BUSINESS PLAN FOR MARKETING GENETICALLY IMPROVED FARMED TILAPIA (GIFT) IN NIGERIA

Prepared for:

WorldFish

By:

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BRIDGING SCIENCE & BUSINESS

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Executive summary

Background

WorldFish (WF) commenced the Genetically Improved Farmed Tilapia (GIFT) program in the early 1990s with the program now thought to underpin more than 50% of Tilapia aquaculture production worldwide.

WorldFish is now seeking to develop new models of working with public and private partners to achieve commercially viable and sustainable operations. These models must support the ongoing provision of quality genetics to the global aquaculture industry, whilst simultaneously delivering an adequate financial return to support the ongoing GIFT breeding program.

In the context of the above, WF has set out to develop a strategic business plan that evaluates business relationship options for future production and sale of GIFT genetics into Nigeria, alongside partner business Premium Aquaculture Limited (PAL).

Premium Aquaculture Limited is a subsidiary of the Stallion Group, a large conglomerate with divisions spanning aquaculture, agribusiness, automobile dealerships and auto assembly, mining/resources, and logistics. Premium Aquaculture Limited currently produces Catfish and Tilapia. In 2021, PAL expect to produce approximately 1,800 tonnes of Catfish while their current annual production of processed Tilapia is 1,500 tonnes, of which 30% is sold as fresh chilled and the remaining is frozen. A further 100 Tilapia cages are being installed which will increase production capacity of Tilapia to 2,100 tonnes per year.

Current Market Assessment

Nigeria consumes > 1.5 million tonnes of fish annually, with 450,000 tonnes produced domestically and the remainder imported. The average aquaculture production from 2016 to 2018 was 298,010 tonnes, across 15 species including Catfish and Tilapia. Catfish production in 2019 was 264,000 tonnes, making it the dominant species in the aquaculture market.

The annual production of Tilapia from aquaculture is likely to be around 7,000 to 10,000 tonnes. Premium Aquaculture Limited are currently responsible for 1,500 tonnes of this output.

While the majority of Catfish production comes from smallholders (~80%[1]), only about half of Tilapia production does, and it is often incidental harvest associated with the use of Tilapia as a live feed source. This is driven by several factors, including lack of knowledge of the management techniques required to raise Tilapia (for example, lack of aerated ponds), as well as a lack of access to good quality seedstock and affordable quality feed.

In 2020, based on Tilapia aquaculture production of 7,000 tonnes per year, the market for fingerlings is approximately 19.4 million fingerlings. Currently, around 36% of fingerlings are sourced from commercial hatcheries and multipliers (6.9m fingerlings). Demand for fingerlings can increase by driving up Tilapia production.

[1] Kaleem, O. and Sabi, A-FBS (2020). Overview of aquaculture systems in Egypt and Nigeria, prospects, potentials and constraints. Aquaculture and Fisheries. See: https://doi.org/10.1016/j.aaf.2020.07.017.

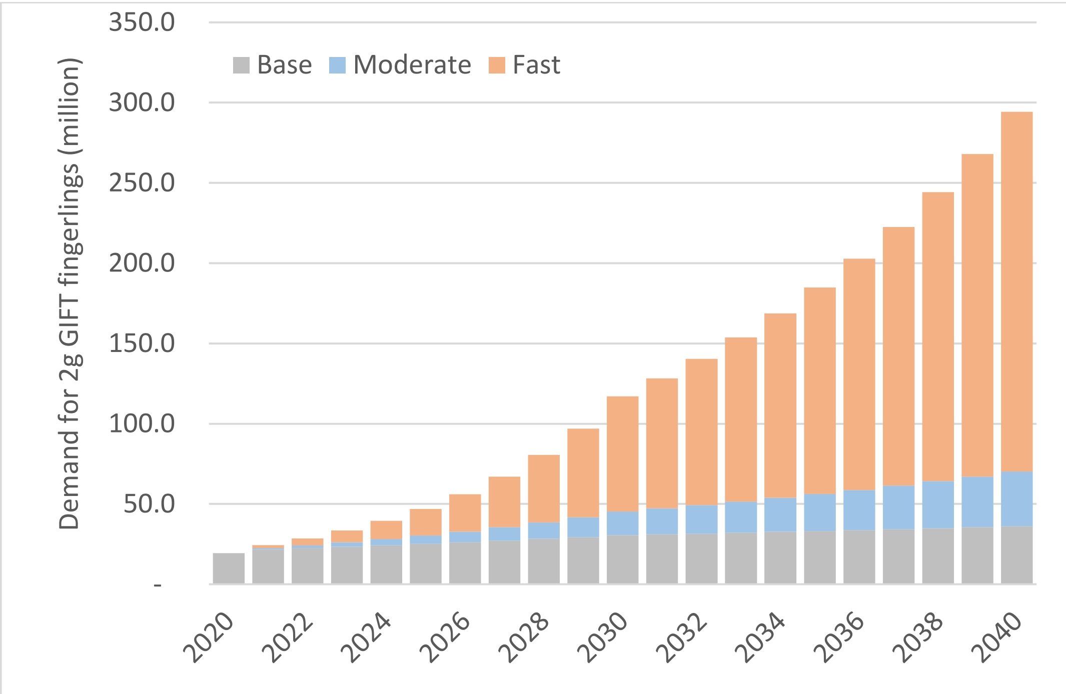
Potential Market Assessment

AbacusBio undertook a market assessment to estimate the size of the potential market for GIFT fingerlings in Nigeria over the next 20 years. The fingerling market was estimated based on the number of fingerlings required to support a forecast level of annual Tilapia production. Commencing from a 2020 base, a series of scenarios were developed to depict different rates of industry growth.

Growth in Tilapia production was projected in two stages: from 2020 to 2030, and from 2031 to 2040. To capture a range of potential growth trajectories for the Tilapia industry, from cautious to optimistic, 3 different scenarios were modelled for output growth: base, moderate, and fast (detailed in report Table 3).

While optimistic, the fast growth scenario represents a realistic upper bound for the industry's growth potential. Egypt produces approximately 860,000 tonnes of Tilapia, having achieved an annualised growth rate of 16% since 2006. Experts have noted similar growth potential for Nigerian production of Tilapia due to a combination of growing consumer demand and a low base of current production[2].

The annual demand for GIFT Tilapia fingerlings, under each of the modelled scenarios is illustrated below.



Under the moderate growth scenario, it is predicted that in 5 years, annual fingerling demand will amount to 30 million, and in 10 years, 45 million fingerlings (estimating that 1 tonne of output requires 2,768 fingerlings). If the market share of GIFT fingerlings is less than 50%, and PAL can reach capacity of 13.25m fingerlings per year, it seems plausible that PAL could meet most of the demand for GIFT in the short term at least (up to 5 years). This underlines the strategic value of PAL as a potential partner for dissemination of GIFT.

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[2] See: https://www.aquaculturealliance.org/advocate/egypt-tilapia-blueprint-africa/

Commercialisation Models for Collaboration with PAL

WorldFish could engage with commercial partners such as PAL via a range of broad market-entry or commercialisation models. A high-level description of the potential market-entry models is provided below.

Commercialisation models and description.

Model	Description
Direct Export	WorldFish could supply GIFT genetics to PAL and other partners via a traditional export model. Under this model, broodstock would be sold/exported to PAL (and other in-market customers) from WF's GIFT breeding program.
Indirect Export	Under this model PAL would act as a distributor or intermediary on behalf of WF. WorldFish would contract PAL to integrate GIFT into its breeding program, managing the multiplication and distribution of GIFT on behalf of WF (including for PAL's internal use). WF would receive the revenue from GIFT fingerling sales, less any commission or fees payable to PAL.
Subsidiary Company	WorldFish could acquire or establish a subsidiary company that owns and controls hatchery facilities and broodstock in Nigeria. Broodstock could be transferred from the GIFT breeding program to the subsidiary hatchery for multiplication and subsequent sale/distribution. The subsidiary would subsequently manage in-market sales and distribution to PAL and other customers.
Joint Venture	WorldFish could form a formal partnership with PAL (or other commercial hatcheries). This would comprise the establishment of a separate business entity that is jointly owned by the partner companies/organisations. This model could potentially involve creation of a JV entity that incorporates PAL's broodstock, hatchery infrastructure and operational resources, in combination with the provision of GIFT genetics and technical expertise from WF.
Strategic Alliance	A strategic alliance represents a less formal version of a joint venture (without the establishment of a separate JV entity). WorldFish and PAL could establish an alliance for the transfer of GIFT broodstock to PAL, and subsequent dissemination of fingerlings to the broader industry. The alliance would be governed by an agreement or contract between the two parties that describes roles, obligations and responsibilities, IP ownership, contribution of resources, allocation of benefits etc.
Licensing	WorldFish could grant a licence to PAL that entitles PAL to access and use GIFT genetics in return for an annual licence fee payable to WF. This could also include the licensing of the right for PAL to multiply and distribute GIFT.
Franchising	Franchising represents an enhanced form of licensing whereby WF could licence PAL the right to use GIFT, along with relevant IP, branding, systems, and processes relating to production and management of GIFT genetic resources.

The following table presents a summarised assessment of each model against a set of assessment criterion that were developed in consultation with WorldFish. Models were ranked from best to worst against each criterion (1 = best, 7 = worst), tied rankings were permitted where . The ranking scores for each model were subsequently summed to provide an overall rank (lowest score = most favourable).

Evaluation of Commercialisation Models

Model	Sustainable Return	Ease of Replication	Strategic Alignment	Flexibility	Brand Protection	Complexity	Risk	Total
Direct Export	7	2	7	2	7	1	1	27
Indirect Export	3	3	2	3	5	2	3	21
Subsidiary Co	1	4	1	1	1	7	7	22
Joint Venture	2	7	4	5	2	5	6	31
Alliance	3	5	4	5	5	4	4	30
Licensing	5	1	2	3	4	2	1	18
Franchising	5	6	4	7	2	6	5	35

Based on this assessment, the licensing model appears the most favourable for WF. Generally, licensing ranks favourably because:

- It is a relatively passive model which minimises complexity for WF.
- Licence agreements can be relatively generic (subject to adaptation to local market laws/regulations regarding IP and other commercial areas), which supports ease of replication.
- It is a low-risk model due to the absence of any need for foreign subsidiaries and investments, exposure to operational activity and presence of partners/co-investors.
- It can be structured (via sub-licences) to maximise dissemination via expansion to multiplication hatcheries.

Financial Projections

Under a licensing model, WF derives revenue from licence fees paid by the licensee (PAL) in return for the right to access and use GIFT. It is assumed that these royalties will be derived from commercial fingerling sales.

To calculate the value of future royalties over a 20-year period (until 2040), AbacusBio calculated the annualised value of royalties under the market growth scenarios depicted previously. The annualised value is a revenue stream of equal annual payments that matches the present value (PV) of the projected GIFT royalty stream. A 5% real discount rate was applied to determine the PV of the royalty stream.

The base market growth scenarios assume 50% market share for GIFT fingerlings, and a ₦5 royalty per fingerling that is stable in real dollar terms (increases in line with underlying inflation). Sensitivity analysis has subsequently been undertaken to quantify the sensitivity of annualised value of royalties to WF, to these parameters. In addition, sensitivity analysis also explored the impact of different rates of growth (real dollar terms) in royalty value over time. The opportunity to increase the value of the royalty over time could be realised as the market grows and matures via efficiencies and economies of scale within the hatchery sector, increased end-user value emanating from genetic progress in future GIFT strains, and intensification/improvement in local aquaculture systems.

The GIFT market share of 50% was attained within 5 years, under an assumption of linear growth (i.e., 10% per market share growth per year).

Under these assumptions and across the sensitivity range, the annualised value of royalties from GIFT fingerling sales is between US$142,000 and US$1,632,000 per year across the three market growth scenarios. The range of annualised value of royalties is presented in the following table.

Sensitivity of annualised return (US$[1]) from 20 years of projected royalty revenue to changes in market share and royalty fee for base, moderate, and fast growth scenarios.

		Industry growth scenario		
		Base	**Moderate**	**Fast**
Market share for GIFT				
	10%	$28,453	$44,282	$129,340
	25%	$71,133	$110,705	$323,351
	50%	**$142,266**	**$221,410**	**$646,702**
	75%	$213,398	$332,115	$970,053
	90%	$256,078	$398,538	$1,164,064
WF Royalty (₦ / fingerling)				
	₦1.00	$28,453	$44,282	$129,340
	₦2.00	$56,906	$88,564	$258,681
	₦5.00	**$142,266**	**$221,410**	**$646,702**
	₦7.50	$213,398	$332,115	$970,053
	₦10.00	$284,531	$442,820	$1,293,404
Royalty Growth Rate (%/year)[2]				
	0%	**$142,266**	**$221,410**	**$646,702**
	2%	$152,761	$239,246	$707,046
	3%	$164,242	$258,829	$773,720
	5%	$205,622	$329,938	$1,018,771
	10%	$305,546	$503,952	$1,631,559

1. 1 US$ = ₦380
2. Real value

The base annual cost of the GIFT breeding program is estimated to be US$1.75M. On this basis, AbacusBio's financial projections demonstrate potential for Nigerian royalties to cover up to 31% of the cost of the core GIFT breeding program using WF's market growth projections, 50% market share, and a ₦5 royalty value. This increases to as much as 93%, with increases in royalty growth rate. Consequently, potential royalty revenue from Nigeria does appear to warrant further exploration of market opportunities, based on the extent to which this royalty stream supports the financial sustainability of the GIFT program, and the relative potential/importance of the Nigerian market.

Commercialisation Action Plan

AbacusBio recommends that the progression of WF's commercialisation strategy for GIFT occur in accordance with the action plan outlined below. The action plan reflects that multiple aspects of the project are at an early or conceptual stage, requiring definition, before WF will be in a position to consider formal due diligence and implementation.

On this basis, AbacusBio have developed an action plan that prioritises activities that address gaps surrounding:

- Definition of the scope and structure of the proposed licence model to enable more formal consultation and due diligence,
- Formal engagement with PAL to convey specific requirements from WF and assess suitability as a commercial partner based on strategic alignment and PAL's capacity to support WF's broader objectives,
- Stakeholder consultation on the appropriateness of licensing as a means of disseminating GIFT, and
- Identifying the scope of further in-market activity required to support development of the aquaculture industry and drive adoption of GIFT.

