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DESIGN OF RESOURCE USE : CASE OF JATROPHA-BASED BIODIESEL IN INDIA

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ABSTRACT

The biofuel programme was promoted around the globe with mandate of decreasing the dependency on petroleum oil, reducing green house gas emissions, increasing agricultural profitability and as option for rural employment and development. There existed acceptable and popular perception that biofuel production is more economical to reduce petroleum oil dependency and green house gas emission primarily. However, this scalar approach is not found to be uniformly applicable across the world. The exploration of political economy of different regions provides varying priorities for promotion of biofuel programme based on the context, type of feedstock under use, technologies employed and the health of the economy.

The issue is not very different for India. Policy documents of government of India mentioned that local level institutions would be given responsibility for resources planning and development through the involvement of panchayat, providing first hand right of resources to local user and priority to local energy use and self-sufficiency. However, at the same time policy remained silent on technology inputs, research and development and institutional support for achieving objectives set for the local level sustenance for resource use and design. Policy became biased toward transport sector with announcement of mixing of biodiesel with petroleum diesel. Based on the meta-analysis of the existing literature this study raised basic questions toward the policy aim and ambition of jatropha-based biodiesel programme in particular for India and biofuel programme across world in general.

Introduction

It would not be wrong to put forward the dilemma of biofuel[1] development in Indian and other developing countries in following lines 'is the fuel driving the economy or the economy driving the fuel.' At first level, for everyone, it is like chicken and egg problem. But a logical scanning of political economy of different regions of world provides varying answer based on the context, type of resources under use, technologies employed and the health of the economy. The increasing emphasis on biofuel to overcome oil pool deficit, decreasing greenhouse gases (GHGs) emission, employment generation and agricultural profitability has gained momentum in last two decades and its relevance as commodity for global trade (Gonsalves 2006; Staley and Bradley 2008). United Nation Conference on Environment and Development (UNCED) in 1992 passed 'Agenda 21' and called the international community to find more efficient

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systems of producing, distributing and consuming energy, which should be environmentally sound with emphasis on renewable options (Goldemberg and Johansson 1995). This is more important in present context, as world is facing problem of environmental issues and uncertainty of fossil fuel availability due to geo-political reasons. Oil crisis of 1970's and issue of climate change had played a pivotal role in acceptance of renewable energy options and developing appropriate technologies. This had led to substantial scale up, investment and advancement on all fronts of renewable energy technology development and uses. An increase in magnitude of petroleum energy consumption in urban / rural areas is considered as one of the important (measurable) variables for human welfare which had underplayed the importance of other energy resources as measure and motor of overall development (Cabraal et al. 2005; Goldemberg et al., 1988).

Biofuel [by]product production and uses remained in controversies and a matter of investigation for researchers across many disciplines (Kher 2005; Maheshwari 2008) for allocation of scare resources like land and water against food production (Braun 2008; Mitchell 2008). Studies have shown that biofuel which are produced on wastelands, marginal lands and on low input grasslands could reduce GHG emission and can be economically and ecologically viable in long run (Hill et al. 2006; Tilman et al. 2006). Brazil and United States (US) accounted for about 70 per cent of world bioethanol production by using sugarcane and corn, respectively (Staley and Bradley 2008). Europe (dominated by Germany and France) accounts for about 80 per cent of biodiesel production of world by the use of used rapeseed oil, cooking oil and sweet sorghum (Deurwaarder 2005).

In the above context this paper is an attempt to examine the simple question of what, why and where of biofuel development in general around world and biodiesel development in particular in India. Meta-analysis of literature was done to probe these questions and issue of concern had been raised in the discussion section.

