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Development of Aquaculture Business in Zambia – Feasibility Considerations and Risk Analysis over Social, Economic and Environmental Problematics

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Development of Aquaculture Business in Zambia – Feasibility Considerations and Risk Analysis over Social, Economic and Environmental Problematics

This thesis is a preliminary study conducted as part of a project proposal aimed to provide an adequate background and feasibility study for the creation of an Aquaculture enterprise in Zambia.

The methodology used is based on the Project Management Body of Knowledge (PMBOK, 2008) and the comparative research method taking in consideration similar study cases, theses, and articles about business creation in Zambia and fish farming.
The thesis analyses in details logistic, environmental, and socio-cultural problematics and furthermore proposes a sustainable type of business model to overcome some of the limits of the fish farming with a low-tech cannery installation.

The study result is an analysis of challenges and risks with an indication of likeability and a hypothetic course of action.
The work concludes demonstrating the feasibility and the potential risks and opportunity at the light of the current situation.
The finds may help local communities relaunching small scale fish farming with an eye on ethical and neutral footprint practices.

KEYWORDS:

West Africa, Zambia, Aquaculture, Aquaponic, Business, Environment, Sustainability, Local Economy, Project, Feasibility Study, Market.

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1 Introduction

Aquaculture is considered by the public to be environmentally unsustainable and dangerous to resources and communities in developing countries.

This thesis is a preliminary study conducted as part of a project proposal carried out by a team of professors and students at AMK University of Turku, with the goal of establishing a fish farm in the East African country of Zambia using an ethical, feasible and self-sustainable business model.
The feasibility study will identify the macro-area of risk, opportunities, and ways to create a value chain based on a sustainable business model.

Articles, case studies and other theses focusing on aquaculture business in developing countries have been used as background. Relevant examples are similar business studies in terms of size and resources conducted in Vietnam and the Mekong Delta area (Genschick S, Kaminski AM, Kefi AS and Cole SM., 2017).
Data collection on business opportunities in Zambia was sparse and outdated, so a comparative study with similar case studies in developing countries and screening through the abundant scientific literature on fish farming was necessary.

The theoretical framework is based on interdisciplinary research, consideration of the availability of technology in the country, potential challenges and issues, historical context, and analysis of the socio-economic environment.
Blue Economy theory (Theblueeconomy.org, 2022) is the basis for assessing the impact of large-scale fish farming and the creation of a value chain.

Personal motivation and interest also influenced the choice of this research path; the author's professional background consists of years of working in logistics for companies and large international NGOs, certainly an incisive experience in imaginative work to design a business feasibility plan.

1.1 General Overview on Zambia's Business Opportunities

Zambia (BBC, 2018) is a former colony of Great Britain, throughout its history has managed to avoid political upheavals and conflicts that have marked much of Africa's post-colonial history, earning itself a reputation for political stability.
Zambia (BBC, 2018) also boasts one of the world's fastest-growing populations, with the United Nations estimating a population of three times its current size by 2050. Zambia is Africa's most urbanized country.

Having clear the economic panorama that the country may offer, it is possible to synthesize the open business opportunity for every sector (Savela N., Salahub J., Keinänen-Toivola M.M., 2018 - International Trade Administration U.S. Department of Commerce, 2018).
For the Energy sector: generation and transmission, refineries, storage facilities and pipelines for petroleum and gas, renewable energy facilities and transport facilities for coal distribution and exports, solar energy for residences, schools, hospitals, health centres, commercial premises, utilities, off-grid facilities, and the agricultural sector.

Infrastructure: the maintenance and construction of water and sanitation infrastructure, housing and other infrastructure projects, development of transport infrastructure, hydropower.

Manufacturing: exploration, mine services, water management, engineering, construction, and environmental services in the mining sector, large-scale farming, farm input and acro-processing, equipment supply, and commodity storage and trading, specialist diagnostic and treatment centres to treat cardiovascular, liver, renal, and cancer diseases (Savela N., Salahub J., Keinänen-Toivola M.M., 2018).

Zambian economy lays on the extraction industry, in particular copper, relevant also the cobalt sector, the construction sector, food and beverage and agriculture,

referred to the cultivation of sorghum, rice, peanuts and their export, tobacco, electricity production sugar and fresh flowers (Expat Arrivals, 2018) are also deserving a mention. Agriculture (International Trade Administration U.S. Department of Commerce, 2018) employs over 70% of the population and accounts for 21% of GDP.

Large-scale farming, farm input and acro-processing, equipment supply, and commodities storage all offer opportunities. The landlocked (BBC, 2018) country has experienced rapid economic growth over the last decade as Africa's second largest copper producer after the Democratic Republic of the Congo in addition to the mineral rich Copperbelt, the most important commercial centres and biggest concentration of population include the capital Lusaka, the tourist hub Livingstone. Privatization of the mining sector has attributed to Zambia's economic growth as it has attracted foreign investment to the country in recent years.

Information Communication Technologies: the provision of retail fibre optics, mobile and internet service providers, software development, and ICT parks.

Tourism: tourism services and infrastructure, such as increasing hotel room capacity, tourism operators, and transportation infrastructure in its tourism and copper producing region (International Trade Administration U.S. Department of Commerce, 2018).

1.2 The Shadow of the "Red-Dragon" - Impact of Chinese Aid on the Zambia's Economy

According to a 2019 U.N. World Population study (UN, 2019), in recent decades the population of Chinese people in Zambia has rapidly increased. There were so far 80,000 Chinese people living in Zambia. Everything started with a significant temporary migration (China Daily, 2014) of thousands of Chinese

workers when from 1970 to 1975 to Zambia to build the TAZARA Railway, the largest aid project, a rail connection between the copper mines of Zambia to the seaport of Tanzania.

With commercial connections exploding in the 2000s (BBC News - Redvers L., 2011), from $100 million in 2000 to $2.8 billion in 2010, Chinese investors in Zambia had a positive increasing trend from huge mining and infrastructure companies, as well as small company owners in retail and agricultural. Chinese investors (Dollar, et al., 2015) are attracted by natural resources and modest political stability over the rule of law. For instance, the cases of Angola, Eritrea, Madagascar, Zambia, and Zimbabwe are all rated to have relatively high political stability overrule of law and all these countries have significant number of Chinese investments relative to their total foreign direct investments.

Zambia (Reuters, 2018) is a leading exporter of copper and Chinese investment in the mining sector has been considerable and accompanied the migration of Chinese owners and managers. Is impressive the record number reached in 2018, when the ZCCM, Chinese firm launched a $832 million copper mine, setting Zambia's mining sector on a recovery path with 5,000 new jobs and deepening ties between the Chinese and Zambian people.

There were 19,845 Chinese people living in Zambia in September 2014 according to the Home Affairs ministry the data was provided to respond to questions raised in parliament (Zambia Daily Mail News - Brautigam D., 2014).

Anti-Chinese riots (Horta, 2015) against Chinese corporations has occurred in several African countries, including Algeria, Zambia, and Madagascar. Companies in China have been accused of importing labour rather than creating jobs for locals. Furthermore, Africans who have been fortunate enough to find work have expressed serious concerns, such as excessively long working days for insufficient pay. Nevertheless, Chinese companies have built many new schools, hospitals, roads, and bridges and almost 50% of Chinese foreign aid is targeted to Africa.

The country suffers due to the high isolation, poor logistics and supply chain channel and infrastructure. The Chinese presence and the increasing debts in the form of public aids, investments and donations represent a worrying figure that keeps foreign investments away retaining the country to access different business opportunities.

The revitalization of the Zambian economy can ideally take place with small-scale entrepreneurship directly involving local communities with the support of foreign investors, bringing not only the funds to stimulate the economy but also machinery and technical know-how.

