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MEMOIRE

The Revolution of Biofuels - at What Price?

**A Case Study on the Programs for Indian Biodiesel
and Brazilian Bioethanol**

Diego Juca Donizeth

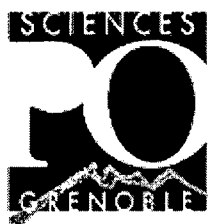
September 1st, 2008

Travail soumis pour l'obtention du Master Spécialisé « Organisation Internationale, OIG, ONG »

Institut d'Etudes Politiques de Grenoble – B.P 48 – 38040 Grenoble cedex 9



D



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D

Abstract:

Since the beginning of the 2000s, the world has witnessed a craze for biofuels, as fossil fuel prices started to dangerously skyrocket. In this paper we analyse two major biofuel programs that will provide the reader with an overview of the issues at stake in current production of crop-based fuels. On the one hand, it will be analysed the Brazilian bioethanol program – whose inception dates back to 1975, the period when the world experienced its first oil crisis – and on the other hand its Indian biodiesel counterpart, created in 2003 as a response to current oil prices surge. Both programs had a common economic *raison d'être*, as their main purpose was to curb national dependence on oil fuels, whereas concerns in the social and environmental fields have been subsidiary. The comparison between both programs will stress the extent to which classic (economic) but also more recent (environmental and social) world concerns have been addressed. At a moment when the debate on food security has reached its height, we will focus our analysis on the sustainability of both biofuel programs. To do so, this paper will analyse recent political discourses and national strategies in order to apprehend the underlying logic of both projects; one can easily draw the conclusion that economic concerns very often prevailed in biofuel strategies, with little attention being paid to the potential impacts of the program on the society and on the environment – even though India's choice to grow jatropha as the main feedstock for its biofuel program relied on hopes that it would avoid conflict between fuel and foodstuff production. The comparison between both programs will also allow us to sketch a set of good management practices to be undertaken in the field of biofuels, which we will draw on from the analysis of the Brazilian “success story” and from its public policy choices. In the light of this experience, the Indian case can be regarded as a counter-example, but it highlights the difficulties that many biofuel newcomers will have to face. Good management is not the only key for a sustainable biofuel program, as social and environmental aspects (cf. land-availability, protection of forests) must be taken into account according to the specificities of each country.

Depuis le début des années 2000, les biocarburants ont suscité dans le monde un grand intérêt, à un moment où les prix du pétrole ont commencé à sérieusement flamber. Dans ce mémoire, nous analyserons deux exemples de programmes nationaux que nous estimons représentatifs dans le domaine des biocarburants, afin de fournir au lecteur une vue d'ensemble des principaux enjeux existant autour de la production des biocarburants. D'une part on analysera le programme d'éthanol Brésilien – créée en 1975, comme une réponse au premier choc pétrolier – et d'autre part, on s'attardera également sur le projet de biodiesel indien, créé en 2003 avec l'intention de répondre à la hausse préoccupante du prix du pétrole. Tous les deux programmes ont eu une même raison d'être, à savoir l'intention de fléchir la dépendance de chaque pays vis-à-vis de l'or noir. Cependant, en même temps, on pourra déplorer le peu d'attention portée sur les impacts directs que ces projets peuvent causer sur l'environnement et sur la société dans son ensemble (bien qu'on puisse avancer que l'intérêt indien pour le biodiesel de jatropha soit une réponse aux inquiétudes liées à un potentiel conflit entre la culture de biocarburants et celle d'aliments). Ainsi, la comparaison entre les deux programmes nous permettra de mieux savoir comment la production de biocarburants a visé à répondre à des préoccupations classiques (tournées vers l'économique) mais aussi à des enjeux plus contemporains (réchauffement climatique, exploitation humaine). A un moment où le débat sur la sécurité alimentaire mondiale atteint son paroxysme, nous allons axer notre analyse sur la soutenabilité des deux programmes de biocarburant. Pour ce faire, nous analyserons les discours politiques et les stratégies nationales afin de mieux appréhender les logiques qui sous-tendent les deux projets ; on pourra facilement tirer la conclusion que les préoccupations économiques ont prévalu, parfois sans même qu'une évaluation préalable des possibles impacts sur l'environnement et sur les hommes ne soit faite. La comparaison entre les deux programmes nous permettra également d'esquisser une série de bonnes pratiques de management qui pourraient être suivies dans le domaine des biocarburants ; le cas brésilien nous servira ici de référence, alors que le cas indien aura l'intérêt de souligner les possibles problèmes auxquels certains pays novices pourront se trouver confrontés. Mais une bonne gestion n'est pas le seul indicateur qui nous permettrait d'analyser la soutenabilité d'un programme de biocarburant, vu que des aspects sociaux et environnementaux (cf. disponibilité de terres arables, protection des forêts) sont aussi à être pris en compte selon les spécificités de chaque pays.

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INTRODUCTION

The global economic order seems to have been experiencing, since the beginning of this new century, a turning point. The dazzling economic emergence of new developing countries as global powers has entailed significant changes in political, economic and environmental world balances – as it has been source of numerous fears. With India and China set to be the next powers of the end of the 21st century, an unprecedented process of development (that will affect one third of Humanity) is expected to pose serious challenges on our planet's capacity of providing limited natural resources for an unlimited thirst for growth. The first early warning signs of this evolution have been the spiralling increase of oil prices since the beginning of the 2000s, which shows that our current model of economic development is under strain.

Simultaneously to this rising concerns on what has seemed to be an inexorable rise of fossil fuel prices (due to increasing scarcity of supply), we have noticed a craze for new sources of crop-based fuels, that were called to offset fossil fuel prices and supposed to be a cleaner source of energy, compared to petroleum. Presented as the remedy for a set of world disorders (climate change, oil-based growth), we have seen recently efforts throughout the world to prompt a biofuel¹ revolution, as if it was a miracle cure to all new challenges of the 21st century. One of the most cited examples of this new spectacular evolution are the bioethanol programs in the US² and in Brazil. Related to the latter case, one can read on a recent article on the British newspaper *Times* that “*Bioethanol demand forces Brazil sugar cane industry upheaval*”³. Since 1975 sugar has been the backbone of the Brazilian ethanol program, but only in the last 10 years this national plan became known by a larger audience. Today, Brazil is home of a robust bioethanol industry that is worth US\$ 20 billions and that employs one million people directly. As it is highlighted in the *Times* article, with the current biofuel craze, Brazil expects to produce a record 24 billion litres of bioethanol this year and is planning almost to double this to 47 billion litres by 2015. The amount of land that the

¹ In this paper we will use the term “Biofuel” and “Agrifuel” indistinctly. But many food activists and NGOs of the south (cf. Via Campesina) prefer using the term agrifuel as they refuse to allocate the Greek term “bio” to biofuels (which are actually causing the death of many poor people); moreover, these activists want also to make clear, by using the prefix “agri”, that this fuel is derived from agriculture, not simply from biological matter (which, technically, could also include fossil fuels).

² Thanks to tax breaks and subsidies, the United States, has multiplied its production by almost 6 since 2001. It overtook Brazil by the year 2004 as the world's leader in bioethanol production. For full data information on this stunning evolution, see <http://www.ethanolrfa.org/industry/statistics/#E>.

³ *Bioethanol demand forces Brazil sugar cane industry upheaval*, *Time*, June 7, 2008

country uses to sugar cane plantations is today to the tune of 8 million hectares, but is expected to increase 14 million by 2020. India is another key developing country that is climbing on the bandwagon of biofuels. India has already a very modern bioethanol industry, also based on sugar-cane production, and is another great producer of ethanol⁴, but its industry faced a fundamental obstacle: India is the world's biggest consumer of sugar and a massive diversion of sugarcane production to the profit of ethanol would be hardly attainable and accepted by the public opinion. This explains India's new interest in a biodiesel stemming from non-edible oil (since the demand for edible vegetable oil exceeds supply) extracted from *Jatropha Curcas*. In 2002, the Indian government set up an ambitious National Biodiesel Mission that plans to meet 20 per cent of the country's diesel requirements by 2011-2012. For this purpose, India's Planning Commission stated in 2003 that up to 13.4 Million hectares of land could be devoted to *Jatropha* plantation on the pretext that they consist of "wastelands".

Nevertheless we can wonder if, today, biofuels are offering a cure that would be worse than the disease they seek to heal⁵. Indeed, biofuel advocates stress that this new source of energy is the cure for many challenges the world is currently going through: it could only be beneficial for economic reasons (offsetting the oil bill for net importer countries), social reasons (source of employment, rural development, and therefore social equality in the Third World) and environmental matters (supposedly, it is a clean energy that addresses climate change). This set of reasons explains the creation of the Brazilian Biofuel Program, the Proálcool, in 1975 – and it has also been convincing other countries to do as such. All major oil importers have at least thought about this option, and the majority of them have already real National Plans on biofuels. The United States is the country that has, so far, invested the most in crop-fuels, to the extent that it is spending over US\$ 7 billion annually in production subsidies, for promoting its corn-based biofuel (OECD, 2007). All told, Brazil spent a total of US\$ 16 billion from 1979 until the mid-1990s on the Proálcool program (Mathews, 2007), and now India is planning to spend at least 300 Mio euros for the early stages of its National Mission on *Jatropha* Biodiesel.

But is it really worth investing so massively in the biofuels alternative? Today, all countries are directly suffering from the structural rise of oil prices and getting exasperated

⁴ According to UNCTAD (2006), India is the fourth largest ethanol producer after Brazil, the United States and China, and its average annual ethanol output amounts to 1,900 million litres with a distillation capacity of 2,900 million litres per year.

⁵ This is a paraphrase of OECD's recent paper on the issue, titled "Is the Cure Worse than the Disease?" (OECD, 2007)

with variations reaching its height due to market speculation. Oil prices reached an unprecedented 147 dollars a barrel on 11 July 2008. This evolution has been triggering countries to consider their energy strategy, so much so as oil prices started its escalating process from a mere US\$ 20 in 2002. But in parallel to this phenomenon, other source of worries have sprung out at the forefront of current events: in April of this year, the UN sounded the alarm bell by stressing that the current rush for biofuels is posing incredible challenges on food security throughout the world. Its clear symbol has been the skyrocketing price of essential food supplies such as cereals. At the same moment, the United Nations World Food Program (WFP) stated a fund gap to the tune of US\$ 500 million that could lead, by June of this year, to a cut in food rations or in the number of people to whom they can deliver aid. Even though it is debatable to what extent biofuels production is the culprit of this phenomenon, if the massive rush to crop-fuel continue, significant impacts on the wider global economy will be perceived. Especially with the development of countries such as India and China (whose population are expected to be better-off and therefore able to eat more and better) it is likely that land-use constraints will limit the amount of new land that can be brought into production, leading to a “food-versus-fuel” debate. On the other hand, it is debatable whether biofuels is improving social conditions of the poorest, as Human Rights violations in Brazilian sugar-cane fields and increasing social tension among Indian farmers (due to government’s push on its Jatropha policy, which has led extension of monocultures) have been reported. Finally, environment benefits of biofuels still did not reach consensus even in the scientific circle, as greenhouse gas (GHG) emissions originating from the combustion of biofuels are not substantially smaller than that from classic fuels, if the whole process of production is taken into account⁶. Another source of concern derives from the impacts that biofuels are causing on biodiversity. It is already proved that palm oil is causing deforestation in Indonesia, and it is yet unclear how additional land use for sugar in Brazil may cause indirect / induced land-use (especially by accelerating the cleaning of the Amazon due to extension of soybean monocultures and pasture) and how large the actual impacts will be on land biodiversity. What is more, the extension of biofuel monocultures will entail more utilization of fertilizers, land-exhaustion and an increase in the use of water for water-dependent crops, such as sugarcane. With the world population in a rise and water to be

⁶ We should stress that some biofuels have been proved to be more environment-friendly than others. Therefore differentiation between different sources of biofuels must be applied. Bioethanol from sugarcane is for instance unanimously acclaimed for the substantial reduction of greenhouses that it causes. This seems not to be the case of corn-based ethanol. Accord to an article by D. Pimentel, “corn requires 29 percent more fossil energy than the fuel production” (Pimentel, 2005)

placed as a major source of concern in the coming years, the current fever for biofuel can only confuse even further the complex balances at stake in world politics.

The very sustainability of biofuels production is therefore in question. The meaning of such an expression is still partially imprecise, partly because only recently the global community started to admit the accelerating deterioration of our human environment and of natural resources. Today, the definition crafted by the Brundland report in 1986, even though vague, is still the most accepted attempt at explaining the meaning of sustainability, as it does not deny the importance of (economic) development for our modern societies. Development has to go on, but must be responsible: "Sustainable development is development that meets the needs of the present without compromising the ability of *future generations* to meet their own needs." In this paper we will take due account of human beings, that are at the center of the above definition: we will therefore wonder if biofuels are compatible with *social development* (i.e. by respecting farmers/ indigenous people interests, by promoting rural development). But attention will also be paid to the environmental impacts of biofuels – insofar as sustainable development represents also a pattern of resource use that aims to meet human needs *while preserving the environment*⁷. Many efforts in creating certificates or track-and-trace systems that measure sustainability of biofuels⁸ have been undertaken or are under consideration and reflect this growing concern (especially from Europeans) on the manner biofuel is being produced. Criteria include deforestation, biodiversity, waste management, use of agrochemicals, soil erosion, nutrient leaching, preservation of surface and ground water, use of GMOs etc. Those criteria are very often forgot in current assessments on the impacts of biofuels on our every day life, but without taking these elements into account, no real assessment of the viability of biofuels can be made (even economically speaking, since water

⁷ Sustainable development is often geometrically represented as a scheme at the confluence of three constituent parts: economic, social, environmental sustainability. According to the UN 2005 World Summit Outcome Document, it refers to the "interdependent and mutually reinforcing pillars". But many critics and members of civil society highlight that the sustainability criteria crafted here was a simply subterfuge intended to continue status quo: the economic pillar is still predominant and the logic of free-market prevails. Therefore, social and environment sustainability are discreetly consigned to oblivion. See FASE, REBRIP, 2007. Our purpose on this report is to reflect those concerns (clearly understood during my internship in the NGO Focus on the Global South) by paying due attention to the two other pillars of sustainable development.

⁸ Many North-European companies have recently launched labels and certificates that indicate to their costumers the origin of imported biomass. Dutch energy company Essent for instance has developed the Green-Gold-Label biomass track-and –trace system. We can also mention academic initiatives on bioenergy trade research, such as that of FairBio Trade research, carried out by Copernicus Institute – Utrecht University. International collaborations in bioenergy also exist, such as IEA Bioenergy, an organisation created in 1978 by the International Energy Agency, whose latest Task 40 aims at contributing to the development of an International Sustainable Bioenergy Trade (<http://www.bioenergytrade.org>)

pollution or depletion and soil erosion can entail irreversible damages on future agriculture production).

Finally, at the same time that we will take into account in our analysis this triple angle of the notion of sustainability, we will also consider that good political management is crucial to analyse the viability of both programs. We will therefore proceed to the study of elements such as: the circumstances in which the choice of biofuel feedstock was created; the coherence of political measures taken (tax breaks, incentives) and coherence of political decision (conflict between administrative levels?) to promote the new biofuel program; the level of acceptance and consensus that such initiative could obtain (especially from social movements and scientific spheres); the extent to which specific sectors of civil society were active –or passive – in this political initiative; the quality of interaction between stakeholders (conflict, solidarity, complementarity). As we will see, all these factors will contribute to the good or bad management of both projects, and they will help us to understand why the Brazilian case is often characterized as a “model” of biofuel program, worthing of gaining a following, whereas the Indian national plan have been facing a series of obstacles that are limiting its viability over time.

This paper will base its analysis on biofuels in the light of two case studies: the Indian national program on *Jatropha* (which is the country’s main source of biodiesel) and the Brazilian program on sugarcane (crop on which rely Brazil’s bioethanol). This choice could arouse criticism as we are dealing with two different sources of biofuels, one that intends to replace car’s need for fossil petrol and the other to their need for diesel. Moreover, the Indian biofuel program relies on a non-edible and drought-resistant plant, *Jatropha*, which, in theory, would not compete with food crops (since they are called to be grown in wastelands) and would not divert water to large monocultures in arable fields (as it has been the case in Brazil). Furthermore, in this paper we will proceed to the comparison of what consist of two incomparable examples: on the one hand we have Brazil, a country that possess the biggest amount of remaining arable lands in the world, and that is far from being densely populated as, on the other hand, India, a country of more than 1 billion people (compared to Brazil’s 190 million people) that fit in a territory twice as small as Brazil. Moreover, Brazil is largely a food (and ethanol) export-oriented country, whereas India is (still) food self-sufficient. Finally both Histories of land occupation are far from being the same, as Brazil is well-known by its latifundia system whereas family-managed farms still prevail in India. We will see throughout

this paper that these structural differences will directly impact on biofuel production in both countries: variable such as pattern of land occupation and food self-sufficiency - linked to prospects of demographic and economic growth – will accelerate or slow down the scope of biofuel production in both countries.

But our conviction is that both countries have a lot to learn from each other, especially India from Brazil's 30-year-old Proálcool program, especially in terms of management. Both examples are the product of innovative projects that aim to curb these nations's dependence on a major source of energy, i.e. fossil fuel. In our study, both examples will be considered in the light of the particular context of their creation (globalization was not an issue in the 1970s as it is now) and of social, economic, political, demographic or geographical particularities of each country. The interest of studying Brazil and India relies also on the fact that both are developing representative projects in the realm of biofuels: massive programs on *Jatropha* have also been promoted in other countries (e.g. Tanzania, Angola, Thailand etc.); thus, the pro and cons of a biofuel policy based on this hardy plant can be drawn on from the analysis of the Indian case – and serve as an example to other countries that are considering starting a national biofuel program; the same can be said of the Brazilian program, as sugarcane fields for ethanol production are already under cultivation throughout Africa and Asia. Today, India and Brazil are renowned for the fast pace of their respective economic development, which allow us to say that they will be one of the major players in the future world order. This is already a reality at one of the most influential International Organization in the current area of globalization: the World Trade Organization (WTO). Indeed, both countries have been gathering forces to become influential in trade talks, and especially inside this eminent forum of discussion, which was so far led by the Developed Countries. Today, five years after the creation of the Group of 20 Developing Countries (G-20) in Cancún, India and Brazil are already seen by the international community as the representatives of the “developing and poor world” when it comes to trade issues⁹. Therefore, due to growing power of both countries in world politics - and therefore to their new capacity of influencing other nations, especially developing countries – it turns out to be interesting to analyse the priorities set by their respective politicians in order to tackle major challenges that their countries started to face. Tension in oil supplies is a main challenges to be overcome, as both economies

⁹ Even though there exists clear divisions of interests between both countries as Brazil has offensive views on the agriculture portfolio, whereas India has no interest in lowering tariffs and other barriers to farm exports, which would put in danger its 600 million small farmers. However, as a senior Indian commerce ministry official puts it, 'It became apparent to Brazil early on in the life of the G-20 that it had to work in tandem with other developing countries in order to achieve its own offensive interests in agriculture.' (Newindpress.com, 25 July 2008)

(especially the Indian) are growing on an unprecedented pace; but other issues such as environmental responsibilities are increasingly been set on the forefront of recent national priorities. In this paper we will try to assess which concerns have been prioritized by national political leaders.

By analysing two national plans on biofuels, we will also attempt to reap the benefits of the technique of comparison to analyse a reality (growing interest on biofuel) in the light of two different instances (that of Brazil and India). By doing so, we will be able to assess different empirical experiences in both biofuel programs, which, in turn, will allow us to see the benefits and shortcomings of each specific national strategy. In other words, comparison will enable us to, on the one hand, better uncover, differentiate or distinguish good and bad practices and, on the other hand, understand the main objectives lying behind the promotion of biofuels. We will see that in both Indian and Brazilian cases, economic matters widely prevailed, to the detriment of social and environmental aspects: can this observation be generalized to other countries?

We chose in this paper to analyze not only two major and representative examples in the field of biofuel programs, but also wanted to compare a recent national plan (the Indian) to an older (the Brazilian). In our view, such comparison we will enable us to stress potential evolutions (mainly in terms of political priorities and concerns, but also in terms of management techniques) that have been perceived in biofuel strategies for the last three decades. Today, the Brazilian national biofuel program (Proálcool) is commonly depicted as a reference in the field of biofuels. Indeed, Proálcool is the oldest (and thus the most experienced) biofuel program in the world, since it consisted of world's first large national program of substitution of fossil fuel by a renewable energy. Therefore, by shedding light on the successes and failures of Brazil's "model", especially in the way it was managed, we will stress which factors permitted the development of an extremely sophisticated sector. As we will see, this has not been the case for India's Jatropha plan suffers today from a series of political and technical mismanagements that are slowing down the whole program. Therefore, to what extent can India follow the Brazilian example and overcome current obstacles? Yet, if India can draw its inspiration from Brazil's "success story", we will find out that many elements of this model cannot be transposed to all countries, the most important of them being land-availability. Therefore, how can other countries, such as India, take advantage of Brazil's long history on bioethanol, and adapt it to their own particularities? Is it worth it?

Through the comparison of both biofuel national programs, we will be able to examine the main motives and consideration that led politicians to invest in biofuels, as well as the main variables at stake. Therefore this work will allow us to draft an analysis grid through which other biofuel experiences, in other countries, could be analysed. Some key variables will play an important role in our comparative study of Indian and Brazilian biofuel programs, such as: the respective role of the public and the private sectors – and the role played by interest groups; the level of national appropriation of the project; the pattern of land occupation and land-availability; the level of food self-sufficiency of each country¹⁰.

In our paper, arguments and examples will be drawn on from different sources, such as reference books; articles, stemming from economic, sociology or scientific journals; newspaper articles; reports or information published on official (e.g. government agencies or ministries and international organizations) websites; and interviews with scientists or social activists. Given that India's national program on jatropha is relatively recent, in contrast with Brazil's 33-year-old Proálcool, we had to resort to two distinctive research works. The Brazilian case study draws on its description and analysis mainly from books, official reports and magazine articles, whereas our analysis on the Indian jatropha plan relies rather on the study of newspaper articles, Indian ministry reports, websites (scientific or political think tanks homepages, NGO websites, blogs of renowned scientists and activists) and interviews¹¹. Thus, though both studies demanded deep research on academic and official sources, our analysis on India's jatropha strategy is also the result of a field study that enabled me to sound out civil society's impressions after five year of jatropha promotion in India.

We will cover in this study the main levers and logic behind biofuel production, which, in our view, do not consider sustainable development as a major priority. The guiding thread of our work will be to analyse the elements of inconsistencies in both biofuel

¹⁰ Official's attention to biodiversity criteria could represent another variable, but given that both countries seem reluctant to pay due attention to this element, we do not believe that this variable is discretionary enough to be taken into account – even though Brazil detain one of the richest reservoirs of biodiversity in the world (the Amazon). This reality could thwart the expansion of bioethanol monocultures in this country, but it does not seem to be the case nowadays.

¹¹ In the framework of my internship, at the NGO Focus on the Global South India, I was able to interact with different activists stemming from agriculture associations, Indigenous people groups or scientific researchers. This experience allowed me to interview and exchange numerous emails with activists that have today the most recent information about the evolution of India's national plan on jatropha and the main conclusions we can already draw from this national strategy. Additionally, my participation on a conference in Bangkok on climate change (that had the slogan "Climate Change Justice Now") – and the opportunity I had to discuss with different members of Asian civil society – also played a major role in the elaboration of many arguments in this paper.

programs. Indeed, the main hypothesis of this paper will consist of showing to what extent the way Brazil and India are leading their biofuel programs is, for various and different reasons, eminently unsustainable. Both programs contain unsustainable aspects, even though the areas they are the most evident do not coincide: for instance, the Brazilian program is more sustainable, in terms than its Indian counterpart, but its social aspect is far glimmer. Moreover, the Brazilian national plan benefits of a political consensus and of a relatively good management – which has not exactly been the case in India. Therefore, we believe that there is real scope for mutual learning through assessments of mistakes made by each program, which could prompt improvements in each respective national plan. Thus, although the current biofuel production in Brazil and India has major shortcomings, we consider that there is still room for improvements in both programs. In our view, the idea of producing fuel from alternative sources, such as sugarcane or jatropha, is not a bad initiative per se. It is the way that those agrofuels have been currently produced that is problematic. Biofuels should not be analysed as the source of all current problems, on the contrary, we think that they can be part of the solution if they meet environmental, social and economic sustainability criteria.

This paper will consist of two chapters. In our first chapter we will highlight how the current craze for biofuel has not been accompanied by a deep reflection on the limits that current economic development have been showing ; the unidimensional economic point of view (ability to face rising oil prices, perspective of profits) has been prevailing in the choice of politicians in Brazil and India whereas environmental and social concerns (reduction of CO₂ or food security problems) are still marginal (even though not totally neglected). This overview of the political mindset prevailing in each country will allow us to better understand the nature of priorities set in the formulation of each biofuel program. It will also show that a huge effort still has to be undertaken for mainstreaming ecological and social issues in national politics. Chapter Two will be devoted to the analysis of the concrete, and already noticeable, social and environmental problems created by both programs; it will also assess the future threats that can appear if nothing is made to curb the current trend. These problems are today all the more difficult to appropriately tackle as political mismanagements in these programs blur political leadership, and indirectly favour actors that are essentially guided by economic interests.

CHAPTER I

The main concerns reflected by the recent craze for biofuels in Brazil and in India

The years 2002 and 2003 consisted of a turning point in biofuels history. Up to that moment; biofuels (and especially ethanol) had been largely neglected by the international community, and were even experiencing a downturn in Brazil due to cheap oil prices prevailing in the 1990s. But events such as the war in Iraq (which aggravated tensions in the Middle-east), the emergence of new actors in the oil market (the speculator), and probably more importantly the increasing demand of oil from developing countries, directly impacted the stability of our economic world order based on cheap oil prices. As a consequence of the spurt of oil prices, an unprecedented international interest for new alternatives was prompted. Developing countries were the most exposed to such evolution, since an upward evolution of oil prices could nip their economic growth in the bud. This cloudy trend triggered therefore the reactivation of Brazil's 30 year-old bioethanol program (that stagnated during the 1990s) and sparked the search for new ideas of biofuel production in other countries, such as in India.

Since the beginning of this century, the thirst for biofuels has been experiencing a chaotic, but steady, evolution. From 2002 to 2006 almost nobody really put in doubt its benefits (so much so as biofuels appeared to be ecologic-friendly). Dissenting voices started to be heard only from mid-2007 - reaching its height in April/May 2008 – as agriculture experts found out that increasing production of biofuels were clearly threatening food security in the world and “could starve the poor”¹².

In this chapter, we will analyse how the political sphere behaved in a context where media and experts blew hot and cold, by praising biofuels in a day and condemning it in the following one. We will therefore proceed to the analysis of the new priorities set on Brazil's and India's political agenda and point out the main motivations behind the Brazilian and Indian programs. In this chapter, it will be argued that economic concerns were always central in discussions on biofuels. Although attention was equally paid to ecological and social benefits that biofuels could bring, we do believe that such targets were marginal. This explains both government stances on the recent controversy on global food crisis, which consisted of minimizing the “food-versus-fuel” debate, and prioritizing economic interest and national sovereignty.

¹² Runge, Senauer, How Biofuels Could Starve the Poor, *Foreign Affairs*, May/June 2007

SECTION I

An analysis of the Brazilian and Indian biofuel programs – or the pre-eminence of economic concerns in setting up a new energy strategy

Economic analysts, pre-eminent magazines (such as *The Economist*) or international agencies (FAO, World Bank) consider some worrying aspects of the current international economy as early warning signs of future turmoil inside and between nations. Since 2007, oil prices have been rising steadily to reach an unprecedented level in beginning July 2008, crossing 140 dollars a barrel. The jump in oil prices, which have doubled in the past year, has triggered inflation fears and worries in the majority of the economies dependent on oil imports. Developing countries, that have in general low energy-efficient economies, have been the most prone to experience a rise in inflation, which could contaminate their economic development performance.

This bleak outlook have been a source of concern for all countries, but specially for countries like India that have been boasting double-digit growth and is almost fully dependent on oil imports to keep its economy rolling. India imports today more than 70% of its energy needs and is home to the world's fastest-growing motor vehicle industry after China. These factors have accelerated the government-backed development of a biofuels industry to diversify the national energy mix. Two feedstocks appeared to have a clear potential to become source of fuels: sugarcane and jatropha. As we have already mentioned, being the first consumer of sugar in the world, India would have a constrained room for manoeuvre in this field¹³, all the more so as sugar cane is water-guzzling and its extension would virtually encroach on existing agriculture land. Moreover, an ethanol-based program would stumble on a major obstacle linked to India's automobile fleet structure: the demand for diesel is five times higher than the demand for petrol in India, as 70% of vehicles in India are diesel-fuelled¹⁴. But at the same time, while the ethanol industry is already mature (since currently petrol is mandated to have a 5% ethanol blend, the ethanol industry had to expand to the extent that India is today the 4th largest ethanol producer in the world) the biodiesel industry is

¹³ That is the reason why India's ethanol is produced by the fermentation of molasses – a by-product of sugar manufacture – in order to avoid competition between sugar and ethanol production. Nevertheless the yield of ethanol from molasses is approximately seven times smaller than that ethanol extracted from sugarcane juice. This is a major obstacle for a growing automobile fleet, but according to activists I interviewed (especially D.Raghunandan from Delhi Science Forum) this did not prevent the government from rising its expectations of ethanol blend with petrol from current 5% to 10%, which is unattainable without changes in the molasses ethanol to pure sugarcane juice one - and massive ethanol import, especially from Brazil.

