Vision for the CTxGreEn "Village-scale Biodiesel Production & Use" Model
Strategic Plan for Sep.'08-Dec.'09

With the completion of four years in February 2008,[1] the biodiesel collaboration between CT$_x$GreEn and Gram Vikas has advanced beyond its initial focus of CT$_x$GreEn serving up an addition to the Gram Vikas renewable energy toolkit for their water and sanitation program into an integrated livelihood service, as described in Boxes 1, 2 and 3 (pp. 4 to 6). There has also been a conscious effort to distinguish "village-level biodiesel production and use" as a 'no-conflict' model.[2,3,4] The dissemination package for biodiesel includes:

a. Process-Technological aspects, including mechanical and chemical aspects of biodiesel preparation (and use in standard/non-modified diesel engine-driven pumpsets, gensets and potentially tractor-tillers), training in standard operating procedures and log-keeping, and quality control mechanisms.
b. Environmental aspects pertaining to choice of underutilized, indigenous species of feedstock including organic agro-ecological practices.
c. Social aspects related to gender equity, reversal of seasonal migration for labour work and bare-foot technician training of village youth.
d. Local economy mobilization through re-circulation of money, and decentralized small-scale, village-level production systems.

The Gram Vikas-CT$_x$GreEn biodiesel project has field-tested three management models for village-level production and use of biodiesel: (1) volunteer-driven (or sweat-equity), (2) SHG-driven, and (3) entrepreneurial models, respectively. It has become quite clear that longer-term sustainability and equitable sharing of benefits across the widest-possible spectrum of stake-holders are achievable only with the entrepreneurial model, even within the development-centric approach taken to-date. (The volunteer-driven and SHG-driven management models may yet be viable in other locations where ground realities and SHG-capabilities are stronger than in the villages where these models have been tested to-date.)

The case has also been made that our *no-conflict biodiesel model* (for productive uses) is better suited for replication <u>now</u> than larger biodiesel projects (aimed at consumptive substitution of transportation fuel) that are fraught with serious issues of food-fuel security,[2,5,6] and uncertainties arising from a lack of adequate knowledge and/or scientific data about long-term impacts on the environment and for that matter even the viability of the livelihoods of farmers who are being encouraged to take up large-scale mono-culture plantations of non-indigenous species such as Jatropha *curcas*.

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[1] The Project started with seed funding won by CT$_x$GreEn from the DM2003 www.developmentmarketplace.org. Research funds & scholarships from IDRC, SSHRC and UW/MacBain, and grants by SDC-IC are acknowledged

[2] "Biodiesel – no conflicts here!", as one of five articles examining the impact of biofuels on food-fuel security, Appropriate Technology, Volume 34, No. 3, Sept. 2007, pp.12-14. Editor: David Dixon; Publisher: Research Information Ltd., UK. See also www.appropriate-technology.org (full paper available only to subscribers). A copy of the paper in PDF format is included in Appendix 1.

[3] "Village-scale Biodiesel-fuelled Energy System," one of four global case-studies on "Sustainable Biofuel Production and Use Options for Greener Fuels," WISIONS, PREP 8, Issue IV, 2006, pp.6-7. www.wisions.net

[4] Geeta Vaidyanathan and Ramani Sankaranarayanan, "Technology and economics where people matter," published in "e-net energy network" magazine, www.sa-energy.net, Vol. 2/2008, July 2008, pp.3-6

[5] Representation made to the Government of Orissa "Discussion of the Draft Biodiesel Policy" 05 Feb 2007, Bhubaneswar, Orissa, India

[6] CBD COP 9 Side Event No. 1568: "Making Informed Decisions about Biofuels: The Role of Strategic Environmental Assessment (SEA)," Conference of the Parties 9, UN Convention on Biological Diversity, Bonn, Germany, 27 May 2008 (Ramani Sankaranarayanan was one of four invited panellists at the side-event.)

"The strategic framework used to describe the (Gram Vikas-CTxGreEn biodiesel) project makes it a well-developed adaptation approach to climate change[7] that also includes a critical element to development per se – we should be able to begin another round of industrial revolution in this manner in remote corners of the world (that are as yet untouched by the last one that started over 150 years ago)." [8]

While the elements of adaptation to climate change are well-defined, the scale of the project is tiny by design (as dictated by local conditions), a scale that is possibly too miniscule to qualify for Clean Development Mechanism (CDM) funding unless several similar projects are "bundled" together. As part of a strategic planning exercise with Intercooperation (IC) the potential CO_2 emissions reductions from an entire cluster of 50 villages was estimated (after full implementation of livelihood strategies outlined in Boxes 1 to 3),[9] and the results are summarized in Table 1 (page 7) and Table 2 (page 7) – the basis for the calculations are shown in Table 3 (page 8). While these calculations are no doubt rough preliminary estimates that would benefit from a more detailed revision, they do indicate two things:

- It is perhaps futile to search for CDM funds to promote projects like ours (when the current minimum CO_2 savings required to qualify for CDM funding being 200 tonnes CO_2/day *vs* 10.1 tonnes CO_2/day shown in Table 1; even this 10.1 tonnes/day is achieved only after accounting for avoided slash-and-burn with its 90% share).
- However, even assuming US$15/tonne of CO_2, and an exchange rate of Rs.40/US$, the credits would be roughly Rs.40/L biodiesel, or more than 80% to 110% of the raw material costs.[10] Carbon credit methods with low transaction costs will no doubt be valuable to maximize the benefit to the project and tribals themselves.

Priorities for the coming year Sep. 2009-Dec. 2010 (partners / funds in parentheses)

1. Build on partnerships nurtured over the past year with NGO's (in addition to Gram Vikas) interested in supporting our work in Orissa as well as in their own areas of operations:
   - Vasundhara, Outreach, PA, RCDC, IC (Sa-Dhan, AFPRO, Sewa Bharti, CPSW, BASIX)
   - Promote exchange visits and joint programs to advance common interests
2. Business profitability demonstrations of biodiesel-fuelled end-use devices in Tumba, with some work in Kinchlingi and Kandhabanta-Talataila
   - Genset for 220V and LED lighting (Kinchlingi – funds to be procured – SDC?)
   - Power Tiller as multi-use device (tiller / rice huller / oil expeller / mobile pumpset) – partially funded by CTxGreEn internal funds – remaining to be procured – SEPS?
   - Stationary Oil Expeller (funds to be procured – SEPS?)
   - Soap making from Glycerin (funds: AUCC/WLU, UW/SICI, in-kind support TWC)

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[7] "Adaptation – Under the Frameworks of the CBD, the UNCCD and the UNFCCC," Published by Joint Liaison Group of the Rio Conventions, on behalf of the Secretariats of the CBD, the UNCCD and the UNFCCC, 2008

[8] The quote sums up the reaction of a respected colleague after a recent meeting in Zurich (two days after the CBD COP-9 side-event # 1568): Othmar Schwank, Managing Director, INFRAS, Zurich, Switzerland. Othmar also expressed his desire (hope) to convince Swiss and German industrial houses to extend their focus to such technologies that could herald the "return of the next industrial revolution".

[9] CTxGreEn data base on the Tumba project, collected since July 2004. Includes tree-borne oil seed tree density surveys (species and tree counts in forest surrounding selected villages), ground-truthing of remote-sensed satellite images of the area (canopy cover, etc.), ethno-botanical and socio-economic surveys, information documented using livelihood, watershed and energy-use mapping workshops, and pre-feasibility studies. More detailed data is being collected to develop business plans for entrepreneurial activities. The data for the GHG calculation exercise with Intercooperation (IC) was drawn from this database. A certain amount of extrapolation of the data was necessary. List of abbreviations for partner names is attached in Page 9.

[10] The raw material cost of biodiesel varies widely with type & source of raw materials (historical data: 2004-08)

Priorities for coming year: Sep. 2008 – Dec. 2009 *(continued)*

3. Develop bankable business plans for each production unit and end-use device/service. (SEPS funding?)
   - Use village youth to collect more accurate data on the supply and demand for oil seeds versus edible oils, non-edible oil seeds and oil, oil cake, farming habits and needs. Improve on the data used by the management students; supplement existing forest survey and other data – analysis to be a part of Geeta's Ph.D. thesis on micro-energy planning in the Tumba area (SSHRC, UW/SICI)
   - Independent assessment of MFIs *vs* commercial banks, gov't *support/subsidy* schemes, carbon credits and green funds (venture capitalists – for development?)
   - Incorporate the initial investment capabilities of potential entrepreneurs and groups interested in owning/operating each unit
4. Establish at least three entrepreneurs to own/operate production units (oil press/expeller, biodiesel reactor), end-use devices. Package should include adequate training at Mohuda (SEPS funding?)
5. Demonstrate benefit-cost of oil cake as a manure with at least three farmers (SDC and MSSRF in-kind-support and guidance; funding from SEPS for documentation/support?)
6. SHG strengthening to play a role in supporting purchase of seeds / marketing of oils and cakes locally, value-added soaps and biodiesel (Gram Vikas SHG training funds; Vasundhara and Outreach for support and exposure visits; Sa-Dhan to anchor the UW/SICI & AUCC/WLU scope of work including forming a federation of Tumba SHGs)
7. Farmers training school: set-up cooperatives, look for financing of new activities such as growing a second crop in the hot/dry season, Jan-April, during which there is inadequate rainfall, using biodiesel-fuelled mobile irrigation pumpset (SEPS funding?)
8. Strengthen the core team in Mohuda and continue the barefoot technician training (SDC funds partial/ending soon; need additional funds to strengthen team. SEPS funding?)
9. Undertake and continue feasibility assessments for replication in other areas of partner NGO's – coach partner personnel to carry out the feasibility with minimal participation from CTxGreEn (partner NGO's funds mainly – Outreach, Practical Action, *etc*.)
10. Stakeholder workshops to bring down excise and other policy related barriers, including Gram Sabha mobilization to pass resolutions in favour of biodiesel in their panchayat (part funding from RCDC, access more government funds, and use part funds from UW/SICI)
11. Case studies of ongoing work including policy – research on organization forms for community-based enterprises to be extended for fair trade of carbon credits (UW/SICI; carbon credit resource person still not identified; Could SEPS assist?)
12. Technology packaging and IP protection becomes important as we look to increase rate of replication. The biodiesel reactor system is well-proven and its innovative features should be protected. The village-level oil refining process, ethanol purification and the biodiesel refining systems require fine-tuning. All have definite IP potential, which when protected could provide some revenue in future to support organizational stability. (Extent of engagement will have to be tempered by funding availability – WISIONS SEPS funding?)
13. Institutional Strengthening for CTxGreEn (need to search for funds – lack of resources for any meaningful attempts – could SEPS assist in the search and establishment of links?)