2 The Logistics Challenge - Available Transportations and Routes

The Zambian logistics may represent one of the focus issues of the Aquaculture in Zambia project, the country economic instability and strict dependence from foreign help led to a lack of development for the infrastructure network causing a decade of delay for the entrance into the global market.
Studies financed by the main international players mainly trade the same conclusions over the potential of the Zambian logistics and the missed opportunity due to the scarce presence of communication routes.

The country acted just with the adoption of the Fifth National Development Plan 2006–2010 FNDP (Jica, 2010 - NFRA, 2021), a crucial step towards realization of the Vision 2030 (Vision 2030, 2006) dated back in 2006 in developing the strategic focus of “Economic Infrastructure and Human Resources Development”. The expenditure focus of the FNDP on infrastructure, and the economic push given mostly by the development of the copper extraction industry and the presence of Chinese stakeholders directly investing in the country infrastructure (ALN, 2021), has accelerated the improvement of the logistic development to satisfy the market needs. The Patriotic Front government has made its view clear on Chinese investment: It is welcomed, if the law is upheld in exchange of loans and grants for farming, health, education, and other projects.
With Vision 2030 (Vision 2030, 2006) the strategic goals of the country for the logistics development brought in a plan to build and maintain productive and social infrastructure and services such as roads, storage facilities, rail network, energy, communications systems, education, training and health facilities, public utilities, and other services. The country has benefited from the cancellation of virtually all its external debt. This implies that the government’s domestic revenues formerly needed to service external debt can be reallocated to domestic expenditures such as infrastructure the Government took 51% ownership of the mines and nationalized a substantial part of the manufacturing sector, all public utilities and key elements of the transport and communications sector allowing

the construction of infrastructure, including an oil pipeline, rail line, roads, bridges, schools, hospitals, and housing units.

The Vision 2030 projects states a situation of decay of feeder roads and other communication infrastructure, lack of rural electrification, inadequate credit facilities, poor agricultural marketing systems and fluctuations in rainfall patterns. The poor state of infrastructure has imposed serious constraints on the delivery of vital services to farmers, including that of technology, which has affected productivity (Vision 2030, 2006).

At the current state of the project for the creation of an Aquaculture Business in Zambia the logistics data represent a precious source of information to enrich the risk analysis and avoid poor strategical choices that may jeopardize the success of the project approval. What is offered in the following paragraph is a list of the available transportation routes and method of which the country can benefit.

2.1 Roads and Trade Corridors

The Zambian Road network has a total length of 91,440 kilometres, of which 20,117 kilometres are paved and 6,779 kilometres are trunk or key roads, leaving 71,323 kilometres unpaved (NFRA, 2021).
Since the early 1980s, the National Road Fund Agency (NRFA) has undergone radical changes, the reforms attempted to turn the industry into a socio-economic growth engine, a key to increasing output and incomes in the country, and a catalyst for enhanced domestic, regional, and global trading. The starting point for this changeset has been through a socio-economic analysis of the country
According to CSO (CSO, 2017), more than 80% of the employed in Zambia are in the informal sector, characterised by low levels of income, productivity, limited or no access to social security, low capital investments and technology, thereby offering limited prospects to contribute to national development and improving the standard of living of most of the people. Overall, the unemployment rate is high at 7.4 percent of the total labour force with urban unemployment rate estimated at 11.5% while the rural unemployment rate is estimated at 4.2%. Youth

unemployment is estimated at 10.5%. This state of affair, especially among the youth, has given rise to an increase in anti-social vices such as vandalism of road infrastructure and furniture thereby, contributing to high maintenance costs. The continued roll out of major road infrastructure development projects and the implementation of the Job Creation and Industrialisation Strategy may, therefore, result in increased employment opportunities, and thus, reduced poverty levels among communities along construction sites and road network as well as reduced incidences of vandalism.

At the political level (NFRA, 2021), soon after assuming office in 2011, the Patriotic Front (PF) Government embarked implementing an ambitious road infrastructure development programme. The programme was aimed at transforming the country from being land-locked to land-linked to stimulate economic growth, facilitate easy movement of people and goods, thereby, promoting domestic, regional, and international trade and as consequence creating employment.

Zambia can also count on a pre-existing network of Trade Corridors (Sano H., Mizuno K., 2000) developed to facilitate the mineral extraction industry. In Zambia's case these are road and/or rail routes which cross international borders to ports, and which are the subject of international agreements on planning, use and management. The corridors have been object of studies by the Japanese International Cooperation Agency that released a detailed report with an outstanding socio-economic analysis of the Southern African supply chain challenges (Japan international cooperation agency, 2010). The study emphasizes the vitality for the connection with the global markets of the trade corridors, however, the study addresses the “bottlenecks” as well that may comport, at the state of the art of our project a potential list of risks. The difficulties of maintaining the street pavements at the service level, road users’ fees and taxes and the long clearance time (1 to 5 days) at the border facilities are just some of the challenges prospected.

Due to the extreme time sensibility of the project object is warmly advised to avoid the use of such international corridors via roads.

2.2 The Railways System

As a landlocked country, any community and economy require an inexpensive, integrated, efficient, safe, and sustainable transportation system. Transport facilitates the import and export of commodities, as well as providing access to national and worldwide markets for industry and commerce. It provides individuals and communities with mobility and flexibility, allowing them to access jobs, education, health, and commercial services, as well as family, friends, and visitors to the country.

Figure 1. TAZARA Rail bridge built by Chinese worker in the 70s.

Transport networks and modes have the potential to have significant environmental and social consequences, and they should be planned, managed, and utilised in such a way as to minimize these consequences. Unlikely the massive Chinese investment the parastatal railway system suffers an endangered unprofitable condition tied to the Chinese debt (Kunda J., 2010).

Railways have been deteriorating (Jica, 2010). The privatization of railways has resulted in extremely long waiting times at ports before cargo can be loaded on trains, hence causing extremely low productivity.

Is therefore excluded a use for the project scope of railways as main vector for the finished product, unreliability and instable connection routes may negatively affect the shipments. Is not possible to exclude it as vector for heavy machinery and row materials especially if coming from the neighbour countries and for the exclusive cabotage and combined transport's use.

2.3 Air Frights

Since the state-owned national carrier failed, Zambia has adopted an "open skies" policy (Transport in Zambia, 2012). Zambian Airways was the sole scheduled airline based in Zambia prior to its closure. There are just a few air charter firms supporting the tourism and mining industries, as well as the government and aid sectors, as of November 2009, and some of these offer scheduled services from time to time.

Figure 2. Ultralight airplanes used for the internal transportation of people and consumer goods.

According to a new World Bank research, Open Skies for Africa – Implementing the Yamoussoukro, where 44 signatory countries to deregulate air services and promote regional air markets open to transnational competition. Decision (World Bank research, 2021), one of the reasons for Africa's underserved condition is

that many African governments restrict their air services markets to protect state-owned air carriers' market share. This trend began in the early 1960s, when many newly independent African states launched national airlines to assert their sovereignty.

Most people now realize, however, that the stringent regulatory protection that keeps such carriers afloat had negative impacts on air safety records, as well as inflating air rates and slowing growth in air traffic.

Zambian air freighters are often tied to international companies rather than local operators. The problem seems common to the whole region excluding the possibility to rely on the neighbour countries for the air shipping.

The lack of national air freight services opens the road to independent contractors that advertise the route to and from Zambia, crucial for the success of the business is the identification of the main stakeholders that may serve as reliable and regular transport service.

