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Economic comparison of mangrove oyster longline grow-out system and traditional homemade basket system

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A cost-benefit analysis to identify the most suitable basket system for small-scale aquaculture operations

1. The purpose of this paper is to present the preliminary results of a cost-benefit analysis conducted by SPC FAME CFAP to provide the Fijian Ministry of Fisheries and Forests (MoFF) with a comparison of two grow-out systems: the traditional homemade baskets and the longline grow-out baskets.

Mangrove oyster farming in Fiji

2. Mangrove oyster farming in Fiji has become an important livelihood opportunity for communities and has involved several villages. The Women's Group of Muanaira, Vutia, in partnership with the MoFF and SPC, established the first oyster farm in 2018. Since then, the Ministry and SPC have continued to support the development of this activity throughout Fiji, by providing collectors, grow-out equipment, and technical assistance to the villages.

3. The farming practices consist of collecting juvenile oysters in selected sites and transferring the spats into homemade plastic mesh baskets hanging on stakes for grow out. Currently, one community farm is in operation with five others being trialled, and 8,000 oysters were sold after the last production cycle.

4. In 2024, SPC in collaboration with the Food and Agricultural Organisation (FAO) and MoFF replaced the traditional baskets with a new longline grow-out system. To ensure that these new systems are suitable for the farming conditions, SPC FAME CFAP has been tasked to undertake a cost-benefit analysis, to compare the impact of the use of these two systems on small-scale aquaculture.

Characteristics of the two systems

5. The two systems can impact the production and operational costs of the farm differently. Their characteristics are presented in Table 1.

Table 1: Characteristics of the two studied systems

	Traditional homemade baskets	New longline grow-out baskets
System		
Capacity per basket	5000 juveniles 250 adults	1000 juveniles 50 adults
Purchase cost per basket[1]	FJD 21.80 AUD 14.40	FJD 34.60 AUD 22.90
Lifespan	1 year	20 years
% saleable oysters end of cycle	60%	90%

[1] The purchase cost of the traditional homemade baskets comes from an estimate based on the process and the material needed to make them, including the cost of plastic mesh roll and rope, and the cost of labour to craft them. The purchase cost of the longline grow-out baskets comes from a quote provided by the supplier.

Method of the analysis

6. The purpose of the analysis was to identify which system is the most suitable and viable option regarding the mangrove oyster farming conditions in Fiji. To achieve this, a simulation of several production scenarios using the two systems was conducted, and different factors were compared for each system option, such as the economic viability of the farm, the labour time and effort allocated to the use of the baskets, the quantity of oysters produced, and the quantity of waste.

7. To assess the economic viability of each option, the investment need, the net present value (NPV) of the investment over 10 years[2], and the cost-benefit ratio (CBR) were calculated under three scenarios:

    - Case (1): Stable production level and stable selling prices over 10 years;
    - Case (2): Stable production level and annual 5% increase in selling price[3] over 10 years;
    - Case (3): Increased production level to reach 200,000 oysters in 10 years and annual 5% increase in selling price.

8. For this economic modelling, we chose to only consider the factors that would be influenced by the basket choice, which are the investment cost, the cost of posts that hold the baskets, and the generated income. The other operational costs such as freight, use of collectors, and farm labour, were not included in the analysis because they are estimated to be similar regardless of the option chosen.

9. To estimate the number of baskets needed (that is the investment need) we supposed an oyster's survival rate of 94% and an average oyster's weight of 100 grams (Vanukon *et al*. 2023). Considering the capacity of the baskets and their lifespan, we assessed the quantity needed for 10-year production, under the three scenarios, as follows:

    - Case (1) and (2): 419 longline grow-out baskets vs. 787 home-made baskets
    - Case (3): 6354 longline grow-out baskets vs. 6690 home-made baskets

10. The cost of the stakes needed to support the baskets varies depending on the chosen farming system and requires evaluation for each component. In the homemade basket system, each basket is suspended between two 12.5 mm wooden posts that are set into PVC pipes. In contrast, the new grow-out basket system uses 75 mm posts, with each basket held between two of these posts. This setup can accommodate up to 150 baskets, anchored at both ends by two larger anchor posts of 180 mm.

11. The generated income was also calculated for each option, considering the proportion of saleable oysters at the end of the production cycle, that is 60% for traditional homemade baskets and 90% for new longline grow-out baskets (Moape Kania [MoFF], personal communication 2 October 2024).

12. The results of the economic modelling and the other factors considered for the cost-benefit analysis were compiled in a table and note -1 or +1 was attributed to each of them, according to whether they represented a cost/disadvantage (-1) or a benefit/advantage (+1) for the project.

[2] The NPV was calculated using a 6% discounted rate
[3] from $15/dz to $23/dz at Y10

Results

13. The results of the economic modelling showed that both options are viable. The investment needed for the use of the traditional homemade baskets is paid off in two years regardless of the scenario. The investment needed for the new longline grow-out system is paid off in three years if the production remains stable or increases slowly, and in four years if the production increases to reach 200,000 oysters at year 10. The new system option becomes economically more interesting than the traditional system after four years if the production remains stable (Figure 1 and Table 2). The traditional system remains more profitable with increased production because the cost of purchasing new longline baskets is not offset quickly enough by the additional revenue they generate (Figure 2 and Table 2).

