EXPERIENCES WITH THE YANMAR DIESEL OUTBOARD ENGINE: OUTER ISLAND FISHERIES, KIRIBATI

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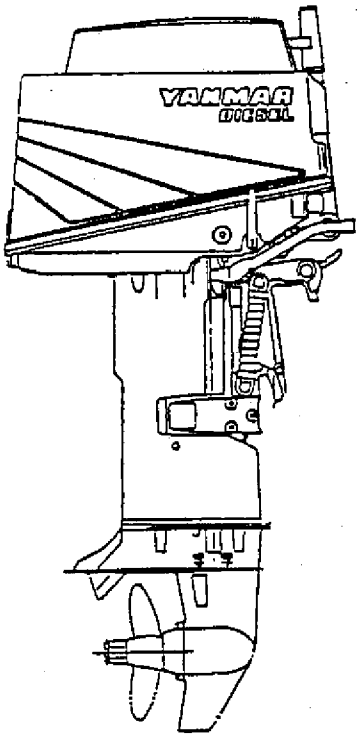
The Outer Island Commercial Fisheries Trial, or Outer Island Project (OIP), has been operating since mid-1988 on two islands in Kiribati: Butaritari in the north of the Gilbert Group, and Abemama to the south of Tarawa, the capital island. Each of these two islands has a project centre, comprising a blast freezer, ice-makers, cold stores, and two generators.

Fish, primarily tuna, are landed at each centre from a fleet of 15 boats; ten are 7.1 m KIR-4 canoes (fitted with 15 hp Yamaha outboards) and five are 5.0 m skiffs (with 25 hp Yamahas), plus other locally-owned artisanal craft. A review of the project in late 1989 concluded that catch rates had to be increased if the centres were to become financially viable and self-supporting.

As the project planned to develop a third centre on the island of Abaiang just north of Tarawa, it was felt that catches could be maximised if large boats (11.0 m KIR-5 canoes and 6.0 m KIR-10 skiffs), all fitted with Yanmar diesel outboards, were used. Consequently, 10 Yanmar D27Y diesel outboard engines (27 hp, standard shaft model with 26.7 cm x 25.4 cm propellor) were purchased directly from Japan and delivered to the project in mid-1990.

For a number of reasons, the centre on Abaiang has yet to be built. If it eventually is, it will be a scaled-down and simplified form of the two existing centres. Emphasis will be placed on supporting the existing artisanal catching sector rather than on large-scale capital investment.



The Yanmar diesel outboard motor used by the Outer Island Project

The centre is likely to be serviced by only two or three larger boats, fitted with Yanmar outboards, for fish transportation to market and for hire.

Before committing these Yanmar diesel outboards to use on an outer island, it was decided in late 1990 to send one engine to each of the existing centres for evaluation; in the case of Abemama, fitted to a KIR-5 canoe, and Butaritari, to a 9.5 m PNG-11 canoe.

All the boats are constructed of marine ply and built locally at the Betio shipyard. One diesel outboard is fitted to a KIR-10 planing-hull skiff, currently based in Tarawa. To date, four of the ten new 27 hp outboards are in use, with one under repair awaiting spare parts from Japan.

The Outer Island Project has so far amassed a total of just over 2500 hours of engine time using these outboards. Initial trials on the PNG-11 indicated very favourable fuel consumption figures (boat load nine persons, no cargo, sea calm with light winds — see table below):

The longest journey so far undertaken using one of these engines also clearly demonstrated its fuel efficiency advantage. Last October, the KIR-5 canoe was delivered by myself and three I-Kiribati from Tarawa to the island of Abemama, a distance of 82 nautical miles.

The journey, motor-sailing, took 12 hours 45 minutes at an

Fuel consumption of the Yanmar diesel outboard

Throttle	Speed (knots)	Fuel consumption (l/h)
Full	13.88	7.34
Three quarters	10.25	3.76
Half	6.45	1.13

average speed of 6.5 knots. Total fuel consumption was 62 litres, or an average of 4.98 litres/hour. More recently, a comparison has been made, using a KIR-10 skiff, of the operational costs of a Yanmar D27Y compared with a Yamaha E40G 40 hp petrol outboard engine. The analysis of operating costs is based on a number of assumptions: as well as the ones stated, they assume equal boat payload (2 persons, fishing gear plus safety equipment) and a 33 per cent longer fishing trip time when using the Yanmar outboard because of the boat's slower speed through the water.

	Yanmar D27Y	Yamaha E40G
Capital costs (A$)	6,500	2,520
Fuel cost — retail (A$/l)	0.50	0.75
Fuel consumption (l/h) (three quarters throttle)	5	15
Maintenance costs (A$) (5% capital cost/year)	325	126
No. engine hours/day	8	6

Note: Fuel cost is based on the price for a litre on 1/7/91

The graph shows that the Yanmar outboard needs to be used for more than 85 fishing days per year before the operating costs become less than for the Yamaha. These calculations do not, however, take account of the following factors that influence the introduction of the diesel outboard to outer island fisheries:

— *Capital costs:* the Yanmar outboard costs almost three times as much as a Yamaha. This cost is a considerable barrier to individual fishermen contemplating investment in a boat and engine;

