CHAPTER 2

UNDERSTANDING THE BIOENERGY AND FOOD SECURITY POLICY LANDSCAPE IN PERU

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2.1 CONTEXT OF THE BEFS PROJECT IN PERU

The Bioenergy and Food Security (BEFS) project is in a special situation following the central government promulgation in recent years for law and regulatory framework to promote liquid biofuel, both biodiesel and anhydrous ethanol. A number of regional governments are supporting bioenergy initiatives such as those of San Martin, Ucayali, Piura and Loreto, which are promoting biofuels through non-governmental organizations (NGOs) and private enterprise.

At the regional level, efforts are being made by San Martin, Ucayali and Loreto to promote the production and use of pure plant vegetable oil from jatropha and sunflower seeds, biodiesel from palm oil and jatropha as well as hydrated ethanol from sugarcane. In San Martin alone there are 16 private-sector and nine public sector liquid biofuel initiatives, Loreto has four private-sector and nine public-sector initiatives; and in Ucayali there are 20 private sector initiatives and six from the public sector to produce liquid. The total of 64 initiatives under way in the Peruvian Amazon[3] (SNV, 2006) is the clearest demonstration of the interest generated in the regions for projects of this type.

In terms of the regulatory framework, the Ministry of Agriculture through the National Energy Plan is defining a future vision, central and specific objectives for the development of bioenergy from biomass generated in the agriculture sector, and setting medium and long-term targets. This opens up a broad framework for promoting the use of biomass for solid and gaseous bioenergy projects, which traditionally have not received sustained government support. Nonetheless, a number of individual projects have been implemented, such as the installation of biodigesters in Cajamarca in the 1980s, which suffered several decades of failure owing to technical shortcomings in the design of the installations, compounded by socio-cultural problems with local population. Accordingly, there are major opportunities to be analysed, such as the exploitation of agricultural residues from rice husks, cotton husk, sawdust, sugar cane foliage which is burned in the fields, and others. The use of biomass from sugarcane foliage for energy is particularly significant as its exploitation would involve reducing consumption of bagasse in the refinery boilers and make this material available for use in the production of paper pulp or chipboard, depending on economic feasibility. Nonetheless, consideration needs to be

3 SNV, Baseline on biofuels in the Peruvian Amazon, 2006

taken of the fact that the refinery boilers would have to be adapted to the use of foliage instead of bagasse which implies a capital investment. The following chart shows the potential for electricity generation from biomass:

Table 2.1

Electric power generation potential using biomass

Region	Generation from biogas (Mwe)	Steam turbine combustion	Steam engine combustion	Stirling engine combustion	Gasification - Internal combustion motor	Gasification - Gas turbine
Amazonas	1.62	5.37	5.03	8.38	8.89	8.38
Ancash	2.53	8.18	7.66	12.77	13.54	12.77
Apurímac	2.59	0.94	0.88	1.46	1.55	1.46
Arequipa	4.94	6.40	6.00	10.01	10.61	10.01
Ayacucho	3.18	0.15	0.14	0.23	0.24	0.23
Cajamarca	4.66	5.88	5.51	9.19	9.74	9.19
Cusco	3.96	3.03	2.84	4.73	5.02	4.73
Huancavelica	1.56	2.33	2.18	3.64	3.86	3.64
Huánuco	2.62	1.88	1.76	2.94	3.12	2.94
Ica	0.45	1.59	1.49	2.49	2.63	2.49
Junín	1.97	0.11	0.10	0.16	0.17	0.16
La Libertad	3.08	47.31	44.35	73.92	78.36	73.92
Lambayeque	0.89	23.81	22.32	37.20	39.43	37.20
Lima	5.48	19.16	17.97	29.94	31.74	29.94
Loreto	0.39	15.68	14.70	24.50	25.97	24.50
Madre de Dios	0.37	4.70	4.40	7.34	7.78	7.34
Moquegua	0.25	0.00	0.00	0.00	0.00	0.00
Pasco	1.02	1.67	1.56	2.61	2.76	2.61
Piura	2.42	6.74	6.31	10.52	6.31	10.52
Puno	4.87	0.14	0.13	0.21	0.23	0.21
San Martín	1.41	11.29	10.58	17.63	18.69	17.63
Tacna	0.31	0.08	0.08	0.13	0.14	0.13
Tumbes	0.12	1.90	1.79	2.98	3.16	2.98
Ucayali	0.57	8.87	8.31	13.85	14.68	13.85
Total	**51.27**	**177.18**	**166.11**	**276.85**	**288.62**	**276.85**

Source: Prepared by the author.

A number of issues need to be taken into consideration in relation to the use of biomass from residue materials for energy production. Particularly, the alternative uses that this have, including industrial uses depending on the type of waste (chipboard, paper pulp, raw material for producing cement in the case of rice husk), fertilizer to prevent soil degradation, and so forth. Moreover, in relation to the energy use of residues from sawmills, there are a number of firms in the selva (Amazon jungle) that sell this material to other sawmills to locations in the coastal regions (costa), such as Tacna and Arequipa, where it is used to generate products such as broom handles, cardboard boxes, chipboard and others.

In order to support the decision process for the use of biomass residues as energy production, it is necessary to know the real energy potential, since this could very well be less than the theoretical calculated potential. One of the key aspects is to assess the trade offs between energy uses and alternative uses. In particular *"Consider the opportunity cost of using some of these residues materials in other more profitable uses, preserving a fraction for use as fertilizer to prevent soil quality degradation, while excluding protected natural areas and primary forests, and adding the criterion of physical accessibility, What potential exists for energy uses of biomass waste obtained from agricultural, agribusiness, forestry and livestock activities?"* This analysis is carried out by BEFS and presented in detailed in Chapter 5 of BEFS Technical Compendia Volume I and II.