3 Aquaculture in Zambia

Land (Genschick S, Kaminski AM, Kefi AS and Cole SM., 2017) and water availability, appropriate temperatures, and agricultural practices have all been cited as reasons for Africa's great aquaculture potential. Increased farmed fish production could help alleviate food and nutrition insecurity in many of these countries, as well as contribute to overall economic growth. The stagnation (Finegold C., 2009) or decline of capture fishery production in many parts of the world, emphasizes the importance of fisheries policy, as the current state of stocks can be at least partially attributed to the difficulties of regulating fisheries and preventing overexploitation. Despite its promise, aquaculture development in most African countries has lagged that in other regions, owing to a lack of infrastructure, markets, government regulations, and the expertise and skills required to build the business. Egypt accounts (FAO, 2016) for most of the global production, accounting for only 2.3 percent of total output.

Figure 3. Fish feeding process in pond-aquaculture.

However, in recent years, aquaculture production in Sub-Saharan Africa has expanded at a 12.6 percent annual average growth rate, with signs of commercial growth in countries like Nigeria, Ghana, Uganda, and Kenya. A similar upward trend can be seen in Zambia, which has risen to become Africa's sixth-largest

producer of farmed fish (Mudenda H.G., 2009). Despite advances in regulation (Finegold C., 2009), pressures on capture fisheries will continue to exist because of population expansion. Continued development of sustainable aquaculture, as well as improvements in the post-harvest sector to reduce losses, could help to keep fish supply and development contributions. While interventionist tactics were used to promote aquaculture for the small-scale sector to increase household fish consumption and food and nutrition security, innovative approaches now recognize the growing relevance of promoting aquaculture as a business. Farmers are expected to be able to manage their systems more sustainably and earn more money if they pursue aquaculture as a company.

Aquaculture (Genschick S, Kaminski AM, Kefi AS and Cole SM., 2017) is frequently marketed as a way for small-scale farmers to enhance their economic, food, and nutrition security. This study tried to thoroughly investigate whether aquaculture participation is associated to poverty reduction. According to a variety of research findings, resource poor farmers profit from aquaculture through "income," "employment," and "consumption" paths. The contribution of fish to improved household food and nutrition security of resource poor consumers because of increasing fish availability, people's access to fish, and accommodating fish preferences, all of which are key factors to consider in the production and sale of farmed fish products. There are numerous ways for resource-poor people to profit from improvements in the aquaculture industry. First, they can benefit directly from upstream or downstream value chain activities, such as production or postharvest operations. Increased fish production and sales by largescale farms/wholesalers, for example, might boost the supply of cheaper fish while also creating jobs. Furthermore, larger-scale hatcheries, feed mills, and other input suppliers might invest in enhancing the availability and quality of seed, feed, and other aquaculture inputs (e.g., lime, cages, hapa material, and so on), making it more viable and less expensive (Edwards P., 2000).

Fish (Genschick S, Kaminski AM, Kefi AS and Cole SM., 2017) that has been prepared according to better food safety standards, such as safer packaging with

suitable and easy-to-understand nutrition information, could benefit everyone. Increased access to appropriate/lower-cost technology for women, as well as opportunities for adolescents to develop skills and knowledge by working as laborers on commercial farms, can all benefit women and youth empowerment. Aquaculture development, on the other hand, faces the danger of being very exclusionary, especially in low-income areas, without direct policy and stakeholder involvement to ensure these benefits are realized. Other more immediate benefit comes from the data of 2014 when 8000 jobs created through aquaculture in Zambia. Fish consumption varies a lot depending on where you live and how wealthy you are. In comparison to high-income groups, low-income groups spend proportionally more on fish than any other animal-food source, however this varies by fish species. The data about the actual consumption of farmed fish are not available in relevant studies we can certainly say that in general, farmed fish plays a role in filling the gap between national fish supply and demand (FAO, 2016).

3.1 Zambia: The Knot of a Value Chain for Aquaculture

Aquaculture (Hasimuna O.J., Maulu S., Mweemba M., 2019) production can relieve pressure on natural fisheries while also addressing Zambia's present fish scarcity.

With improved aquaculture production, fish consumption levels, which are now low, can be boosted. Zambia's copious water resources and adequate area make cage aquaculture a particularly viable option. Cage fish culture in the Siavonga district accounts for most of the national aquaculture production. Because of its plentiful water resources, Zambia has a lot of potential for expanding fish output through cage aquaculture (GIZ Deutsche Gesellschaft fuer Internationale Zusammenarbeit, 2019).
Other bodies of water, such as Lake Mweru, Lake Bangweulu, and Lake Tanganyika, have seen little to no cage aquaculture despite favourable ecological circumstances.

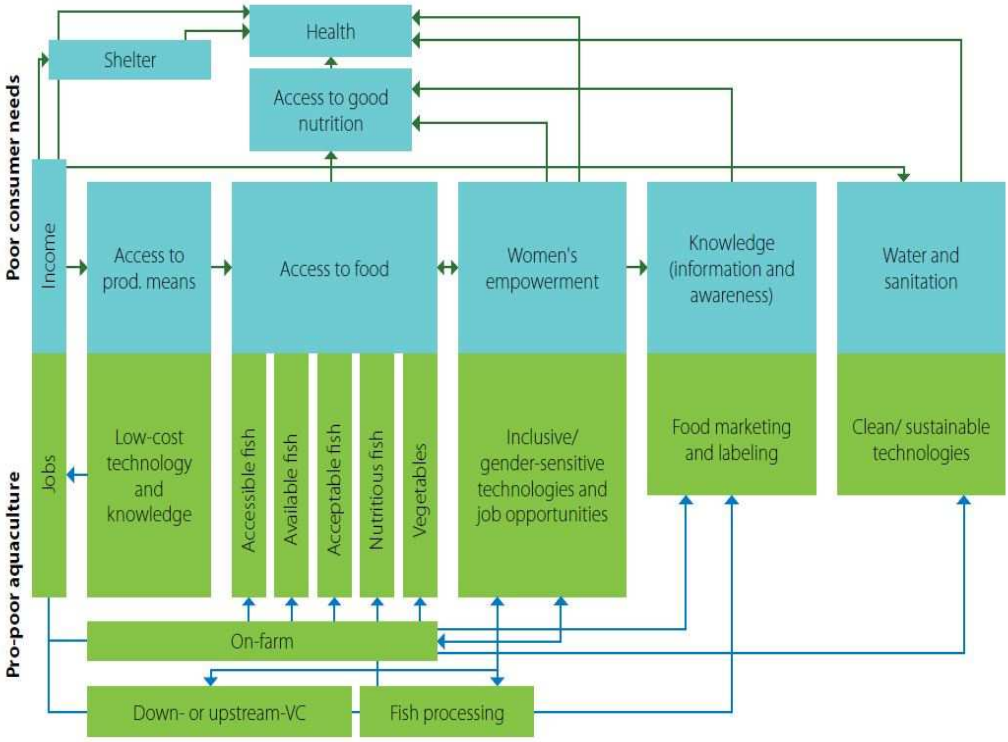

Figure 4. The virtuous cycle of the Aquaculture, opportunities, and effects.

As a result, we believe that cage aquaculture production in the Siavonga district, as well as Zambia as a whole, has a lot of promise. This capability can be strengthened by making the best use of existing resources.

Policy discussion (V.A., 2018) and investment activities are aided by value chain analysis. They aid comprehension of how agricultural development interacts with market dynamics. They make it possible to analyse the impact of value chains on smallholders and companies. Even though Zambia has abundant natural water resources that provide substantial opportunities, nearly half of the estimated fish demand is unfulfilled. Capture fisheries in Zambia are either fully fished or over-exploited. Production of aquaculture

In Zambia, there is a growing interest in the development of the burgeoning aquaculture business. With the help of FAO, the Ministry of Fisheries and Livestock prepared a National Aquaculture Development Plan for 2015-2020. The African Development Bank (AfDB) is funding an aqua-parks project based on an FAO-endorsed strategy (V.A., 2018).

