Wind Energy, Hydropower and Heat Pumps for Aquaculture

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Wind and water power have a significant contribution to make to onshore fisheries. Wind energy can provide mechanical power to operate pumps and aerators. The wind can also be used to generate electricity.

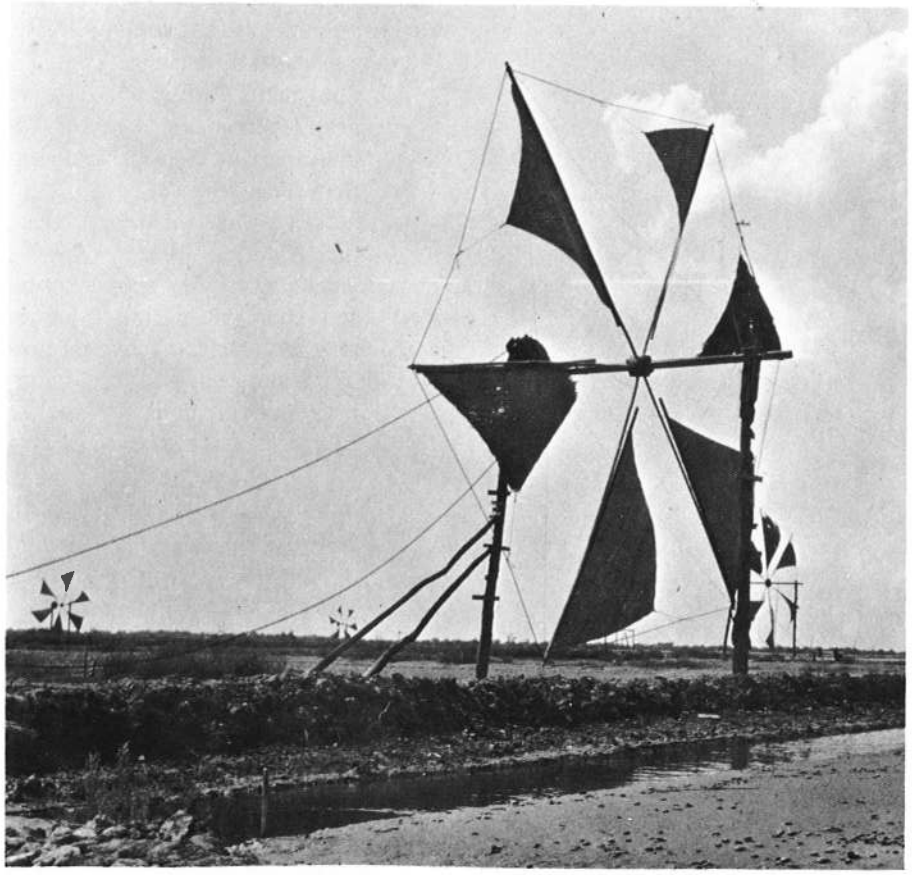
Small-scale hydropower may be used to serve aquaculture in many ways wherever there is a sufficient flow and fall of water.

Refrigeration equipment and heat pumps may be driven by both wind and water power.

The integration of these systems can combine to serve energy needs in fish farming for processing, ice making, mechanical power and electricity.

Wind Power

Wind energy can directly benefit aquaculture by pumping water, aeration and generating electricity. The windmills and associated equipment required for pumping, aerating and circulating water can all be manufactured locally and inexpensively. This provides employment and keeps currency at home that might otherwise go towards foreign imports of equiment and oil. Most electricity-producing windgenerators require industrial fabrication.



Thai sail motor pump used for pumping water into salt beds: coastal provinces of the inner Gulf of Thailand. Photo by R.S.V. Pullin.

Water Pumping

Wherever water has to be pumped from a well or river into a fish pond, wind power is probably the best way . . . a possible exception being a hydraulic ram pump. The fabrication of the wind rotor is a simple technology creating local employment.

In addition to filling fish ponds and rearing ponds, windwmills can be used to circulate water which stimulates growth. They can be used for filtration and for crop irrigation using rich pond water.

Aeration

Windmills are suitable for the continuous aeration of ponds and reservoirs. Wind power compliments photosynthesis by sunlight. At night and in cloudy weather, when photosynthesis cannot occur, the wind is frequently high enough to drive a wind-powered aerator.