The Ministry of Energy and Mines under the regulatory framework for renewable energies recently held an auction for electricity generation projects which consider the use of solid biomass from residues for energy production. As a result, a total of 26 projects were awarded, including two for electricity generation from biomass, namely the Paramonga power plant with a capacity of 23 MW and a cost of cUS$ [4]5.2 per kwh and the Huaycoloro landfill with a capacity of 4.5 MW and a cost of cUS$11.0 per kwh (OSINERGMIN, 2010). The potential for generation of electricity from biomass is substantive in particular for the use of residues from sugar operations from the existing 11 refineries in the country and hundreds of municipal waste dumps, some of which, in the future, could be converted into sanitary landfills like Huaycoloro. Sanitary landfills offer great potential as waste management practices are improved through media campaigns or, in particular, by imposing fines on illegal dumping. In this regard, the Ministry of the Environment is undertaking the "National evaluation of municipal solid waste management services in Peru 2010." This initiative will be carried out in cooperation with the Inter-American Development Bank (IDB), the Inter-American Association of Sanitary and Environmental Engineering (AIDIS) and the Pan-American Health Organization (PAHO/WHO). The aim is to improve municipal solid waste management and coordination with the district and provincial municipalities.

MINEM is also planning to hold tenders in the coming months as part of the Strategic Sustainable Energy and Bioenergy Plan, and this could be a good opportunity to complement the efforts made by various stakeholders in the local domain. In addition, at the government level, a Multisectorial Bioenergy Commission has been set up with

4 US$ cents.

participation from the Ministries of Production, Energy, Environment and Agriculture, promoted by the BEFS Peru initiative. The commission has set up technical groups on various issues such as food security and poverty, policies, technologies, and others. The Commission sees this as a good framework for formally articulating intersectoral policies, and also because other public institutions have been convened through the technical groups, such as DEVIDA, CONCYTEC and civil society representatives such as SPDA, SNV, Soluciones Prácticas ITDG, GVEP International and others. To the extent that BEFS can contribute with its methodologies and tools to this process, the project will be extremely useful.

2.2 AREAS IN WHICH BEFS PROGRESS INTERACTS WITH OTHER GOVERNMENT INITIATIVES

Both in implementing the National Agro-Energy Plan and in the Strategic Sustainable Energy and Bioenergy Plan, the BEFS can make a valuable contribution to strengthening these processes. This would help to optimize budgets, to avoid duplication and reduce the times needed to achieve the proposed targets. A number of aspects of this are highlighted in the following table (2.2).

Table 2.2

BEFS linkages to Government Initiatives on Bioenergy

Agro-energy plan (MINAG)			BEFS
General objective	Specific objective	Targets	
Promote and strengthen inclusive and participatory business models to develop the agro-energy sector	Promote the formalization of land ownership and user rights	By 2012, mapping of zones with hydro-energy potential	The land component in the biomass potential category is undertaking a national land mapping on agro-energy crops. The BEFS through land suitability analysis provides the tools to carry out this.
Strengthen and implement the legal framework for sustainable bioenergy development	Identify sustainability criteria for each region and generate mechanisms for its implementation	By 2015, all regions have identified at least one activity and/or project related to agro-energy	The BEFS has generated information of the existing potential for agri-fuels and biomass projects
		By 2020 there is a 50 percent reduction in the rate of deforestation owing to the consumption of firewood and coal as an energy source nationwide.	The BEFS, through WISDOM methodology, is establishing a mapping of supply and demand for bio-mass residues for energy uses

Strategic sustainable energy and bioenergy plan (TDR preliminary version –MINEM)		BEFS
Components	**Component content**	
Component 1: Preparation of the strategic sustainable energy and bioenergy plan (PEESB).	- Promote sustainable development of these resources in the economic, environmental and social domains. The PEESB will pave the way for achieving the targets established in the areas of renewable energies and bioenergy. It will identify constraints and risks for the development of these areas and also actions to promote mechanisms to overcome them.	The methodologies and tools of the BEFS pursue the sustainable development of the agriculture sector, analysing the viability of bioenergy projects within that framework.
Component 2: institutional strengthening, design of mechanisms to promote renewable energies and bioenergy, and dissemination of results.	(I) Strengthening of the MEM and related institutions for the sustainable use of biofuels; (II) Design of tools and mechanisms (financial, fiscal or of another type) to promote bioenergy projects, guaranteeing their sustainability and the application of clean development mechanisms (CDMs); (III) Design of a research and development programme in renewable energies and biofuels; (IV) Dissemination of results obtained through national and regional workshops.	The BEFS includes preparation of a public policy document that includes an institutional analysis of proposals for strengthening. Regional workshops will also be held.
Component 3: studies of illegal, regulatory and tax framework, and proposals to promote renewable energies and bioenergy in Peru.	(I) Analysis of the legal, regulatory and taxation framework; (II) Definition of suitable proposal to promote the use of renewable energies and sustainable production of biofuels in Peru; (III) Study of the fiscal effects of the changes proposed on tax legislation.	These aspects are expected to be included within the policy documents to be produced in the project.
Component 4: analysis of the productive chain, identification of zones with potential for sustainable production and analysis of the demand for biofuels in Peru.	(I) Life cycle o analysis of the biofuels; (II) With support from a geographic information system (GIS) and basic information, zones with potential for energy crops will be identified, to determine and prioritize those with major potential for the sustainable production of biofuels; and (III) Analysis of demand, availability of raw materials and distribution channels.	The BEFS includes geographic information analysis to identify the adaptability and availability of land for growing agri-fuels drops and supply and demand of readily available biomass from residues for energy uses.

