oil and hence coconut farmers should think differently.

Smt. Minnie Mathew IAS, Chief Secretary, Andhra Pradesh delivering the inaugural address

Shri. T.K. Jose IAS Chairman, Coconut Development Board in his presidential address informed that the state government of Andhra Pradesh has better potential with more focus and convergence for developing coconut enterprises. There is scope for setting up a minimum of 500 tender coconut Water units in the country to cater to the demand for packed tender coconut water. At present Coconut Development Board is trying to promote and market a basket of value added products viz packed tender coconut water, desiccated coconut powder, virgin coconut oil, ice cream milk and milk powder in JnNURM cities. There is scope for setting up 1600 chips units in all main metros having population of more than one crore. Like the government of Kerala and

Presidential address by Shri. T.K. Jose IAS, Chairman, CDB

Karnataka the AP also need to provide an extra subsidy of 25 percent in addition to the 25% subsidy being provided by CDB under Technology Mission on Coconut. There is vast potential for promoting neera, the vascular sap of immature coconut inflorescence. The palm sugar produced from neera is having only one third glycemic index of white sugar. Instead of prescribing iron and folic acid to children, one table spoon of neera can be administered against iron deficiency. Coconut producing countries like Indonesia & Philippines are providing much benefit to the growth of their economy through neera tapping. Indonesia had exported 6 lakh metric tonnes of palm sugar which had fetched a return of 1.3 billion dollar. Shri T.K.Jose IAS appreciated the activities of CPS in Srikakulam district wherein they have formulated 120 societies with the initiative of the district collector.

Dr.Rajat Kumar, IAS, Commissioner of Industries was the Guest of Honour. Shri. Devendra Surana, President, FAPCCI, Smt. K. Rama Devi, President ALEAP, Shri. K. Bhaskar Reddy, Chairman Agriculture and Food Processing Committee, FAPCCI and Shri. M.V. Rajeshwara Rao, Secretary General, FAPPCI spoke on the occasion. Shri Sugata Ghose, Chief Coconut Development Officer welcomed the gathering.

The participants

The inaugural session was followed by a technical session. Dr. K. Muralidharan, Director CDB presented a paper on value addition & by product utilization in coconut and financial assistance offered under TMOC. Dr, George V Thomas, Director, CPCRI, Kasargod in his presentation highlighted the various new technologies developed by CPCRI in coconut processing. Shri. Y. Sudheer, Associate Vice President GMR Group, Kakinada; Shri. B. J. Jawahar, Anu Coco Food Products and Shri. Swaroop Chandan shared their experiences in coconut processing. State Bank of India and State bank of Hyderabad highlighted their various financial schemes available for promotion of coconut based industries. Shri. K R Kutty Krishnan, Deputy Director, CDB proposed vote of thanks. Around 100 entrepreneurs attended the meeting.

Technologies developed and ready for transfer to entrepreneurs by various reputed institutions like Coconut Development Board, Defence Food Research Laboratory and Central Plantation Crops Research Institute were presented in the meeting.

113th Board meeting held

The 113th meeting of Coconut Development Board was held on 16th March 2013 at Hyderabad. Shri. T K Jose IAS, Chairman, Coconut Development Board presided over and members of the Board, Shri. Jagadeesh Singh, Central Excise and Customs Commissioner, Dr. Gerorge V Thomas, Director, CPCRI, Adv. Varkala B Ravikumar, Smt. K R Netravathi and Shri. R Kaliselvan took part in the meeting.

A view of the Board Meeting. Seen are Shri. T K Jose IAS, Shri. Jagadeesh Singh, Dr. Gerorge V Thomas, Adv. Varkala B Ravikumar, Smt. K R Netravathi, Shri. R Kaliselvan, Shri. Sugata Ghose and Dr. A.K. Nandi

Board approved the list of international exhibitions proposed to be participated by the Board in 2013-14. The list includes 11th Global Festival- 2013, Kulalumpur, Malaysia, Summer Fancy Food Show, Washington, America, Fine Food, Sydney, Australia, Anuga, Germany, Gulf Exhibition, Dubai and Lyon International Fair, France during next financial year.