Mohuda
24 August 2008

* * * * *

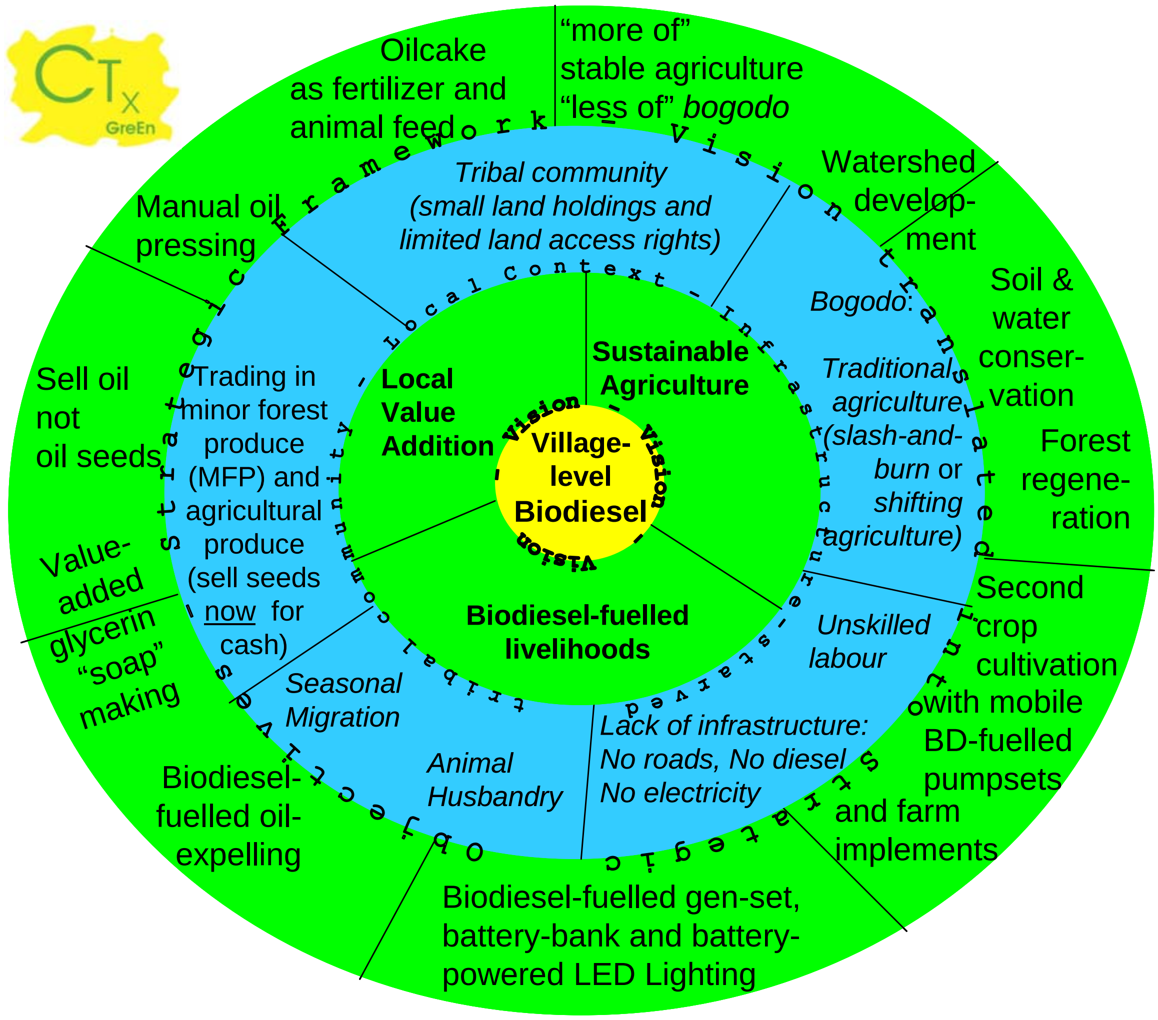

Figure 1:A Strategic Framework for implementing the three-pronged village-level biodiesel vision (comprising *local value addition*, *sustainable agriculture* and *biodiesel-fuelled livelihoods*) within the context of an infrastructure-starved forest-dwelling tribal community that depends on shifting agriculture (*bogodo* in Oriya) to partly meet its subsistence needs and makes up the gap by trading minor forest produce and farm produce with minimal value addition, working locally for a daily wage, raising animals, and migrating seasonally to far-away metropolitan cities in search of labour work.

Some of the strategies outlined above in the outermost ring are ripe for implementation as independent and self-sustaining entrepreneurial activities, *viz.*, manual oil pressing, biodiesel-fuelled oil expelling, local resource based biodiesel production and related livelihood activities such as farming using mobile pumpset irrigation and other small-scale farm implements, LED-light charging using biodiesel-fuelled gen-sets and battery-banks. They do require concerted hand-holding to boost the confidence of the entrepreneurs in running them as profitable businesses. Even the use of oil cake as fertilizer, known as part of traditional agriculture amongst plains-dwelling farmers, is largely unfamiliar to the tribals and so will require demonstrations before it gains wider acceptance. A 2-month business profitability demo of a manual-oil-press for edible oil seeds (for edible oil consumption in village) and non-edible oil seeds as biodiesel feed stock was completed in Raikhal village during Jan.-Mar.'08.

Other strategies such as "sell oil not oil seeds," "more of stable agriculture and less of *bogodo*," "second crop cultivation in the non-rainy season with biodiesel-fuelled mobile pumpsets" are in reality "broad conceptual goals," which, in spite of being *in sync* with the dreams of at least some of the free-spirited tribals in the Ankuli and Burataal panchaayats of Gram Vikas' Tumba project in Ganjam district, need to be further translated into concrete actions on the ground within the context of the market forces, legal and policy frameworks, and the tribals' own cultural and habitual dependencies that are at play (see Box 2).

Box 1: Strategic framework for "integrated livelihood services" in tribal Orissa using village-level biodiesel.

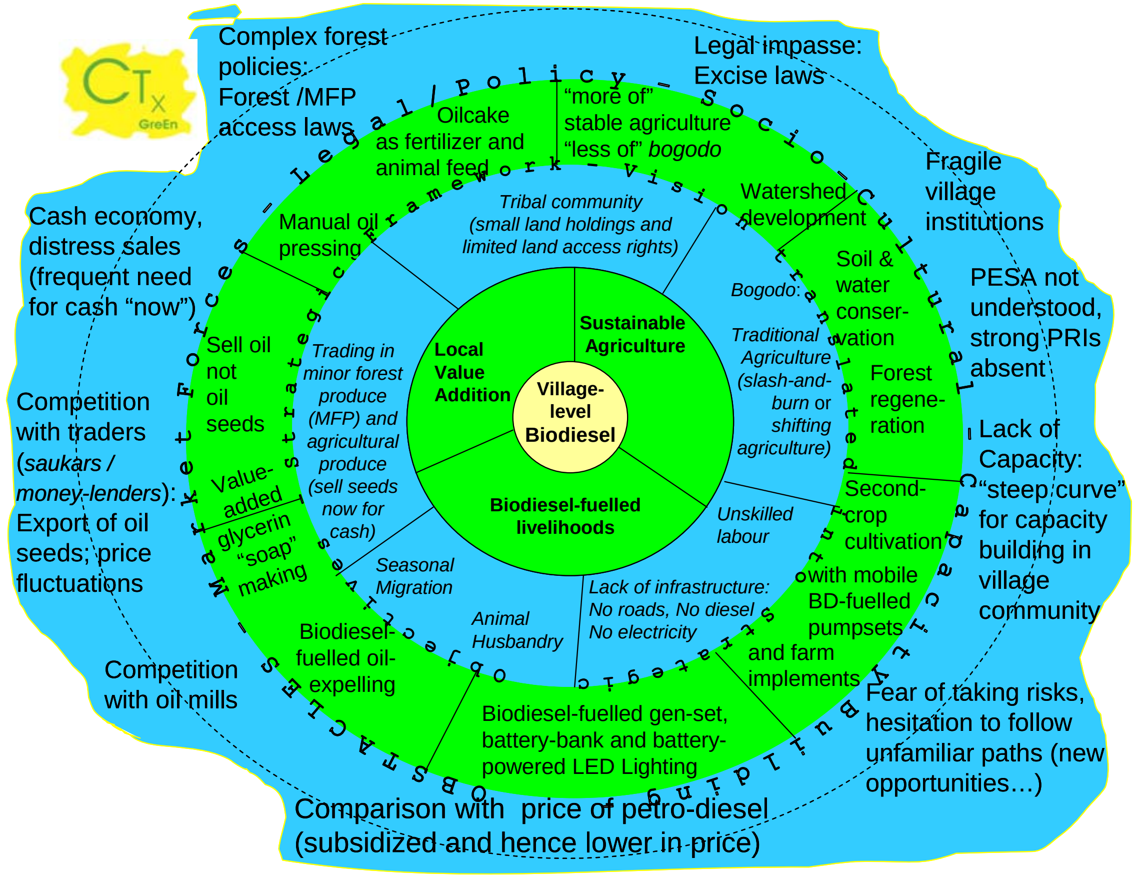

Figure 2:The *climatic conditions* within which the "village-level biodiesel strategic objectives" outlined in Box 1 need to be converted into *ground actions*: Barriers that need mitigation include (a) the traditional market forces of supply and demand, competition and so on as they apply to oil seeds, oils and oil cake, (b) Existing legal and policy frameworks regarding access to forest and minor forest products, and excise laws and biodiesel making, (c) Lack of strong village-level institutions – need for capacity building and (d) Cultural and habitual tendencies of the tribals themselves.

The objective of implementing village-level biodiesel production and use in an entrepreneurial manner is to ensure sustainability through local participation. Benefits will not only accrue to the entrepreneurs running the hand-operated oil mill(s), the biodiesel production centre(s), biodiesel livelihood services, and the by-product value addition group, but also to the community-at-large in terms of increased agricultural productivity, progressive reversal of shifting agriculture, more jobs in the local area, capacity building, reduction in the cash outflow for purchase of edible oils, and so on.

Barriers that need to be addressed include: (1) Complex forest policies (2) Excise laws (3) fragility of village institutions (4) competition with market forces that could derail well-intentioned attempts to add value locally. Much of this centers on capacity building, the learning curve appears to be dauntingly steep given the relatively low level of literacy in the community, and the need to raise awareness and support hesitant first steps to take up new initiatives and so on. An additional threat to these efforts is the dependence of the tribals on the traders (who double as *saukars* or money-lenders in times of need) which skews the success of local value addition.

A number of steps have already been taken to address these barriers. Excise barriers and strategies to mitigate them were studied by ELDF and a policy brief "Legal Challenges – Village-level BD production and use" was published in 2005-06 with SDC-IC funding; excise officials of the Govt. of Orissa are beginning to support permit application. A Forum of Orissa-based NGO's hosted jointly by CT$_x$GreEn and Gram Vikas in Feb'08 has resulted in a "barrier-mitigation roadmap" and "replication strategy" for village-level biodiesel projects in Orissa with specific roles for various partner NGOs.

Box 2: Barriers faced by village-level biodiesel-fuelled "integrated livelihood services" in tribal Orissa.

