

Agriculture Sector Strategy and Framework for Action for the Development of Bio-fuels in Pakistan

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Development of Bio-fuels in Pakistan**

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1. The Context

Energy is now one of the most limiting constraints affecting economic development in the country. The reversal in energy policy from hydel to thermal power during the last two decades had now started affecting the industry and agriculture sectors adversely because power produced from thermal energy is costly and local industry and people do not have the capacity to pay the full cost of power produced from thermal energy. Even the IPPs already commissioned are not operating at full capacity due to the reason of deferred payments from PEPCO (Pakistan Electric Power Company) to the IPPs. Until full cost of thermal power is not recovered from the consumers it will be difficult for the PEPCO to make timely payments to IPPs. Moreover, the inefficient power transmission infrastructure (transmission losses including theft sometime reaches to 35%) and rent seeking behavior in the distribution, metering and billing of electricity have increased the price of power for the consumers. The only option left with NEPRA (National Electric Power Regulatory Authority) and WAPDA is to increase the price of electricity for the consumers because the PEPCO and other regional power companies are not in a position to reduce the line losses, control theft and manage power failures and breaks. ***Load shedding is the only management tool available with the national and regional power companies to manage the peak demand.***

Energy is vital in agriculture sector, as farming is now mostly done through tractor and machines. The field operations (seedbed preparation, planting, hoeing, harvesting, threshing and cleaning) are largely being done by machines which require diesel-fuel. In addition, there are over one million tubewells in the country being operated using electric or diesel prime-movers. Around 87% of the population of tubewells is being operated by diesel fuel. Therefore, diesel is now has larger application in agriculture compared to electricity. Therefore, the price of diesel fuel in future is going to further affect agriculture productivity and profitability.

The sources of bio-fuels are: ethanol; biogas; bio-diesel from oil plants and crops; etc. There are around 84 mills in the country, which are now fully functional and producing sugar largely from sugarcane. The molasses is the by-product which can be value added as ethanol and can be added in fuels. This is the first-most important option to be considered by the decision makers. For example, Brazil is using larger proportion of ethanol as fuel for the automobiles. The other option is biogas, which can be generated from animal and plant wastes, city wastes, etc. The biogas can be compressed for operating tubewells in the country. In addition, the slurry as a by-product is a pasteurized fertilizer and can be separated as liquid fertilizer and compost under large commercial scale plants. ***The bio-diesel can be produced from plants like *Jatropha*, *Castor*, *Sukh Chain*, *Salicornia*, etc. The by-products of these seeds can be used either as an ingredient of animal feed (if not toxic for animal health i.e. *Jatropha* cake is not recommended as animal feed) or for compost.***

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The country have vast tract of lands, where plantation economy can be developed for bio-diesel plantations. However, the limitation is the freshwater, which is also needed for achieving and sustaining food security in the country. There might be some mis-perception regarding sewage water, although it is suitable for growing *Jatropha* but its quantum is almost negligible compared to the total amount of freshwater available in the country. Furthermore, sewage water is normally preferred for vegetables in peri-urban areas. Therefore, marginal quality waters and rainwater have to be used for developing plantation economy for bio-diesel plants, as the first-most option to make it cost-effective. The water harvesting techniques have to be used for the harvesting of rainfall and runoff in areas like Pothwar plateau, deserts, Sulaiman and Kirthir ranges, salt-affected lands having access to drainage water or saline groundwater. The trick is that can we utilize the drainage water to reduce the surplus for disposal which is difficult because of long distance to the sea and environmental hazards for the lower riparian. The other option with large potential is the cultivation of *Salicornia* which can be grown using seawater and highly saline groundwater. The coastal areas can be developed for a mix of farming by integrating production of shrimp, mangroves and *Salicornia*. But one has to be very careful with the selection of land for *Salicornia* because once cultivation is made using seawater then the land may not be economical to reclaim it for the traditional crops. The integrated farming will result into a sustainable ecosystem. But the change is needed in the mind-set to have concept of dryland farming dovetailed with aquatic food resources using seawater.

The above-mentioned options available in the country provides the context, where country can conduct R&D for developing cost-effective alternatives for the development of bio-fuels and using all the available by-products and plant materials from wastelands to produce ethanol. Coupled with biogas provides an ample potential for developing strategy for the development of bio-fuels in Pakistan. The real question in front of the R&D experts is that “what are the potential areas where bio-diesel plantations can be developed without hampering the food security of the country”. This was the motivation for developing the strategy and framework for action for the development of bio-fuels in Pakistan.