¹⁴ Indian activists argue that this reality is the consequence of substantial government's subsidies going to the diesel industry.

still in its infancy. But in 2002, in a context of rising oil bill expenses, the Indian government faced the urgent need of reconsidering India's energy policy, and in a bid to diversify the national energy mix, it decided to create a program on biofuels. To trigger off a great national effort on biodiesel and to facilitate the development of a new industry, the government established in 2002 the Committee on Development of Biofuels. In April 2003, the latter submitted a report, which surveyed the country's potential in biofuels and recommended establishing a National Mission on Biofuel, which duty was to promote the production of jatropha-based biofuel in order to make it meet 20 per cent of the country's requirements by 2011-2012. The decision of betting on the vegetal oil stemming from the transesterification of jatropha curcas relied on a series of supposedly advantages of this hardy plant: jatropha requires low water and fertilizer for cultivation, is not grazed by cattle or sheep, is pest resistant, is easy propagated, has a low gestation period, and has a high seed yield and oil content, and produces high protein manure (see annex for more details on the main conclusions of the 2003 Committee on Development of Biofuels Report). This set of botanical and chemical features would transform jatropha in India's wonder plant. Thanks to its drought-resistance properties and its quality of being a non-edible oil, jatropha cultivation would avoid in the future, and the recent debate was already anticipated in 2002, controversies on food security issues or land diversion. Moreover India's jatropha plan was intended to prompt social development in poor rural and dry regions in India

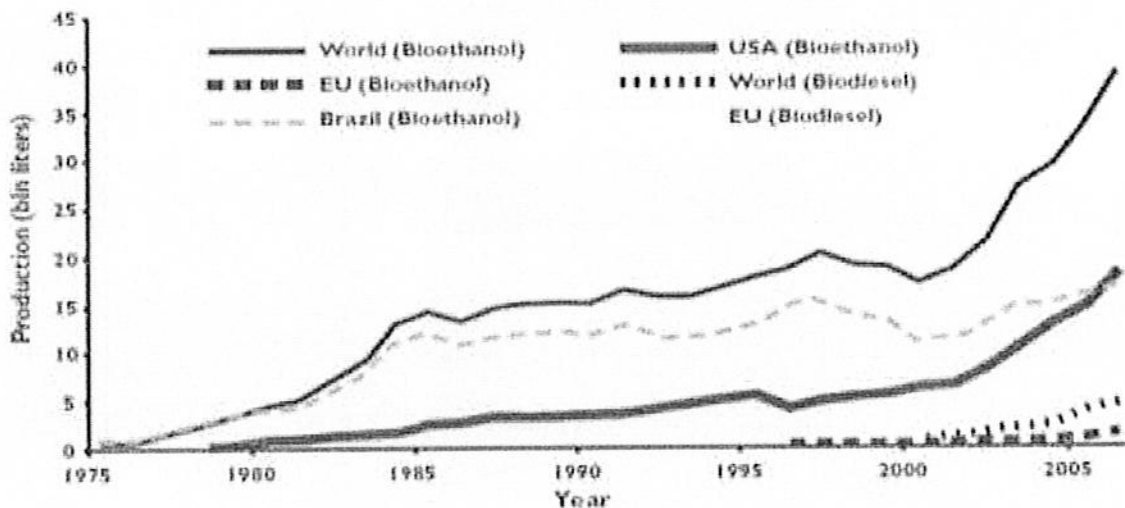
To what extent the recent biofuels evolution experienced by India is a repetition of what Brazil went through in the 1970s, the decade when it started its Bioethanol National Plan (baptised Proálcool)? Brazil's ethanol program was a reaction to the 1973 oil crisis, which hit hard an economy that relied to the tune of 80 % on oil imports, and whose 40 % of foreign exchange earnings were used to import oil. To offset this major fragility and keep up economic development, the government launched in November 1975 the Proálcool program, with the goal of fostering national alcohol production and the distribution industry. In a way, India tried to follow the path of Brazilian acclaimed "success story"¹⁵. Our purpose in this section is therefore to stress that both countries adopted a biofuel program in a similar context and had also similar concerns to cope with when decision was made in favour of a biofuel bid.

¹⁵ Indeed some facts and estimates corroborate the idea of a success story. Proálcool can be described as a great national effort that rallied different economic actors (from sugar cane producers to the automobile industry) and that allowed Brazil to make considerable economies: from the moment the ethanol industry attained maturity, around 1979, until mid-1990s, Brazil saving in oil imports amounting to at least US\$120 billion (and spent only US\$ billion (Mathews, 2007). After a moment of torpor in the 1990s, the ethanol industry became again competitive and since 2002 all records have been broken in ethanol production, to the extent that this biofuels today accounts for at least 40 % of all Brazilian vehicle fuel, and is rising.

The revealing correlation between interest in biofuels and rise of oil prices

Since 2002, crude prices soared past US\$ 24 to more than US\$ 140 a few weeks ago. This structural evolution of oil prices has sparked new energy strategies worldwide and especially prompted many countries to promote biofuels as the silver bullet to secure their energy security. The graphic below clearly shows an abrupt rise of biofuels production since the beginning of the 2000s. Since the last two decades, its production tripled from a few billion litres to more than 35 billion litres in 2005

Global Biofuel production



Source: F O Licht's World Ethanol and Biofuels Report, Vol. 4 No. 16, p.365 and Vol.4 No. 17

Brazil and India are major players in this new scenario since they reactivated their respective ethanol programs (in which field both are global leaders) and are building new strategies in their biodiesel programs¹⁶. Both countries started a rush for biofuels which embrace ethanol and biodiesel. This is an element to be stressed: although the purpose of this paper is to analyse the ethanol program and its jatropha counterpart, in Brazil and India

¹⁶ Brazil is also investing in the biodiesel industry. The Brazilian government passed a bill in 2004 that created a Biodiesel program intended to tackle, as in India, the country's dependence on fossil fuels and also benefit people in Brazil's poorest region – the semi-arid Northeast. The bill required that the diesel fuel sold at Brazil's 35,000 fuel stations contain at least 2% vegetal oil. The new biodiesel policy – which will rely on the extraction of different sorts of oil, including soybeans, jatropha, but also on local non-edible oil, extracted from Castor beans – is expected to save approximately US\$ 410 million annually and reduce Brazil reliance of imported diesel from 7 to 5. For more details: « La Fièvre du biodiesel s'est emparée du Brésil », *Le Monde*, 13 August 2006 and FASE, REBRIP (2007) *Agrocombustíveis e a Agricultura Familiar e Camponesa, Subsídios ao Debate*, Rio de Janeiro: FASE/REBRIP. For an update, see *Folha de S. Paulo*, "Petrobrás inaugura amanhã primeira usina de biodiesel", 28 July 2008, which reports that, according to national statistics of last February 2008, soybean is still, and by far, the main source of Brazilian biodiesel (68,41% of the production)

respectively, both countries have parallel programs in the other sources of fuel. It is especially the case for the Indian bioethanol program, which is well advanced: endeavours in this field started in India during the National Democratic Alliance when the Indian government mandated the incorporation of 5% ethanol; this partly explains that India is today the 4th largest producer of ethanol. Our choice of analysing the case of jatropha production in India stems from our opinion that its current policy is representative of a worldwide effort in the field of biodiesel (especially at those that would not directly threat food security); therefore the analysis of the latest progresses and the interests at stake in the Indian example, will allow us to better understand the main priorities leading countries to invest in this technology¹⁷.

As far as India is concerned, these priorities have been principally of economic order. When oil prices started to follow an upward trend, the attention of the government was focused on its diesel consumption, as, contrary to Brazil (where most vehicles are run on petrol) the demand for diesel is five times higher than for petrol in India. This meant that further efforts on the bioethanol front could no longer be the only solution for increasingly expensive oil prices. Governmental will of sparking a national debate on future energy strategies was limited and, in the context of economic take off, the very idea of limiting oil consumption (through improvements in public transportation for instance) was unthinkable in the very pro-market oriented government in power. Moreover, it must not be neglected the power of the industrial lobby (especially of the powerful automobile sector, which is currently booming) in this outcome.

The government's room for manoeuvre was limited and to better show this reality it is worth analysing the context of India's economy six years after the implementation of its National program on biofuels – that is, now ; by doing so we will be able to highlight, retrospectively, the real priorities at stake when the government adopted a policy on jatropha. Indeed, as time went by, it became clear for all, that investment in jatropha-based biodiesel was regarded as a palliative measure to offset economic tensions resulting from the rise of oil prices. All praises song to environmental features and social impacts in the investment in a large-scale jatropha plan were marginal.

¹⁷ On the other hand, the Indian experience can be seen as an example by other countries, which are now investing in jatropha or intending to do so (Thailand, Angola, Tanzania and even Brazil). sharing of information and experiences are crucial in the current context of globalization, and it represent one of the main priorities set up by member of civil society I met in Bangkok. As an activist put it: "there is no excuse in investing in a technology that has already been experienced elsewhere and that turned out to be inefficient, if not a total failure. In a way, we must take advantage of the opportunity that globalization is giving to us, which is the possibility of sharing information and experience".

As mentioned, India imports today more than 70% of its total fossil fuel consumption. But National government's subsidies on oil and its industrial policy (which bets on the rise of the rate of car penetration in the country) prove to be dangerously in contradiction with attempts to reduce India's dependence on fossil fuels (see next sub-section and our analysis on India's support of "national interest"). This contradiction has been leading India to an economic impasse. Obsessed by the recent spectacular performance of India's economy, which expanded by 9% in the last three years in a row, the government created in 2007 an "Automotive Mission Plan" which aimed for automotive sales to more than quadruple to 145 billion dollars by 2016 (which would lead the employment prospect of this industry to grow to 25 million, from 13 million today). For the government, investment in the automobile industry might continue, since it accounts for five percent of India's gross domestic product – even though it is one of the main sources of pollution in a country that is already ranked as the 4th biggest CO₂ emitter¹⁸. But on the other hand the steady rise of fossil fuels is leading the country to a deadlock, since it is impacting on India's inflation and widening its fiscal deficit: India's deficit, if it is combined with various off-budget subsidies, is one of the highest in the world and is projected to reach more than 7 per cent of GDP this financial year (according to Goldman Sachs). Growing oil price bills is becoming unquestionably a major burden for a country whose energy market is already heavily biased towards fossil fuels (which as a result keeps oil prices very reasonably priced for the poor and contains inflation). Given that the government did not show the will to substantially change the structure of oil subsidies since 2002, it has been forced to pay a very high price for its "pro-growth policy": an incredible 37 billion euros was spent in subsidies only during this year (3% of India's GDP)¹⁹.

In 2002, the government had anticipated future economic strains if oil prices were set to continue its upward trend – even though it did not expect that oil prices would go beyond 100 dollars. Investment in jatropha was seen as a palliative measure to alleviate possible tensions in the future. In other words, it was a way found by the government to support its expansionist policy in the economic field, and avoid a real national debate on the sustainability of India's energy policy. Many reasons led the government to opt for a biofuel extracted from jatropha. Economically speaking, the biodiesel looked very attractive.

¹⁸ « Les quinze plus gros émetteurs de CO₂ dans le monde », *Le Monde*, 17 April 2007

¹⁹ *Le Monde*, *Faire face au troisième choc pétrolier*, 8 June 2008. This untenable situation led, last June 4th, the government to cut fuel subsidies and to rise petrol and diesel prices by 10%. This measure sparked a wave of protests throughout India, which shows that such measure is extremely costly from a political point of view, especially on the eve of an electoral year.

Many scientist, agronomists or economists have reiterated the high properties of jatropha. They wrote books, scientific articles and created websites (cf. for instance www.jatrophabiodiesel.org) too song the praise of this plant. Satish Lele is one of them: this chemical engineer and entrepreneur from India who has become an expert on biofuels and been influential in the debate in India (see his website: www.svlele.com). His argumentation reflects the stance of the government (see annexes) on the benefits that jatropha could bring to the Indian economy: in his website, he sums up the potentialities of jatropha in India, as it was pointed out by India's Planning Commission in 2003. His estimates are extremely optimistic, and therefore convincing: according to studies, there are today 13.4 million hectares of underutilized land in India that could immediately be planted with jatropha. Jatropha yields 250,000 tons of crude jatropha oil per year per every 100,000 hectares of plantation. This converts to 2.5+ tons of jatropha crude oil per hectare, which at 5.2 barrels of oil per ton, equates to 12.9 barrels of oil per hectare per year. If one multiplies this figure by 13.4 million, which is 4% of India's land area, immediate jatropha oil potential in India would be 173 million barrels of oil per year - 22% of India's current consumption of petroleum-derived crude oil.

An economy of 22% in crude oil, that would entail the utilisation of only 4% of India's land area (which turn out to be wastelands), represented the dreamt solution for a government that was obsessed by keeping the pace of its high economic growth without resorting to structural measures in the energy field. If the economic advantages of jatropha-based biodiesel as summed up above are already convincing for any politician, this wonder plant could open other bright perspectives for India. On the one hand, worldwide studies were pointing out that the production of this plant offered chances for social and rural development and environmental advantages in terms of GHG and could represent a remedy to land erosion. As we will see on our next pages, this series of advantages also influenced the government's choice. But, on the other hand – and in the economic field – studies made by international companies pointed out that low costs of jatropha production in India could lead the country to be a potential exporter of cheap biofuel to increasingly biodiesel-eager Developed countries, such the EU members²⁰. Today, some rich farmers²¹, owners of huge expanses of land, are already investing in monocultures of export-oriented jatropha. But if this tendency is confirmed, wouldn't it amount of benefiting rich farmers – the ones who would be able to

²⁰ For more details on India's potentials on jatropha export, see our next sub-section.

²¹ We can cite the example of States such as Chaatisgarh,, which is already investing massively on jatropha, but not with the purpose of serving national interest, as local and rich jatropha producers, with the support of the local government, are getting attracted by new profit opportunities stemming from biofuels trade

invest in huge monocultures for economy of scale purposes –at the expense of the average Indian, that lives with 13 dollars a month²²? In this trend is confirmed, wouldn't the Indian example on biofuels run the risk of following the same unjust agriculture policy that has always been a stain on Brazil's husbandry landscape?

The Brazilian 33-year-old program on ethanol can be characterised, above all, as an economic strategy established by the Brazilian military regime²³ to curb Brazil's dependence on oil (which was in the 1970s to the tune of 80%, a figure even greater than that of India today). The economic context that Brazil was experiencing was also characterised by an economic boom, since during this decade, Brazil had the second biggest economic growth in the world, after Japan. Therefore the oil crisis that the world entered in 1973 was seen by the government in power as a direct threat to Brazil's development process. The oil crisis also represented a threat to the social order, even though the dictators in power were less obsessed by social unrest than by economic considerations (and the political benefits it could entail). During this period, although the whole country had, for already one decade, been thrown, into civil rights deprivations, people were growing optimistic about the chances of their country to finally take-off. Pervading enthusiasm could be compared to what an average Chinese is witnessing today: what counted for an average Brazilian was more the chance granted to each one to reach greater lifestyle than the nature of the political regime (which was by the way less bloody than other Latin American dictatorships). Finally, attention on the world political context might also be paid, since in this moment the world was still experiencing what French literature calls the "Trente Glorieuses", a period when the paradigm of development was essentially analysed from a pure economic point of view (i.e. maximisation of value added). Therefore if one could blame the Brazilian government for not paying enough attention to environmental and social priorities, s/he must put the Proálcool program into the perspective of a world that still did not care about the idea of sustainable development (the first steps in the direction of this realisation started only at the beginning of the 1970s, when the first United Nations Conference on the Human Environment was held in Stockholm, in June 1972).

The economic problems that Brazil was experiencing in the mid-70s are to be compared to those depicted above on the Indian case. As we have already mentioned, Brazil

²² Figure from CNN especial dossier on India: "Eye on India", <http://edition.cnn.com/SPECIALS/2007/eyeonindia/> retrieved on August 1st, 2008.

²³ Brazil experienced a military regime for 20 years, from 1964 to 1985

was highly exposed when 1973 oil crisis broke out²⁴. Because Brazil produced only 20% of the oil it consumed, the cost of its oil bill exploded. Moreover, in the early 1970s, the performance of the export sector was undermined by an overvalued currency. With the trade balance under pressure, the oil shock led to a sharply higher import bill. To see Brazil through the oil crisis, the government borrowed billions of dollars, which increased an already large current-account deficit. The country therefore slid into recession, and by the mid-1970s was facing bankruptcy. The Brazilian government, under the threat of a meltdown of the country's economy, had to look for possible alternatives to fossil fuel. All the governments that acceded to power during the Brazilian military regime had the particularity of being extremely patriotic – which explains that the last thing the government in power would like to see is Brazil's perspective of economic growth overshadowed by rising oil prices. A national effort on a new energy strategy started and consultation with the closest circles of power²⁵ led to the conclusion that the oil crisis could also be interpreted as a great opportunity to a nascent and flourishing national industry. Furthermore, nobody can underestimate the power that the agribusiness lobby has always had in Brazil – which was tremendously enhanced during Brazil's military regime. This economic sphere, dominated by landowners that possessed large expanses of agricultural land (the *latifúndios*) – and that, very often, also controlled the growing sector of food processing – was increasingly concerned about the gloomy perspectives of the world economy. As we will point out in our next sub-section, the lobby power of the sugar cane sector was decisive to make the Proálcool program take off. Indeed, this national program consisted of creating a new outlet for increasing surpluses in sugar cane production.

Environment matters were not an issue during the Proálcool program, even though the government started to boast, from the end of the 1990s on, the benefits of ethanol in terms of GHG reduction. A compelling proof is that the National Program ran the risk of being dismantled at the end of the 1980s because it seemed to lose its economic interest. As it was highlighted for the Indian case, there has always existed a *direct correlation* between Brazil's interest in biofuels and international oil price quotation. This explains the crisis that the Brazilian bioethanol sector experienced in the second half of the 1980s – period when oil prices started to considerably level off. The production costs associated with ethanol rendered

²⁴ During the first oil crisis, the average price of a barrel of petroleum increased from \$2.91 in September 1973 to \$ 12.45 in March 1975

²⁵ The idea of an open dialogue between the government and the civil society during this period would be wishful thinking.

the product less competitive and highlighted the costs of Prálcool subsidies²⁶. Disputes between the government and producers over price controls resulted in decreased subsidies and, consequently, decreased production. Domestic ethanol was not able to satisfy the demand generated by the spread of alcohol-fuelled vehicles, making ethanol imports necessary²⁷. At the same time, Brazil started to experience a series of financial problems due to high level of its external debts. Therefore, as oil prices declined, the economic case for ethanol eroded, as Brazil's economic priority shifted to combating inflation.²⁸

If the Brazilian ethanol program even ran the risk of disappearing because of a plunge in oil prices, it was revived once again when fossil fuels re-started to become particularly expensive, at the beginning of the 2000s. But as time went by, the composition of Brazil's energy mix diversified. Therefore when fossil fuel prices started to skyrocket, Brazil's vulnerability to oil imports was almost inexistent. Indeed the country became self-sufficient in oil in 2006²⁹. Today, Brazil is even a potential oil-exporter with new offshore drills expected and new giant oilfields that have been discovered³⁰. Brazil's revived interest in bioethanol stems rather from its potentials of export (but also of increasing domestic demand³¹) as the ethanol industry became highly competitive with the course of time. Logically, Brazil would be the first country to benefit from the current worldwide rush for biofuels, as its industry is already thirty-three years old, and learnt with management mistakes how to be competitive in biofuel production³². Brazil has been by far the largest exporter of ethanol in recent years. In 2006, its ethanol exports amounted to almost 3.5 billion litres, out of almost 5 billion litres of ethanol traded globally (cf. overall figures in appendix, Figure 6) Today, the country can take advantage of its vast expanses of arable lands still available and of its historical advance in

²⁶ Thanks to favourable fiscal policies that favoured the rapid expansion of the ethanol industry, or the subsidies to farmers, ethanol production increased from 500 million liters per year in the late 1970s to 15 billion liters per year in 1987, which is a success.

²⁷ This created a dramatic situation for ethanol motorists, that had invested in the acquisition of an ethanol-run car and faced ethanol shortages in the late 1980s

²⁸ One of the measures adopted by the government was to overvalue the country's currency. This automatically made oil imports cheaper and inadvertently damaged ethanol's competitiveness.

²⁹ 2006 is the year that Brazil's oil company Petrobras started the extraction of oil at the P-50 rig off Brazil's south Atlantic coast, which boosted national oil production to an average of 1.9 million barrels a day in 2006, more than average consumption of 1.85 million barrels a day.

³⁰ Massive offshore oil was discovered in Tupi field, in the waters off Rio de Janeiro, that could raise Brazil's petroleum reserves by 40% and boost this country into the ranks of the world's major exporters See for further details "God may indeed be Brazilian after all", *The Economist*, November 15th, 2007

³¹ There is no denying that Brazil's renewed interest on ethanol is also consequence of a little technological revolution in the car industry: in 2003, the Brazilian manufacturing industry developed the first flexible-fuel car that can run on any proportion of gasoline and ethanol. These vehicles became a commercial success and by March 2008, the fleet of "flex" cars had reached 5 million new vehicles sold, which represents around 10% of Brazil's motor vehicle fleet. They already represent 88% of car sales ("Brasil tem 5 milhões de veículos biocombustíveis", *Globo.com*, March 10th, 2008)

³² For more details, see Chapter Two

bioethanol technology that made its ethanol industry highly competitive. Thus, world's increasing worries on the rise of fossil fuels has positioned Brazil in a very privileged position. A compelling proof is the estimated cost of ethanol production compared to the current price of an oil barrel. In 2005, the costs of producing ethanol from sugarcane in Brazil, by using the most advanced technology in the country, which already prevails in São Paulo, amounted to \$ 0.23 per litre of bioethanol. In October of the same year, the litre of gasoline was sold at \$0.44, in a period when the barrel of crude oil was sold at 58,5 US\$ (Furtado, 2007)³³. Brazilian ethanol became with the benefit of its own experience highly competitive, especially in the current context of increasing oil prices; according to the Organization for Economic Cooperation and Development (OECD), Brazilian ethanol is today calculated to be competitive with oil prices at \$29 per barrel!³⁴ With growing pessimism on the future cost of oil prices, the Brazilian government is trying to take advantage of its ethanol production – and therefore is creating a new, and promising, source of revenue for the country³⁵. So much so as behind this renewed interest in biofuels, there lies the pursuit of national interests.

Biofuel programs – or the pursuit of national interest by other means

Throughout our analysis on Indian and Brazilian programs for biofuels, we stressed the collusion between the government and economic actors to advance in a new, and promising, source of revenue for each country. To what extent elements such as the government's obsession on economic growth coupled with the ascension of a flourishing (and growing influential) industrial elite³⁶, were linked up to prompt the promotion of biofuel programs? What was the real weight of patriotism in decision-making, reflected by the ideal of insulating a country from international instability? In other words, the creation of a national biofuel industry wouldn't indeed contribute to the self-sufficiency of a country, whose development would be increasingly based on internal capacity? National interest – synonym with economic growth (and so increased political leverage in world affairs) – prevailed when politicians turned to the biofuel choice. We will argue that because the development paradigm conceived by governments was based on the idea that a country can only develop by getting

³³ Even though international ethanol prices are more or less linked to the prices of fossil fuels, and hence to crude oil, OECD's recent report (OECD,2007), shows that ethanol still highly competitive (\$ 48 a barrel in November 2007). See appendix for a comparison between ethanol prices in Brazil, US and Europe (Figure 7).

³⁴ According to the British National Farmer's Union : <http://www.nfuonline.com/x286.xml>

³⁵ According to F.O. Licht Managin Director, "there is a good chance total Brazil exports reach 4 billion liters in 2008" (Reuters, 5 March 2008).

³⁶ In the case of Brazil, we must add the power of the agricultural elite, composed by the traditional landlords (latifundiários). These influential actors had a major role in the creation of Proálcool and were one of the main beneficiaries of this plan, which transformed many of them in major ethanol entrepreneurs.

highly industrialized, it became a national concern to defend the interests of the jewels of the industrial sectors. It represented the main philosophy defended by Import Substitution Industrialization in the 1970s – and, for the majority of Developing Countries, still constitutes an ideal to strive for, even though they can deny it categorically. For the Brazilian and Indian governments, the promotion of biofuels was a means to put new life into industrial sectors that were threatened by a major crisis and a strategy intended to reinforce the industrial base of the country (which would, in turn, increase its prospects of growth). In this context, the industrial lobby (but also the agribusiness³⁷) did not have to take a lot of trouble to influence the government.

Certainly, it can be controversial to compare the economic strategy of a military regime (Brazil's political regime until 1985) with that of a democracy (which is the nature of both Indian and Brazilian regimes now), but it seems clear that the imperatives of economic growth remained almost untouched as time went by. More interestingly, patriotism – something inherent to the majority of dictatorships, such as the Brazilian military regime – is been clearly noticed in both countries, that are increasingly self-confident and aware about the important role they already play in the international arena³⁸. This has been especially the case of India; any observer that goes to this country today can witness in the media how confident Indians are becoming about their own development and about the historical chance they are having to, finally, play a major role in world politics. A representative example, among others, is a recent article wrote by former Indian President, A.P.J. Abdul Kalam, and published last June 26th, 2008 in *India Today* (India's most widely read newsmagazine), with the title "Spirit of India – A Transformation in Thinking"³⁹. Brazil's self-confidence is also at its height, after its 1990s' "lost decade".

³⁷ The agribusiness lobby was critical for the creation of Proálcool (whereas it was not really the case in India). In Brazil, this economic sector did not have much pain to convince the government, as the "green revolution" and modernization of agriculture were priorities set by the Brazilian government, which in its view would increase Brazil's economic power.

³⁸ An example of this state of affairs is the increasingly tense negotiations in the WTO, where both countries started to question the interests of the developed countries and became extremely aggressive when it comes to the protection of their agriculture. A compelling example was the latest world trade talks in Geneva that took place in July 2008. After nine days of marathon talks, negotiations collapsed because of disagreements between the US and India on farm imports rules.

³⁹ In his article, Abdul Kalam describe the emergence of a new collective mood in the country, that is full of self-confidence: "India is now a country that exudes confidence and gives rise to hopes to deal with the challenges. I see the spirit of India in the capacity of its people to do their work and lead a contented life (...) Can I share with you how India graduated within a decade from a country about to be forced to pledge gold to meet its foreign exchange needs to a nation that is now growing at an average annual rate of 9 per cent GDP? (...) Shall I mention with pride the capability of our nuclear scientists in reprocessing the high burn-up carbide fuel using sodium-cooled fast reactors?"

Economic patriotism represents a pertinent notion through which we can analyse and interpret the main reasons that led both countries to adopt their biofuel policies. This was of course the case for Brazil's Proálcool, which was launched in 1975, period during which Brazil was run by nationalist segments of the military. Interest in expanding state presence in the economy was a reality (cf. creation of future jewels of the industrial sector, eg: Embraer), as Brazil was one of the supporters of the Imported-Oriented Industrialization policy, formulated by the theoreticians of the Economic Commission for Latin America in the 1960s. In this context of interventionism, the national government did not have to hide (as it would probably have today) that the creation of a new National plan for bioethanol in 1975 was a new strategy meant to save entire sectors of Brazil's economy from collapse, especially sugarcane producers and automobile industries. As Michel Duquette (Duquette, 1989) argues, Proálcool was the product of the interreaction of three groups, a "tripod", that consisted of the State, Brazilian contractors (both agricultural and industrial) and the multinationals producing automobiles.

The lobbying power of interest groups that supported, and prompted, the idea of creating a substitute for petrol cannot be neglected (even though the collusion of interest was clearly symbiotic). Brazilian big landowners (*latifundiários*) always enjoyed a considerable power in the History of the country⁴⁰: conclusive proof is that all attempt of agrarian reform failed miserably and the last president that proposed a real reform in this field (João Goulart), was opposed by São Paulo *latifundiários* that, with other sectors of the Brazilian ruling class, sponsored the military coup of 1964 (Welch, 1999). Therefore, landowners consisted of one of the interest groups that the military regime had to deal the most carefully with. Authentic agrarian reform was cast aside in favour of a project of modernization of the countryside and shifts in the economic model. Agricultural production would be subordinated to the search for a new comparative advantage of Brazil in the world market. This new strategy led to the encouragement of mono-crop exports, the development of agro-business – but also to further concentration of agricultural production. It was a way to promote and privilege the idea of capitalist enterprise over *latifúndio*. (Maybury-Lewis, 1994). This modernization policy really took off after 1968 with heavily subsidised credits and below the market interest rates for

⁴⁰ Indeed, the roots of Land Concentration in Brazil and power of big landlords goes back to the Portuguese colonization when, in order to control the territory, the Crown created a powerful oligarchy by giving away large extensions of land to those that took the responsibility for defending and administering it. International division of labour in the 19th and 20th century, coupled with export-oriented agricultural production (that especially affected sugar cane and coffee) contributed to perpetuate this reality and kept those oligarchies in possession of their *latifúndios*.

agricultural production⁴¹. Government subsidies can explain a significant increase of sugarcane production in 1971/72, boosted by the increase of international sugar price. Yet, one of the characteristics of the sugar market is that it represents an extremely volatile sphere of transaction, and after 1973, international prices plunged, to the dissatisfaction of sugarcane producers.