World Scenario of Biofuel Development

Biofuel development in countries like Brazil, US and EU had got thrust either from one or / and more of these factors, viz., i) oil crisis of 1970s, ii) to develop new avenues and markets for agricultural outputs and iii) environmental concerns (Demeritt 2001; Rajagopal and Zilberman 2007). However, the primary motive for the biofuel development has not been same for all these countries / continents. On one hand, oil crisis of 1970 hit the economy of many countries which are dependent on imported oil and on other hand, it led to the exploration of alternative energy options around the world. This had led to the development of efficient technologies, processes, for the use of renewable energy. This was supported by the investment in Research and Development (R & D) and formulation of supportive domestic, national and international policies.

In 1975, after the oil shock, Brazilian government launched a programme named 'Pro-Alcohol', to promote sugarcane based ethanol with purpose to restrict high import bill, negative growth and high inflation. In addition to fuel security, the support to sugarcane based ethanol production was also due to the non-availability of hard currency with Brazil at that time and to give impulse to rural employment, by revitalising the sugar industry. PETROBRAS, the state owned Oil Company of Brazil played a proactive role in linking the supply chain of ethanol production from farm to pump. Small-on-farm ethanol distilleries were provided to build on-farm institutional pillar for small farmers who produced about 30 per cent of total sugarcane produce. Favourable climatic condition of Sau Polo for sugarcane cultivation proved boon for Brazil. Sau Polo region accounted for more than 70 per cent of sugarcane and ethanol production (Abramovay 2008). By 2006, sugarcane-based

ethanol constituted 30 per cent of Brazil's total energy matrix, mostly fueling transport and industrial sector (Mol 2007; Sennes and Narciso 2008). The success of Brazil is an exemplary case for the world in general and developing country in particular. According to Staley and Bradley (2008), the success of ethanol programme in Brazil can be attributed to the adjustment of state, industry and technology development as per countries' own requirement of energy, in synergy with sugar industry, rather than being pushed by the international development organisations. The synergy of sugar industry to produce sugar and ethanol had led to the improved technology over the year for electricity and heat production for industrial use. During the initial phase of Pro-Alcohol programme Brazilian government had given tax breaks and social labels to sugarcane industry on purchase of raw material from small farms (Abramovay and Magalhaes 2007). This had led to more inclusive approach of development for agriculture and self-sustaining energy matrix in Brazil in last 40 years. In 2006, Brazil produced about 33 per cent (~17 billion liters) of world's total ethanol production. The production has been supported by about 330 sugar industries, with average production of 1.2 million tonnes per year. However, the ethanol programme in Brazil is not out of political debate and scientific investigation, as it has raised the problem of increasing land concentration, issues of monoculture and huge subsidy to industry over the years (Rothkopf 2007).

EU initiative on biofuel production came in 1992, with reform in Common Agricultural Policy (CAP). In 1992, under CAP farmers were allowed to grow non-food crops on set aside land for income generation which are not in use for agricultural purpose (Henniges and Zeddies 2006; Kojima, Mitchell and Ward 2007). In May 2003, the European Parliament and the Council had adopted the 'Directive on the Promotion of the use of Biofuels or other Renewable Fuels for Transport'. The directive stated that the member states have to replace minimum of 5.75 and 10 per cent of fuel requirement for transport fleet using biofuel by 2010 and 2020, respectively (Deurwaarder 2005; Laak et. al. 2007). The motive behind promotion of biofuel in Europe was i) sustaining the farming activities, ii) reducing the cost of farm support policies, iii) to diversify energy supplies and iv) creating a value added product and employment in countryside. The issues of reducing the GHG emissions, net production cost and energy efficiency of the biofuel crops remain in controversies in Europe, in comparison to the biofuel crop grown in Brazil or in other countries. In spite of that, biofuel production has gained momentum in Europe as the farmers had gained in the process, viz., i) revised CAP allowed farmers to grow energy crops on set aside land, which otherwise would have to be fallow, with ensured earning of about €100 to 500 per hectare, ii) the dung from high density animal husbandry activities is profitable now, as the dung is used as manure in biofuel cultivation, iii) a premium •45 was paid per hectare for assisting energy crop plantation and iv) biofuel production had led to stronger prices for agricultural commodities due to requirement of feedstock (Henniges and Zeddies 2006; Kojima, Mitchell and Ward 2007). However, in 2007, EU had revised its CAP guideline on subsidy to the 'set aside' land in wake of increasing food prices (Waterfield 2007). The increase in the global food price in 2012 was attributed the increasing demand of biofuel from EU (Kelly 2012). Viewing this, EU had reduced its target of 10 per cent of biofuel production for transport to 5 per cent by 2020 from raw material like wheat, rapeseed or soya (Bauwens 2012).