Once the BEFS project has been completed (scheduled for next May) MINEM and MINAG need to have coordinated to include the results of BEFS-Peru in these processes. This involves essential training in methodologies for appropriate staff of those organizations, as well as discussion and review of the main results.

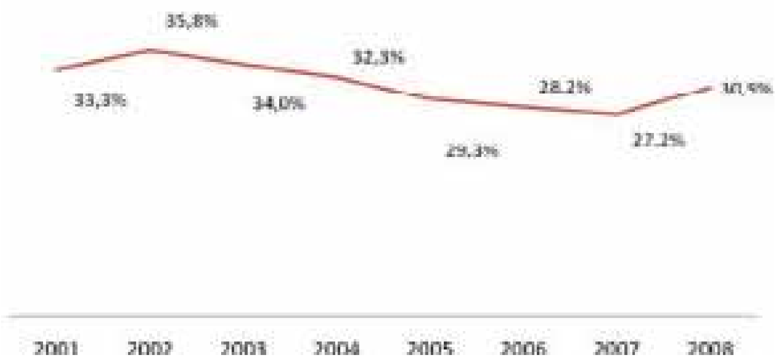
Nonetheless, given the government institutional frailty in terms high staff turnover, information platforms (website) and thematic technical committees need to be set up to provide services when required. This is an essential aspect that would do much to help institutional strengthening of the government. Otherwise the potential applications for the BEFS analytical tools in Peru will gradually fade into insignificance.

2.3 BIOENERGY AND FOOD SECURITY

Peru is in a state of food insecurity. The food insecurity in the country is mainly associated with low levels of income and inadequate use of food by the population. In 2008, roughly 30.9 percent of the national population suffered from calorie deficiency in their diet (Figure 2.1). This caloric deficit reached close to 42.5 percent in rural homes and 28.9 percent among urban families (CEPLAN, 2010).

Figure 2.1

Trend of population suffering from calorie deficit (percent of total)

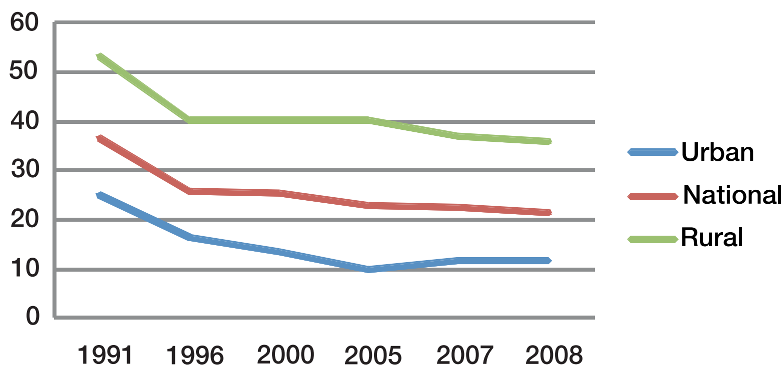


Source: Plan Peru, CEPLAN 2010.

Poverty is directly associated with chronic undernourishment. In 2008, 21 percent of children under 5 were suffering from chronic undernourishment; 50 percent suffer from anaemia and 11 percent display vitamin A deficiency; and in extremely poor households 35 percent of children under 5 suffer from chronic undernourishment compared to 13 percent of non-poor children. Nonetheless, these national aggregated indices conceal major differences between socioeconomic groups, in both urban and rural areas (Figure 2.2).

Figure 2.2

Chronic undernourishment in Peru (percent of children under 5 years of age)



Source: INEI, indicators of results identified in strategic programmes (ENDES 2000, 2005, 2007 and 2008

The 2004-2015 National Food Security strategy for Peru is being implemented against this backdrop. The general objective of the strategy is to prevent the risk of nutritional deficiencies and reduce levels of undernourishment, particularly among families with children under five years old, expectant mothers and those segments of the population in situations of greatest vulnerability; promoting healthy food consumption and hygiene practices, and ensuring a sustainable and competitive supply of domestically produced food products.

The strategy's targets include reducing chronic undernourishment among the under-fives from 25 percent to 15 percent, reducing micronutrient deficiencies, especially anemia among children under 36 months and pregnant women, from 60.8 percent and 50 percent, respectively, to under 20 percent in both groups. As chronic undernourishment is related to education and the family income level, the least affected by this problem are the children of mothers in the highest income quintile, of whom just 5.4 percent suffer from stunting, whereas the worst affected are children of mothers in the lowest quintile, with 45 percent chronic undernourishment rates. Although chronic undernourishment has been declining in the country, Peru still has a high level when compared to other countries in the region.

Despite these facts, Peru is in a promising phase in terms of the interest shown by the government in resuming programmes after an interlude of several years to combat food insecurity among the lowest-income groups as part of its development strategy, Previous work was done under a welfare-assistance approach consisting of social programmes that provided food through the so-called *Vaso de Leche* [glass of milk] programme, targeting popular food kitchens and mothers clubs; or through the JUNTOS programme, to periodically provide money to poorest population groups as means to access food.

Nonetheless, unlike previous years, the Ministry of Economy and Finance (MEF) is now responsible for the monitoring of results from the various programmes including the fight against poverty and child undernourishment. The MEF is instituting the budget by results approach to assign budget to other sectors and programmes. Under this approach, the MEF is working to design a food strategy, which it will apply in the coming months in coordination with other sectors. This approach is considered very important, because it goes beyond welfare support. It seeks to build capacity and empower the rural population so that, on the basis of the development of productive activities linked to each zone and optimal exploitation of local produced food resources (restoring ancestral uses of certain food products), they can help combat the existing food insecurity.