The government had therefore two major problems to cope with when the oil crisis burst out. The effort of the military regime to find one solution for two tricky problems deserve credit, as, by prompting researches on sugarcane's calorific power, it found out that it could use domestic sugar surpluses to reduce its dependence on foreign oil. And because the government compromised itself to financially support the construction of independent distilleries, capable of producing ethanol for fuel engines, sugarcane farmers could only be delighted, as they could, in turn, have two different outlets for their sugarcane crops. A similar analysis can be made on the relationship between the Brazilian government and the automobile industry, which were linked in mutual economic interests. (cf. Chapter Two). This alliance could surprise many observers, since no real interest would apparently lead automobile multinationals to participate to the national effort on biofuels, in a country where car penetration rates were still not considerable. But Michel Duquette points out that, if the automobile multinationals invested in research, it was because there were clear economic interests behind it – and Brazil was not necessarily in an awkward position during this deal. According to the author, the automobile industry embraced the Proálcool programme with the aim of closing off the Brazilian home market from their international competitors (particularly the Japanese).

As far as India is concerned, when politicians noticed that rising oil prices could lead to dim prospects in the economic field, they also tried to go to its industry rescue. It is true that international context changed drastically between the 1970s and the 2000s, as globalization became a reality in the meanwhile, leading countries to open up their economies and making national interests expand to a global scale. Today, many Western companies outsource part of their production to India, a new reality that blurs the very notion of national interest, as a job created by an American IT company in India participates to the economic growth of the country. Still, when oil prices started to escalate, the first reaction of the Indian

⁴¹ From 1960 to the mid- 1970s the real value of new agricultural loans increased more than six-fold, and agricultural credit as a share of total credit rose from 11% in 1960 to about 25% in the mid-1970s (Baer, 2005).

government was to think about its jewels of its industry, which have recently enjoyed considerable economy of scale. A representative example of India's booming industries is the automobile sector. Recent trends of this sector show an outstanding trajectory of rise, making, today, India world's largest tractor and three-wheel vehicle producer, and second largest two-wheel vehicle producer⁴². More importantly, as we have already mentioned, this sector plays a crucial role in India's economy (in terms of job creation and of share of GDP), which makes the government very receptive to the automobile lobby. The Indian market is dominated by a national giant, Tata Motors⁴³, which is India's largest truckmaker and world's 20th largest automaker. No wonder that Tata became one of the main sponsors of the new Indian jatropha program, as it felt directly threatened by the rise of oil prices, which could thwart the spectacular⁴⁴ expansion of car's sales in India; in coalition with India's Council for Scientific and Industrial Research (CSIR), Tata Motors is testing its vehicles on Jatropha-based biodiesel.

Yet we cannot conclude this panorama of the main interests that supported biofuels promotion without mentioning the role of Indian oil companies. Indian national oil companies (such as Indian Oil Corporation and Reliance Energy, Godrej Agrovet) and international oil companies working in India (such as D1 Oil⁴⁵, British Petroleum) showed very early a particular interest in biofuels and regarded biodiesel production as an interesting option for their diversification strategy – as with increasing global apprehensions on pick oil, oil companies have already started to plan the post-oil era in their research-development centres. But possibly more importantly, Indian oil companies realized that they could take advantage of growing international interest in biodiesel (especially manifested by countries such as EU members) and develop a promising strategy of jatropha-based fuel exports. The lobby power of these companies seem to have been decisive in convincing the Indian government to adopt a jatropha mission in 2003: their strategy consisted of carrying out assessment studies on India's potential on jatropha – and especially in the field of exports (regarded as the most profitable) – and providing the government with very attractive estimates (that turned out to be by far too optimistic). According to these studies, India could clearly take advantage of its

⁴² This is the result of 1991's government's de-licensing of the automotive sector and subsequent opening up for 100 % FDI through automatic route. See http://www.business-in-asia.com/countries/automotive_industry_india.html for more figures.

⁴³ Ranked among top 10 corporations in India, this company is bidding for global status: in March 2008 it bought Ford's Jaguar and Land Rover units and early this year launched its Tata Nano, which is meant to be world's cheapest car in the world.

⁴⁴ At the end of 2008 first semester, car sales rose 14.3 % to 110,743 units: <http://naatmad.com/2008/06/10/indias-may-car-sales-rise-14-pct-vs-year-ago/>

⁴⁵ UK's D1 Oil works in India through its Indian joint venture D1 Mohan Bio Oils Ltd.

low cost labour force to export biodiesel to developed countries⁴⁶. UK's biggest biodiesel company, D1 Oil⁴⁷, which have shown a big interest in India's jatropha production, pointed out that the production costs of this plant in India would amount to Rs. 13/17 per liter (around £0.16/ 0.20) to grow and refine it and one hectare of Jatropha plantation yields 25,000 Rupees/ year (around £300). This would make India a very competitive producer of jatropha⁴⁸ and create a new source of revenue for the country. Five years after the creation of India's mission on jatropha, oil companies represent today the main private investors in the field: D1 Mohan is a key player, having 10,000 hectares of the crop planted in India and targeting to reach in the near future 267,000 hectares⁴⁹. Reliance Industries Ltd. is also investing massively on the sector as it has earmarked 200 acres of land in the State of Andhra Pradesh (Kakinada) to cultivate jatropha. The cultivation could increase to thousands of acres, depending on the progress of the project⁵⁰. Godrej Agrovet also demonstrated its interest in biofuels by announcing that it would invest over Rs. 5 billion in jatropha and palm oil cultivation in the states of Gujarat and Mizoram. This overview already hints that the Indian policy on jatropha has been taking a very liberal path, and mainly advantaging big actors – which back up early fears of small farmers (see Chapter two).

Today, India and Brazil seem very committed to the expansion of biofuels production in their respective countries, for all the economic interests we mentioned above. Proof of this commitment has been the recent strengthening of commercial⁵¹ and political collaboration between both countries in the field of ethanol: with South Africa, Brazil and India created in 2004 the IBSA bloc, which focus on the promotion of south-south cooperation between these three emerging south democracies: in their 2006 meeting, IBSA members agreed to support the “ethanol initiative” worldwide⁵². Due to its potential, Brazil is undoubtedly world's main ethanol advocate today. Through its ethanol diplomacy, Brazil has been extremely active in the world arena, by promoting Brazil's ethanol exports worldwide and by struggling to

⁴⁶ We think especially of the European countries here. The European Commission has pledged that biofuels, such as biodiesel and bioethanol, make up 10% of transport fuel by 2020.

⁴⁷ Figures found on the website of *Renewable Energy UK*.

⁴⁸ According to D1-Oils, 'the transport costs of shipping 1 tonne of Jatropha from India to Northern Europe is \$100', whereas 'landed cost of 1 tonne of Jatropha oil to Northern Europe is between \$348 and \$500 and refining Jatropha oil into biodiesel costs less than \$125'.

⁴⁹ *State Bank of India Funds Jatropha Cultivation for Biodiesel*, Green Car Congress, http://www.greencarcongress.com/2005/04/state_bank_of_i.html

⁵⁰ Satish Lele, http://www.svlele.com/biodiesel_in_india.htm

⁵¹ In June 2007, Brazil announced plans to quadruple ethanol trade with India to \$ 10 billions by 2010

⁵² <http://www.hindu.com/2006/09/10/stories/2006091002401200.htm>, retrieved on September 1st, 2008

reducing trade barriers to ethanol in developed countries⁵³. This interest has been translated by various signatures of cooperation agreements with several countries in sub-Saharan Africa (Nigeria, Ghana) and Asia (China, Japan).

With so many economic interests lying behind biofuels, one could even wonder if politicians are, by any chance, interested in the social and environmental benefits that this new source of energy was expected to bring to biofuel producers.

⁵³ This explains why Brazil looks to WTO talks to boost biofuel exports. Last July 2008 it asked WTO members to classify ethanol as an environmental product rather than an agricultural product, which would give it greater access to export markets such as the US (that imports half of Brazil's ethanol production) and the EU.

SECTION II

The reality of proclaimed official hopes for a “greener fuel” that should “prompt social development”

On the sub-section above, we drew the conclusion – through the analysis of economic data and political discourses – that dim economic outlook and compelling economic concerns seemed to have had a decisive influence on the choice of politician for a biofuel programme. Yet, the same politicians that praised the economic advantages of biofuels, did not forget to always mention, on the conclusive paragraphs of their official statements (which tell us a lot about the general mindset prevailing in the political sphere), that national biofuels projects were intended to benefit all sectors of the society and would be conducive to national efforts to curb GHG emissions.

It is always capital to remind the lector the guiding thread of this research paper (the sustainability of Indian and Brazilian biofuel projects) and the way under which we are structuring our paper in order to properly answer this question. In our view, the understanding of politician’s motivations is crucial to better understand the underlying sense of both programs, given the multitude of cross-cutting issues that biofuels can potentially deal with. Indeed, the production of crop-based fuels could not only help country’s effort to curb budget deficits, resulting from soaring oil prices, but also be a tool for development and emissions reduction. Thus, the study of the main motivations that led India and Brazil to grow agrifuel crops is capital to apprehend the concrete potential of sustainability of both projects on the long run, from a triple economic, social and environmental point of view.

Therefore, in this section we will wonder if preoccupations on ecological and social well-being were really an issue in the inception of both biofuel programs – or simply represented a “plus” for the image of the overall project. Did politicians thoroughly consider potential “side effects” that such programs could create or exacerbate (tensions over land occupation, threat to biodiversity)? The analysis of the recent controversy on the links between growing biofuel production and decreasing world food security represented an interesting moment of truth, as countries were compelled to admit –or refuse – any link between both phenomena. Consequently, the analysis of the Indian and the Brazilian stances in this context will help us to shed light on the real priorities set up by both biofuel programs.

The real attention paid to social and ecological consequences of biofuels

If in the recent hype around biofuels, economic imperatives have had an upper hand over other concerns, it is worth noting that, simultaneously, official reports and public statements of politicians, in India and in Brazil, have been full of praise for other biofuel advantages: the latter is often acclaimed as a tool of social development, at the same time that it is set to help reduce GHG emissions and, for the Indian case, participate to national effort on land management. How can we interpret these recent statements? To what extent the Brazilian and the Indian examples have seriously taken into account both dimension depicted above? A comparative analysis of their strategies will not only help us uncover similar national concerns in these fields, but also highlight a real evolution in mindset with regard to ecological awareness. Global politics has evolved deeply since the 1990s, with the consolidation of globalization and the emergence of new issues such as environmental concerns on the state of our planet. Therefore, the current Indian jatropha program is not identical to its Brazilian counterpart (at least to its early stage), since environmental impacts of biofuels were treated from a different angle of approach. So, in this section, we will have to take account of the impacts that recent international environment negotiations (especially the Kyoto protocol) had on environmental protection. But, more importantly, it is worth stressing the real place that both aspects were set out on hierarchy of national priorities.

Probably the best way to start this section is to sum up recent hopes that were pinned on jatropha and that can be read on political speeches or on official reports or on newspapers. A recent speech of former president Kalam, a strong advocate for production of biodiesel, reflects recent general mood on jatropha potentials: in 2006, Kalam, still president of India, envisioned more than half of India's wastelands greened with oil-bearing of jatropha, because "Jatropha requires very little water when compared to other cash crops"⁵⁴. Still according to Mr. Kalam, his PURA (Providing Urban Facilities in Rural Areas) plan estimated that the cultivation of jatropha on 11 million hectares of wasteland could yield approximately Rs 200 billion a year and provide employment to over 12 million people – both in plantations and in the extraction and processing units⁵⁵. The President's will to incorporate environmental and social aspects into India's national jatropha plan reflected a genuine ambition that the main

⁵⁴ India eNews, "Kalam to attend jatropha planter's convention", 8 July 2006

⁵⁵ Nevertheless, the analysis of this context can only be complete if we also put things into perspective and remember that President Kalam was also (probably more?) worried about other figures, such as those released by IEA on its 2005 World Energy Outlook, which suggested that in a business-as-usual scenario, by 2030 India would be consuming 5.6 millions barrels of oil per day, of which 94% would be met through imports.

architects of India's new energy strategy bore in mind. According to them (cf. the Report of 2003 Planning commission in appendix, document 2), it was to be believed that, thanks to jatropha, 1) not only in a few short years India would have significantly reduced its petroleum import bills, 2) but also provided worthwhile employment to millions of farmers in rural areas and 3) vast acreages of wasteland would be green with oil-bearing jatropha, which is conducive to land management and to a substantial reduction of GHG emission.⁵⁶

To understand this third point, we have to situate India's recent National Mission on Biofuels in its context: since Rio's Earth Summit, politicians, but also world citizen, had started to understand that our model of development was causing irreversible damages to our planet's fragile ecosystem. Increasing CO₂ emissions have been particularly blamed for increasing world's temperature⁵⁷. International realization of the problems at stake led to the signature of the Kyoto Protocol in December 1997 – which entered in force eight years later. India, as Brazil, ratified the protocol, even though both countries did not have any binding commitment to respect, a part from monitoring and reporting emissions. Today, although India continues to appear as one of the top CO₂ emitters in the world (cf. appendix, Figure 8, and *The Little Green Data Book 2007* for an overview of recent trends)⁵⁸, there is growing (though still very limited) public concern on the deterioration of the environment from harmful emissions. We can cite, for the sake of example, recent court orders compelling public transporters in Mumbai and Delhi to switch to CNG, which have definitely spurred search for newer biofuels and technologies. Therefore, we can argue that recent government interest in the environment-friendly characteristics of jatropha is a reflection of growing public awareness⁵⁹ and of (loose) world commitments on the Climate Change agenda.

What are precisely these so called environmental benefits that jatropha could bring to India? To understand why jatropha became an environmental wonder plant, it is worth citing

⁵⁶ And on the top of this, Indian authorities got extremely excited at the prospect of earning many Clean Development Mechanism (CDM) credits.

⁵⁷ In 2007, United Nations Intergovernmental Panel on Climate Change (GHG) found out that over the course of the 20th century, the average global temperature increased by 0.6°C, and would, to the effort made by our countries to reduce GHG, continue to rise by between 1.8°C and 4°C during the 21st century, according

⁵⁸ According to this World Bank report, the global carbon dioxide emissions have risen 19 percent since 1990, whereas the Kyoto protocol had set the goal of a 5.2 percent reduction from 1990 levels. The report stresses that India's increasing CO₂ emissions (88 percent increase) is particularly preoccupying. For further details:

<http://siteresources.worldbank.org/INTDATA/64199955-1178226923002/21322619/LGDB2007.pdf>

⁵⁹ Yet, we can express our doubts on "growing public awareness" when we know that, in 2001, literacy rate in India was at 64.84% and that the first preoccupation of Indians is by far to have enough to eat. On the other hand, any observer that goes to India can witness the eager of the average Rich to blindly copy the American way of life, especially by buying powerful cars.

some general estimates that can be found on websites and on official reports⁶⁰. We can read: “like all trees, *Jatropha* removes carbon from the atmosphere, stores it in the woody tissues and assists in the build up of soil carbon”, thus, it “contributes significantly to climate change mitigation by reducing CO₂ emissions” (for estimates by the Planning Commission, see appendix, Figure 9) . Indeed, “this biodiesel is an oxygenated compound containing no sulphur. It does not produce sulphur oxides, which lead to acid rain formation”. *Jatropha* can also be excellent for land management, because it is “excellent at preventing soil erosion”, “*jatropha* prefers alkaline soils” and “*jatropha* trees are productive for up to 30-40 years”. Another argument supported by the Indian government to promote *Jatropha* relied on the supposedly ability of the plant to contribute to afforestation and soil improvement in wastelands. Thus, *jatropha* was to be primarily planted in wastelands, but the extent to which wastelands could be suitable to *jatropha* was never clear known⁶¹.

Yet, this ecological concern is only part of the reality. Indeed, in politics, hardly one interest comes alone when a government decide to set up a national program. In the environmental field, the Indian government undoubtedly tried to capitalize on recent evolutions of international negotiations on climate change – which stressed the importance of global cooperation and of transfers of technology to the global South. In this framework, if *jatropha* proved to bring down GHG emissions (and so help address climate change), it could have extremely interesting potentials in especially one arrangement under the Kyoto protocol: the CDM. These three letters stand for Clean Development Mechanism, a scheme that promotes North/South cooperation under the chapter of GHG reductions, and allows industrialized countries (listed on Annex 1 of the Kyoto protocol, and having binding commitments in terms of greenhouse gas reduction) to invest in projects that reduce emissions in developing countries as an alternative to offset – or avoid for critics – expensive emission reductions in their own countries. Why the production of *jatropha* diesel could potentially earn India CDM credits? Defenders of biofuels argue that this new green fuel does not disrupt

⁶⁰ Figures found on the website of *Renewable Energy UK*, on the 2003 Commission Plan Report and on 2006 UNCTAD report on biofuel industry in India.

⁶¹ Former Indian President, Abdul Kalam used to say in his speeches that out of the 60 million hectares of wasteland available in India, over 30 million ha are suitable for *Jatropha* cultivation. The National Mission on *Jatropha* Biodiesel, seemed more realistic when it stated that 13 millions ha of unused lands were to be cultivated with *Jatropha*. *Jatropha* was to be primarily planted in wasteland. As we will see, 13 millions ha is already an excessively high amount of land diverted to *jatropha* plantation, and NGOs and social activists unanimously urge politicians to decrease this target.

Earth's natural carbon cycle, as fossil fuels do⁶². According to them (cf. UNCTAD, 2007), CO₂ reductions occur because the biomasses that serve as feedstock for biofuels production require CO₂ to grow. Thus, much of the released when biomass is converted into biofuel and burned in automobile engines is recaptured from the atmosphere when new biomass is grown to produce more biofuel. This is what they call a "closed circle".

Therefore India – which was along with Brazil the second biggest beneficiary of the CDM last year (it made \$ 443m) – has seen in this new international scheme an interesting means of attracting fresh Foreign Direct Investments to the country. It is undeniable that, from the outset, the Indian government considered the specific possibility of attracting CDM funds through its biodiesel production: we can cite as an example a CDM biodiesel project that took place in the State of Andhra Pradesh, where a private company (Southern Online Biotechnologies) set up a biodiesel manufacturing plant with capacity of 30 t/day or 9,000 t/year, and looked, in July 2004, for funds through the CDM mechanism. The company claimed to the CDM Executive Board⁶³ that its project would promote a carbon emission reduction of 26,792 ton of CO₂ equivalent a year. At an estimated price of \$ 4 per ton of CO₂ reduction, the revenue was expected to be about \$ 108,000!

According to the Indian government, environmental well-being is not the only benefit brought by the recent national program on jatropha. Social well-being was also considered a top priority of the new program, as it was regarded as a way to support and improve life of small farmers, the most vulnerable social category in India⁶⁴. In the description of the CDM project cited above, the government proposes an interesting definition of what it understands by social well-being: it is a notion related back to "alleviation of poverty by generating additional employment, removal of social disparities and contribution to provision of basic amenities to people leading to improvement in quality of life of people" (p.2). According to the government (Planning Commission, 2003), jatropha promotion could contribute to this effort, as it is conducive to a number of social objectives, such as meeting domestic needs of energy services including cooking and lighting; being an additional source of household income and employment through markets for fuel, fertilizer, animal feed medicine, and industrial raw material for soap, cosmetics, etc.; last but not least, jatropha could improve the

⁶² Indeed, since the beginning of the industrial age, our increased use of fossil fuels for energy has released on the atmosphere tremendous quantities of CO₂ that was stored in "fossils" for millions of years. Therefore, CO₂ is now being released quickly, which threatens the natural balance of the carbon cycle.

⁶³ http://cdm.unfccc.int/UserManagement/FileStorage/FS_686206579, retrieved on 1st August 2008

⁶⁴ Indeed it was already a habit among farmers to use jatropha hedges to separate land divisions in their farm plot – as, being poisonous plant, it is not browsed by cattle for instance.

protection of crops or pasture lands, as it represents an hedge for erosion control, it is an windbreak, and consists of a source of organic manure. Biodiesel therefore appeared to be of special importance for the reduction of increasing – and preoccupying – social inequalities in India. It would play a major role in the upliftment of the rural poor, neglected by the booming IT industry and urban middle-class, and, at the same time, correct climate imbalances, as the rural poor is the first social category tending to directly suffer from current climate change evolutions⁶⁵. According to the Planning Commission (2003), in order to reduce the widening gap in India's society, the Indian government expected that biofuel production could offer chances for social and rural development, by allowing these communities to “diversify their crop portfolio”, “generate substantial incomes” and hence “increase their economic power” “without threatening their food security”. To prove the validity of this last set of hypothesis, the government remembered that it was already a habit among farmers to use jatropha hedges to separate land divisions in their farm plots; the plant could thus become a new source of revenue for farmers, especially for those that had wastelands laying barren; furthermore, jatropha is a hardy plant that produces a non-edible oil (jatropha is indeed poisonous); for all these reasons, the Commission plan insisted that its strategy was set to avoid any sort of conflict between food and biofuel crops.

Though a series of positive potentials in the social field are to be stressed, and as free of egoistic interest the government could be, the latter probably knew when it chose jatropha as the source of India's new biofuel program that considerable obstacles were to be overcome. Although in many parts of India jatropha has been traditionally used as boundary plantations, farmers never grew it for commercial purposes; thus, an education effort, as well as governmental incentives, would have to be provided. As we will analyse in our next chapter, it has not been the case. But more importantly, the government also knew that India, as a very densely populated country, and where land-availability is narrow, tensions and controversies could spark off over potential diversion of agriculture lands at the benefit of jatropha cultivation. Additionally, the risk was real that, during the implementation phase, market forces had the upper hand over the social aspect of the national plan - and prompt the government to have second thoughts about its strategy on jatropha (promotion of monocultures for instance). This possibility was not to be kept out of consideration by the government, in the light of recent transformations in India's countryside, which have

⁶⁵ As *The Economist*, (Melting Asia, *The Economist*, June 5th 2008) puts it: “according to the Peterson Institute for International Economics, India's agriculture will suffer more than any other country's. Assuming a global temperature increase of 4.4°C over cultivated areas by 2080, India's agricultural output is projected to fall by 30-40%”.

benefited essentially rich farmers. Since the liberalization of the economy, at the beginning of the 1990s, India's agriculture has witnessed a series of social tension. Since then, economic growth has been benefiting a very few (urban middle-class) whereas small farmers became the main victims of a substantial change in economic paradigm⁶⁶. A liberalized regime has led to mass displacement of small farmers to cities, creating loss of livelihood and despair among farmers – as it is reflected by widespread farmer's suicides, which reached 150,000 in just eight years (1997-2005)⁶⁷. In such an explosive context, the latest biodiesel plan could be easily regarded by small farmers as a new governmental tactic to allow big farmers to grab their land.

And indeed, fears partly proved to be truth as tensions have been reported in many Indian states, in which farmers have accused the government of granting public communal lands to private companies in order to promote jatropha monocultures (see our second chapter for more details on this issue). But conversely, the recent controversy over a deepening world crisis on food security clouded the issue and made the Indian government remember that India, with its booming economy and demography, is increasingly vulnerable to the rise of food prices. In our next sub-section, we will wonder if this recent crisis has affected India's stance on jatropha.

Let's turn now to the Brazilian case, in which concerns on the triple sustainability of its bioethanol is also to be questioned, given the series of attractive economic factors that seemed to have had the upper hand in governmental considerations.

First of all we have, again, to put Proálcool national program into perspective and remember that a factor such as GHG reductions was a non-issue in 1975. Very few studies were linking up steady evolution of CO₂ emission to climate change (which was not really perceivable in this period). Diversification in energy supply was therefore the main priority of this plan. But it does not mean that other elevated environmental costs were not pointed out, such as water contamination by the stillage or air pollution from the traditional burnings of field residues ("queimadas"), which causes air pollution. Nevertheless, if the choice of ethanol at that moment was solely motivated by strategic and balance of payment considerations, the governmental position changed smoothly as debates on climate change started to concern the

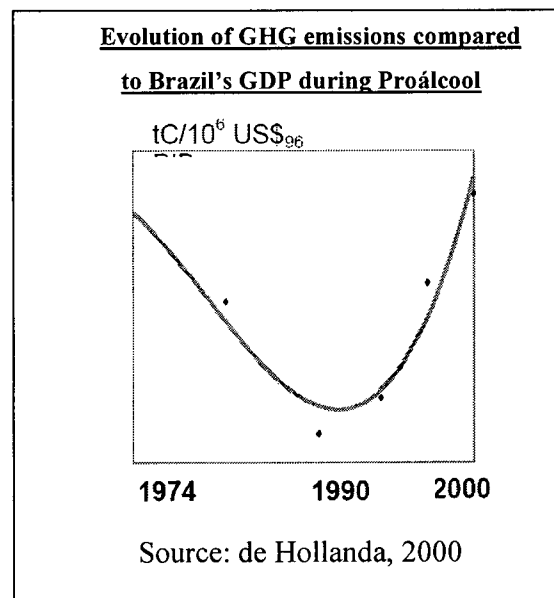
⁶⁶ A paradigm shift in agriculture was introduced under the World Bank direction which "required India to move away from the existing subsidy-based regime and instead, invest in building a solid foundation for a highly productive, globally competitive and diversified farm sector." ("World Bank for radical farm policy changes", *The Hindu Business Line*, December 20, 2004)

⁶⁷ "Farm suicides rising, most intense in 4 States", *The Hindu*, November 12, 2007

international community. As we have pointed out in our last section, the choice of sugarcane-based ethanol relied on a conciliation of interests between the government and the sugarcane manufacturers and on conclusive public R&D findings, which pointed out that sugar-cane juice was a very interesting energy-efficient plant. But as time passed by, and environmental paradigm changed, the Brazilian government happened to be in possession of a widely praised energy-clean program that was cited worldwide as an example to be followed. In a way, this evolution in mentality was presented to Brazil as a *fait accompli*, and Brazil could then take advantage of thirty-years of experience to export its “model”. Today, Brazilian official websites boast that “it is estimated that a total of 644 million tonnes of CO₂ were not emitted into the atmosphere during the period 1975 – 2005”, given that “the use of ethanol from sugarcane produced in Brazil avoids the emission of nearly 2.7 kg CO₂ per litre of ethanol used to replace gasoline.⁶⁸”.

It is true that since the creation of Proálcool, Brazil reduced considerably the amount of GHG it emitted into the atmosphere. The direct correlation between ethanol and reduction of GHG can be clearly seen on the opposite curve, which shows the levels of CO₂ emissions compared to Brazil’s GDP: during the period Proálcool program experienced its golden age, (until the beginning of the 1990s) levels of GHG emissions had reduced drastically; whereas in the 1990s, emissions described the other way around, as the program suffered from a significant slow-down.

Recent studies (OECD, 2008) corroborate recent Brazilian arguments that bioethanol produced from sugar-cane is one of the most environmentally-friendly biofuels available in the markets. Scientists confirm that GHG savings from bioethanol from sugar cane are substantial in the absolute, without taking into account externalities. In its compilation of recent works on this issue, the Organization for Economic Cooperation and Development found out that “all studies agree on the fact that ethanol from sugar cane can allow greenhouse gas emission reduction of over 70% compared to conventional gasoline. The largest majority of reviewed studies converge on an average improvement around 85%.” (OECD, 2008 p.44).



⁶⁸ “Mitigating Climate Change: the Brazilian Perspective”: http://www.climateactionprogramme.org/features/article/mitigating_climate_change_the_brazilian_perspective/

Excellent GHG savings have been achieved in Brazil, especially thanks to the high level of energy-efficiency of some mills that use the waste of sugarcane (bagasse) for energy production. The bagasse holds 41,5% of sugarcane stored energy (Furtado, 2007) and when it is burnt it can be used for process heat and power, which results in a high energy balance (output energy/input energy), which varies from 8.3 for average conditions to 10.2 for best practice production⁶⁹. This biological feature of sugar-cane is allowing many Brazilian mills to attain energy self-sufficiency – and even export the surplus of energy created to the grid⁷⁰. This trend in Brazilian industry towards more integrated concepts of energy production, is allowing higher values (beyond 100%) of GHG savings, according to the OECD. Additionally, sugarcane contribution to climate change mitigation, proudly boasted by the Brazilian government, coupled with increasing consumption by the Brazilian fleet of bioethanol, is projecting the country worldwide as an example in terms of GHG emissions: with recent popularity of flex-fuel cars (which are indistinctly run on ethanol and gasoline) that account today for 88% of car sales in Brazil and rise of gasoline prices, Brazilian motorists already consume more bioethanol than gasoline⁷¹. But these encouraging figures hide a preoccupying reality: the increase of deforestation in the country. According to the United Nations Food and Agriculture Organization (FAO) Brazil is today responsible for 42% of the net loss of global forest. Deforestation is not only putting in danger biodiversity, but, ironically, is responsible for massive GHG emissions (as we see in the appendix, Figure 11, estimates on carbon stock in forests for South America is considerable): in other words, by burning the Amazon, Brazil is simply wiping out all ecological gains that come from the expansion of its bioethanol consumption⁷²

As for the social impacts of biofuels recent studies show mixed findings, as overexploitation of workforce and violations of Human Rights have been reported (for more details cf. our second chapter). Yet, when it was created, Proálcool had a strong social constituent in terms of net job creations, as sugarcane is estimated to be seven times more

⁶⁹ Macedo Isaias, M. Lima Verde Leal and J. Azevedo Ramos da Silva (2004) "Assessment of Greenhouse gas emissions in the production and use of fuel ethanol in Brazil". Secretariat of the Environment, Government of the State of São Paulo.