The transport fuel in US is dominated by gasoline, which makes ethanol derived from the corn a favourable option as renewable energy source. The US ethanol industry has been protected from the foreign competition (especially Brazilian ethanol obtained from sugarcane) since 1980 under Ethanol Import Tariff. About $0.54 per gallon of tariff is levied on

imported ethanol. The issues of subsidies and regulation on US biofuel programme have been more complex than other countries.This was due to the nature of raw material used, viz., corn, for ethanol production. It is an agriculture crop used as staple food. The post-production tax credits and relaxed fuel efficiency for flexed vehicle is more favourable in US than in any other country (Staley and Bradley 2008). About 95 per cent of ethanol produced in US comes from corn, which is heavily subsidised. From 1995 to 2010 corn had received the subsidies of around $89 billion, against $38 and $34 billion for wheat and cotton, respectively[2] . US policies support the ethanol industry from both supply and demand side. On supply side, heavy agricultural subsidy is provided which led to low cost feedstock. On demand side, mandatory blending and tax incentives on consumption enhances sales of ethanol in open market.The Energy Policy Act of 2005 had given direct support to ethanol programme through Volumetric Ethanol Excise Tax Credit (VEETC) and tax credit of $0.51 per gallon of ethanol mixed with gasoline (Koplow 2006; Staley and Bradley 2008). US Farm Bill 2008 had increased the support for biofuel programme from $2.5 billion in 2002 to $7.14 billion in 2008. Section IX on Energy of US Farm Bill 2008 had supported 'Biomass Crop Assistance Programme', which provided 75 per cent of cost for establishing an eligible bioenergy crop. Also support had been provided in terms of annual payments for production and matching payments of up to $45 per tonne for two years for collection, harvest, storage, and transportation for raw material to a biomass conversion facility [3]. On other side, the potential of corn based ethanol to reduce the GHG emission has been in debate and questioned (Searchinger, et al, 2009; Tilman et al, 2006). Also concern has been raised on link of corn being used as feedstock and rising food prices international market, which hits the poor and the poorest of world most (Braun 2008; Babcock 2008).This protectionist policy and trade options of US to run its biofuel programme indicates the mandate for making the agriculture and related bio-energy production more viable and profitable financially, irrespective of environmental concerns.

India on Biodiesel Path

In 2003, Government of India came up with 'Report of the Committee on Development of Biofuel', to promote biofuel (ethanol from sugarcane and biodiesel from Jatropha and Karanja) on wasteland. Biodiesel programme has been able to catch attention of different stakeholders due to the requirement of huge and scarce resources from the hinterland of country, viz., wasteland, manpower for employment and other related inputs, with emphasis on fulfilling the guzzling fuel requirement of transport sector (Planning Commission 2003). The rationale given for biofuel development was its role as alternative to petroleum fuel for transport sector, environment-friendly in checking green house gases (GHG) emission and generating employment options in rural areas (Bhojvaid 2007; Kher 2005). The Planning Commission report had drawn a two-phase developmental programme to promote biodiesel from jatropha. First phase involved demonstration project (from 2003 to 2007) for plantation of jatropha on wasteland, through Joint Forest Management (JFM) and non-JFM approach, across eight compact areas [4]. Based on the assessment of first phase, the second phase (from 2007 to 2012) envisioned that villagers would take up the plantation work at community level, with institutional and financial support from government [5]. Chhattisgarh, Madhya Pradesh, Rajasthan, and Uttarakhand have constituted separate biofuel development boards for the promotion of biofuel plantation and uses. Also government has approved the long awaited National Policy on Biofuel (in September 2008) to expedite the development of biofuel in near future.

