Biofuel Growers Market Network

- A Success Story

Biofuel Growers Market Network – A Success Story

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Foreword

The energy requirement has been a major concern currently across the globe. The ever increasing population, fast depleting fossil fuels, global warming and climate change are the major causes of this concern. The energy crisis in future is being felt in the tropical world with large number of developing countries. The situation is no different in developed countries too as they account for high per capita consumption of energy in the world. Hence, alternative and eco-friendly energy resources such as biofuels, (biodiesel, bioethanol) have lately become important and have successfully been tried and used across the world. Several plant species have been used as source of biofuel. Southeast Asia and Pacific nations like Indonesia, Malaysia, and Singapore concentrate on large plantations of palm oil as a source for biodiesel, while Thailand and Philippines concentrate on coconut oil and Myanmar on *Jatropha*. Studies in the Indian sub-continent on various biofuel programs are underway with main focus on *Jatropha*, especially for production of biodiesel. However, the traditionally available feed stock resources like *Pongamia* and host of other local non-edible oil yielding species are well known.

In India, use of biofuel feed stocks for production of eco-friendly fuel has drawn attention of both producers and users. The policy makers are keen as these fuel species bring multiple benefits to farming communities and to the industry. India has more than 300 plant species that are suitable for biofuel production and can thus be exploited. The important common species, which can provide feed stock for biofuel production, include *neem* (*Azadiracta indica*), *honge* (*Pongamia pinnata*), *hippe* (*Bassia latifolia*), *turuka haralu* (*Jatropa curcas*) and paradise tree (*Simarouba glauca*).

This publication entitled "Biofuel Growers Market Network- A Success Story" by Dr. K. Narayana Gowda is rather timely and describes the potential and usefulness of a successful model which can be replicated under similar situations across the states/countries with modifications to suit to the local needs. The publication embodies six important sections, i) introduction giving status and scope alongwith marketing systems, ii) initiatives taken at the University of Agricultural Sciences, Bangalore, iii) launching of biofuel growers association, iv) benefits to farmers, v) success of the model and vi) future prospects.

The Asia-Pacific Association of Agricultural research Institutions (APAARI) has been publishing success stories on various aspects of agricultural research and development that have large scale impact and have brought tangible benefits to both farmers and consumers alike. So far, more than 40 success stories on diverse topics have been published by APAARI, the details of which are available on APAARI website (**www.apaari.org**).

We are thankful to Dr. K. Narayana Gowda for synthesizing this valuable information relating to the efforts made at the University of Agricultural Sciences (UAS), Bangalore. It is our expectation that APAARI members and stakeholders will find this publication both informative and of real practical value.

Raj Paroda
Executive Secretary
APAARI

Acronyms

ATM	:	Any Time Money
DARE	:	Department of Agricutural Research and Education
DG	:	Director General
DOLR	:	Department of Land Resources
GKVK	:	Gandhi Krishi Vignana Kendra
GOI	:	Government of India
HSD	:	High Speed Diesel
ICAR	:	Indian Council of Agricultural Research
INR	:	Indian Rupees
KSRTC	:	Karnataka State Road Transport Corporation
KMF	:	Karnataka Milk Federation
KVK	:	Krishi Vigyan Kendra
MPCS	:	Milk Producers Cooperative Society
NREGA	:	National Rural Employment Guarantee Act
PRA	:	Participatory Rural Appraisal
RBGA	:	Rural Biofuel Growers Association
RBRC	:	Rural Bio-Resource Complex
UASB	:	University of Agricultural Sciences, Bangalore
R&D	:	Research and Development

BIOFUEL GROWERS MARKET NETWORK – A SUCCESS STORY

1. Introduction

Energy requirement has been a major concern for the 21st Century across the globe. The ever increasing population, fast depleting fossil fuels, global warming and climate change are the major causes for the concern. The energy crisis in future is already felt in the tropical world with large number of developing countries. The situation is no different in developed countries too as they account for high per capita consumption of energy in the world (Anonymous, 2002). Hence, alternative and eco-friendly energy resources are the hot pursuit in this context. But, not all the alternative sources are suitable for mass usage as they have their own limitations of adaptability in different situations and availability in the required scale of economy. However, biofuels, viz., biodiesel and bioethanol are very promising and have been successfully tested across the globe for their suitability with all categories of users.