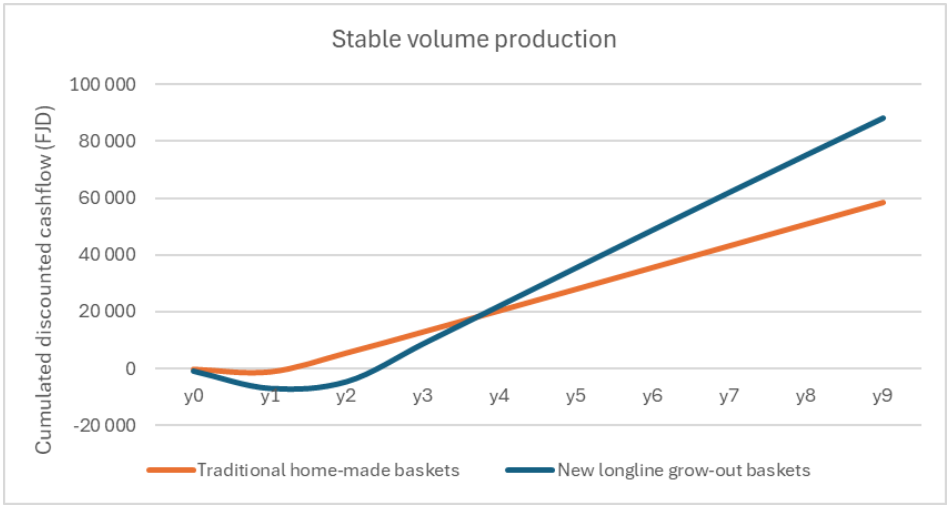

Figure 1: Cumulated discounted cashflow generated under the two-basket system options with a stable production over 10 years (case 1)

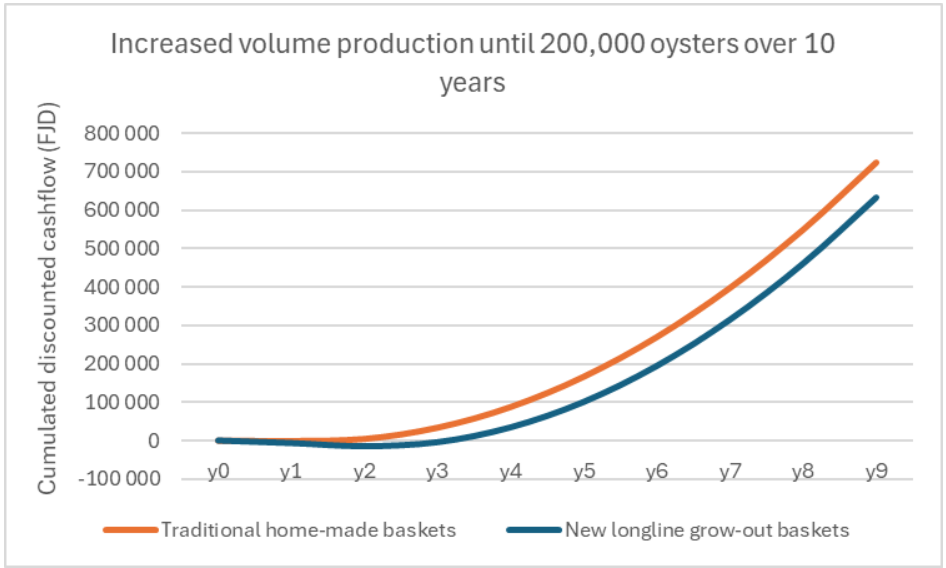

Figure 2: Cumulated discounted cashflow generated under the two-basket system options with an increased production over 10 years (case 3)

Table 2: Net present value and cost-benefit ratio of each option for cases 1 and 3

Indicators	Traditional basket system	New basket system
NPV (FJD) / CBR for case (1)	FJD 50,430 / 5	FJD 77,812 / 7
NPV (FJD) / CBR for case (3)	FJD 919,778 / 10	FJD 833,931 / 6

14. Case 2 "stable production level and annual 5% increase in selling price over 10 years" showed similar results to the 1st case, except for the amount of revenue, which was greater. As it does not impact the cost-benefit analysis to compare the two systems, we removed it from the tables.

15. The results of the analysis considering the other factors in addition to the economic modelling are presented in Table 3.

Table 3: Scoring of the factors considered in the CBA

Factors[4]	Traditional basket system - OPTION I	New basket system – OPTION II	Points OPTION I	Points OPTION II
NPV/CBR case (1)	FJD 50,430 / 5	FJD 77,812 / 7	-1	+1
NPV/CBR case (3)	FJD 919,778 / 10	FJD 833,931 / 6	+1	-1
Waste	Meters of plastic every year as baskets are remade annually	Waste every 20 years	-1	+1
Daily labour	Heavy bags	Easy to handle	-1	+1
TOTAL			**-2**	**+2**

Discussion and recommendations

16. Both basket system options are economically suitable for small-scale oyster farming.

17. The hand-made baskets system is a good and safe option for starting the oyster farming activity, coping with production falls, and increasing gradually the volume of production. The baskets are relatively cheap to make, and the number of baskets made annually can be easily suited to the number of oysters produced.

18. Longline basket system is a good option for improving farming practices, making labour easier, reducing waste, and improving oyster growing conditions, especially when the target volume of oysters annually produced is reached, as the investment is quickly paid off and is usable for 20 years.

19. If the farming objective is to increase the volumes produced, the longline system will be more interesting than the homemade system after a few years, only if the increase is gradual and moderate. Otherwise, the increased need for baskets will be more costly for option II (new system), and it will take more time to offset this cost with the generated revenue, than with option I (traditional system).

20. Further analysis is needed to estimate the conditions of production increase which allow the longline system to become more interesting than the traditional system within less than 10 years.

[4] Factors such as unit price, lifespan of baskets, time to renew them, quality of growing are not visible in this tables because they are already included in the NPV and CBR calculation.

21. The NPV value is used here to compare the two systems and does not reflect the amount of money that the farms will generate after 10 years of activity. To assess this, other operating costs such as the collector purchase, the freight, the labour, the fuel, etc. would have to be included in the analysis.

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