⁷⁰ Therefore, many mill owners (especially those in São Paulo) are already exploiting this potential source of revenue and striving for improving bagasse productivity (which is still generally low): According to Furtado, a mill that produce 2 million tones of bagasse per year, has the potential to export up to 80,000 MWh.

⁷¹ According to Brazil's Oil National Agency (Agência Nacional do Petróleo), in the first two months of 2008 1,432 bi. litres of ethanol were sold in the market, more than gasoline consumption (1,411 bi. litres.). Bioethanol consumption grew by 56% during this period, whereas gasoline consumption stagnated at +2,9%. According to the agency, this mainly reflects the rise of oil derivatives in the Brazilian market (*Folha de S. Paulo*, 04-25-08)

⁷² In our second chapter we will analyse more in detail the different ecological threats created by Brazilian bioethanol from an environmental point of view.

labour-intensive than pastures. During the first five years of Proálcool, it is estimated that 25,500 new jobs were created per year in São Paulo, a region that concentrates more than half of Brazilian production of ethanol (Smeets et al., 2006). An upward evolution in job creations was confirmed until the mid-1990 (see appendix, Table 1), even though since 1995, a significant reduction of employment rates has been noticed in this sector, especially on account of increasing reliance on mechanical harvesting. Still, according to the UN (UN,2007) sugarcane industry employs today 1 million Brazilians (especially cane cutters), and 300,000 of these cutters are situated in São Paulo. Because it represented a source of employment, bioethanol became, over time, more difficult to attack by its main critics, especially NGOs and social movements⁷³. In a way, the fact that Brazil has experienced, since the beginning of 1980s, a series of economic crisis reinforced sugarcane producers. The latter could put forward that the sector was not only creating new job, but also argue that it was also improving life conditions of many workers: its compelling proof is that in the late 1990s, sugar cane workers in São Paulo were receiving, on average, wages that were 80 % higher than those of workers holding other agricultural jobs. Their incomes were also higher than 50% of those in the service sector and 40% of those in industry (Macedo, 2005). Therefore, even though human rights violations is something that is known by every single citizens in Brazil (many soap operas broadcast in the 1990s popularized the problem of exploitation in sugarcane fields), politicians had to recognize that they were in a way more dependent on sugarcane landlords, than the other way round.⁷⁴, which explain that they are very selective in data when they want to show to the rest of the world that ethanol production has brought social development to the country. Therefore, although politicians know that the extension of sugarcane mono-cropping challenges the overall meaning of the project's social constituent, they very often put forward two sets of argument: firstly that rising mechanisation of the sector (especially in harvesting) is reducing human exploitation (see Chapter Two); secondly that substantive progress in the amelioration of conditions has been made, but that sugarcane labour must put into perspective with other strenuous tasks: as President Lula put it at last

⁷³ In the conference « Climate Change Justice Now » a member of a Brazilian social federation (FASE – Federação de Órgãos para Assistência Social e Educacional) highlighted that even though social movements in Brazil are very critical towards the current state of biofuel cultivation in Brazil, they have to take into account that now Biofuels are already part of Brazil's reality. No-one denies the economic benefits it is bringing to the country; therefore the most important thing Brazilian civil society can do is to put pressure on the State for increasing monitoring on Human Rights violations.

⁷⁴ São Paulo, a region that produced more than half of Brazil's ethanol, and the richest State in Brazil, production of sugar cane/ethanol is an important source of employment, both directly (employment in the sugar cane and ethanol production) and indirectly (employment in the industries that produce intermediate deliveries to the sugar cane and ethanol production sector).

FAO Conference in Rome, “Everyone knows that sugar cane labor is tough(...) [but] it's not tougher than labor in coal mines, which was the basis for the development of Europe. Take a big knife to cut cane and then go down in a mine, 90 meters deep, to explode dynamite. You'll see which is better.” (*Los Angeles Times*, June 16th, 2008)

When it created Proálcool, the military regime had also in mind the purpose of keep up national efforts to correct social inequalities linked to the territorial distribution of wealth in Brazil. Since the 1950s, politicians started to realize that the unequal distribution of population and economic development in the country was a major threat to its territorial integrity (danger of rivalries on territorial borders) but also to its own development (as Brazil was spoiling the immense potential it had in terms of natural resources). Former President Juscelino Kubitschek probably incarnated the best this vibrant political will to bring development and State presence to the countryside. It was during his presidency (1956-1961) that Brazil decided to change its capital city from Rio de Janeiro to Brasilia, located in the very middle of the country. When the military regime took over the power, this effort towards further decentralization continued, and consisted of an important priority. Furthermore, since the 1950s the country's economy was booming and rural exodus towards crowded cities was seen as a major threat to social stability. Therefore the creation of a national plan on ethanol would one the one hand help fixing unskilled workers in the countryside, and on the other hand contribute to alter the direction of economic growth vectors, decentralizing the investments from the large urban centers to the hinterland. Good examples of this movement are some cities in the interior of São Paulo, such as Ribeirão Preto and Piracicaba, whose growth is due not only to sugar-alcohol industry but also to that of citric fruits and soybean.

Nevertheless, 33 years after Proálcool is a reality, national social impact of bioethanol has not revolutionized the economic distribution of wealth in Brazil. São Paulo still gathers one third of Brazil's GDP, and the share of urban population in Brazil increased from 58 to 80 percent between 1970 and 2000. The very purpose of spreading economic development out of the country, at the expense of São Paulo State, thanks to Proálcool can even be considered as a failure today, when we know that the region is the place where the buck of sugarcane ethanol is produced nowadays (57.7% of national production according to Furtado), due to favourable weather and land, but also to the proximity to Brazil's main industry pole. According to the World Bank (2005) social costs in the North-Northeast area, where economic development was most needed, turned out to be extremely high between 1978-1987 (especially due to the overexploitation of sugarcane cutters), even though it is reported that the Brazilian economy channelled more than US\$3.6 billion (1987 U.S. dollars) in resources

into the two northern states to support ethanol production. Yet, this did not stop massive national migration of poor peasants towards the rich Center-South part of Brazil, and the irony is that many of them ended up being sugarcane cutters in São Paulo, given that social legislation in this State is far stricter⁷⁵

A last aspect on social cost that must be considered is that sugarcane ethanol production, far from alleviating social inequalities in Brazilian society, exacerbated this tendency. As Duquette highlights in his book, Proálcool was a program crafted at the benefit of the elites – especially of the local bourgeoisie represented by sugarcane landlords (that became “new sugar lords”, particularly in the paternalistic Northeast region of the country, traditionally run by old colonial landlords). Duquette argues – and that will be used here as a transition to our next subsection – that such a plan, instead of striving for fixing old inequalities, created a system of subsidies and taxes that promoted sugarcane monocultures – at the expense of small farmers, that very often sold out their lands to the “new sugar lords”. In other words, Proálcool was a system that *de facto* created incredible social costs, such as growing land concentration, the generation of landlessness (increasing numbers of *bóias-frias*) and the replacement of food cultivation by sugar production.

Competition between food and biofuel cultivation have been real in Brazil as in India, although pattern of land occupation and land-availability in both countries are considerably different. Moreover, this reality distinguishes also these two countries with regard to their vulnerability to recent growing concerns on food security. We will now turn our attention to the recent debate on global food security crisis in order to better understand if social sustainability has been a major concern in Brazil and India. Official statements and governmental stances from both sides have made analysts sceptical about it.

The Food Vs. Fuel debate seen by Brazil and India: reality or conspiracy by “Geneva-based technocrats”?

Since last April 2008, the debate on biofuels has considerably intensified, and political speeches finally started to put environment and poor people at the centre of discussions. The beginning of this year consisted of these sudden moments of realization, during which politicians and the media take their time to stand back to judge the consequences of a policy. The factor which triggered questions from the international community was the surge of food

⁷⁵ In 2003, the percentage of sugar cane cutters employed in the formal sector was higher in the Centre-South (74%) than in the North-Northeast (49%), and highest in São Paulo (85%) (Macedo, 2005).

prices and subsequent food riots that it created in Developing countries. Experts analysed different factor contributing to this new spectre of food crisis and found out that biofuels consisted of one of the main culprits. According to analysts, since 2000, biofuel production was creating a silent revolution in world's agriculture landscape (figure 1 in our first section shows that production has doubled) and generating significant tensions on the food market. At the beginning of this year, questions about agrifuels started coming from various fronts. The United Nations and other international institutions were the first organisations to make clear alarming warnings about fuels derived from agriculture, which were diverting the use of lands to food and leading to the surge of raw material prices. Development agencies such as the World Bank sounded the alarm bells by highlighting that the crisis of surging food prices could mean "seven lost years" in the fight against worldwide poverty⁷⁶ and that it could push 100 million people into deeper poverty⁷⁷. The director of the International Monetary Fund (IMF), Dominique Strauss-Kahn, added fuel to the fire when stating that producing biofuel from food crops constituted "a truly moral problem" while poor countries face full-fledged food crises. The UN's Special Rapporteur on the Right to Food Jean Ziegler called the massive production of biofuels a "crime against humanity", since using fertile lands to produce fuels reduces the amount of land used to grow food, which in turn raises food prices. Although many commentators criticized this apocalyptic statement, Ziegler's stance can be supported when we notice that commodities such as maize are being diverted at a whopping 20% in the US to produce the biofuel ethanol⁷⁸, which, according to the IMF, has accounted for a minimum of 50 % of the increase in global corn output since 2006. Moreover, one cannot neglect that Brazil is currently using half of its sugarcane area to make biofuel as the European Union has been using the greater part of its area under vegetable oil seeds production to make biodiesel.

Yet, since the closure of the High-Level Conference on World Food Security, held at FAO Headquarters in June 2008, media interest and political will to address this issues waned, as other economic or geopolitical event attracted the attention of the international community. In this summit, rapidly growing global biofuel countries escaped unscathed, as the draft summit declaration avoided negative language on biofuels, and simply called for further international dialogue. The United States and Brazil were, not surprisingly, the main

⁷⁶<http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21726628~pagePK:64257043~piPK:437376~theSitePK:4607,00.html>

⁷⁷<http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21729143~pagePK:64257043~piPK:437376~theSitePK:4607,00.html>

⁷⁸ Estimates from the credit rating agency CRISI, *Businessword*, 7 April 2008

advocates of biofuels: Washington maintained that biofuels “contribute today only about 3 percent of total food inflation which has seen commodities’ prices doubled in the last couple of years”⁷⁹. Brazil, on the other hand, could remind the International Community that sugarcane is grown today on 3.6 million hectares of land, which represents only 1% of Brazil’s arable land, consisting of about 355 million hectares⁸⁰

The fact is that it would be wrong to put food and fuel in direct confrontation, because the reality is that there is a basketful of problems that are causing food prices increase. UNCTAD drew recently the conclusion that the current spurt in food prices stems from multiple reasons like depletion in food stocks, rise in crude oil prices, climatic conditions, speculation in food commodity markets, consumption factors, limited capacities of production networks of developing countries, multilateral trade rules, unfair competition.⁸¹ Thus, the rise in commodities costs is not only imputable to the cultivation of biofuels: behind the current evolution, many forget to mention speculation and the rise of fossil fuels that feed this upward dynamic, the rise of fossil fuel prices. With regard to the latter factor, we must remember that fossil fuel is essential for our current mechanized agriculture, and its rise impacts not only the costs of transportation, but also the price of oil’s derivatives such as fertilizers.

In the light of this outlook one can notice the main challenges posed by the current rise of oil and food prices. In a global context of speculation and penury, the tendency is set that the current evolution of price will be structural. Therefore which coherent and general policy one government should adopt: prioritize energy-security (and then avoid widening national budget deficits for oil importers) or food-security (knowing that the duty of every State is to feed its population)? What is the real extent of land diversion taking place in India and Brazil? Is this putting at risk food security in these countries? If it is the case, this will indicate a major failure in the social sustainability of biofuel production in these countries. Therefore, what is the governmental stance in the current food crisis debate?

The recent surge of oil prices coupled with the rise of staple food have represented a dilemma for the Indian government. As we mentioned above, Indian authorities have been investing massively in biodiesels (and especially in jatropha’s potential) since the early 2000s with the aim of making India less dependent on oil-imports and also as a strategy to address climate change. Up to now, a lot of effort, money and time have been spent on the drafting

⁷⁹ <http://www.planetark.com/dailynewsstory.cfm?newsid=48661&newsdate=06-Jun-2008> (Visited 08/01/2008)

⁸⁰ “Ele é o falso vilão”, *Veja Magazine*, 27 April 2008

⁸¹ UNCTAD (2008), *Addressing the Global Food Crisis*

and the implementation of the National Jatropha Mission. Today, the ministry of rural development estimates that there are already between 500,000 to 600,000 ha of jatropha growing across India, and in 2004 the government estimated that Jatropha could be planted in 13 Mio ha of land in the near future. A lot of money has also been spent: in 2003, the government estimated that the total National Mission on Jatropha Biodiesel (2003-2012) would cost Rs. 1,500 core (around 300 Mio euros). Additionally, States are also helping farmers through financial support (e.g. utilization of centrally-sponsored schemes) and technical assistance.

But recent controversy on food security was a bolt from the blue, in that it reinforced growing doubts about the very choice it made in favour of jatropha as India's main source of biodiesel. As we will highlight in our second chapter, a series of dissonances and disaccords between different stakeholders (especially between scientists and politicians, and among politicians themselves) have tarnished the ambitious plan announced with particular solemnity in 2003. Many doubts appeared with the increasing realization that the hopes placed on Jatropha benefits (yields, drought-resistance quality) were partly short-lived. The whole philosophy that underpinned India's choice to process oil from jatropha was conceived with the aim of avoiding any sort of competition between biofuel and foodstuff, in a country that is barely self-sufficient in food production and where the number of the undernourished is considerably high (77 percent of the Indian population survive on Rs. 20/- (half a US dollar) a day)⁸². Thus, one of the first goals of the government was to make sure that biodiesel would not be produced from edible oils, which are today the main feedstocks for many biodiesel programs in the world (though animal fat could also be used)⁸³. In India such a project would be hardly feasible, given that the demand for edible oil exceeds the domestic supply. Therefore, based on (what the Indian government called) "extensive research" carried out by national and international agricultural R&D centres, it was decided to use jatropha oilseeds (producing a non-edible oil) as the major feedstock for India's biodiesel programme. More interestingly, a biological feature of this originally Central American plant showed that, being a hardy plant, jatropha could have appraisable yields in wastelands – which means that it might avoid encroachments on arable lands.

⁸² Arjun Sengupta's (National Commission for Enterprises in the Unorganised Sector) Report said that 77 percent of the Indian population or 836 million people survive on a per capita daily consumption of up to Rs. 20 (in 2004-05). http://nceus.gov.in/Condition_of_workers_sep_2007.pdf

⁸³ Rapeseed oil has today around 80% of the share of the world's biodiesel feedstock, followed by sunflower oil (10%), soybean (5 %) and palm oil (3 %). The choice of feed is country specific and depends on availability. The US uses soybean, Europe rapeseed and sunflower, Canada canola, Japan animal fat and Malaysia palm oil.

But little by little, scientists, politicians and farmers, actually slowly came to realize that *Jatropha* is a very input responding crop and has much higher yields in arable lands with good rain conditions or irrigation than in wastelands⁸⁴. The idea that *jatropha* would be grown exclusively on wasteland turned out to be an illusion. As yields in wastelands turned out to be mediocre, dissonances and cacophony between different ministries appeared, and to make the plan financially sustainable, cases of diversion of land at the benefit of *jatropha* monoculture started to be reported. As the analysis on our next pages will point out, this diversion of land was principally undertaken by private landlords and companies, since, as time went by, other actors such as States, companies, private-farmers also caught the bandwagon of biodiesel, seeing it as a new business opportunity.

When the controversy over food crisis broke out in April 2008, India could not avoid admitting that a dangerous tendency of competition between food and fuel was gradually taking shape. Our field study (see appendix, Document 3) showed that so far, most small farmers have not used fertile lands to *jatropha* plantation and are not replacing their food crops that still fetch much higher prices on the market. But some big farmers are already speculating on future possibilities of returns and betting on future profitability of *jatropha* biodiesel. When the international community started to discuss about competing biofuels and food productions, the Indian government proved to be incredibly silent. Not surprisingly it asserted that people's need should prevail over agrifuels, something that any government would deny at this critical moment. But India's internal situation was that grassroots and advocacy organizations (such as the National Forum for Forest People and Forest Workers, Delhi Science Forum or Focus on the Global South India) were increasingly demanding a greater accountability for government's policy on this subject, whereas the government simply turned a deaf ear to their request. As D.Raghunandan, from Delhi Science Forum, points out, concerns on surge of oil prices were unquestionably prevailing and at the same time that the Indian government was participating on UN Conferences on world food crisis, it did not amend its plan: "Current policy of the Government is to go ahead with *jatropha* plantation: they have over 10,000 hectares under plantation in different parts of the country including under corporate lease of lands in Tamil Nadu/Andhra Pradesh and otherwise even in fertile North-east. They claim, this is not taking away cultivable land but it does. What is beginning to happen is that economic viability issues are beginning to hit the programme both

⁸⁴ Under appropriate irrigation, *Jatropha* can be harvested three times a year and its seed production can reach 12.5 t/ha/year, after five years of growth (see Table 3 in appendix, for an overall idea about yield estimates according to the quality of the land used).

for farmers and for bio-diesel manufacturers”. Souparna Lahiri, from National Forum for Forest People and Forest Workers also pointed out something that many ignored so far: forests are now bearing a tremendous pressure to bear the brunt of jatropha planting – “because there is a mindset in the government machinery that say that large areas within forests are wastelands. Other than dense forests, including the degraded ones, pasture and grazing lands, and under-stocked forest land could be used for jatropha plantation, *thereby avoiding large tracts of cultivable agricultural land*”. This statement clearly meant to highlight that jatropha is not only putting in danger food security, but also forest people livelihood, whose pasture, grazing lands, village commons are being threatened to fall under possession of “big jatropha lords”.

Interestingly in May/June of this year, the media and politicians suddenly stopped talking about food crisis (whereas inflation in India has been rising dramatically) and turned their attention to what appeared to be an inevitable surge of oil prices, which were breaking record over record, to hit 147 dollars a barrel on July 11th. At the same period, newspapers and newsmagazines started to publish on their pages special reports on alternatives available today to replace India’s dependence on fossil fuels. And interestingly Jatropha re-started to be regarded as the wonder plant that could save India from a major national budget deficit : it was what we could notice on India’s newsmagazine *The Week* (June 15th), which reflected recent concerns on oil price through the eye-catching title ‘*Simple steps to a Green Life*’. In its special report, the magazine cites Jatropha as the ‘N° 1 seed’, and highlights that ‘Jatropha-refined fuel is significantly cheaper than crude oil, at an estimated \$ 43 a barrel, nearly one-third of crude oil price’. As we can see, in India the die is still not cast, and priorities can change very fast in the political arena.

The case of Brazil’s national program on bioethanol deserves to be analysed here under a different angle of approach. Brazil is today the second largest producer of biofuel and accounts today for 34% of world’s production; moreover, being a country that has invested on this technology for 30 years and has today a clear technology advance in this field, Brazil became the principal advocate of the benefits (environmental, social and economic) that biofuels could bring to developing countries. By adopting this particular pro-biofuel stance, has it been sincere or guided by pure economic interest? In the light of what we have already mentioned about the enhancement of South-South cooperation through commercial

partnerships and transfers of technology in the bioethanol field⁸⁵, there is no denying that Brazil tried to help other countries to develop national biofuel capacity. But, simultaneously, and more importantly, Brazil has been trying to take advantage of growing international interest in bioethanol and has multiplied bilateral agreements with countries from the four corners of the world (the US, Sweden, India, Japan or South Africa, to mention representative countries from different continents that have signed strategic agreements with Brazil so far). As a consequence, since the beginning of the 2000s, Brazil is banking on biofuels as a new promising source of revenue: a compelling proof is that the country's exports of Biofuels experienced an unprecedented surge since a couple of years: according to the UN (2007), during the first 6 months of 2007 ethanol exports shot up by 70% (and is growing with Brazil's objective to double its production by 2015), which explains that Brazil accounts today for 50% of global ethanol exports. Therefore, as a major actor in the world's ethanol production, Brazil could not confine itself to an evasive stance on this subject as India. One of the main concerns of the country was to provide proof that there were no grounds for doubts on a contradiction between food and agrifuel production.

But before further analysing Brazil's stance on this debate, we should wonder if the authorities of the fifth largest country in the world have been paying seriously attention to the social impacts of its new bioethanol policy. By analysing social sustainability from a food security angle, we will wonder to what extent arable lands have been directly – or indirectly – redirected to sugarcane production and affected food supply.

To understand the current national trend on land occupation, the best thing will be to rapidly analyse the degree to which, still during the Proálcool period, the expansion of sugarcane monocultures put in danger foodstuff production. In our view, what is happening now is mainly the continuation of the logic of the early years of the Proálcool plan. Today it is proved that, even though Proálcool had the positive social aspect of increasing national rate of employment, it also created landless people. According to Smeets et al. (2006) out of the 25,500 new net jobs created during Proálcool's first five years, 15,000 posts were suppressed. This figure mainly represented the amount of people directly affected by displacements of crops and pastures: according to Smeets et al., about 376.000 ha (or about 25% of the total

⁸⁵ Brazil is offering its expertise to nations in the Caribbean and African countries. Most agreements signed so far involve transfer of Brazil's ethanol production technology. In a recent agreement signed with Benin, for instance, Brazil commits itself to use its expertise to help develop production capacity. Such agreements have been seen as a good deal for both sides, since on the one hand African countries reduce their dependence on oil and, on the other hand, Brazil exports its technology. See our analysis on Brazil's ethanol diplomacy and also the weblink: http://www.cfr.org/publication/13721/brazils_ethanol_diplomacy.html?breadcrumb=%2Fregion%2F245%2Fbrazil

sugar cane area) in the state of São Paulo was converted by displacing crops (36%) and pastures (64%). This reality highlights that there was real competition between land for food and land for fuels. Critics of Proálcool argue that this was due to the inability of Brazil's agriculture to incorporate large amounts of arable lands still available in order to meet new priorities and needs of agriculture production⁸⁶. In other words, as sugarcane is a very demanding plant⁸⁷ in terms of irrigation and quality of soils (which distinguish this plant from *jatropha*), the project of expansion promoted by Proálcool led to the substitution of subsistence crops (that many times were focused on the national market) to sugarcane monocultures. In other words, the creation of Proálcool, and of new federal incentives to sugarcane production, prompted big land owners not only to replace their food crops at the profit of sugarcane monocultures, but also increased the level of concentration of land and the power of *latifundiários* at the expense of small farmers. This liberal logic, consisting of cultivating the most profitable crops, has continued over time (and especially during the periods of increase in bioethanol consumption): pasture and other crops that were cultivated in arable lands in the economic heart of Brazil (i.e. in the Centre-South Brazil) have been replaced – mainly because ethanol industries are concentrated in the region of São Paulo⁸⁸. Diversion at the benefit of sugarcane clearly participated to fuel hyperinflation in Brazil during the 1980s.

What about the situation today, in a period when the whole world experience a thirst for bioethanol? Brazil's agriculture is still run by *latifundiários* and sugarcane is still grown on large expanses of land (7.2 million hectares). Moreover, the displacement of pasture and crops at the benefit of sugarcane monoculture is still a reality. In an article for the *Agencia Lationamericana de Información* (2008), Medonça (coordinator of the Network for Social Justice and Human Rights in Brazil) denounces sugarcane plantation owners (and especially multinational enterprises such as Total and Louis Dreyfus) for destroying Brazilian savannah (*Cerrado*) reserves⁸⁹, but also for replacing areas of food production in Centre Brazil. In her field study she reports accounts given by small farmers that are being increasingly surrounded by sugarcane monocultures. Dario Paulineli describes the disastrous impacts of sugarcane in

⁸⁶ <http://www.ichs.ufop.br/conifes/anais/MPC/mpc1004.htm>

⁸⁷ Sugarcane is a water-guzzling crop compared to the majority of other food plants. During a period of 330 days, it needs 700 mm of water. For more details on irrigation requirements of sugarcane, in comparison to other major crops, see appendix (Table 4)

⁸⁸ The Center-South region is dominated by the state of Sao Paulo, which alone accounts for around 60 percent of the country's sugarcane production. This region supplies three-quarters of the country's cane, over 70 percent of the sugar output, and approximately 90 percent of the ethanol (Bolling et al. 2001)

⁸⁹ For more details on the highly pernicious impacts that this progression of sugarcane fields is creating, see Chapter Two.

the State of Minas Gerais : “Sugarcane plantations expanded quickly in the last few years. The company Louis Dreyfus has made many lease-contracts with local farmers, and the environmental impact has been enormous (...) The contracts are for 12 years, and after that the sugarcane has destroyed everything (...) My neighbours have stopped producing corn, beans, coffee, and milk, and leased out their lands. I still plant corn, beans, and produce milk, but for small producers the price did not increase, only for the middleman and for consumers.” Farmer Sebastião Ribeiro has the same opinion. “The company insisted, but I didn’t want to lease out my land. My neighbours who did it ended up getting into depression, because it is the same as if you lose your land. What will happen if all farmers stop planting food crops?” The answer to Ribeiro’s question was partly provided by the Brazilian government last April, when it suspended temporarily Brazil’s rice exports over fear that a supply crunch and rising global prices could threaten food supplies at home. For a major rice consumer in the world, this news simply shows that Brazil’s agriculture is today led by a profit-based logic that turns a blind eye to its underlying role: that of nourishing people.

Rather than assuming that biofuels are competing with food production, the government prefers to stress other (true) arguments: firstly that productivity in the sugarcane sector has been increasing at a vigorous pace, especially due to mechanized harvesting that is revolutionizing production; secondly that land grabbed from expanses devoted to food production is being offset by the utilization of new arable lands. In this respect, Brazil is in a good position to increase sugarcane mono-cropping, given its stunning rates of land-availability: according to Brazil’s influential newsmagazine *Veja* (2008), today the country uses only 20.2% of its arable lands for agriculture purposes. Brazil’s potential for a net increase in agriculture production seems unbeatable – even though it is not certain that the current capitalist-based logic is environmentally sustainable. Today, new lands are being transformed into pasture and crop plantations, given that general demand for agriculture products has been skyrocketing (due to a surge in exports and internal demands thanks to recent improvement of life standards in major Developing Countries). Yet, what is preoccupying in this evolution is that behind the term “arable land” that we have mentioned above, we can also find forest lands, that have been transformed in arable lands thanks to deforestation (for more details, see Chapter Two)

The Brazilian government has been replying to critics that Brazil is concerned about risks on worldwide food security, but that sugarcane in Brazil is not directly putting in danger food supplies for Brazilians. This mindset is for example reflected by the arguments advanced by the Brazilian newsmagazine *Veja* (2008): “the irony in this debate is that the extension of

sugarcane in Brazil even contributes to the rise of food production. This is due to the rotation period needed by sugarcane. Therefore, 15% of sugarcane lands lying fallow can be used for other crops, such as red kidney beans or soybeans". This explains that, according to the former Minister of Agriculture, Roberto Rodrigues, "when sugarcane encroaches on pastures, actually the supply of food increases, and not the other way round. This explains why Brazil has been beating record by record in terms of grain production for the last years. (...) Over the past fifteen years, the area used for grain production grew only 23%, while output rose more than 110%". The Brazilian government has been making the same case for biofuel, by ensuring the international community that sugarcane production today do not put in risk food security in Brazil. It is argued that, on the contrary, never the Brazilian government cared so much about the basic needs of the poor – a compelling example being the creation of efficient social programs under the presidency of Lula, especially "Hunger Zero", a program that have been guaranteeing that the poorer sections of the population eat three square meals a day. Today, the Brazilian authorities stress that, unlike the United States, that is redirecting today 30% of its corn harvested for ethanol production, Brazil is today one of the rare countries that have the potential to keep a steep rise in bioethanol production without making it compete with food crops. Yet, what is difficult to understand in the case of Brazil, is that if 80% of its arable lands are kept intact, why deforestation is going up. This represents the major failure of the Brazilian government today, that (for economic reasons), instead of cracking down on loggers, is growing complacent about deforestation. To be successful, the government would have to provide a major national effort in this field, by especially getting round the table different stakeholders, especially those directly or indirectly involved in deforestation, such as landlords, State governors⁹⁰, and the agribusiness sector. So far, facts show that this has not been the case.

In the international arena, President Lula have been stressed that bioethanol is a major tool for the development of poor countries, especially in Sub-Saharan countries an "historical opportunity that improves the distribution of global wealth by combining energy security with social aspects like the generation of jobs"⁹¹. Therefore, when the food crisis debate broke out, he was the first to rise up against UN assessments – according to which biofuels putted in danger the survivor of millions of people – which were not telling the truth, and highlighted

⁹⁰ Indeed, the governor of the State of Mato Grosso, that was re-elected in 2006, is himself a major landlord in the State and one of the biggerst promoters of deforestation in the country – which according to him, is economically essential for the economic development for the country. Today it is in this State where the rate of logging is the highest in Brazil.