The Planning Commission (2003) approach toward biodiesel programme got mixed reaction in terms of selection of

feedstock and promotion of plantation on wasteland. Report mentioned that local level institutions would be given responsibility for resources planning and development through i) the involvement of Panchayat, ii) providing first hand right of resources to local user and iii) priority to local energy use and self-sufficiency. However, the report remains silent on how to mobilise and use the local / regional resources for local / regional energification process. On the other hand, all financial and environmental standards stated in the report are of transport sector, showing the one way scalar approach of state resource mobilisation for R &D and biodiesel production. Biodiesel Purchase Policy (MoPNG 2005) had given rights to oil marketing company for purchase of B100 (with effect from 1 January 2006) from local produces and entrepreneurs at INR 25 per liter. The policy had raised concern about large land ownership by big industries but provide no measures to check them or to empower the involvement of Panchayat through the formation of local institutions or Rural Business Hub. Also the 2003 report can be criticised on been overlooking the basic research to support the bioenergy crop varieties across different agro-climatic zones in India. The target of harvesting 65 million hectares of wasteland for biofuel cultivation had been criticised on the ground of being encroachment to the commons of poor people, who depend on it for day-to-day activities, livings and requirements (SPWD 2007).

National Policy on Biofuel 2008 had targeted the blending of biofuel (ethanol and biodiesel) up to 20 per cent by 2017. Also the report had encouraged the biodiesel plantation on community / government / forest wastelands, while plantation on fertile irrigated lands would not be encouraged. The Minimum Purchase Price (MPP) of bio-ethanol was based on the actual cost of production and import price of bio-ethanol. For biodiesel, the MPP was linked to the prevailing diesel price in retail market. Also the National Policy on Biofuel envisages that biofuel (namely, biodiesel and bio-ethanol) may be brought under the ambit of 'Declared Goods', by the government to ensure unrestricted movement within and outside the states of India[6]. On one hand, the MPP for biofuel was welcome step to grower for diversifying the revenue generation options; on other hand, unrestricted movement of biofuel may open it to be influenced by market fluctuation and may defy the developmental goal of rural employment, agricultural productivity and energification in long run. However, the assessment of programme implementation and its socio-economic impact required a detailed and comprehensive study.

The Design Aspect of Biofuel Development

This section gives an overview of approach which had been followed by the major biofuel producing countries / continents. The biofuel programme of EU and US can be characterised with emphasis on i) centralised production approach, ii) large land requirement which varies from 1,000 to 4,00,000 hectares, and ii) huge farm subsidies. This design stems its origin as market oriented, protectionist trade with profit motive for fueling the transport need. On the other hand, Brazil adapted a mixed bag of approach with decentralised way of acquiring raw material and centralised way of final processing to produce ethanol. In Brazil, 70 per cent of land under sugarcane cultivation was owned by the 340 industries, while rest of the 30 per cent was owned by about 60,000 smaller farmers having average landholding of about 27.5 ha (Cotula, Dyre and Vermeulen 2008). Over the years Brazil's ethanol programme had led to the two-pronged social change. First, the technological innovations led to the expansion of ethanol boosted high skilled job opportunities with positive spin- off in many regions and sectors. Second, it led to the concentration of land and wealth in hands of few industries or corporations (Abramovay 2008). To overcome this design flaw of ethanol programme, the National Programme for the Production and Use of Biodiesel (PNPB) of Brazil had charted out steps for the inclusion of small and low income

farmers. This was done through setting up of favourable institutional arrangements, public subsidies and capacity building, in the supply chain of biodiesel. This would have been impossible for the small producers who were not well organised. This is aptly put by Abramovay and Magalhães (2007: 17) as:

'The arrangements stimulated by the PNPB contribute for creating new patterns for the inclusion of low income farmers in dynamic markets. Such conditions are met by three basic political components: a new organisational model, new technical productive standards (by the use of new products) and strategic models of social responsibility on the part of the companies.'