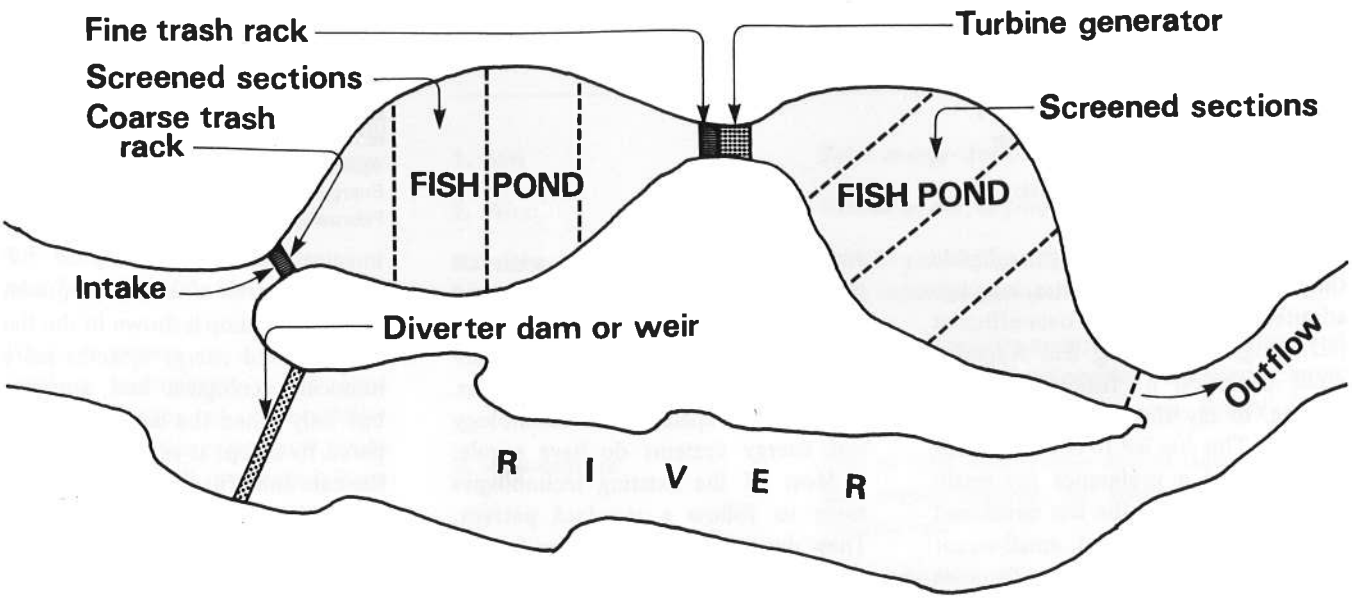
Aeration and circulation of water in a fish pond increases the oxygen level which encourages the growth of fish. Propellers or a paddle attached directly to the shaft of a floating vertical axis windmill are good ways to achieve aeration.

Wind Generated Electricity

For small electricity needs, windgenerated electricity deserves consideration and comparison with oil generators and utilities.

A wind energy system comprises of a wind-driven generator with battery storage for calm spells. It is better if the wind energy is used to operate DC (direct current) appliances as this avoids the added expense of an inverter to take DC from the batteries up to AC (alternating current). Small inverters can then be used for specific appliances. To use windgenerators for heating in aquaculture is out of the question due to the cost and because passive solar collectors or shells provide heat easier than can the wind.

Ideally, wind generators should be used for applications, such as lighting, radio, alarms and other appliances



that cannot be mechanically operated. By using a windmill for mechanical operations the expense and maintenance of both a generator and motor is spared.

A typical one- or two-family operated fish farm would use a wind generator with an output of between 200 and 500 watts.

Wind Powered Vessels

The rising cost of fuel is destined to bring the sail back on the deck of engine-driven fishing boats.

On August 1, 1980, the Japanese launched the first sail-equipped oil tanker, designed to save about 50% of fuel costs. This saving amounts to $442,500.00 annually, compared to an added cost for the two sails of $260,000.00. That means a payback in costs of just over six months.

Hydropower and Aquaculture

Wherever there is flowing water, there is the potential for both hydropower and aquaculture. Most freshwater ponds use rivers or streams as the source of water. Those same rivers and streams may be used to generate electrical power. Most of the work required for a water turbine installation is also needed for aquaculture; inlet channel, tailrace and small diverter dams. It follows that the marriage of the two is a natural one resulting in a supply of both electricity and food.

The most productive aquatic farms use fast flowing waters. An example is the Snake River Trout Company in Idaho, U.S.A., which uses a flow of 60,000 gallons per minute to produce approximately half a million pounds per acre per year. Such water can also be used to generate electricity at the same location as the fish farm.

The optimum location for a "Hydro-fish-farm" is wherever a stream or river has a fall (drop or head) of five feet or more. A fall of that height is generally sufficient to generate electricity.

Refrigeration and Heat Pumps

Refrigeration and heat pumps both depend upon the vapor compression cycle. Heat pumps can supply both heat and cooling, whereas refrigerators are restricted to cooling.

Perhaps the perfect system for a fish farm is a turbine driven heat pump, which takes the heat out of water to form ice and uses the heat for processing hot water, scouring and cleaning. This can be achieved using standard refrigeration equipment, but instead of dissipating the heat into the air, use a refrigerant-to-water heat exchanger to supply the processed hot water.

A windmill or windgenerator may also be used to drive heat pumps and refrigerators with the same multiplying effect. However, the fickle wind must be supplemented with a backup power system to make up for calm periods. For example, a wind driven ice maker or refrigerator could be supplemented with an oil-fired engine to provide backup power.

Conclusion

Compared to the rising cost of oil, and its uncertain supply, the use of wind and water power in aquaculture makes for an independent, integrated and economic supply of protein food and energy.

The cost of locally made windmills and water turbines is below that of oil-driven generators and the oil required to operate them. More important, the locally made product provides employment, keeps currency at home and so benefits the overall economy. An added benefit is the avoidance of air and water pollution.

As our population continues to expand and as each country strives to attain its own energy independence, nothing can contain the growth of these technologies and of aquaculture, which they so ideally serve.