⁹¹ "Lula Calls for Flexibility from Rich Counties", *Ipsnews*, 21 February 2008

that recent documents were produced by a bunch of “Geneva-based technocrats”, that did not take their time to see what was happening in the field. President Lula took his time to differentiate sugarcane bioethanol made in Brazil from that made from corn and commercialized in the US (which was indeed responsible for the rise of staple food, such as the Mexican tortilla for instance)⁹². In his official statements, Lula has been rejecting arguments that biofuels reduce the amount of land available for food production, notes that 1% of land in Brazil is used for sugarcane but also that Brazil has 60 million hectares of unused grasslands that have already been deforested and can be “recuperated” for the cultivation of sugar cane⁹³. For him, the current phenomenon of agflation, is due more to the rise in consumption in China, India and other less populous countries as people’s incomes there increase. In a political exercise that consist of struggling for the credibility of Brazil’s ethanol and of convincing the international community that it is wise to keep importing Brazil’s biofuels (for the set of biological and economic advantages it has), the President has been selecting all data that leads to the same cause it champions⁹⁴.

This overview of Brazilian and Indian cases for biofuels highlighted that today both countries are betting in biofuels essentially for its economic advantages, many times at the expense of social and environment aspects. We have seen that political discourses very often deals only with one aspect of the reality, but overlook other elements that could bring future problems for both countries. Our purpose now is to turn to the concrete analysis of the sustainability of both projects, primarily by wondering to what extent good political management have been essential for the success of demanding and complex national projects, and secondly, by paying attention to main environmental and social aspects that have urgently to be addressed if politicians intend to create responsible and viable alternatives of fuel for the future.

⁹² Cf for instance “Lula muda discurso sobre biocombustíveis e critica etanol americano”, *UOL*, 19 April 2008

⁹³ In a *Washington Post* editorial, President Lula sums up this general stance: “(...) sugar cane (does not) threaten food production. Less than a fifth of the 340 million hectares of arable land in Brazil is used for crops. Only 1 percent, or 3 million hectares, is used to harvest cane for ethanol. By contrast, 200 million hectares are pasture, where the production of cane is beginning to expand.”

⁹⁴ For instance, the International Energy Agency in its recent press release denied to blame biofuels as currently less than 2 percent of global agricultural cropland is used for biofuels production, http://www.iea.org/journalists/arch_pop.asp?MED_ARCH_ID=417

CHAPTER II

The Concrete Viability of the Brazilian and the Indian Biofuel Programs in Question

Sugarcane and jatropha-based biofuels are the result of two ambitious initiatives that took place in two powerful Developing countries with the aim of reducing their respective vulnerability in terms of energy-sufficiency. Our purpose in our First Chapter was to analyse the main motivations that led the political elites of both countries to turn toward the biofuel option. We stressed that Indians and Brazilians opted for investing in biofuel mainly for economic reasons – and pushed into the background many fundamental considerations that, without been correctly addressed, could represent in the future a hindrance to the progress of both projects. Therefore, after analysing motivations in policy-making, now we turn our interest to the aftermath of these political decisions and the way they were managed as time went by.

In other words, our interest in this chapter will be focused on the study of the concrete viability of both projects. The study of the viability of our case studies is essential to better understand if both projects are doomed to success or failure. Our analysis will take into account a long-term perspective, to know if both national strategies can be long-lasting. Brazil's bioethanol program can boast today 33 years of life, which could automatically imply the preconceived idea that Brazil's current successes in this field is the crowning achievement of three decades of arduous and coherent target-based efforts. But, as we have already briefly mentioned, Proálcool's History experienced various ups and downs – to the point that Brazil almost gave up the project in the beginning of the 1990s. Therefore, what allowed Brazil's ethanol program to become a technical, economic and political success and a long-lasting project? Have politicians been paying due attention to the series of problems the project is still generating, and is there any hope for a real leap in quality of biofuel production?

This series of questions will also be applied to our Indian case study, not only because India's National Mission on jatropha is a recent project, and still has a lot to prove of its real sustainability, but also because it has been experiencing many challenges and setbacks that need urgently to be addressed – in the case biofuel promoters want to reap the fruits of their efforts. Contrary to sugarcane bioethanol, even the efficiency of jatropha-based biodiesel is still contested inside India, many researchers argue that several years of intensive research is

still needed to make jatropha-based diesel commercially viable. Would this mean that one of the first big initiatives in the world to use non-edible oil – whose purpose was to avoid direct competition between food and agrifuels – is doomed to failure? First of all, we will argue that political mismanagements have been the main cause of hindrance to this project. But in an effort to anticipate future successes and failures of this national plan, we will proceed to a thorough analysis of advantages and disadvantages (that turned out to be numerous as research progressed) of jatropha properties and the impacts that a large scale production could have on India's agriculture landscape. It appears that this intellectual effort was widely neglected by Indian politicians when they conceived their project. By doing so, we will be in position to see if jatropha can really fit India's needs – and be viable.

By viability we mean the ability of a project to be successful in the long-term. As far as biofuels are concerned, viability obviously implies sustainability, a notion that is at the heart of this paper. As indicated in Introduction, this concept is today analysed at the confluence of three constituent parts: economic, social and environmental. So far, we have mainly stressed the first aspect of this concept; thus in this chapter we will rather concentrate on the two remaining realities of sustainability, that are very often pushed into the background by our politicians. Furthermore, in the framework of this study, we will suggest the adoption of a fourth constituent of sustainability: good political management. Indeed this element was capital for the success of the Brazilian model in the long-term – and it is the lack of it that has very clearly been jeopardizing progress in India's jatropha mission.

Finally, due attention will be paid to structural differences in both countries. As we highlighted in our last sub-section, the problem of food-security have been arisen differently in India and in Brazil, simply because the pattern of land occupation (*latifundia* vs. family-based farms) and the reality of food self-sufficiency – linked to demography and land-availability, but also to prospects of economic growth – are extremely different in both countries. In our view, other variables will also deserve our attention here, such as the level of national appropriation of both projects (which is directly related to the economic period that both projects were conceived, which were favourable or not to the opening of internal market to foreign stakeholders) and the role played by the public and the private sectors.

SECTION I

Management and mismanagements of a (in)coherent political choice

As we can see on appendix's Table 2, Brazil was last year the second producer of ethanol in the world and the largest exporter of this new commodity. On the other hand, if India is among the 5 biggest producers of ethanol in the world, its production of biodiesel is still meagre and far behind that of other countries such as the US, EU, Indonesia – and even Brazil, which produces its biodiesel mainly from soybeans. A first glance on these figures make us automatically wonder why Brazil's bioethanol program took off whereas its Indian biodiesel counterpart makes no headway?

It deserves to be repeated that the purpose of this paper was not guided by figures such as overall production of biofuels. We could have made the choice of analysing India's bioethanol industry, instead of that of jatropha. But our objective here was rather to highlight new trends in the field of biofuels. The Brazilian case of ethanol was interesting to be studied, simply because it is seen today as an example to be followed by other countries, given its increasing sustainability⁹⁵. As to the Indian case, its project on Jatropha interested us because it is a representative example of new – and original – attempts intended to overcome the apparent contradiction between food and biofuel productions, without substantially compromising the agricultural landscape of a country. Because this program has been led by a major country, it could represent in the future a major source of inspiration. Jatropha is already a feedstock that interest many countries in the world – and even Brazil, that in its last biodiesel bill, showed a particular interest in the potentials of jatropha. Therefore, by analysing the Indian project on jatropha biodiesel, our purpose⁹⁶ is not only to be in a position to say if it is worth investing in this crop or not, but also to highlight appropriate policies and good practices that politicians in other countries should adopt, in the light of the Indian experience. Information sharing is indeed a major asset of globalization.

After having analysed on our previous pages the main motivations during decision-making, our purpose in this section is to enter into the details of the implementation phase of both biofuels programs. Thanks to its long experience in biofuel sector, Brazil is viewed today as a country that can provide other Third World countries with a good example of political

⁹⁵ See for instance the latest Gallagher Review of the indirect effects of biofuels production, released in July 2008 and elaborated upon UK Parliament request

⁹⁶ The study of the concrete impacts of jatropha plantation in India consisted of my major assignment at the NGO Focus on the Global South India, which reflects that India's civil society is increasingly concerned about the real impacts that jatropha is creating in India's agriculture landscape.

management in this field – so much so as Brazil is today the second largest producer of biofuels in the world. The analysis of the Brazilian case will show us that this country witnessed during the last three decades a series of successes - but also of setbacks - in terms of public policy management, and it is in position today to offer a series of advice to newcomers. In our second sub-section we will analyse the implementation phase of India's jatropha program. We will highlight that the program faces today a series of mismanagements, which is partly due to incoherencies in the political choice of jatropha, and that are compromising the very viability of the project in the long-term; this assessment will make us wonder if, in the light of the Brazilian "success story", India would have anything to learn from what has happened in the South American country.

The Brazilian ethanol strategy – a product of massive public intervention and of large national consensus on the benefits of the program

Brazil today boasts its ambition of doubling its production into less than a decade, thanks to a high increase in productivity (allowed by new technologies and mechanisation), to an incredible availability of unused arable lands and to a rising demand in national and international markets. Its experience in the field of research and management has also been an asset, and allowed Brazil to enjoy a comparative advantage in the field of ethanol. Therefore, it is no surprising that recent enthusiasm for biofuels is making Brazil serve today as a model for many countries seeking to establish vibrant biofuels industries as a tool for development, energy diversification and emissions reductions. Our purpose in this section is to show what have made the Brazilian case a successful case, and then point out in which aspects newcomers in the field can take advantage of 30 years of successes – by also of mistakes – in terms of political management at the creation of a biofuel sector. As we will see, Brazil's path has not been linear, and the changing global environment requires more than ever foresight and adaptation to new challenges. Understanding the rise, fall, and resurgence of biofuels in Brazil is critical to assessing the country's current competitive position and crafting a strategy for newcomers.

A first element of success of this plan was the capability of main stakeholders to agree on a main feedstock to invest in biofuel production. During the oil crisis in 1973, when Brazil had to find a solution for its dependence on oil, it turned its attention the country's main asset: its high potential in sugarcane production. The warm Brazilian climate, with rainy summers and clear skies in the winter, helps the cane to build a strong fibre structure during its growing phase and then to increase its energy content (through photosynthesis) in the winter.

Furthermore, when the Brazilian government decided to choose sugarcane, it could rely on sound research, that pointed out high yields of the plant, which have to do with sugarcane being one of the few crops (besides sorghum and maize) to exhibit what scientists term 'C-4' photosynthesis — a more efficient solar energy-deploying mechanism for capturing atmospheric carbon dioxide and water, and converting into starch matter or sugar. As Furtado (2007) points out, federal researches on ethanol as a fuel started in Brazil in the 1930s, a period when sugar prices plunged in international markets due to the 1929 crisis. It was at this moment that the populist government of Getúlio Vargas not only directly helped sugarcane producers to diversify their market, but also created the Instituto do Açúcar e do Alcool (IAA) – the Ethanol and Sugar Institute. Since then, studies were carried out on the possible blends between this biofuel and gasoline, but given that the sugar international market experienced until the 1970s a clear progression, the idea of creating an industrial bioethanol sector did not take off.

As we mentioned in our first chapter, the idea of creating a National Plan on Bioethanol appeared in 1975 as a successful strategy to conciliate in only one plan different interests: 1973 was a black year not only for Brazil's balance of trade (hit by the surge of oil prices) but also for the powerful sugar industry that had heavily invested on the expansion of its capacity and were, again, hit by volatile – and increasing distorted – sugar markets. Therefore the context in which Proálcool was created was extremely favourable to its longevity, as it was built on a large national consensus between stakeholders and was based on national research that corroborated the viability of sugarcane as an energy-efficient feedstock for biofuel. Thus, it is worth further analysing how the State, national industries and sugarcane producers coordinated and how a national effort on research and federal incentives was key to make Brazil's bioethanol program a success story.

The 33-year story of relationship between three major stakeholders in the sugarcane sector was far from being totally smooth, as probably many external observers of Proálcool think by hastily attributing to this plan a label of good management. Many times interests entered in clear competition, and could be overcome by a major factor: individual interests (i.e. perspectives of profits for industries and sugarcane producers) coupled with national interest (which is by definition defended by the State). National interest, as defined in our first chapter, was dictated by the chaotic evolution of oil prices; and the volatility of this commodity over time influenced the perpetuation of the program, even at its most critical times (in the 1990s).

There is no denying that the State was the keystone of Proálcool. Created in 1975, this plan was the result of political voluntarism from an authoritarian State that had the power over different sectors of the society and industry. Therefore, attention must be paid on the context in which the program was created: during the military regime, the State controlled main State industries (such as Petrobras), universities (and their department of research), and was able to lay down the law, create new national programs, institutes or programs without much contestation from the civil society. Environmental and social concerns were not an issue in a State that forbade any sort of grassroots organizations and public gathering. This lack of democratic decision explains why the Program took off so fast and why sugarcane crop increased fivefold in only four years (from 664 thousands m³ of cane harvested in 1976/1977, the production reached 3,7 millions m³ in 1980/81) (Furtado, 2007). But though the existence of an authoritarian state contributed to a booming industry, political voluntarism and coherent management were probably the main reasons that explain the success of Proálcool during its first years of existence. Indeed, the Brazilian government understood that to strategize around this new renewable energy, it had to resort to interventionist industry policies to kick-start a new industry based on growing and distilling biofuels. But more than this, such a project called, in parallel, for a sophisticated design of institutional settings that would prompt a rise in demand and supply of ethanol.

To address a serious economic crisis that was looming in 1975, the military regime launched the Proálcool under Decree 76.953, with the goal of fostering a national ethanol production and distribution industry. In November 1975, the government set this priority in the framework of the four-year plan 1975-1979 to help the sugar sector and open to it the perspective of a new outlet for its sugarcane production. The idea was to convert part of the sugar into ethanol in special distilleries close to the sugar mill ("*destilarias anexas*"). Therefore, financial support through low-interest loans was provided to sugarcane companies to help construct distilleries adjacent to existing sugarcane mills. Initiatives along the supply chain were intelligently coupled with interventionist policies on the demand side: the success of the program is also due to the decision of the government to mandate, by a directive, the use of ethanol-petrol blends in motor vehicles: by doing this, the military government required that the country's gasoline was blended with 10% ethanol (E10) – a level that would be raised steadily in the coming years. On the other hand, to facilitate the shift, the government also provided loans to national research, with the clear purpose of triggering synergies in the bioethanol sector – and create a car that would run on pure alcohol (which was achieved at a Brazilian Air Force laboratory in 1979). Therefore Proálcool consisted,

above all, of a massive campaign to promote synergies along the supply chain from sugarcane farmers to ethanol producers and on the end users. Between the ethanol producer and the motorist, Petrobras represented the middle link in the chain. Petrobras, the Brazilian State-owned oil industry that had at this moment a monopoly on gas distribution, was made responsible by the government for distributing the new E10 bioethanol – and, later on, the pure E100. A coherent structure was therefore created, which united different interests under the banner of a national program, creating what today some would call a “win-win” situation that benefited not only Brazil’s current account, but also the agriculture, the industry (which thanks to injections of capital experienced a significant growth) and the research (see our analysis on the national effort on research below).

The second oil crisis, in 1979, exposed Brazil’s continuing vulnerability to international oil chocks and fortified the political will to enhance Proálcool. The National Program moved on to a second phase: noticing the success of the targets set in the first period of Proálcool (the production of ethanol was multiplied by five), the government came up with more ambitious measures when the second oil chock occurred, with the aim of keeping up the momentum that the whole industry was experiencing. The government considered that national production of ethanol was already high enough to mandate a raise of blend targets to 25%. Further subsidies and low-interest loans were made to sugar companies to raise ethanol production. In this second phase, the government set the target of tripling the production of ethanol by 1985. At this time, Petrobras was ordered to make ethanol available at filling stations in the four corners of the country – which demanded a considerable effort for a country that counted numerous gas stations spread out over the whole territory. Guaranteeing the *supply* was crucial for the success of the whole system, since the government also had invested heavily on the *demand side*: it negotiated with car manufacturers to develop 100% ethanol-fuelled vehicles, which was a success thanks to collaboration in R&D between both sides and to tax breaks from the government. Fiat released its first ethanol-only vehicle for sale in Brazil, by end of 1979. The new E100 car became a success because motorists were sure they would find ethanol at their gas stations, but more importantly because the government encouraged car drivers to buy E100-fuelled vehicles through tax breaks and kept E100 ethanol prices low. This second phase of the program was a success and the industry responded: both sorts of ethanol (E100 and anhydrous, that was produced to be blended) increased steadily. Overall ethanol production increased from 500 million litres per year in the late 1970s to 15 billion litres per year in 1987 (de Hollanda, 2000). Incentives provided to the auto industry led to the proliferation of alcohol-fuelled vehicles, which reached 92% of new

car sales between 1983-1988 and comprised more than 50% of the total car fleet by 1992. The target of ethanol production (10 million m³) was reached even before the deadline set by the government (Barbieri, 2005).

To understand this success, attention must be paid to the effort of other stakeholders that contributed to the success of Proálcool. As we have already mentioned, one of the major beneficiaries of this plan was the sugarcane sector, which benefited of subsidies to sugar production and to the construction of distilleries. From the 1970s, this sector underwent a clear structural transformation; sugarcane producers became many times director of mills, and controlled a great extent of the chain of production of ethanol production. This new reality put an end on the long vulnerability of this sector linked to volatile sugarcane international prices. Henceforth, owners of their distilleries, sugarcane producers will be able, at the flick of a switch, to produce sugar or ethanol, depending on world prices of both commodities. Sugarcane producers also actively participated to the success of the program, and many gathered in new cooperatives and adopted a professional management. One cooperative created was COPERSUCAR, that became a major trader and substantially contributed to R&D by opening a research centre – which has helped boost productivity throughout the years⁹⁷.

Probably one of the main assets of the whole Proálcool was its ability to mobilize national research that transformed Brazil in the country that owns today the most advanced research centres on sugarcane. The government financed a vast research network, under the name Planalsucar (the National Program for Sugarcane Enhancement), which operated inside the IAA (the Alcohol and Sugar Institute). This program structured and coordinated Brazilian efforts to develop improved, diversified strains of sugarcane. Over time, in the 1990s, Planalsucar research stations were integrated into the Brazilian federal university system, the backbone of Brazilian academia. This move, in turn, led to the creation of Ridesa, which today is an important driving factor in the genetic enhancement of Brazilian sugarcane. This evolution towards the creation of Ridesa (*Rede Interuniversitária para o Desenvolvimento do Setor Sucroalcooleiro* - Interuniversity Network for the Development of the Sugar and Ethanol Sector) consisted of a move towards integration of research centres from IAA with federal university (Ridesa today comprises seven federally-funded universities).

⁹⁷ We can cite as another example the Brazilian Sugarcane Industry Association (UNICA), which represents the top producers of sugar and ethanol in Brazil's South-Central region, especially the state of São Paulo. According to UNICA's website, the association "develops position papers, statistics and specific research in support of Brazil's sugar, ethanol and bioelectricity sectors."

Therefore, as reminds Duquette, Proálcool represented a triangular relationship made up of three main stakeholders: the State, Brazilian contractors (both agricultural and industrial) and the multinationals producing automobiles⁹⁸. But this triangular relationship was not always harmonious, and in the mid-1980s the exemplary management of Proálcool experienced a major crisis.

The circumstances of the creation of Ridesa reflect a period of incertitude and confusion in the management of Proálcool. Certainly favourable macroeconomic and fiscal policies enabled the rapid expansion of the industry, but a shortcoming of the Program was that it was not able to anticipate possible exogenous shocks. In other words, as strong as the government support to the bioethanol industry could be, it could not completely insulate it from a sudden decrease in oil prices. It was what happened in mid-1980 when declining oil prices considerably eroded the economic case for ethanol. Production costs associated with ethanol rendered the product less competitive and highlighted the exorbitant costs of Proálcool subsidies⁹⁹.

Moreover, this new crisis, highlighted frictions of interest inside the architecture of Proálcool, that so far could be cleverly overcome thanks to expensive oil prices that made the program financially viable. Despite becoming slowly one of the major primary energy sources in Brazil, the sugarcane industry was never fully accepted as an energy source. De Hollanda (2000) suggests this state of affairs is due to “its agricultural roots, and the fact that it was privately owned in a government-controlled energy sector” (p.5). Petrobras for instance did not appreciate the emergence of this new source of energy, and never accepted the sugarcane industry. The state-owned oil monopoly suffered direct competition from this sector, that affected its own structure. For the company, it has always been far more advantageous to sell oil than ethanol. Petrobras always controlled the whole oil chain of production (extraction, refining¹⁰⁰, distribution) and keeps the profit margin stemming from all the links of this long chain of production. Yet, for the case of ethanol, the company is only in charge of its

⁹⁸ Which, as we pointed out in our first chapter, had their own interest to participate to the plan – by ensuring the supply of new pure ethanol-fuelled cars to Brazilian car-drivers? Auto multinationals clearly benefited from government subsidies but also wanted to win the trust of the Brazilian government and convince it to keep this promising country close to other international competitors (particularly the Japanese). This also helps to explain the “adoptive nationalism” manifested by multinationals, which is rarely found in Third world countries. This also explains their solidarity when the programme entered into difficulty.

⁹⁹ Yet, researchers such as Methew (2007) reminds that all told Brazil “spent a total of \$16 billion from 1979 until the mid-1990 on the Proálcool program – with savings in oil imports amounting to at least US\$ 120 billion”

¹⁰⁰ Petrobras refines today 99% of Brazil’s oil. Refining is therefore the sector of the chain of production where the company has its largest margins of profit

distribution: it buys the product from sugarcane distilleries and retails it to car drivers (*Folha*, 25 April 2008)¹⁰¹. De Hollanda reports that Petrobras even built MTBE plants, “which is being abandoned throughout the world for environmental reasons, although its sale was formally forbidden in Brazil and anhydrous alcohol was cheaper than this additive” (p.5). Another example of lack of coordination between different actors was the underused power generation capability of bagasse. At the time when Proálcool was launched, this option was discarded because Brazil had then a large hydroelectric program, which was owned by the state-owned power monopoly Eletrobras. The latter did not consider this resource, even though, in many regions, the harvesting of sugarcane coincides with the dry season. This clear lack of coordination of interest is partly due to the fact that Proálcool was under the responsibility of the Ministry of Agriculture, as the government considered the plan almost exclusively through its agricultural characteristics – without reflecting about synergizing the project with other ministries, such as that of Mines and Electricity.

When oil prices levelled off in the mid-1980s, the government clearly showed that it was not prepared to handle this new situation. What is more, Brazil was at the same time facing a change of regime, and many political changes towards democracy modified the approach with which politicians regarded the plan. Interpreted as a plan defending national sovereignty under the military regime, Proálcool was regarded afterwards as a costly program and a source of additional costs – especially in a moment where Brazil was experiencing a difficult economic context, as Latin America as a whole was facing the aftermath of the debt crisis. Therefore, Brazil’s economic priority shifted to combating inflation, leading the government to overvalue the country’s currency – which would inadvertently further damage ethanol’s competitiveness. Oil prices declined sharply and the price of ethanol followed the same trend, as its price was indexed to the price of gasoline. At this critical moment where the ethanol industry needed the most governmental support to keep the progression of production (as consumption of ethanol was in a rise due to the success of E100 ethanol-fuelled cars), the government decreased its subsidies – which resulted, as a consequence, in a decrease of ethanol production. In 1989, in a moment when almost half of Brazilian fleet was run on ethanol, domestic ethanol was not able to satisfy the demand, making ethanol imports necessary. 1989 marked the beginning of a downward trend: ethanol shortages in gas stations sapped the credibility of ethanol. At the eve of Gulf War, Proálcool was about to be

¹⁰¹ We can also read in this article that the recent rise in international oil prices is preoccupying Petrobras. Indeed, because the company is today bounded to reflect international prices in the national market, drivers are increasingly opting to put bioethanol on their flex-fuel cars. Therefore the company is more and more reluctant to pass on the rise of international oil prices to the customer.

terminated, but because this new war had a slight impact on oil prices, the government preferred to maintain the program. But at this moment ethanol's credibility was damaged and consumers lost confidence. Sales of hydrated ethanol (E100) began a steady decline, reaching 5.1 million m³ in 2000, from a peak of 10 m³ in 1992.

Proálcool was never formally terminated, but the program suffered from the increasing liberalization of the economy. When President Fernando Henrique Cardoso acceded to Presidency in 1994, the country experienced a clear shift towards neo-liberalism. Inflation became government's enemy number one; the Brazilian currency was artificially pegged to Dollar – which had a direct impact on Brazil's exports whereas the national market was flooded of imported products. Priority was given to the transparency of prices, which entailed the reduction of subsidies to different sectors; Petrobras was partly privatized. Therefore the logic that underpinned Proálcool changed substantially: from 1998, subsidies were gradually extinguished and ethanol prices were set to fluctuate and follow market rules.

When we look retrospectively the History of Proálcool, it is difficult to judge if this neo-liberal phase that experienced the project was necessarily bad for the program. Many authors and especially the Brazilian government think that the policy applied to bioethanol in the 1990s was beneficial for the competitiveness of the biofuel– but they set up this hypothesis because they know that from 2002, the biofuel program started booming again. Yet, the reality is that this second life given to bioethanol was totally unexpected, and was mainly a result of an exogenous cause, the rise of international oil prices. There is no denying that, given the notoriety the ethanol industry obtained worldwide – to the extent that it became a strategic sector – we can today analyse the development of Brazil's ethanol industry as a global leader that went through the two phases of development that Friedrich List theorised in his analysis on the economic development of a national industry. According to this German economist, the economic task of the State is to promote through legislative and administrative actions the conditions required for the development of national industries. In a second period, when a national industry has grown strong enough, then free trade should become a rule. Of course this comparison with List's theory is flawed in that Brazil's ethanol industry did not face any competition with foreign industries in its inception. Brazil simply pioneered in the ethanol sector – as England did in the field of textile industry or steam powered machines in the First Industrial Revolution – and then moved on to free trade, enjoying considerable comparative advantage in this field. But the mode of development of Brazil's ethanol industry clearly experienced the two phases theorized by List, a first one characterized by political voluntarism (during which protectionism applied to allow home industries to develop)

followed by a liberal stage, when the industry becomes strong enough to compete in the international arena. Until 2002 this competitiveness applied to the national scale (as the purpose of Proálcool was that ethanol becomes competitive compared to gasoline). It is important noting that ethanol cost of production decreased substantially in the 1990s to the extent that today Brazilian ethanol is competitive with international oil prices at US\$ 29, according to the OECD. Moreover, the main objectives of Proálcool in the 1990s were achieved, since over US\$ 20 billion in oil imports, per year, were avoided during this decade, and in the beginning of 2000 the retail price of ethanol reached a point where it became competitive with gasoline (de Hollanda, 2000). Thus, when bioethanol became an option to other nations, from 2002 on, the Brazilian ethanol industry, already competitive on the Brazilian national market, could enjoy a clear international comparative advantage.

Although, over this overlook on Proálcool, we perceived a series of political mismanagements, especially in the 1990s, there are many aspects of this program that deserve attention from other nations that are starting their biofuels programs – such as India. First of all it is critical to stress the importance of political voluntarism in the early stages of the development of any biofuel industry. Public interventionism at the creation of this new sector, through tax breaks, or public loans was crucial for the success of Proálcool. Measures on the demand side of ethanol (mandated petrol blends, investment on ethanol-fuelled cars) was also fundamental to create a sustainable balance between supply and demand. Many could assert that the costs of public investments might amount to many billions of dollars and such costs could not be affordable to developing countries, that could not spend US\$ 16 billion as Brazil has spent during the most interventionist period of Proálcool. But nations have to put this amount into perspective. According to the OECD (2007), Brazil has estimated the savings on its fuel import bills since the launch of the Proálcool program to be of the order of \$50 billion per year – which is far larger an amount than what the country has spent in promoting ethanol. With the recent escalation of oil prices, this could be a compelling argument, so much so as many analysts argue that the rise of oil prices is not temporary, but structural. This argument applies especially to India: as we can see on appendix (Figure 10), imports are expected to exceed 75% of the country's requirements by 2010 if the country continues to grow at 9% per annum.

We will not deny that many factors, particular to Brazil, and the context in which Proálcool was created smoothed the progress of the whole program – and these variables are far from coinciding with the reality of other countries today. For instance, no-one will deny

that authoritarianism from the military regime was capital for the success of the program, in that it accelerated the process of decision-making and the implementation stage of the project¹⁰². Furthermore, Brazil's pattern of land occupation, characterised by its *latifúndios*, reduced dramatically the number of representatives of the agricultural sector to negotiate with, which facilitated the success of Proálcool – all the more so as the program was in the line with their interests. Moreover, today, the context of globalization that our world faces reduced country's room for manoeuvre in the field of protectionism and subsidies. More importantly, international investors that sprung up during recent years, such as oil multinationals in the field of biofuels, could undermine national interests when they volunteer today to be a major stakeholder in biofuel production – and very few multinationals would accept any form of “adoptive nationalism” (Duquette) that automobile multinationals expressed to Brazil. In other words, Brazil is a major and relatively rich Developing Country, that interests investors mainly because it has 190 million potential consumers¹⁰³; and it is a country with large amounts of fertile lands still available and sugarcane prone. Therefore, in the light of all this concrete facts how could other developing countries successfully import Brazil's model? Would it be worth it at all?