2. Definition of Bio-fuels

There is a need to clearly articulate the definitions of bio-fuels so that all the stakeholders are on the same framework. The PARC and MINFA can adopt these definitions for large scale use in the country. Thus, there is a need for building consensus of various stakeholders covering the decision makers (MINFA), PARC, AEDB, and provincial Agriculture and Irrigation and Power Departments. Some of the important definitions, which are used in the strategy and framework for action, are presented in this section⁷.

⁷ **Bio fuels** mean liquid or gaseous fuels for the use of various prime movers (automobiles, automotives, tractors, farm machinery, tubewells, etc.) and produced from biomass;

Biomass means the bio-degradable fraction of products, wastes and residues from agriculture, forestry and related industries, as well as the bio-degradable fraction of industrial (i.e. ethanol produced from molasses) and municipal wastes (solid wastes);

Other renewable fuels means renewable fuels, other than bio-fuels, which originate from renewable energy sources Products as listed below shall be considered as bio fuels:

- a) **Bio-ethanol:** ethanol produced from biomass and/or the biodegradable fraction of wastes, to be used as bio-fuels;
- b) **Bio-diesel:** a methyl-ester produced from vegetable or animal oils of diesel quality, to be used as bio-fuels;
- c) **Others** such as biogas, bio-methanol, bio-dimethylether, bio-ETBE (ethyl-tertio-butyl-ether), bio-MTBE (methyl-tertio-butyl-ether), biosynthetic fuels, biohydrogen, pure vegetable oil, etc.

3. The National Bio-fuels Policy and Implications on Agriculture Sector Policy

The National Bio-fuels Policy is aimed to contribute to energy security of the country through sustainable production, conversion and applications of bio-fuels. The ECC (Economic Coordination Committee) of the Federal Cabinet has approved the policy recommendations for the use of bio-fuels as an alternate fuel in its meeting held on 15th February 2008. The policy illustrate that “*Gradual introduction of bio-diesel fuel blends with the petroleum diesel so as to achieve a minimum share of 5% by volume of the total diesel consumption in the country by the year 2015 and 10% by the year 2025.*”

The National Bio-fuel Policy provides the direction for development of marketing and industrial infrastructure; pricing, fiscal and financial support, environmental, legal and administrative issues and for creating the environment for extensive research, design and development required to align the characteristics and cost of bio-fuels with those obtained from crude oil.

The aim of the National Bio-fuel Policy is to:

- attain the local capacity for the bio-fuels in order to ensure preparedness among the government institutions and the society, if there is depletion of global fossil fuels and bio-fuels become cost-effective; and
- promote the use of bio-fuels to replace petrol and diesel for transport and other applications with the objective of contributing to energy security and in meeting the objective of environmental protection and climate change.

The National Bio-fuel policy is based or should be based on the following approach involving different stakeholders:

- Time horizon for the policy is clearly spelled out as 2015 and 2025 for achieving targets of blending bio-diesel fuel into petroleum fuel by 5 and 10%, respectively;
- Priority would be given to those bio-fuels which provide competitiveness, comparative advantage and security of supply and also show cost-effective environmental balance;
- Farmers are to be encouraged to undertake farming of crops that provide the feedstock for ethanol and other bio fuels;
- Providing support to such cultivation by assuring a minimum support price to be offered by the Government and industries;
- Education and training of farmers on high oil contents of bio-fuel crops, cultivation techniques and economic benefits;
- Use of waste lands to be encouraged to raise plantation of Neem and Jatropha, saline lands for salicornia and arid lands for castor, and other such species to grow oilseeds for bio-diesel production along with the assurance that these lands and water resources do not compete with food security crops;
- Extensive support to R&D institutions is to be provided for developing suitable process for bio-fuels from various feed-stocks, developing agricultural processes for growing crops for bio-fuels in wastelands besides there should be research on the high yielding varieties of different bio-fuel crops;
- Collaboration must be extended with various agencies including provincial and federal Governments’ organizations (i.e. Pakistan Oilseeds Development Board, National Dairy

Development Board, etc.) and provide support through district level forest and agriculture officers;

- Industrial sector to be encouraged to increase ethanol production from all available feedstock such as cereals, agro-residues and starch-based crops besides optimizing the present level of production from sugarcane molasses route. For this purpose, necessary incentives such as soft loans for establishing new industries/updating existing industry, tax holiday and classification of ethanol as a chemical to allow its free and unhindered movement need to be provided; and
- While large volumes of production of bio-fuels for blending in transport applications for fossil fuels would take some time, parallel use of bio-fuels in the short term may be encouraged for diesel powered machines, water pump sets for irrigation, agricultural machines using diesel, liquid fuel stoves for cooking, distributed power generation, etc. As the major interim use will be in the agriculture sector, therefore a comprehensive Bio-fuel Policy for Agriculture Sector may be formulated by balancing the overall objective of the agriculture sector to attain and sustain food security in the country.