South East Asia and the Pacific nations like Indonesia, Malaysia, and Singapore having large plantations of oil palm concentrate on palm oil as a source for biodiesel harnessing the benefits of equatorial region, while Thailand and Philippines concentrate on coconut oil and Myanmar on *Jatropha oil* (Christina, 2009). Studies in the Indian sub-continent on various biofuel programs especially on production of biodiesel are underway with main focus on *Jatropha*. However, the traditionally available feed stock resources like *Pongamia* and host of local non-edible oil yielding species are well known. The experience of several southern states

like Andhra Pradesh, Karnataka, Tamil Nadu is noteworthy with substantial benefits to farmers growing *Pongamia* on marginal lands/ravines, uncultivated waste lands as additional income. The adoption of National Rural Employment Guarantee Act (NREGA) was considered as one of the important vehicles to move forward the biofuel species. The farmers are expected to get about US$ 800-1,400 per ha of *Pongamia* plantation with additional income from intercropping to the tune of US$ 600-1,000 per ha which is a promising feature of cultivation in most of the 30 million ha of waste lands (Prabhakar and Elder, 2010).

In the Indian context, the concept of using biofuel feed stocks for production of eco-friendly fuel has drawn the attention of both producers and users. The policy makers are keen to provide the use of biofuel feed stocks as these fuels bring multiple benefits to farming communities and industries. The advantage that India has is that more than 300 plant species suitable for biofuel production are available and can be sustainably exploited (Subramanian *et al.,* 2005). Among these, the most extensively grown (naturally grown and cultivated) species are: *P. pinnata* and *A.indica,* particularly in South India (Figs. 1-3). The other important species are depicted in Figs. 4-11. All the farmers

Table 1. Common biofuel species in India

S. No.	Local/common name	Botanical name	Oil content%
1.	Honge	*Pongamia pinnata*	24-35
2.	Turuka haralu	*Jatropha curcus*	34-38
3.	Neem	*Azadiracta indica*	28-35
4.	Hippe (Mohua)	*Bassia latifolia (syn. Madhuca longifolia var. latifolia)*	30-35
5.	Hippe (Mohua)	*Madhuca indica*	30-35
6.	Paradise tree	*Simarouba glauca*	55-60

Fig. 1 *Pongamia tree*

Fig. 2 *Profuse flowering in Pongamia*

Fig. 3 *Seeds of Pongamia*

including small and marginal farmers can grow these species in view of their wide adaptability as well as easy and low cost of cultivation.

Fig. 4 *Plantation of turuka haralu (Jatropha curcus)*

Fig. 5 *Fruiting branch of turuka haralu (Jatropha curcus)*

Fig. 6 *Neem (Azadiracta indica) tree*

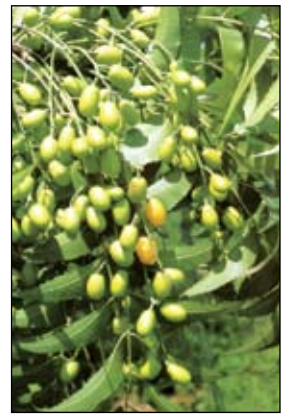

Fig. 7 *Abundant fruiting in neem*

Fig. 8 *Hippe (Bassia latifolia) tree*

Fig. 9 *Mohua (Madhuca indica) tree*

Fig. 10 *Seeds of mohua (Madhuca indica)*

Fig. 11 *Paradise tree (Simarouba glauca)*

1.1 Status and Scope

Biofuel species are not new to people of India as traditionally they are being used in various applications in rural areas as well as industries as a source of energy and other purposes. Thus, they are already contributing to the national economy even without being converted as biodiesel. The country has an estimated potential of more than 5 million tons of tree borne oilseed which

has the exploitable potential of more than 1 million tons of oil. However, only 0.8-1.0 million tons of seeds are being collected from which around 15,000–20,000 tons of oil is being extracted (Anonymous, 2005).