Overlooking possible social and environmental problems that a biofuel program can cause, and focusing our analysis on a simple management perspective, we can say today that many developing countries¹⁰⁴ can turn to the biofuel option without having to go through all the painful episodes of Brazil's Proálcool History. As newcomers, these countries can learn the successes and the failures of the Brazilian example, and especially take advantage of the latest advances in technology and management. With regard to management, the Brazilian case shows that to strategize around this new source of fuel calls, on the one hand, for interventionist industry policies to kick-start a new industry (especially those based on growing and distilling biofuels), and on the other, for sophisticated design of the institutional settings. Proálcool measures showed that a transition to utilization of biofuel energy may be effective through especially two measures: mandating provision of ethanol-petrol blends

¹⁰² But another powerful argument is that democratic regimes are able today to create more sustainable programs, simply because the decision of creating a new biofuel industry will be the result of a broad consultation of the whole civil society – and will not contradict the interests of important stakeholders.

¹⁰³ The potential of Brazil's ethanol industry is increasingly interesting international investors that consider it a credible project to invest in today. In the last two years British Petroleum invested \$ 1 billion in a joint venture with a local mill, Santelisa. Goldman Sachs, the US investment bank, has recently bought a 16% stake in Santelisa.

¹⁰⁴ The opportunity of starting a biofuel program arises more clearly as an option for Developing countries than for Industrialized countries, given that, for the latter, biofuels would be an expensive option because of already intensive land use and need for further fertilizers for fuel crops. Developing countries have much larger land resources to devote to raising energy crops.

(starting with E10 and moving to E25) within a few years; mandating supply of flex-fuel vehicles¹⁰⁵ (directed at the automotive industry).

It is on this regard that countries – especially tropical developing countries – can utilize their competitive advantage as newcomers, and benefit from the latest advances in technology that represented the creation in 2003 of the first flex-fuel vehicle – built for the first time by Volkswagen (the Gol 1.6 Total Flex). Given the success of this new car, by 2005, all popular automakers that sell cars in Brazil (Chevrolet, Fiat, Ford, Peugeot, Renault, Volkswagen, Honda, Mitsubishi, Toyota, Citroen) (*Fortune*, 01/24/2006) were already building flex-fuel vehicles. This simply means that technology is today available in the market – and that if governments put pressure on automakers to collaborate with a national biofuel effort, it will not demand, *de facto*, a huge effort for automobile multinationals.

Without highlighting the commercial success of flexible fuel cars since their inception in 2003, we cannot understand recent bioethanol's rebirth in Brazil. The progression was simply dazzling: sales of flex represented 15.2% of the car sales in 2004, and in the first months of this year they already corresponded to almost 90% (*Folha de S.Paulo*, 07/31/2008). This incredible evolution, coupled with the steep rise in oil prices at gas stations, explain that today, drivers consume more bioethanol than petrol: according to Brazil's Oil National Agency (*Agência Nacional do Petróleo*), in the first two months of 2008 1,432 billion litres of ethanol were sold in the market, more than gasoline consumption (1,411 billion litres.)¹⁰⁶(*Folha de S. Paulo*, 04-25-08). In other words, countries that aspire to build a new biofuel industry, should pay particular attention to recent trends in Brazil's market and understand that the recent leap ahead of biofuel in Brazil was principally due to the twin impact of flex-fuel vehicles and the mandated provision by fuel companies of ethanol blends (from E25 to E85) all across the country. This recent evolution show that if it is true that politicians must set up important supply-side policies to kick start new biofuel industries, they have also to understand that the key to getting these new industries off the ground is to influence demand coming from the auto industry and from the motoring public for such ethanol blends.

After an overview of the evolution and the mode of management of the Brazilian sugarcane industry, we will be able to compare this “success story” with our second case study, the jatropha biofuel industry created in India. We will notice that the National Mission on Jatropha followed some management policies that had been set up by Proálcool. But more

¹⁰⁵ Dual-fuel (Flex-Fuel™) of full flex-fuel vehicles are cars that run on any proportion of ethanol and gasoline

¹⁰⁶ Bioethanol consumption grew by 56% during this period, whereas gasoline consumption stagnated at +2,9%

importantly, this example will also show us some inevitable challenges that Third world countries have been facing in their effort to create new alternatives to fossil fuels.

The Indian National Mission on jatropha – a series of mismanagements due to conflicts between stakeholders and increasing doubts about the viability of the feedstock chosen

To address the problem of rising oil-prices that was threatening the entire Indian economy, the government set up an ambitious National Biodiesel Mission that plans to meet 20 per cent of the country's diesel requirements by 2011-2012. The government decided to put at the centre of this project the biodiesel extracted from *Jatropha Curcas* oilseeds - as researches at that time had shown that *Jatropha Curcas* offered many advantages (see our chapter one). But very soon criticism on the choice of *jatropha* as feedstock appeared: a series of concerns sprung up with the increasing utilization of cultivable land to the plantation of *Jatropha* and with the increasing realization that the hopes placed on *Jatropha* benefits (yields, drought-resistance quality) were partly short-lived. Nevertheless the national policy on *Jatropha* has not changed fundamentally. On the contrary, as time went by, other actors such as States, companies, private-farmers also caught the bandwagon of biofuels, seeing it as a new business opportunity. Indeed in 2003 a dynamic was created, money stemming from the government or from the private sector has been invested on the cultivation of *Jatropha* and on the creation of transesterification plants. Numerous Public Private Partnerships have been established and some States have shown interest on *Jatropha* potential and massively invested on its cultivation. Therefore, as this biodiesel dynamic kicked off, we can wonder to what extent different stakeholders would be inclined to abandon a project on which they have put so much hope – and money.

But since the creation of the project, contestation appeared from scientists, (asserting that *Jatropha*'s yields were not good enough for wastelands) and from members of civil society that protested against increasing land dispossessions. Moreover, India's *jatropha* project suffered from a series of malfunctioning over time. Our purpose here is to highlight these mismanagements of the initial national plan – and therefore to point out the series of complexities that revolve around the implementation of a national plan that: 1) is not based on a large consensus (which means that in a democratic society, a broad consultation with members of civil society is requested), 2) involves a complex administration where interests can vary), 3) and take place in a context of globalization (in which private investors, which have their particular interests, become key stakeholders).

An overview of the National Mission on Biofuel shows that it followed Proálcool's philosophy. Firstly, the implementation of the National Mission evolved into two progressive phases. Basically, phase one would consist of a demonstration period over the period 2003-2007 aimed at cultivating 400,000 hectares of *Jatropha* to yield about 3,75 tons of oilseed per hectare annually. The mission estimated a government contribution of Rs 13,840 millions in loans and incentives. The government was also expected to build a transesterification plant. During this period, it was to be shown "the viability of other aspects like seed collection and oil extraction" (Planning Commission, 2003). Phase Two, ranging from 2007 to 2012, would consist of a period of "self-sustaining expansion of the project and of commercialization", where *Jatropha* cultivation and installation of transesterification plants would continue and allow India to meet 20 per cent of its diesel needs through biodiesel. Secondly, in the framework of this plan, the government clearly intended to deal simultaneously with the demand and the supply side of production and consumption of *jatropha*. As far as *demand-side policies* were concerned, the Ministry of Petroleum and Natural Gas asked, on the one hand, oil marketing companies to purchase biodiesel at a price of Rs. 2/ litre at purchase centres located in 12 States, and on the other hand oil companies to blend conventional diesel with biodiesel at a maximum of 5%¹⁰⁷. As to biodiesel purchase price, it was revised to Rs. 26.5/ litre, which is still seen by private sector actors as too low to encourage investments. As to *supply-side policies*, biodiesel has been fully exempted from excise duty, which is estimated to reduce the price for biodiesel at about Rs. 4/litre. Moreover, in the field of research it was created in 2004 the 'National Network on *Jatropha* and *Karanja*' a group promoted by the National Oilseeds and Vegetable Oils Development Board (NOVOD)¹⁰⁸. In order to support the production of biodiesel, NOVOD was set to provide subsidies for activities such as nursery raising, establishment of procurement centres, establishment of pre-processing and processing equipments. Loans from the National Bank for Agriculture and Rural Development (NABARD) were also granted to farmers. Moreover, a large number of centrally-sponsored schemes are been used for biodiesel plantation, with the National Rural Employment Guarantee Scheme (NREGS) being the most important one¹⁰⁹. But given the

¹⁰⁷ But, so far, there is no commercialization of biodiesel in India as large quantities of seeds and biodiesel are not yet available.

¹⁰⁸ According to NOVOD, this network is involved in fields of research such as identification of planting material suited to various agro-climatic conditions of the country or techniques for mass multiplication of quality planting material.

¹⁰⁹ In their survey on four states, Altenburg and al., found out that other centrally-sponsored schemes are being used to biofuels plantations. They cite the National Afforestation Programme, the Watershed Development Programme, the Village Energy Security Programme or the Swarnajayanti Gram Swarozgar Yojana.

uncertainties around *Jatropha* plantation, one can wonder if by diverting national schemes funds, States are contributing to the interest of all.

Controversy around the plan stemmed from clear doubts about the biological features of *jatropha*, which, according to the government, were extremely favourable to India's condition. In its 2003 report, the Planning Commission (cf. appendix, document 2) reported that the commission relied on "extensive research" on the plant, from which it could draw the conclusion that not only that *jatropha* "can be grown in areas of low rainfall (200 mm per year), on low fertility, marginal, degraded, fallow and waste lands" but also that "oil yield per hectare for *Jatropha* is among the highest for tree-borne oil seeds. The seed production ranges from about 0.4 tons per hectare per year to over 12 t/ha. There are reports of oil yields as high as 50 per cent from the seed." These findings were judged totally biased and unrealistic by scientist¹¹⁰, which found out that this ambitious national plan was set up prematurely. The very text of the Planning Commission, quoted above, shows incertitude about research, as information about *Jatropha* yields was said to be expected to range from 0.4 to 12 tones/ha. This vagueness is due to a clear lack of concrete findings on the properties of *Jatropha*: results on the agro-climatic and soil conditions, inputs and maintenance of *Jatropha* plantations were missing, which are findings that are crucial for getting economically viable yields from the crop. Moreover, no clear research was made on the environmental and social impacts of *Jatropha* plantations. Some studies had already been conducted in other countries (Heller, 1996; Jones and Miller, 1993), but they all highlighted that the effectiveness of the cultivation of *Jatropha* could vary in function of a range of factors such as water, soil conditions, altitude, sun and temperature. Very likely, overoptimistic figures stemming from different studies from scientists or private companies (D1 Oils, British Petroleum) made the crop attractive for countries looking for original strategies in the field of energy supply. As we pointed out in our first chapter, a series of attractive figures on *Jatropha* – that were showing clear advantages in terms of energy-security and creation of new trade opportunities – can probably explain the rushed choice made by the Indian government to choose this plant.

Beside the lack of clear findings on the properties of *Jatropha*, politicians did not resort to broad consultations with members of civil society, especially those that were directly affected by the project (as farmers and indigenous people)¹¹¹. This absence of broad consultations, in a democratic society, caused harm to the viability of the mission on *jatropha*,

¹¹⁰ Such as those that I interviewed, that came especially from Delhi Science Forum or Tata Institute of Social Science

¹¹¹ See our analysis on the direct impacts of *jatropha* on farmers and indigenous people livelihoods in our next section.

as resistance would soon appear from the scientific and peasant levels. Additionally, not only the project lacked of external support, but its coherence from the inside was not clear: no real coordination between ministries and government officials was really planned, which, at least in terms of image – not to mention of functioning, – would be crucial to make the plan look consistent to the eyes of the public opinion and especially to farmers. Moreover, as time went by and initial hopes on jatropha started to be contested in the field, the project seemed to become a political hot potato – to the extent that it is difficult to know what clearly happened to the National Mission after February 2005. As Altenburg et al. (2008) point out, the leading role for the Mission was transferred from the Ministry of Rural Development to the Ministry for New and Renewable Resources, and the discussion on the topic was to be held by a Group of Ministers, headed by the Ministry of Agriculture. For months, the meetings on the topic have been postponed. According to the authors, the reasons for this attitude were twofold: “the stalemate was less due to controversies about the content of the policy, but rather a) about which ministry will be assigned which role in it and b) whether it would be premature to release a policy before reliable research findings are available” (p.8). This ambiguity on the national government policy on biofuels led to confusion among ministries, responsible agencies and actors involved in the biodiesel sector. As Sandeep Chaturvedi, head of the Biodiesel Association of India puts it, “By not agreeing to a subsidy or on a policy, the government has dealt a blow to biodiesel (...) the basic reason behind the delay in the biodiesel policy is subsidy. Some ministries favour subsidy for the sector as it is in nascent stage, while the Finance Ministry seems to be opposed to the idea” (Mahabir, 2008). It goes without saying that if the Indian government is targeting at a success of its jatropha mission, it will have to give clear signals to farmers and private investors about its commitment to the coherence of the plan. First of all, stakeholders need reliable research and results on the economic viability (especially in terms of yields) of the plant that was chosen as the flagship in the national biodiesel production. Yet, in this field, some experts say jatropha is several years of intensive research away from being a commercially viable biofuel (Ron Mahabir, 2008). On the other hand, if the government wants the plan to take-off, it will have to proceed to interventionist industry policies as Brazil did in the framework of Proálcool. Today, the federal government heavily subsidizes India’s retailed oil¹¹², which jeopardizes the competitiveness of biofuels. Entrepreneurs in the biodiesel sector state that currently biodiesel

¹¹² In the first semester of this year, India spent an incredible 37 billion euros in subsidies (3% of India’s GDP) (Le Monde, 06/08/2008).

production is only viable at a price of Rs. 45-50/litre¹¹³ (today the government oblige Indian oil companies to buy biodiesel at a price of Rs. 26.5/litre, which is half of the economic viable price).

In spite of the existence of a national-sponsored policy, the National Mission on Jatropha Biodiesel remains incoherent (*find in our appendix, document 4, a full analysis on biofuel policies adopted at the State-level*) In the absence of comprehensive national biodiesel policy, several States of the Indian Federation have taken steps forward its promotion, by trying to adopt their own Biodiesel program. The existence of a two-tier program took away all clarity of a program that since the beginning was lacking of coherence. Furthermore, private investors (including international companies) put themselves into the cultivation of jatropha, which, consequently, blurred all visibility of overall interests behind the production of Jatropha. This multiplication of stakeholders, which is a new characteristic of globalization, shows how it became difficult today to manage a national plan in a democratic society and conciliate different points of views from different stakeholders. The Indian case also suggests that coherence of interests in a federal administration should not be taken for granted, and divergences of interests between different State-levels can represent a major hindrance to the success of a national public policy.

In the absence of a coherent national policy on Jatropha, many States in India have decided to adopt their own Biodiesel policy. Five states have jumped onto the jatropha train: Uttarakhand, Chhattisgarh, Andha Pradesh, Tamil Nadu, Karnataka, Maharashtra and Maharashtra. Each State has adopted their specific plan, according to their particular conditions, which include the availability and ownership of uncultivated land (government, private land or collective lands), social structure, the involved actors (creation of government agencies on biofuels, private farmers, corporations, local communities) and the ambition of each government to promote the cultivation of this new biofuel plant (which is reflected by the targets set up).

To stimulate production and attract investors, States have resorted to different policies with regard to supply-side measures and demand-side measures. As far as supply is concerned, many States have allocated government land to the cultivation of Jatropha. Inputs, such as seedlings, have also been generally subsidized (Chhattisgarh for instance has planted 160 million saplings in quest for bio-diesel self-sufficiency¹¹⁴). States departments are also

¹¹³ Altenburg T. Biodiesel Policies for Rural Development in India, 2008

¹¹⁴ http://www.greencarcongress.com/2006/04/indian_state_to.html

providing and funding services¹¹⁵ or processing facilities¹¹⁶. Finally centrally-sponsored schemes has been used to the promotion of biofuels programs, such as the National Rural Employment Scheme (NREGS) On the other hand, to stimulate demand, State governments are creating incentives¹¹⁷, that vary according to the targets they aim to achieve. This series of incentives coming from States are increasingly attracting the attention and the interest of the private sector, which has led to many partnerships. Some major players in the field can be identified, and they represent either foreign companies (such as the British producer of green fuel, DI Mohan which is a key player on this field, having 10,000 hectares of the crop planted in India and targeting to reach in the near future 267,000 hectares¹¹⁸) or national firms (such as Reliance Industries Ltd., that has earmarked 200 acres of land in the State of Andhra Pradesh (Kakinada) to cultivate *Jatropha*¹¹⁹).

This increasing interest of the Private sector in biofuel production explains in a way the diversity of modes of value chain organizations that we can find in each State – which were created to meet with diverse backgrounds We can distinguish basically three categories of value chain organizations that promote biodiesel production for consumption at the national market. They can be distinguished by the role played by different actors – government, farmers or the private sector – in the cultivation phase. We can find the *government-centred cultivation*, where *Jatropha* is grown on government and communal land, the government being the main risk-taker; the *corporate-centred cultivation*, where the private sector is the main risk-taker and the cultivation is often of large-scale block plantation; finally, the *farmer-centred cultivation*, which is characterized by cultivation on farmer's private lands but risks are shared between government, farmer and private processing companies

This overview of the various levels of management that guide *jatropha* cultivation in India today highlights the level of complexity the plan have got due to an anarchic multiplication of stakeholders and to the loose leadership took by the National State. As the

¹¹⁵ For instance, agriculture department from Chhattisgarh or Tamil Nadu are providing free services for cultivation. Funding is also provided to NGOs (Uttarakhand)

¹¹⁶ The government of Chhattisgarh for instance installed 10 oil extraction units and provided financial support for setting up private processing units.

¹¹⁷ We can cite for instance a minimum support price for *Jatropha* in states such as Chhattisgarh, Andhra Pradesh or Uttarakhand. Moreover, with the predictable failure of national-level ambition to make production of biodiesel meet 20% of the country's diesel requirements by 2011-12, States are setting up biodiesel blending requirements. Finally, tax exemptions (especially VAT) of biodiesel is also been used as a policy tool to promote demand.

¹¹⁸ *State Bank of India Funds Jatropha Cultivation for Biodiesel*, Green Car Congress, http://www.greencarcongress.com/2005/04/state_bank_of_i.html

¹¹⁹ Satish Lele, http://www.svlele.com/biodiesel_in_india.htm

latter did not show a clear willing to kick start the program it created – which generated substantial hopes throughout India – it arouse a feeling of exasperation to individual States. This state of affairs, led to a chaotic management of the national program as the nature of stakeholder’s economic interests differed according to the three modes of value chain organization that were set up. Thus, general interest is primarily sought in government led cultivation (with stress been laid on social development and environmental protection), whereas in corporate- centred cultivation, companies mainly aim at obtaining high returns on their investment, maximization of productivity and economic outcome. What can be astonishing is the fact that corporate planting is taking place not only on privately owned lands, but also on government owned lands or communal lands Finally, through farmer-centred cultivation, land is also been diverted to the use of Jatropha.

Today, the lack of a coherent policy from the Indian government and competing views from states are hindering the overall project and not contributing to the viability of India’s biodiesel project¹²⁰. Political management is a factor that clear distinguishes the Brazilian and Indian program. Whereas the former took place essentially under a military regime in which actors were limited and mobilized towards the same general purpose, the latter was set up by a very complex democratic regime, in a period when interests between a myriad of stakeholders diverged. Today, if India expects to set up a clear biofuel program that benefits the whole country, it will have to streamline the whole public support to a given biodiesel feedstock (further research will have to prove that jatropha deserves the current status it enjoys). Equally, if India, but also Brazil, are looking for the viability of their respective biofuel programs, they will also need to look more thoroughly into their social and environmental sustainability.

¹²⁰ According to Sandeep Chaturvedi, recent delays “have left edible oil processing companies, which have built capacity to turn 1.2 million tonnes of jatropha into biodiesel, in the lurch and \$227 million poorer”

SECTION II

Biofuels: a threat to environmental and social well-being?

Although politicians have been praising the economic advantages of biofuels, environmental and social sustainability should not be taken for granted. In a period when the balances of global ecosystem is highly under strain, due to the irresponsible pattern of development carried out during the last century, our planet could not be able to afford a biofuel revolution. From a strictly environmental point of view, increasing concerns have been expressed with regard to the sustainability profile of biofuels. Most frequently cited issues of concern include land occupation, carbon stock decrease, water depletion, water pollution, biodiversity losses and air quality degradation (Fargione *et al* 2008). Brazil's biofuel program has been directly criticized for accelerating deforestation in the Amazon; India's jatropha program (even if research is still not advanced) is causing diversion of pastures and degraded forest lands, which could probably lead to an augmentation of GHG emissions.

In addition to these environmental problems, criticisms point to potential social conflicts derived from energy-food source competition or tensions created from land grab. These conflicts are palpable especially in India, due to the structure of its agriculture that preserved many common lands or family-based farms. In Brazil, land of *latifúndios* and where agribusiness sector is extremely powerful, social tensions are today more linked to the overexploitation of labour force.

Both factors deserve more consideration, because they are the main elements of unsustainability of biofuels today. Pressure from scientists, but also from biofuel importers (such as the EU), has been a factor of hope, since it is triggering off considerable progress toward the emergence of more sustainable biofuels. Therefore there are encouraging signs of improvements, and Brazil is particularly striving to set up more social and environment-friendly biofuels through the integration of all levels of ethanol manufacturing. Therefore it will be important to take into account in this paper recent progress made in this field, which shows that there is still substantial room for improvements in the sustainability of biofuels.

Preoccupying social impacts of biofuels cultivation

To be successful, biofuels initiatives must be sensitive to conditions of local level lifestyle, pay particular attention to land rights, and take account of the views of local stakeholders. This set of measures should apply in countries where agriculture is centred on small family-managed plots of land, and where land labouring is still at the heart of the country's economic activity. This is clearly the case of the majority of Asian countries. Yet, today there is evidence that attractive prices for some biofuel feedstock (eg. jatropha in India, palm oil in Indonesia) has led to land grabbing and to involuntary displacement of people.

As we demonstrated on our last subsection, many hopes were put in India on claims that farmers could grow jatropha without irrigation on poor soils. The plant was seen from the outset as a potential source of rural development in India – by especially empowering the poor and marginalized people in the rural areas (home to three quarters of the Indian poor); moreover, according to the World Bank (2006), the agricultural sector employs almost 60% of the Indian workforce. Biofuel related activities could therefore work toward generation of employment and income for farmers and landless people (that could be employed in cooperatives or corporation-led cultivations). It is because Jatropha cultivation was assumed to promote the general interest of all Indians that Centrally-sponsored schemes (such as the National Rural Employment Guarantee Scheme) have been used to support the Jatropha plan. But after more than five years of experimentation on the field, and doubts around productivity and environmental benefits of this shrub, one can wonder if such governmental expenditures were worth the investment. Indian studies today show that, without irrigation, the average jatropha yield after five years is 1.1–2.75 tonnes per hectare, compared with 5.25–12.5 tonnes per hectare with irrigation¹²¹. This (late) realization undermined the main objectives of the project. First, today, instead of being grown in marginal areas, jatropha production for agrofuels is increasingly competing directly with the production of food crops on the most fertile, irrigated lands. Secondly, even though proponents say that the crop is ideal for small-scale farmers, it turns out that in practice, they are being pushed aside for tightly controlled corporate production. It is under this form of chain value production that we are finding today the most numerous instances of land grab, which can possibly affect India's food security. We can cite the case of corporate-cantered activity under the Joint Venture mode - seen in Chhattisgarh for instance¹²² – by which large amounts of government land is leased to a Joint

¹²¹ <http://www.jatrophabiodiesel.org/jatrophaPlantation.php>

¹²² Altenburg T. Biodiesel Policies for Rural Development in India, 2008

Venture for the purpose of biodiesel production. The main problem is that these government lands are often used by nearby villagers for meeting some of their daily needs (fodder-purposes), even if the land is no longer fertile. More generally, it has been reported that arable lands (under the appellation 'wasteland') have been leased by state-level politicians to big farmers. Manipulation of the appellation of lands given to *Jatropha* cultivators and irregularities have been noticed by Dr Vandana Shiva and Many Sankar¹²³, who have reported destruction of village commons and grazing lands (referred to as 'wastelands') by the government of the state of Rajasthan, who passed on May 2007 rules creating a new law called 'The Rajasthan Land Revenue (Allotment of wasteland for biofuel plantation and biofuel). These rules allow 1,000 ha to 5,000 ha of village common lands¹²⁴ (called 'wasteland') to be transferred for 20 years from the village community to biofuel industries – whereas it is mainly the poor that are dependent on the village community pastures to earn their living. Diversion of common pastures to the plantation of *Jatropha* can therefore be seen as a sword of Damocles hanging over the head of this vulnerable population and as a potential source of social tension¹²⁵. Dr Vandana Shiva and Many Sankar also noticed real cases of 'land grab' in a field work they conducted in the state of Chhattisgarh, where agricultural crops of tribals have been destroyed to plant *Jatropha*. The State, through the forest department, has 'forcefully' planted *Jatropha* on paddy lands.

In this context, local NGOs have contested government's definition of "wasteland", which includes the common lands and the forests where many farmers, pastoralists and indigenous peoples depend on. In an interview, Souparna Lahiri, from the National Forum for Forest People and Forest Workers, argues that "forests, totalling around 22.6 per cent of the reporting area for land utilization are under tremendous pressure to bear the brunt of *jatropha* planting (...) actually the fact that pasture and grazing lands, village commons, common property resources are part of the forest ecosystems and contribute to the forest communities' economy and livelihood is not properly understood, even by the forest department (...) indigenous and local communities have been contesting the criteria of barren and degraded lands. Many arid and semi-arid ecosystems have been classified as 'barren and degraded'. However, these areas are often inhabited and used by communities, who themselves do not consider them to be barren nor degraded!"

¹²³ 'Biofuel Hoax: *Jatropha* and Land Grab', <http://www.navdanya.org/news/5dec07.htm>

¹²⁴ According to Shiva and Sankar, Rajasthan has 1.94 million hectares of common pasture lands and more than 70% of the total geographical area is under the common lands

¹²⁵ The destruction of the livelihoods of pastoralists and livestock herders such as Gujars have already led to major riots in Rajasthan according to Shiva and Sankar

So far, small farmers have not embraced jatropha with the same interest as private companies, even though they have been actively influenced by private firms to do so (see our case study in annex). The long gestation period of the plant, imprecision around its real yields, and still low oilseed prices partly explain their pressing need for subsidies. Government and firms are holding out the prospect of substantial subsidies to small farmers to convince them to use a part of their land (which can turn out to be the totality in some marginal cases) in jatropha cultivation. Because jatropha cultivation is still not economic sustainable, small farmers that divert their lands to the cultivation of this biodiesel crop, become totally dependent on federal subsidies. But this dependence can lead to social catastrophes, such as the case reported of a farmer of Buldana who shifted its land cultivation from Bt cotton crops to jatropha and that committed suicide in April 2007, because of the government's inability to provide with the promised subsidy in due time.¹²⁶ So far, most farmers are not using arable lands to Jatropha plantation and are not replacing their food crops that still fetch much higher prices on the market. But, according to global economic trends, the risk exists.¹²⁷

As we see, social sustainability of the overall project on jatropha is very hypothetical – all the more so as social unrest have been seen in places where communal lands were leased to private companies, and where agricultural crops were destroyed to plant jatropha.

The spectres of social turmoil and of food scarcity are not the only negative social impacts that can cause current projects of biofuels, and that explain its lack of viability on the long-term – especially if the country in case is run by a democratic government, as India, where justice acts fairly independently and where civil society has been strongly empowered since the last two decades. When we turn our attention to Brazil, we also realize that Human rights violation is another major topic to treat in the assessment of biofuel social impacts. One could assert that human exploitation in the fields, coupled with child work, represents a major lever for the economic sustainability of biofuels, given that loose labour laws and lack of monitoring would bring more competitiveness and margins of profit for the sector. This argument was indeed supported by facts in the first period of Proálcool in Brazil, when intense human exploitation was reported – whereas biofuel productivity skyrocketed. But as

¹²⁶ 'Biofuel Hoax: Jatropha and Land Grab', <http://www.navdanya.org/news/5dec07.htm>

¹²⁷ But, although Jatropha is still not replacing economically viable food crops, there is a potential that farmers start using their arable lands to grow this plant in the future, especially if biodiesel prices keep rising (which is possible with the current rise of fossil fuel price). It is already been reported that farmers in Chhattisgarh have started growing Jatropha in agriculture land due to higher expected incomes. This type of speculation stems essentially from middle-income and well-off farmers, who are able to take risks, as very often they own large parcels of land and have a more diversified source of revenues.

time goes by, and as bioethanol is increasingly transformed in a commodity for exportation, the capitalist logic of exploiting labour force in order to make bigger profits has been weakening, especially with the creation of international regulations and certifications.