In addition, the European Investment Bank (EIB) has been looking into a possible aquaculture blending operation with the European Union (EU).
The EIB and the EU Delegation in Zambia want to try out various bottom-up and inclusive approaches (V.A., 2018).
At the state of the art, economic growth appears to be less inclusive at the value chain level. Wholesale activities are concentrated, with a few numbers of traders purchasing a substantial share of the tilapia, implying a monopoly position in the Value Chain. When it comes to importing, wholesalers gain from comfortable margins, but they provide few jobs; youngsters are employed as general laborers on larger farms, but their participation in rural fish farming appears to be limited. For low-income people, tilapia farmed for urban markets is prohibitively expensive. The social capital in the aquaculture industry appears to be low. There are little options for extension assistance and training. Fish farming in groups appears to be troublesome (V.A., 2018). Nonetheless, rural people can acquire fish for food and nutrition security, as well as earn a modest bit of money, thanks to the current production mechanisms in place. During the wet season, though, hunger persists. This is a major concern as new and current feed mills target rural farmers for food crops as the key ingredients in aquafeeds (V.A., 2018).

3.2 Environmental Problematics; The Blue Economy Topic

The ocean economy is more than just a source of economic growth in the blue economy. Large-scale industrial nations have witnessed the growth of their ocean economies through the exploitation of maritime and marine resources — for example, through shipping, commercial fishing, and so on – under the ‘business-as-usual' paradigm, and the oil, gas, minerals, and mining sectors - sometimes without regard for the long-term health or production of those same resources.

Small island governments have tremendous ocean resources at their disposal, relative to their land mass, which presents an enormous potential for improving economic growth and addressing unemployment, food security, and poverty. They also stand to lose the most if marine resources are depleted.

The blue economy concept (Theblueeconomy.org, 2022), like the ‘Green Economy,' strives to promote human wellbeing and social equality while minimizing environmental hazards and ecological scarcities. It establishes an inclusive paradigm in which coastal states, which may lack the competence to manage their abundant ocean resources, are included, may start to share the benefits of such resources with everyone. Realizing the blue economy's full potential requires the engagement and inclusion of all impacted social groups and sectors.

The blue economy is about more than simply commercial possibilities; it also helps vulnerable governments manage the often-disastrous impacts of climate change by protecting and developing intangible ‘blue' resources including traditional ways of life, carbon sequestration, and coastal resilience.

Just to give some metrics over the Blue Economy situation: The global ocean economy is estimated to be worth approximately US$1.5 trillion each year and sea transport accounts for 80% of worldwide commerce volume. Fisheries provide 350 million employments worldwide and aquaculture is the fastest-growing food sector, accounting for roughly half of the fish consumed by humans.

The EU has lately on realized an action plan over the Blue Economy problematic. For many years (Theblueeconomy.org, 2022), if not decades, the European Green Deal and the European Recovery Plan will shape the European economy. Both projects rely heavily on the EU's blue economy. The blue economy, like every other sector, should comply to the European Green Deal. It's also required to satisfy the EU's environmental and climatic goals. After all, the ocean is the world's primary climate regulator. It provides us with clean energy as well as oxygen, food, and a variety of other essential supplies. Green is inextricably linked to blue.

The specific blue economy agenda should aid in the achievement of the European Green Deal's goals and complement other recent Commission efforts on biodiversity, food, transportation, security, data, and other topics. As an

example: By generating offshore renewable energy, decarbonizing marine transport, and greening ports, the blue economy helps to mitigate climate change.

It will make the economy more circular by updating rules for fishing gear design, ship recycling, and offshore platform decommissioning.

Green infrastructure development in coastal regions will assist to protect biodiversity and landscapes while also benefiting tourists and the coastal economy.

Rather than a comprehensive action plan, the new strategy promotes coherence among blue economy sectors, enables their cohabitation, and seeks synergies in the marine area, all while minimizing environmental damage. It also emphasizes the need of investing in research, education, and innovation.

3.3 Aquaculture Role in Zambia

Fish farming started in Zambia in the years 1958–60 and by the end of 1965 there were about 1 231 ponds with a total area of approximately 100 ha.

Zambia (Fao.org, 2022) has been hit hard by the drop in the international market price of its main export, copper, and has been operating in a deficit balance of payments since then. Fertilizer and gear shortages, which resulted from austerity measures limiting foreign exchange expenditure, have been a major impediment to agricultural development in recent years, and shortages of agricultural consumer items and livestock feeds are common. Imports of fishery goods from neighbouring nations, which were previously used to support domestic fish output, have been substantially reduced.

A lack of varied income and adequate sources of nutrition has created a vicious cycle of poverty and malnutrition for maize-dependent, impoverished people in rural Zambia. Zambia produces the most fish in Sub-Saharan Africa, although the reach of fish production in many rural communities has yet to take root. People in rural Zambia lack the resources or awareness to pursue alternative sources of income and nutrition, yet small-scale fisheries have enormous potential, and the

benefits of a family-owned fish farm extend beyond the household to the neighbouring community.

Fish is a nutrient-dense and protein-rich food. It's an excellent supplement to starch-based diets, which is one of the issues that rural Zambian's face. People consume maize without many additional sources of nutrients because of the corn monoculture.

Family-owned Pond cultures have evolved into a sustainable means of producing fish throughout the year, reducing the impact of bad crops on families. In comparison to farming cattle or pork, it is also a more efficient use of land and resources. Land used to raise fish yields ten times more consumable output than land used to raise cattle or pork, yet fish farming takes less input than rearing cattle or pigs.

Even though household producers have adopted small-scale aquaculture systems, aquaculture is rarely featured in national development goals. There is little data on small-scale fisheries productivity to track their progress or demonstrate their influence. Aquaculture, on the other hand, has obviously increased employment, particularly in Asia, where the industry has developed the greatest. Women benefit from aquaculture because it employs millions of women in poor nations, promotes gender equality, and gives women more control over their household's livelihood.

Communities in Bangladesh, Cambodia, and the Philippines have been transformed through aquaculture. Because of the great potential for aquaculture in Zambia, the World Fish Centre has chosen to concentrate its efforts in Africa. The Zambian government acknowledges the importance of diversifying sources of revenue and nutrition, which should lead to better aquaculture regulation and support in the future.

About environment sustainability (V.A., 2018), for all systems, the environmental implications are mostly described by the phase of feed production. Due to poor yields, small semi-subsistence and widespread systems have larger impacts per produced tonne of fish. Small commercial systems, on the other hand, have the

best performance of any system, and so a management transition from semi-subsistence to commercial (small or medium) systems would significantly reduce the mean impacts per tonne of fish. Large cage systems outperform large pond systems, and both are significantly more environmentally friendly than poorly maintained systems (extensive, smallholder subsistence). The polluted waterways are only treated by massive pond systems. Only large pond systems clean polluted waters through artificial wetlands and other processes, whereas small pond systems dispose of some polluted water untreated. Finally, certain well-managed systems in Zambia (management of water, feed, and seed) can be judged satisfactory in terms of environmental performance. The poorly managed ones are currently environmentally unsustainable, while economically they presently generate small profits (V.A., 2018).