Monthly operations in coconut gardens

April

Andaman & Nicobar Islands:

Continue irrigating the nursery. Irrigate the palms if dry spell prevails. Repair bunds and channels to facilitate drainage. Collect seednuts. Lay out nursery for raising seedlings. In sandy and sandy loam soils dig pits of 100 cubic cm and in clayey soils of 60 cubic cm for replanting and under planting at a distance of 7.5 meters both ways. In single hedge system provide spacing of 6m x 9m and in double hedge 6m x 6m x 9m. The rows should be aligned in north south direction. In water logged areas raise mounds with alternate layers of clay and sand for replanting. Take linear trenches of 50 cm width and 60 cm depth between rows of palms. Arrange husk in these trenches layer by layer with concave surface facing upwards and cover with soil. Give a prophylactic spray with 1% Bordeaux mixture to all the palms in areas where the bud rot is occurring every year. Cultivate vegetables and other intercrops in the inter spaces.

Andhra Pradesh: Irrigate the garden regularly. Clear the irrigation channels, if necessary. Take all measures to conserve soil moisture by mulching coconut husk, coir pith, dry coconut leaves etc. in coconut basins. Continue collection of seednuts from selected mother palms. Plough the garden and broadcast green manure seeds for the enrichment of soil fertility. To enrich soil fertility apply tank silt in the garden. Tie the buckled bunches to avoid shedding of nuts. If the attack of blackheaded caterpillar is noticed spray the affected palms with 0.02 percent Dichlorovos or 0.05 percent Malathion and release larval or pupal parasites 3 weeks after spraying. If the attack of mite is noticed, spray neem oil formulation containing 0.004 percent Azadiractin (Neemazal T/S 1% @ 4 ml per litre of water). The spray droplets are to be directed towards the second to fifth immature bunches.

Assam: Transplanting of quality seedlings should be done in the main field. Irrigation should be continued if required. First split dose of fertilizers i.e. 500 gram urea, 1000 gram single super phosphate (SSP), 1000 gram muriate of potash (MOP) and 25 gram borax should be given during this period. The quantity of potash may be increased if nut fall and cracking of nuts are noticed. Prophylactic spray should be given to coconut trees by 1% Bordeaux mixture. Leaf axils must be filled with a mixture of 25 gram Sevidol (8G) and 250 gram of fine sand, if not done in March against the attack of rhinoceros beetle.

Bihar: Clean the irrigation channels, if necessary and continue frequent irrigation in the garden during summer months. In the case of basin irrigation 200 liter of water is adequate once in 4-5 days depending upon the moisture retention capacity of the soil. Young palms upto the age of 3 years should be irrigated at least once in 3 days. Young seedlings should be shaded properly. If there is water scarcity drip irrigation method can be adopted to save water. Mulch the coconut basins. Clean the drainage channels. Clean the coconut crowns and apply plant protection chemicals. If bud rot is noticed, cut and remove all the affected tissues and apply Bordeaux paste.

Chhattisgarh / Madhya Pradesh: Clean and if necessary deepen the irrigation channels and continue irrigation. Plough the land and destroy the weeds. Remove weeds from the basins. Take basins around the palms and mulch with coconut leaves, coir pith etc. Take plant protection measures in the garden. Harvest the intercrops such as turmeric and vegetables.

Karnataka: Continue irrigation and collection of seednuts from selected mother palms. Start preparing the nursery beds for sowing of seednuts. Nursery should be raised on well drained light textured soils having irrigation facilities. Application of sufficient quantities of organic manures and balanced doses of inorganic fertilizers is recommended to improve the

nutrient status of the soil to meet nutrient requirements of the palms. Apply organic manure (FYM) @ 50 kg and neem cake @ 5 kg per palm per year. Keep a watch on the incidence of leaf eating caterpillar if the temperature is high and adopt appropriate measures if not taken earlier. If the attack of the mite is noticed, spray neem oil formulation containing 0.004 percent Azadirachtin (Neemazal T/ S 1% @ 4 ml per litre of water) or root feed @ 7.5 ml with equal quantity of water.