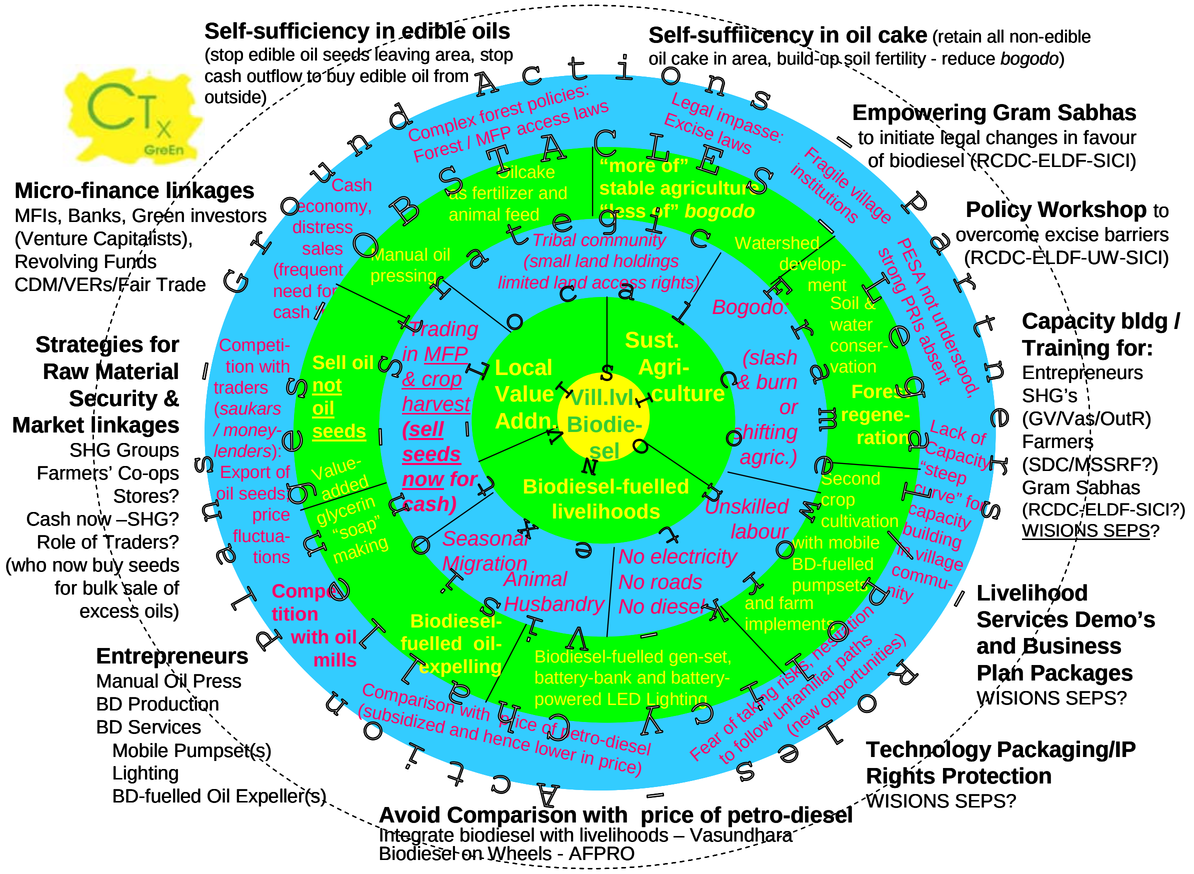

Figure 3: Ground-level actions, players and their roles, Action Plans.

The two-month business profitability demonstration of the manual oil press in Raikhal was followed by a pre-feasibility assessment by three management students and an independent rapid assessment by Basix (MFI), both of which concluded the manual oil press as viable, with investment loans repayable within 2 years, and profit margins rising sharply after 2nd year. The concern is with ensuring a steady stream of customers (paying a milling charge to extract oil from their seeds), without distress sale of seeds to traders to satisfy perennial shortage of hard cash for buying essential commodities. Solutions are readily available though in the form of "cash" banked by Self-Help-Groups (savings groups) that could be used to pay for the seeds, and the investment recouped by selling oil and oil cake profitably within one or two months. The SHGs however were largely "inactive" and so need strengthening to take up this role. Similarly there is a need to demonstrate the benefits of oil cake as a fertilizer. A bankable feasibility report with more accurate information on the availability of seeds, current demand (and source) for edible oil, *etc.* prior to setting up an entrepreneur with financing. Business Profitability Demonstrations of the other components of the technology package from biodiesel-making to irrigation, lighting, oil expeller, etc., are all needed. Farmer's schools are needed too, along with support for their needs for seeds, oil cake as fertilizer, water for irrigation during the hot (dry) season, provision for post-harvest cash crunch, etc.

While the strategies above are specific to Phase III of the Tumba project, the structure is generic enough to allow its use for different locations with situation-specific differences.

Interactions over the past year with various potential partners have also allowed us to identify specific roles for each of the partners in the Tumba project as well as a methodology to undertake replication projects in the partner project areas. For example, several strong examples of vibrant SHGs in Vasundhara (and Outreach) operating areas, and exposure visits and training are envisaged. Practical Action undertook a 10-day study tour and is in the process setting up a replication project in Sri Lanka. A pre-feasibility assessment of implementation of biodiesel-fuelled livelihoods in Outreach project areas has been completed Aug-Oct'08 through two exchange visits. Report under preparation.

Gaps as well as potential funding sources could also be identified in this framework.

Box 3: Ground-level Actions…

Table 1: Estimated CO_2 reduction for a cluster of 50 villages, 1500 hh – Tumba after full implementation of Biodiesel-fuelled livelihood services

Sl. No.	CO_2 Reduction Potential by Item	kg CO_2 per day	t CO_2 per year	Notes and assumptions
1	Avoided Kerosene for home lighting	480	174	50 villages; 1500 hh/cluster
2	Avoided Diesel for Genset-LED Lighting	160	58	1500 hh; 2 LED/hh; 18.25 kL BD/y
3	Avoided Urea: Use Oil cake as fertilizer	152	56	925 acres; 55.5 tonnes avoided urea
4	Avoided Slash&Burn acres (replantation?)	9,107	3,324	750 acres 'avoided slash&burn/year'
5	Avoided Diesel for BD-fuelled Oil Expelling	109	40	20000 trees; 375t seeds; 12.5 kL BD/y
6	Avoided Diesel for 2nd crop irrigation	110	40	1500 acres; 12.6 kL BD/y
7	Impact of 1,500 acres/year replantation			not included
8	Avoided firewood (usu. Collected in slash & burn)			Biodiesel stoves for cooking - not incl.
	Total CO_2 Reduction Potential	**10,118**	**3,692**	
	Subset of the above:			
	CO_2 Reduction Potential w/o including Slash-and-burn credits	**1,011**	**368**	avoided slash-and-burn credits constitute more than 90% of 'total (not including biodiesel stoves for cooking and plantation credits)'

Table 2: Estimated daily and annual requirements of Biodiesel (and capacity and number of production and end-use units) for full-implementation of biodiesel-fuelled livelihood services in a cluster of 50 villages (1500 households) in Tumba

Sl. No.	Biodiesel Consumption by Item	L BD/d	L BD/y	Notes and assumptions
2	For BD-fuelled Genset-LED lighting	50	18,250	approx 4 to 6 BD-fuelled gensets
5	For BD-fuelled Oil Expelling	50	12,500	6 BD-fuelled expellers @ 30 kg/h
6	For BD-fuelled 2nd crop irrigation	50.4	12,600	approx 4 to 6 BD-fuelled mobile pumps
8	For BD-fuelled cook stoves			not considered - needs more dev'lpmt.
	Total BD Consumption Potential	**150.4**	**43,350**	approx 4 BD Reactors - 20L/batch

Note(s): The number of BD-fuelled gensets and pumpsets will have to vary according to the needs, the number of hours of use, distance between villages served (including transportation time, etc.). The no. of gensets and pumpsets will need to increase as project takes root (expands) after the demo phase.
It is also possible that one multi-use Power Tiller (walking tractor) may replace genset & pumpset (evening hours for charging the "large bank of batteries" and day-time hours for use as pumpset and tractor/tiller).
Not including use of Power Tiller for Paddy hulling (rice polishing), oil expelling, etc., in mobile fashion.

Lighting through battery-charged LED lights is used as the starting point, so that biodiesel production could be ramped up slowly with demand.

In the Demo phase 2008-09, the business profitability of various end-use devices will be demonstrated with the core group of potential entrepreneurs. Business Plan packages will be prepared. Additional survey data (household-level, village-wise) on seed collection, oil consumption, land holding and edible oil seed harvest, etc., will provide more reliable business models than available at present.

Table 3: Basis for the CO_2 savings summarized in Table 1 and Table 2.

1. Avoided Kerosene for home lighting			**2. Avoided Diesel for Genset-LED Lighting**	
50	villages			
30	hh/village (average)			
1,500	hh/cluster			
3	L/month/hh kerosene for lighting		1	L BD/day/30 hh
30	days/month (average)		30	L BD/month/30 hh
3.17	equivalent kg CO_2/L kerosene (source: UNEP 2000 guidelines)		3.19	equivalent kg CO_2/L Diesel (source: UNEP 2000 guidelines)
150	L kerosene/day/50 village cluster		50	L BD/day/50 village cluster
480	kg CO2/day/50 village cluster		160	kg CO2 /day/50 village cluster
54,750	L kerosene/year/50 village cluster		18,250	L BD/year/50 village cluster
			73,000	kg seeds/year/50 village cluster
174	tonnes CO2/year/50 village cluster		58	tonnes CO2 /year/50 village cluster
3. Avoided Diesel: Oil cake fertilizer ~~(urea)~~			**4. Avoided Slash&Burn acres (replantation?)**	
			Assumptions: (not incl plantation 1500 acres/y)	
20,000	trees (mahua/karanj/kusum): 50 villages		1	acre(s) slash&burn avoided/hh/year
25	kg/tree/year (average)		50%	per cent "avoided slash&burn"/year
75%	per cent trees bearing fruit/year		29,900 acres	known "minimum" acres of land (satellite image: 11kmx11km "area")
375,000	kg seeds/year/50 village cluster			
277,500	kg oilcake/year/ 50 village cluster		750	**"acres/y" avoided slash&burn**
			5.0%	**calc'd. % "new" bogodo land/y (same as "sat. image estimate=5% new bogodo")**
300	kg/acre of oil cake (requirement)			
60	kg/acre of urea (chem. fertilizer)		Estimates based on Tumba Forest survey Data:	
1	kg CO_2/kg urea (urea prod'n fuel GHG); assumption to be verified.		800	trees/acre; ave tree: 0.05 m dia x 2 m ht, from Survey: 98trees (<0.1mdia)/500sq.m plot; avg from 305 plots or 15ha; fits firewood kg/y/hh. Survey also indicated 31trees (>0.110cm dia
925	acres of land fertilized w/oilcake		Assume firewood/y/area=intense slash&burn fire	
55,500	avoided kg urea/year/50 village cluster		**<u>Estimates below are worth revisiting later:</u>**	
152	kg CO2/day/50 village cluster		9,107	kg CO2/day/50 village cluster
56	tonnes CO2/year/50 village cluster		3,324	tonnes CO2/year/50 village cluster
5. Avoided Diesel for BD-fuelled Oil Expelling			**6. Avoided Diesel for 2nd crop irrigation**	
			1	acre/hh additional 2nd crop
30	kg/hour oil seed "expelling" rate		1,500	acres/year addn'l. 2nd crop
1	L/hour BD fuel consumption		6	irrigations (3 mox 2/mo) per crop
			2	hours per irrigation per crop
12,500	operating hours oil expeller(s)		0.7	Litres/hour BD for irrigation
12,500	Litres BD/y for BD-fuelled oil expeller(s)		12	hours irrigation per crop (/acre)
			8.4	Litres BD/acre/crop
3.19	equivalent kg CO_2/L Diesel (source: UNEP 2000 guidelines)		3.19	equivalent kg CO_2/L Diesel (source: UNEP 2000 guidelines)
			12,600	Litres BD/year
109	kg CO2/day/50 village cluster		110	kg CO2/day/50 village cluster
40	tonnes CO_2/year in avoided HSD while operating oil expeller		40	tonnes CO_2/year in avoided HSD while providing 2nd crop irrigation