3.4 A Look at the Experiences in the Mekong Delta, the “Dark Side” of the Aquaculture Business

Sven Genshick's work (Genschick S, Kaminski AM, Kefi AS and Cole SM., 2017) has been important in the attempt to build the business idea, not only for the incredible amount of information that this author provided about the pangasius aquaculture in Vietnam, but also for his involvement in first person in the activity of research over this topic in the very same Zambian landscape. The work has been for the author of this paper the first comprehensive text able to summarize all the passages in project and operative phase that a successful aquaculture business must pursuit. The inspiration over the orientation to some key problems such as the pollution and the environmental impact, the sustainability, the influence of local government in the actuation of a successful project, the economic and social impact of this fascinating business over the local markets.

First is necessary clarify the nature of the fish is relevant in the strategic choices of the scaling up of the business, pangasius aquaculture has developed into an economic success story due to the international success on the international markets. This global attention wasn’t too late to point the finger over the low environmental performances of this aquacultural practice.

Figure 5 At Tonle Sap Lake in Cambodia, and throughout the Mekong region, aquaculture is a key source of income

Even so the matter has been discussed just in technical/scientifical environments with just a partial transposition in the political life. The most significant part, and what is supposed to be the safer strategical choice for starting a new business is the intensive field work campaign, with a systematic administration of semi-structured questionnaires carried on in the Mekong Valley. The finds have showed up the incapacity of most of the small business owners of ponds to cope with the changing in the new environmental, economic, and institutional directives. This situation resulted according to Genshick in an increasing of uncertainty, expressed in a high economic risk and loss of effectiveness/efficiency of the pangasius cultivations. Pangasius business in most of the cases resulted as a socio-economical trap.

The fast rise and expansion of the business registered in the last decade for the only Vietnam area a 72% of the fish production covered with the only pangasius aquaculture, the most intensive driver of the rural change with a shocking 90% of the export share. The rural changeset brought the reshaping of the landscapes, rise cultivation left and ponds appeared, the intensity of the ratio fish/m3 has registered in Vietnam some record data, with a productive rate (the study is from 2011) of 600 tons per hectare per year against the traditional Chinese carp aquaculture with 30 tons per hectare per year. The unicity of this high output may

be explained by the biological characteristic of the same fish, the pangasius does not need the oxygen to be pumped staidly into the pond, as is capable of get out the level of the water and breathe air. They can certainly withstand environmental condition harmful to other species of fish such as high density and high temperatures.

The dark side of this “too good to be true” kind of business stays in the astonishing data labelled “background problems” by the same Genschick. The amount (U.S. EPA, 2010) of water and biological oxygen needed to refresh a pond, the amount of sewage waste or TSS (total suspended solids) produced by the fish, the hundreds of kilos of nitrogen and phosphorus due to produce a ton of fish filets, result in the production of 60 to 90% of the pollutants of the whole process.

The interesting data comes from the situation in Vietnam before the year 2000 when the aquaculture of the catfish was popular, the inhabitants of the area in the proximity of a pond were able to use the water of near rivers for cooking after clearing it from alums, this is no longer possible with the pangasius. Untreated waters represent a real thread for the native fishery and his related livelihoods, in an area where fish is the most relevant protein large part of the population traditional food.

With a 90% of exported product pangasius’s industry image of sustainability is important in the surviving on the foreign markets where the sustainability and the footprint are point of remarks influencing consumer’s choice. Isn’t a mystery that the Mekong River is one of the most polluted rivers on Earth, the likelihood of consume Pangasius in Western countries is hardly influenced by the needing of those with a lower purchasing power. Pangasius is the fish presents in discount’s branded fish sticks and other sub products of the frozen supply/retail chain. Is consequential to conclude that produce a low-cost fish, with a bad reputation costed the Vietnamese government thousands of hours of marketing campaigns, advertisements propaganda and money in lawsuits and counter-defamatory inquiries. The tightness between the pangasius aquaculture and the Vietnamese economy risk to appear like a dog chasing his own tail. Is the Pangasius aquaculture sustainable? Apparently not.

4 A Low-Tech Cannery to Create Socio-Economical Opportunities and Redemption

4.1 The base idea

Fishes are perishable and dependants by a fast supply chain able to carry them from the farm to the market in a short timeframe at a controlled temperature. Zambia has logistic problems that would certainly be a challenge in a delicate supply chain like the one for the ichthyic products.

The creation of a small low-tech cannery installation can certainly overcome one of the biggest challenged of the project, creating opportunity as for his own low-tech nature would require work force trained to process and pack treated fish fillets.

Deprived of the entrails on the spot fish can be stored in cans longer and exported and distributed with a more flexible time frame.

4.2 The Favignana's Example

A previous study experience and in particular a field thesis work in the Western Sicily (Negroni L, 2012) has offered the opportunity to visit a 180-year-old Tuna fishery and manufacture facility in the island of Favignana, an incredible middle scale industry born in an era without automation and machines. The Tonnare di Favignana (LiVigni V., 2006 - Tusa M., 2006) run by the Florio family for generations was processing the Tuna from the fishing to the high-end canned fish spacing from a gamma of products offering fillets and slices of different measure, weight, and quality, carefully soaked in olive oil, and placed by hand in decorated tin cans. Through the full process, all handmade, the tuna was previously sectioned, cleaned, boiled, and then packed in the container suitable for the long conservation.

Figure 6 Favignana's Tuuna facility, preparations of the tin cans.

The process required just water, oil, and abundant sea salt with no adding of chemicals. The cooking process was carried out in the front space of the facility in big industrial pots with coal-fired chimneys. The Favignana's facility worked till the 60's when they were forced to shut the fishing and production down due to the high custom duties and for the radical drop in the fish population. The high competition of foreign players made the rest. Today the industrial site hosts the Ex Stabilimento-Florio's Museum.

Figure 7 Favignana's Tuuna factory cooking pots facilities.

A similar industrial experiment (Carannante A., 2006) was actuated in the close Island of Levanzo, where species such as blue fish including tuna, sardines,

mackerel, and anchovies were of paramount importance to the establishment of a first industry and then marketing of sauces and brines.

Without get into the matter of what destabilized the South Italian fish industry, what we can save from this long-lasting industrial history is that the principle of high competitivity and price orientation is nowadays not a fact as in a globalized and various market customers are always looking to buy high-end and fair-trade products whenever is possible to guarantee the origin and sustainability. The Favignana's example offers even in modern times an insight and an inspiration for developing countries with no access to automation and high-tech.

4.3 The Portuguese Case

The possibility of products that may be designed are endless and the importance of replace the machine automation with handwork it enhances the product quality communicating to the final customer this feeling of care and attention brought into the manufacture of his canned treat.

Figure 8 Conservas Pinhais

The magazine Insider (Romeo Business Insider, 2019) offers a detailed report of the modern sardine manufacture in Portugal, that's still mostly handmade preserving the tradition method and recipes. The case of the *Conservas Pinhais* located close to the city of Porto is an inspiring modern times story of resilience.

Every can receive the and touch and the precious fish after getting through the cooking process is carefully placed inside the tin box with the sauce that variate based on the preparation.

Canned sardines are a delicacy in Portugal. The country has a long fish-canning tradition, to the point that the sardine has become a national icon. Having the occasion to visit Portugal in impossible to don't step into a traditional sardine's shop like the one located in Lisbon ideated by Fábrica de Conservas da Murtosa with the name "Fantastic World of Portuguese Sardines" (https://www.mundofantasticodasardinha.pt, 2022) with at the active 6 shops in the main cities and in the best neighbourhood's located few steps from the major touristic attractions. The case has been object of a study (Verrier A., 2018) titled "How Do You Create a Unique Brand Identity? 3 Lessons from A Portuguese Sardine Company" and propose a 3 steps approach for the branding of a prospective fish cannery: First and this may be a very close connection with our case, stepping out with a unique story with an unconventional brand image.