The major implication on agriculture sector policy is that how to balance the objectives of attaining and sustaining food security on longer-term basis and to identify potential areas suitable for the production of bio-fuels without affecting the land and water resources required for food security and export orientation of high value crops. Therefore, the need arise to formulate strategy for development of bio-fuels and agro-energy without hampering the vital objective of food security and export earnings.

4. Proposed National Agriculture Sector Strategy for Bio-fuels and Agro-Energy

The prime objective of national agriculture sector strategy is to ensure food security, export orientation and import substitution for self-reliance in agriculture. The freshwater resources available in the country have to be kept for agriculture purposes for favourable environments where soils are problem free. However, fragile environments where marginal soils and waters are available can be used for production of bio-diesel plants and crops. The marginal water resources can be augmented through harvesting of rainwater and runoff. Therefore, there are potential areas where bio-diesel plantations can be developed without hampering the food security. In addition, the molasses available with the sugar industry can be used for production of ethanol. Similarly, available biomass materials can also be used for the production of ethanol.

The bio-fuels would be able to grow rapidly in the future only if continuous policy support and direction is provided, which is not going to affect the food security on one side and on the other side these plantations are cost-effective because country like Pakistan is already under heavy debt can't afford to subsidize the plantations. Various strategies have to be developed and tested for their cost-effectivity at times when international price of crude oil is increased to a level, where local production of bio-diesel become cost-effective. The point worth mentioning is that the duties and taxes on imported crude oil are more than 100%. Therefore, the real question for the government is how to forego such a lucrative source of taxation by supporting bio-diesel, when the edible oil retail price is almost double of the retail prices of diesel in the market. It is too early to indicate the production cost of bio-diesel oil in Pakistan and conversion into diesel fuel because there is hardly any data available in the country. Even the international information and data is so variable that it is difficult to infer

economics of bio-diesel production in Pakistan. Major strategies proposed for the agriculture sector strategy for bio-fuels are:

Planning and Research

- Conduct detailed surveys and feasibilities for the identification of potential sites where bio-diesel plantations can be established cost-effectively. For example, the plants like *Millettia pinnata* (Sukh Chain) can be grown as watershed management plant in mountainous and Barani regions of the country. For crops like Castor and Jatropha, areas have to be identified where soils are sandy and shallow brackish waters (groundwater or agricultural effluents) can be used without significantly affecting the productivity of these plants;
- Initiate large scale pilot projects in potential areas for large scale testing of bio-diesel plantations to establish cost-effectivity. Based on the research findings, the development projects can be initiated for establishing the plantation economy;
- Undertake studies for comparative evaluation of technologies commercially available in the world and findings should be widely disseminated to all the stakeholders; and
- Undertake evaluation studies on a periodic basis for the followings:
 - Evaluate cost-effectiveness of measures undertaken to promote the use of bio- and renewable fuels;
 - Study economic and environmental impacts of the share of bio-fuels and other renewable fuels;
 - Evaluate life-cycle perspective of bio- and other renewable fuels to indentify measures for future promotion of those fuels that are climate and environmental friendly having potential of becoming competitive and cost-effective;
 - Study sustainability of crops used for the production of bio-fuels, particularly land use, degree of intensity of cultivation, crop rotation and other uses;
 - Assessment of the use of bio- and renewable fuels to study differentiating effects on climate change and impacts on CO₂ emissions reduction; and
 - Review of long-term options concerning energy efficiency measures in agriculture sector.

Development

- Notify standards and specifications for bio-fuels for various applications in the country at par with the international standards and in consultation with the concerned stakeholders. The beginning may be made from the agriculture and rural sectors, where adoption will be much easier for stationary applications;
- Initiate demonstration projects with the financial support of government for production, conversion and applications of various types of bio-fuels with state-of-the-art technologies at specific locations and replication for further expansion in areas which do not hamper food crops;
- Encourage use of byproducts of non-edible oil, bio-ethanol and bio-diesel in established as well as emerging new applications (seed cake, bio-glycerin, bio-pesticides, biogas, biomass gasification and bio-fertilizers) to maximize returns to entrepreneurs and farmers;
- Targeting applications of bio-fuels initially in agriculture sector for stationary and portable applications for generation of distributed power, tubewells and lift pumps and liquid fuel stoves for rural areas;

- Active involvement of federal and provincial governments and their agencies along with the private sector in the production, extraction, processing and distribution of bio-fuels for commercialization;
- Expand feedstock supplies that combine centralized with decentralized production and application;
- Promote public and private partnership in development efforts for bio-fuel plantations; and
- Enforce decentralized market driven approach taking into account local and regional variations, biodiversities and requirements.