On completion of these initial actions, WF can undertake a Go/No-Go assessment to confirm the ongoing applicability of the licensing model and WF's appetite to proceed further with its due diligence. This also represents an appropriate juncture for identifying further due diligence activity based on both requirements for internal approval and implementation, and remaining areas of uncertainty.

Contents

EXECUTIVE SUMMARY **2**

CONTENTS **8**

BACKGROUND **9**

WORLDFISH OBJECTIVES **11**

PROPOSED PARTNER - PREMIUM AQUACULTURE LIMITED (PAL) **11**

PHASE 1 – INDUSTRY AND MARKET ASSESSMENT **12**

CURRENT MARKET ASSESSMENT 12

POTENTIAL MARKET ASSESSMENT 16

MARKET RISKS 19

PHASE 2 – EVALUATION OF COMMERCIALISATION OPTIONS **21**

DESCRIPTION OF COMMERCIALISATION MODELS 21

EVALUATION OF COMMERCIALISATION MODELS – ASSESSMENT CRITERIA 24

MODEL DESIGN AND IMPLEMENTATION 26

ALTERNATIVE MODELS 28

FINANCIAL FORECASTS **28**

COMMERCIAL VALUE OF GIFT 28

POTENTIAL ROYALTY VALUE 30

ROYALTY REVENUE PROJECTION AND SENSITIVITY ANALYSIS 30

DISCUSSION 32

KEY RISKS AND UNCERTAINTIES 33

COMMERCIALISATION ACTION PLAN **35**

APPENDIX 1 – MODEL EVALUATION **40**

APPENDIX 2 – DESIGN AND IMPLEMENTATION OF ALTERNATIVE MODELS **47**

INDIRECT EXPORT MODEL 47

JOINT VENTURE MODEL 48

STRATEGIC ALLIANCE MODEL 51

Background

WorldFish (WF) commenced the Genetically Improved Farmed Tilapia (GIFT) program in the early 1990s with the program now thought to underpin more than 50% of Tilapia aquaculture production worldwide.

WorldFish is now seeking to develop new models of working with public and private partners to achieve commercially viable and sustainable operations. These models must support the ongoing provision of quality genetics to the global aquaculture industry, whilst simultaneously delivering an adequate financial return to support the ongoing GIFT breeding program. This will entail developing approaches tailored to geographical and economic circumstances of specific markets.

In the context of the above, WF has set out to develop a strategic business plan that evaluates business relationship options for future production and sale of GIFT genetics into Nigeria, alongside partner business Premium Aquaculture Limited (PAL).

This report first provides an assessment of the current and potential market (volume and value) for GIFT genetics in Nigeria, in the context of the structure of the local aquaculture industry and of potential customer relationship/supply models for commercial engagement with PAL.

AbacusBio have identified risks and uncertainties arising from the market situation and provide some commentary on mitigation.

In an analysis of market reach, a suite of commercialisation model options (how a WF and PAL business relationship might look) is presented, as are criteria by which to assess and shortlist potential options.

A basic financial model with a 20-year horizon is provided, informed by the market assessment, to determine the financial viability of the potential commercial relationship between WF and PAL. Sensitivity/scenario analysis have been conducted to capture volume and price variation in the potential market, quantifying the impact of these on the projected financial returns.

Based on the commercialisation model chosen, AbacusBio have identified and described areas of an action plan comprising discrete steps required to advance the commercialisation strategy, and subsequent implementation by WF. Figure 1 provides an overview of the market analysis and commercialisation strategy for GIFT in Nigeria.

Figure 1: Report Overview: Market Analysis and Commercialisation Strategy for GIFT in Nigeria.

WorldFish Objectives

WorldFish have a set of overarching objectives for entering the Nigerian market. To fit these objectives, the commercialisation opportunity must:

- Be compatible with WF's broader strategic goals and charter, resources and capability, and risk appetite,
- Enable a sustainable level of financial return to support the GIFT breeding program,
- Be appropriate to support dissemination to the broader aquaculture industry,
- Be conducive to appropriate protection of GIFT IP and brand,
- Be flexible and adaptable to an evolving GIFT breeding program (new traits etc.), and
- Be scalable and replicable to enable application to other geographies, species, and commercial partners.

WorldFish have developed a relationship with PAL over recent years and have identified PAL as the preferred partner for commercialisation of GIFT in Nigeria. The other key Tilapia producer in Nigeria is Triton Group; however, due to recent financial challenges they were not considered as a commercialisation partner for GIFT dissemination in market. The pre-existing relationship with PAL need not compromise WF's overarching objectives, but it does require that additional objectives be considered. Given this situation, the commercialisation model must also:

- Maximise the benefit to commercial smallholder farmers, without compromising the commercial value of the relationship to PAL, and
- Build PAL as a key national node (multiplication centre) for Nigeria but without any expectation from PAL that the relationship is exclusive.

Proposed Partner - Premium Aquaculture Limited (PAL)

Premium Aquaculture Limited is a subsidiary of the Stallion Group, a large conglomerate with divisions spanning aquaculture, agribusiness, automobile dealerships and auto assembly, mining/resources, and logistics.

Stallion Group's corporate vision is:

"*To be Africa's leading company by adopting global best practices and localizing it to develop scalable, impactful and sustainable business that is committed to improving the socio-economic conditions of the communities*."

Stallion Group, via PAL, is the largest producer of Tilapia in Nigeria and has a range of investments across the supply chain – including processing, distribution, logistics and cold chain storage. This means PAL can access resources for scaling, processing, and distributing product to market.

Premium Aquaculture Limited currently produces Catfish and Tilapia. In 2021, PAL expect to produce approximately 1,800 tonnes of Catfish while their current annual production of processed Tilapia is 1,500 tonnes, of which 30% is sold as fresh chilled product and the remainder is frozen. A further 100 cages are being installed which will increase production capacity of Tilapia to 2,100 tonnes per year. Premium Aquaculture Limited's production infrastructure is located in Ogun State, in south-western Nigeria.

Premium Aquaculture Limited have the capacity to process 12 tonnes of Tilapia per day, equivalent to 3,600 tonnes per year. Further to this, and in addition to the supply chain assets Stallion Group holds, PAL are in the process of setting up their own feed mill so that they can produce their own feed.

Premium Aquaculture Limited currently only process their own production but expect to source Tilapia from other producers in the future, subject to available capacity within their processing plant and subsequent market demand.

Phase 1 – Industry and Market Assessment

This section provides an assessment of the industry, with a focus on the characteristics that:

a) define the scale of opportunity for GIFT driven by market dynamics over time, and
b) represent risks to the proposed WF/PAL business venture in capturing the market opportunity.

A model was developed, which includes an analysis of the current market and a range of future market growth scenarios, to quantify the size of the opportunity in terms of number for GIFT fingerlings and overall market value. The model is aligned with the structure and scale of the industry and captures pricing options for GIFT genetics for subsequent revenue projections. An assessment was also undertaken of market risks as they pertain to the expected further size of the industry and the preceding market assessment.

Current Market Assessment

Industry insight

Today, over half of Tilapia traded globally originate from WF's original GIFT genetics strain via commercial releases undertaken by original partners in the GIFT breeding program. WorldFish have built on this genetic base with a strong selection programme, focussing on yield traits. It is this genetically improved Tilapia WF wish to introduce to Nigeria, alongside a commercial in-market partner who can support the multiplication and broader dissemination of GIFT. WorldFish have identified PAL as their desired commercial partner. To make this partnership a success, it is important to understand the Nigerian fish industry and market structure.

Nigeria consumes > 1.5 million tonnes of fish annually, with 450,000 tonnes produced domestically and the remainder imported[3]. The average aquaculture production from 2016 to 2018 was 298,010 tonnes, across 15 species including Catfish and Tilapia. Catfish production in 2019 was 264,000 tonnes[4], making it the dominant species in the aquaculture market. In contrast, from 2016 to 2018 Tilapia production averaged only 22,660 tonnes per year, with a decreasing trend in production over these years[1]. This likely represents an inflated estimate of actual Tilapia production from aquaculture, because a large amount of Tilapia is produced as a by-product of other systems - the by-product is Mozambique Tilapia, as opposed to Nile Tilapia (strain from which GIFT originated). The annual

[3] Kaleem, O. and Sabi, A-FBS (2020). Overview of aquaculture systems in Egypt and Nigeria, prospects, potentials and constraints. Aquaculture and Fisheries. See: https://doi.org/10.1016/j.aaf.2020.07.017.
[4] Nigeria Fish Futures Scoping Study (2020).

aquaculture production is likely to be 7,000 to 10,000 tonnes[5]. Premium Aquaculture Limited are currently responsible for 1,500 tonnes of this output.

The key fish value chains within the Nigerian market are:

1. fresh Catfish (the dominant value chain),
2. smoked Catfish,
3. dry Catfish,
4. fresh Tilapia, and
5. smoked Tilapia.

In addition to fresh and processed fish, large corporate producers are able to freeze fish either at their production facility or in a nearby cold storage facility, with these products then distributed to various parts of the country and marketed alongside imported frozen fish, largely coming in from China. Fish are also illegally imported. While corporate producers are able to freeze fish, a lack of cold chain facilities is an issue for smallholder farmers – and a key driver of the processed fish market.

A summary of the value chain and associated supply chain actors (across all fish species) is presented in Figure 2.

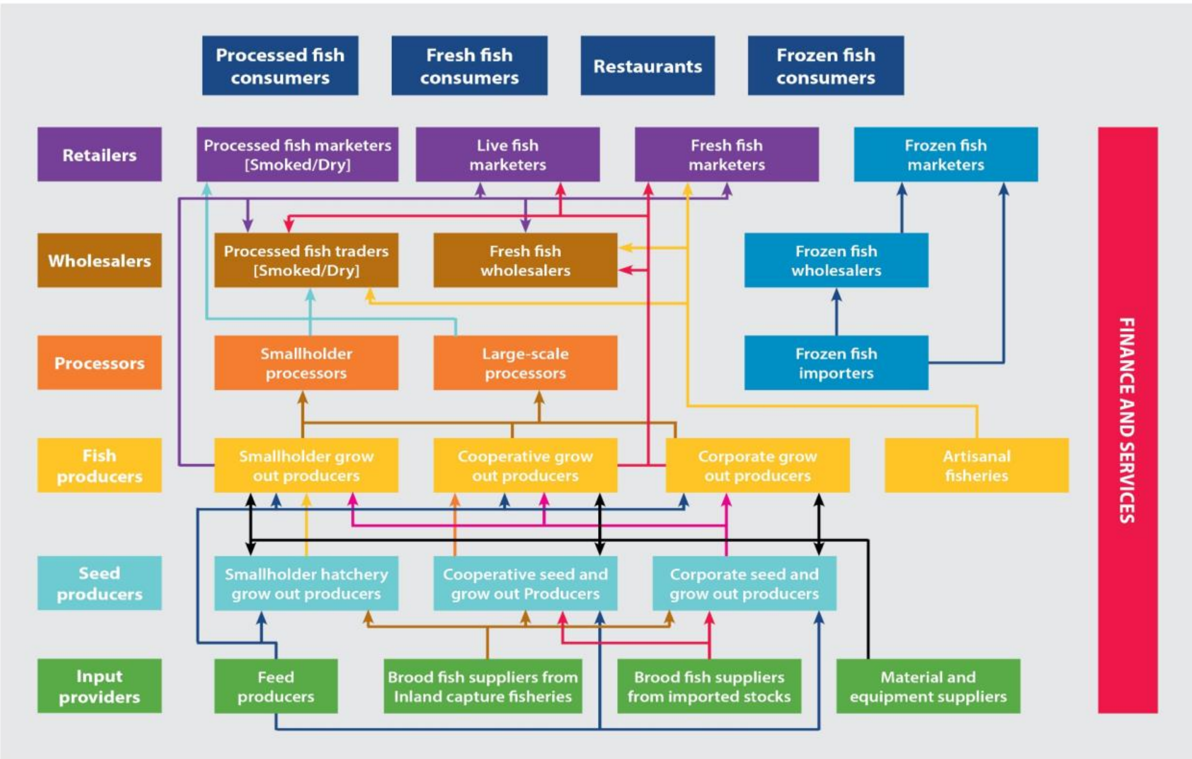

Figure 2: A summary of the fish value chain and associated supply chain actors (across all fish species). Taken from the Nigeria Fish Futures report (2020).

[5] Personal communication, Rohana Subasinghe.

While the majority of Catfish production comes from smallholder producers (~80%[6]) only about half of Tilapia production comes from smallholder producers and it is often incidental harvest associated with the use of Tilapia as a live feed source for other fish. This is driven by several factors, including lack of knowledge of the management techniques required to raise Tilapia (for example, lack of aerated ponds), as well as a lack of access to good quality seedstock (i.e., seed, fingerlings, fry) and affordable quality feed.

Lack of access to quality seed is the result of a lack of broodstock management and Tilapia genetic improvement programs in Nigeria. The current practise is to import Tilapia broodstock from other countries (e.g., Thailand and Netherlands), and this imported broodstock is often falsely sold as 'GIFT' genetics. Once imported, broodstock is not properly maintained, or improved within well-managed breeding programs. Currently, commercial Tilapia hatcheries produce about 6.9 million fry/fingerling (~55% of their production capacity of 12.4 million). The sale price of 2g Tilapia fry is about ₦17-20 (~₦18 for fingerlings), while 3-5g Catfish fry cost ₦18-20. Small-scale Tilapia breeders and fry/fingerling producers do not exist in Nigeria due to lack of access to quality broodstock. Therefore, production of Tilapia seed in Nigeria is limited, resulting in a lack of access to Tilapia fry/fingerlings by smallholder producers.

In addition to the challenges smallholder producers face in producing Tilapia and competing with the established Catfish market, in smallholder systems Tilapia currently appear to be less profitable compared to Catfish (Table 1).

Table 1: Comparison of yield, price, revenue, cost and profit margin, for Catfish and Tilapia[1].

	Catfish	**Tilapia**
Yield (tonnes/ha/cycle)	15.98	6.89
Price (USD/kg)	2.29	2.53
Revenue (USD)	36,594	17,432
Costs associated with production (total USD/ha/cycle)	22,370	14,876
Profit (revenue less costs only)	14,224	2,555

[1] derived from Nigeria Fish Futures Scoping Study, 2020.

