UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

Renewable energy for the agricultural sector to enhance energy security and food security

Energy Policy Trends in Asia and the Pacific

POLICY BRIEF

Number 1

December 2009

Renewable energy for the agricultural sector to enhance energy security and food security

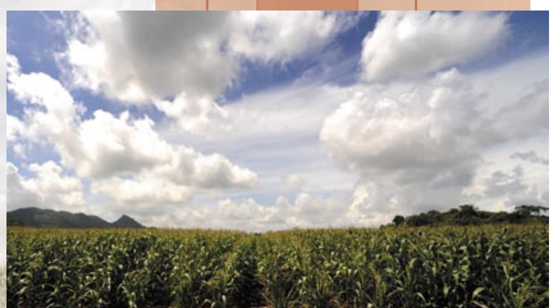
Energy demand in Asia and the Pacific is expected to rise as rapid industrialization increases the thirst for higher living standards and consumption driven by newly acquired wealth and purchasing power. As analysed in great depth in ESCAP's theme study, *Energy Security and Sustainable Development in Asia and the Pacific (2008)*, this economic boom in the region has been fuelled by surges of energy consumption, especially of fossil fuels, including oil, gas and coal. However, high dependency on fossil fuels is aggravating Asia-Pacific region's vulnerability to volatile energy prices, threatening energy security as the share of fossil fuel consumption is expected to remain as high as 82 per cent in 2030.[1] The establishment of a sustainable energy framework was proposed in the study, which certainly would have ramifications for the agricultural sector and rural development in terms of energy inputs for improved agricultural productivity. Even though energy efficiency is one approach for cutting energy costs, this brief will broadly argue for renewables as an option to supplement fossil fuels for the foreseeable future.

> *"Deepening dependence on fossil fuels as a result of unsustainable energy production and consumption patterns and energy insecurity has begotten vulnerability to volatile energy prices, which have affected agricultural production, transportation, and commodity prices, and, hence, adversely impacted food security."*

Fossil Fuel Driven Agriculture is Unsustainable

Today, deepening dependence on fossil fuels as a result of unsustainable energy production and consumption patterns and energy insecurity has begotten vulnerability to volatile energy prices, which have affected agricultural production, transportation, and commodity prices, and, hence, adversely impacted food security. By some accounts, agricultural production in the United States of America is extremely energy-intensive, requiring 50 times more energy than traditional methods (Giampietro, 1993). If developing countries were to pursue the farming techniques of the developed countries, about 50 per cent of all available fossil fuels would be mobilized for agricultural production. In addition, there would be more pressure on the ecosystem in terms of irreparable damage to natural resources, water, soil and the environment. For countries that are dependent on imported fossil fuels, there needs to be a way to decouple the food system from oil dependency if food security is to improve.

At least until peak oil is reached, non-fossil-fuel energy alternatives need to be found in order to supplement energy inputs. Organic farming methods have proven to be effective at least in the growing of crops without the use of fertilizers and requiring less energy inputs per acre. There is also research being done to decrease the so-called "food miles" to encourage both production and consumption of food in a localized manner to reduce the carbon emissions generated by long-distance transport. It has been said that, by moving away from the meat diet, the use of energy in the animal feed and production cycles could be cut down.



Another way to move away from oil dependency is to secure renewable energy sources in order to remove some of the constraints that farmers and fishermen face in investing in agriculture/livestock/

poultry production to increase crop yields, meat and larger fish catches for the commodity markets. In today's large-scale agribusiness and fishery businesses, energy inputs are essential for improving food productivity and therefore enhancing food security (Rifkin, 2002). Food security has become directly dependent on energy resources as mechanized agricultural production and interdependent trade regimes gave rise to globalization. This has led to greater reliance on energy to transport food supplies farther across continents. Thus, enhancing energy security in the Asia-Pacific region by employing alternative energy and energy efficiency measures in order to lower the dependency on fossil fuels would also serve to improve and stabilize food security.

Typically, fossil fuels have been the mainstay energy source, regionally and globally, for agricultural mechanization, irrigation pumps, fertilizer and pesticide production, food processing, and transportation for many decades. The long-term sustainability of global agricultural production would have to rely on renewable energy resources to replace fossil fuels. As fossil fuels will eventually be depleted, it is critical for the region to have a substitute energy supply which includes biofuels to power agriculture production, and each country would have to devise a sustainable energy strategy to ensure that its people can be fed.