Some regions have also been holding roundtables to combat poverty, which convene central, regional and local government bodies, together with multilaterals and the private sector. Other notable efforts include those being implemented by the Presidency of the Council of Ministers through the Inter-sector Social Affairs Commission (CIAS) and the JUNTOS programme, through the CRECER strategy to combat child undernourishment, supported by FAO. All of these initiatives are aimed at combating child undernourishment and food insecurity.

Until a few years ago there was no national strategy such as those being articulated at present time, apart from isolated efforts by central government and a number of regional governments. Nonetheless, several issues remain to be resolved to ensure that these initiatives achieve better results, including updating of the National Agricultural Census, the most recent version of which was held in 1994. This study establishes the national agricultural production regime, and the land ownership regime, among other aspects which are important to food production. Another important issue is to define jurisdictions on these issues between the Ministry for Women and the Ministry of Agriculture. The Ministry of Agriculture has maintained an approach aimed more at productive analysis linked to specifically social issues. This is one of the reasons explaining the lack of leadership in terms of food security.

On aspects of food security, one of the most recent studies undertaken has been the "Impact of increasing food prices on the vulnerable population of Peru" by GRADE. This analyses how the rise in food prices, particularly commodities, is affecting the population's food consumption, particularly among the lowest-income groups, relating the food consumption basket to calorie consumption. It can thus establish the extent to which the rise in food prices is affecting the fulfillment of the population's calorie needs. It should be noted that multiple reasons may be forcing up prices, not necessarily linked to liquid biofuels.

In relation to bioenergy and its links with food security, there is an important issue to mention, namely the production of crude palm oil. This can be used as an input both for local production of refined oil for food consumption and for the production of biodiesel through a transesterification process. In this case, the Romero group a major producer of palm oil for food, is expanding its operations to incorporate the production biodiesel. The feedstock for the production of oil for food and for fuel is to be supplied by their plantations (17 000 ha). There is also the possibility that, if the international market price for palm oil biodiesel rises in relation to the prices of refined food oil, areas currently destined for the production of refined food oil will be turned over to biodiesel. This scenario will affect the volume of local production of refined food palm oil and could cause an increase in imports of food oils, and thus affect the local market price for this commodity, making it more expensive to use. This aspect shows the direct relations that can exist between the development of bioenergy projects and food security and needs to be evaluated. Moreover possible commercial opportunities for expanding palm oil cultivation areas for biodiesel production can place pressure on primary forests. This has already happened in the Barranquita district in the region of San Martin between (SPDA, 2008) as documented by the Peruvian Environmental Law Society (SPDA).

2.4 BIOENERGY AND SOCIAL CONFLICTS

In developing bioenergy-related projects, particularly large-scale ones and those targeting the residential sector, the social dimension needs to be taken into account. Examples include the ongoing project by SENCICO (SENCICO, 2010), GTZ and others to replace traditional wood-burning stoves with more efficient types through a process of certification and evaluation. This project forms part of the mass programme to upgrade half a million stoves, being promoted by the Presidency of the Council of Ministers with participation from other ministries, and regional and local governments. The process has a major social component, so the success of the programme depends heavily on adequate planning and execution by specialists. The project not only involves replacing one type of stoves with another, but understanding the population's sociocultural situation to facilitate the adaptation process and to ensure the good use of the improved stoves. The same approach can be used in programmes for heating homes using "Trombe" walls. This is currently being implemented by SENCICO and forms part of the government strategy to combat the devastating effects of frosts on low-income population groups living in high Andean zones. Incorporation of the social dimension would make it possible to avoid a repeat of the bad experiences that occurred in past projects implemented by NGOs in the same state.

The social dimension is different in the case of agrofuels, where land ownership is a crucial issue. Excluded from land located in protected natural areas or areas already under concession, extensive untitled areas are used informally by small-scale farmers. For this reason, the Government, through COFOPRI, has been working intensively on land titling programmes with thus far only partial results. With a land titling process under way and interest among business groups to develop sugarcane bioenergy projects on the north costa of Peru, or biodiesel production from palm oil in the Peruvian Amazon, the potential for social conflict clearly exists. This has already happened as mentioned above in the Barranquita district in the San Martin region where the Romero group destroyed primary forest zones to develop oil palm plantations, despite legal measures imposed and the opposition from the population and clergy (Figures 2.3 and 2.4). This not only generated a serious social dispute, but also caused irreparable environmental damage by destroying primary forest areas. In the case of sugarcane ethanol development by the Maple project in Piura (Analisis, 2009) abuse of the population has also been denounced. In this case, land was alleged to have been irregularly sold in the Chira Piura project, without taking account of the fact that there were population centers, homes and concession holders located in the area. This incident clearly infringe on the property rights and legal stability.

Figure 2.3

Deforestation associated with palm cultivation[5]

Figure 2.4

Deforestation in Barranquita - Oil palm plantations[6]

This type of situation undermines the population's belief in bioenergy projects. Given existing institutional weaknesses, it is worth asking what policy measures should be implemented and what type of control actions should be put in placed to avoid conflicts. Given the economic influence of powerful groups, local communities clearly have limited

5 Large volumes of timber are extracted from forests every day to make way for new palm oil plantations.

6 What previously was a forest is now an access road. Fauna and flora are the hardest hit by deforestation.

capacity to uphold their rights, particularly when the government is institutionally weak. Nonetheless, this does not mean that it is impossible to develop bioenergy through inclusive projects that generate employment for the local population and contribute to local economies. A participatory approach for bioenergy development is what institutions like SNV are promoting, through pilot projects in regions such as San Martin, Ucayali and Loreto.