List of Abbreviations – Names of Partners & Funders

AFPRO	Action for Food Production (All-India NGO providing socio-technical support on livelihoods)
AUCC	Association of Universities and Canadian Colleges
BASIX	Bhartiya Samruddhi Investments and Consulting Services (BASICS Ltd.)
CPSW	Council of Professional Social Workers (Orissa based NGO)
CTxGreEn	Community-based Technologies Exchange fostering Green Energy Partnerships (Canadian renewable energy and resource assessment NGO)
ELDF	Enviro-Legal Defence Firm, Noida, UP (specializes in natural resource and environmental law; also has a non-profit arm by same acronym ELDF with a full expansion of Environment Law and Development Foundation)
Gram Vikas	Gram Vikas ("village development" in Oriya, largest NGO in Orissa, 29 years)
IC	Intercooperation (Swiss foundation)
IDRC	International Development Research Council, Canada
INFRAS	Swiss consulting firm specializing in natural resources, infrastructure, and energy; has long experience in SDC-funded development projects in India
Outreach	Outreach (Karnataka-based South-Indian NGO, livelihoods, SHGs)
PA	Practical Action South Asia (based in Colombo, Sri Lanka; Int'l NGO, formerly known as ITDG – Intermediate Technology Development Group)
RCDC	Regional Centre for Development Cooperation – Centre for Forestry and Governance (Orissa-based NGO focusing on Natural Resource Management and policy issues)
Sa-Dhan	Sa-Dhan (Delhi-based NGO focussing on Micro-finance and SHGs)
SDC	Swiss Agency for Development and Cooperation (Swiss bilateral)
SEPS	WISIONS Sustainable Energy Project Support
Seva Bharati	Seva Bharati (Orissa NGO working on livelihoods and empowerment)
SICI	Shastri Indo-Canadian Institute (project awarded to University Waterloo with CT_xGreEn and Gram Vikas-CT_xGreEn Biodiesel project as partners for a Millenium Development Goals project:)
SSHRC	Social Sciences and Humanities Research Council, Canada
TWC	The Working Centre (Canadian NGO working in employment resources, community tools for empowerment, Kitchener, Ontario, Canada)
UW	University of Waterloo, Waterloo, Ontario, Canada
Vasundhara	Vasundhara (Orissa based NGO focusing on natural resource management, strengthening people's organizations and SHGs, and livelihoods)
WLU	Wilfred-Laurier University, Waterloo, Ontario, Canada (a Master's of Social Work student will join our project with a AUCC scholarship for three months: Sep.-Dec.'08 to work on SHG strengthening and training)

* * * * *

Appendix 1

Copy of Reference cited in Footnote # 2, Page 1
Geeta Vaidyanathan and Ramani Sankaranarayanan "Biodiesel – no conflicts here!"
as one of five articles examining the impact of biofuels on food-fuel security,
Appropriate Technology, Volume 34, No. 3, September 2007, pp. 12-14.
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See also www.appropriate-technology.org
(full paper available only to subscribers – extracted here for reference – do not circulate).

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Incorporating
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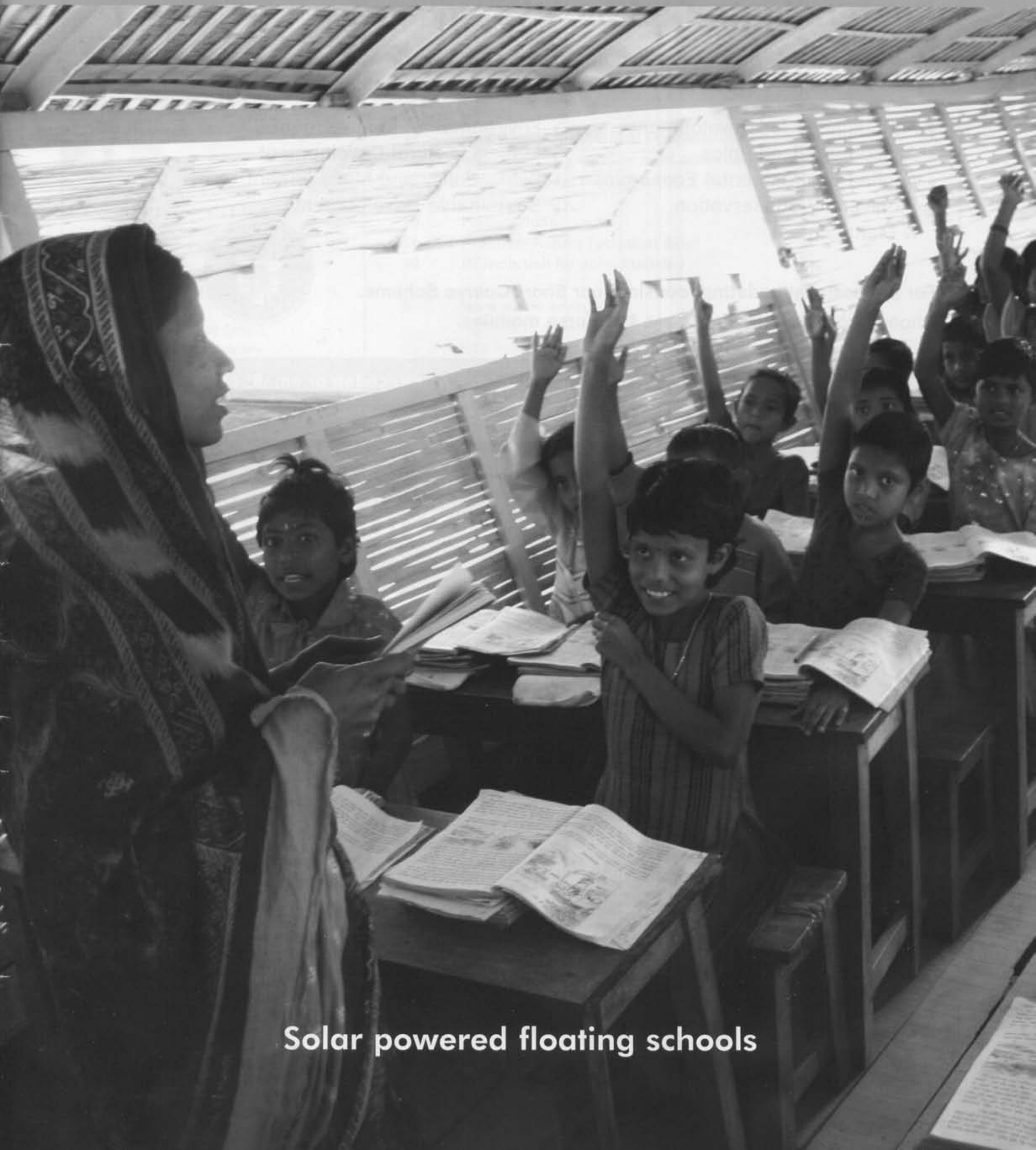

Solar powered floating schools

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Front Cover: Enthusiastic pupils on one of Shidhulai Swanirvar Sangstha's on-board classrooms, in rural Bangladesh. Shidhulai is using a fleet of 88 flat-bottomed boats to bring a range of educational services and renewable energy supplies to over 400,000 people.
Credit: Ashden Awards *(see page 42)*

Biodiesel - no conflicts here!

Over the last three years a village-scale biodiesel project has been taking place in some of the villages of Orissa, India. It has been promoted by the Gram Vikas-CTxGreEn Biodiesel Project. Geeta Vaidyanathan and Ramani Sankaranarayanan outline how the project has progressed.

A barefoot technician trainee from Tumba demonstrating the hand-operated Mafuta Mali oil press. Niger seed grown by farmers in Tumba is being pressed during this demonstration and feedback session.

Credit: CTxGreEn

For the last three years CTxGreEn, a Canadian NGO, has been working in partnership with Gram Vikas in three village clusters of Orissa to provide the villagers with a secure source of energy based on locally available biomass. The approach has been to ensure that no damage is done to the environment, that traditional livelihood systems are respected, and that new technology can be sustained in the community.

The term biodiesel is used very loosely today to describe anything from straight vegetable oils (SVO) to a 5:95 mix of vegetable oil and petro-diesel, and is even sometimes confused with ethanol, which is also a bio-fuel but not biodiesel. Biodiesel is prepared from vegetable oil* but involves a chemical transformation, transesterification, which converts triglycerides to esters in the presence of alcohol (99.5 per cent pure ethanol or methanol) and lye (sodium hydroxide or potassium hydroxide). Such a change results in the formation of biodiesel, which can be used directly in diesel pumps and generating sets, and glycerin a by-product that must be removed and can be either composted or converted to soap.

The attractiveness of this chemical transformation of oil, from the engineer's point of view, is that oil that is acidic in nature is neutralised in the process and can be used directly in diesel engines without any deterioration of mechanical parts. Thus the user is not subject to the burden of maintaining a modified and thus unfamiliar diesel engine. For the villager it is perhaps the only renewable energy technology that (a) produces a fuel that could be stored easily and used as and when needed, (b) has the lowest capital investment, (c) maximises local value addition (increased income) and (d) minimises cash-outflow from the village economy (for capital as well as operating expenses).

Unlike most biodiesel efforts in India that are hell-bent on promoting large-scale mono-culture plantation of Jatropha curcas, a non-indigenous plant species (even suspected to have allelopathic effects on native species), the Gram Vikas-CTxGreEn biodiesel project is unique in that it sources only locally available and under-utilised oil seeds.

The very small scale of the technology (a five litre batch production on a bimonthly or weekly basis requires only 20 kilograms of seeds/batch) was developed in dialogue with the community and includes good organic agronomic practices to supplement local forest seeds like karanja (Pongamia *pinnata*) and mahua (Madhuca *indica*) with niger (Guizotia *abyssinica*), an indigenous oil-seed, that can be grown in village community fallows.

