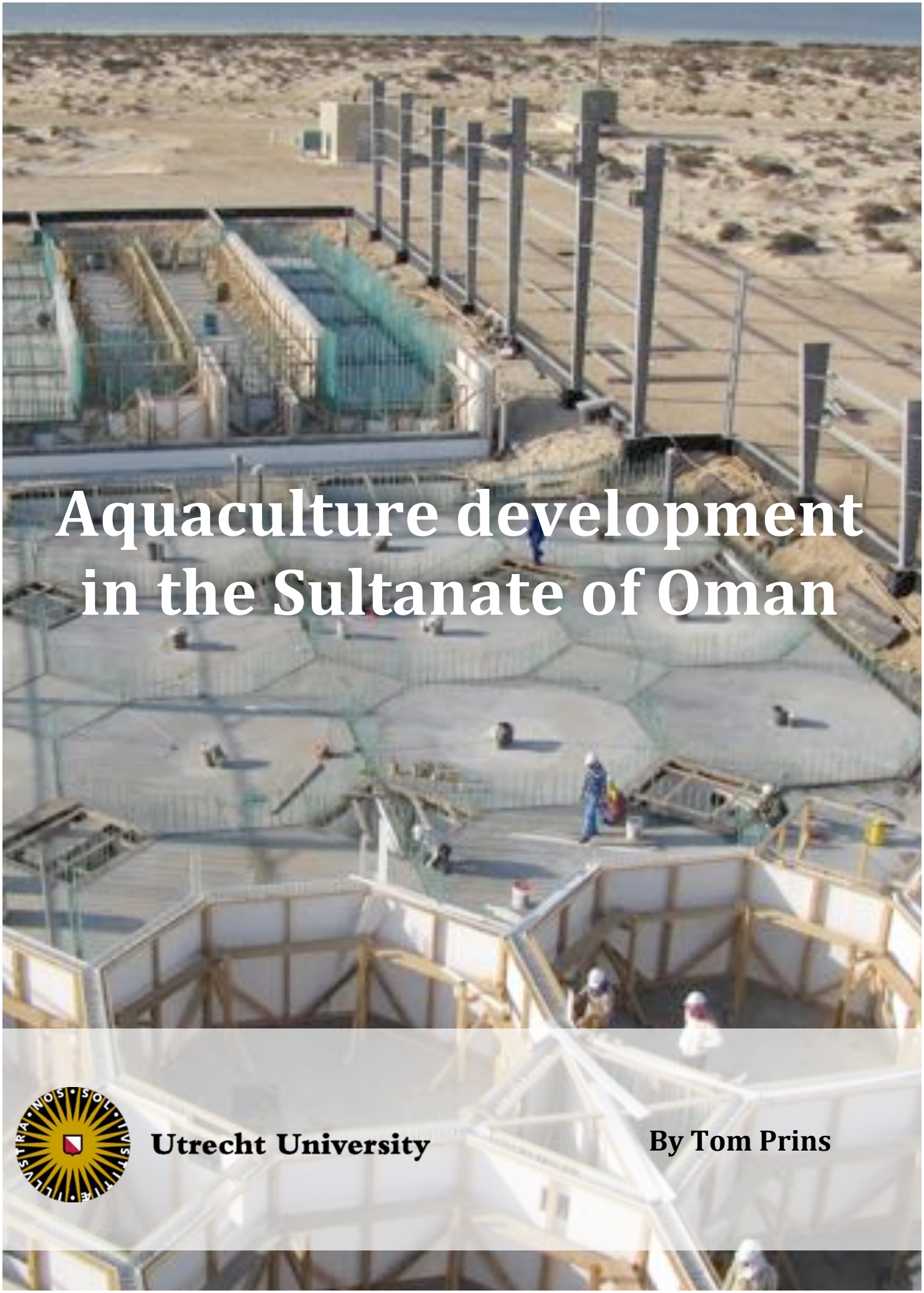

Aquaculture development in the Sultanate of Oman

Utrecht University

By Tom Prins

Towards a blue revolution in a hydrocarbon society?