The Government of India recommended the use of a 10 per cent biodiesel blend in high speed diesel (Anonymous, 2009) in the country. Hence, the demand for biodiesel is expected to increase in coming years. According to the Planning Commission, country's annual consumption of diesel is expected to reach around 83.58 million tons during 2016-2017, thus there will be a need to produce around 8.36 million tons of biodiesel for a 10 per cent blending with the regular diesel (Anonymous, 2003). For instance, Karnataka State Road Transport Corporation (KSRTC) has been blending 10 per cent biodiesel with diesel for operation of its buses. Considering the total consumption of 106.2 million liters of diesel by KSRTC during 2004-05, it would require 10.6 million liters of biodiesel annually for blending at a rate of 10 per cent. The additional demand created due to its potential use in production of biodiesel calls for effective management of these renewable resources to meet the growing demand and ensure additional income to growers/farmers.

1.2 Current Marketing System and Its Limitations

The *Pongamia* seeds and other oil yielding seeds like *neem* and *mohua* are collected from door to door by the local vendors at a very low cost. The system is centuries old and well proven, but the mismatch of the labour cost and returns has discouraged the practice and people had stopped the practice of collection of the seeds. Hence, it calls for an effective marketing system that ensures remunerative additional income to growers/farmers. Such an arrangement will encourage the farmers to harvest existing resources and to grow more biofuel species to supplement their agricultural income.

1.3 Sustainable Energy Farming and Social Acceptance

In the recent years, the State and the Central Governments are promoting biofuel plantations to meet the growing demand for environmental friendly renewable energy resources. The state and national policies on biofuels have ensured that food production will not be affected due to growing of biofuel plants. The policies clearly specify that no agriculture land will be utilized for biofuel production and only the non-arable land, borders, bunds and unused land should be utilized for this purpose. According to the Department of Land Resources (DOLR), GOI, about 64 million ha of waste land is available in India out of which a portion of the area can be brought under biofuel plantation (www.dolr.nic.in).

The trees like *Pongamia*, *neem* and *mohua* are normally grown by the farmers in the fields, back yards, ravines and other waste lands as a support species to agriculture. Annually, paddy fields are enriched to the extent of 10 tons /ha of green herbage from *Pongamia* tree, while minor lops, tops and dried leaves form the part of farm yard manure. These species basically provide much needed leaf litter for use as manure which also has the role in controlling the incidence of pests in soil and in crops. The leaves of *neem*, *mohua*, *Pongamia* are also used as fodder for goat, sheep, and sometimes for cattle. The presence of these trees improves the soil health, improves percolation of water and helps in meeting the needs of fuel, small timber and other requirements relating to agriculture. Growing of these species contributes towards ensuring the energy security of the villages with least input costs and farmers are well aware of these facts and thus the practice is widely accepted without much resistance. The need of the hour is the organized cultivation of these species by using quality planting material supported by effective and organized marketing system that will assist in building strong renewable energy resources in rural India, subsidiary employment generation and improved economic benefits to the farming community.

2. Initiatives under RBRC-UAS, Bangalore

The Rural Bio-Resource Complex (RBRC) was a pilot project implemented by the University of Agricultural Sciences, Bangalore in the State of Karnataka with financial assistance from the National Bio-Resource Development Board, Department of Biotechnology, Government of India.