Oil is pressed in a manual oil press and the de-oiled cake is used as organic manure in local agriculture. The oil is then mixed (stirred) with alcohol and lye in a pedal-driven machine for an hour during which period the mixture is converted into biodiesel and glycerin. A clear separation occurs between the two products within an hour after pedalling. The denser lower phase glycerin is drained out first, followed by the lighter biodiesel, into separate containers. All the products are environmentally-benign, and most importantly the entire system promotes recycling of nutrients within the region and money is re-circulated in the local economy.

In stark contrast to conventional biodiesel projects which produce fuel for automobiles, this project produces fuel for prime-moving devices which enhance productive livelihoods, food production and access to basic needs. Secondly, in this approach food crops are not displaced, nor is there any mono-culture. The focus is on locally under-utilised oil seeds: forest tree-borne oil seeds, such as mahua and karanja, and minor oil seeds, like niger. These are traditionally sold to

* Biodiesel can only be prepared from vegetable oils that are predominantly triglycerides. Such oils are mostly the product of oil seeds, whereas oils prepared from leaves and other portions of trees and plants tend not to be suitable for biodiesel preparation as they do not contain any triglycerides.

Manjula Pradhan from Kandhabanta using pedal power to mix the newly pressed oil with alcohol and lye to produce biodiesel. Sukumari, also of Kandhabanta, awaits her turn.

Credit: CTxGreEn

middlemen for a pittance, bulked up and then sold on for a profit. Most of the niger seeds are exported, with a large mark-up, as bird seed to Canada. Oil is expressed from some tree-borne oil seeds and sold to soap manufacturers, while the oil cake is used as fertiliser outside the area. Thirdly the technology is very small with the capacity to scale-up as needed.

Kinchlingi village

Since November 2004, the biodiesel technology has functioned as a volunteer-driven enterprise in the village of Kinchlingi. The villagers are being motivated to grow oil seeds on community land and use tree-borne oil seeds collected from their forests, allowing money to circulate within the village and restricting cash and nutrient out-flows.

A few oil-bearing trees have been identified as locally underutilised species: mahua, karanja, and kusuma (Schleichera *oleosa*). Cultivation of niger and castor beans (Ricinus *communis*) in agricultural land and kitchen gardens has begun, to supplement oil seeds collected from forests. Preliminary biodiesel recipes have been developed for a few of these local oils.

Only half of the 16 households in Kinchlingi own land and even these are small or marginal farmers with landholdings ranging between 0.5 to two acres. While half the village practices a mix of shifting agriculture and horticulture (mainly in the form of cashew), the other half are wage labourers. In spite of that, last year the village cultivated niger on about three acres of land, spread out in four plots. The harvest was good on one piece of land (1 acre) and has provided for roughly a quarter of their annual requirement of oil for biodiesel. Additional seeds were purchased from a neighbouring village to supplement the needs by exchanging forest seeds for salt. By growing their own seeds the village of Kinchlingi can offset their cash outflow, and reduce the cost of biodiesel by 60-80 per cent.

Every household is currently volunteering time (roughly an hour shift once every month) to produce biodiesel and operate the pump-set. However, when a community is dependent on a daily-wage earned either from selling fuel-wood lopped from forests, or from labouring in public works projects of the government, or worse still migrating seasonally in search of work, it is hard to sacrifice even one day a month for making biodiesel. In spite of these challenges the village has been running the biodiesel pump for over 25 months using more than 325 litres of biodiesel to pump over 2,150,000 litres of water.

Yudhisthir Behera remembers the travails of his wife and daughter-in-law going down to the river to fetch water, especially during the monsoon when the path was slippery and the water muddy. "The path leading to the river today is overgrown with weeds from lack of use, thanks to biodiesel."

Kandhabanta and Talataila villages

In the villages of Kandhabanta and Talataila biodiesel is owned, operated and managed by the women in the community, with the assistance of a barefoot technician. For the women the time saved in going and fetching water from the river (not to mention the hazards of slipping on treacherous terrain during the monsoons) can be pooled to make enough biodiesel for the village. However such a connection is at best tenuous as women are usually involved in some activity or the other throughout the year and if indeed time were saved they would use it to augment their income.

Biodiesel in these villages was initially used for water-pumping (over 148 days, 90 litres of biodiesel were used to generate 130kWh of electricity and pump up over 488,000 litres of water) but a gravity-flow water-supply system has since replaced it. The communities would now like to use biodiesel for pumping water in the months that the gravity flow runs dry and for providing two-to-three hours of electricity for home-lighting. The communities are currently discussing how to sustain such an enterprise with village-grown feedstock and a minimal cash-flow to the outside, even as alternatives for lighting (individual LED based mobile lighting versus a mini-grid supplying to two power points in the house) are being explored.

Hara Guru, a member of a self-help-group, feels that the responsibility cannot rest on an individual. "Our group can take it up but a single person will not be able to." With constantly changing demand the self-help-group continues to be dependent on the barefoot technician. Once routine operations set in, the intention is that the women will be able to supplement their income by providing an energy service to their community of 32 households.

The Sauras of the Tumba hills

The third area of implementation, in the Tumba cluster, has been a slower but a more involved and elaborate process, involving eight-ten villages and 180-200 households. There are nearly 50 villages dotting these hills some of which are 1000 metres about sea level. Access is mainly by foot as there is little infrastructure. The people belong to the Saura tribe, an indigenous community dependent on the forest for subsistence. They practice a form of shifting agriculture known as *bogodo* and collect forest produce to supplement their income. Seasonal migration by men to cities is common to supplement cash income, breaking up the family unit and leaving women to fend for themselves and their families.

Working with the villagers in this community, an assessment was done of the underutilised oil-bearing trees in their forests. Using watershed boundaries to demarcate resource clusters, the community has identified two core villages for siting the biodiesel unit and other villages in the vicinity where the service from the fuel will be provided. The protection of aquifers through soil and water conservation measures, terracing to protect soil erosion, identifying forest tree-oil species and enumerating them, quantifying their yield, and identification of community land to grow oil seeds has been the focus of activity so far.

An oil pressing and biodiesel water pumping demonstration was carried out and the local community participated in assessing the viability of the technology in their area. The community has identified small livelihood activities like oil expelling and water pumping for irrigation as the niche for biodiesel. The hope is to run the unit as an enterprise for generating income. Local Saura youngsters who dropped out of school (rebelling against the system), are undergoing extended training in processing and quality control of the fuel, stock keeping, operation and maintenance of the machines, and additionally in agronomy so that they come to understand the ethics of local economic development and environmental concerns.

The aim is get the community confident in handling the technology and, also to ensure they have sufficient locally grown or collected feedstock to run the prime-moving device be it the pump or the generator set.

For us, the spark in the eyes of the young boys and girls training with us as they realise that the chemistry is familiar - the same as in their traditional alcohol brewing, or when they fully comprehend the importance of viscosity as a measure of the flow of fuel to feed the engine - the same as how food in our stomachs energises us, is reward enough..

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Hands-on training of bare-foot technicians on the biodiesel generator

Credit: CTxGreEn

Appendix 2

Village-Scale Biodiesel-Fuelled Energy System
One of four global case studies featured in the PREP 8 (WISIONS issue):
"Sustainable Biofuels Production and Use - Options for Greener Fuels"
Issue IV. 2006

Promotion of Resource Efficiency Projects (PREP) – WISIONS of Sustainability
Wuppertal Institute for Climate, Environment and Energy, Germany
A copy of the above publication is available in the web: see www.wisions.net
(only the introductions and our case study are included in Appendix 2)

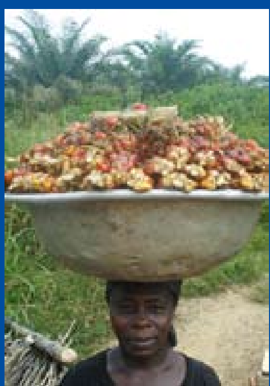
8

PREP

Promotion of Resource Efficiency Projects

Sustainable biofuel production and use
Options for greener fuels

IV. Issue 2006



www.wisions.net

WISIONS

Sustainable Development is Possible

WISIONS is an initiative of the Wuppertal Institute for Climate, Environment and Energy, carried out with the support of the Swiss-based foundation Pro-Evolution, to foster practical and sustainable energy projects.

Photo: PixelQuelle.de

Sustainable development is possible. Numerous innovative and valuable contributions from different countries, fields and institutions have shown that an appropriate reconciliation of economic, ecological and social factors is not unrealistic utopia. We have made a promising start, but the greatest challenge still facing us in the 21st century is to learn how to use the world's resources more efficiently and in an ecologically sound and socially balanced way.

Progress is being made; however, fourteen years after the UN Conference on Environment and Development in Rio de Janeiro, many people, especially in developing countries, still lack access to resources, clean technologies, and education. At the same time, people's level of resource consumption and means of production remains unsustainable.

To meet global challenges like climate change, water scarcity and poverty, it is necessary to foster projects of potential strategic global importance by supporting them so that they can be implemented locally. Examples of good practice need to be actively promoted to a wider audience.

WISIONS promotes good practice in resource efficiency through its publication of relevant successful projects in its Promotion of Resource Efficiency Projects: **PREP**

WISIONS also provides consulting and support to ensure the potential seen in visions of renewable energy and energy efficiency can become mature projects through its Sustainable Energy Project Support: **SEPS**

Sustainable biofuel production and use
Options for greener fuels

As fossil energy resources are in decline and the need to become less reliant on energy imports is becoming more and more relevant in political discussions, alternative energy sources are needed. Biofuels are one possible replacement for fossil fuels. Although biofuels still cost more than fossil fuels, their share in terms of use is increasing worldwide. The global production of biofuels is now estimated to be about 35 billion litres per year.

Biofuels can make a significant contribution in reducing the dependency on fossil fuel imports, especially in the transport sector. Another advantage of biofuels is their contribution to climate protection: as biofuels are usually considered to be CO_2 neutral, their use helps to reduce greenhouse gas emissions. Fossil fuels, on the other hand, are a major source of CO_2 emissions. In Europe, for example, transport is responsible for about 21 percent of all GHG emissions that contribute to global warming.

Biofuels are usually used for transport fuels, but they are also applicable for electricity and heat generation. In relation to reducing dependency on fossil fuel imports, the use of biofuels as transport fuels is particularly effective; however, from a climate protection point of view the efficiency could be greater if biomass were also used for generating both heat and electricity in CHP plants.

There is a wide range of appropriate biomass sources and a broad mixture of resulting biofuels. Biomass input for biofuel supply often constitutes waste products from some other activity or process, but biomass can also be grown for specific use as a biofuel. Common liquid biofuels of the so-called "first generation" are pure plant oil, biodiesel and ethanol based on sugar and starch crops. Among the "second generation", synthetic biofuels as biomass-to-liquids are currently the subject for wide-ranging discussion. Last but not least biogas is a possible future option.

However, the promising qualities and potential of biofuels also bring an element of risk – the social and environmental dimension of cultivation has to be taken into account and, in particular, plantation areas could become a problem. A new and growing market for biofuels may provide incentives for over-harvesting and the establishment of plantations; the intensity of agricultural land may rise and this would have major impacts on habitats, biodiversity, water supplies and soils.