There are several factors that contribute to the apparent lower profitability of Tilapia:

- Lack of aerated ponds within smallholder systems – Tilapia are more adversely affected by poor aeration than Catfish, reducing growth rates and requiring lower stocking densities.
- While Tilapia can be produced on a lower cost, plant-based diet, the availability of suitable Tilapia feed is a major limitation to profitability.
- Tilapia production is constrained by poor quality seed and limited seed availability.

Through consultation with WF and PAL, it was established that the comparative economic advantage of Catfish relative to Tilapia is not as great as depicted above, given the appropriate genetics, management technology and training of smallholder farmers. In addition, Tilapia is preferred by

[6] Kaleem, O. and Sabi, A-FBS (2020). Overview of aquaculture systems in Egypt and Nigeria, prospects, potentials and constraints. Aquaculture and Fisheries. See: https://doi.org/10.1016/j.aaf.2020.07.017.

consumers (perceived as a 'party' fish), with market demand affected by price and availability. Tilapia is also more suitable for freezing, enhancing the distribution potential of local product.

It should be noted that Tilapia production dominates in other regions of Africa, particularly Egypt, where over 70% of African aquaculture production occurs. Consequently, whilst published data indicates growing market demand could be more readily filled by increased Catfish production, due to more favourable economic returns, both WF and PAL believe there is considerable scope for Tilapia to increase its share of Nigerian aquaculture output.

Availability of GIFT removes a key roadblock to increased production of Tilapia in the Nigerian aquaculture industry. Results from a study[7] showed that GIFT Tilapia were harvested at a weight 1.8 times that of the AKOS Tilapia. AKOS Tilapia being the Akosombo selection line, which has been disseminated in Ghana. Harvest weight of the GIFT strain was 2.2 times that of the AKOC Akosombo control strain, which is representative of other farmed Tilapia strains. It is worth noting that these results are based on a controlled environment for Tilapia production and due to genotype by environment effects (GxE) the yield advantage in GIFT Tilapia may not be as great under less optimal conditions. For example, results from smallholder farmers in Bangladesh showed that while GIFT strains grew 30% faster than non-GIFT strains, with average yield 1.3 times higher in GIFT versus non-GIFT ponds, the magnitude of the effect was not as great as that observed in more controlled conditions (unpublished data)[8]. However, given the right technical support, using GIFT genetics is likely to drive an increase in profitability through the increase in yield outputs.

In summary, the Tilapia aquaculture production industry in Nigeria can be described as immature. While lack of access to quality seed is reported as a bottleneck to increased Tilapia production performance, more specialised and intensive management techniques (relative to Catfish), as well as access to affordable quality feed would also impact the industry.

Current Tilapia fingerling market

In 2020, based on Tilapia production from aquaculture of 7,000 tonnes per year, the total market for fingerlings was approximately 19.4 million fingerlings. This figure can be increased by driving up Tilapia production.

Currently only 6.9m fingerlings are sourced from commercial hatcheries and multipliers (36% of the market). In the current market, GIFT fingerlings will displace a proportion of these fingerlings. However, the hope is that a successful partnership between WF and PAL will demonstrate the potential for Tilapia producers to generate increased returns, and therefore increase the number of smallholder farmers (market size), and increase the adoption (i.e., market share) among smallholder producers. This will allow PAL to upscale capacity and/or supply broodstock and fry/fingerlings to other commercial hatcheries to increase seedstock supply to smallholders and the broader industry. Alongside this, there needs to be market pull for more Tilapia product, which would influence Tilapia production, along with other factors presented in Table 2.

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[7] Trinh et al (2020). Performance evaluation of Nile tilapia (Oreochromis niloticus) improved strains in Ghana. Aquaculture. See: https://doi.org/10.1016/j.aquaculture.2020.735938

[8] Tran et al (2020). Growth, yield and profitability of genetically improved farm tilapia (GIFT) and non-GIFT strains in Bangladesh. Unpublished – provided by John Benzie.

Table 2: Market factors which could drive an increase in Tilapia production in Nigeria over the next 20 years.

Factor increasing production	Influencing factor	Comments
Increasing demand (i.e. market pull)	*Population growth and corresponding increase in demand*	Nigeria currently has a population of 209 million. It is estimated that by 2045, the population could rise to 394 million and by 2050, 440 million[9].
	Increase in fish consumption per person	The average Nigerian annual per capita fish consumption is predicted to increase from 11.2kg in 2015 to 14.8kg in 2050[10].
	Economic growth	Corresponding to an increase in demand for high quality proteins such as Tilapia (noting this will tie into an increase in fish consumption per person).
	Affordability of end product	Driven by favourable margins for Tilapia production and associated reduction in sale price at market.
Increasing supply (i.e., production push)	*Favourable margin for Tilapia production relative to Catfish, displaces a proportion of the Catfish market*	PAL estimate that approximately 20-30% of Catfish ponds could be replaced with Tilapia production, thus driving an increased demand for Tilapia fingerlings.
	Displacement of a proportion of the illegal Tilapia market	10,000 tonnes of frozen Tilapia were imported into Nigeria in 2011, displacing this would require an extra 20-30 million fingerlings per year.
	Displacement of other fish species	Both those domestically produced and imported, again, with a potential to increase the demand for Tilapia fingerlings.

Potential Market Assessment

AbacusBio undertook a market assessment to estimate the size of the potential market for GIFT fingerlings in Nigeria over the next 20 years. The overall fingerling market was estimated based on the number of fingerlings required to support a forecast level of annual Tilapia production. Commencing from a 2020 base, a series of scenarios were developed to depict different rates of industry growth.

As discussed in the previous section, the estimated current level of Tilapia aquaculture production is 7,000 tonnes per annum; this was subsequently adopted as the base production level in 2020. Approximately half of this originates from cage production, or commercial producers (including 1,500

[9] Nigeria Fish Futures Scoping Study (2020).
[10] Nigeria Fish Futures Scoping Study (2020).

tonnes from PAL), with the other half produced by smallholder producers, who farm using ponds. Based on a 72% survival rate from fingerling stage to a harvest weight of 500g (around 150 to 170 days), 1 tonne of output requires 2,768 fingerlings. The total number of fingerlings required for Tilapia aquaculture production in 2020 is therefore estimated to be 19.4m. Based on a fingerling price of ₦18, this equates to a market size of ₦349 million (or US$0.9 million at 1US$: ₦385).

Growth in Tilapia production was projected in two stages: from 2020 to 2030, and from 2031 to 2040. To capture a range of potential growth trajectories for the Tilapia industry, from cautious to optimistic, 3 different scenarios were modelled for output growth: base, moderate, and fast (Table 3).

Table 3: Growth rates for Tilapia production under base, moderate, and fast growth scenarios.

	Industry growth scenario (%)		
Stage	**Base**	**Moderate**	**Fast**
2020 to 2030	5.0	10.0	22.0
2031 to 2040	2.0	5.0	10.0

The base scenario assumes growth in Tilapia production in line with projected growth for the Nigerian aquaculture industry: 5% per year to 2030, and 3% per year thereafter[11]. The moderate and fast growth scenarios assume faster growth across both time periods.

While optimistic, the fast growth scenario represents a realistic upper bound for the industry's growth potential. Egypt produces approximately 860,000 tonnes of Tilapia, having achieved an annualised growth rate of 16% since 2006. Experts have noted similar growth potential for Nigerian production of Tilapia due to a combination of growing consumer demand and a low base of current production[12]. The annual demand for fingerlings, under each of the modelled scenarios is illustrated in Figure 3.

[11] Nigeria Fish Futures Scoping Study (2020).
[12] See: https://www.aquaculturealliance.org/advocate/egypt-tilapia-blueprint-africa/

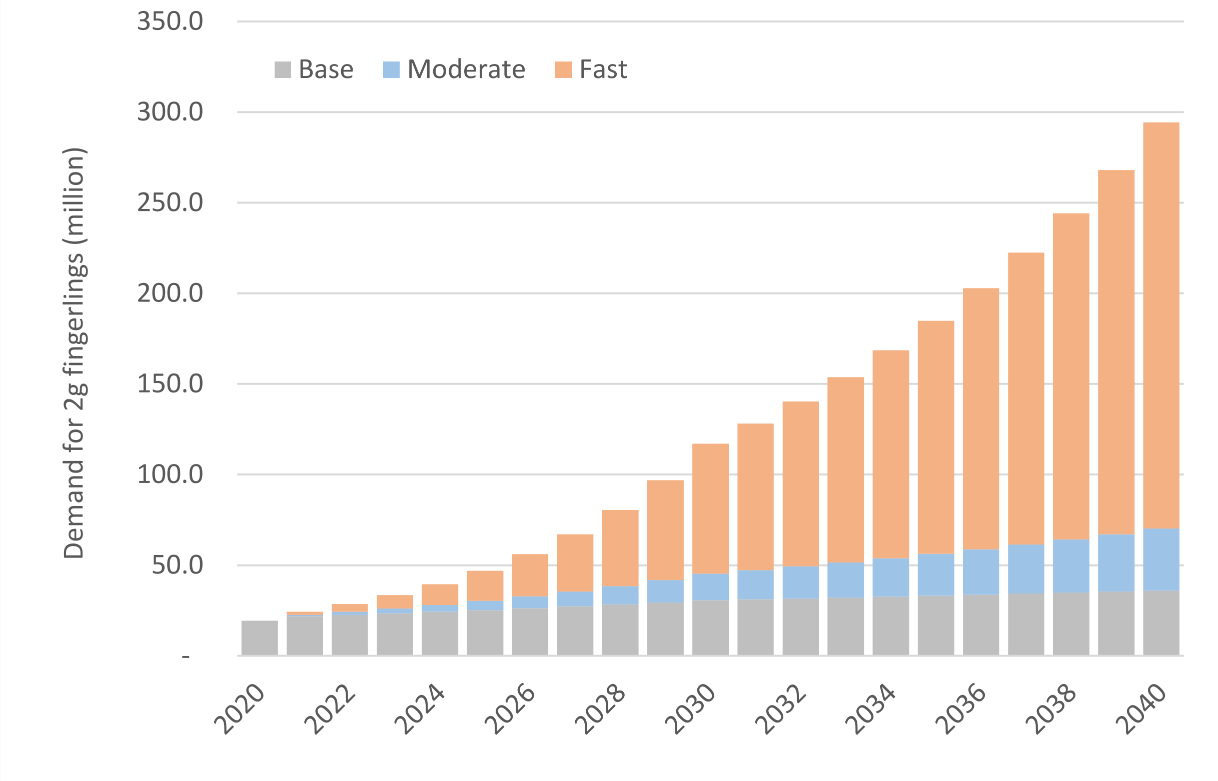

Figure 3: Projected demand Tilapia fingerlings in Nigeria, from 2020 to 2040 under base, moderate, and fast growth scenarios.

The projected requirements for fingerlings range from 36 million to 295 million in 2040, and the annual value of the overall market ranges from US$1.7 million to US$13.94 million (Table 4).

Table 4: Market for Tilapia fingerlings in 2040 under base, moderate, and fast growth scenarios.

	Industry growth scenario		
	Base	**Moderate**	**Fast**
Tilapia output (tonnes)	13,021	25,337	106,305
Fingerlings required (million)	36.0	70.1	294.3
Value of fingerling market (US$ million)[1]	1.71	3.32	13.94

[1] Assuming current fingerling price = ₦18

Given PAL's current production capacity and processing output, PAL's internal fingerling requirements are estimated to amount to 4.15 million Tilapia fingerlings per year. In addition, currently PAL are selling 40,000-50,000 Tilapia fingerlings per month (480,000 – 600,000 per year), with a hatchery capacity to produce up to 750,000 fingerlings per month (9 million per year). Fingerlings sold to external parties are sold by number, at a current price of ₦20/fingerling.

To support the proposed collaboration with WF, PAL have indicated an intention to enhance their hatchery capacity (in 2 states of Nigeria) by another 4.25 million fingerlings per year. Therefore, it is possible that PAL alone could generate 13.25 million fingerlings per year for internal and external use over the first 5 years.

As previously described (see Current Market Assessment) current demand for Tilapia fingerlings within the Nigerian aquaculture industry is estimated at 19.4 million per year. Under the moderate growth scenario, it is predicted that in 5 years, annual fingerling demand will amount to 30 million, and in 10 years will be 45 million fingerlings. If the market share of GIFT fingerlings is less than 50%, at least initially, it seems plausible that PAL could meet most of the demand for GIFT in the near term at least. This underlines the strategic value of PAL as a potential partner for dissemination of GIFT.

Market risks

Key market risks and associated mitigation strategies are described in Table 5.

