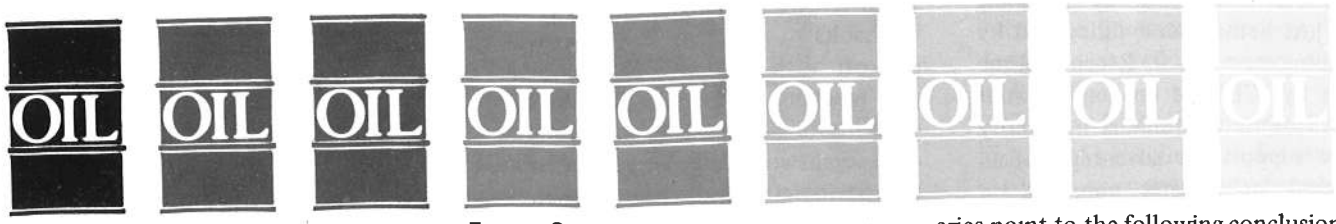
Oil, Fish and the Sun and the Wind



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World oil reserves indicate that replacements for oil must be sought and fairly speedily at that. There is perhaps a 100-year supply of oil at 1979 production levels. However, allowing for increased use in developing countries and moderate conservation policies in developed countries, comfortable production may also continue up to the year 2060. Beyond 100 years, solar and nuclear energy seem the only large-scale options. For us here and now though, shorter perspectives prevail as we discuss various aspects of an energy transition for aquatic food production.

Fish are now the most important animal protein component in the diet of hundreds of millions of people around and in the Pacific. Fish will keep this nutritional importance whether they be fished in boats driven by synthetic fuels or methane, and be iced or otherwise preserved with power derived from the sun by means of ocean thermal energy, by tides, by waves, and in places by solar icemakers, perhaps by hybrid chemical-solar energy generating devices or just plain sun-dried.

It is valuable first to examine in terms of total energy inputs, that is, accounting for fuel as well as the energy costs of process-related equipment and supplies, the costs of various methods of fishing, fish growing and fish saving.

Energy Costs

Fishing

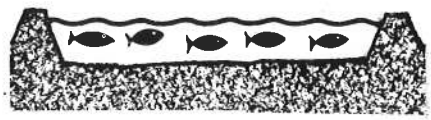
No detailed energy accounting has been performed for tropical fisheries.

However, we can note from examples from temperate fisheries, that by and large, the smaller and simpler the vessel, the greater the proportion of fuel inputs into getting the fish, compared to the other cost components such as material, construction, and amortization.

Fuel costs now near-choke the operators in the Philippine banca fisheries. Clearly there is wisdom in towing small vessels to the fishing grounds and back. Also the slow penetration of the new 200 mile sea spaces of extended economic zones by fishermen of various nations can in part be explained by fuel costs aside from reasons of fish distribution. The relations of boat sizes to fuel costs and to productivity, incidentally, apply equally to smaller fishing units of differing sizes.

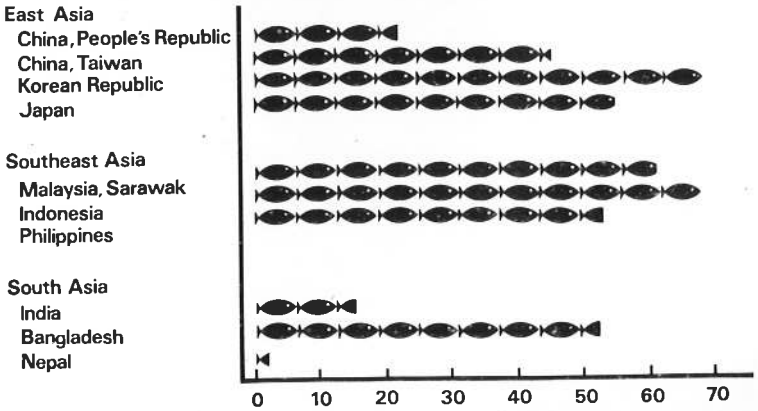
Energy analysis of temperate fisheries point to the following conclusions of importance to policymakers in the nutrition and energy domains: fishing for non-luxury food fishes and much of aquaculture can be cheaper in energy terms and also in monetary terms than most practices of animal husbandry. Non-moving gear such as setnets, weirs and fishtraps win out overall, provided, of course, that the fishery is properly managed to conserve the stocks. By the same token, fish-concentrating devices reduce running time, even though the energy inputs into the large seines used with rafts are considerable. However, if raft fishing for tuna is done with pole and line, it is far more economical in terms of energy than longline and ordinary pole and line fishing for the various species of tuna.

Growing Fish



In culture fisheries, it is of energy advantage to use sewage for fertilization to rear fishes of various feeding types (polyculture), especially herbi-

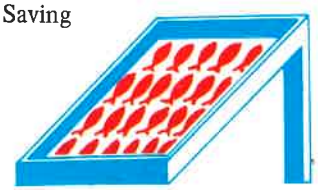
Seafood in Diet of Selected Asian Nations in % of Animal Protein Intake



vores, and to try and shift such artificial diets as are needed into having more plant than animal matter components (we, in Hawaii, are now about to try this for Malaysian prawns *(Macrobrachium)*, both by sprouting seeds just before pond filling and by fashioning new diets). Recent compilations by ICLARM on combinations of aquaculture and animal husbandry further support the advantages of an ecological or systems approach to animal protein production in the tropics*. The Chinese have perhaps gone further than others in their holistic and sound ecological approach to labor intensive food and commodity production practices from land and water.