Kerala / Lakshadweep: Plant coconut seedlings if there are facilities for irrigation. The new roots will sprout before the onset of monsoon and derive the full benefit of the rains. This will help the seedlings to tolerate the water logging condition during monsoon. Continue collection of seednuts during the month. Apply river silt or tank silt to the palms at the rate of half tonne per tree in sandy type of soil. Take pits for new planting/ underplanting of coconut. If the attack of mite is noticed, spray neem oil formulation containing 0.004 per cent Azadirachtin (Neemazal T/S 1% @ 4 ml per litre of water). The spray droplets are to be directed towards the second to fifth immature bunches.

Maharashtra / Goa / Gujarat: In low-lying areas where coconut is planted on bunds, clean the channels between bunds, strengthen and level up bunds by adding top soil dug up from the channels. Continue collection of seednuts and store the collected seednuts in shade. Take pits for planting of seedlings.

Orissa: Continue irrigation. Remove weeds and mulch the basins with dry coconut leaves and coir pith. Husk burial may also be taken up in the basins. If attack of pests is noticed, adopt integrated pest management practices comprising mechanical, chemical and biological methods. For the management of leaf eating caterpillar, cut and burn the severely infested lower whorl leaves and spray the under surface of the lower leaves with 0.02% Dichlorovos. Release parasitoids like braconids. To manage the rhinoceros beetle infestation, hook out the beetles using a beetle hook. Fill up the inner most 2-3-leaf axils with 25 g Sevidol (8G) mixed with 250 g fine sand per palm. Treat the manure pits with Carbaryl (50WP) at 0.01 % concentration. Root feed Azadirachtin 10000 ppm (7.5 ml) with 7.5 ml water against the eriophyid mite attack.

Tamil Nadu / Puducherry: Continue irrigation in areas where summer showers are not received. Apply tank silt in gardens with sandy soils to increase the soil fertility and to improve soil condition. Continue collection of seednuts. If the attack of mite is noticed, spray neem oil formulation containing 0.004 per cent Azadirachtin (Neemazal T/S 1% @ 4 ml per litre of water). The spray droplets are to be directed towards the second to fifth immature bunches. If the attack of blackheaded caterpillar is noticed spray the affected palms with 0.02 percent Dichlorovos or 0.05% Malathion and release larval or pupal parasites three weeks after spraying.

Tripura: Plough the interspaces for proper aeration of the soil. Clean the garden by weeding. Improve drainage facilities. Transplanting of seedlings should be taken up during this month. Prepare nursery beds for sowing of seednuts. Prepare raised beds in areas of poor drainage. The seedbeds are to be treated with 0.05 percent Chlorpyrifos twice at 20-25 days interval to protect the nuts from the attack of termites. Spray 1% Bordeaux mixture on coconut palms if bud rot is prevalent. Fill the top most 3-4 leaf axils of the palms with a mixture of 25g Sevidol (8G) with 250g fine sand per palm to protect the palms from rhinoceros beetle and red palm weevil.

West Bengal: Continue irrigation. Select the site for new plantation and dig out pits. Search for rhinoceros beetles on the crowns of the palms with beetle hook and kill the beetles. Fill the top most 3- 4 leaf axils of the palms with a mixture of 25g Sevidol (8G) mixed with 250g fine sand. Take up cultivation of intercrops like ginger, turmeric and other seasonal vegetables.

Market Review - February 2013

Deepthi Nair S.
Marketing Officer, CDB, Kochi

Highlights

- The price of milling copra and coconut oil expressed a downward trend at all the major markets during the month under report.
- The international price of coconut oil expressed an upward trend during the month under report.

The month of February witnessed a downward trend in the prices of copra and coconut oil at important markets in Kerala. The price of coconut at Nedumangad market remained steady through out the month.

COCONUT OIL

The price of coconut oil quoted at all the major marketing centres in the country expressed a downward trend during the month under review.

The monthly average price of coconut oil at Kochi was Rs. 6715/- per quintal. The price of coconut oil at Alappuzha market also moved in tune with the price behavior at Kochi market. The monthly average price was Rs. 6703/- per quintal at Alappuzha market and Rs.7083/- at Kozhikode market. The prices at Kochi, Alappuzha and Kozhikode markets were 4-5% lower than the prices prevalent in January 2013.