Table 5: Key market risks and potential mitigation options

	Description	**Risk**	**Mitigation**
Brand Differentiation	WorldFish GIFT is a well-known brand/product that needs to be protected in any release of GIFT via a commercial partner. In addition, there is also a need to ensure the commercial release of GIFT incorporates a clearly identifiable and distinguishable product.	The risk arises because there are already examples of the GIFT name being used for Tilapia that are not, in fact, GIFT originating from the WF breeding program. This practice risks diminishing the value of GIFT, because other strains may not perform at the same level as GIFT, undermining its market perception and subsequent value.	Any product originating from PAL and/ or other multiplication partners, must be appropriately identifiable as GIFT. Contractual relationships between WF and PAL (plus other multiplication partners) will need to consider appropriate controls to ensure differentiation of the GIFT product, and ensure its multiplication and dissemination is conducive to protection of the GIFT brand.
Smallholder capability	While there appears to be significant interest in access to improved Tilapia seed, the market segment operated by smallholder producers, is immature. Premium Aquaculture Limited currently "struggle to sell fingerlings – a small number of buyers who take fingerlings for culture".	There is a risk related to realisation of the market potential of GIFT that arises because of the capability of smallholder producers and the limitations of their commercial skills. Feedback from PAL indicated that farmers can be slow to adopt improved practices and technologies due to a lack of technical and commercial aptitude.	To mitigate this risk, significant effort will need to go into upskilling smallholder producers, to ensure they can realise the benefits offered by farming GIFT Tilapia. A package of best practice and technical support information should be put together by PAL, with support from WF.
Competition from Catfish	Aquaculture in Nigeria, particularly smallholder production, is currently dominated by Catfish.	There is a risk that the market opportunity for Tilapia may not be captured unless key blockages affecting the relative	Premium Aquaculture Limited with support from WF will need to "create" the smallholder Tilapia market through an industry support

	Description	Risk	Mitigation
	As previously described, Catfish often out-perform Tilapia in smallholder systems due to their greater adaptation to low intensity pond culture, and lack of suitable Tilapia aquaculture production systems.	performance of Tilapia in smallholder systems are addressed. Provision of GIFT addresses one of the key blockages restricting the growth of the Tilapia industry, however there is a need to consider the availability of suitable feed resources and technical support to enable the potential of Tilapia to be realised.	program and embed the use of GIFT as a key component of improved Tilapia production and management practices. When available, produce updated information on the difference in profit margin between Catfish and GIFT Tilapia, as a matter of urgency. Make this information available as part of a package of best practice and technical support information mentioned above. Part of this difference in benefit-cost ratio will be offset by yield improvements resulting from GIFT Tilapia.
Realisation of yield gap	Underlying both the market demand and the price premium for GIFT is the realisation of increased performance in Nigerian aquaculture systems, particularly smallholder farm systems.	Genotype by environment effects (GxE), including those related to smallholder producer management capability mentioned above but also feed and environmental quality and health resources, have the potential to significantly alter GIFT performance in different geographies and production systems.	The mitigation of this requires PAL and other partners to deploy trained technical personnel to the field to support smallholder farmers in all aspects of GIFT production.
Increased competition from imports	Nigeria imported over 940,000 tonnes of fish in 2018, nearly 45% of its total fish supply. This occurred despite policy mechanisms (tariffs and quotas) designed to limit/control imports. Increased competition from imports could restrict the scale of market opportunity for WF.	Imported fish can be accessed at lower cost than domestically produced product. The Nigerian government has attempted to restrict imports to support its domestic fisheries and aquaculture. If competition from imports were to increase, potentially because of changes to policy, growth in the local Tilapia industry could be adversely affected.	This risk is mitigated by ensuring GIFT is disseminated to the broader industry along with appropriate technical support. Local product needs to be produced more cost-effectively to compete with imports in lower socio-economic market segments. A more competitive aquaculture industry is fundamental to this.

Phase 2 – Evaluation of commercialisation options

Description of Commercialisation Models

WorldFish could engage with commercial partners such as PAL via a range of broad market-entry or commercialisation models. A high-level description of the potential market-entry models is provided in Table 6.

Table 6: Commercialisation models and description.

Model	Description
Direct Export	WorldFish could supply GIFT genetics to PAL and other partners via a traditional export model. Under this model, broodstock would be supplied to PAL (and other in-market customers) from WF's GIFT breeding program. There would be no legal relationship between WF and PAL outside of a basic supplier-customer relationship. Broodstock could be priced based on their intrinsic value reflecting historical investment in the GIFT program, and/or potential value to PAL. It is possible to incorporate conditions of sale into a transaction agreement, this could provide some level of IP/brand protection for WF.
Indirect Export	Under this model PAL would act as a distributor or intermediary on behalf of WF. WorldFish would contract PAL to integrate GIFT into its breeding program, managing the multiplication and distribution of GIFT on behalf of WF (including for PAL's internal use). WorldFish would receive the revenue from GIFT fingerling sales, less any commission or fees payable to PAL.
Subsidiary Company	WorldFish could acquire or establish a subsidiary company that owns and controls hatchery facilities and broodstock in Nigeria. Broodstock could be transferred from the GIFT breeding program to the subsidiary hatchery for multiplication and subsequent sale/distribution. The subsidiary would subsequently manage in-market sales and distribution to PAL and other customers. WorldFish would extract value via its ownership interest in the subsidiary company (profits and dividends, growth in subsidiary value). Equity in the sub co could be divested over time to crystalise any growth in value of the sub co.
Joint Venture	WorldFish could form a formal partnership with PAL (or other commercial hatcheries). This would comprise the establishment of a separate business entity that is jointly owned by the partner companies/organisations. Ownership interests would be determined based on relative contributions of each partner (financial contributions, assets and infrastructure, IP, operational resources, goodwill etc), considering both contributions at establishment and on an ongoing basis. The JV entity would be subject to shared ownership and governance amongst the partners. WorldFish can extract value via its ownership interest (share of profit and growth in company value). This model could potentially involve creation of a JV entity that incorporates PAL's broodstock, hatchery infrastructure and operational resources, in combination with the provision of GIFT genetics and technical expertise from WF.
Strategic Alliance	A strategic alliance represents a less formal version of a JV (without the establishment of a separate JV entity). WorldFish and PAL could establish an alliance for the transfer of GIFT broodstock to PAL, and subsequent

Model	Description
	dissemination of fingerlings to the broader industry. The alliance would be governed by an agreement or contract between the two parties that describes roles, obligations and responsibilities, IP ownership, contribution of resources, allocation of benefits etc.
Licensing	WorldFish could grant a licence to PAL that entitles PAL to access and use GIFT genetics in return for an annual licence fee payable to WF. This could also include the licensing of the right for PAL to multiply and distribute GIFT. Premium Aquaculture Limited would retain control and responsibility over relevant breeding and production processes. The licence fee could comprise a fixed annual fee, or replicate a royalty or commission based on the use and distribution of GIFT by PAL. Sub-licensing could also be incorporated whereby PAL grants a sub-licence to commercial hatcheries that acquire hybrid GIFT broodstock from the PAL breeding program.
Franchising	Franchising represents an enhanced form of licensing whereby WF could licence PAL the right to use GIFT, along with relevant IP, branding, systems, and processes relating to production and management of GIFT genetic resources. Franchising generally contains greater specification and control over how the licenced material is used by the franchisee (PAL). Fees paid to the franchisor (WF) are generally more substantial than under a licensing model and could comprised a fixed fee, or a margin-based fee.

Examples of Commercialisation Models

A series of case studies have been identified to provide examples of the application of specific models for breeding program commercialisation and dissemination of genetics (Table 7). Due to commercial sensitivities, it is not feasible to provide detail about the application of the models described below, rather the intent is to demonstrate that each model has been applied in similar contexts to WF's objectives.

Table 7: Examples of commercialisation models and case studies.

Model	Case Study
Direct Export	• **Nam Sai Farms** offer Tilapia broodstock for sale as swim-up fry directly from their hatchery. Pricing incorporates a fixed 'Broodstock fee' payable every 3 years, and a fee per 1,000 fry[13]. • **Aquaculture ID** offer mature African Catfish broodstock (plus fry and fingerlings) for export from their Dutch hatcheries[14].
Indirect Export	• **Dutch Boy Farms** operate as the exclusive US agent/distributor for **Nam Sai Farms**, providing coordination of importation of Tilapia swim up fry direct from Nam Sai Farms hatchery, or provision of mono-sex fingerlings from the Dutch Boy Farms hatchery[15]. • **Accesso El Salvador** operate as the exclusive El Salvadoran agent/distributor for **Spring Genetics**[16].
Subsidiary Company	• **Hendrix Genetics** have established an Indonesian subsidiary **(PT Kona Bay Indonesia)** that will operate as a multiplication hatchery to supply locally reared shrimp broodstock to Indonesian commercial farms. The multiplication hatchery is supplied by the Kona Bay nucleus breeding program in Hawaii[17].
Joint Venture	• **Spectra-Hexa-Nam-Sai** is a JV between **Nam Sai Farms and Spectra Hexa Co**. The JV incorporates the establishment of a commercial hatchery for production and distribution of Tilapia mono-sex fingerlings throughout Bangladesh[18]. • **Nutreco, Hendrix Genetics and Ecuacultivos** have formed a JV to take over and upgrade the Macrobio shrimp hatchery in Ecuador. The JV will support multiplication and dissemination of Kona Bay shrimp to local farms[19].
Strategic Alliance	• **Rajiv Gandhi Centre for Aquaculture** and the **Oceanic Institute of Hawaii Pacific University** have collaborated to evaluate the commercial performance of shrimp families from the OI nucleus breeding program on Indian commercial farms. The performance evaluation is used to select family lines for production of broodstock for importation into Indian breeding programs[20].
Licensing	• **Genomar** have commercially released lines of broodstock from their GST Pro Tilapia strain via commercial licence agreements[21]. • **Spring Genetics** (subsidiary of Benchmark Genetics) have executed a 5-year broodstock agreement with Lake Harvest Group. The agreement provides Lake Harvest with exclusive access to Tilapia broodstock and a licence to produce and sell sex-reversed fingerlings to local farms[22].
Franchising	• **Spring Genetics** (subsidiary of Benchmark Genetics) promote a franchise model to support international distribution of their Tilapia broodstock. Ongoing transfers of Tilapia broodstock are provided to franchise hatcheries in conjunction with breeding program support services. Franchise hatcheries provide a down payment on delivery of the first broodstock, as well as an annual franchise fee[23][24].

[13] See: http://Tilapiathai.com/project/broodstock/
[14] See: https://www.aquacultureid.com/african-Catfish-broodstock/
[15] See: http://Tilapiathai.com/usa-agent/
[16] See: http://spring-genetics.com/articles/exclusive-distribution-agreement-signed-with-acceso-el-salvador/
[17] See: https://www.hendrix-genetics.com/en/news/hendrix-genetics-expands-global-shrimp-breeding-activities-indonesia/
[18] See: http://Tilapiathai.com/bangladesh-branch/
[19] See: https://www.skretting.com/en/settings/news/general-news/hendrix-genetics-and-nutreco-partner-to-deliver-sustainable-shrimp-solutions-in-ecuador/
[20] See: https://www.aquaculturealliance.org/advocate/broodstock-center-in-india-supports-domestic-shrimp-farming-industry/
[21] See: http://www.genomar.no/?page_id=150
[22] See: http://spring-genetics.com/articles/spring-genetics-signs-agreement-with-africas-largest-integrated-Tilapia-producer/
[23] See: http://spring-genetics.com/
[24] See: https://www.hatcheryinternational.com/major-player-in-Tilapia-genetic-work-seeks-broodstock-distributors-3023/

Evaluation of commercialisation models – assessment criteria

As presented in Table 6, each potential commercialisation model is utilised for the sale and distribution of genetics, demonstrating potential applicability under certain contexts and for certain objectives. Consequently, it is important to identify key factors that are relevant to WF and its commercialisation objectives, in the evaluation of the suitability of each model.

Consultation with WF has identified the following objectives and imperatives associated with its commercialisation of the GIFT breeding program. WorldFish objectives require that the:

- Model enables a sustainable level of financial return to support the GIFT breeding program (**"Sustainable Return"**).
- Model is replicable to enable adaptation to other geographies, species, and commercial partners (**"Ease of Replication"**).
- Model is appropriate to support WF's strategic objectives to support industry development and growth, providing smallholder agriculture and inclusive opportunities, and enhancing food/nutritional security. Crucial to these objectives is a model that encourages and supports dissemination of GIFT to the broader aquaculture industry, including smallholder producers. The relationship with commercial partners such as PAL is not intended to support exclusive use of WF genetics. This should also consider the applicability of the model within the supply chain structure of the target species/industry/market (**"Strategic Alignment"**).
- Model is flexible to enable adaptation to an evolving GIFT breeding program, including release of new strains (new traits) that may be released by global partners (**"Flexibility"**).
- Model supports appropriate protection of GIFT IP and brand (**"Brand Protection"**).

In addition to the above, it is also prudent to consider more generic imperatives for evaluating the applicability of the available commercialisation models, including that the:

- Model must be implementable by WF, recognising WF's internal resources and capability, consistency with organisational strategic objectives, and expected demands placed on WF to implement and manage the model (**"Complexity"**).
- Model must minimise risks to WF associated with financial exposure, commercial risks (including partner non-performance), exposure to production risks and losses, and exposure to potential regulatory and sovereign risks (**"Risk"**).

AbacusBio has utilised the above as criteria for evaluating the potential applicability of each model for use by WF as a means of partnering with commercial entities for dissemination of GIFT genetics. The evaluation incorporated an assessment of the compatibility or suitability of each model against each criterion. The assessment was undertaken subjectively and at a high/generic level, reflecting constraints related to limits on consultation with required people (especially within PAL), availability of all data and information on both WF and PAL, as well as the need to consider models that could be applicable across broad geographic, species and commercial contexts. As discussed later in the report, further due diligence is strongly recommended in areas of financial, legal, and commercial risk specific to the proposed partner and geography.

Table 8 presents a summarised assessment of each model against each assessment criterion. For a more detailed analysis, see Appendix 1. Models were ranked from best to worst against each criterion

(1 = best, 7 = worst), tied rankings were permitted where appropriate. The ranking scores for each model were subsequently summed to provide an overall rank (lowest score = most favourable).

During consultation, WF indicated that all criteria are strategically and equally valuable and therefore the criteria did not require independent weighting. Due to the need for further due diligence and consultation (particularly with potential partners), the intention of the assessment process is to undertake a reasonably broad but systematic assessment to enable the identification of a limited set of key models that could be explored further, particularly via consultation and negotiation with PAL and other potential partners.

Table 8: Evaluation of Commercialisation Models

Model	Sustainable Return	Ease of Replication	Strategic Alignment	Flexibility	Brand Protection	Complexity	Risk	Total
Direct Export	7	2	7	2	7	1	1	27
Indirect Export	3	3	2	3	5	2	3	21
Subsidiary Co	1	4	1	1	1	7	7	22
Joint Venture	2	7	4	5	2	5	6	31
Alliance	3	5	4	5	5	4	4	30
Licensing	5	1	2	3	4	2	1	18
Franchising	5	6	4	7	2	6	5	35

Based on this assessment, the licensing model appears the most favourable for WF. Generally, licensing ranks favourably because:

- It is a relatively passive model which minimises complexity for WF.
- Licence agreements can be relatively generic (subject to adaptation to local market laws/regulations regarding IP and other commercial areas), which supports ease of replication.
- It is a low-risk model due to the absence of any need for foreign subsidiaries and investments, exposure to operational activity and presence of partners/co-investors.
- It can be structured (via sub-licences) to maximise dissemination via expansion to multiplication hatcheries.