Renewable Energy for the Agricultural Sector

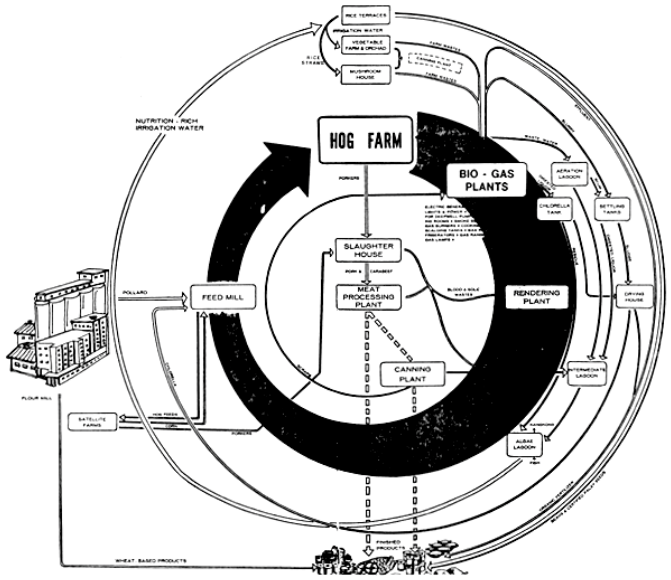
The critical question is: How would food production be maintained vis-à-vis the expected decrease in fossil fuels? Already, there are efforts being made to address the potential fuel shortage problems by introducing alterative fuels, such as renewable energy, including solar, wind, hydro, geothermal, hydro and biomass wastes, to run farm machinery and equipment. However, these efforts are still in the developmental stages, and there have been limitations and difficulties, one of which is high investment and capital costs. Global demand for agricultural machinery rose from $52.7 billion in 2000 to $70.2 billion in 2005 and is expected to rise to $88.8 billion by 2010 (Mehta and others, 2007), but that assumes that fuel will be available to operate the machines. Diversifying energy sources, including renewable energy, would not only improve the energy supply but also enhance food production in remote areas.

Photovoltaic systems or solar energy applications for rural farming can provide electrification and heat on site. Aside from the typical use—that of supplying hot water through solar heaters and electricity—solar crop drying could be applied to colder climates (UNDP, 2000). Solar-heated water can be utilized for cleaning livestock pens and crop processing as well. The advantage of simple to manage solar applications is that they provide energy that is needed and where it is needed to raise agricultural productivity. Solar systems are very useful in remote locations on farms, ranches and agricultural lands where there are no central power sources. Very common in rural areas is the use of water pumps with solar-generated electricity for food cleaning, livestock watering and crop irrigation. Other uses are for feed/product grinding, electric egg collection, refrigeration, livestock feeding, water sprinkling, etc. The advantage of water pumps is that water can be pumped into storage tanks when the sun is shining for use later. Asia and the Pacific as a whole is estimated to have 30-35 per cent of the world's solar energy potential.

Cogeneration and biomass gasifiers are another ideal form of decentralized energy that can be used for generating electricity for rice and sugar mills. Cogeneration power plants can operate on renewable fuels for greater environmental and economic savings. By using biomass wastes, biomethane and biodiesel, these plants can provide a localized energy source to power farm machinery and mills. Biomass gasifier-based power generation system use a clean waste disposal technique that is carbon neutral. In a recent study done by ESCAP in Indonesia and Thailand, it was found that many agricultural factories use biomass sources of excess residues (rice husk, oil palm shell, bagasse, corn cobs) to fuel cogeneration systems also referred to as combined heat and power (CHP) generation (Gonzales, 2007). Such systems allow for local plants to sell their excess electricity to the power grid and use the profit to operate agriculture processing.

Biogas produced from manure, biomass, sewage and energy crops through anaerobic digestion is typically used for domestic heating and cooking fuel. In Asia, the value of biogas usage has already been demonstrated in China, India, Nepal and Viet Nam. In particular, a biogas support programme in Nepal sponsored by SNV (Netherlands Development Organisation) has been successful in providing over 200,000 biogas plants in rural parts of the country. It is said that more than 35 million biogas units were in operation throughout the world by the end of 2008, with 175 million people in China and India having access to biogas (SNV, 2009). There have been verifiable cases in which biogas has been applied to agricultural production—cases that are capable of being replicated in other countries of the region. The Maya Farms model in the Philippines is one of the best examples of a tangible integrated system—a self-sufficient and self-contained farming system based solely on animal and agricultural wastes.[2] The integrated farming model provides a multitude of benefits that maximizes food production with limited natural resources. Not only do biogas plants generate feed for pigs via feed mills, but the electricity generated provides power for lights, engines, pumps, dryers, burners, cooking and refrigeration. Animal wastes are used for algae cultivation and as feed for fish in aquaculture ponds.

