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

Energy Policy Trends in Asia and the Pacific

POLICY BRIEF

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

The energy demand in Asia and the Pacific is expected to rise as rapid industrialization increases thirst for higher living standards and consumption driven in pursuit of 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] 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.

> *"Today, deepening dependence on fossil fuels as a result of unsustainable energy production and consumption patterns and energy insecurity, has led to vulnerability to high energy prices affecting agricultural production, commodity prices and 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 led to vulnerability of volatile energy prices affecting agricultural production and transportation, commodity prices and hence, adversely impacting food security. Based on some accounts the practice of agricultural production in the United States of America is extremely energy-intensive which requires 50 times more energy than the traditional methods. (Giempietro, 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. Not only that, there would be more pressures on the ecosystem in terms of irreparable damages to the natural resources, water, soil and the environment. For countries depending of imported fossil fuels, there needs to be ways to decouple the food system from oil dependency if food security is to improve.

At least until peak oil is reached, economies and agriculture sector would have to find other alternative means of energy which are non-fossil methods 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 are 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 carbon emissions from transporting long distances. It has been said that by moving away from the meat diet we could cut down on the use of energy in the animal feed and production cycles.

Another way to move away from the oil dependency is to secure renewable energy sources, so that farmers and fishermen would experience lower constraints in investing in agriculture/livestock/poultry production to increase higher crop yields, meat and larger fish catches for the commodity markets. Energy inputs are most essential in today's large scale agribusiness and fishery businesses for improving food productivity, and therefore enhancing food security (Rifkin, 2002). Food security has become directly dependent on energy resources as mechanised 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 which were not needed in the past with subsistence economies. Thus enhancing energy security in this region by lowering our dependency on fossil fuels with alternate energy and energy efficiency measures, food security would improve and stabilise as a result.

Typically, fossil fuels have been the mainstay energy source for agricultural mechanization, irrigation pumps, fertilizers and pesticides production, food processing, and transportation for many decades globally and regionally. A long-term sustainability of global agricultural production would have to rely on renewable energy resources to replace the eventual drying up of fossil fuels. Because there is a time horizon in which fossil fuels would be depleted, substitute energy to power agriculture production which includes biofuels is critical for the region and each country would have to set a sustainable energy strategy to feed its population.

Renewable Energy for the Agricultural Sector

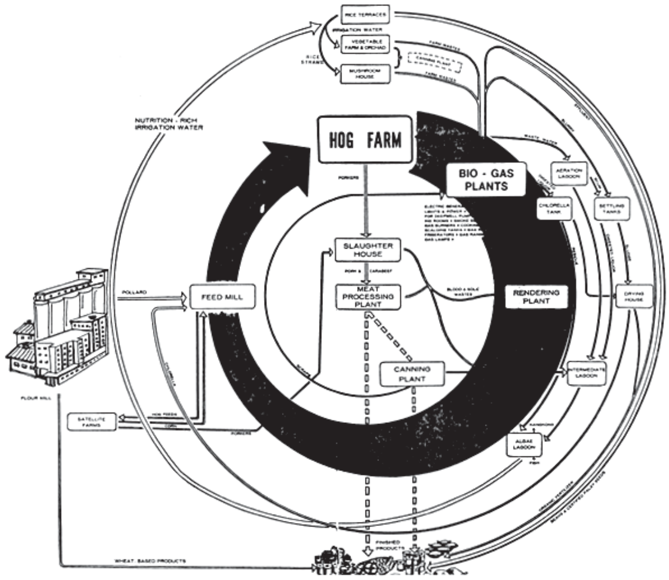
With the realization that oil peak will be approaching and our dependence on fossil fuels would decline in the distant future, agricultural and fishery sectors would have to search for renewable energy to supplement the energy mix for its food harvest, production and distribution. The critical question is how would food production be maintained with the expected decrease of fossil fuels? Already, there are efforts being made to address the potential fuel shortage problems by introducing alterative fuels to run farm machineries and equipment such as renewable energy, including solar, wind, hydro, geothermal, hydro and biomass wastes. However, these are still in their development stages with limitations and difficulties experienced, one of which is high investment and capital costs. Global demand for agricultural machinery has moved from $52.7 billion in 2000 to $70.2 billion in 2005 and should rise to $88.8 billion by 2010 (Mehta etc., 2007). This is with the understanding that fuel will be available to operate the machines. Instead, diversification of energy using alternative sources, including renewable energy would simultaneously improve both energy supply and enhance food production in remote areas.

Photovoltaic system or solar energy application for rural farming can provide electrification and heat on site. Aside from the typical application to supply hot water through solar thermal heaters and electricity, solar crop drying of agricultural products could be applied for colder climates (UNDP, 2000). Solar heated hot water can be utilized for pen cleaning of livestocks 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 the agricultural productivity. Solar systems are very useful in remote locations on farms, ranches and agricultural lands where no central power sources exist. 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-Pacific as a whole is estimated to have 30-35 per cent of the world's solar energy potential.