The project model was implemented in Tubagere Hobli of Doddaballapura Taluk in Bangalore Rural District involving 8,340 families spread over 75 villages during April 2005 for a period of five years. Under the project activity, about twenty interventions were critically evaluated including the promotion of use of biofuel in agriculture. Every intervention promoted in the area was thoroughly analyzed and debated in respect of its demand, availability of resources, suitability, sustainability and marketing avenues to improve the farm income and living standards of rural people. Taking clue from its potential application and considering the use by farmers for their own needs, it is visualized that the benefits of promotion of biofuel as one of the components in agriculture system are immense. As part of the capsule of technologies promoted by the Project, biofuel plantation and technological interventions for enhanced production were promoted to ensure the rural livelihood security with the following objectives:

- To ensure sustained source of income
- To build effective mechanism to produce oil and cake to meet the rural demand
- To create subsidiary employment for the rural youth
- To improve environment and ecology

2.1 Pre-Project Status

The project team made the groundwork by collecting data

through Participatory Rural Appraisal (PRA) technique to know the existing types of biofuel species, their number, age of trees and productivity, besides, mindset of the farmers and local leaders for promotion of biofuel intervention. It was observed that there was good number of biofuel species already existing in the project area with substantial production. A large number of *Pongamia* trees could be seen on the roadsides in the project area (Fig. 12). Interestingly, the total number of biofuel plants existing in the project area were 66,843 with an annual production of 1,18,778 kg of seeds (Table 2). *Pongamia* topped the list of biofuel species in terms of number of plants and seed production with 59,194 (83.75%) plants contributing about 1,16,668 kg of seeds. *Pongamia* generally starts yielding at the age of five years and more than 55 per cent of plants were in the age group of less than five years indicating that the production was set for an increase in the next one to two years with increased production potential in the area.

Fig. 12 *Pongamia trees on roadsides - a common scene in the project area*

Table 2. Status of existing biofuel plants and production in the project area

Plant species	No. of plants in different age groups				Seed yield (kg)
	0-5 years	5-10 years	>10 years	Total	
Pongamia pinnata	32,540	21,120	5,534	59,194	1,16,668
Azadiracta indica	4,059	2,535	1,055	7,649	2,110
Total	**36,599**	**23,655**	**6589**	**66,843**	**1,18,778**

2.2 Stakeholders and their Perspective

Over the decades, the biofuel seeds were harvested and sold by farmers to middlemen in their villages at a nominal price. It was also learnt from the growers that more than one third of the seed produced was not even harvested because of low price and lack of assured local market which did not attract farmers to grow more trees on their land. Majority of farmers were interested in perennial biofuel plantation under non-arable land in view of increasing problem of availability of labour for various farm operations. The analysis of data collected from the study area provided the insight to identify two major bottlenecks, (i) non-availability of seedlings within easy reach of growers, and (ii) lack of assured local market as well as respectable price. Keeping these major issues in view, a strategy was designed by the project staff to address through constant empowerment to all stakeholders, ensuring availability of seedlings locally and organize the growers for marketing.

2.3 Empowerment Programs

A few convincing empowerment programs like training, campaigns and *vanamahotsavas* (afforestation programs) were organized in the project area during the first two years to educate the people about the importance of biofuels (Fig. 13, 14). A total of

Fig. 13 *Training program on biofuels at Hadonahalli during 2007*

Fig. 14 *Education of school children on biofuels in a campaign at Turuvanahalli during 2008*

1,663 farmers participated in all the awareness programs conducted (Table 3). The women Self Help Groups (SHGs), local leaders and young farmers were trained during these awareness programs. The activity also involved local institutions such as *Panchayats*, Schools and Milk Producers Cooperative Societies.