This indicate how biofuel policies have been matured, learned and unlearned in Brazil, for more inclusive growth to suit their own socio-technical and economic environment.

The roles of international organisations have been controversial when it comes to harvesting energy to support the guzzling requirement of developed country (Margonelli 2008)[7]. The development of biofuel programme in African and Asian country seems to be no different at present. The issue of big versus small biofuel projects is already under debate and controversies. Under the guideline and financial support from the international organisation, the developing and third world countries have not got any chance to design the resource use as per their own requirement. Till now the biofuel story had mixed outcome with less of success and more of failure and controversies. This raises the concern for researchers, policy students and planners to investigate of what are the constructs that are favouring or not favouring the biofuel development in a given context.

The few small scale projects in African countries, like, in Mali, Mozambique, Burkina Faso, Ghana, Guinea and Senegal, are running successfully due to following reasons, viz., multipurpose approach of biofuel project for energification rather than electrification only, participation of local communities, women's participation, small land requirement of about 10 to 150 ha with catchment of 20 to 50 square kilometers, decentralised approach and multiple stakeholders (Jongh 2006; Henning 2000). Small scale success story on local innovation and use of biodiesel from Jatropha and Karanja was also observed in India like, Powerguda and Chaloadi village in Adilabad district of Andhra Pradesh, Gardih village in Bokaro district of Jharkhand, Gudiyattam in Vellore district of Tamil Nadu and many more to count. The commonality of these success stories is realisation and involvement of local people to use the resources as per local requirement with support of indigenous socio-technical system. On the other hand, the development of large scale project in African and Asian continent was marked with i) targeted production of biofuel for transport fuel, ii) coercive approach by the state and industries for land consolidation (varies from 1000 ha to 400,000 ha) and other resource mobilisation, and iii) large scale displacement of people (Cotula, 2008: 36). Biofuel project in Indonesia, Brazil and Colombia are facing the problem of land consolidation, land allocation, land tenures in addition to social acceptance by the local people (Peskett et al. 2007; Rothkopf 2007). Conflict on local land rights and access to resources has been in question for biofuel projects in Africa, Latin America and Asia (Cotula 2006: 62). Eijck and Romijn (2008) had also raised the concern regarding local use versus export of biofuel in international market.

If this trend is not checked at early stage, the issues of small verses large scale production of biofuel can be a cause of rift between the local people, the industry and the State. This is particularly important when in developing and third world countries, where land to people ratio is too skewed, agriculture is labour intensive and people are dependent on commons for not only income but also food, fuel and fodder to larger extent. The issues of undefined property rights

in India and in other developing countries will only aggravate this problem[8].

India's Rural Energy Scenario and Placing of Biodiesel

Rural energy system remained an unsolved mystery for planners and developers, even after more than six decades of India's Independence. Rural energy system is unlike urban one where access to electricity, Liquefied Petroleum Gas (LPG) connections and petroleum products fulfill and define the energy statistics. The energy matrix and its uses in rural area is wide, complex and socially embedded in contextual details[9] . Reddy (1999) has rightly recognised that rural energy has become an abandoned priority. The planning and policies to fulfilling the need of rural energy remained piecemeal, rather than prioritising, having bias toward urban users. In 1970s the primary focus of rural energy was on providing efficient cook stoves, which remained partial success. The case of biogas movement was also not very different. With initial success of pilot stage in 1980s, the movement lost its pace in 1990s, due to number of reasons naming few are flaws in design, bias in subsidisation and distribution of biogas plants, regional variation of dung availability etcetera (Dutta 1997). Under Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) by 2011 about 91 per cent villages (~537,947 villages) were electrified. This covered about 56 per cent of rural households (~about 7.72 crore). While as per 2001 Census of India, only 84 per cent of villages were electrified[10]. The number of households that were electrified in 2001 were about 43.5 per cent, leaving apart the quantity and quality provided (Das 2006; Gouri 2007). On positive side, RGGVY was able to create the physical infrastructure for the village electrification. However, the quality, quantity and who is and how the services are used is still matter of further exploration (Dixit and Sreekumar 2011). Also these need is need of conscious effort, so that these electrification drive at village can not become a show for influential people for agricultural purpose, leaving behind the small, marginal and landless (Reddy 1999). The electrification drive under RGGVY emphasised the unitary approach of village electrification rather than village energification for overall energy security.