Nonetheless, the following question arises in its own right: *What type of policies should the Government promote to generate commercial initiatives among private enterprises (which could be done without generating employment and local development apart from fulfilling their environmental and tax obligations) to ensure that they are inclusive?* In addition, if making a project of this type inclusive reduces its profitability, *Has the Government considered compensating the enterprise for this opportunity cost loss?* Here it is important to analyse whether what is being sought is to promote and give incentives, or rather to impose or oblige the private sector. A priori, it would seem that the promotion or incentives mechanism would be more easily accepted by entrepreneurs. *So, what type of incentives could the state give?* The idea of tax breaks in return for employing a certain percentage of previously trained local people sounds interesting. Commitments to purchase a given percentage of production, development of transport and communications infrastructure that improves opportunities for commercial exchange, provided the firm generates local employment and directly contributes to the development of the local economies, also seems to complement the above.

On the other hand, with a view to address problems caused by land-ownership disputes between small farmers and business groups, the National Industries Society (SNI) has put forward a new Land Trust Fund scheme. Under this arrangement, the small-scale farmer does not sell his land to a businessman but rents it to a third party as tenant for a given period of time. This tenant will negotiate use-concession conditions with farmer associations, signing an agreement and then negotiating a land-use concession with a firm interested in implementing a bioenergy project, for a given period. None of this would involve sale of the property, which would continue to be owned by the small-scale farmer. The farmer would thus avoid problems of lack of negotiating power vis-a-vis large entrepreneurs and would receive a more than fair price for the land without losing ownership of it. The intermediary would gain by negotiating with farmer associations the fairest price for rental of the land. The entrepreneur would also gain because he would not have to negotiate with hundreds of farmers but with just one intermediary. This proposal is still under debate and has not yet been implemented.

2.5 BIOFUEL REALITY IN THE REGIONS OF PERU

The development of biofuels and bioenergy generally, opens up an opportunity for strengthening the agriculture sector in developing countries such as Peru. However, this requires a process of strategic planning and taking account of sustainable development. These development opportunities manifest themselves in local job creation, the development of local and regional economies, an increase in regional government revenues in the form of payments for water or land-use rights, among other items.

Regional governments, such as those of San Martin, Ucayali, Loreto and Piura, have undertaken initiatives to promote biofuel projects in degraded or abandoned land areas, in coordination with entities such as the Peruvian Amazon Research Institute (IIAP), NGOs such as SNV of Holland, and Soluciones Prácticas ITDG. In the case of San Martin, Lambayeque and Piura, these processes have also been strengthened by setting up biofuel consensus roundtables. These have succeeded in involving private institutions which otherwise would have found it difficult to reaching agreement with the regional authority (Figures 2.5 and 2.6).

Nonetheless, these regional processes generally show that regional governments have shortcomings in terms of the technical staff involved in this process, as well as limited infrastructure for implementing projects with their own resources. Moreover, there is little information available on the region’s natural resources base, supply and demand for biomass residues for energy uses, etc.

For these reasons, it is extremely important to engage the regions in the transfer of methodologies developed by the BEFS project in Peru. Clearly to be useful, such methodologies need to be applied on a regional scale but if staff from the regions is trained and regional governments acquire the necessary infrastructure and hire suitable staff, these processes will be achievable. Nonetheless, implementation is likely to be done in stages, starting first in the the regions where bioenergy development is well underway and then continuing with the others.

Figure 2.5

Biodiesel projects - Oil palm - San Martin

Figure 2.6
Oil palm plant at Espino - San Martin

2.6 SITUATION OF SPECIFIC TYPES OF BIOFUEL

2.6.1 LIQUID BIOFUELS

According to FAO's unified bioenergy terminology, liquid biofuels include ethanol and biodiesel. These fuels are mainly produced from bioenergy corps and are primarily discussed in the context of its use in the transportation sector.

2.6.1.a Anhydrous ethanol and hydrated ethanol

As part of its policy on liquid biofuels, the Peruvian Government is clearly making efforts to promote the use of anhydrous ethanol and biodiesel. In the case of anhydrous ethanol, there is potential for obtaining ethanol from sugarcane. Development of this industry is likely to be concentrated around sugar cane refinery plants in the north costa areas and centre of the country. In total there are 12 refineries with a potential for a production capacity of around 64 million liters per year of ethanol from molasses. Annual volumes of sugar cane processing amounts to between 6 million and 8 million tonnes (including both commercial scale and small-scale producers). The country total commercial sugar production ranges between 600 000 and 800 000 tonnes. Sugar cane production on the Peruvian costa has high productivity levels, averaging 110 and 160 tonnes per hectare per year (MINAG, 2007).

Nonetheless, there are water constraints along part of the Peruvian costa, particularly in the north, which raises the question of whether using water to grow agrobiofuel crops like sugar cane is more beneficial than using the water to grow other corps, including those that are less water-intensive crops. However, the issue of water resource availability also related to existing infrastructure for storage and distribution, and the technologies used to irrigate the crops. In both cases, there are opportunities for improvements; according to Ministry of Agriculture reports, less than 20 percent of water flowing into the Pacific Ocean is exploited, and the rest goes into the sea. Technology-based irrigation is a much more efficient option than the gravity irrigation used in various plantations. Nonetheless, it is important to note that the new sugar cane projects on the northern costa use droplet irrigation which is 98 percent efficient compared to the 55 percent efficiency rate of gravity irrigation. The National Water Authority assigns distribution quotas for water resource to new sugar cane projects only after demands for the population and other agricultural crops have been satisfied. Accordingly, the following issues arise in relation to this topic: *How much would be saved in terms of existing water consumption from technology-based irrigation implemented by new sugar cane production projects for ethanol on the northern costa of Peru* (Figure 2.7)*? What investment do such facilities require? To improve the rate of recovery of water discharged into the sea by 1percent, how much investment is needed in the construction of reservoirs and water distribution infrastructure? How much investment is needed to improve the storage capacity of the Poechos reservoir by 1percent, considering that only is very small part of the reservoir is sediment free? Which option is more profitable, dredge Poechos or build a new reservoir in that zone?* These are some of the questions that need to be answered to ensure that the development of new agro-energy crops production projects will not affect water availability.