Table 3. Empowerment programs organized for promotion of biofuel use

Type of program	No. of programs	Duration	Place	No. of participants
On-campus training programs	3	One week	UAS, GKVK Campus, Bangalore	87
Off-campus training programs	13	One day	Hadonahalli, Doddaballapur (T), Bangalore Rural (D)	358
Campaigns	3	One day	Hadonahalli, Melekote, SS Ghati	720
Vanamahotsavas	1	One day	Turuvanahalli, Doddaballapur (T), Bangalore Rural (D)	498
Total	**20**	**–**	**–**	**1663**

T: Taluk, D: District

2.4 Planting Material

Timely availability of planting materials within reasonable distance of the farming area was one of the major limitations in the project area. Moreover, it was difficult proposition to arrange required number of seedlings and make available to the farmers with minimal travel to the source nursery. The nursery managed by the state department was the only organized source of supply of seedlings of biofuel tree species which are generally located

at the *taluk* headquarters far away from majority of villages. Keeping this in view, twenty five rural youth were given intensive training (Fig. 15) covering all the technical aspects, viz., selection of mother plants, raising of nurseries, grafting techniques and production of quality seeds, with technical support from the Department of Forestry and Environmental Sciences of the University of Agricultural Sciences (UAS), Bangalore. Incentives were provided to raise the biofuel seedlings in their private protected land holdings. This activity has helped to raise more than 1,00,000 seedlings of biofuel trees and make these available locally to interested farmers as well as for mass planting besides generating additional income of INR 8,000-10,000 (US$ 160-200) per annum per youth. This had a spin-off benefit as the trained youth gained so much confidence that their nursery activity

Fig. 15 *Farm youth attending nursery management training at GKVK Campus, Bangalore*

was diversified by taking up raising of seedlings of other tree species of high economic importance like drumstick, jackfruit and mango which had high demand among local farmers. This initiative motivated the farm youth to become entrepreneurs due to skill enhancement through focused training programs in the project area.

2.5 Planting

After raising the seedlings in the early monsoon, the project staff managed to link planting program through Milk Producers' Cooperative Societies (MPCSs) of the area by involving mainly farm women who are also the members of MPCSs. As part of continuous empowerment program, a large scale planting of biofuel tree species (Fig. 16) was undertaken in the project area on degraded lands, school premises, road sides and bunds. The details of different biofuel tree seedlings planted in the project

***Fig. 16** Biofuel tree planting program at Melekote village in 2007*

area are given in Table 4. There was a great demand for *Pongamia*, which accounted for the maximum plantation (59,020 plants), while other species were also planted in relatively small numbers. Very interestingly, many farmers had gone for pure plantation in large scale. The timely availability of biofuel tree seedlings in the neighbourhood had motivated small and marginal farmers to take up tree planting on a large scale.

Table 4. Biofuel seedlings planted in the project area

Biofuel species	2005-06	2006-07	2007-08	2008-09	Total
Pongamia pinnata	8,210	16,410	25,650	8,750	59,020
Jatropa curcas	3,370	-	-	-	3,370
Azadiracta indica	470	800	150	983	2,403
Simarouba glauca	450	-	-	6	456
Bassia latifola	-	-	28	-	28
Total	**12,500**	**17,210**	**25,828**	**9,739**	**65,277**

3. Launching of Rural Biofuel Growers Association

The successful planting of biofuel tree species gave strong impetus and motivation to form 'Rural Biofuel Growers Association' with core activities of procurement, processing, better price and assured local market for seeds. The efforts to build an organized farmers' forum was a difficult task and time consuming process and it was the greatest challenge for the project staff to mobilize growers to form the Association. In principle, the complex process of convincing and mobilizing growers took more than eighteen months with 42 rounds of meetings, debates and study tours to various institutions for consultations and in-depth discussion with related Associations. These consultations and discussions resulted in the formation of Rural Biofuel Grovers Association in 2007 (Fig. 17). Left to the people on their own, it would have taken couple of decades to form such an association.

Fig. 17 *Formation of Rural Biofuel Growers Association at Hadonahalli in 2007*

The formulation of byelaws, eligibility criteria for membership, membership fee, nomination of office bearers, conduct of first general body meeting, opening of bank account, mobilizing funds from various sources, registration, acquisition of land for the purpose of establishing oil extraction plant and other pertinent aspects were facilitated by the project staff involving the growers to make the functioning of the Association more effective and efficient. It was essential to monitor the functioning of the Association continually to identify limitations and rectify them. The formation of byelaws and trust building process among the farmers resulted in formal registration of the Growers' Association in January 2007. The Executive Committee of the Association comprised Honorary President, President, Vice-President, Secretary, Board of Directors and Technical Directors with defined roles in order to build the Association as a fully functional and effective entity based on a model system.