As previously described, other models are in use by other parties for similar purposes and with related objectives. This assessment does not suggest that these other models do not work, rather it highlights the need to consider requirements and objectives specific to WF, most notably:

- WorldFish is not a commercial organisation and has limited experience managing foreign commercial operations and consequently, models such as subsidiary companies and joint ventures are complex and risky for WF.
- Commercial organisations are motivated by commercial return and by nature are more opportunistic and flexible. In contrast, whilst the commercial return is important, WF's objectives are broader and this requires a model(s) that encourage dissemination and

promote accessibility to GIFT genetics. This also favours models that can be easily replicated to promote expansion into new markets/geographies.

Consultation with PAL revealed that collaboration discussions were early stage, and there was no current thinking or preference as to how the relationship with WF should be structured. This highlights a strong need for ongoing consultation with PAL over the potential design and implementation of the preferred model.

Model Design and Implementation

Development and implementation of the model can be broken down into three steps that should be progressed in consultation with internal WF stakeholders in the first instance, supported by input from relevant legal and commercial advisors, and then involving PAL.

Development of Revenue Model

WorldFish should seek to use the licensing model to generate a stream of royalties from sales of commercial fingerlings that originate from commercial hatcheries licenced (or sub-licenced) to produce and disseminate GIFT genetics.

Beyond this broad concept, key components of the revenue model need to be properly defined. These key components comprise:

- Development of a transparent and robust system for identifying and measuring commercial fingerling sales for apportionment of royalties. Indicative areas requiring consideration include:
    - Assessing whether it is feasible to rely on commercial hatcheries reporting their sales of GIFT fingerlings and remitting royalties to WF (potentially via PAL). This requires identification of mechanisms that could make a self-reporting system more transparent and describing how royalties are collected and remitted back to WF based on fingerling sales.
    - Assessing whether it is more appropriate to consider a system that determines royalties based on a proxy for fingerling production/output such as hatchery pond area (assuming this is proportional to expected fingerling production) or installed capacity to produce fingerlings, and simply charges a set annual royalty based on this proxy metric.

- Identification of an appropriate level of royalty that WF can extract from commercial fingerling sales. Financial projections incorporated into this report are based on a limited pool of performance evaluation data and have also not been subject to consultation with PAL, other commercial hatcheries, or commercial producers. Indicative areas requiring consideration include:
    - Determining an appropriate level of value-add based on the yield gap between GIFT and non-GIFT strains. This may need to consider GxE effects across different systems, levels of hybridisation based on dissemination pathway, and different methods of valuing the yield gap.

    - With reference to the above, WF will need to determine an appropriate share or distribution of the additional GIFT value across end users (commercial and smallholder producers), licensees (hatcheries) and to WF.
    - Integration of the revenue model into the broader in-market commercialisation and adoption strategy. This will require planning of the phasing in of price increases to support early adoption momentum, and the need for a tiered structure to the price and royalty model that incentivises sales.

These components need to be informed by further consultation with PAL (and potentially other stakeholders) to ensure the revenue model is feasible, commercially attractive, and leads to adoption. Adoption which is ultimately driven by fingerlings quality (vigour and survivability), fish performance (growth and feed conversion), and efficient distribution (logistics and pricing).

Development of the Licence

WorldFish will need to define a licence scope that is legally and commercially robust and fit for purpose. Key components of this area of activity comprise:

- Creating a licence scope that meets WF's strategic and commercial objectives. Indicatively this will include:
    - Clearly defining the scope of activity permitted by the licence, and the relevant obligations of the licensee (PAL) and WF, by identifying what is incorporated into the transfer of GIFT broodstock to the licensee, appropriate licence term/duration, and the scope of additional services provided by WF to the licensee. In addition, there will also be a need to consider mechanisms for licensing or sub-licensing of other commercial hatcheries to support broader dissemination of GIFT.
    - Identifying mechanisms to manage misuse or unlicensed use of GIFT such as broodstock management requirements to limit inbreeding or excessive hybridisation that could diminish commercial fingerling performance. This could also extend to mechanisms to limit or prevent unlicenced use of GIFT (e.g., restricting fingerling sales to mono-sex fingerlings and preventing unlicenced transfers of broodstock).

- Integrating the revenue model into the licence agreement. Beyond describing the royalty structure, this must clearly define how royalties are measured/quantified and the process for remitting royalties back to WF (including from sub-licensed hatcheries). This should include:
    - Responsibilities and obligations of each party for measuring and reporting activity subject to licence fees/royalties.
    - Responsibilities relating to royalties payable from sub-licensees.

- Ensuring the legal and commercial terms of the licence are appropriate to:
    - Adequately protect WF and its interests.
    - Consistent with commercial law and regulations within the appropriate jurisdiction.

As per development of the revenue model, these components need to be informed by further consultation with PAL and other stakeholders to ensure the licence scope and structure is feasible and commercially attractive.

WorldFish Implementation

WorldFish is an international not-for-profit organization primarily focussed on research and science to support fisheries and aquaculture development. Implementation of commercial licence agreements to support commercialisation of its genetic assets may require structural and organisational changes. This should be informed by a review of the WF charter to ensure its compatibility with the implementation of the proposed commercial licence model, and the identification of structural changes that may be required to ensure compatibility (e.g., creation of a separate, fully-owned entity, to manage commercialisation activity).

In addition, further internal due diligence may be required to understand (indicatively):

- Restrictions surrounding the use and management of funds collected via licence fees/royalties.
- Restrictions imposed by staff contracts/agreements (e.g., external directorships) if the licence model is implemented via a separate entity.
- Implications of this model (and activity) for current insurance and indemnity policies.
- Compatibility with internal risk management frameworks and organisational policies.
- Requirements to integrate into financial systems and financial reporting processes.

Beyond the steps above, there will also be a need to consider requirements for internal governance and management of this area of new activity.

Alternative Models

If further due diligence and/ or consultation with PAL suggests that the licensing model is not suitable, considerations should be given to the indirect export, joint venture and strategic alliance models, as high ranking alternatives.

Appendix 2 contains a description of the potential design and implementation of these alternate models.

In selecting the alternate models, it is important to recognise the following:

- There is similarity between the licensing model and indirect export model (see Appendix 2). Consequently, further alternate models (joint venture and strategic alliance models) are put forward to mitigate risk that the indirect export model may not be sufficiently different from the preferred licensing model, and thus may not provide an effective alternative.
- The subsidiary company and direct export models are relatively highly ranked (Table 8). However, both models have significant and distinct areas of weakness (Table 8) and have been considered unsuitable on this basis.

Financial Forecasts

Commercial Value of GIFT

Current Nigerian market prices for 2g Tilapia fingerlings range from ₦17 to₦20 as per WF market data and feedback from PAL.

Following consultation with WF it was agreed that a yield gap of 20% between GIFT and local Tilapia strains could constitute a conservative but realistic estimate, based on limited performance evaluation data across similar geographies (Ghana) and similar production systems across other markets.

Table 9 utilises data provided by WF to evaluate the potential value of GIFT (at a 20% yield gap) across indicative Nigerian production systems. The analysis incorporates the following assumptions:

- Generic fingerling values of ₦18 across all scenarios.
- Harvest price of ₦750/kg across all scenarios.
- Feed cost of ₦340/kg across all scenarios and fixed FCR of 1.4.
- 20% increase in harvest output due to GIFT across both systems.
- Labour and other overhead costs were fixed and independent of adoption of GIFT.

Table 9: Analysis of Potential Value of GIFT at 20% Yield Gap

System	**Pond Culture**		**Cage Culture**	
Tilapia System	**Non-GIFT Pond**	**GIFT – Pond**	**Non-GIFT Cage**	**GIFT Cage**
Dimensions (m)	30 x 15	30 x 15	6 x 6 x 4.5	6 x 6 x 4.5
Fingerlings Stocked	3,600	3,600	6,480	6,480
Harvest (Kg)	1,440	1,728	2,592	3,110
Cycle Revenue (₦)	1,080,000	1,296,000	1,944,000	2,332,800
Seed Cost (₦)	64,800	64,800	116,640	116,640
Feed Cost (₦)	685,440	822,528	1,233,792	1,480,550
Cycle Margin (₦)	329,760	408,672	593,568	807,610
GIFT Margin (₦)	–	**78,912**	–	**214,042**
Margin per Fingerling (₦)	–	**21.92**	–	**33.03**

Relative to current market pricing for generic Tilapia fingerlings, the potential additional value of GIFT appears to be significant (at ~₦22-₦33 per fingerling) (Table 9). The analysis also demonstrates the potential for GIFT to deliver increased benefit per fingerling within more intensively managed systems, such as cage culture systems.

It is likely to be unfeasible to operate separate pricing models for different production systems and customers. Therefore, WF and its partners need to consider a pricing system that balances the potential value foregone within intensive systems if adopted pricing reflects GIFT value across lower-intensity systems. Alternatively, WF could price GIFT on the basis of its higher value to more intensive systems, if this increased margin offsets the potential loss of market share/potential from the lower-intensity systems. This trade-off/ balance represents an important area of further due diligence. There is also the potential to go to market in the future with price differences for specific strains of GIFT/ products, e.g., cheaper lines (less productive) targeted at lower input systems with expensive material (more productive) target at more intensive systems. However, this approach requires a more mature and price-informed market, so is unlikely to be possible in the medium term.

To forecast potential GIFT royalty revenue, it was assumed that WF would adopt pricing reflecting expected value across lower-intensity systems, accepting this foregoes potential value within more intensive systems. This approach would also be consistent with WF's non-commercial objectives associated with supporting industry development and enhancement of smallholder agricultural systems. On this basis, GIFT was estimated to have a commercial value of ₦20 per fingerling above generic Tilapia fingerlings currently utilised within Nigerian commercial aquaculture.

Potential Royalty Value

The analysis presented above provides a conservative estimate of the potential value of GIFT to Nigerian commercial and smallholder producers. To support adoption of GIFT, adopting producers need to retain a large proportion of this value.

Farm production is exposed to significant risk and uncertainty from the impact of market price movements and performance/production variation. In this context, farmers are often risk averse and may require a larger incentive to overcome uncertainty of the visibility and realisability of benefits.

Furthermore, ensuring producers retain a large portion of the value of GIFT is also consistent with broader WF objectives associated with increasing the profitability and sustainability of local aquaculture production, particularly within smallholder systems.

On this basis, it is estimated that a residual value of ₦10 (i.e., 50% of the yield gap value) per fingerling could be shared between WF and its licenced commercial hatcheries, with the remaining 50% captured by adopting producers. This structure will help ensure farmers can adopt GIFT with greater confidence.

It can be argued that WF could be entitled to the greater share of this residual value in recognition that hatcheries already generate a profit margin at current fingerling prices and GIFT will provide an opportunity to increase overall fingerling sale volumes. However, it is also important to recognise the difficulty for WF in controlling hatchery pricing under a licensing agreement.

Conservatively, AbacusBio has assumed an average royalty value for WF of ₦5 per 2g fingerling. This would represent WF's expected licensing revenue from sales of fingerlings via commercial hatcheries.

Indicatively, this level of royalty would establish longer-term pricing for GIFT at ~₦23-₦28 per 2g fingerling, depending on pricing responses from licenced hatcheries.

The analysis underpinning this estimate must be reviewed both during subsequent phases of due diligence and following collection of in-market performance evaluation data for GIFT (yield gap data). This should also be informed by consultation with both partner hatcheries and commercial and smallholder producers.

Royalty Revenue Projection and Sensitivity Analysis

Future royalty revenues from sales of GIFT fingerlings depend on the overall demand for fingerlings (Table 4), the market share for GIFT fingerlings, and the size of the royalty received per fingerling.

To calculate the value of future royalties over a 20-year period (until 2040), AbacusBio calculated the annualised value of royalties under the market growth scenarios depicted previously in Figure 3. The annualised value is a revenue stream of equal annual payments that matches the present value (PV) of the projected GIFT royalty stream. A 5% real discount rate was applied to determine the PV of the royalty stream.

The base aquaculture production market growth scenarios assume 50% market share for GIFT fingerlings, and a ₦5 royalty per fingerling. Sensitivity analysis has been undertaken to quantify the sensitivity of annualised value of royalties to WF, to these parameters. In addition, sensitivity analysis also explored the impact of different rates of growth (real dollar terms) in royalty value over time. The opportunity to increase the value of the royalty over time could be realised as the market grows and matures. This could be achieved via efficiencies and economies of scale within the hatchery sector, increased end-user value emanating from genetic progress within future GIFT strains, and intensification/improvement of local aquaculture systems.

The GIFT market share of 50% was attained within 5 years, under an assumption of linear growth (i.e., 10% per market share growth per year).

Through consultation, WF and PAL indicated that it may be prudent to maintain GIFT fingerling pricing at a level consistent with generic fingerling prices for an initial period. This would de-risk initial adoption of GIFT by commercial farmers and support greater acceptance of higher future pricing after initial adoption of GIFT and validation of its performance. On this basis, each scenario incorporated an initial 3-year period where no royalties were levied on GIFT fingerlings.

Under these base assumptions and across the sensitivity range, the annualised value of royalties from GIFT fingerling sales is between US$142,000 and US$1,632,000 per year across the three market growth scenarios (Table 10).

Table 10: Sensitivity of annualised return (US$[1]) from 20 years of projected royalty revenue to changes in market share and royalty fee for base, moderate, and fast growth scenarios.

		Industry growth scenario		
		Base	**Moderate**	**Fast**
Market share for GIFT				
	10%	$28,453	$44,282	$129,340
	25%	$71,133	$110,705	$323,351
	50%	**$142,266**	**$221,410**	**$646,702**
	75%	$213,398	$332,115	$970,053
	90%	$256,078	$398,538	$1,164,064
WF Royalty (₦ / fingerling)				
	₦1.00	$28,453	$44,282	$129,340
	₦2.00	$56,906	$88,564	$258,681
	₦5.00	**$142,266**	**$221,410**	**$646,702**
	₦7.50	$213,398	$332,115	$970,053
	₦10.00	$284,531	$442,820	$1,293,404
Royalty Growth Rate (%/year)[2]				
	0%	**$142,266**	**$221,410**	**$646,702**
	2%	$152,761	$239,246	$707,046
	3%	$164,242	$258,829	$773,720
	5%	$205,622	$329,938	$1,018,771
	10%	$305,546	$503,952	$1,631,559

1. 1 US$ = ₦380
2. Real value

Discussion

The analysis above has projected potential royalty revenue ranging from US$142,266 to US$646,702 in annualised present value terms, with royalty value of ₦5 (from 2025 – 4th year of commercial availability) per fingerling and GIFT market share of 50% (achieved at year 5). At higher or lower market shares for GIFT Tilapia, along lower or higher WF royalties per fingerling, the analysis projects annualised returns ranging from US$28,543 to US$1,631,559.