Photo: PixelQuelle.de

In this brochure, WISIONS focuses on sustainable biofuel production and use. WISIONS presents successfully implemented projects from Ghana, India, Austria and Indonesia, with the intention of further promoting the particular approaches used by these projects. Using a key number of internationally accepted criteria, the main consideration for the selection of the projects was energy and resource efficiency, but social aspects were also of relevance. The assessment of the projects also included the consideration of regional factors acknowledging different needs and potentials.

All projects that fulfilled WISIONS application criteria were independently reviewed, and four of them, with the potential to make a significant impact on global energy and resource efficiency, are published in the following pages. WISIONS is pleased to present good practice examples from ambitious projects which have been successfully implemented on different continents. All of these projects are appropriate within their local context and have been developed to a level which meets WISIONS selection criteria. Although uniquely designed for a particular setting and problem, the projects presented can be adapted to different situations or can provide valuable information from their implementation phase. Links to the illustrated good practice examples shown in the brochure, as well as a couple of other issue-related good practice projects, are available on www.wisions.net.

The selected projects are not intended to represent the only possible courses of action to take in the area of sustainable biofuel production and use but they do demonstrate promising approaches.

The next **PREP** brochure, following the same objectives, namely to collect, evaluate and promote good practice examples, will highlight the issue of "Renewable energy in the food supply chain".

Photo: PixelQuelle.de

VILLAGE-SCALE BIODIESEL-FUELLED ENERGY SYSTEM

Location:
Orissa, India

Project's Aim:
To provide running water in non-grid villages using locally produced biodiesel

Technical Answer:
Establishment of a biodiesel-based water pumping programme

Photo: Pedal-driven Biodiesel Reactor; CT_xGreEn

The organisations CT_xGreEn (Canada) and Gram Vikas (India) are working together to create a biodiesel-based water pumping programme in four village communities in the region of Orissa, India. The project's objective is to provide the communities with water supply and sanitation services by means of an energy system based on renewable resources, which also helps to create local economic opportunities.

Underutilised forest seeds will be collected and native local oil-bearing crops will be grown in order to create a sustainable plant oil source. The vegetable oil can then be extracted and used as feedstock for conversion into biodiesel using reagents/catalysts. The biodiesel will then fuel pump-sets and small-scale power generation sets.

Photo: CT_xGreEn

Two installations have already been completed; in Kinchlingi and in the twin villages of Kandhabanta-Talataila the villagers are producing biodiesel from vegetable oil via the process of transesterification using pedal-powered machines. Water pumping fuelled by biodiesel has been in use since May 2004 and biodiesel-fuelled power generation since July 2005.

BENEFITS

Three of the non-grid villages within the target region now have access to a piped water supply. A further benefit will be the extension of the biodiesel energy system to provide electricity in rural areas, which will commence once the sustainability of the project has been proven for water pumping.

Additional benefits include new livelihood opportunities for the villagers, conservation of indigenous forest trees, cultivation of under-utilised oilseeds in fallow land, and enhanced skills within the local community to operate and manage the biodiesel-based energy system. The project operates according to the principle that the technology used can, and will, lead to land regeneration.

SUSTAINABILITY

The simplicity of the pedal-powered equipment, together with rigorous operating procedures and partnerships with diesel equipment suppliers, has contributed to the project's success. The technology is presently based in self-help groups, which are run by women and act as savings and credit organisations geared toward activities that generate additional income. A core team of local staff members is being created to support the operational training at village level as well as to train maintenance personnel.

The strategy for the future of the project foresees extending the operations of the pilot plant into a resource centre for biofuel-based livelihood strategies. Later, it could be expanded to offer action-oriented research support to field NGOs and to facilitate the installation and commissioning of new biodiesel units including South-North training sessions and knowledge exchanges, micro-energy research and development, and further collaborative partnerships.

TECHNOLOGY

Biodiesel-fuelled pump sets (3.5-5 HP) and small scale power generation sets (2-3kW) are being structured as a closed-loop package. Vegetable oil extracted from locally grown (and native) oil-bearing crops serves as feedstock for conversion into biodiesel. Alcohol (methanol or ethanol) and lye (sodium or potassium hydroxide) are the reagents/catalysts required to convert vegetable oil into biodiesel. Alcohol and lye are both currently being purchased, but in the near future these will be produced from local biomass.

Photo: Hands-on training; CT_xGreEn

FINANCIAL ISSUES

The core funding for the energy systems (pilot plants plus four village units) was provided by WBDM (World Bank Development Marketplace) in 2003, amounting to US$ 230,000. The water supply systems in three villages were built through bilateral funding (Rs. 202,200) with the village communities contributing the remaining 40 percent of the infrastructure cost. The Swiss Agency for Development Cooperation-Intercooperation (SDC-IC) funded a study on legal challenges (Rs. 190,000).

Support in the community is provided by Gram Vikas. The University of Waterloo and The Working Centre of Kitchener, Canada, have been partners at various stages. The International Development Research Centre Canada, which provided C$ 20,000, and the Social Sciences Humanities Research Canada have recently funded a doctoral research project.

OBSTACLES

The main challenge for the project was to communicate the complexity of managing a renewable energy system to the local communities. Most obstacles were overcome by involving the community in the early stages in technology development and by training barefoot technicians. Developing the pilot plant as a nodal centre for raw material procurement and final product testing, establishing standard operating practices in all installations, working with local equipment suppliers for servicing diesel engines and setting up an efficient information retrieval system are all measures that have helped reduce bureaucratic and technical hurdles.

REPLICABILITY

Training the local youth to provide technology support to the women's groups that operate and manage the biodiesel units in the villages has begun on a small scale. The goal is to increase the number of trained barefoot biodiesel technicians and for them to act as ambassadors for replication in other villages. The pilot plant on the Gram Vikas campus was set up in February 2004 for the design, development and testing of machines and processes, and to train villagers. Performance monitoring of diesel pump sets and gensets are ongoing, along with exploratory discussions with engine manufacturers to ensure warranty coverage.

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More information about WISIONS, application criteria for PREP and SEPS, as well as prior PREP-issues are available at

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Appendix 3

A copy of the most recent publication on our work:
Geeta Vaidyanathan and Ramani Sankaranarayanan “Technology and Economics Where People Matter”
Published in the “e-net energy network” magazine, www.sa-energy.net, Vol. 2/2008, July 2008, pp.3-6.
(Cover page, editorial and our paper extracted for reference only – do not circulate)
See www.sa-energy.net

editorial

The July 2008 issue of the **e**-net magazine focuses on emerging technologies in the renewable energy sector for community based initiatives. In the context of the world energy crisis and competing demands for resources these initiatives show how the burgeoning energy needs of the world's populace can be met. Articles within this issue feature technology solutions aimed at enabling the poor to meet their energy needs. We are happy that we have a contribution from Bhutan for this issue along with valuable contributions made from India, Sri Lanka, Nepal and Pakistan.

The articles highlight emerging technologies which are being managed, or have potential to be managed by community based institutions to address their energy needs. Mr. Punchibanda's article describes a biomass rice cooker developed by NERDC Sri Lanka that can cook rice and keep it warm using coconut shells and reduce a household's increasing fuel cost burden. Dr. Chanakya's article on biomass based biogas (3B) introduces a new development in biogas. It explains how biogas can be produced from organic wastes other than cow dung and offers biogas to communities not owning cattle. The issue also carries an article from Nepal describing how communities have benefited from the improved water mills. The contribution from Bhutan is about the e8's micro hydro project that meets the energy needs of the rural poor. Geeta Vaidyanathan and Ramani Sankaranarayanan share the experiences of CTxGreEn in biodiesel production at the village level and make a case for supportive policies, and community structures as strong enabling mechanisms.

Of key importance to the introduction of any technology to a specific area apart from its technical viability are the socio-economic and cultural considerations which need to be taken into account to make the technology a success. Nusrat Habib's article which looks at the need for cook stoves and ovens in Pakistan highlights such compatability.

The **e**-forum conducted in June, as part of **e**-net's initiative to promote collaboration and the sharing of experiences in the South Asian region, focused on information needs of communities. The contentious question was whether the South Asian region had the expertise, knowledge, and resources to meet this gap. An excerpt of the outcomes of this forum is included in this issue.

We hope that you find the contents of this issue relevant to your information needs. Please let us know what you think by filling in the feedback slip attached with this issue or write to us at e-net@sa-energy.net. This issue as well as previous issues are available on the e-net website www.sa-energy.net.

IMPRINT

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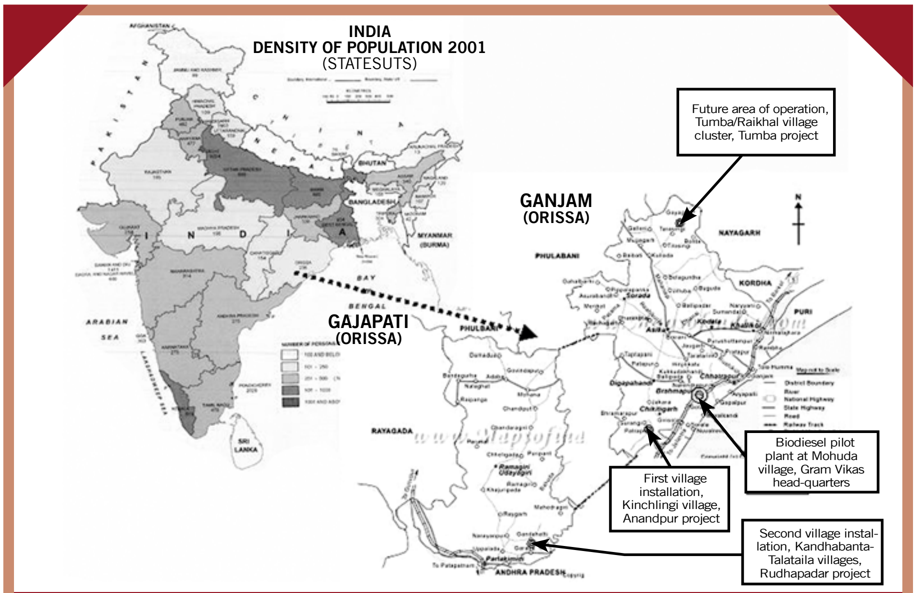
TECHNOLOGY AND ECONOMICS WHERE PEOPLE MATTER

By Geeta Vaidyanathan and Ramani Sankaranarayanan

This article deals with village-level biodiesel production in rural India using locally available and under-utilised oil seeds. Challenges faced when introducing technology and complementary implementation systems that are "new" to the villagers are explained. Apart from technical feasibility, other key factors that ensure the robustness, replicability and sustainability of such a technology system are also highlighted.

Today, biodiesel is in the centre of the food-fuel conflict. While the tension between food and fuel has to be better understood what cannot be ignored is that growing your own food and meeting your energy needs in a decentralised manner with renewables both face macro-policy challenges that make it difficult for "Small is beautiful" to be sustained economically. Independently producing energy and growing food for personal use cannot be assessed at their face-market-value alone. They should both account for the non-market exchange aspect of their production and use, and be accredited for their environmental soundness and contributions to lowering of greenhouse gas emissions.