The Association has established a functional linkage with Corporation Bank, Karnataka State Department of Agriculture, Karnataka State Road Transport Corporation, Indian Institute of Plantation Management, Karnataka State Forest Department and the local *Krishi Vigyan Kendra*, University of Agricultural Sciences, Bangalore. The merits and demerits of the Association over the cooperative society was debated at length and finally it was decided to opt for Association instead of society to enjoy the advantage of autonomy for its functioning. The cooperative society model was not adopted mainly due to likely interference from various local political bodies and policies of the government.

The Association established under the project in a entrepreneurial model was encouraging the growers to venture into value addition to their produce which will ensure additional economic returns to them.

In order to ensure the sustainability of biofuel production, the project activity evolved an innovative management model (Fig. 18).

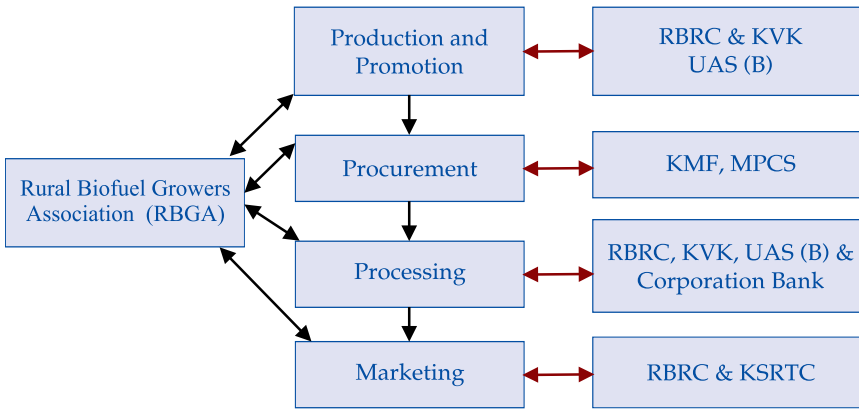

Fig. 18 *Management model for sustainable development of biofuel plantation and marketing*

The model consists of four additive phases which are given below:

- Promotion and production of biofuel feed stock
- Procurement of seeds from farmers
- Processing of seeds and oil extraction
- Marketing of oil and cake

The project team and office bearers of the Executive Comittee of the Association contributed significantly and played vital roles in making these phases effectively operational. RBRC project mandate provided initial leadership in mobilizing the growers to start the Association and ably facilitated its effective functioning and creating functional linkage with other stakeholders/agencies. As a follow-up activity, being a member of the Association, the Program Coordinator of *Krishi Vigyan Kendra* (KVK) participated in the Executive Committee meetings and provided constant technical guidance in the functioning of the Association.

3.1 Establishment of Rural Biofuel Processing Unit

With the establishment of Associations, the growers were able to coordinate not only production related activities but also processing and marketing of the produce. As a result, the Association has started the Rural Biofuel Processing Unit with an oil extraction machine at Hadonahalli, Doddaballapur Taluk of Bangalore Rural District in March 2008. The Rural Biofuel Processing Unit was inaugurated by the Governor of Karnataka (Fig. 19). The Secretary, DARE, Govt. of India and the Director General (DG), Indian Council of Agricultural Research (ICAR) alongwith the Vice Chancellor, University of Agricultural Sciences (UAS) Banglore visited the Rural Biofuel Processing Unit established at Hadonahalli (Fig. 20). The scientists of University of Agricultural Sciences (UAS), Bangalore and the project staff have

Fig. 19 *Inauguration of Rural Biofuel Processing Unit at Hadonahalli by the Governor of Karnataka*