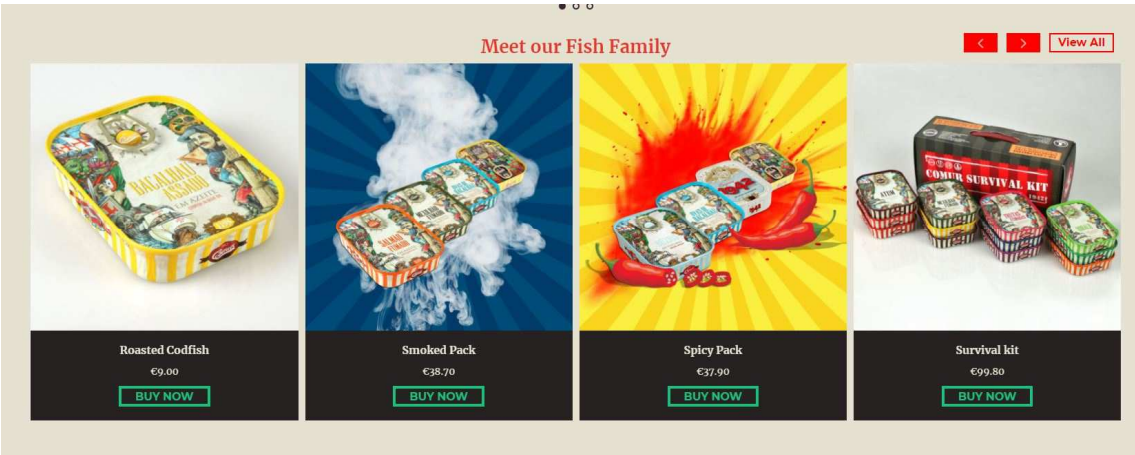

Figure 9 Canned products with catchy graphic packaging and sold for a consistent high price as souvenir.

Second: The personalization of the product, every can of the Portuguese chain has a unique design, creative, almost pop art, a way to transform canned food in a significative souvenir, something that can in the process of the customer experience leave a positive memory and represent an original gift idea, safe to carry. Canned fish would even be in line with the TSA (Eagleman j., 2019) rules, which allows the transportation by airplane of the canned food in the checked

luggage and with some limitation in the carry-on following the standard rule for liquid transportation. Third: Designs, text, packaging, store staging even the music played inside the retail space, is coherent with the brand and is studied to create a certain ambiance. Also, the social is important and reflect fully the company vision providing daily contents and insight.

Is very desirable try to replicate, also if in a small scale, a similar experiment, trying to become a phenomenon in the Zambian tourist industry, maybe with special series of canned fish that propose a special graphic or packaging, aiming being coherent with the social nature of the project and the narration of the ethics behind the scenes.

4.4 Low Tech Cannery, Possible?

Many of the processes made by machines, may certainly be realized in a smaller production scale with traditional manual techniques. In the specific simple operation like packing, filling, cooking, or smoking can be operated by hands without effect the quality of the product rather enhancing the quality of an entirely hand processed fish canned instead of a cheap product coming out of a production line.

Machinery for low-middle scale canneries can be easily purchased online from Chinese vendors that provide also reasonable fast shipping.

Is still necessary training for the prospective personnel and recipes for the canning process. This would take too far to be analysed in this occasion, a further feasibility study would be needed. The aim is to design a product environmentally sustainable, that could carry out of the national border the heritage and the resilience of the fishing tradition of the country bringing back to the local community's part of the proceeds, reinvesting in the country infrastructures, education, markets.

The cannery product, with an appropriate labelling and packaging, an intensive advertisement and social media campaign, an accurate and well-aimed

placement in the international airports and major touristic location of the surrounding countries, can alone, against all the odds, sustain the long-life standing of such an ambitious project.

The challenge to develop a new recognisable branded product would require an extra project, important funds and several hundred hours of work and effort of a multidisciplinary team. Competitors, cost effectiveness, feasibility and time are the odds to keep in consideration. Would be necessary analyse the market of the canned products and draw the concept of a niche market where to grow steadily. Develop a “concept” canned product in a so traditional industry that may survive and carry-on in time, standing against the competitors with certainly cheaper alternatives it is also particularly challenging.

5 Risk Analysis

5.1 Business Definition - The Project Idea

The project for the Aquaculture firm in Zambia is a joint venture of Finnish representatives of the Aquaculture world and academics from the University of Turku AMK. The project is not yet defined in any juridical form so could shape as a Ltd as well as an NGO spin-off. The business has the main goal of install on the Zambian territory a successful running Aquaculture establishment, with a great attention for quality standards, environment, and social give back to local communities. As side project can be also parallel run a small cannery for the creation of a new conserve product with a strong national identity, for the internal market and for future exports.

5.2 Identification

The primary outputs (PMBOK, 2008) to identify risks, according to the method described in PMBOK, are the entries into the risk register. The identified risks are described in as much details as is possible and reasonable. The structure adopted in this work will be enlisting the EVENT, IMPACT, CAUSE and EFFECT (when is possible to forecast so). This process of risk analysis ensures to help highlighting the risk roots, which may be the cause of the rising of one of more identified risks. For this reason, such casualties must be recorded and kept for supporting future risks identification for this or other project.

The following table represent a valid example of what would be according to the author of this thesis the structure of the project risks analysis.

Some of the enlisted risk come from the deduction made during this study of the Zambian economy and society, so are therefore to consider very likeable to happened or to be taken in consideration.

For the Risk ID will be used a term or more followed by a number if those risks are part of the same category, risks are enlisted in series for the same topic/group.

Risk ID	EVENT	IMPACT	CAUSE	EFFECT
Political /Legal 1	A New Law regarding Aquaculture establishments get approved by the Zambian parliament	The new Law will immediately from the approval effect any existing establishment forcing to take Immediate Action	A new law about a particular sector may be caused by internal pressure of parties and faction interested on a determined topic.	Laws may affect the business in relevant way transforming what in project design phase were considered advantages in disadvantages.
Political /Legal 2	A.P. (Aquaculture Products) may receive a different labelling by law causing a less likeability on the local market.	A different labelling by law may influence the consumer behaviour brought to think than an aquaculture product has an inferior quality than a fished product.	Fishermen unions can see their product likeability on the market jeopardized by the competitive price of the A.P.	Consumer may get the wrong impression by the Gov imposed labelling.
Political /Legal 3	A.P. intellectual property may be leaked to the competition.	All the practices, Intel and recipes of the firm not protected by patents and copyright are jeopardized	The legal department or the legal counsellor didn't advice correctly.	Another counterpart may user these information and patent them before. It's necessary a tempestive reaction.
Political /Legal 4	A.P. may be taxed differently to ensure a fair competition with local fishery communities	The A.P. may not be on the market that competitive to ensure the profitability of the operations.	Fishermen unions can see their product likeability on the market jeopardized by the competitive price of the A.P. Internal pressure from parties and factions on the government.	The new taxation may impose new strategic decision to re-establish the profitability of the operations to reduce the damages.
Political /Legal 5	A.P. may be stigmatized by the public opinion for the scarce resources of the fishing industry and the chronical shortage of fish.	Protests, strikes and demonstration may occur on site.	Fishermen unions, political parties and faction may exploit the aquaculture for the chronical shortage of fish on the market.	Exploitation and stigmatization may affect sales, production and therefore profitability.
Political /Legal 6	The type of fish chosen may be	The consume of the specific fish may see	Fishermen unions, consumer	Exploitation and