As previously described, WF's market projections reflect the 'Fast' growth scenario. This scenario incorporates a 'likely' royalty value of US$646,702 per year in annualised present value terms.

One of the key objectives associated with commercialisation of the GIFT breeding program is to develop a revenue stream that can support the core GIFT breeding program, creating independence from external funding sources.

Consultation with WF has identified the following:

- The current cost of the core GIFT breeding program is estimated to be US$1.1 million per year comprising basic management and facilities costs.
- A cost base of US$1.5 million per year would provide a suitable allowance for costs associated with supporting R&D programs, recognising the increasing role of genomics and the cost associated with this technology.
- The breeding program is currently housed at WF's Penang facility. It is expected that relocation to a new facility will occur in 2-3 years. Consequently, an allowance for upgrades and modifications (US$250,000 per year) should be included.

Further internal consultation is required to understand:

- Expectations regarding contribution of royalties toward WF overheads and indirect costs, not associated with the GIFT program.
- Expectations regarding the contribution of royalties toward costs of industry development activity within Nigeria that is not directly associated with provision of GIFT genetics.
- Appropriate discount rates applicable to valuation of future royalty streams. AbacusBio have used a 5% discount rate which is lower than investment hurdle rates utilised within commercial entities (likely to be upwards of 8% at current risk-free rates).

Based on the above, the base annual cost of the GIFT breeding program is estimated to be US$1.75M.

On this basis, AbacusBio's financial projections demonstrate potential for Nigerian royalties to cover up to 31% of the cost of the core GIFT breeding program using WF's market growth projections, 50% market share, and a ₦5 royalty value. This increases to as much as 93%, with increases in royalty growth rate,

Beyond Nigeria, GIFT is expected to be commercialised within a broad range of markets. Consequently, additional royalty streams are expected to be realised to complement Nigerian revenue. WorldFish has advised that markets such as India and Bangladesh offer significantly larger royalty potential than Nigeria.

Consequently, potential royalty revenue from Nigeria does appear to warrant further exploration of market opportunities, based on the extent to which this royalty stream supports the financial sustainability of the GIFT program, and the relative potential/importance of the Nigerian market.

Several key risks and uncertainties affect the confidence of this assessment, as described in the section below.

Key Risks and Uncertainties

Table 11 describes key areas of risk and uncertainty affecting the financial projections presented above.

The size of the Nigerian Tilapia market, and the market share achieved by GIFT are key risks affecting the projected royalty revenue for WF. Some market risks have previously been explored (see 'Market Risks') and are excluded from the table below.

Table 11: Risks and Uncertainties associated with Financial Projections.

	Description	**Risk**	**Mitigation**
Size of Royalty	The size of the royalty that can be extracted by WF is a key driver of subsequent revenue. As per the methodology embedded in the financial projections – royalties need to be levied at a level that provides sufficient incentive for both producers and commercial hatcheries to adopt GIFT.	The potential royalty is primarily impacted by the size of the yield gap relative to other Tilapia sources and the subsequent value this yield gap creates for adopting farmers. A yield gap below 20% could reduce potential royalty rates. In addition, there is also risk that royalties could be affected by unsustainable pricing from licenced hatcheries.	• Ensure royalty levels are reviewed based on in-market performance evaluations. • Ensure GIFT is supported by appropriate technical support and technology transfer that underpins adoption of suitable farm production practices, enabling expected expression of GIFT phenotypic advantages. • Consider mechanisms within the licence agreement to influence pricing practices from licenced hatcheries.
Speed of Dissemination and Adoption	The present value of the royalty stream is impacted by the speed of adoption and dissemination of GIFT. A slower initial period of growth can diminish the PV of royalty returns even if final demand targets are achieved.	Speed of adoption and dissemination is primarily driven by market demand but is also affected by capacity and availability of GIFT. Capacity constraints will primarily arise from a lack of hatchery capacity, and unavailability of GIFT broodstock to meet demand	• Ensure the licence model is conducive to extension to new hatcheries. • Alongside PAL, ensure there is adequate broodstock to meet an expanded hatchery sector. • Ensure industry development programs incorporate a focus on coordination of industry

	Description	Risk	Mitigation
		from new/expanded hatcheries.	growth and investment and provide expertise to support these needs. • Develop a strong extension-information support structure to clearly demonstrate the advantages of using GIFT.
Longevity of commercial relationships	The longevity of the royalty stream requires hatcheries to renew licences and continue to incorporate GIFT into their breeding programs. Dis-adoption of GIFT has not been incorporated into the scenario/sensitivity analysis but has the potential to significantly reduce revenue streams for WF.	Continuation of licences by hatcheries can be impacted by numerous factors, including: • Market demand for GIFT, primarily reflecting the value for money of GIFT and its performance advantage. • Commercial terms associated with access and use of GIFT. • Cost of incorporating GIFT into breeding programs and availability of adequate technical support. • Inability to control unlicenced use of GIFT, disincentivising licensed usage.	• Ensure license royalties are set at a level that retains adequate incentive to support adoption by both hatcheries and the broader market. • Maintain investment in core breeding program to maintain rates of genetic progress, develop new traits, and maintain diversity. This will help support the ongoing value of GIFT. • Ensure license agreements are commercially attractive and provide adequate technical support to licensees. • Ensure license agreements directly manage risks of unlicenced use.
Exchange Rates & Economic Conditions	The Nigerian economy and the Naira are heavily exposed to oil/resource prices and demand. Devaluation of the Naira could result from falling oil prices resulting from further economic shocks.	The financial projections are based on an exchange rate of ₦385 per US$1. The value of the royalty stream in US$ terms is directly impacted by the exchange rate with the Naira.	• It is possible to mitigate this via hedging instruments but this creates risk and uncertainty of its own. • Can mitigate via exposure to multiple global markets. • Integration of pricing reviews into licence agreements can provide further protections.

	Description	Risk	Mitigation
			• Could also set royalties in USD but this may reduce adoption by hatcheries.

In addition to the above, there is also significant uncertainty surrounding the cost of market entry.

Costs associated with technical support that is provided to PAL (and other licenced hatcheries) to support their use of GIFT have not been quantified due to the need for further engagement with PAL to identify the scope and duration of this support.

Additional support

In addition, PAL and WF have identified the critical need for appropriate industry support to assist dissemination of GIFT to the broader aquaculture industry. Indicatively this support is expected to include:

- Coordination and technical input into the development of new Tilapia multiplication hatcheries to support dissemination of improved Tilapia fingerlings to the industry.
- Provision of ongoing technical advice to commercial hatcheries to support integration and management of new GIFT broodstock.
- Development of a technology transfer package to ensure growers benefit from the availability of GIFT through the provision of a suitable production environment (feed, health and biosecurity, pond/cage management etc) that enables expression of GIFT's genetic advantages.
- Training of local technical personnel to support delivery of technology transfer package via a train the trainer model.

WorldFish's role and investment in the above requires definition. Furthermore, the relationship between this activity and the commercialisation of GIFT needs to be clarified to that extent this broad industry support constitutes 'core business' for WF and is separate from GIFT commercialisation.

Irrespective of these uncertainties, the projected revenue streams, underpinned by strong growth in the Nigerian aquaculture sector, appear sufficiently substantial to justify further due diligence.

Commercialisation Action Plan

AbacusBio recommends that the progression of WF's commercialisation strategy for GIFT occur in accordance with the action plan outlined below. The action plan reflects that aspects of the project are at an early or conceptual stage, requiring definition, before WF is in a position to consider formal due diligence and implementation.

On this basis, AbacusBio have developed an action plan that prioritises activites addressing:

- Definition of the scope and structure of the proposed license model,
- Formal engagement with PAL to understand requirements and strategic alignment, and assess suitability as a commercial partner,

- Stakeholder consultation on the appropriateness of licensing as a means of disseminating GIFT, and
- The scope of further in-market activity required to support development of the aquaculture industry and drive adoption of GIFT.

On completion of these initial actions, WF can undertake a Go/No-Go assessment to confirm the ongoing applicability of the licensing model and WF's appetite to proceed further with its due diligence. This also represents an appropriate juncture for identifying further due diligence activity based on both requirements for internal approval and implementation, and remaining areas of uncertainty.

Table 12: Action and description for next steps of commercialisation plan.

	Action	Description
1	**Develop Concept Model**	AbacusBio has described the key areas of activity associated with the development of a concept model under the section 'Model Design and Implementation'. Development of a detailed concept model, including a basic licence agreement, is vital for formal stakeholder consultation, detailed forecasting, and internal approval processes. Key output from this activity is to produce a tangible and well-defined licence model for progression of further implementation activity. **Key steps include:** **1. Internal consultation to confirm broad acceptance of licensing model and document/understand key requirements and priorities from internal stakeholders relating to design of a commercial licensing model.** **2. Completion of work described under 'Model Design and Implementation', supported by legal and commercial advisors as required.**
2	**Partner Engagement and Due Diligence**	Current discussions between WF and PAL have been preliminary and high level. There is an urgent need to more formally engage and define: • Premium Aquaculture Limited's requirements for GIFT and related support from WF. • Premium Aquaculture Limited's proposed use of GIFT and willingness/capacity to support broader dissemination and industry development. • Premium Aquaculture Limited's perspective on commercial terms associated with access to GIFT, including pricing and conditions of use. • Premium Aquaculture Limited's input on strategies to support dissemination, pricing of fingerlings, market assessments, and market entry strategies etc.

	Action	Description
		WorldFish need to use this engagement to refine its licence model and undertake due diligence to confirm PAL's suitability as a key commercial partner. In particular it is vital to confirm PAL is aligned with the need to ensure GIFT is disseminated to the broader industry and can contribute to this objective. Also, important to ensure PAL is aligned with the need to manage GIFT appropriately to protect the brand and has suitable expertise to achieve this with support from WF. **Key steps comprise:** **1. Definition of the parameters of the broader relationship/collaboration outside of the licence agreement – specifically this would include some concepts associated with developmental objectives and potential roles and requirements for PAL within those objectives.** **2. Engagement with PAL to explore PAL's needs and perspectives and consultation on 1 above.** **3. Confirmation of PAL's suitability and identification of actionable feedback to take forward to subsequent phases.**
3	**Stakeholder Consultation**	Development of the concept model provides a tangible basis for formal consultation with key internal stakeholder and further external stakeholders (beyond PAL). This consultation will be required to: • Refine the licence model to ensure it is acceptable to both internal and external stakeholders. • Seek input from a broader range of external stakeholders, particularly other potential licensees. Understand potential demand for GIFT (outside PAL), and acceptance of licensing model as a means of accessing GIFT. • Understand market perceptions of the value of GIFT genetics and potential pricing and royalty models for commercial fingerlings. • Clarify internal approval processes and pathways to understand requirements to support internal decision making. • Clarify relevant financial targets and metrics for internal approvals and financial due diligence. **Key steps comprise:** **1. Identification of key stakeholders (internal and external) for consultation and create a consultation plan that identifies specific areas of feedback required from each stakeholder type.** **2. Completion of consultation in accordance with the above.** **3. Collation of responses and identification of actionable feedback.** **4. Revision of the concept model in accordance with actionable feedback.**
4	**Project Plan for Adoption Support Activities**	AbacusBio's consultation with WF and PAL has identified the need for a substantial industry support project to underpin development of the

<table>
<tr><th></th><th>Action</th><th>Description</th></tr>
<tr><td></td><td></td><td>Nigerian aquaculture industry that will also support growth in demand for GIFT. Broadly this comprises:
Providing support (coordination and technical input) for the development of new Tilapia multiplication hatcheries to support dissemination of improved Tilapia fingerlings to the industry.
Provision of ongoing technical advice to commercial hatcheries to support integration and management of new GIFT broodstock.
Development of a technology transfer package to ensure farmers benefit from the availability of GIFT via the provision of a suitable production environment (feed, health and biosecurity, pond/cage management etc) that enables expression of GIFT’s genetic advantages.
Training of local technical personnel to support delivery of technology transfer package via a train the trainer model.
The scope of industry support activity needs to be defined and incorporated into a detailed and costed project plan. This will support decision making regarding the commercial feasibility of the proposed release of GIFT by quantifying the scope and cost of support activity that underpins development of the Nigerian aquaculture sector.

In addition, it is vital to understand the internal WF perspectives on the linkage between WF investment in industry development activity and potential revenue streams from GIFT commercialisation. This will support assessment of the adequacy of expected GIFT royalty streams.

Key steps include:
Engagement with PAL and other key in-market stakeholders to identify industry needs, appetite and resources to support WF.
Identification of areas and scope of activity, objectives, resourcing requirements, delivery models for provision of technical support, budget, milestones/deliverables and identify potential funding sources and partners.
Development of a project plan for consultation and completion of internal and external consultation.
Outlining of internal WF perspectives on whether potential GIFT revenue streams need to recover/offset this investment.
Subject to 4, proceeding with implementation of project (pending securing of funding) or incorporation into ongoing due diligence associated with GIFT commercialisation.</td></tr>
<tr><td>5</td><td>Go/No-Go Point</td><td>On completion of actions 1-4, WF will be in a position to assess the merit of progressing further with its GIFT commercialisation strategy. This assessment can be based on:
The proposed structure of the licensing model, and its impact on potential royalty streams.</td></tr>
</table>

	Action	Description
		• Stakeholder feedback and acceptance of the concept model. • Understanding of implementation requirements and subsequent timeframes/ and complexity. • Understanding of the scope and scale of support activity, and any need for this to be offset by royalty revenue. • Understanding internal financial targets and objectives for GIFT royalty revenue. Beyond the Go/No-Go point, WF will initiate final legal and commercial due diligence to prepare for internal approvals and implementation.