The existence of Human Rights violations in Brazil's sugarcane fields is not surprising for a country that 500 years ago started bringing slaves from Africa to work in the sugarcane sector. Perpetuation of mistreatments and cases of modern slavery are massively reported by Brazilian NGOs. Pinto et al. (2007) et Mendonça (2007), members of the Pastoral Land Commission and of the Network for Social Justice and Human Rights, respectively, remind that Brazil's sugarcane industry is today a central agro-industrial complex because it is very competitive in the international market thanks to low costs of production – which is associated with low salaries paid to workers. For the sake of comparison, after Australia, Brazil has the lowest cost of sugar production in the world; in the state of Sao Paulo, the cost of production is US\$ 165 per ton. In the European Union, the cost is US\$ 700 per ton. Low cost in labour is due to internal immigration from poor regions (especially Northeast) to the state of São Paulo. According to the Pastoral Service for Migrants (<http://www.pastoraldomigrante.com.br>) close to 40,000 migrant sugarcane cutters work in São Paulo during the harvest period of sugarcane. For thousands of workers this “temporary” situation becomes permanent because of the lack of alternative employment in their regions of origin. This explains that these workers become an advantageous reservoir for the sugar cane sector. According to Mendonça, many cases of modern-day slavery have been reported of workers having to live in “dormitory-cities” and meeting the goal of 10-12 tons of sugarcane harvested per day (it is estimated that this implies approximately 10,000 machete blows). More worrying are the cases of death registered by the Pastoral Service for Migrants, that counted, between 2005 and 2006, 17 workers' deaths due to an excess of work in the cane fields of the Ribeirão Preto region (situated in the state of São Paulo) alone.

These examples of mistreatments are alarming, so much so as bioethanol production is skyrocketing today, due to rise of exports. This trend could logically lead to a rise in the number of workers employed – and mistreated – in the sugarcane sector. Nevertheless, in parallel to the expansion of Brazil's bioethanol market, the sector has been more than ever exposed to pressure of stringent rules, especially created by European countries but also by the Brazilian government to reduce Human Rights violations. In other words, if the socially unsustainable mechanism of bioethanol production (labour exploitation) was as a key element

explaining the success of this industry in the 1980s¹²⁸, today two major elements are changing the very logic of human exploitation in Brazil's sugarcane fields: a first economic factor is the search for productivity gains, which is leading to the mechanization of sugarcane harvesting, and therefore reducing the number of cutters (see our next subsection); and second political factor is the rampant pressures from different legislations that are compelling sugarcane mills to respect essential people's rights¹²⁹

Thus, in a totally unexpected combination of circumstances, a social aspect of the production of biofuels became more than ever crucial for the economic viability of biofuels in Brazil. It is still difficult and highly risky to confirm any substantial improvement in the field of Human Rights. But some reports have been hailing bioethanol production as more socially responsible. For instance, a recent Dutch-Brazilian report (Smeets et al., 2006), which represents a scientific paper that provides us with clear figures about the scope of mistreatments in sugarcane fields, draws up a much less bleak picture of the sector than what can be read in many NGO statements. This report is a result of first attempts to analyse Brazil's sugarcane sector in the light of new sustainability criteria released by European Countries, such as the Netherlands.¹³⁰ Smeets et al. take into account some crucial variables that allow us to assess the concrete social sustainability of sugarcane production in Brazil; these variables are: wages, working conditions, worker rights or child labour. The report analyses labour conditions and Human rights in the light of compliance with International Labour Organization (ILO) standards and with the Universal declaration of Human Rights. The report finds out that as far as wages are concerned, the sugarcane sector does not remunerate workers in an inferior level to what is seen in the whole Brazilian economy. On the contrary: it was assessed that in the late 1990s wages in sugar cane production in São Paulo were 80% higher than those of workers holding other agricultural jobs, and their incomes were also higher than 40% of those in industry (Macedo, 2005). Thus, putting sugarcane wages into a Brazilian perspective, it becomes, in theory, harder to blame the whole sector. Nevertheless, the report reminds that these wages may still be too low to avoid poverty. An increase of wages is needed – and is economically feasible on the short-term, since a 50% increase in general wages would entail only a 4% rise of ethanol costs for sugarcane mills. This means that if the international community and Brazil's legislation

¹²⁸ Indeed, sugarcane production was multiplied by 10 between 1975 to 1985

¹²⁹ Higher political pressure is the result of a combination of an internal variable (the democratic election of a president – Lula – that is politically committed to reduce the exploitation of the poorer) and an external one (higher pressure from importers) partly explains this recent trend

¹³⁰ Dutch politicians came to an agreement in 2006 on the criteria through which biomass fuel must be analysed today before it is commercialized.

amplify pressure on the sector, wages should not be a bottleneck for international certification. As to labour conditions, Smeets et al. admit that it can represent a major bottleneck, and base their analysis on Mendonça's assessments to point out the challenges the sugarcane sector still have to take up.. But the report reminds that national legislation is in line with international laws¹³¹; this means that, if monitoring practice is strengthened (which seems to be increasingly the case under the Lula presidency), the stain of slavery in sugarcane mills could be reduced – even though it is clear that law enforcement in Brazil has always been a major problem. Low enforcement of Worker Rights is another problem that clearly relates back to Brazil's inability to suppress informal market. Compared to the Brazilian 55% mean rate of formal jobs, the sugar cane industry's agricultural activities now have a rate of 68.5%, which represents a rise compared to 53.6% in 1992 (ESMAP, 2005). With regard to cases of modern slavery (ILO's annual report (2005) estimated that the country still has 25 thousand slave laborers), Smeets et al. draws on the conclusion that although serious worker rights violations have been observed and that poor law enforcement is a key problem in Brazil, "Brazilian legislation in general seems sufficiently strict to prevent these violations"(p.66), and that wages and working conditions are criteria that should attract more attention of legislators than worker rights. Smeets et al. come up with a same conclusion when they analyse Child Labour in sugarcane mills: according to the ILO, in 2006 the total number of workers active in the sugar cane sector was 764,593, of which 2,606 were under the age of 18. It suggests that child labour in sugarcane production is not widespread, but existent. But as the report remembers, recent implementation of social programs, such as "Bolsa Familia"¹³², have encouraged families to register their children at school, which, coupled with the increase of child labour inspections, is collaborating to the decrease of overall child labour in Brazil. This trend is all the more favourable as the authors also remember that the economic cost for the sugarcane sector to suppress child labour is negligible (+ 4% of costs), which makes this criterion a minor bottleneck for future certification.

Should we conclude that social mistreatments in the ethanol branch are decreasing in Brazil? The report that we briefly mentioned above corroborate this idea, but stresses that the scope for progress has been faster in São Paulo than in other regions. The general trend is clearly favourable for substantial social improvements in sugarcane fields – which has been reinforced by the introduction of harvesting machines in this sector.

¹³¹ Law limits the workweek to 44 hours and specifies a weekly rest period of 24 consecutive hours, preferably on Sundays. The law also stipulates that hours worked above the weekly limit must be compensated.

¹³² Bolsa Familia provides approximately US\$ 6 to US\$ 40 monthly to low-income rural and urban families for each child between the ages of 6 and 15 whose attendance rate is at least 85%.

The real environmental impacts of biofuels and the recent hopes of technological improvements

Competition between food and fuel, land confiscation and change of livelihoods, social mistreatments are not the only elements that threaten the viability of biofuels: environmental factors count as well. Our objective in this section is to wonder the extent to which hopes on ecological improvements, especially in terms of GHG emissions, brought by the whole process of production and consumption of biofuels are well-founded. Today everybody admits that, at the early analysis of biofuels impacts, many factors were overlooked, such as carbon stock decrease, water depletion, water pollution or biodiversity losses. Given that further scientific research in this field is still needed, we will draw up here a balance sheet on what can be read on position papers (e.g. the recent British Callagher report), or on general assessment works on the real impacts of biofuels (e.g. OECD, 2008).

The first series of reports on biofuels, released in the beginning of the 2000s, are today deeply criticized for being extremely naïve on the idea that biofuels are “carbon neutrals” without considering a range of additional emissions that are created in the process of fabrication. For instance very few were written 1) on emissions created during the stage of cultivation of biofuels (cf. use of machineries) or during intermediate transportation of either the feedstock of the biofuel, 2) on the increase of nitrous oxide emissions from fertilizer applications on extending monocultures; or 3) on emissions from the energy used to convert the feedstock into a liquid fuel.

Moreover, no real attention was paid to the fact that the intensification of agricultural production – including the increased use of pesticides and fertilizers – could have implications for water quality or lead to an increase in water use (therefore creating shortages, soil degradation and erosion). As we have already many times highlighted, India’s choice of promoting jatropha, was based on the preconceived and erroneous idea that this feedstock was drought-resistant. Yet, as research progressed, government assessments slowly came to acknowledge that irrigation would be needed if higher yields were expected. As the latest paper released by the Department of Science and Technology (2008) puts it: “one hectare of plantation on average soil will give 1.6 MT oil. Plantation on poorer soils and with low irrigation will give 0.9 MT of oil per hectare”. The report also points out that water is needed in different steps of jatropha processing, for instance in the purification process – “which can be accelerated tremendously by boiling the oil with about 20% of water”. Increased irrigation and water use during the transformation phase is not good news for a country that has been directly affected by climate change: India’s groundwater has fallen to dangerously low levels

due to increasing droughts and poor monsoon rains; according to the ministry of water resources, the per capita availability of water has fallen to 1,869 cubic metres a day from 4,000 about two decades ago and with the rate at which the population is growing, it could dip to below 1,000 in 20 years”¹³³. With regard to sugarcane, experts admit that the plant is water-guzzling and requires intense irrigation for acceptable yields. In the region in which sugarcane is grown in Brazil, mainly São Paulo, the use of rainfall for crop production is generally considered as acceptable¹³⁴ (Smeets et al. 2006). Nevertheless growing demand for sugar cane in the Centre-South of Brazil has led to the exploitation of dryer regions in the West of São Paulo – which could expose the region to water shortages if irrigation is generalized and becomes economically feasible (which is not the case so far). Attention should also be paid to the use of water for the conversion of cane to ethanol: today it requires large quantities (the total water use is calculated to be 21 m³/t cane). Furthermore, as monocultures of jatropha and sugarcane are extending in Brazil and in India, this is leading to an overspread use of fertilizers of pesticides, which can negatively impact the environment. As far as jatropha is concerned, first researches pointed out that jatropha did not need any particular use of fertilizer. But hopes were short-lived and the Department of Science and Technology (2008) acknowledges today that “although jatropha is adapted to soils with low fertility and alkalinity, better yields can be obtained on poor quality soils if fertilizers containing small amounts of nutrients viz. calcium, magnesium and sulfur are used for the first two years”. More detailed studies on the direct impacts of intensive cultivation of jatropha on soil are still to be made, but no wonder that the extensions of monocultures will lead to an increase in risks of agricultural run-off¹³⁵ and other ecological catastrophes, such as those already assessed in Brazil’s sugarcane monocultures: sugar cane cultivation “is affecting workers, that many times do not use adequate protection while applying chemical products. In the state of Pernambuco, many areas of cane planting have a slope of close to 45%, which causes the poisons to run off and spread further afield. The waste residues of sugarcane are constantly deposited in rivers, causing the death of fish, crustaceans, and vegetation, as well as the pollution of the riverbeds and subterranean water” (Mendonça, 2007, p.48). Another major ecological challenge to be cited is that linked to the waste produced by biofuels monocultures.

¹³³ *Reuters*, “Millions in India Lack Water as Country Dries up”, June 9th, 2003

¹³⁴ According to Macedo (2005) the total rainfall required by sugar cane is estimated at 1500-2500 mm/y, which should be uniformly spread across the growing cycle. For comparison: the annual rainfall in São Paulo is roughly 1000-2500 mm/y. These figures indicate that water can be a limiting factor for sugar cane crop production under certain conditions in São Paulo.

¹³⁵ In India, most water sources are contaminated by sewage and agricultural runoff. World Bank estimates that 21% of communicable diseases in India are related to unsafe water. In India, diarrhea alone causes more than 1,600 deaths daily—the same as if eight 200-person jumbo-jets crashed to the ground each day (www.water.org)

In the sugarcane of sugarcane, we can cite the case of the vinasse. The latter is a corrosive liquid (having a pH of 4-5) and a by-product of ethanol distillation. Vinasse is produced in large volumes and has a high organic load (11 l/l ethanol). It is hot and therefore requires cooling. In the mountainous areas of northeastern Brazil, the pumping cost and the cost of land to store vinasse are prohibitive, and many times they are released into rivers, resulting in pollution (and fish kills) during each harvest. Yet evolution in technology at the sugarcane sector is convincingly grappling with environmental problems linked to waste (see above more details) and reducing many negative impacts of sugarcane by-products.

Today, one of the main controversies on biofuels is its real ability of being carbon-neutral. Early studies, especially on the American maize-based ethanol, turned out to be scientifically unfounded¹³⁶. This reality is due to the fact that first estimates overlooked emissions of CO₂ generated by the use of machinery or transportation of the chosen biofuel feedstock (which were run on fossil fuels). Politicians and scientists were also unable to anticipate the potential damages that biofuels could cause to the environment (in terms of GHG emissions) if they were grown in lands that required massive transformation before being arable and appropriate to biofuel monoculture. According to a report from the Environmental Audit Committee of the British House of Commons (2008), “if forest is cut down to grow biofuels it would take between 50 and 100 years for the biofuels to compensate for the initial release of carbon” (p.10). This is due to the fact that if non-agricultural land is used to grow the feedstock, massive reservoirs of stocked carbon dioxide (sequestered in the soil, peatland or forests for instance) would be released on the atmosphere and on the one hand “negate any carbon savings associated with biofuels”, and on the other hand contribute, in the same process, to the increase of GHG in the atmosphere through the destruction of major “carbon sinks”

In an effort to take these elements into account in order to have an extensive assessment of overall emission of CO₂ released on the atmosphere, scientists use today two main analytical tools for evaluating the efficiency and environmental trade-offs of different biofuels: the life cycle assessment (LCA), which tackles the first problem mentioned on the paragraph above, by determining the life cycle environmental profiles of different biofuel chains and comparing them with the ones of fossil transport fuels; and the agro-economic modelling, which assesses the precise land-use change impacts, caused, for instance, by the

¹³⁶ Accord to an article by D. Pimentel, “corn requires 29 percent more fossil energy than the fuel production” (Pimentel, 2005)

use of forest lands for biofuels. In the case of bioethanol production, though substantial improvements in the field of LCA have been noticed (see above), the agro-economic modelling highlights the risks that increasing deforestation is causing to the sustainability of ethanol in Brazil. Emissions of CO₂ due to the destruction of forests, at the global level, are already estimated to represent a bigger source of global warming than emissions from transport (Stern, 2006). As issue such as land use change, preservation of indigenous forests, and expansion of forest resources as a mechanism for establishing carbon sinks, are gaining considerable attention from the international community, more studies are being released on the direct impacts of forest or soil burnings (for the cultivation or not of biofuels) in Brazil. As specialists point out “when land is converted into arable land for growing energy crops for biofuel production, its carbon storage can change very significantly, depending on the type of land previously used. In order to take this important effect into account in the total GHG balance, the difference between the C-storage of the land before and after its change for biofuel production has to be calculated. This difference (either positive or negative) can be attributed to the biofuel by annualising the emissions” (OECD,2008, p.48). Through this analysis, it is possible to know which lands (forests, savannah, scrubland) can release more or less CO₂ due to burning or microbial decomposition of organic carbon stored in the plant biomass and soils. Today, carbon stored in forests is estimated to be 638 GtC (FAO, 2005) and is divided between biomass, soils and litter (see appendix, Figure 11, for an overview of total carbon stocks in forests by region). This carbon stocked in forests is of a similar magnitude to that in the atmosphere. According to the FAO, 10 countries with two-thirds of global forest area (including Brazil) are key to preserving existing forest. But between 2000 and 2005, Brazil (with Indonesia) was responsible for two-thirds of global net loss in forest.

Brazil's stance in this issue is very vague and ambiguous. In a recent editorial on *Washington Post*¹³⁷, Lula correctly remembers that “Amazonian soil is not suitable for growing sugar cane”, but it does not ensue from this reality that “ethanol is not a direct menace to tropical rain forests”, as the Brazilian President states. Today; if Brazil's ethanol is not a direct threat to Amazon (which is questionable), it turns out that it have been an *indirect* threat to the tropical forest. Many activists from NGOs, such as Friends in the Earth Brazil, have clearly established an indirect correlation between the increased demand for agriculture

¹³⁷ “Our Biofuels Partners”, *Washington Post*, 30 March 2007

products (such as sugarcane) and deforestation¹³⁸: it is indeed revealing that livestock and soybean farming have been increasing in the lands taken from the forest, whereas both instances exactly represent the cultures that have been most massively diverted to sugarcane production in São Paulo and other regions of Northeast Brazil. According to Friends of the Earth, “you can buy 800 hectares of land in the Amazon for the price of one hectare in the ethanol belt of São Paulo state, making it inevitable that cattle and soya producers are going to move northwards” (*The Guardian*, 10 June 2008). This search for profit is now the main logic that underpins Brazil’s agriculture, and that explains cases of deforestation and environment degradation in other places of Brazil. In a paper for *Agencia Latinoamericana de Información* (2008), the renowned activist Luisa Mendonça denounces sugarcane plantations for also destroying Brazil’s savannah (*Cerrado*) the main vegetation found in Middle Brazil. In its field study, the author points out irreversible environmental damages that are being caused on forests of the region because of a particular savage extension of monocultures. This case study can be generalized to many parts of Brazil, especially to North-Northeast regions, where “idle” lands are still abundantly available.

Difficulty of setting up clear and strict definition of “idle” and “potentially suitable” land is a problem, and consists today in a concrete loophole that is to the advantage of dishonest land owners. This lack of a clear definition is not affects only Brazil. As the Gallagher report puts it: “the way in which different studies have defined suitability varies, making comparisons uncertain. Terms such as ‘idle’ and ‘marginal’ lands do not have internationally agreed definitions, though they are generally used to refer to the quality of land used and its suitability for agriculture. Idle land is sometimes used to refer to underutilized agricultural land, such as EU set aside land, but might also be used to refer to potential good quality land that has not been used previously”(p.38). Especially in a big country as Brazil, where monitoring is inefficient, owners of lands allotments taking in forests (it is especially the case in Centre Brazil), seem today free to preserve or destroy it when they feel like it. In her article appeared on *Agencia Latinoamericana de Información* (2008), Luisa Mendonça describes the appalling reality of forest clearance in the State of Minas Gerais due to extension of sugarcane mono-cropping. The author accuses especially new companies that are now investing in sugarcane (such as Louis Dreyfus) without observing any environmental ethics: without any license or technical study, companies are diverting rivers (such as the São

¹³⁸ Friend in the Earth claims that “250,000 hectares of the Amazon are already being used for growing sugar cane and believes 350,000 head of cattle a year are moving into the “legal Amazon” as a result of being displaced by ethanol activity in the state of São Paulo alone” (*The Guardian*, 10 June 2008)

Francisco River) that go through their land properties, burning native forests – and carefully “knocking down and burying the trees to escape inspection” according to the author. The process of mono-cropping expansion has been intense in the State and not only native forests are being burnt, but also national reserves are being affected. Mendonça reports that the company Total for instance is building now mills in the region of Bambuí, which are near to restricted conservation zones of the National Park Serra da Canastra, considered of extreme biological importance by the Atlas of Biodiversity in Minas Gerais. Given the unethical activities that have been committed so far, there is no denying that the expansion of sugarcane production would have a strong impact in the area, because of its invading potential and the intensive use of pesticides. The chief of the Brazilian Environment Institute (Instituto Brasileiro do Meio Ambiente – IBAMA), Joaquim Maia Neto, acknowledges that multinationals are committing environmental crimes in the region: “They plant sugarcane practically inside the water. The company [Total] deforested and burned the area, and it was a major threat for the whole region. The Public Prosecutor’s Office filed a lawsuit against the company. We hope that the area will be restored soon (...) this activity [is bringing] serious environmental problems. Brazil should prioritize a diversified model of agriculture”.

This case study is far from being isolated and is an example of what recent liberalization of agriculture is causing in the world, especially in countries such as Brazil, where large amounts of land is still available. Land is now treated as a rare commodity, in a context of world population growth and spurt of agriculture prices. But this evolution is preoccupying, because the irresponsible spreading of agriculture lands risks to further disturb the fragile balance of our global ecosystem. Studies clearly show that current conversion of land to an agricultural use is resulting in a net increase in carbon emission. As it can be seen on the FAO graph in appendix (Figure 11), today South-America’s biomass gathers alone almost 100 giga tonnes of CO₂. In other words, if still available “idle” lands continue to be savagely converted into sugarcane mono-cropping, bioethanol – the so-called “cure” for current climate change – runs the risk of being worse than the disease. In order to remind that land-use change can eliminate GHG savings (that would otherwise be derived from the biofuel feedstock planted), the Gallagher report released recently an interesting table where it can be seen typical payback times for replacement of lost carbon in places where land-use change is due to increased demand for biofuels feedstocks (see appendix, Table 5). It can be seen that if sugarcane is planted in current forests, the emissions of CO₂ into the atmosphere will be such that it will take 15 to 39 years to start seeing positive net reduction of GHG on

the atmosphere thanks to the utilization of bioethanol by cars. According to the recommendations of the report, Europeans should exclude any support for cultivations that lead to a payback of longer than 10 years by the biofuel produced. Yet, it is interesting to note that replacement of Brazilian grasslands for biofuel feedstock is estimated to be sustainable, given that the payback period assessed is of 3 to 10 years.¹³⁹ This fact probably explains the optimism on the potentials of land-use intensification in Brazil: “the Brazilian case study points to opportunities to release pasture land for cropland by intensifying the currently very low density of cattle heads per hectare (...) It is estimated that 50-70 million hectares of pasture land would be made available in Brazil if the Sao Paulo productivity rate were extended to the rest of the country. (Gallagher report, 2008, p.37). This optimistic statement can yet be questioned: as we demonstrated, instead of looking for intensive livestock farming, many Brazilian cattle owners are expanding their livestock production to the Amazon as a result of direct pasture vs. sugarcane monoculture competition in Centre-South Brazil. This trend can only be a further threat to biodiversity in vulnerable regions such as the Amazon and also the region of Centre Brazil’s woodland-savannah *Cerrado*¹⁴⁰. Moreover, as pointed out above, intensification of agricultural production, has always meant an increased use of pesticides and fertilisers with implications for water quality and increased use of water (which result in shortages) and soil degradation.

But recent research on sugarcane in Brazil has led to many technological advances, which have been impressively contributing to reduce the negative social and environmental costs of sugarcane production – and enhance the economic one. Brazil is today particularly betting on these recent technological breakthroughs to improve the sustainability of the sector and its international image (with a view to get certifications).

¹³⁹ Fargione et al, (Smeets, 2008) also calculated the number of years needed for net reductions in GHG from converting land into energy crop. In their comparative analysis, we can notice that payback time in Brazilian idle land *Cerrado* (savannah) is of 17 years. For the US, if abandoned cropland is transformed into energy crop, its payback time will be of 48 years and of 93 years if grassland is converted.

¹⁴⁰ As to the Brazilian case, research on the impacts of bioethanol production on biodiversity is more advanced than for India. Steems et al.(2006) for example argue that, so far, sugarcane production on Centre-South Brazil is still not directly threatening biodiversity : “ the direct impact of cane production on biodiversity is limited, because cane production replaces mainly pastures and/or food crop and sugar cane production takes place far from the major biomes in Brazil (Amazon Rain Forest, Cerrado, Atlantic Forest, Caatinga, Campos Sulinos and Pantanal).. Yet, these findings can be criticized by those that blame the indirect pressure that ethanol is currently putting on Brazil’s Amazon and especially *Cerrado* (via the displacement of livestock farming in South Brazil). Indeed, recent trends show that livestock production is moving particularly to the central part of Brazil (into *cerrados*) more than into forest areas. Brazil’s *cerrados* are today an important biome and biodiversity reserve: 10.000 plant species, 195 mammal species, 607 bird species, 225 reptile species, 186 amphibian species and 800 fresh water fish species live in this region (cf. <http://www.biodiversityhotspots.org>).

One of the most exciting progresses in the sector has been current trends toward integrated concurrent production of ethanol and electricity from bagasse of sugarcane. The bagasse is the fibre left-over produced after the extraction of the sugarcane juice. Especially São Paulo mills are taking advantage of this waste to provide, through co-generation units, electricity, mechanical power and thermal requirements to the entire sugar/ethanol making process. It must be reminded that the bagasse contains approximately 30-40 percent of the total energy available in the sugar-cane plant, and there is a great potential of improvement in the energy-self-sufficiency of Brazilian sugarcane mills. According to Furtado (2007), substantial progress in energy generation is still possible, especially with recent advances in boiler's pressure: average energy production could therefore climb from current 22 bar to 60 or 80 bar, and allow mills to export to the national grid up to 40 KWh per ton of sugarcane. In other words, a mill that processes 2 million tons of sugarcane per year would be able to export 80,000 MWh per year. This recent trend toward a further integrated production of ethanol would not only represent a new source of revenue for the sugarcane industry, but also be a substantial improvement of the life cycle assessment (LCA) of the ethanol industry, as emissions of CO₂ would be avoided by a self-sustained process of energy generation. Another clear advance in this process of integration of externalities has been seen in the treatment of another sugarcane waste: the vinasse. The latter is a residue of distillation of sugarcane and represented a major concern at the beginning of Proálcool, when there was a fear about river pollution due to improper vinasse disposals. Since the 1980s substantial progress in this field has been made, thanks to researches carried out by the Sugarcane Technology Centre. Vinasse was found to be a good fertiliser and is used today for ferti-irrigation of cane crops, together with wastewaters (floor washing, closed circuit purging, condensate remainders). If in the early stages of experimentation, various environmental problems were encountered as a result of the high vinasse doses that were applied, since then vinasse application rates have been gradually reduced (especially thanks to new sprinkler installations). Thus, recycling is seen today as a crucial element of a "wastewater reduction strategy"; more importantly, recycling has been incorporated into a larger strategy of water management. According to Macedo (2005), the bioethanol industry has been reducing dramatically its consumption of water, which is the result of legislation and technological progress. According to the author, it seems possible to reach a 1 m³/t cane water collection and (close to) zero effluent release rates by further optimizing and reuse of water use and recycling. In 1998, the World Bank had

reported a target value for wastewater release of at least 1.3 m³/t cane and an achievable rate of 0.9 m³/t cane.

Another source of hope of further environmental – but also social – viability of biofuels is current substantial increase in mechanical harvesting. Today it is already possible to avoid trash burning in sugarcane fields, which represents one of the major environmental damages caused by the cultivation of this crop. Cutters very often resort to burning in order to simplify manual harvesting; but by doing so, large amounts of CO₂ are emitted on the atmosphere, which compromise one of the main arguments that underpin bioethanol production. In order to eliminate this contradiction, private investors have been changing their practice of production: mechanical harvesting is already applied by approximately 25% of the cane in São Paulo (Smeets et al, 2006), whereas in the mid-1990s it was simply nonexistent. Not surprisingly, this new interest for mechanic harvesting was mainly sustained by economic reasons: in the mid-1990s, when the sector was liberalized, the whole sector had to start looking for the reduction of costs. According to Braunbeck et al., (2000), in the beginning of the 2000s, the cost for mechanical harvesting was twice as cheaper as manual harvesting. Yet, loading of “burned cane”, at US\$ 2/t, was still cheaper than green cane harvesting (even though the latter did not exceed US\$ 3/t). However, Braunbeck et al. remember that field burning results in sucrose losses by exudation, and ethanol losses is in the range of 59 to 135t/ha. Therefore, conversion of manual harvesting toward mechanized green cane harvesting has been attracting sugarcane mills owners, who have today to decrease the number of harvest failure in a competitive international market.

The role of the Brazilian government in this trend was also capital to understand this recent evolution. As we argued in our first subsection, Brazilian authorities are vigorously cracking down on human mistreatments on sugarcane fields – and simultaneously concerned about the environmental and social image of its ethanol industry. Brazil’s sugarcane History shows that burnings are a direct threat to the environment: not only they cause pollution, but many times they are simply uncontrolled and lead to the destruction of forest and their wildlife – not to mention to high levels of pollution in neighbouring cities. That is the reason why in 2007 the State legislators decided to lay down a law that sets out a deadline to stop this practice: authorities set out that by 2014 burnings would no longer be permitted and that the majority of sugarcane plantations would have to shift from manual to mechanized harvesting (UN, 2007)

This decision will certainly have a direct impact on the whole logic that underpins the ethanol industry. Labour exploitation in sugarcane fields will be, in theory, dramatically reduced since reported cases of modern slavery result from mistreatments toward sugarcane cutters. This social class, as old as Brazil's own History, risks even to disappear if the law is properly implemented by 2014. According to the United Nations (2007), it is estimated that three workers that operate in machines can replace sixty cane cutters today. If we can hail this initiative as being a major landmark in the field of Human Rights (as sugarcane cutting is an extremely degrading job), it is still not clear what will be the impacts of this measure on the whole industry sector. The sugarcane industry employs today one million Brazilians, which are unskilled workers. Their conversion to new jobs is thus very hypothetical and given the high level of agriculture mechanization in Brazil, it is likely that this mass of unemployed cutters will end up in city shantytowns. Mill directors, interviewed by the UN (2007) say that they will collaborate to avoid a major social chaos: "cutters will be absorbed in our future expansion, this is our responsibility – because we need social stability, it's not only about the government and the unions, we have to be involved". But today it is still not clear how former unskilled cutters will be converted into other sugarcane-related jobs.