	object of a campaign of stigmatization (as for the Pangasius in EU)	a negative trend forcing the production to stop and sort new strategies.	associations, environmental groups and competitors may exploit the public opinion and the press causing a changeset in the consumer's behaviour.	stigmatization may affect sales, production and therefore profitability.
Political /Legal 7	The type of social project chosen as "give back" plan of the Aquaculture business may be exploited to blame the social sphere around aquaculture businesses.	The target group of the social project may be object of turbulence.	Different social groups, ethnic or national groups, Fishermen unions, consumer associations, environmental groups and competitors May use the social group chosen to exploit the whole business category.	Pressures on the media and in the social sphere of the business, potential loss of popularity on the market, may affect sales, production and therefore profitability.
Political /Legal 8	Terrorist or military attacks in the areas around the site.	The interruption of the productive activity and the securing of the facility.	Terrorism of Islamic nature or attacks from faction and paramilitary groups are a risk.	Account securing protocols and plans. Extra costs for the security.
Health 1	A.P. may be temporality banished from the market due to sanitary outbreaks in similar kind of business facilities	The stop of the production is an event that jeopardize the financial stability of the business as some cost like rents of cost of the personal are still to be paid	Hygiene conditions in Aquaculture are a hot topic, health audits in similar facilities may bring some problematics at the attention of the authorities	The authorities may decide an interruption of the business from the same branch till next audit
Health 2	Outbreaks of Covid 19 in different variants may force the workforce to stop the production	The stop of the production is an event that jeopardize the financial stability of the business as some cost like rents of cost of the personal are still to be paid	The Covid-19 pandemic is a global scale phenomenon.	Production may be stopped for 10+ days for single contagions waves. A sanitary protocol may be started.
Health 3	The facility may be hit by a pandemic that result in the destruction on partial or all the batch.	The Sanitary protocols and the authorities will take charge of contain the outbreak. Entire batches may be destroyed.	Unclear practices, exposure to pathogen agents, unhealthy and unhygienic practices, malfunctioning of the facility or an inexperienced staff and/or all the above.	The production will suffer unprogrammed delays and may suffer extra costs of sanitation and refurbishment.

Environmental 1	Natural catastrophes	The facilities may be permanently damaged	Natural causes or human intervention on the nearby landscape.	The whole project risk to stop, delay or get cancelled.
Environmental 2	Attention of local environmental groups	Strikes, protests, and demonstration may occur on the site of the Aquaculture installation.	A business fresh launched with a foreign capital at its back may attract the unwonted attention of environmental activists and groups.	The project will delay till the remotion of the protestors / demonstrators.
Environmental 3	Pollution from bad waste management may contaminate the ponds.	Liquid and solid waste material can generate pollution in same case to hazardous level.	Malfunctioning or bad practices may be the cause.	The project will delay, the implant contaminated need to be sanitized and refurbished.
HR /Org 1	A person taking care of single aspects of the business may quit or die.	The company will have a static moment, may even stop to take care of the task if needed.	The company does not satisfy the employ, general causes, natural causes, accidents.	The whole project risk severe delays. May not be easy replace a key element of a project/ business.
HR /Org 2	A person taking care of single aspects of the business may get sick on a long term, get into a parental leave.	The company will have a static moment, may even stop to take care of the task if needed	Natural causes.	The whole project risk delays to temporary replace the resource
HR /Org 3	A person taking care of single aspects of the business may betray the company offering intel to competitors	The company will have a static moment, may even stop to take care of the task if needed	The company does not protect the data correctly encouraging the leaks of classified information of strategic importance.	The company strategic information is used by unfair competitor that may profit jeopardizing the company intellectual property, recipes, and secrets.
HR /Org 4	Cultural differences in the organization.	Cultural differences may affect the perception over risk, safety, security and jeopardize the correct functioning of the organization	Underestimating cultural differences inside an organization, miss to collect proposal, feedbacks, and ideas from all the stakeholders, fail to propose a common Vision	A company without a common vision is dysfunctional, therefore does not perform at the 100%.
HR /Org 5	Communication flood: Too much information gets	The relevant people/departments have no reaction time to take action.	The management communicates in wrong way.	The expected actions are not taken in time or at all.

	released at the same time			
HR /Org 6	Info dosed down from management.	Too few information gets back to the relevant people7 departments	The management communicates in wrong way.	The expected actions are not taken in time, the vision of the action is partial therefore causing delays and dysfunctional team behaviour.
Operational/ Logistics 1	Delays on Material delivery	The whole batch is jeopardized if the material is related to the production.	Logistics problems have several causes, often coming from third parts.	The production process will suffer delays.
Operational/ Logistics 2	Delays on preparation of informative material and schedules.	The personal proposed to attend certain duty is missing or unprepared	The organization fails at management level to provide the right scheduling and training.	The production process may not pass the quality assurance screening.
Operational/ Logistics 3	Delays on site: Recon, installation, preparation.	Phases of the project get to stop, procuring a chain effect delay.	The organization fails at project level	The project will delay.
Operational/ Logistics 4	Delays from multiple parts.	All the previous combined.	Disorganization, Third parts delays, Poor management.	The whole project risk to stop, delay or get cancelled.
Financial /Project Management 1	Delays on funding availability and/or possible delay in the approval of fundings.	The funds are necessary to start-up and sustain the project, missing to pay stakeholders or partners may jeopardize the whole project.	Third parts delay coming from banks and credit institutions, missing documentations, misunderstandings, others.	The whole project risk to stop, delay or get cancelled.
Financial /Project Management 2	Deadline Missing, Project milestones unseen	Disattend deadlines according to specific fields may bring the whole project to an arrest.	Shifting in the management, communication problems, third parts intervention.	The whole project risk to stop, delay or get cancelled.
Financial /Project Management 3	Insolvency of one of the parts	The company bank account may go below zero.	The financial situation of one of more counterparts may be caused by a bad investment, an unexpected financial contingency.	Credits and accounts in minus costs extra money for loan interests.
Financial /Project Management 4	Gov temporary delay in releasing /approving funds	The company and the project will not receive the expected financial aid	Financial contingency in the Government may affect fund allocation.	The whole project risk to stop, delay or get cancelled.

Financial /Project Management 5	Unexpected expenses like fines or lawsuits (from current or potential stakeholders)	The company need to pay as soon as possible the bills and get in touch with a lawyer to take care of the lawsuits	Contracts and partnership suffer struggles when one of more events do not happen as forecasted in project phase.	The whole project risk to stop, delay or get cancelled
Financial /Project Management 6	Extra installation costs	The company has to pay costs not planned in the projects phase.	The contracts with the provider of the service have been misinterpreted.	The company need to cover the extra costs.
Financial /Project Management 7	Extra delivery costs	The courier, moving company, or provider of logistic service may refuse to deliver if the extra is not covered keeping the goods as partial refund of the suffered costs.	The contract with the vector has been misinterpreted.	The company need to pay the costs, the extra and maybe the fee for delaying the payment.
Financial /Project Management 8	Extra replacement parts, repairs, appliances and devices, costs.	The company has to pay costs not planned in the projects phase.	The risk analysis has been ignored.	Extra costs effect the profitability and significantly.
Financial /Project Management 9	The project runs out of budget.	The money is not enough to pay for salaries, raw materials, managing costs, rent of facility, cost of personnel, bills, and taxes.	The management failed administrating and allocating the budget.	The project fails and the company bankrupts, after filing a bankruptcy application the firm need to sell the asset and the inventory to pay debts with the stakeholders.
Business /Law 1	Partners and/o Stakeholders involved in any phase of the project break the contract.	On legislation and operative side, the company may be affected, if those partners were key figures.	In a project with certain complexity may have to forecast that some counterparts may break contracts and agreement parting from the team.	May be necessary reorganize entire phases of the project, recruit new partners, include different stakeholders, and even start a lawsuit.
Tech/ Facility Management 1	Shortage of power (Otieno H.O. - Awange J.L., 2006)	The facility appliances will shut down.	The main power plant / power source is defective, temporary deactivated, damaged.	All the appliances are out of power.
Tech/ Facility Management 2	Incompatibility of electrical /electronical devices and appliances with	The appliances interested cannot work in safety.	Different appliances have different standards of production and requirements.	Several appliances or the whole electric / electronical