Figure 2.7

The Caña Brava project in Piura production of anhydrous alcohol

Consideration should also be given to alternative biofuel crops such as sugar sorghum, which has a considerably lower water consumption than sugar cane (7 000 m^3/ha per year compared to 15 000 m3/ha per year). Pilot projects have been carried out for producing ethanol from sorghum (Figures 2.8 and 2.9) with very promising results, such as those implemented by Monder S.A.C. in Lambayeque (Gianella, 2009). Nonetheless, there are still many shortcomings to be resolved, such as evaluating yields and annual water consumption on a commercial scale.

Figure 2.8
Sorghum crops

Figura 2.9
Lambayeque experimental sugar sorghum project

On the other hand, in the Peruvian selva (where there is no lack of water) the productivity of sugar cane production is low (about half of the costa productivity level) for various reasons, including the fact that soils are continuously water-logged by rainfall and a problem of pest control in these plantations. Also, the areas cultivated with sugar cane are small affecting the economies of scale.

Nonetheless, there are regional initiatives (Figures 2.10 and 2.11) that have not yet received the Central Government's blessing, such as the use of pure vegetable oil and hydrated alcohol in the transport sector. Nonetheless, the lack of support has not prevented pilot projects of this type in regions such as Loreto, Ucayali and San Martin. In the case of hydrated ethanol, firms such as Riso Combustibles and Bioenergía S.A.C. produce fuel to be used in the San Martin region, particularly in motorcycles and adapted motorcycle taxis.

Figure 2.10
Hydrated ethanol plants - Selva[7]

Figure 2.11
Motorcycles adapted for hydrated ethanol

2.6.1.b Combustible pure vegetable oil

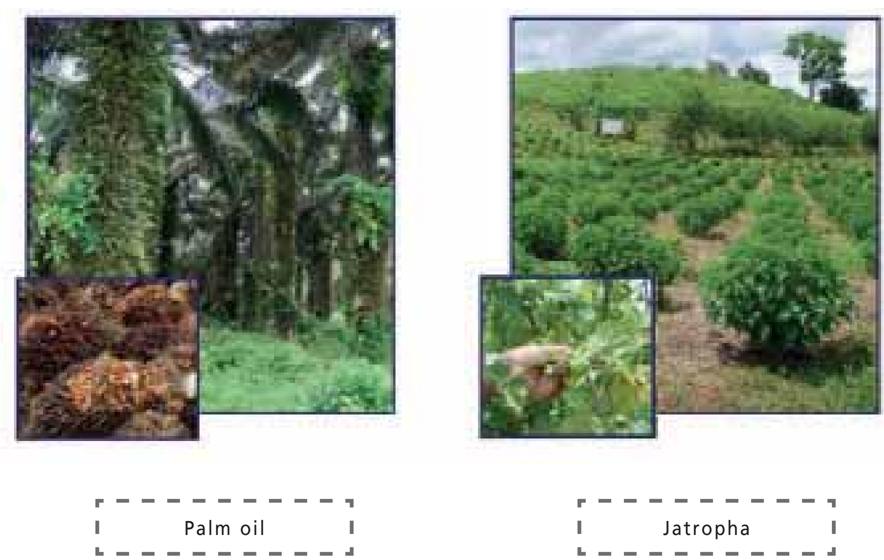
In the case of pure vegetable oils there are a number of pilot projects such as that being implemented by the DED-CFC consortium and WWP Latinoamericana S.A.C. in San Martín (Figure 2.11). The use of pure plant oil as substitute for diesel has the advantage that its international price is lower than diesel oil (about 30 percent, considering that the price of sale to the public of diesel is about US$0.85 per L, compared to the estimated production cost of pure vegetable oil of between US$0.4-0.6 per L) (PUCP, 2009). Nonetheless, for this market to develop, cheaper diesel engines adapted for use with pure vegetable oil are needed, which currently cost between US$350 and US$400 per engine. There is also the believe that the use of vegetable oil as fuel goes beyond environmental benefits but also offers a viable social option to serve local markets.

7 Image to the left: Sugarcane plantations cultivated with high technology by the firm Riso Biocombustibles- San Martín region. Image to the right: Microdistillery for producing hydrated ethanol fuel (AEHC) –Empresa Bioenergía - San Martín region.

Within the Peruvian context, incorporating this type of fuel would help improve development opportunities in rural zones, thereby contributing to diversification of the energy matrix. Nonetheless, there is a risk that given the lack of a legal framework to formalize its use, and defining quality standards and minimum specifications for the end-use equipment, they will not be able to enter a sustainable commercial phase and will gradually fade out of use (Figure 2.12).