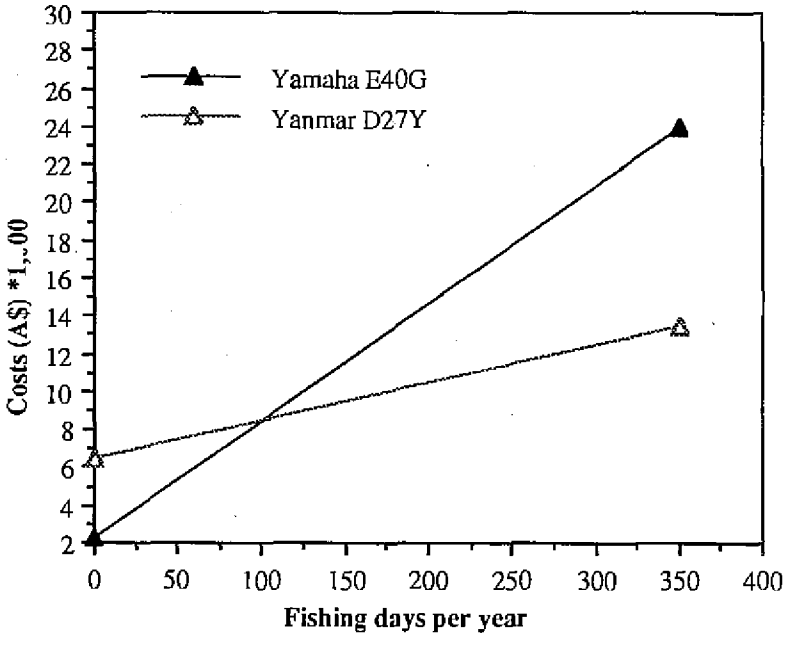
— *Operation and maintenance:* whilst fishermen are very familiar with Yamaha engines, the Yanmar engine is both innovative and new to Kiribati. Consumer reaction to an expensive machine that has yet to stand the test of time is therefore not inconsiderable. The skills and equipment required to maintain Yanmar engines are at present only to be found on Tarawa;

—*Fishing practices:* a number of opportunity costs exist for fishermen on the outer islands. In the OIP's experience, the maximum fishing effort is 145 days per year, and the mean for both centres is only 100 days per year. Such a pattern of fishing effort also means that loan repayments are irregular, which further discourages fishermen from investing heavily in capital items such as a diesel outboard engine.

All of these factors conspire to make the Yanmar diesel outboard unsuitable at present for large-scale introduction to outer island fisheries in Kiribati. In addition, the engine's relatively large size and weight (82 kg) mean that the engine has to be bolted through the transom, which in turn requires strengthening. Boats in Kiribati are traditionally pulled up onto the beach when not in use; the extra weight of a diesel outboard makes this more difficult.

So far, the Yanmar engines in use have been very reliable. The main operating and design problems encountered have been as follows:

— The fuel-tank cap has no air-bleed port. On one occasion this resulted in a vacuum building up in the tank, collapse of the fuel-line priming-bulb and stalling of the engine. Air



can be bled from the fuel lines by loosening the fuel filter and priming the engine. The fuel-tank cap should be opened once every 30 minutes.

— The tilt mechanism does not lock properly. When the engine is in the tilt-up position, the engine is kept in place only by its weight acting through a 'tilt-lock lever' which sits on the engine bracket. Pitching of the stern of the boat, either under sail or in a seaway at anchor, is often enough to lift the engine slightly, unlocking it from tilt.

— The engine is bolted through the transom, using four bolts and locking nuts provided by the manufacturer. The four locking nuts (two either side of the engine bracket, one above the other) are very close together and the bottom pair cannot be tightened without taking out the top pair. This is particularly irritating because the extra transverse strengthening to the transom runs just below the lower pair of locking nuts.

Despite the operational problems, cost and minor design faults of the Yanmar diesel outboard engine, it can have a significant effect on the profitability of a boat's operation if used on a regular basis.

Although highly variable, due to the seasonality of the tuna fishery, the average CPUE (kg tuna per litre fuel consumed) for the 30 Yamaha-powered canoes and boats landing catches to the project is 1.5 kg per litre. Translated into cash terms, this is A$ 0.83 (income) per A$ 0.75 (fuel cost). This is clearly not a good return for the outer island fisherman, bearing in mind that he also has to make loan repayments, maintain his engine and boat, and purchase fishing gear.

By contrast, the KIR-5 fitted with a Yanmar engine, which has been operational on the island of Abemama since November 1990 and is rented out to fishermen for A$ 20.00 per day (plus fuel costs), has achieved an average CPUE of 1.56 kg per litre, or A$ 0.86 (income) per A$0.50 (fuel cost). Including the hire charge revenue, this level of CPUE allows the project to employ a boatman full-time to run the boat, provide for maintenance costs, and also attempt to allow for depreciation of boat and engine over a five-year period.

The project intends to continue using the Yanmar diesel outboard engines on a small scale, fitted to boats belonging to, and operating from, each of its centres, and available on hire to church groups, schools, the island councils, outer island fishermen, etc.

In this way, the project can afford both to operate and maintain these engines, and maximise their use; in Abemama since last November this has averaged 20 days per month, or 240 days per year. Only in this way can the introduction of the Yanmar D27Y diesel outboard engine to outer island fisheries in Kiribati be technically and financially justified.