Appendix 1 – Model Evaluation

Model	Sustainable Return	Ease of Replication	Strategic Alignment	Flexibility	Brand Protection
Direct Export	**Rank: 7^{th} out of 7** - Difficult to extract value from multiplication and subsequent commercial fingerling production under this model. - WorldFish would need to negotiate a transaction price that reflects potential downstream revenue – this could be hard to sell to partners, particularly where the fingerling market is small and hard to access (dominated by smallholders).	**Rank: 2^{nd} out of 7** - Is simple and requires limited adaptation to new markets or partners. - Key challenge is the availability of suitable partners/ customers and the ability to attract these. - Pricing of broodstock could also limit expansion into small and fragmented markets.	**Rank 7^{th} out of 7** - Successful dissemination to industry, particularly smallholders, is entirely dependent on partner multiplying and releasing broodstock/fingerlings. - Pricing adopted by the partner is also important in facilitating dissemination and is difficult for WF to control. Potentially mitigated by WF engaging with multiple in-market customers or incorporating conditions of sale into any purchase agreement. - Creates conflict between revenue generation for WF via its pricing model, and the need to disseminate globally – will favour larger markets.	**Rank: 2^{nd} out of 7** - Transactional relationship that can easily adapt to the availability of new strains or distribution methods.	**Rank: 7^{th} out of 7** - WorldFish has limited capacity to oversee or control the partners use of GIFT. - Transaction could be subject to terms restricting use of GIFT, but this could be difficult to incorporate and enforce.
	Complexity	**Risk**	**Total Score**		
	Rank: 1^{st} out of 7 - Does not require major operational or organisational changes. - Very limited exposure to international trading but no international operations to manage or integrate. - No exposure to foreign entities or subsidiaries. - Key challenge is effective marketing and customer management, customer support and logistics.	**Rank: 1^{st} (eq) out of 7** - No requirement for investment or creation of major areas of recurrent cost. - Relationship is simple supplier-customer relationship, no legal relationship or obligation beyond any transaction/ sale agreement. - Main commercial risk revolves around payment defaults and foreign exchange risks. No significant increase in production risks	**Rank: 4^{th} out of 7**		

<table>
<tr><th>Model</th><th>Sustainable Return</th><th>Ease of Replication</th><th>Strategic Alignment</th><th>Flexibility</th><th>Brand Protection</th></tr>
<tr><td rowspan="3">Indirect Export</td><td>Rank: 3rd (eq) out of 7
- Provides opportunity for WF to extract value from commercial broodstock and fingerling sales, net of commissions/ fees payable to partner.
- Downstream value relative to distribution fees may be limited in smaller and more fragmented markets.
- Revenue will also be driven by partner efficacy and reach.</td><td>Rank: 3rd out of 7
- Replication is potentially complicated by the likely need for some adaptation to each market and partner. Particularly as partners will seek to negotiate the most commercially favourable terms, thereby limiting opportunities for a cookie cutter model.
- Availability and suitability of potential partners may also limit opportunities in certain markets.</td><td>Rank: 2nd (eq) out of 7
- Generally, supports WF's objective of maximising dissemination of improved genetics by directly incentivising the partner to generate fingerlings and broodstock for dissemination.
- Reliance on a partner does create risk that the partner will focus on segments/ geographies that offer the highest reward to effort ratio.
- As previously noted, structuring the commercial terms between WF and its partner in smaller and more fragmented markets will be challenging and may make the model more conducive to larger markets.</td><td>Rank: 3rd (eq) out of 7
- Can easily adapt to the availability of new strains or distribution methods from the GIFT nucleus.
- Does carry some loss of flexibility due to the likely reliance on a single in-market partner – subject to terms of agreement, this could limit opportunity to capitalise on opportunities with other in-market producers.</td><td>Rank: 5th (eq) out of 7
- WorldFish can mitigate some risks via its choice of distributor and terms of the distribution agreement.
- Does place significant reliance on the role of the distributor which carries risk.
- Lacks direct interaction with end customers.</td></tr>
<tr><th>Complexity</th><th>Risk</th><th>Total Score</th><td></td><td></td></tr>
<tr><td>Rank: 2nd (eq) out of 7
- Relatively easy to integrate into current WF operations.
- Does not require major operational or organisational changes.
- No international operations to manage or integrate.
- No exposure to foreign entities or subsidiaries.
- Main complexity surrounds the development and management of commercial distribution agreements and partners, noting the likelihood that the terms and obligations of these relationships may often be different across partners and markets.</td><td>Rank: 3rd out of 7
- Some increase in risk relative to direct export.
- Relationship with PAL/ Partner will be more contractually oriented and complex than a supplier-customer relationship.
- Increased importance of effective management of the partner organisation to ensure sales/revenue targets are achieved.
- No requirement for investment or significant increases in production risks.</td><td>Rank: 2nd out of 7</td><td></td><td></td></tr>
</table>

Model	Sustainable Return	Ease of Replication	Strategic Alignment	Flexibility	Brand Protection
Subsidiary Company	**Rank: 1st out of 7** - WorldFish can utilise subsidiary company (sub co) to maximise market opportunity and subsequent sales. - Sub co captures all sales revenue (less production costs) without commissions/ payments or margin sharing with partners. - Some risk that smaller markets could be less profitable but mitigated by sub co structure/ scale.	**Rank: 4th out of 7** - Is quite easily replicated. - Major limitation comprises availability of suitable acquisitions versus time and complexity of a greenfield development. - Foreign investment regulations in certain markets may also require modification of sub co structure.	**Rank: 1st out of 7** - WorldFish can control structure and operation of the sub co to maximise alignment to broader objectives surrounding industry development and public good – some possibility that this could conflict with financial returns in some markets. - Could be limited in its applicability to markets where multiple target species exist.	**Rank: 1st out of 7** - Can easily adapt to the availability of new strains or distribution methods from the GIFT nucleus.	**Rank: 1st out of 7** - Allows WF to exercise a high degree of control over the use and dissemination of GIFT within the target market. - Provides direct control over the production of saleable germplasm and its subsequent distribution.
	Complexity	**Risk**	**Total Score**		
	Rank: 7th out of 7 - Creates significant complexity for WF via creation of foreign subsidiaries. - Creates significant challenge with the need to consider management of a large and diverse workforce, operating under diverse employment conditions. - Will also require new skillsets and expertise for WF to effectively manage and coordinate its operations.	**Rank: 7th out of 7** - Exposes WF to significant offshore investment with associated financial and commercial risks. - Will also create exposure to production risks associated with overseas facilities/ operations. - Likely focus on developing country markets also creates risk around foreign investment and sovereign risks.	**Rank: 3rd out of 7**		

<table>
<tr><th>Model</th><th>Sustainable Return</th><th>Ease of Replication</th><th>Strategic Alignment</th><th>Flexibility</th><th>Brand Protection</th></tr>
<tr><td rowspan="4">Joint Venture</td>
<td>Rank: 2nd out of 7
- Depending on structure and the level of ownership interest in the JV entity – WorldFish gains direct exposure to a share of sales revenue from commercial fingerling sales (less production costs).</td>
<td>Rank: 7th out of 7
- JVs are relatively common and implementable in most contexts.
- Main challenge is the difficulty in creating a generic JV model – every partner will have different requirements, resources and capability.
- Will also be subject to commercial negotiation with JV owners, and adaptation to the local commercial environment. Consequently, it is likely that each JV will require customisation to each market and partner context.
- Replication will also be constrained by the need to locate a suitable partner in each market.</td>
<td>Rank: 4th (eq) out of 7
- Provides WF with the opportunity to identify and work with strategic partner/s that have the capability to support WF's developmental goals.
- Partnering with commercial entities could create some strategic tensions, however this can be mitigated through careful selection of partners and ensuring the JV has a clear strategic mandate and appropriate governance.
- WorldFish may also be restricted by the availability of suitable partners within key markets.</td>
<td>Rank: 5th (eq) out of 7
- Has good flexibility subject to the degree of strategic alignment between the JV partners, and the level of autonomy granted to the JV entity.
- The presence of a partner does create a low level of risk that the model may not be completely responsive to changes in the production and distribution of GIFT.</td>
<td>Rank: 2nd (eq) out of 7
- Allows WF to exercise a high degree of control over the use and dissemination of GIFT within the target market.
- Provides direct control over the production of saleable germplasm and its subsequent distribution.</td></tr>
<tr><th>Complexity</th><th>Risk</th><th>Total Score</th><td></td><td></td></tr>
<tr><td>Rank: 5th out of 7
- Creates significant complexity for WF via creation of foreign subsidiaries/entities.
- Depending on the partner there is also potential for significant challenge with the need to consider management of a large and diverse workforce, operating under diverse employment conditions.
- Will also require new skillsets and expertise for WF to effectively manage and coordinate its operations.
- Shared governance with the JV partner is also potentially complex.</td>
<td>Rank: 6th out of 7
- Exposes WF to co-ownership of an offshore entity with associated financial and commercial risks.
- Will also create exposure to production risks associated with overseas facilities/ operations.
- Likely focus on developing country markets also creates risk around foreign investment and sovereign risks. These risks are mitigated to some degree (relative to the sub co model) via the inclusion of a JV partner/s.</td>
<td>Rank: 6th out of 7</td><td></td><td></td></tr>
</table>

Model	Sustainable Return	Ease of Replication	Strategic Alignment	Flexibility	Brand Protection
Strategic Alliance	**Rank: 3rd (eq) out of 7** - Potential revenue depends on the structure of the alliance and the roles/contribution of WF versus the partner/s. - There is scope to structure the alliance to ensure WF receives a revenue stream from subsequent commercial fingerling sales.	**Rank: 5th out of 7** - Similar to JV models, alliances are reasonably common but are typically bespoke and lack a generic model. - Is also subject to the strategic and commercial objectives of the partner. - Relative to a JV, alliances are marginally easier to establish due to their greater simplicity and flexibility.	**Rank: 4th (eq) out of 7** - Provides WF with the opportunity to identify and work with strategic partner/s that have the capability to support WF's developmental goals. - Partnering with commercial entities could create some strategic tensions, however this can be mitigated through careful selection of partners and ensuring the alliance has a clear strategic mandate and appropriate governance. WorldFish may also be restricted by the availability of suitable partners within key markets.	**Rank: 5th (eq) out of 7** - Has good flexibility subject to the degree of strategic alignment between the alliance partners. - Flexibility can be more restricted than a JV as the relationship between the partners is generally contractual, however the use of a defined contractual term can mitigate this somewhat. - The presence of a partner does create a low level of risk that the model may not be completely responsive to changes in the production and distribution of GIFT.	**Rank: 5th (eq) out of 7** - WorldFish can structure the alliance to manage risks associated with the use and dissemination of GIFT within the target market. - However, the model is more limited than a JV in terms of the capacity for WF to influence activity that is under the control of the alliance partner (beyond contractual terms).
	Complexity	**Risk**	**Total Score**		
	Rank: 4th out of 7 - Is less complex than a JV as it is underpinned by a contractual relationship between the parties. - Does not require exposure to ownership or investment in foreign entities and would likely place the onus on the partner to manage operational activity. - Main challenge for WF will comprise governance and oversight of the alliance.	**Rank: 4th out of 7** - Main risks are predominately related to contractual disputes. - Does not require any investment or ownership interest from WF, nor is there direct exposure to production risks (expected to be borne by the partner). - Depending on the structure, it is likely that the partner will primarily bear the risks associated with in-market operations.	**Rank: 5th out of 7**		

Model	Sustainable Return	Ease of Replication	Strategic Alignment	Flexibility	Brand Protection
Licensing	**Rank: 5th (eq) out of 7** - Revenue is restricted to a royalty, commission of subscription/licence fee, however it can be structured to be proportional to commercial fingerling sales. - There is scope to sub-licence other commercial hatcheries to facilitate transfer of broodstock from PAL, and creation of additional multiplication and dissemination capacity. - Main risk is providing licences to partners who are appropriately incentivised to maximise sales volume.	**Rank: 1st out of 7** - Subject to subtle differences in IP and commercial law across markets, licence agreements can be generic. - There may be a need to consider the appropriate revenue or fee structure for each market and licence agreement, however this is not complex and carries low risk.	**Rank: 2nd (eq) out of 7** - Provides WF with the opportunity to identify and work with strategic partner/s that have the capability to support WF's developmental goals. - Depending on the revenue model, licensing can be low risk for each party and can be structured to incentivise the licensee to maximise sales (e.g., tiered fee structures linked to sales volumes).	**Rank: 3rd (eq) out of 7** - Has good flexibility to adapt to changes in the GIFT product and its delivery. - Can be time-bound (non-perpetual), non-exclusive and contain clauses (e.g., assignment and termination clauses) that create flexibility. Sub-licences could be used to support transfer of GIFT broodstock from PAL to other hatcheries.	**Rank: 4th out of 7** - Generally, provides good control over the use of the licenced product. - In practical terms there are challenges with managing risks of un-licenced dissemination and use of GIFT. - Furthermore, as a biological product it is difficult to manage use and dissemination of GIFT beyond the expiry of the licence.