MILLING COPRA

The monthly average prices of FAQ copra recorded at Kochi market was Rs.4680/- per quintal. The monthly average prices of Rasi copra at Alappuzha market was Rs.4567/- and at Kozhikode market was Rs.4554/- per quintal. The prices at Kochi, Alappuzha and Kozhikode were 4 to 5% lower than that of the previous month. The Minimum support price of milling copra has been fixed at Rs. 5250/- per quintal for 2013 season

The monthly average prices of milling copra at Ambajipeta market in Andhra Predesh was Rs.4340/- per quintal compared to Rs. 4440/- recorded during the previous month.

EDIBLE COPRA

The monthly average prices of Rajapur copra at Kozhikode market was Rs.4893/- per quintal, which was about 6 percent lower compared to the price of the previous month.

The monthly average prices of ball copra at Kozhikode market averaged at Rs.4380/- per quintal.

The monthly prices of ball copra at APMC market Tiptur, in Karnataka averaged at Rs. 4895/- per quintal in February 2013 while it was Rs 5800/- in Bangalore and Rs.4852/- in Arsikere.

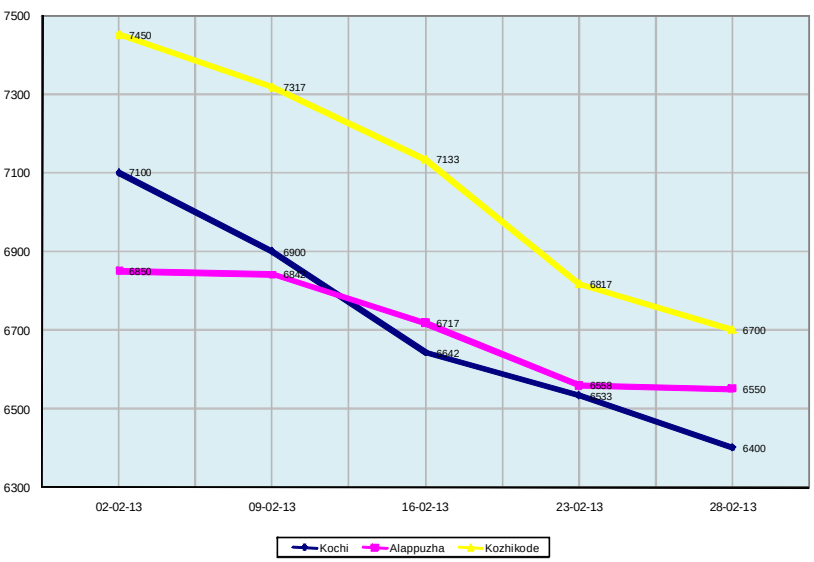
The minimum support price of edible copra has been fixed at Rs.5500/- per quintal for 2013 season.

DRY COCONUT

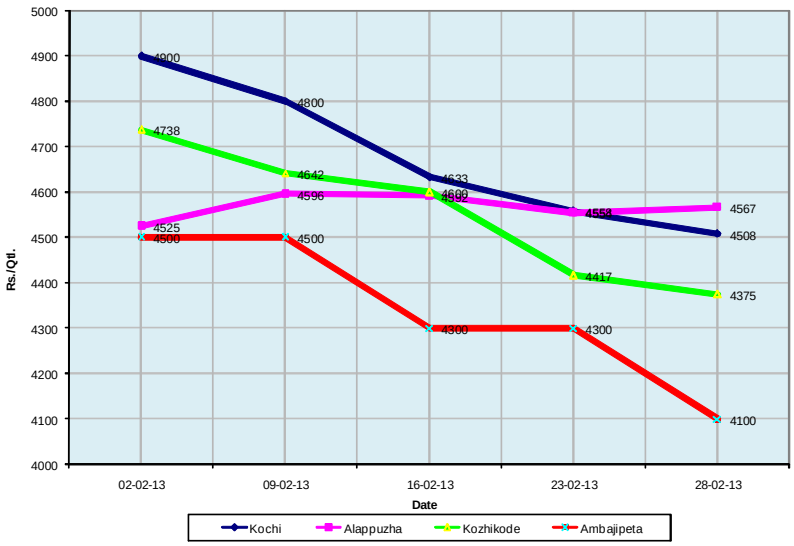
The monthly average price of dry coconut was around Rs.4100/- per thousand nuts at Kozhikode market which was about 4 percent lower than that of the previous month.