Training and Capacity Building

- Initiate Human Resource Development Programmes at the federal and provincial levels including education, awareness, training and capacity building for the farmers to grow bio-fuel crops competitively and cost effectively.

Policy Support

- Promote R&D extensively for advanced technologies for bio-fuels and establishing bio-refineries;
- Enforce policy based on the feasibility studies and R&D project findings for identification and promotion of bio-diesel plantations in various ecologies in consultation with the provincial governments and federal agencies. The policy would include the followings:
 - Identify community/government wastelands inside and outside forests based on research findings for bio-diesel plantation economy;
 - Identify wastelands/degraded/fallow lands;
 - Encourage plantations along the boundary of agricultural fields;
 - Promote intercropping in Barani and Rod-Kohi areas; and
 - Identify lands with sparse vegetation and degraded rangelands.
- Stimulate demand for bio-fuels by issuing bio-fuels directive, setting national targets, ensuring sustainable production, conversion and applications;
- Announce appropriate tax incentives for setting up of bio-fuels plants, appropriate policies on government controlled waste/degraded lands, transfer of lease procedures to potential entrepreneurs, public and private companies, cooperatives, NGOs and farmers for raising diesel-fuel plantations. Provision of Tax incentives may follow one of the following strategy:
 - Partial or full exemption of central excise duties on all bio-fuels;
 - Energy taxation directives; and
 - Incentives for bio-fuels production, conversion and applications in stationary, portable and transport applications.
- Capture environmental benefits through:
 - Fix minimum environmental standards for feedstock production; and
 - Provide fuel quality directives.
- Financial support would also be provided for R&D programmes/projects jointly taken up by the leading research institutions like PARC, public- and private-sector companies to evolve methods to lower the cost of bio-fuels; quality enhancement; product development; production, commercialization and applications on second generation bio-fuels; blending of bio-fuels with fossil fuels; for stationary applications (modification/development of engines required for power generation, agriculture machineries, etc.)

5. Framework for Action

The Framework of Action is important to implement the proposed strategy. The most limiting factor is that when the tax and duties on the diesel and patrol fuel are so high (i.e. over 100%) how the government will afford to provide huge subsidy on bio-diesels because the current retail prices of edible oils are almost double of the diesel fuel. This is the critical element to be considered while developing framework for action. The broad elements suggested for the framework for action are:

- Establish Agriculture Energy Cell at MINFA to address the policy and related issues of bio-fuels and energy efficiency in agricultural operations in the country. This Cell would also address the aspects related to renewable energy resources and their application in agriculture;
- PARC already established Directorate of Agricultural Energy in the Natural Resources Division and work on projectization will be started shortly. PARC should ultimately establish an Institute of Agricultural Energy and Bio-Fuels at NARC to implement the field level activities. Currently, this work is being done by the Water Resources Research Institute at NARC and AZRIs at Bahawalpur and Umerkot;
- Initiate surveys and feasibility studies to identify the potential sites for production of bio-diesel through establishment of plantation economy. PARC may take lead in this area through the involvement of Consultants and experts under the international initiatives being undertaken in collaboration with PARC;
- MINFA may use this Research Briefings as a Discussion Paper and finalize the strategy for Bio-fuels with the participation of all stakeholders and arrange approval of the government;
- MINFA and PARC jointly develop R&D projects including the training and capacity building programmes for the potential areas identified under the feasibility;
- MINFA also form an Advisory Committee to oversee the development of bio-fuels and ensure that these activities will not hamper the overall objective of the agriculture sector strategy to achieve and sustain food security for the country. This Committee will also indentify the areas where policy support is needed for the promotion of cost-effective production of bio-fuels in the country; and
- Develop strong linkages with all the stakeholders relevant to bio-fuel production in the country as the major user of bio-diesel will be the agriculture sector due to applications for stationary engines like tubewells. Strong linkages and partnerships are needed between the government, research institutions, private sector and civil society at large, as there are environmental benefits which can be achieved from the plantation of trees on degraded mountains and rangelands.

As far as the bio-fuels from crops are concerned, the basic hypothesis is that the percentage of small farmers is significant in Pakistan, without their involvement success in this sector is not possible. On one hand subsidizing bio-fuels is not in the favor of government and on other hand even if government subsidizes, how long it can afford subsidy for the perennial crops like Jatropha and Castor whose yield is obtained after one year till then farmer cannot manage to have the food security met. Therefore, the crops whose returns are long term are not favoring the farmers.

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