Figure 1. Fuel, feed and fertilizer production and pollution control through recycling at Maya Farms



Source: FAO (http://www.fao.org/DOCREP/004/X6518E/X6518E09.htm)

The added benefit of biogas processing is the use of slurry and organic farming to reduce greenhouse gas emissions and substitute for nitrogen fertilizers. Typically organic agriculture would save energy because synthetic fertilizers, which account for over half of agricultural energy consumption, would not be used. By contrast, the current non-organic industrial agriculture and food system contributes 34 per cent of global greenhouse gas emissions (Ho, 2008). While conventional agriculture production methods use more energy due to heavy reliance on energy-intensive fertilizers, chemicals and concentrated feed, organic agriculture uses 30 to 50 per cent less energy in production. Furthermore, organic agriculture is found to decrease the need for irrigation because of better water retention capacity of organic products. In addition, food labels indicating the amount of energy used in the planting, cultivation, harvesting, production, packaging and distribution of agricultural products would serve to heighten awareness of energy conservation issues in the agricultural sector (Ziesemer, 2007).

Irrigation of agricultural lands also requires water pumps that run on diesel and electricity. In India, about half of the available electricity in farm areas is used to operate water pumps (Brown, 2008). In today's agricultural production, large-scale farming techniques require ever greater use of irrigation systems and investments that rely on energy use. Demand for investments in irrigation infrastructure is increasing, which poses challenges for supplying energy to rural areas, where access to energy is very limited. Therefore, small farm owners should be given support so that they can use small, inexpensive pumps requiring either minimal fuel or no fuel, in order to manage their small-scale irrigation needs, especially during dry spells, when they have difficulty accessing groundwater.[3]

Wind power can provide the necessary electricity in select locations where wind endowment is strong and ideal. Wind-generated electricity could make a contribution to farming similar to that of solar-powered electricity and provide rural communities with some energy. Two major drawbacks prevent the wider use of wind power in most inland locations in the region: the high cost of installation and maintenance and the unsuitability of most locations. Wind power is generally known for providing homes with electricity, but small-scale wind turbines are an alternative to diesel and electric pumps for irrigation. According to *World Energy Assessment* in 2000, the ESCAP region possesses about 12-18 per cent of the world's total wind energy potential.

Even though hydropower and irrigation often lead to conflict because upstream water release may interfere with downstream riparian zones, proper design and management can also enhance the water supply for irrigation. Although hydropower is not suitable in some areas, several Asian countries with high potential (China, India, Indonesia, Lao People's Democratic Republic, Nepal and Russian Federation) could generate hydroelectric resources to provide rural and agricultural lands with additional power source for irrigation pumping. The hydroelectric potential of the ESCAP region is 41 per cent of the global total, contributing to an average of 14 per cent of the region's electricity production (ESCAP, 2008).

Hydropower would provide additional energy for grain milling, sawmills and other activities related to farming. Furthermore, surplus power can be sold to the grid, providing communities with additional income.

What is interesting is that small-scale hydroelectric plants, windmill-operated pumps, biogas plants, photovoltaic units, solar energy technologies, biomass conversions and geothermal power in the rural areas of Asia and the Pacific are applications associated mostly with improved living conditions (for example, for lighting, cooking, heating and transportation). The challenge lies in developing the applications further so that renewable power can be diverted to food production in order to enhance energy security and food security. Furthermore, economical and efficient energy conversion technologies would still be needed and would need to be researched in parallel in order to conserve fossil fuels. Another challenge lies in scaling up agricultural production through the utilization of renewable energy in many parts of rural communities with a view to increasing the share of renewable energy in agricultural production significantly.

Biofuels for the Agricultural Sector

Biofuels continue to gain attention among policymakers and stakeholders as one solution to providing an alternative to fossil fuel for transportation and machinery operations. There is no clear-cut, correct answer to this complex issue which is complicated by a trade-off dilemma and a food-versus-fuel debate; however, there is a movement still to maintain certain levels of biofuels as part of the energy mix. The European Union, for instance, has established a mandatory target of 10 per cent renewable energy consumption in transport by 2020 for its member countries to follow, most of which would come from biofuels. To accommodate the expected expansion of biofuel use, imports of vegetable oils into the European Union biodiesel market will eventually rise, much of it coming from Asia and the Pacific, specifically Indonesia and Malaysia. As for the United States of America, legislation known as the Energy Independence and Security Act compels fuel blenders to increase the amount of biofuel annually added to gasoline from the current level of 9 billion gallons (approximately 8 per cent of total fuel by volume) to 36 billion gallons by the year 2022. This would increase imports of feedstock from abroad, including the Asia and the Pacific. It remains to be seen how biodiesel exports to Europe will be impacted as the European Commission is currently in the process of developing a clear framework to address the issue of sustainability criteria by 2010.

As for intraregional biofuels trade in the region, it is considered relatively minor, but there are export opportunities for key biofuel feedstock producers, such as Indonesia, the Philippines, Malaysia and Thailand. China, Japan and the Republic of Korea are projected to be major importers of biofuels in the region in the foreseeable future.