COCONUT

The monthly average price of Rs.7200/- per thousand nuts for dehusked coconut at Nedumangad market remained the same as that of the previous month.



Price behaviour of coconut oil during February 2013



Price behaviour of milling copra during February 2013

Arsikere APMC market recorded an average of Rs.6323/- for thousand partially dehusked nuts which was marginally lower than that of previous month.

The monthly average prices of partially dehusked coconut at Bangalore APMC market was Rs.7400/- which was about 11 percent higher than that of previous month.

The monthly average price of partially dehusked coconut Grade-1 quality at Mangalore APMC market improved to Rs.10,100/- per thousand nuts which was about 4 percent higher than that of the previous month.

The monthly average price of coconut was Rs.33/- at Sonitpur and Rs.36/- at Guwahati in Assam, while it was Rs.50/- at Aizawl in Mizoram and Rs. 28/- at Agartala in Tripura.

TENDER COCONUT

The retail prices of tender coconut at Kochi market ranged from Rs.20 to 25/- per nut. The monthly average price of tender coconut at Guwahati in Assam was Rs.26/- per nut while it was Rs.40 at Aizawl in Mizoram and Rs. 20/- at Agartala in Tripura.

INTERNATIONAL PRICE

The monthly average price of US $867 per MT for coconut oil in Europe (C.I.F. Rotterdam) for the month of February 2013 was about 3 percent higher when compared with the price in previous month and lower by about 40 percent compared to that of the corresponding month last year. The monthly average price of US$ 551 per MT for copra was about 12 percent higher than that of the previous month and about 62 percent lower than that of the corresponding month last year.

The domestic price of coconut oil during the month of February 2013, in Philippines was US$807 per MT and in Indonesia; the price was US$802 per MT. The international price of Palm oil, Palm kernel oil (RBD) and Soybean oil were US$855, US$850 and US$1194 per MT respectively.

Market Price

Date	Coconut Oil			Milling Copra				Edible Copra	Ball Copra				Dry coconut	Coconut	Partially dehusked coconut		
	Rs./Qtl.												Rs./1000 nuts				
	Kochi	Alappuzha	Kozhikode	Kochi (FAQ)	Alappuzha (Rasi Copra)	Kozhikode	Karkala	Kozhikode	Kozhikode	Tiptur	Bangalore	Arsikere	Kozhikode	Nedumangad	Arsikere	Bangalore	Mangalore (Grade-1)
02-02-13	7100	6850	7450	4900	4525	4738	4500	4913	4413	4881	5800	4803	4100	7200	6500	7000	10000
09-02-13	6900	6842	7317	4800	4596	4642	4500	4888	4375	4870	5800	4804	4100	7200	6417	7000	10350
16-02-13	6642	6717	7133	4633	4592	4600	4300	4908	4392	4829	5800	4788	4100	7200	6367	7000	10050
23-02-13	6533	6558	6817	4558	4554	4417	4300	4892	4385	4982	5800	4962	4100	7200	6183	8000	10050
28-02-13	6400	6550	6700	4508	4567	4375	4100	4867	4333	4915	5800	4905	4100	7200	6150	8000	10050
Average	6715	6703	7083	4680	4567	4554	4340	4893	4380	4895	5800	4852	4100	7200	6323	7400	10100

Source: **Kochi:** Cochin Oil Merchants Association and Chamber of Commerce, Kochi - 2, **Kozhikode:** The *Mathrubhumi* daily **Alapuzha:** The *Malayala Manorama* daily, **Arsikere :** APMC, Arsikere
Price quoted for *office pass* copra at Kozhikode and *Rasi* copra at Alappuzha markets. NT : No transaction