Cogeneration and biomass gasifier are another ideal form of decentralized energy that can be used for generating electricity for rice and sugar mills. The 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 localized energy source to power farm machineries and mills. Biomass gasifier-based power generation system can use different types of organic materials and uses 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). What is more is that 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. Already in Asian region, the value of biogas usage has been demonstrated in China, India, Nepal and Viet Nam. Especially, the SNV (Netherlands Development Organisation) sponsored Biogas Support Program in Nepal has been successful in providing over 200,000 biogas plants in rural parts of Nepal. It is said that more than 35 million biogas units are in operation in the world by the end of 2008, with 175 million people in China and India having access to biogas. (SNV, 2009) There have been proven cases where biogas could be applied to agricultural production which can be replicated to other countries in the region. The Maya Farms model in the Philippines is one of the best examples of tangible integrated system which is a self-sufficient and self-contained farming system based solely on animal and agricultural wastes.[2] The integrated farming model provides multitude of benefits that maximizes food production with limited natural resources. Not only do biogas plants generate feed to the pigs via feed mills, the electricity generated provide power to lights, engines, pumps, dryers, burners, cooking and refrigeration. The animal wastes are further used for algae cultivation and as feed for fish in the ponds for aquaculture.

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 green house gas emissions and substitute for nitrogen fertilizers. According to a study, organic agriculture would lead to energy savings because of non-use of synthetic fertilizers which account for over half of energy consumption for agriculture. On the other hand, the current industrial agriculture and food system that is non-organic contribute to 34 per cent of global greenhouse emissions (Ho, 2008). While conventional agriculture production method uses more energy due to the 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 to indicate the energy used in the planting, cultivation, harvesting, production, packaging and distribution of agricultural products would help in bringing more awareness to energy conservation 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 the farm areas is used to operate water pumps (Brown, 2008). In today's agriculture production large scale farming techniques require ever more use of irrigation systems and investments that rely on energy use to operate as elaborated in the previous chapter. Demand for irrigation infrastructure investments are increasing and pose challenges for energy supply in rural areas to improve water security. Small farm owners should be given support in using small and inexpensive pumps, requiring either minimal fuel and no fuel, to help them manage their small-scale irrigation, especially during dry spells, to get groundwater and scarce water resources.[3]

Wind power can provide the necessary electricity in select locations where wind endowment is strong and ideal. Wind generated electricity could contribute to farming similar to that of solar powered electricity and provide rural communities with energy service provisions. Two major drawbacks prevent the wider use of wind power in most inland locations in the region - high cost of installation and maintenance and the suitability of location. Wind power is generally know for powering homes, but using small scale wind turbine is an alternative to diesel and electricity pumps for irrigation. According to the 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 water conflict because upstream water release may interfere with downstream riparian zones, proper design and management can also enhance water supply to irrigation. Although hydropower is not suitable in some areas, several Asian countries which have high potential in the region (China, Lao People's Democratic Republic, India, Indonesia, Nepal and Russian Federation) could generate hydroelectric resources to provide rural and agricultural lands with additional power source for irrigation pumping. The hydroelectric potential for ESCAP region is 41 per cent of the global total, contributing to an average 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. What is more, surplus power can be sold to the grid for additional income to the communities.

What is interesting is that small scale hydro plants, windmill operated pumps, biogas plants, photovoltaic units, solar energy technologies, biomass conversions and geothermal in the rural areas of Asia-Pacific are applications used mostly for improving the living conditions such as lighting, cooking, heating and transportation. The challenge is to develop the applications further so that the renewable power can be diverted to food production in order to enhance energy security and food security. Furthermore, economic and efficient energy conversion technologies would still be needed and researched in parallel to conserve fossil fuels. Another challenge is to scale up agricultural production through utilization of renewable energy in many parts of the rural communities so that the share of renewable energy in agricultural production is significantly increased.

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 trade-off dilemma and food-versus-fuel debate, however there is a movement still to maintain certain levels of biofuels as part of the energy mix. EU 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. With the biggest share in the global biodiesel industry with approximately 80 per cent global share, it is expected that imports of vegetable oils into the EU biodiesel market will come in great part from Indonesia and Malaysia. As for the United States of America, the Energy Independence and Security Act compels fuel blenders to increase the amount of biofuel annually mixed 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 create added increase in the import of feedstock from abroad, including the Asia and the Pacific. We will have to wait until how biodiesel exports to Europe will be impacted as the EU 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 remains a potential opportunities for export by key biofuels 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-Pacific is still very much in its development stages, with potential to multiply, but currently not at a level that would have a tremendous impact on domestic food markets. The biofuels policies among major producers in Asia-Pacific 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 through some of the steps that have been taken in both countries 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 the international markets, and potential put the poor and vulnerable in a position of food insecurity.