Overall, the biofuels industry in Asia and the Pacific is still very much in its early stages, with potential to expand, but it is currently not at a level that would have a tremendous impact on domestic food markets. The biofuels policies of the major Asia-Pacific producers seem to suggest that there exists a difference in orientation between the more established producers and those with biofuels industries that have only taken off within the past year or two. Policies in China and India indicate an obvious concern for the issue of food security which has been echoed in some of the steps that both countries have taken to prioritize this issue over the continued rapid growth of their respective biofuels industries. It should be generally noted that biofuels, if not managed properly, may drive up food prices in international markets, potentially putting the poor and the vulnerable in a position of food insecurity.

The scope of the biofuels industry in Asia and the Pacific and its relationship and interaction with the global biofuels movement and international agricultural markets is worth considering in analysing the impact of the expansion of biofuels on food security in the region. ESCAP has undertaken a policy review of various impacts that biofuels can have on sustainable development, as explained below in the text box. It is worth noting that, while biofuels production has been expanding in Asia over the past five years, production is currently quite small in relation to the established fuel ethanol and biodiesel industries in the United States, Brazil and Europe. The Asia-Pacific share of fuel ethanol production in 2007 was just 5 per cent, and the current share of biodiesel production likely stands higher, at about 10 to 20 per cent.[4]

Future Considerations

Many questions remain as to how to overcome the energy crisis—the big one—which is expected to occur once oil reserves are depleted. The search for other energy options must continue if the availability, accessibility and affordability of energy for agricultural production is to remain sustainable. Renewable energy is definitely one solution that can be capitalized on, and it is never too late to look deeper into this issue as a sizeable production capacity requires a long lead time to develop. The energy-intensive nature of the current agriculture industry and production makes it imperative to find a sustainable solution. Although the solution may sound easy, the barriers and challenges that exist are formidable: insufficient financial support and difficulties in achieving self-sustaining commercial viability. Thus, renewable energy applications to the agricultural sector should be considered in the current climate change negotiations as one of many means to reduce overall greenhouse gas emissions. In the future, large-scale renewable projects implemented in the agricultural sector will permit more countries to claim credits for emissions reductions.

Box 1. Policy Dialogue on Biofuels in Asia: Benefits and Challenges

In collaboration with the Energy Research Institute (ERI) under the National Development and Reform Commission (NDRC) of China, ESCAP organized a Policy Dialogue on Biofuels in Asia: Benefits and Challenges, held in Beijing from 24 to 26 September 2008. The objective of the Dialogue was to better understand policy issues related to the utilization of biofuel energy resources in a sustainable manner and discuss on country and regional strategy through an open discussion among senior officials and experts from Asian countries that have a strong interest and potential. The participants shared their experience and best practices from their country perspectives, and representatives of the United Nations system (FAO, UNDP, UNAPCAEM and ESCAP) provided information and analysis. The Energy and Resources Institute (TERI) of India, on behalf of the Roundtable on Sustainable Biofuels (RSB), presented the outcomes of an RSB study on the sustainability criteria and standardization of biofuels. The Policy Dialogue focused on six main areas: biofuel and food security, socio-economic impact on rural development, environmental impact, technology transfer, regional cooperation, and sustainability standard and certification. The participants concluded that sustainable development should be the guiding principle for biofuel expansion. The summary report of the Policy Dialogue highlighted priorities for policies and activities that would contribute to the improvement of livelihood of the poor and consider their well being during the entire life cycle of biofuels. The report also called for standards, codes and criteria which promote the use of next generation biofuel technologies according to the specific conditions of individual countries. The view was expressed that trade among Asian countries should be given priority and opportunities explored for trade to flourish in support of energy security in the region. Moreover, information exchange was encouraged among international/regional institutions, government agencies, industries and experts to share relevant data, information and studies in providing a comprehensive and accessible platform for stakeholders to access and use.

Footnotes

[1] Based on primary energy demand outlook for oil, natural gas and coal from *Energy Security and Sustainable Development in Asia and the Pacific* (Bangkok, ESCAP, 2008).
[2] More details of Maya Farms can be accessed from http://www.fao.org/DOCREP/004/X6518E/X6518E09.htm.
[3] Treadle pumps use only human power and are suitable for small irrigation as they can lift water up from a depth of seven metres.
[4] Percentage share derived from figures in Planet Ark, *World Biodiesel Output Growth May Slow—Licht,* http://www.planetark.org/dailynewsstory.cfm/newsid/41147/story.htm.

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ST/ESCAP/2564

Energy Security Section
Environment and Development Division
UNITED NATIONS - Economic and Social Commission for Asia and the Pacific
5F, UN Building, Radjadamnern Nok Avenue, Bangkok 10200 THAILAND
www.unescap.org/esd/energy