Model	Complexity	Risk	Total Score
Licensing	**Rank: 2nd (eq) out of 7** - The reasonably generic nature of licences and the passive revenue stream limits complexity for WF. - Resourcing and operational requirements are negligible. - There is no exposure to overseas operations as multiplication and dissemination is managed by the licensee (PAL) under the terms of the licence agreement. - Key challenge is the need to ensure effective and transparent measurement of GIFT dissemination to support accurate determination of licence revenue/fees.	**Rank: 1st (eq) out of 7** - There is a need for good commercial relationship management skills to ensure alignment with the licensee and appropriate incentivisation to maximise licence revenue. - Main risks are predominately related to contractual disputes and disputes relating to determination of licence fees.	**Rank: 1st out of 7**

Model	Sustainable Return	Ease of Replication	Strategic Alignment	Flexibility	Brand Protection
Franchising	**Rank: 5th (eq) out of 7** - Contains higher revenue potential than the licensing model via the ability to package more than the right to use and distribute GIFT (potentially IP, support/systems/processes etc). - This generally more substantial fees than is charged under a basic licence model.	**Rank: 6th out of 7** - Difficult to see how WF could create a franchise model that is materially different to a usage add distribution licence. - As per other models there is also a likelihood that each partner will have different needs and capability that potentially requires a customisable approach for each partner.	**Rank: 4th (eq) out of 7** - Provides WF with the opportunity to identify and work with strategic partner/s that have the capability to support WF's developmental goals. - However, the model does create strategic tensions for WF as to the need to ensure the franchise model also supports the goals and objectives of the commercial partner. - There is also potential that a franchise model that is attractive to potential partners may require support or contributions from WF that are not aligned to its priorities and optimal use of resources.	**Rank: 7th out of 7** - Can be more rigid than a licensing agreement due to the fact it tends to operate under a longer-term commitment between the relevant parties, model also has a more complex and clearly defined scope of relationship. This is somewhat offset by a stronger level of integration between the parties, and the model generally providing more control to the Franchisor (WF).	**Rank: 2nd (eq) out of 7** - Allows WF to exercise a high degree of control over the use and dissemination of GIFT within the target market. - Provides direct control over the production of saleable germplasm and its subsequent distribution.
	Complexity	**Risk**	**Total Score**		
	Rank: 6th out of 7 - Is complex and demanding of WF time and resources. Standardised franchise models are difficult to design to ensure these fit all contexts, markets and partners. - Alternatively, customised models are demanding to establish and manage, particularly across diverse markets and partners. - Depending on the structure, the model does create some exposure to foreign entities and operating in foreign commercial environments.	**Rank: 5th out of 7** - Main risks are predominately related to contractual disputes. Ensuring WF's obligations are achievable and transparent is paramount. - Depending on the structure, it is likely that the partner will primarily bear the risks associated with in-market operations. - Franchising of the GIFT/WF brand does hold some reputational risk for WF.	**Rank: 7th out of 7**		

Appendix 2 – Design and Implementation of Alternative Models

Indirect Export Model

Indirect export is mostly used for manufactured products and non-perishable, processed foods and beverages. It most commonly incorporates the transfer of the finished product to an in-country agent or distributor, who subsequently manages the in-country sales and distribution in accordance with the terms of a distribution agreement. The agent or distributor is typically renumerated via commissions or revenue-share models.

Application of this model to the commercialisation of GIFT is somewhat atypical due to the reliance on PAL to essentially manufacture/produce the commercially saleable product (commercial fingerlings) via their multiplication hatcheries utilising GIFT broodstock and IP provided by WF. This will necessitate a more comprehensive distribution agreement to ensure WF have adequate oversight of the production of GIFT fingerlings from PAL hatcheries, to ensure GIFT fingerlings achieve acceptable performance.

The agreement and relationship will also need to consider ownership rights of GIFT broodstock and fingerlings within PAL hatcheries. Under standard distribution agreements, the supplier (WF) may own the product until the point of sale, but this may not be feasible under this specific adaption of the model, due to the reliance on PAL to produce the saleable product. Understanding the legal and commercial risks/implications of GIFT ownership within the multiplication hatcheries will be required during further due diligence by both WF and PAL.

Further development of this model requires consideration of the following issues when negotiating a potential distribution agreement with PAL (many of these are equally applicable to the licensing model):

- Identifying an appropriate term for the distribution agreement. A shorter agreement term provides greater flexibility but also increases risks for WF, associated with market entry costs and potential loss of IP (if agreement is not renewed). The agreement term will also need to consider the time required to integrate GIFT into the PAL breeding program, and scale-up production of GIFT fingerlings for commercial release, as well as the effective useful life of the GIFT broodstock. Ultimately this area requires negotiation/consultation with PAL to identify a mutually agreeable term.
- The agreement will need to consider the expected future availability of new GIFT strains and transfers of new/improved lines of broodstock.
- The agreement with PAL should be non-exclusive, providing WF with the flexibility to consider engaging with additional partners as the market develops. This will also mitigate risks that PAL could exploit access to GIFT to monopolise the commercial fingerling market. In addition, WF should also consider incorporating sales/performance targets into its agreement. This could provide WF with the right to terminate the agreement if PAL is not achieving acceptable dissemination of GIFT.
- Similar to a licence, distribution agreements typically define a specific distribution territory. Restriction of the agreement to the distribution of GIFT within Nigeria may need to consider implications for PAL (and other partners) if they were to expand their operations into

neighbouring countries, or if WF were to establish agreements in other countries with partners that may seek to operate in Nigeria. There are a number of mechanisms (e.g. restricted territories) that could be used to manage territorial conflicts between partners.

- As previously described, the reliance on PAL to produce commercial GIFT fingerlings will require the inclusion of appropriate mechanisms to ensure GIFT fingerlings meet appropriate quality standards. As per the licensing model, this could incorporate mechanisms such as broodstock management requirements/guidelines to limit inbreeding or excessive hybridisation that could diminish commercial fingerling performance. This could also extend to mechanisms to limit or prevent misuse of GIFT (e.g., restricting fingerling sales to mono-sex fingerlings and preventing transfers of broodstock to other hatcheries).
- Branding and marketing of GIFT, including claims/representations relating to performance advantages, will need to be incorporated into the agreement.
- The agreement will need to consider pricing of GIFT and the share of sales revenue between WF and PAL. This should consider/reflect the following:
    - Generally, WF and PAL need to negotiate a commission/fee that covers PAL's production costs, provides a margin to both parties, and supports a price point that is consistent with the expected commercial value of GIFT (versus generic Tilapia strains).
    - The agreement will need to consider which party bears the applicable foreign exchange risks, as well as risks associated with non-payment by customers.
    - WF needs to ensure the payment system (determining payments to PAL) is GIFT sales-based (not total fingerling production based) to reduce risks associated with low sales volumes of GIFT. WF does not want to be paying PAL to produce fingerlings that PAL cannot sell.
    - Generally, compared to the licensing model, there is lower risk associated with the visibility of fingerling sales – PAL is paid to report and maximise sales. However, there is risk associated with the visibility of some sales transactions, particularly cash sales to smallholder farmers and PAL's internal fingerling usage. The agreement may need to consider the management of these risks.
    - WF could seek to include sales targets and other performance metrics within the distribution agreement. This would enable WF to terminate the agreement if PAL consistently fails to meet sales targets.

As per the recommendations for development of the licensing model, further progression of the indirect export model will also require:

- Evaluation of the potential implementation of this model by WF (see WorldFish Implementation).
- Consultation and negotiation with PAL to ensure acceptability to PAL.
- Further legal and commercial due diligence to develop the model in accordance with applicable local laws and regulations and to ensure the model can be structured to best cater for and protect WF's interests.

Joint Venture Model

Establishment of a joint venture would broadly comprise collaboration between WF and PAL to establish a separate, jointly owned entity that produces GIFT fingerlings for sale to industry. The respective shareholdings of PAL and WF within the JV entity should reflect the relative contributions of each party at establishment and on an ongoing basis. This shareholding would require a valuation of:

- Physical assets contributed by each party (infrastructure, plant, facilities, fish etc),
- Capital and financial contributions by each party,
- Intangible assets and IP contributed by each party, and
- Ongoing contributions by each party (e.g., support and resources, further broodstock transfers etc).

Both WF and PAL would appoint directors to the JV entity, with the governance structure reflecting the relative ownership interest of each party, or an agreed structure. It is possible to adopt a 50/50 ownership structure and appoint independent directors or rotate the majority control of director positions between the JV partners.

The JV is generally staffed by personnel employed by the JV. Expertise/input from employees from the respective companies could be utilised via consultancies/contracts, secondments, or as in-kind contributions – care needs to be taken to ensure compliance with applicable employment laws, and workplace health and safety/insurance requirements (both local and within the parent company in its home jurisdiction).

Indicatively, there are three potential JV options that could be pursued:

1. The JV entity could be formed by transferring all or some of PAL's existing hatchery assets and hatchery management staff to the JV entity, with WF contributing GIFT broodstock and associated breeding and genetics IP/expertise.
2. PAL could retain ownership of its hatchery assets and instead the JV entity could execute a agreement with PAL to access and use these assets for production of GIFT fingerlings, or contract PAL to produce fingerlings. Hatchery management and operational staff could be provided by the JV entity or provided by PAL under the terms of the agreement. Similarly, the agreement could extend to cover the provision of feed and other production inputs. As per the above, WF would contribute its GIFT broodstock and associated IP/expertise to the JV.
3. PAL and WF could establish a JV entity that acquires or develops its own hatchery infrastructure for production of GIFT fingerlings. In addition to potential co-investment in the new hatchery, WF would contribute its GIFT broodstock and associated IP/expertise to the JV. This option may not be appropriate if it is not feasible to repurpose the existing PAL Tilapia hatcheries (e.g., from use for production of Catfish or other species, convert to nurseries etc).

Ostensibly, Option 1 or 3 would likely produce the most profitable JV structure but may not necessarily achieve the highest return for WF if it can only secure a minor shareholding in the JV entity. A more definitive assessment cannot be undertaken without a more comprehensive understanding of the relative value of the respective contributions to the JV by WF and PAL, and the scale and structure of JV operation.

Achieving recognition of the highest possible value for GIFT and its associated IP is crucial to WF securing a substantial shareholding in the JV. While valuing intangible assets such as GIFT is complex, there are several broad approaches that could be applied to valuing WF's contribution of GIFT to the JV:

- The valuation could be derived based on the expected 'relief from royalties' (or other access or acquisition costs) associated with accessing a similar genetically improved Tilapia strain from an alternate supplier or under a royalty-based model with WF.
- The valuation could be derived based on the excess earnings or marginal benefit (with/without value) that is attributable to the availability of GIFT to the JV. These methods primarily reflect the expected increase in market demand and market price for GIFT fingerlings versus generic/alternate strains.
- The valuation could be derived from the expected replacement/replication cost of producing an equivalent genetically improved Tilapia strain. This would be preferable to the use of historical costs due to the need to adjust historical costs to account for inflation, new methods and priorities etc.

Alternatively, WF and PAL could simply negotiate their respective shareholdings in the JV entity; however this approach still implicitly requires some understanding of the potential value of GIFT and other contributions to the JV.

In addition to the above, there are several factors that will shape the design and implementation of the JV model; outlined below:

- PAL's requirements, strategic objectives and contribution will strongly influence the design, implementation and ongoing management/operation of the JV entity, particularly under Options 1 and 2 that incorporate the use of existing PAL hatchery infrastructure. Whilst WF should be encouraged to pursue the model/option that best suits its interests, ultimately the reliance on PAL as a JV partner will require extensive consultation and negotiation with PAL to identify a structure that is agreeable to both parties.
- The design and management of the JV will need to comply with local commercial regulations. WF will need to undertake appropriate due diligence to understand these requirements and broader implications for WF, its personnel and its investments in the JV entity. Indicatively, this could comprise a requirement to understand local laws affecting:
    - Movement of funds (capital and profit/dividends) into and out of Nigeria, as well as applicable taxes and duties on both corporate earnings and foreign transfers.
    - Restrictions affecting ownership and investment by foreign entities in assets, companies etc, and security of asset ownership.
    - Employment requirements/restrictions e.g. quotas or mandatory use of Nigerian nationals, visa requirements for non-nationals etc, as well as applicable employment and workplace laws.
    - Director and shareholder duties, responsibilities, liabilities etc, and local corporation/company law.
    - Access to local capital markets.
    - Protection of IP.
- As with most companies there will likely need to be an articles/constitution developed in conjunction with PAL. It may also be feasible to execute a shareholder agreement with PAL that can serve to protect the strategic and commercial interests of each party across areas not typically captured within the Company articles/constitution. These documents/agreements can be used to address areas such as:
    - Strategic purpose and objectives of the JV.

    - Board structure, governance and Director positions.
    - Dividend policies and capital management.
    - Partner roles and contributions.
    - Entry of new shareholders.
    - Exit and termination of the JV, dispute resolution etc.
- As per the recommendations for development of the licensing model, further progression of the JV model will also require evaluation of the potential implementation of this model by WF (see WorldFish Implementation).

Strategic Alliance Model

A strategic alliance between WF and PAL could closely resemble a JV with the key distinction being that an alliance does not require the creation of a jointly owned JV entity. Instead, both parties would agree to collaborate and share resources, expertise etc under a commercial agreement/contract. Essentially an alliance represents a less complex and less formal version of a JV.

Unlike the range of structural options available under a potential JV model, the absence of a separate jointly owned entity from the alliance model limits the design and structural options for an alliance between WF and PAL.

Essentially the only feasible form of an alliance would comprise an agreement for WF to transfer GIFT broodstock and associated support/expertise to enable PAL to produce GIFT within its hatcheries. In return for the transfer of GIFT, PAL and WF would negotiate a remuneration model that provides a royalty, or revenue share, or annual fees to WF.

The relationship between PAL and WF would subsequently be managed under a contract or commercial agreement. This contract/agreement would outline:

- Strategic intent and objectives of the collaboration
    - Description of the alliance and its objectives.
    - Applicable boundaries and restrictions.
    - Term of the collaboration.
- Commercial terms of the collaboration between WF and PAL
    - Contributions of both parties to establish the alliance.
    - Ongoing contributions of resources.
    - Operational management of PAL hatcheries and breeding programs, use and management of GIFT broodstock etc.
    - Share and allocation of commercial benefits from the alliance.
    - Expansion and growth of the alliance and entry of new partners/collaborators.
- Governance and management of the relationship between the parties
    - Composition and management of oversight/governance structures (eg management committees).
    - Performance targets, reporting and information sharing.
    - Integration of personnel, systems, policies/procedures, risk management etc.
    - Operational oversight, coordination, and planning of activity.
    - Confidentiality and IP protections.
    - Dispute resolution mechanisms.

  - Renewal/termination and exit by the parties

Across these broad areas of the agreement, it will be important to ensure WF's strategic and commercial objectives are addressed. This will primarily comprise ensuring the terms of the agreement are appropriate to ensure GIFT is available and disseminated to the broader industry, provide adequate protection of WF's IP and the GIFT/WF brand, and ensure WF's obligations are realistic/achievable.

In addition, WF will need to negotiate an appropriate remuneration model to achieve an appropriate financial return. As per the JV model, WF's share of the revenue attributable to the alliance would likely reflect the relative value of GIFT (and other WF contributions) versus the contribution of PAL and other partners. Valuing the contribution of GIFT to the alliance can be undertaken using the same methodologies described previously.

As per the design and implementation of a JV model, similar factors will shape the design, implementation, and management of a strategic alliance between WF and PAL:

- The alliance will need to be designed in consultation with PAL.
- The design of the model will need to consider local laws and regulations covering commercial/corporate law, foreign investment and employment/workplace law.
- The model will need to be implementable by WF (see WorldFish Implementation).