Revelle (1976) had opined that rural India's energy system is partially closed, which is powered by the photosynthesis and can be disrupted in future by rapid population growth. However, the list of disruption has increased to include administrative apathy, lack of regional / local / decentralised planning, missed investment in R&D to support indigenous energy use pattern at local level and lack of database on end uses at local / regional level for better planning. The drive from National Rural Electricity Policy of 2003 which calls for developing implementable regional or local distributed energy development options and involvement of local institutions, viz., Panchayats are hope for future. This is important where grid connectivity is not possible and areas where population density is low (Mishra 2011). In condition when 88 per cent of rural households in India are dependent on biomass based fuel for daily uses (Reddy 2004), the option of jatropha-based biofuel provides an opportunity to be harnessed for producing more efficient liquid fuel. Field study done by Bhattacharya et al. (2005) in Jharkhand and Odisha shows that there are ample opportunity and uses of biofuel plantation in the rural areas, if proper market and institutional support are provided by the State.

Discussion

Before going further, it is worth discussing the seminal paper of Christopher (1965) in the field of design and city planning. While studying the natural and artificial cities from design perspective he concluded that 'natural cities' are like 'semi-lattice' and 'artificial cities' are more like 'tree'. He said that modern design of cities are more like tree which ignores the social planning and had overlooked the concept of overlapping units by more simpler form of

non-overlapping units. In his opinion this extreme compartmentalisation and the dissociation of internal elements of a unit while planning are the first sign of coming destruction. A biologist can appreciate this concept by comparing the 'tree' with 'food chain' and 'semi-lattice' with 'food web'. Ecologically it is an established fact that food web is more stable and risk absorbing to environmental disturbances than food chain. The case is not very different for planning of natural resource production, processing and utilisation. The proof for this is growing acceptance of organic farming all around the world. Jatropha and Karanje-based biodiesel and its related by-product provides us one such option and opportunity of linking the design of natural resource use with local socio-economic requirement of rural area, added by appropriate technological intervention.