Figure 2.12

Raw material for combustible plant oil and biodiesel production



2.6.1.c Biodiesel

In the case of biodiesel, two types of potential feedstock have been identified namely oil palm and *jatropha*. Nonetheless, they are both in very different stages of development. Edible oil palm has been used for decades from the commercial production of palm oil in agricultural lands. On the other hand, *Jatropha* is at an experimental stage and to date a number of *jatropha* pilot projects are been implemented in the Amazon region with participation from GTZ, DED, SNV, INIA and the regional government of San Martin. Apart from *Jatropha*, there have also been experiences with rapeseed, sunflower and castor oil, although the results have indicated a lesser potential than *Jatropha* and are less developed. The attractiveness of jatropha is that it requires little water, adapts well to high altitudes in the selva and can be developed on arid or deforested land provided the soils are not flooded. These are some of the reasons why there is so much interest in the *jatropha* commercial development. Nonetheless, the technology package for exploiting them is still in the development phase, and their production costs do not compete with those of oil palm.

Figure 2.13
Vegetable oil extraction plants

For oil palm according to SNV, there is an installed area of 44 882 ha of which 38 percent are in production, 34 percent in growth, and the other 27.74 percent in nurseries. Productive yields vary according to the production technology and level of inputs used, ranging from 10 to 15 tonnes of fruit per hectare per year, using the traditional technology and/or low inputs; whereas the use of high technology and/or inputs raises production to up to 25 tonnes of fruit per hectare per year. The Palmas del Espino extraction plant reports 25 percent extraction of crude oil, which produces 6.25 tonnes of crude oil per hectare per year. This firm has been working with this crop for 30 years, and has recently started new projects that will cover 15 000 ha of new plantations, to add to their existing plantations (Figure 2.14).

In addition to that commercial production, palm growing associations also cultivate oil palm. In Ucayali the association is called OLAMSA, and in San Martin it is Indupalsa, which, with support from the regional government of San Martin, have set up crude palm oil extraction plants, for commercial sale.

One of the emerging issues with regard to the cultivation of oil palm is that this crop uses farmland rather than abandoned or degraded land. Moreover, palm oil has an edible use and Peru has a deficit in terms of local supply of oil production to meet national food demand, which makes it necessary to import food oils. Oil Palm thus poses a direct impact to food security if this is used for the production fuels rather than for human consumption.

Figure 2.14

Palma del Espino plant - Biodiesel

2.6.2 SOLID BIOFUELS

Solid biofuels are the most widely type of bioenergy used in the local market. It is estimated that between 10 percent and 12 percent of total energy consumption is based on solid biomass. There is also consumption of dung, firewood which has been used in the residential and commercial sector for a long time; and also the commercialization of charcoal (mostly through informal enterprises) for use in the commercial sector. In both cases, the technologies used are informal, so that there are hundreds of thousands of wood burning cookers used in the residential sector mostly in the rural area, but also in the urban sector (Figure 2.15 and 2.16). There are also charcoal ovens. In addition, there is bagasse obtained from the sugar cane refineries and used in the agribusiness sector.

Figure 2.15

Traditional wood-burning cooker

Figure 2.16

Improved wood-burning cooker

2.6.3 GASEOUS BIOFUELS

Peru is fortunate in terms of the potential for biomass resources available. Nonetheless, biomass has several existing uses. In the case of biomass uses for energy generation only large scale generation within agro-industrial sector are considered economically viable in part due to production cost, the availability of raw material, storage and transport. Nonetheless, the following table (Table 2.3) illustrates existing potential:

Table 2.3

Types of bioenergy used in Peru

Type			Inputs	Production zones	Uses of biofuel
Liquid	1st generation	Biodiesel	Oil palm mainly	Amazonia	Transport, electric power generation in isolated communities
			Potentially: white pine nut, castor oil	Deforested costa and Amazonia	
			Rape seed mainly	Mountain	
		Combustible plantoil	Oil palm mainly	Deforested Amazonia	
			Potencialmente: piñon blanco, higuerilla	Deforested costa and Amazonia	
			Rape seed: potentially	Mountain	
		Anhydrous ethanol	Sugar cane potentially	North Costa mainly	Transport
			Sugar sorghum potentially	Ciast	
		Hydrated ethanol	Sugar cane potentially	Deforested Amazonia	
			Sugar sorghum potentially	Costa	
	2nd generation	Ethanol	Forestry residues	Sawmills throughout country	Transport
			Agricultural residues from crops such as sugarcane, rice and others	Zones producing these crops throughout the country	
		Pyrolisis oil	Wild cane, forestry residues, plant bio-mass generally	Amazonia, costa	Electric power generation, heat

Type		Inputs	Production zones	Uses of biofuel
Solid	Firewood for domestic use	Wild and planted trees and bushes	Costa, mountain and selva	Domestic use: cooking, basic productive processes in families or microenterprise, bakeries
	Dung, animal faeces	Animal residues	Mountain	Domestic use: cooking,, heating
	Charcoal	Wild and planted trees and bushes	Costa, mountain and selva	Domestic use: cooking, basic productive processes in families or microenterprise, bakeries
	Agricultural residues	Agricultural residues from crops such as sugarcane, rice and others	Zones producing these crops throughout the country	Electric power generation using heat produced by waste combustion
	Bricquets, pellets	Forestry or agricultural plant residues	Sawmills, zones producing these crops throughout the country	Combustion to generate heat (timber drying ovens)
Gaseous	Bio-gas	Forestry or agricultural plant residues	Costa, mountain and selva	Energy for domestic use, electricity generation.
	Gasification	Plant residues	Costa, mountain and selva	Energy for industrial use, electricity generation.

Source: 2009-Energy Plan - MINAG.

The main source for the generation of electric power based on biomass to supply the interconnected system, is that obtained from biogas generated by the anaerobic decomposition of plant and animal waste. Animal waste can be obtained from livestock ranches, poultry farms, and also from the combustion or gasification of biomass residues produced in activities from the agroindusttrial sector as well as the forest products industry (sawmills). Exploitable residues materials for these purposes include sugarcane bagasse, rice husk, wheat chaff and forestry waste. Also considered are residues produced by poultry, beef cattle and pigs.