Map of India indicating the three areas of operation of the Gram Vikas-CTxGreEn Biodiesel project in the state of Orissa (Source: www.censusindia.net/maps/popden.html, viewed on 28/09/2005)

Biodiesel from non-edible oil seeds when used for fuelling livelihoods in a decentralised/dispersed manner, can lead to stronger local economies without creating any conflict with food security. When used as a community-tool for productive livelihoods instead of fuelling more personal transportation (tantamount to consumption) there will be enough renewable-fuel that can be grown in addition to sufficient food. In the context of rural economies of developing countries, biodiesel could translate into fuel for pumpsets and thus assured irrigation for a high value second crop. The Gram Vikas-CTxGreEn Biodiesel project launched through a World Bank Development Marketplace Award (WBDM 2003) is an example of how biodiesel could be produced and used locally in rural communities. The collaboration between Gram Vikas and CTxGreEn has completed four years in February 2008 and has since advanced beyond its initial focus of serving up an addition to the renewable energy toolkit for the water and sanitation program into an integrated livelihood service. The "village level biodiesel production" is a 'no-conflict' model[1] (Biodiesel - no conflicts here! 2007) that does not promote large-scale mono-culture plantations but relies on under-utilised locally available indigenous oil seeds.

Most biodiesel efforts in India that rely on promoting Jatropha curcas, which is a non-indigenous plant species (suspected to have

The term biodiesel is used very loosely today and could mean anything from straight vegetable oils (SVO) to a 5:95 mix of vegetable oil and diesel, and is even sometimes confused with ethanol, which is also a biofuel but not biodiesel. Biodiesel is prepared from vegetable oil but involves a chemical transformation - triglycerides to esters - in the presence of alcohol (99.5% pure ethanol or methanol) and lye (sodium hydroxide or potassium hydroxide). Such a change results in the formation of biodiesel, which can be used directly in diesel pumpsets and gensets. The glycerin which is a by-product of the production process can either be composted or converted to soap. The attractiveness of this option from the engineer's point of view is that oil, which is acidic in nature, is neutralised in the process and can be used directly in diesel engines without any deterioration of mechanical parts. Thus the users are not required to do any modifications to their familiar end-use device. For the villager it is perhaps the only renewable energy fuel that could be stored easily and used as and when needed, without incurring great expenses, while maximising local value-addition with very low "cash-outflow" from the village economy.

[1]Biodiesel when produced from under-utilised oil seeds does not lead to diversion of land previously allocated for producing food and so does not create conflicts with food security. Additionally, since the fuel is produced and used locally for productive livelihoods it does not create huge demands of the nature and scale generated by consumptive transport fuels. Moreover, since the fuel and food are both produced and consumed locally, there is a much lower risk of these conflicts creeping up.

Kunnu Pradhan, Self Help group member, at the biodiesel reactor during a training session (Photo courtesy of CTxGreEn)

allelopathic effects on native species[2]). The GV-CTxGreEn biodiesel project is unique in that it sources only locally available and under-utilised seeds. The production schedule for this very small-scale technology (5L and 20L batch production on a bi-monthly or weekly basis requiring only 20kg to 80kg seeds/batch respectively) was developed in consultation with the community. The package includes good organic agronomic practices to supplement local forest seeds like karanja (Pongommia pinnata) and mahua (Madhuca indica) with niger (Guizotia abyssinica) an indigenous oil-seed, that can be grown in village community fallows. Biodiesel is produced in a pedal-driven reactor that can be maintained by anyone with basic bicycle-maintenance experience. The fuel thus produced can then be used in a regular pumpset, replacing diesel fuel.

The Mohuda Pilot Plant and Training Centre were established during May-June 2004. Biodiesel production units were set up in Kinchlingi in November 2004 and in the twin villages of Kandhabanta – Talataila in December 2004. Although the (bio)diesel-pumpset was installed in Kinchlingi early February 2005, daily water pumping could commence only in June 2005, after completion of the water tank in the village. In spite of several challenges, the village of Kinchlingi has succeeded in running the biodiesel pumpset for 690 hours using more than 452L of biodiesel to pump over 2,180,000L of water.

In the second set of villages, Kandhabanta and Talataila, a (bio) diesel pumpset alone was not suitable since the water table dips 35 feet below ground level in summer. A biodiesel-fuelled generator set was required to generate electricity, which could then power the ½ HP submersible pumpset.

The third area of implementation, is Tumba - a cluster of villages. Detailed assessment of natural resources and prevalent livelihood practices has led to an integrated micro-energy plan being designed for this area. The objective is to implement village-level biodiesel production in an entrepreneurial manner and ensure sustainability through local participation and local utilisation. Benefits will accrue to the entrepreneurs running the hand-operated oil mill, the biodiesel production centre, biodiesel livelihood services, as well as to the by-product value addition group. The community at large will also benefit in terms of increased agricultural productivity, progressive reversal of shifting agriculture[3] through stabler agricultural practices, more jobs in the local area, capacity building, and reduction in the cash outflow for purchase of edible oils and so on. As the first step, business profitability of the hand-operated oil press was demonstrated during the months of February-March 2008 at Raikhal[4], and potential entrepreneurs and Self Help Groups have been recruited for future implementation.

The biodiesel unit in Kinchlingi, which was initially planned as a "technology demonstration unit" and continuously functioned for almost four years is now the learning ground for further replication.

Biodiesel in Kinchlingi

Kinchlingi is a village of 16 families and a population of 73 belonging to an indigenous forest community called the Sauras. Almost all the families have income levels less than a $1 a day (source: www.wakeupcall.org). Only half of the families own land, mainly small-holdings ranging from 0.5 to 2 acres, while the rest earn their living through sharecropping or as casual labourers. The dependency ratio of the village is about 1:3, i.e., every earning member has roughly 3 mouths to feed. The Sauras practice a form of slash-and-burn agriculture with the difference being that they rotate between limited numbers of land and are back to the same plot 3 years later. Sometimes they use the same plot for two consecutive years, and even move to stable agro-forestry practices by growing cashew as a cash crop. Kinchlingi is attached to a reserve forest and the village has formed a Forest Protection Committee which jointly manages the forest with the Forest Development Agency. A forest assessment conducted in the vicinity of the village revealed that there was not enough feedstock for biodiesel. With the village having very little land (private or community owned), growing seeds was going to be an uphill task. The reason for choosing Kinchlingi for implementing the biodiesel system was that the NGO Gram Vikas felt that the small

[2]Pankaj Oudhia, "Bare facts about poisonous Jatropha curcas".

[3] Shifting agriculture in Tumba, also called Bogoda, uses the ash from the burnt biomass as fertilizer avoiding any chemical inputs. Oilcake can serve as a substitute for ash and in the absence of chemical fertilizers sustain the prevalent cropping pattern without slash and burn.

[4]Raikhal is one village in the Tumba cluster of 22 villages and is at 600m elevation. None of the villages in this cluster have access to electricity and all of them are accessible by foot only.

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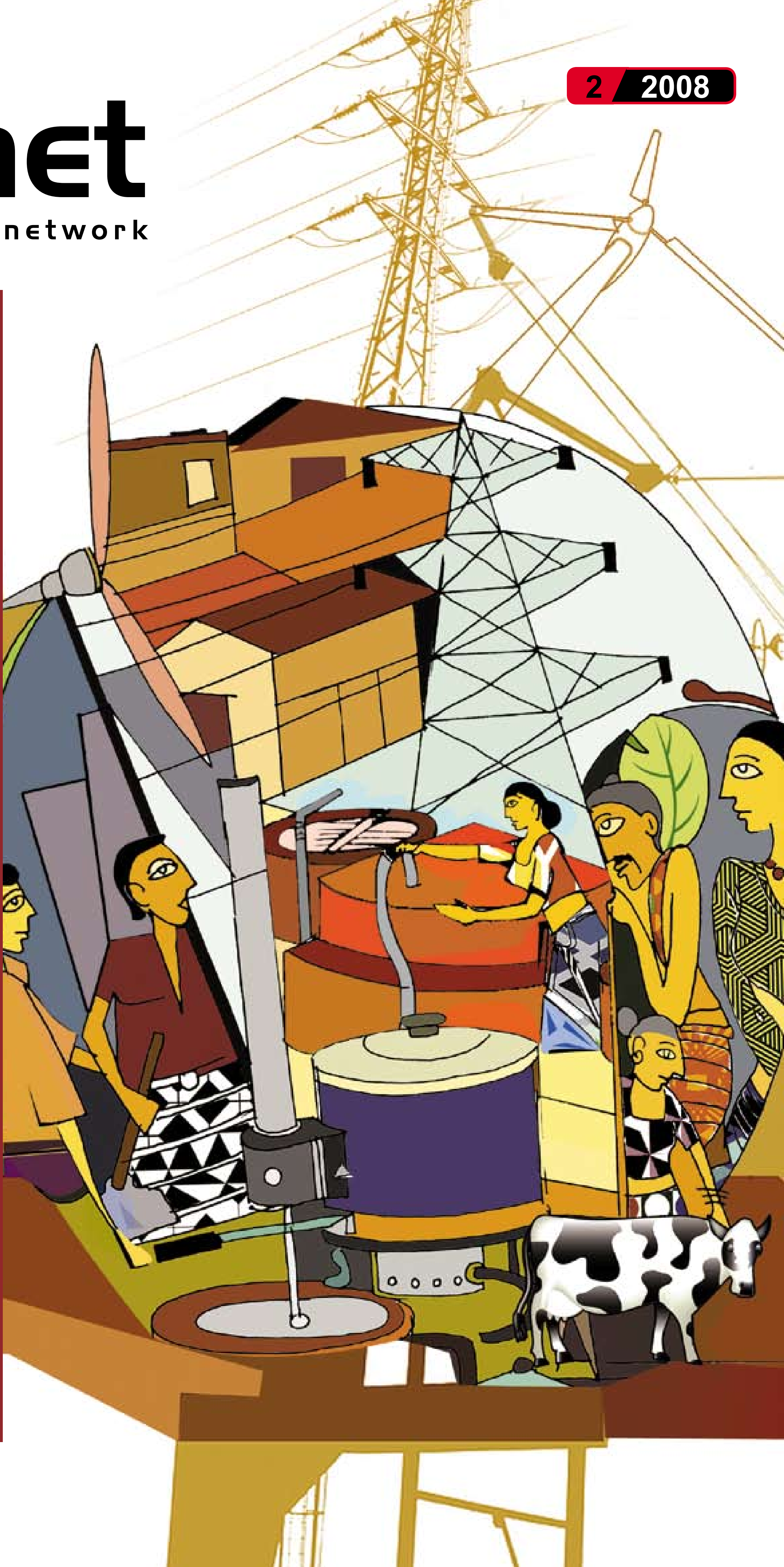

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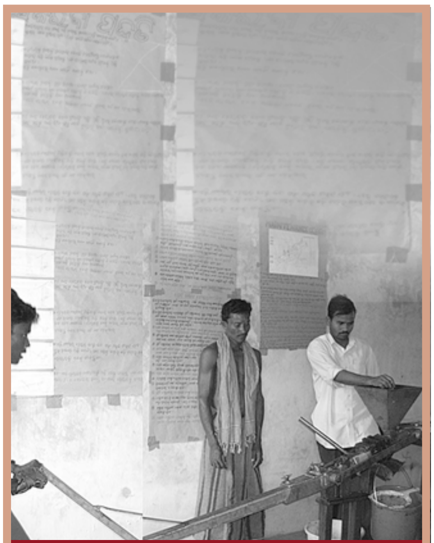


Mangala pressing niger seeds during the Mafuta Mali oil press demonstration in Kinchlingi on Feb 2007 (Photo courtesy of CTxGreEn)

village could be easily motivated. The village was to serve only as a demonstration - a test of the technical feasibility of the project. The only criterion was that the selected village should have a village committee for water-supply and sanitation, be willing to implement the program and build washrooms and a water tank. A readily available source for pumping water but no access to grid-power meant that to provide running water in the washrooms, an alternate energy source was needed and it is here that biodiesel fitted in.