	the current network and/or system.			network does not respect safety requirement therefore it's unusable.
Tech/ Facility Management 3	Differentiation in terms of standards, Security standards Iso standards and quality.	The appliances interested cannot work in safety.	Appliances, devices, and tool purchased abroad have been designed with specifics to work in the country of origin unless the producer specify differently.	Several appliances or the whole electric / electronical network are unusable.
Tech/ Facility Management 4	Different Operational temperature may affect the efficiency of appliances, devices, and tools	The appliances interested cannot work in safety.	Appliances, devices, and tool purchased abroad have been designed with specifics to work in the country of origin unless the producer specify differently.	Several appliances or the whole electric / electronical network are unusable.

5.3 Risk Management Plan, Analysis, Treatment and Actions.

The following Keys are to describe in the analysis the severity for the Likelihood, Impact and Priority of every single Risk:

VH	**Very High**
H	**High**
M	**Medium**
L	**Low**

Is also given a Possible Treatments scheme:

Accept	**Avoid**	**Contingency**	**Control**	**Mitigate**
Prevent	**Reduce**	**Response**	**Sharing**	**Transfer**

Risk ID	**Likelihood**	**Impact**	**Priority**	**Action**	**Risk Treatment**

Political /Legal 1	M	H	M	This can be forecasted monitoring the local press.	Control
Political /Legal 2	M	M	L	Monitor press and gov sources, may be necessary engage the medias.	Control
Political /Legal 3	H	M	VH	All recipes, practices and devices invented by the project need to be patent.	Avoid
Political /Legal 4	M	VH	M	Gov sources and media need to be monitored in an effort to forecast such eventuality.	Prevent
Political /Legal 5	H	H	M	The company must clearly on the website and media channel clarify the vision and the transparent sustainability behind the products.	Response
Political /Legal 6	VH	H	H	If inevitable the aquaculture plant needs to shift on another fish species.	Transfer
Political /Legal 7	L	L	L	The company cannot take the distance from the social group chosen.	Mitigate
Political /Legal 8	L	M	M	These events can in general not been forecasted. Pay attention to media and insert security and securing protocols in the budgeting	Contingency
Health 1	M	H	M	Company resources can temporary get allocated to R&D and to refurbish and sanitizing of the plant.	Contingency
Health 2	H	H	H	The site needs workers. Safety protocols and health measures may prevent an interna outbreak.	Prevent
Health 3	M	VH	M	Routinary controls by a quality assurance expert or an external laboratory are warmly recommended.	Prevent
Environmental 1	M	M	M	Natural catastrophes are often forecastable an insurance policy that covers such eventuality may be a smart move.	Mitigate

Environmental 2	M	M	L	Social media need to be monitored offering a proactive communication with the consumers.	Mitigate
Environmental 3	M	H	H	Facility management need to be monitored.	Prevent
HR /Org 1	M	VH	H	Work should be organized in Team with Agile kind of framework.	Prevent
HR /Org 2	M	M	L	Organizing the work in Teams and keeping sharing knowledge files will reduce the damages.	Contingency
HR /Org 3	L	VH	M	The probability of this event is quite scarce; however, the damage may be significative. Monitor, Inform and communicate with the staff periodically.	Reduce
HR /Org 4	H	H	VH	Differences if not addressed may create a dysfunctional working environment, session of brainstorming and team building may help define the focus area.	Sharing
HR /Org 5	L	L	L	The flood needs to be interrupted and a recap of the information spread instead.	Sharing
HR /Org 6	L	H	M	Information needs to be given in a way to cover an entire task or topic.	Sharing
Operational/ Logistics 1	VH	VH	VH	Logistics problem must be accounted and contact with authorities and customs are needed to take action.	Prevent
Operational/ Logistics 2	L	M	H	All the material to train the personnel and the workplan need to be done as exclusive task.	Avoid
Operational/ Logistics 3	H	VH	H	Delays can be forecasted keeping an open communication with service providers and stakeholders.	Prevent
Operational/ Logistics 4	L	VH	H	Delays can be forecasted keeping an open communication with service providers and stakeholders.	Prevent

Financial /Project Management 1	H	M	M	Other credit sources may be consulted.	Transfer
Financial /Project Management 2	L	H	L	Working in teams two people minimum are on the same work, there is always a double control and monitoring of the job.	Avoid
Financial /Project Management 3	M	M	L	It is a contingency that can be forecast screening the partners solvency bad payers are often flagged in the bank system.	Prevent
Financial /Project Management 4	H	M	L	Most of the funds are likely to come from European banks rather than Zambian's.	Accept
Financial /Project Management 5	M	L	L	A legal consultant must be ready in payroll.	Control
Financial /Project Management 6	L	L	L	If a contract is made for every external provider, service, work, is unlikely that extra costs may emerge, but not impossible.	Prevent
Financial /Project Management 7	M	L	L	Delays due to logistics third parties' issues, taxes, intermodal transports, different vectors, may result in extra costs. Account a percentage of the logistics cost upfront if the problem becomes chronic.	Contingency
Financial /Project Management 8	H	H	M	Improve facility management practices and allocate budget to the regular maintenance is a good prevention system.	Prevent
Financial /Project Management 9	L	VH	H	Is very unfortunate that a series of expenses, accidents, and financial disaster strike all together, if the occasion occur there is not much to do if not try with a loan.	Accept
Business /Law 1	L	H	M	Contract may offer inside their legal redaction a resolution for every occurrence.	Control

Tech/ Facility Management 1	H	VH	H	Explore alternative sources of energy or invest in power supply appliances.	Mitigate
Tech/ Facility Management 2	L	M	L	All facility appliance and devices may be inspected before assembling production lines.	Control
Tech/ Facility Management 3	L	M	L	All facility appliance and devices may be inspected before assembling production lines.	Control
Tech/ Facility Management 4	M	H	L	All facility appliance and devices may be inspected before assembling production lines.	Control

6 Conclusions

The objective of the thesis was to provide adequate background and feasibility analysis for the establishment of an Aquaculture enterprise in Zambia.

Risks were addressed through a case-by-case risk analysis, defining a course of action. The analysis is not intended to be definitive and may represent only the tip of the iceberg.

The challenges of the project are logistic, environment, sourcing, and entering the local market with a neutral footprint.

The project itself arises at a very particular time in history, with the constant threat of new pandemic waves of Covid-19 and the resulting paralysis of the global supply chain. It is also relevant to consider the country's socio-political mutation due to its high public debt and linkage to Chinese investment.

Punctually framed the project can be presented to national agencies, NGOs, government institutions, potential investors, partners, and stakeholders. To complete the work, it would certainly be interesting to research and study the possibility and market feasibility of an original Zambian canned product. Despite the chronic demand for fish from the domestic market, the cannery side project could solve some of the logistical challenges involved in exporting fresh product.

It is desirable that the knowledge contained in this paper may help concretize the first project draft, laying down the foundations and providing some extra reflective ideas. The project may need further review and updating before the actual draft keeping an analytic eye on the current economy of Zambia at the light of the next future events and developments.

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