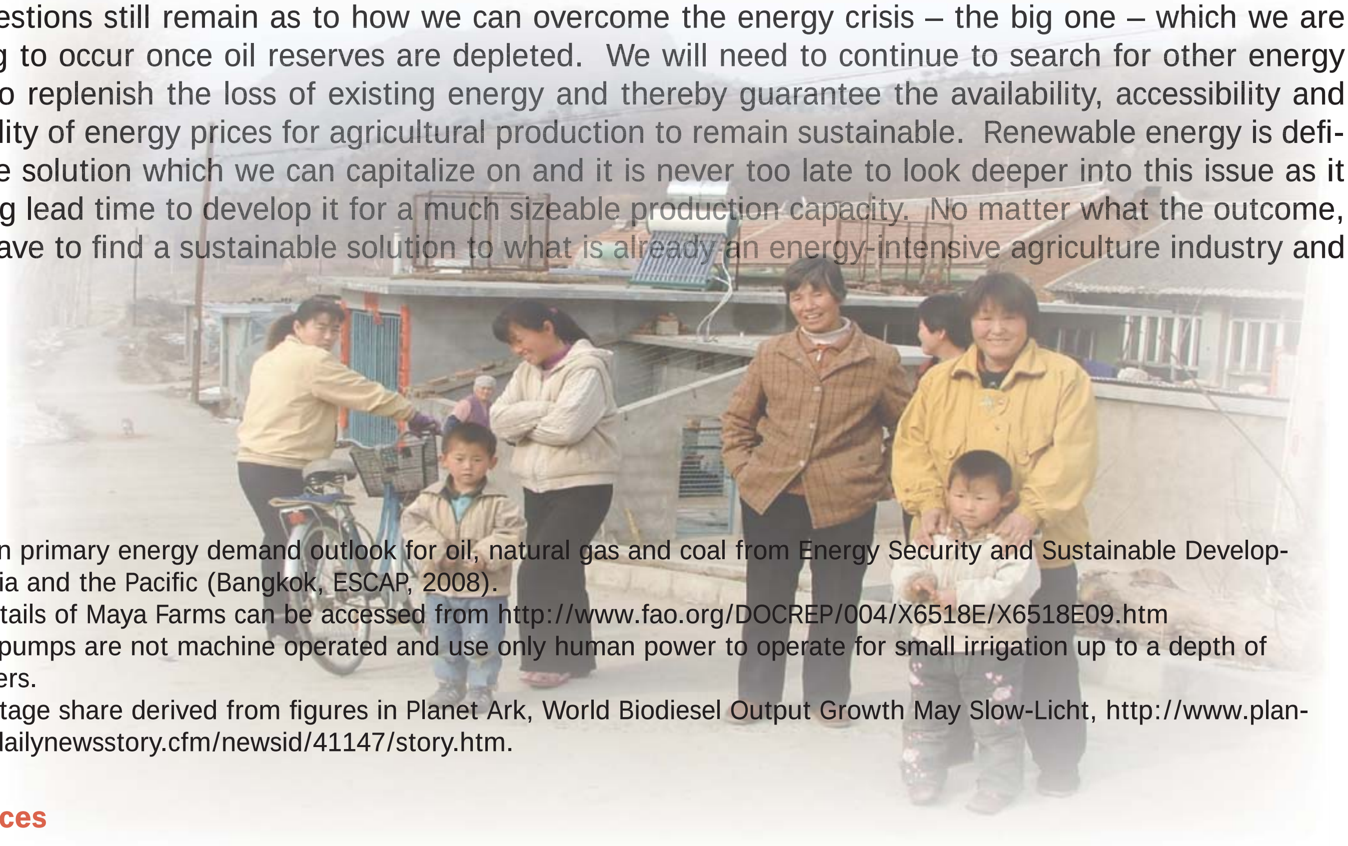
The scope of the biofuels industry in Asia-Pacific and its relationship and interaction with the broader global biofuels movement and international agricultural markets is worth considering in analyzing the impact of the expansion of biofuels on food security in the region. It is worthy to note that while biofuels production has been expanding in Asia over the past five years, production is currently quite small relative to the established fuel ethanol and biodiesel industries in the United States, Brazil and Europe. Asia-Pacific's share of fuel ethanol production in 2007 was just five per cent, and the current share of biodiesel production likely stands higher at around 10 to 20 per cent.[4]

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

ESCAP, in collaboration with the Energy Research Institute (ERI) under the National Development and Reform Commission (NDRC) of China, had organized Policy Dialogue on Biofuels in Asia: Benefits and Challenges from 24 to 26 September 2008 in Beijing. 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 countries in the Asian region that have strong interest and potentials. The participants shared their experience and best practices from their country perspectives and the 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, presented the outcomes of 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. Trade within 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.

Way Forward

Many questions still remain as to how we can overcome the energy crisis – the big one – which we are expecting to occur once oil reserves are depleted. We will need to continue to search for other energy options to replenish the loss of existing energy and thereby guarantee the availability, accessibility and affordability of energy prices for agricultural production to remain sustainable. Renewable energy is definitely one solution which we can capitalize on and it is never too late to look deeper into this issue as it takes long lead time to develop it for a much sizeable production capacity. No matter what the outcome, we will have to find a sustainable solution to what is already an energy-intensive agriculture industry and



Notes:

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 are not machine operated and use only human power to operate for small irrigation up to a depth of seven meters.
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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