Gram Vikas field staff decided to explore the idea with Kinchlingi villagers. Biodiesel appeared to fit the bill and the villagers felt that in future they could collect or barter seeds from neighbouring resource-rich villages in the future or even acquire community land and grow seeds.

As Kunnu, one of the women in Kinchlingi said on the day of the initial meeting "We should not rely only on the forest seed but cultivate our own seeds so that we can have control rather than rely on people outside." The women in the village immediately launched into the construction of the washrooms and most of the time filled in for the men who had migrated to the city for work, in order to complete the infrastructure on time. Biodiesel was produced in Kinchlingi using a pedal driven biodiesel reactor in record time - within nine months of the launch of the project.

In the meantime there was a regular exchange of information and opinions between the village and the biodiesel project team. These included inputs into the machine design (e.g. 'the oil press requires too much effort', 'the bicycle seat in the biodiesel reactor is too high', 'can the reactor tank where oil is poured be lowered?') and knowledge about availability, collection, drying and storage of local forest oil seeds. Land was identified for sowing niger communally and orientation and trainings were organised for the village youth in the hope of enlisting them as future biodiesel technicians. One boy from a neighbouring village was identified for intensive training in order to support the village in the operation and maintenance of the biodiesel unit. The Kinchlingi community decided that they would run the unit by volunteering time in the form of sweat equity[5].

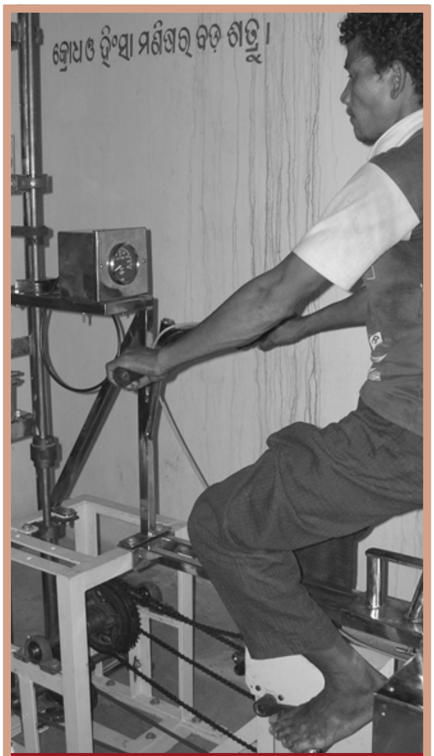
The village of Kinchlingi needs between 11-13 litres of biodiesel every month, which can be produced in roughly 2-3 batches, with each household providing one volunteer every month. The villagers have used community and private fallows belonging to other neighbouring villages to grow niger consecutively for the last three years. Cost of oil and therefore the price of oilseed have a great bearing on the final cost of biodiesel. Oil is over 80% of the raw material cost of biodiesel, while alcohol is 14% and lye 2%. In 2006, the village of Kinchlingi harvested about 141kg niger seeds through voluntary labour and were even able to get a fairly good harvest of about 80kg/acre in one of the four plots. The actual cash outflow for these seeds was nil, and so the cost of biodiesel was only about Indian Rs. 50/L.[6]

Every household is currently volunteering time (roughly a one hour shift once every month) to produce biodiesel and operate the pumpset. However, it is hard to sacrifice even one day in a month to provide sweat equity for making biodiesel when a community is dependent on a daily wage earned either from selling fuel wood lopped from forests, or from labouring in public works projects of the government, or worse still migrating seasonally in search of work. In spite of these challenges the village has been running the biodiesel pumpset since 2005 because of the enthusiasm of a handful of villagers.

Gravity flow water system has replaced biodiesel pumping in Kinchlingi as of May 2008. Since there may be a drastic reduction in flow from the gravity flow source during the hot/dry season (May-June), biodiesel will continue to be a back-up energy source for water pumping. Discussion has been initiated with the community members of Kinchlingi on the future use of the biodiesel reactor and pumpset. Villagers want to retain the biodiesel system for another two years. Lighting through biodiesel-fuelled battery-charging of

[5]Sweat equity is a term popularised by Habitat for Humanity, for labour contributed in terms of voluntary-work that is assigned a monetary value equivalent to the opportunity cost. The Kinchlingi volunteer-run model was suggested by Gram Vikas staff working there as they felt that the community could contribute labour but might not have extra disposable income to pay tariff for water. A volunteer-run model was worked out and a base amount established for each household: sweat equity as contribution towards biodiesel production and for growing or collecting feedstock in addition to a basic tariff for other chemicals.

[6]The cost of biodiesel could be further reduced by approximately 15% with improved harvest (200 to 300kg/acre is the potential harvest) and better oil yields, both of which are possible with timely sowing and input of organic manure. If the seeds were fully paid at market price the cost would go up by 15% to 20%. However, 80% of that money would remain in the village economy.



Narsing Pradhan pedalling to produce 5L biodiesel in Kinchlingi on Dec 2004 (Photo courtesy of CTxGreEn)

LED lighting systems, irrigation and oil expelling are some possibilities for use of biodiesel, besides pumping during the summer months. Villagers have agreed to grow niger this year too. They will try to sow at least 4 acres of land including a patch of previously unused community land, in a timely manner.

The technical feasibility of village-scale biodiesel-fuelled water pumping has been established beyond any doubt in Kinchlingi. However the approach proposed by the CTxGreEn project looks at technology as only one among four other key elements essential for project sustainability, the other elements being:

1. Land - to promote optimum use of soil, water resources and avoid conflict of use

2. Robust community structures for management of the technology

3. Understanding the current energy use patterns and future aspirations of the villagers

4. Legal and policy issues to facilitate the grassroot processes.

The robustness of the biodiesel system and its replication will depend on these four factors and not on technology alone.

Another area of concern has been the gap between planning and implementation owing to the cultural milieu where village decisions are still male-dominated and often not beneficial to women. Thus gender-sensitive planning does not always translate into an actual gender-sensitive plan. Similarly, the literacy level within the village is extremely low, making the training process more challenging. Young girls are being recruited into the training process as they are less likely to migrate to cities. There is the risk of girls leaving the village after marriage, yet the chances of their being in the region and continuing to assist the development work is high. The ultimate test of the viability of the technology will be the ability of the local youth being trained as bare-foot technicians to independently operate and manage the technology.

References

"Biodiesel – no conflicts here!" One of five articles examining the impact of bio-fuels on food-fuel security, Appropriate Technology, Volume 34, No. 3, September 2007, Editor: David Dixon; Publisher: Research Information Ltd., UK. – also available on www.appropriate-technology.org (full paper available only to subscribers).

Poverty Line statistics, www.wakeupcall.org/administration_in_india/poverty_line.php

Pankaj Oudhia, "Bare facts about poisonous Jatropha curcas," http://ecoport.org/ep?SearchType=earticleView&earticleId=877&page=2, viewed 19 August 2007

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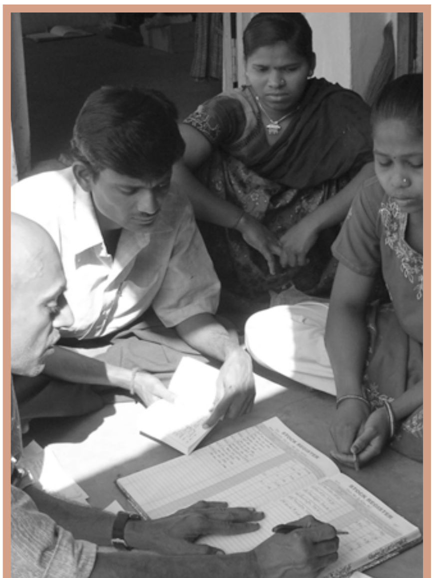

Kinchlingi youth being trained in stock and log keeping (Photo courtesy of CTxGreEn)

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Appendix 4

2005 Intel Environmental Laureate, CTxGreEn, Tech Awards 2005
The Tech Museum of Innovation, San Jose, California, USA

See www.techawards.org for more details of the citation and the project.
A short video-clip is also available on-line at above website
(search for Laureate videos and then choose CTx GreEn)

THE TECH MUSEUM AWARDS
Technology Benefiting Humanity
Presented by Applied Materials, Inc.

2005 Intel Environment Award Laureate

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Project Overview:

CT_x Green is an abbreviation for "**C**ommunity-based **T**echnologies E**x**change – fostering **Gre**en **En**ergy Partnerships." CT_x GreEn is a small voluntary sector organization that promotes green energy technologies and partnerships within the context of sustainable livelihoods. The mission of CT_x GreEn is to research, assess, facilitate and implement community-based renewable (green) energy projects in a manner that improves the total quality of life in the community and the environment.

Problem Addressed:

Absence of electric grid connection in 90% of rural tribal villages in Orissa. These tribal regions are in desperate need for infrastructure infusion and ecosystem regeneration to reverse large-scale deforestation in the aftermath of large scale illicit timber logging and prevalent shifting agriculture practices. Being remote there is no value addition to forest produce or agriculture produce.

Technology Solution:

A small-scale renewable energy system in Orissa, India based on the utilization of local biomass. The system is being implemented in 4 villages with human-powered machines: pedal-driven grinder and hand-operated oil seed press to extract oil from indigenous oil seeds; and a pedal-driven biodiesel reactor to convert the oil into biodiesel using a reaction with absolute alcohol and lye. Biodiesel is used as fuel in standard diesel engines to pump water for consumption and for irrigation. Small, remote villages using this application are unlikely to get an electric grid connection in the next 15 years.

Local systems of management for collection of forest oil seeds and for operating the machines are reinforcing existing women self help groups and forest protection councils. Integration of indigenous crops such as niger and the use of oil cake as organic manure into agricultural practices will provide options to move away from shifting agriculture. Income generation activities and additional livelihood opportunities will emerge as the technology takes root in the community.