Present status of development of biodiesel in India and other developing countries is showing a unidirectional approach in terms of programme conception and design. This scalar approach is similar to the concept of 'tree', where producers are at one end (in the rural area) and users (urban transport) on the other end. This design presumes that producers are the ones who do not need the output[11] (the existing dominant perspective) of the production and it should go to the users at the other ends, irrespective of taking into account the type of resource under consideration and accessible options available to the producers and users. Argument can be forwarded that technically and economically it is not possible to produce and use the biodiesel in pure form and it has to be blended with petroleum diesel. This requires advance technology for processing and mixing, available only with big oil marketing companies. However, studies have shown that jatropha-based biodiesel and other by-products can be produced and used at the local level for local use with low capital input technologies. Sardar Patel Renewable Energy Research Institute (SPRERI, Gujarat) had developed the concept of holistic approach to utilise all the components of jatropha fruit – shell for combustion, hull / husk for gasification, biodiesel for running combustion engines, cake for production of biogas and spent slurry for manure. It is found that by using holistic approach, the jatropha fruit can give three times more energy against when it is used only for biodiesel (Singh et al, 2008). Study done by group of scientists at Central Salt and Marine Chemicals Research Institute, Gujarat has shown that the products of Jatropha fruit can be used for promoting organic farming by using its oil cake. Shell can be used as coal substitute by changing it into briquettes, in addition to the use of neat biodiesel for running agricultural appliances (Ghose et al, 2007). With the use of lignocellulolytic fungus as inoculum, now it is possible to reduce the phytotoxicity of jatropha hull (by lowering the pH and phenolic content) with four months of gestation period. The resultant organic manure can be used as remedial for acidic soil (Sharma et al, 2009). In addition to this, the opportunity for creating employment in rural area is enormous through jatropha plantation due to involvement of labour- intensive activity which would also have multiplier benefits (Grorge et al, 2005). It is important to recognise that transports fuel use is also linked with other important issues like mobility, lifestyle choice with economic progress, public transport in urban centres, urban land use pattern and international trade. So, the use of biofuel as the only major option to solve the problem of sustainable transport is in itself inadequate and unsustainable. In this context, it is imperative that biofuel programme should not be only hijacked in the name of fulfilling the oil pool deficit and GHG emission reduction by taking away the issue of local resource use design and sustenance in backdrop. In absence of which future will only read that biofuel policy was not diligent enough to [un]learn from the trial and error done earlier in policy implementation.

Notes

1. Used for bioethanol and biodiesel in recent literatures, excluding the biomass based biofuel mostly used in rural areas of developing countries.
2. Accessed from < http://farm.ewg.org/progdetail.php?fips=00000&progcode=corn> on 12th December 2012.
3. Accessed from <http://www.ers.usda.gov/FarmBill/2008/Titles/Title IX Energy.htm #biobased> on 11th March 2009.
4. Each compact area is a group of districts covering 50,000 to 60,000 hectares of wasteland for Jatropha plantation and establishing forward and backward linkage for biodiesel production and use. The four JFM-based compact areas are in the States of Gujarat, Chhattisgarh, Tamil Nadu and Tripura. The four non-JFM-based compact areas are in the States of Uttar Pradesh, Madhya Pradesh, Maharashtra and Andhra Pradesh (Planning Commission 2003, pp 120-121).
5. In 2010 The Energy and Resources Institute carried out detailed study regarding present status of Jatropha plantation in nine States of India (Andhra Pradesh, Chhattisgarh, Karnataka, Madhya Pradesh, Odisha, Rajathan, Tamil Nadu, Uttarakhand, and Uttar Pradesh). The executive summary of the report can be accessed from < http://www.teriin.org/index.php?option=com_completed &task =details&pcode=2009CM04 >. Based on the report, Ministry of Rural Development had put on hold the Jatropha plantation programme. Accessed from <http://dailypioneer.com/ nation/66165-jairam-has-no-faith-in-jatropha-biofuel.html> on 04th December 2012.
6. Accessed from <http://pib.nic.in/release/release.asp?relid=42733> on 12th September 2008.
7. For details see chapter eight of the book where author had discussed the case of 'Chad'.
8. For details about the issue of land acquisition, conflict and related issue of development see Gopalakrishnan (2012).
9. For details see ASTRA 1982, Bowonder et al. 1985, Devadas 2001a,b,c, Giriappa 1991, Reddy 1999; Sinha, et al. 1998 and Das 2006.
10. Census of India, Government of India (2001), Accessed from <www.indiastats.com> on 18th February 2009.
11. Although the Planning Commission (2003) report on biofuel mission states that local people had the first right over the use of the output from jatropha plantation (fuel) and if in excess, it will be taken out for other uses. But to support this Central Government have not come up with any action plan at administrative, institutional and scientific level. Although few State governments like Rajasthan, Chhattisgarh and Madhya Pradesh had come up with pro-rural policies for biodiesel development, which need further exploration. However, the present status of development raises many questions and calls for further studies.

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