Figure 2.17

Sugarcane bagasse - Tuman Lambayeque

Of the biomass currently consumed in Peru, the only type used for generating electric power through steam turbines in aqua-tubular boilers is cane bagasse. In 2008, 1 055 tonnes were used to generate electricity in sugar refineries, representing 3.1 percent of total energy consumed for electricity generation in 2008 (MINEM, 2009). Bagasse is a byproduct obtained from the processing of sugar cane, and is used in sugar refineries to co-generating energy to produce both electricity and generate heat in the form of process vapour. The table shows (Table 2.4) the potential installed in refineries in MW.

Table 2.4
Sugar refineries 2003 - Installed power

Firm	Name of Plant	Installed Power MW	Type	Region
Compania Peruana del Azucar S.A.	CT Compania Peruana del Azucar	3	Interconnected	Ancash
Complejo Cartavio S.A.	CT ASCOPE	9,8	Decentralized	La Libertad
Empresa Agroindustrial Cayalti	CT Turbinas-Planta Fuerza	7,2	Interconnected	Lambayeque
Empresa Agroindustrial Pomalca	CT Pomalca	12,5	Interconnected	Lambayeque
Empresa Agroindustrial Pucala, S.A.	CT Casa Fuerza-Fabrica	8,5	Interconnected	Lambayeque
Empresa Agroindustrial Tuman, S.A.	CT Tuman	8,4	Decentralized	Lambayeque
Empresa Agroindustrial Laredo	CT Laredo	5	Interconnected	La Libertad
Empresa Agroindustrial Casa Grande S.A.A.	CT Casa Grande	24,6	Decentralized	La Libertad
TOTAL		79		

Source: Ministry of Energy and Mines.

The energy production capacity varies depending on the type of technology that is employed in the process, since each technology has its own efficiency ranges. In addition, each technology entails specific investment requirements in terms of US$ per kilowatt. Nonetheless, the analysis does not include other factors such as the operating characteristics of technologies that make it more feasible to use certain types of biomass materials versus others. A generalization has been made to present the various technological options available on the market.

In addition, there is the potential for production of biogas to generate electricity, using waste from bovine animals, pigs and poultry. For that purpose, considering that only 5 percent of the existing population is concentrated in poultry farms or stables and that only 50 percent of the waste generated from an can be used. The result of this evaluation shown below (Table 2.5):

Table 2.5

Potential electricity generation using biogas

Region	Generation from biogas (Mwe)
Amazonas	1.62
Ancash	2.53
Apurímac	2.59
Arequipa	4.94
Ayacucho	3.18
Cajamarca	4.66
Cusco	3.96
Huancavelica	1.56
Huánuco	2.62
Ica	0.45
Junín	1.97
La Libertad	3.08
Lambayeque	0.89
Lima	5.48
Loreto	0.39
Madre de Dios	0.37
Moquegua	0.25
Pasco	1.02
Piura	2.42
Puno	4.87
San Martín	1.41
Tacna	0.31
Tumbes	0.12
Ucayali	0.57
Total	51.27

Source: Prepared by the authors

2.7 CONCLUDING REMARKS

- The current bioenergy situation in Peru shows that the country is going through a promising period in part due to the policy measures implemented over the last few years. These include the creation of the Multisectorial Bioenergy Commission, which brings together four ministries and various public and private bodies; the holding of the first auction to support electricity generation projects using renewable energy sources; and the holding of three national congresses on biofuel and renewable energy with wide-ranging participation from public and private bodies. In addition, there are some 84 initiatives for bioenergy projects under way in the Peruvian Amazon (SNV, 2006).
- Nonetheless, the institutional weakness of the govenrment and the lack of a clear and sustained policy developed based on solid technical criteria, means that market forces

may raise the risk of large enterprises exploiting small-scale farmers. An example of this is the Barranquita development in San Martin, where a dispute arose over the deforestation of primary forests for oil palm cultivation. An effort by various institutions to provide the government with tools and methodologies to help guide policies development that considers sustainable development of agriculture through bioenergy is extremely important. Efforts such as SNV, Swisscontact, Soluciones Prácticas ITDG, FAO BEFS and the State itself through IIAP and INIA have contributed much in this regard.

- To complement the policy measures already implemented, it is important to define policies on liquid biofuels in rural zones, with a clear aim of generating rural development, safeguarding food security, stimulating development of value chains and promoting the creation of market niches, as well as job creation. Before preparation of this type of policy, information on geographic zonification to identify areas suitable for bioenergy crops and to evaluate the supply of and demand for biomass from residues for energy uses, analysis of water availability, analysis of the impact of these projects on the local and national economy, and their incidence in terms of job creation are necessary. All these aspects are included in the BEFS methodological analysis.
- These policies should take account of the following aspects: What type of incentives should be provided to promote bioenergy projects (preferably in rural areas), once the areas that have potential for these initiatives are known, and following evaluation of the aforementioned aspects? What type of incentives should be used: tax, economic, or a mixture of the two? For how long should such incentives be maintained: medium or long term? What mechanisms will be used to ensure that long-term incentives are kept in place following changes in regional or national government?
- Another issue when defining bioenergy promotion policies is the need to clearly identify the key priorities for developing these projects. For example, projects with low environmental impacts, projects that generate large regional government revenues, inclusive projects with high rates of job creation that make a substantial contribution to improving the local population's economy, among others. Moreover, mechanism and parameters to clearly monitor and weigh out these priorities need to be defined to guide evaluation and implementation of bioenergy project on the ground. In addition, as some parameters may be measurable and others non-measurable, how will the non-measurable parameters be weighted?

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