Fig. 20 *Secretary, DARE & DG, ICAR along with Vice Chancellor, UAS Bangalore visting the Rural Biofuel Processing Unit at Hadonahalli*

helped in mobilization of funds and provided all the technical support required for the Processing Unit. While establishing the biofuel unit, the following strategic issues were critically examined:

- Techno-economic feasibility report with the help of concerned scientists
- Building plan and cost estimates with the help of Engineers
- Appropriate machineries, accessories and their costs
- Manpower requirement, their qualifications and the recruitment process

The size of the oil extraction plant in the project area was decided considering the present level of production of biofuel seeds in the area and the likely increase in production in the near future. The processing capacity of the unit is about one ton per day.

The initial cost of establishment of extraction plant including recurring and non-recurring cost was about INR 7,00,000 (US$ 14,000). The success of grass root institution depends greatly on the funds available for its functioning. Elaborate discussions were held at different points of time to mobilize the funds for setting up the processing unit and managing the associated expenditure. In the first instance, a membership fee at the rate of INR 100 (US$ 2.0) was collected from the growers, while 49 Milk Producers Cooperative Societies were convinced to contribute each a sum of INR 2,000 (US$ 40.0). The 12 Executive Committee Members were motivated to contribute each a sum of INR 10,000 (US$ 200.0) as chief promoters. The RBRC project provided a sum of INR 2,00,000 (US$ 4000.0) as seed money to the Association. The additional cost of INR 6,00,000

(US$ 12,000) was met from the support through loan from the Corporation Bank.

3.2 Feed Stock Procurement

The procurement of feed stock seed was initiated through the deployment of the existing 49 Milk Producers Cooperative Societies (MPCS) spread over 75 villages. A series of meetings were held with the secretaries of MPCS in order to determine their roles and responsibilities and also the mode of payment. The seeds were procured through MPCS once in three days at a specified time during the harvesting period. The procured biofuel seeds were then consolidated at the biofuel processing unit for further processing. The payment was made through MPCSs with provision for commission @ 5 per cent of total transaction amount (3% to the Secretary and 2% to the Society) for facilitating procurement of biofuel seeds. At present, the seeds are procured @ INR 20 per kg which is four fold higher than the price before the start of the Association. The strong point of the model was the use of the existing MPCS infrastructure facilities and man power which reduced the overhead costs. Had there been any other mechanism of procurement in place, the cost of overhead charges would have been 34 per cent, while with the present arrangement, 29 per cent of the total transaction cost was added to the growers' basket as profit.

3.3 Processing and Value Addition

The biofuel seeds procured form different sources are consolidated at the biofuel processing plant for further processing. Seeds collected at processing plant are segregated and processed for oil extraction using oil expelling unit. Two major products are produced by processing of the biofuel seeds, viz., oil and de-oiled cake. The processing unit is managed by four semi-skilled and less skilled rural underemployed youth. Most part of this work is being managed by office bearers of the Association under the

constant guidance and management by the specialists initially by the project staff and thereafter by KVK staff of the University of Agricutural Sciences (UAS) Bangalore.

3.4 Marketing

The marketing arrangement was made by a series of deliberations looking for all possible avenues involving all stakeholders. The marketing of oil was linked with the University of Agricultural Sciences, Bangalore and Karnataka State Road Transport Corporation (KSRTC) at a predetermined and mutually agreed price. Sizable quantity of raw oil was used locally for domestic consumption by growers as well as for social functions. Presently, major quantity of oil expelled at the plant is supplied to Biodiesel Production Unit established at the University of Agricultural Sciences, Bangalore. The de-oiled cake, a by-product of oil expelling, is a very rich source of organic manure and has

Table 5. Details of seeds processed and income generated by biofuel extraction plant