The trend of mechanisation and expansion of sugarcane fields will be the two main vehicles for the increase of sugarcane production in Brazil (the government has set a target to double the country's ethanol production into 10 years). Advances in technology are therefore offsetting many obstacles that the sector has been facing so far. This evolution is not only enhancing the sector's productivity and economic viability¹⁴¹, but also having indirect – and positive – impacts on the social and environmental sectors. The role of Brazil's research (public and private)¹⁴² in this field is capital to the reduction of the level of incompatibility between economic and environmental sustainability. This state of affairs can be a source of hopes, but also of fears. For instance, never research on genetically modified sugarcane crops has been so popular in Brazil's research centres. Advances in GM crops could have very

¹⁴¹ The economic viability of bioethanol is clearly linked today to its "social responsibility" label. If Brazil wants to export its ethanol to promising markets (such as the European), its industry will have to fit stringent certification requirements. An example that can illustrate this new reality is the recent agreement that Brazil signed with Sweden: www.reuters.com/article/environmentNews/idUSN2547192320080625

¹⁴² As we pointed out in the beginning of this chapter, Brazil's research on ethanol can be public (cf. research carried out by Ridesa, the interuniversity network for the development of ethanol, or Brazil's national research centre Embrapa) or private. Private research is today mainly carried out by centres created by associations of sugarcane mill directors (cf. Copersucar Technological Centre for instance). Furthermore, Brazilian industry R&D departments are also increasingly interested in the new opportunities created by new market needs (cf. Embraer that built in 2007 world's first aircraft run on pure bioethanol; Brazil's petrochemist Baskem, which is putting sustainability at the heart of its strategy of expansion, will start manufacturing plastic bags made of sugarcane bioethanol from 2009).

negative impacts on the environment, by damaging wildlife, leading to gene flow with native species or by competitively displacing native species. This last threat is more than ever real today, as increases the temptation of extending the area of sugarcane cultivation in Brazil; for instance, intense research has been undertaken to adapt sugarcane cultivation to Centre Brazil's *Cerrado*, a region where idle land is still abundantly available, but that represents an important biome and biodiversity reserve (see footnote 139)¹⁴³. Therefore if certain technological progresses¹⁴⁴ can be praised for improving the level of ethanol's sustainability, the irregular or uncontrolled encroachment of biofuel feedstocks on forests or on regions having a rich reservoir of diversity is probably the main challenge to be addressed nowadays.

¹⁴³ We also found out that important researches have been carried out in India with a view to enhance *Jatropha*'s drought-resistance. In 2006 for instance, India's *The Energy and Resource Institute* have found a manner to improve the productivity of *Jatropha* by applying a fungi (through the mycorrhiza technique) to its roots, which allowed yields to increase up to 30% and shortened the gestation period of the plant. Research has also been carried out on the creation of hybrid varieties of *Jatropha* (by picking up positive properties from 14 existing *Jatropha* species) that can be better adjusted to different local conditions of dry lands.

¹⁴⁴ Experts would say that Brazil supports today a "weak version" of sustainability, i.e. in which manufactured capital can take the place of natural capital, since the function natural capital performs can be duplicated by manufactured capital

CONCLUSION

The main purpose of this paper was to provide the reader with an overview of the real sustainability of biofuels through two case studies that illustrate today ambitious strategies in this field. On the one hand we analysed the second largest biofuel industry in the world, (that of Brazil), which served as a benchmark, given its experience and recent international exposure. On the other hand we went into the study of India's jatropha program with a view to provide insights on recent attempts to improve the level of sustainability of biofuels cultivation: India's bet relied on hopes that jatropha could be grown on marginal and degraded lands, which would therefore avoid competing land use claims.

The first chapter of this work aimed at pointing out the main levers and reasons that pushed politicians to invest on biofuels. It analysed the political discourse in both countries and stressed the nature of considerations that prevailed in a complex - and continually evolving - economic and political context. By making clear the way the question of sustainability was considered, we hinted the possibility of futures bottlenecks in both projects. If biofuel projects appeared in Brazil or India, it was not essentially due to ecological concerns, which were marginal, but to economic priorities (fears of widening national budget deficits caused by more expensive oil bills). Furthermore, Brazil's arguments putting forward the ecological benefits of its "green fuel" are recent. Brazil took advantage of the recent shift of international public opinion in favour of ecological measures to appropriate a new green discourse. But during the creation of Proálcool, public research did not focus its effort on the environmental impacts of ethanol, but on its level of energy-efficiency. If the government took into account the positive social prospect of the introduction of this new technology in terms of job creation, it turned a blind eye to sugarcane landlord's long tradition of mistreatments towards cutters. Human rights violations in the early years of this industry was a real social stain on the program, and only recently, as national and international public opinion started to criticize this reality, substantial improvements have been made

In our second chapter we turned our attention to the implementation phase of both programs, by highlighting how political strategies were manifested in the field. Given that economic concerns prevailed in the decision-making stage – and that it did not take a long time to see a set of environmental and social problems appear – governments had to adapt their initial policy to a new and evolving context. By studying the evolution of both programs, we ended up drawing the conclusion that Proálcool and India's jatropha plan evolved very

differently, not to say that they went on the opposite directions. Political voluntarism and efficient management of these respective national projects were central to explain failures of the Indian example successes of the Brazilian case. India's choice on jatropha was extremely premature as national and international research on this plant was several years away from convincing sound results. India's Jatropha National Biofuel Mission adopted from the outset a very narrow perspective and essentially consisted of a mere "acceptable" plan to cope with government's priority number one: the offsetting of India's dependence on oil imports. It is clear today that the level of preparedness of the government to address environmental and social impacts caused by its jatropha plan was extremely low. The fact that the whole project was based on inconsistent jatropha yield data only accentuated problems of mismanagement. To overcome this difficulty, the government would need to count on the support of stakeholders, especially farmers, agri-industries or grassroots organizations. This was not the case and since the beginning the government adopted a very vague policy on jatropha. Farmers would especially need enough subsidies to start planting or replacing their crops to jatropha – all the more as fossil fuels currently benefit of high subsidies, which make it very competitive. This did not occur. This lack of economic sustainability of the cultivation of Jatropha largely explains farmer's reluctance to massively invest on monocultures¹⁴⁵.

This lack of preparedness contrasts with Brazil's Proálcool plan. As we stressed, political and social variables may have been decisive to understand Proálcool's success. The latter was implemented under a military regime, in which bureaucracy was streamlined thanks to centralized and authoritarian rules – whereas India is today characterized by a very complex democratic regime where the number of influent stakeholders is high. Consensus was therefore easier to attain in Brazil – so much so as Brazil's agriculture has always been dominated by its *latifúndio* landlords – and coincidence of interests between sugarcane landlords and the government helped to path the way of Proálcool. Furthermore, another capital variable that cannot be dismissed is the level of land-availability of Brazil, which consists of its main asset in terms of resource.

Indeed, a major element that differentiates India from Brazil is unquestionably the expanses of land that are still available for cultivation in both countries. Today, 60% of India's population lives in the countryside, which is divided in small plots mainly managed by families. Unlike Brazil, India's rural area is overcrowded and land-availability is low, which

¹⁴⁵ That is the reason why many impassioned discourses accusing jatropha of being the main source of food price rise due to land diversion have to be carefully put into perspective. Many studies show that diversion is still not overspread, even though social tension is already noticeable in communal lands leased to private companies.

explains the reason why the country could never afford to meet ambitious jatropha-oil blend targets. According to Surya P. Sethi, Government of India's energy adviser, any ambitious policy on jatropha would face this compelling obstacle: "if 60 million hectares of land is used for energy plantation like jatropha and other crops [first government target was to devote 13 million hectares to jatropha], the commercial bio-energy produced would meet only 29 per cent to 35 per cent of country's energy needs even after 25 years. [What's more], data on annual bio-diesel yields from Jatropha ranges from a low of 0.3 tonne to one tonne per hectare". (www.mynews.in, 27 January 2008). Conversely, Brazil uses today only 20.2% of its arable lands (Veja, 2008), of which 1% is being devoted to sugarcane monoculture. This further puts Brazil in the forefront of international ethanol producers, and makes its target of doubling production by 2015 easily attainable: Furtado (2007) reports that Brazil's prestigious university UNICAMP released in 2005 a study which states that Brazil has extremely favourable conditions to meet by 2025 half of global demand for ethanol if a worldwide decision is made to blend this biofuel with gasoline at a proportion of 10%. This means that Brazil would have to multiply its ethanol production by 6.5, which is asserted to be feasible – mainly thanks to immense land-availability.

But in many respects this prospects of expansion of biofuel monocultures may be preoccupying, especially in terms of risk of increasing competition between sugarcane and foodstuff cultivation and of land confiscation. As it was analysed throughout this paper, agriculture in India and in Brazil has been more and more guided by neoliberal prerogatives. Nobody knows, even in Brazil, if the extension of monocultures will result in land diversion. For instance, during the Proálcool era, the impacts of biofuels in Brazil were very negative, in terms of land confiscation of the poorer¹⁴⁶. According to Mendonça (2007), the prospect of widening sugarcane monocultures is a reason for concern, because this sector is mainly concentrated in the hands of a few families¹⁴⁷, which are powerful enough to encroach little by little on neighbouring foodstuff production. As Mendonça puts it: "the further expansion of the sugarcane sector could make the availability of land for redistribution to the landless even more difficult in many regions of the country" (p.44). Moreover, as we pointed out, the region of Brazil's savannah (*Cerrado*), located in Centre Brazil, has been the scene of preoccupying progression of sugarcane mono-cropping because of its invading potential and the intensive

¹⁴⁶ According to ESMAP (2005), the 362.000 ha of cane added in São Paulo between 1974 and 1979 occurred largely at the expense of food crops. The greatest impact was on maize and rice, of which the planted area declined by 35%.

¹⁴⁷ According to Mendonça, of the total five million acres, barely 20% of the sugarcane produced in Brazil comes from small or medium-sized properties

use of pesticides. It is reported that big producers (such as multinationals as Total or Louis Dreyfus) are investing heavily in monocultures, by leasing out lands used by small farmers or threatening permanent forest reserve areas¹⁴⁸ The same trend has been noticed in India and, worryingly, been enhancing as the number of international (oil) firms, and well-off land owners investing in this new economic “opportunity” are increasing¹⁴⁹. It is too early to assess the real impacts of jatropha cultivation on India’s agriculture landscape, but there is reason for being concerned as India’s energy-security is considered by the current government as a top priority on the agenda. The current government in power has been harshly attacked for its neoliberal fanaticism, which has been the main economic recipe for India’s current 9% GDP growth per annum. Therefore, if India adopts, in its agriculture sector, policies striving for the promotion of free enterprise and for the opening up of its market to international stakeholders (policies advised by international agencies, such as the World Bank and more recently the German Development Institute) it will allow a larger participation of international companies, whose main purpose is the pursuit of their own profit. As we demonstrated in our analysis on corporate-centred cultivations of jatropha in India, this pattern of land management is the most dangerous type of land cultivation from a food security perspective, because it is leading to land dispossession of poor farmers.

In a framework trend of growing population, food and feed demand and consequent crop-land needs, to what extent does the large scale deployment of biofuels risk to accelerate and worsen unsustainable trends of increasing deforestation and depletion of carbon- and biodiversity-rich natural resources ? There is no blunt answer to this question, but it is clear today that biofuels are causing direct and indirect deforestation in the Amazon and sugarcane monocultures are expanding to regions that gather a rich level of biodiversity. Today, Earth’s “lung”, the Amazon, is breathing uneasily in a time that it is being (directly or indirectly) one of the main victims of biofuels progression in Brazil. It is impossible to know nowadays the extent to which deforestation will keep its current escalating pace, all the more as the government is very often accused by ecologists of being too lax with the agri-business sector on this subject. As Rights and Resources Initiatives points it on their website¹⁵⁰, “cultivating soya beans and sugar cane for biofuels in Brazil is expected to require up to 128 million hectares of land by 2020 – up from 28 million hectares now. Much of the additional land is

¹⁴⁸ According to *Agencia Latinoamericana de Información* (2008)

¹⁴⁹ Although *Jatropha* is still not replacing economically viable food crops, there is indeed a potential that farmers start using their arable lands to grow this plant in the future, especially if biodiesel prices keep rising (which is possible with the current rise of fossil fuel price). This type of speculation stems from rich farmers that are able to take risks, own large parcels of land and have a more diversified source of revenues.

¹⁵⁰ <http://www.rightsandresources.org/>

likely to come from deforestation in the Amazon". To a lesser extent, the same argument can be posited to the Indian case, as what the government have been calling "degraded" or "wastelands" are often fragile forest lands, under the Scheme of Joint Forestry Management, where Indigenous people cultivate lands according to their own tradition. On the other hand, no one can today deny the negative environmental impacts caused by the intensification of monocultures, such as impacts as soil acidification, fertilizer use, biodiversity loss and toxicity of agricultural pesticides. When those elements are heeded, the overall environmental impacts of ethanol and biodiesel can very easily exceed those of petrol and mineral diesel (the OECD [2007] assert that in general, conventional biofuel technologies typically deliver GHG reductions of less than 40% compared with their fossil-fuel alternatives).

But in the same report, the OECD refines its analysis by stressing that the whole complexity of the problems of "biofuels" is that behind this term there lies a myriad of initiatives and feedstocks. According to the Paris-based organisation, "among current technologies only sugarcane-to-ethanol in Brazil, ethanol produced as a by-product of cellulose production (as in Sweden and Switzerland), and manufacture of biodiesel from animal fats and used cooking oil, can substantially reduce GHG compared with gasoline and mineral diesel". Today it is estimated that Brazil's bioethanol can reduce up to 90% GHG emitted by cars; furthermore, recent evolution in technology, which is leading to the integration of the whole vale chain of sugarcane biofuel production, is enhancing the energy auto-sufficiency of the sector and therefore its environmental sustainability. Critics of biofuels would nevertheless remember that his recent positive evolution is stained by rising levels of deforestation. There is no denying that deforestation in Brazil is rising, and this trade-off between continuous deforestation on the one hand and environment-friendly production of ethanol, thanks to technological evolution, on the other, is at the heart of all international controversies around Brazil's biofuel. Nevertheless, recent attempts at creating certificates of biofuels can be a useful tool for promoting sustainable practices – even though it cannot be trusted as a safeguard.¹⁵¹

Behind this vivid debate, it can be noticed a conflict between two interpretations of sustainability. As the majority of governments today, Brazilian authorities support a "weak

¹⁵¹According to the OECD (2007), there are serious questions that must be raised about the effects and effectiveness of certification schemes: "First, enforcement and chain-of-custody control could prove to be an enormous challenge, as recent experiences with the certification of wood products has shown. Second, the effectiveness of certification could be undermined by displacement of biofuel products. As long as certification is not a multilateral requirement but conducted on a country by country basis, it will merely lead to a segmentation of the market, not a reduction of unsustainable practices. Third, without a uniform certification scheme exporters will face increasing costs and bureaucratic complexity. A final limitation is that certification schemes do not easily capture knock-on effects on agricultural markets".

version” of sustainability, which is praised by developing countries for not endangering their own development effort. This weak version of sustainability, as the OECD puts it, ”allows for the depletion or degradation of natural resources, so long as such depletion is offset by increases in the stocks of other forms of capital”¹⁵². In this context, deforestation could be offset by improvements of biofuel technology for instance. This is not what many ecologists of International NGOs support, when they accuse Brazil of destroying world’s main hub of diversity by allowing the agribusiness sector to have designs on Amazon’s “idle” land. Thus, according to these advocates of a strong sustainability, man-made and natural capital could never be substitutable.

Under these circumstances what biofuel policy should politicians strive to adopt? Politicians have been increasingly concerned about the upward trend of oil prices, and more than ever economic priorities have prevailed. The recent spurt of oil prices have been puzzling public policies, so much so as the upward trend of oil fuels seems to be structural, as the latter will probably never go back again to previous U\$ 20 a barrel. It was in this context that appeared the biofuel opportunity, which happened to be the most *economically* viable strategy to adopt in the beginning of this decade. No real sound research was undertaken on other aspects of biofuels, and as time went by, politicians happened to realize that investments on biofuel posed a major problem of competition between feedstock and foodstuff cultivation. Therefore, from 2007 on a fundamental question appeared: which general policy should be favoured by governments, energy-security or food-security? As we demonstrated in our work, this economic, social – and political – choice has been challenging countries such as India, whose room for manoeuvre in terms of land-availability is narrow: this one-billion-people country experiences today both fast population growth and rising income levels (which is increasing demand for agricultural products); moreover, on the top of this, flawed government policies have been putting the country’s land and water resources under enormous strain.

Given the heterogeneity of biofuel programs, it is impossible to pretend that one policy could fit all. As it was argued in this paper, many elements differentiate Brazil’s ethanol program and India’s jatropha plan, simply because the choice of the feedstock, land availability, demographic density and political management were far from being similar. In the case of India’s jatropha plan, given jatropha’s disappointing biological features, further attention must be paid on future social and environmental impacts of jatropha’s national

¹⁵² According to the online OECD glossary on Statistical terms: <http://stats.oecd.org/glossary/detail.asp?ID=6611>

programme. If politicians keep their will to maintain this national project¹⁵³, they will have to investigate more thoroughly the use of idle or marginal land and avoid encroachments of jatropha plantations on wastelands that are used for subsistence agriculture or that perform important ecosystem functions. The Indian government should apply some criteria suggested by Woods and Black (2008), and consider whether the land used is 1) of low carbon stock; 2) of low biodiversity value; 3) of low value cost; 4) capable of high productivity; 5) in need of rehabilitation; and 6) in an area where investment will support food production and wealth growth for local inhabitants. Nevertheless, due to India's low land availability, Indian authorities should look for new possibilities, diversify its energy mix and consider investing in other renewable energies, such as solar, given that the country enjoys a privileged tropical weather: according to Government of India's energy adviser, Surya P Sethi, "just 2.25 million hectare land under solar cells with 15 per cent conversion efficiency could yield the same energy as 60 million hectare of wood plantation. Only 7 to 8 million hectare land under solar cells can give India energy independence for the next two decades and a half." Other possibilities could also appear with progress of second generation biofuels. India must take this evolution in research into account, if it wants to better adapt its biofuel policy to more sustainable biofuel crops. As *The Economist* puts it, 'the biofuels of the future will be tailor-made'¹⁵⁴ and "researches are exploring new avenues of biofuels, with the double purpose of finding new crops that do not put food consumption at risk and that are energy-efficient". So far, three varieties of crops have been studied: grasses, trees and algae. Possibly the latter would worth more attention from authorities, as algae 'promise a high-quality product, oil, that will not need much treatment to become biodiesel'.

With regard to Brazil's bioethanol, its level of global sustainability is improving, thanks to advances in technology (especially in sugarcane harvesting) that are already contributing to reduce sugarcane burnings and labour mistreatment. Today Brazil's sugarcane ethanol is seen by the international community as probably the most sustainable large-scale production of biofuel in the world, to the point that the OECD (2007) states that "liberalising trade in biofuels is essential for global objectives", because "ethanol made in Brazil is by far the cheapest biofuel today" and "South America has a large potential to increase biofuel production". Brazil seems to be ready to double its production by 2015, and overall arable land surface devoted for soybean and sugarcane could be multiplied by ten by 2020. This

¹⁵³ Because the government spent a lot of effort, money and time on the drafting and implementation of the National Jatropha Mission, there is so far no real willingness from authorities to drop the whole project

¹⁵⁴ *Grow Your Own*, *The Economist*, Jun 19th 2008

target seems technically feasible, but these prospects directly arouse doubts on the benefits of agricultural production intensification and fears of deforestation. The Brazilian government argues today that the increase of bioethanol production will be made through productivity gains – that is, by investing in infrastructure (the government plans today to build pipelines for a more efficient transportation) and in research. According to Furtado (2007), if Brazil's ethanol appropriately meets expected high levels of competitiveness, it may be exported at an unbeatable US\$ 0.30 per litre, and could then generate net inflows of US\$ 30 billion per year. If this occurs, ethanol would consist of one of the main source of revenue of the country. We cannot help remembering that the economic dimension¹⁵⁵ of biofuels still widely prevails today, and is put on the forefront of concerns. But in the field of deforestation, the government is still blowing hot and cold: last May, Brazil's Environment Minister, Marina Silva, a staunch defender of the Amazon rainforest, resigned from her post. Greenpeace Brazil argued that the minister left because her firm stance against deforestation was becoming unbearable; and, last June, it was reported¹⁵⁶ that the government was been intensely lobbied by biofuel advocates to allow the use of already devastated parts of the Amazon rainforest to sugarcane for ethanol. This is a worrying trend, because if the government allows that producers go into the 20% Amazon damaged area, not only runoff from sugar mills will pollute the region, but also producers will be prompted to raze further surrounding virgin forest. But as countries are now increasingly concerned about their international image – and it has been clearly the case of Brazil, since recent controversies on biofuels sprung out – it is more than ever accurate to say that if governments and civil society put forward a strong stance on vital issues, and prompt global awareness around them, then it will become politically costly for governments to allow small interest groups to carry too much weight in public affairs at the expense of the majority. This represents one of the major challenges that NGOs and grassroots organisations will have to take up in their effort of creating an (upcoming) global civil society.

¹⁵⁵ But there is no denying that on the condition they do not harm social and environment well-being, biofuels could represent a concrete window of opportunity for poor countries, especially for those living in tropical areas. As Jacques Diouf, Director-General of FAO puts it :”bioenergy provides a chance to enhance growth in many of the world's poorest countries by bringing about an agricultural renaissance and supplying modern energy to a third of the world's population” (*Financial Times*, 15 August 2007)

¹⁵⁶ Forbes.com, “Brazil defends Amazon sugarcane planting”, June 1st, 2008

BIBLIOGRAPHY

Books and reports :

- Agencia Latinoamericana de Información (2008) “Sugarcane plantations destroy the *Cerrado* in Brazil” by Mendonça M, July 2008
- Altenburg T. et al. (2008), Biodiesel Policies for Rural Development in India, German Development Institute, New Delhi
- Baer B., Filizzola M. (2005) “Growth, Efficiency and Equity: The Impact of Agribusiness and Land Reform in Brazil”, *Latin American Business Review*
- Barbieri J. (2005) “30 anos do Proálcool no centro do debate”, *Jornal da Unicamp*, Edição 309
- Braunbeck O, Cortez L.(2000) “Sugarcane Culture and Use of Residues”, in: *Industrial Uses of Biomass Energy: The Example of Brazil*, dir. Rosillo-Calle F., Bajay S. ,CRC Press
- Bolling C., Suarez N. (2001), “The Brazilian Sugar Industry: Recent Developments”, *Economic Research Service/USDA*
- De Hollanda J. B, Poole A.D (2000) “*A cana de açúcar como fonte de energia no Brasil*”, Instituto Nacional de eficiência energética
- Department of Science and Technology (2008), “Biodiesel: Technology & Business Opportunities – An Insight”, *Technology Information, Forecasting and Assessment Council (TIFAC), Department of Science & Technology*
- Duquette M. (1989) *Grands Seigneurs et Multinationales: l'économie politique de l'éthanol au Brésil*. Montréal : Les Presses de l'Université de Montréal
- Environmental Audit Committee of the British House of Commons (2008), *Are Biofuels Sustainable?* First Report of Session 2007/2008
- ESMAP (2005), Potential for Biofuels for Transport in Developing Countries, Energy and Water Department, World Bank.
- FASE, REBRIP (2007) *Agrocombustíveis e a Agricultura Familiar e Camponesa, Subsídios ao Debate*, Rio de Janeiro: FASE/REBRIP
- Food and Agriculture Organization (2005), *Global Forest Resources Assessment 2005*
- Furtado A, Scandiffio M. (2007) « A promessa do Etanol no Brasil », *Visages d'Amérique Latine*, septembre 2007
- Gallagher report (2008), *The Gallagher Review of the Indirect effects of Biofuels Production*, Renewable Fuels Agency
- Gonsalves, J (2006), An Assessment of the Biofuels Industry in India, UNCTAD, Switzerland
- Heller, J. (1996) *Physic Nut Jatropha Curcas L. Promoting the Conservation and Use of Underutilized and Neglected Crops*. Gatersleben: Institute of Plant Genetics and Crop Plant Research, and Rome: International Plant Genetic Resources Institute.
- Jones, N. and J.H. Miller (1993) *Jatropha Curcas, a Multipurpose Species for Problematic Sites*. Washington, D.C.: The World Bank
- Joshi, S (2007), *Simarouba glauca, Lakshmi taru*, University of Agricultural Science, Bangalore
- Macedo, I. d. C (1995), *Converting Biomass to Liquid Fuels: Making Ethanol from Sugar Cane in Brazil. Energy As An Instrument for Socio-Economic Development*. United Nations Development Program,
- Macedo, IC, Nogueira, LAH (2005), *Biocombustíveis, Cadernos do Núcleo de Assuntos Estratégicos da Presidência da República*

- Mahabir R. (2008) "India in slow lane in drive for greener fuels", *The Economic Times*, 15 February 14, 2008
- Mathews J. (2007) Can Renewable Energies be Turned to a Source of Advantage by Developing Countries?, *Revue de l'Énergie*, n° 576, mars-avril 2007
- Maybury-Lewis, Biorn (1994), *Politics of the Possible. The Brazilian Rural Workers' Trade Union Movement, 1964-1985*, Philadelphia, Temple University Press.
- Mendonça M. L. (2006) "Excess Sugar: The Devastating Impacts of the Sugar Cane Industry in Brazil", LRAN Briefing Paper Series
- Mera M.G. (2007) "Macroeconomic Concerns and Intrastate Bargains: Explaining Illiberal Policies in the Brazilian Automobile Sector", *Latin American Politics & Society*
- Ministry of Rural Development (2006), *The National Rural Employment Guarantee Act 2005 (NREGA), Operational Guidelines 2006*, 2nd Edition Government of India, New Delhi
- Organization for Economic Cooperation and Development (2007), *Is the Cure Worse than the Disease?*
- Organization for Economic Cooperation and Development (2008), *Economic Assessment of Biofuel Support Policies*. Directorate for trade and agriculture
- Pimentel D., Patzek T. (2005) "Ethanol Production Using Corn, Switchgrass, and Wood, Biodiesel Production Using Soybean and Sunflower", *Natural Resources Research, Vol. 14, No. 1, March 2005*
- Pinto E. et al. (2007) "The Myth of Biofuels", LRAN Briefing Paper Series
- Planning Commission (2003), *Report of the Commission on Development of Bio-fuel*, Planning Commission, Govern of India, New Delhi
- Smeets et al. (2006) *Sustainability of Brazilian bio-ethanol*, Universiteit Utrecht, Unicamp
- UNCTAD (2008), *Adressing the Global Food Crisis*
- United Nations (2007), *Brazil: The Ethanol Revolution from a Cane Cutter's Perspective*, UN Television, 21st Century Television Series, Programmes 12.
- Welch, Cliff (1999), *The Seed was Planted. The São Paulo Roots of Brazil's Rural Labor Movement, 1924-1964*, University Park, PA, The Pennsylvania State University Press
- Woods J, Black M (2008) *Summary of local land use change impacts and opportunities*, UK Renewable Fuels Agency.
- World Bank (2005), *Potential for Biofuels for Transport in Developing Countries*. ESMAP, Energy and Water Department.
- World Bank (2006) , *India, Inclusive Growth and Service Delivery: Building on India's Success*, Development Policy Review, May 29, Washington D.C.
- World Bank (2007) *The Little Green Data Book*.

Articles from newspapers, magazines :

- *Commodity Online*, "India to see Jatropha revolution", <http://www.commodityonline.com/news/topstory/newsdetails.php?id=3163>
- *Folha de S. Paulo*, "Veículos flex somam 6 milhões e alcançam 23% da frota" 31 July 2008
- *Folha de S. Paulo*, "Petrobras teme perder mercado para o álcool", 25 April 2008.
- *Forbes.com*, "Brazil defends Amazon sugarcane planting", June 1st, 2008
- *Fortune*, "How to Beat the High Cost of Gasoline. Forever!" 24 January 2006
- *Green Car Congress*, "State Bank of India Funds Jatropha Cultivation for Biodiesel", 14 April 2005
- *India eNews*, "Jatropha harmful for kids, soil and aquatic life", 8 May 2008
- *Ipsnews*, "Lula Calls for Flexibility from Rich Counties", 21 February 2008
- *Le Monde*, « Faire face au troisième choc pétrolier », 8 June 2008,

- *Le Monde*, « Les quinze plus gros émetteurs de CO2 dans le monde », 17 April 2007
- *Le Monde*, « La Fièvre du biodiesel s'est emparée du Brésil » 13 August 2006
- *Livemint.com* "Jatropha may secure energy, but planting schemes fail to bear fruits", 21 November 2007
- *Los Angeles Times*, "Human Cost of Brazil's Biofuels Boom", June 16th, 2008
- *Navdanya.org* "Biofuel Hoax: Jatropha and Land Grab", www.navdanya.org/news/5dec07.htm
- *Reuters*, "Millions in India Lack Water as Country Dries up", June 9th, 2003
- *Reuters*, "Brazil's ethanol exports to rise in 2008:F.O.Licht", 5 March 2008
- *The Economist*, "Melting Asia", June 5th 2008
- *The Guardian*, "Biofuels: Brazil disputes cost of sugar in the tank", 10 June 2008
- *The Hindu*, "Farm suicides rising, most intense in 4 States", November 12, 2007
- *The Hindu Business Line*, "World Bank for radical farm policy changes", December 20, 2004
- *Time*, "Bioethanol demand forces Brazil sugar cane industry upheaval", June 7, 2008
- *UOL*, "Lula muda discurso sobre biocombustíveis e critica etanol americano", 19 April 2008
- *Veja Magazine*, "Ele é o falso vilão", 27 April 2008
- *Washington Post*, "Our Biofuels Partners", 30 March 2007