In general, energy inputs into marine fish culture are difficult to target properly because of the open environment; in any case they have not been the subject of organized and extensive practical research. However, life history attributes of some marine fishes point to sea ranching. I am certain that biological research on migration and feeding habits of some tropical fishes will pay off with the aim of developing new ranching approaches that obviate concentrating devices.

Fish Saving



All preservation methods are energy demanding. Those requiring the least cost (i.e., fuel derived energy inputs, namely drying, smoking and pickling) have dominated fish saving throughout history. They have lost ground in this century, so far, but it does not take much imagination to foretell that they will retain their importance, or regain it, especially in the tropics.

From the scant quantitative data there are on energy requirements of processing fish, one learns that fishing may be far cheaper in energy terms certainly than canning but also than freezing. Sardines caught with stationary gear can take ten to twenty times as much energy to can than to be secured into the hold of a boat.

In contrast, the energy needs of drying and also those of smoking and pickling do not fall within the same order of magnitude; they should, therefore, receive renewed practical research emphasis also with a view to product improvement.

Many fuel efficient gears, such as this beach seine in the Philippines, are highly labor intensive. Photo by Manny Goloyugo.

Renewable Energy Sources

What sources of energy or power, other than dwindling liquid fossil fuels and engines that use them, are, or should be, developed for the various processes that go into fishing, fish processing and aquaculture?

There is no question that sail-assisted fishing boats will undergo rapid and prominent development in the near future. As communicated by Iversen, trials with refurbished and/or new specially designed motor sailers are underway in Britain as well as in the United States, registering fuel savings of as much as 30% over unassisted motor use without inconvenience in the course set or in time; even more ambitious ventures of Japanese ship builders with sail-assisted freighters claim savings as much as 50% in fuel costs. Applied research efforts geared to regional fisheries applications of sail propulsion are highly recommended. They should deal with technical as well as organizational (i.e., social) aspects of retaining or changing over to sail-powered or partly sail-powered fishing fleets.

For the land-based components of fish production, processing, including cooling, and pumping of water, there are opportunities in the use of the sun, wind and biogas, diffuse and intermittent as these first two natural energy sources are.

Windmills, as well as generating electricity, can be perhaps more useful, because of efficiency considerations, for the mechanical work of lifting water, prominently for aquaculture. They may even lend themselves to power simple cooling devices, based on the compression-evaporation cycle of a low boiling point fluid. Research in this direction would be worth pursuing, initially to set limits and test the principle.

Solar icemaking has real potential for villages and small towns, it is, however, the prime example of an intermittent, and sometimes none too reliable energy source.

Solar heating of ponds can create temperature differences from which a gas turbine can be run. Israel hopes to obtain perhaps 20% of its electricity from such devices by the year 2000.

Biogas

Biogas is a much discussed small scale energy resource, nowadays. Fisheries and aquaculture-related applications certainly exist for the heat that biogas can provide; the fail-safe coupling of biogas-generated heat to solar fish dryers is one very obvious one. In general, though, the development of biogas (village)' technologies is usually approached with all the varied and sundry heat or light uses of daily life in mind.

The Crux of the Transition

The need for fish and the nature of fish catching are such that the introduction of engines, and replacement of older with newer boats, will remain a prime need of fisheries. This presents the opportunity to adapt the least fuel demanding engines to boat designs that encompass sail propulsion and to consider towing schemes for non-motorized small boats. At the same time, fuel subsidies for fisheries remain of paramount necessity to be developed at national energy planning levels.

The land based component of the process of providing fish for people to eat has more opportunity for injection of renewable energy devices than fishing per se. It is very important that the nations of this region put emphasis, and therefore funds, on their adaptation to local ecologic, social and economic conditions and, as soon as possible, to their manufacture.

It makes good sense, of course, especially in traditional fishing communities, to plan technology improvements in a systematic, potentially synergistic fashion—e.g., vegetable and fish drying skills and engineering expertise applied to them are clearly interactive and additive.

Studies are needed in which sociologists, economists, biologists and engineers jointly look at the following energy problem areas, among others, as they relate to fisheries.

1. Constraints to the adoption of new technologies, especially as these pertain to realizing potential yield increases.
2. Public policies that can speed the adoption of energy-saving technologies, locally, regionally and country-wide; attention to be given to credit schemes, environmental costs and foreign currency exchange impacts involved.
3. Examine current research geared to production increases and/or improvements in the quality of goods produced, and other like parameters, so as to determine the allocation of future funds for research.
4. Examination of training and extension processes in the entire field.

Participants visit Maya Farms, a large piggery complex powered almost exclusively by biogas. Residue from the digesters is also dried and makes up 10% of the pig feed. Photo by I.R. Smith.

*Pullin, R.S.V. and Z.H. Shehadeh, Editors. 1980. Integrated agriculture-aquaculture farming systems. ICLARM Conference Proceedings 4, 258 p.