Plant species	Seeds crushed (kg)	Cost of seeds (INR)	Yield of processed products (kg)		Income (INR)			
			Oil	Cake	Oil	Cake	Gross	Net income
Pongamia	39,025	5,85,375	9756	27,317	4,03,436	3,47,742	7,51,178	1,65,803
Neem	100	1,000	8	70	480	1,400	1,880	880
Castor*	350	7,000					7,500	500
Total	**39,475**	**5,93,375**	**9,764**	**27,387**	**4,03,916**	**3,49,142**	**7,60,558**	**1,67,183**
Other operational cost (electricity, labour, bank interest, etc.)								**1,02,183**
Net profit								**65,000**

**Castor seeds were sold without processing*

huge local demand. It is collected by the local farmers themselves either in proportion to the quantity of seeds supplied or at a pre-decided price (INR 14-16 per kg) for applying to their crop fields. The cake has huge demand, considered as any time money (ATM) and most of the time one month advance booking was noticed. The details of oil and cake produced and income realized is given in Table 5. However, it is envisaged that additional processing units can be established once there is constant supply of seed stocks in the project area.

4. Benefits

Several direct and indirect benefits are being derived due to the implementation of this model. These are given below:

Direct benefits

- There is a assured income to growers even in the years of poor rainfall.
- It generates additional employment opportunities during the off season as well as full time employment to underemployed semi-skilled farm youth.
- The system of procurement is through local Milk Producers Cooperative Societies with minimum overhead cost, as well as transparent and prompt payment to growers.
- The middle man is eliminated in the marketing chain and this leads to greater profits.
- Intercropping is possible in biofuel plantations during the first ten to fifteen years which gives extra income to the farmers.
- Biofuel trees have high timber value and are the excellent source of fire wood.

Indirect benefits

- The soil fertility is improved and it also helps in moisture conservation in the soil.
- The system is eco-friendly, improves environment and contributes to reducing greenhouse gases besides being useful for bee keepers, improving pollination and productivity.
- The processed products have some medicinal value for human beings as well as animals.
- The dependency on fossil fuels is reduced which contributes towards improving the national economy.
- Technology is scale neutral and feasible for adoption by all categories of farmers.

5. The Success of the Model

Various time-tested measures taken at different levels in the process of production of biofuel, initially making available the quality planting material on site, effective mechanism to procure the seed materials, organizing assured marketing modalities, adopting the existing model and/or creation of an institutional mechanism, defining assured income generation model, employment generation and production of ecofriendly fuel has given great satisfaction to all the growers and other stakeholders. The demand for the biodiesel and cake will be in increasing order and therefore there is no anxiety among the growers for the decline in prices. Besides, a number of indirect benefits realized by the beneficiaries of the project over the period has contributed immensely to the success of biofuel program. The coordination between different activities in the process of production of biofuel has made the activity as a self-reliant model and the system is functioning effectively on its own despite the closure of the project during March 2010.

This model utilizes the existing parallel mechanisms with required logistics and infrastructure of MPCS, as a result of which the overhead costs are low. This model has been successful due to the fact that it provides additional and regular income to the farmers. The processing plant site has been visited by several growers, scientists, planners and administrators almost every day both from within and outside the State. Each of the visitors has appreciated the functioning of the model and expressed the need for the replication of such a model.

6. Future Prospects

The model evolved has great potential and is replicable under similar situations across the States with suitable modifications to suit to local needs since MPCSs exist across the country. Presently, the model is being considered for implementation in other parts of the State in a phased manner. The Karnataka State Biofuel Development Board has initiated the process during 2010 to implement the model developed under RBRC project across all the districts of the State for the benefit of the rural community. The University of Agricutural Sciences, Bangalore with support from the State Government has undertaken a mega model to implement in one of the districts (Hassan) covering about 2,000 villages and creation of linked Associations of the farmers/growers at village, *panchayath*, *hobli* and *taluk* level for seed collection, trade and with a plan to initiate the establishment of oil expelling units for processing and value addition. Overall, the rural empowerment centered around the innovative model developed under RBRC project has great promise and will prove to be effective to scale-up and to build rural economy and enhance employment generation for the benefit of the farming community across the country besides meeting the growing energy demand.

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