Master Thesis Business Geography

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Summary

At the South-Eastern tip of the Arabian peninsula the Sultanate of Oman has demonstrated impressive economic growth rates over the last few decades ever since the discovery of oil in the country. As a result todays reality is an economy that heavily depends on incomes derived from hydrocarbons, accounting for 86% of the government revenues in 2012, which is equal to more than 51% of the country's GDP (National Bank of Oman, 2013). Depending on the level of production however could the 5,5 billion barrels that account for Oman's oil reserves already be depleted by the year 2022 (Campbell & Heaps, 2008). Back in 1995 the Omani government already acknowledge the limited availability of its natural resources and hence the need to diversify the economy and create wealth beyond hydrocarbon revenues. As such it developed a long term development strategy named the '*Vision 2020 Development Plan*'. This development plan was, and still is, centred around three main pillars; *diversification of the economy, human resource development* and *private sector development*. In order to diversify the economy and *create* wealth beyond the availability of natural resources several potential high growth sectors have been appointed by the Omani government. Aquaculture is one of these sectors and hence is the Ministry of Agriculture and Fisheries Wealth committed to get a world-class aquaculture industry off the ground in the Sultanate. Considering the worldwide growth rates of aquaculture over the past few decades as well as the future projections for the sector this ambition is pretty much understandable. On the other hand, diversifying the economy by investing in new productive industries has proven to be rather problematic for the Gulf economies. Besides a few exceptions (like e.g. Dubai) have efforts to develop knowledge intensive industries not been successful so far, leaving the question on how to transform sudden oil wealth in to a knowledge economy unanswered (Ewers & Malecki, 2009). This research has contributed to this pool of knowledge as well as to the knowledge around path creation, path development and collaboration processes on the basis of both. The central research question that has been answered in this research is as follows; *Does the current growth trajectory of aquaculture in Oman hold the potential to create a viable new growth path in the economy?* By adapting a qualitative multi-actor approach insights have been generated in the collaboration processes between different agents that lie on the basis of the growth path of the aquaculture industry in Oman. In-depth interviews with a wide range of informants from the public and private sector in combination with extensive desk research have been used to answer the above mentioned research question.

Theory

From a theoretic point of view industrial growth paths are explained by two growth models, namely endogenous growth and exogenous growth. Within the evolutionary economic geography the majority of the work done explains industrial growth paths through endogenous growth, within which the development of new industries is stimulated and enabled by "*pre-existing resources, competences, skills and experiences from previous local paths and patterns of economic development*." (Dawley et al., 2010, p. 656, after Simmie & Martin, 2010, p. 6), and hence are imbedded in a regions' DNA (Bristow & Healy, 2014). From this perspective industries with skills related to existing skills in the region are more likely to grow as skill-relatedness leads to regional labour matching and favours regional embedding of new industries (Boschma, 2014). Exogenous growth however is explained through the transplantation of industries, firms or new technologies from elsewhere to create or develop growth paths in the economy (Dawley, 2013). For both endogenous and exogenous growth the existing human capital translated in the absorptive capacity of a region plays a major part. For endogenous growth it's the existing skills and regional assets that define the boundaries between which a region can diversify its economy by developing new growth paths (Boschman, 2014; Neffke et al,. 2011). In general the absorptive capacity of a region is understood as to comprise existing human capital in combination with the complementarity between local and external, or global knowledge. As developing new industries in the Gulf countries mainly depends on the acquisition of knowledge and technologies from elsewhere the most relevant interpretation of the absorptive capacity

here is the capacity to recognize and understand valuable new knowledge outside the region, assimilate this knowledge locally and create new knowledge and commercial outputs (Simmie et al., 2008, p.16). Only through regional learning these consecutive processes can enhance a region's overall absorptive capacity. The successful transplantation of knowledge in order to develop new industries is highly depended on a region's absorptive capacity, therefore regional learning deserves major attention from economic policy makers. A whole ensemble of place specific institutions is responsible for a regions learning ability (Ewers, 2013; Hassink, 2010; OECD, 2001). Hence in order to learn, innovate and technologically advance a region or specific industry this whole ensemble of institutions should be integrated in the learning strategy for the sake of economic development. One way of doing this is by addressing a so called Local Innovation System, which is defined by Simmie et al. (2008, p. 14) as "*a functionally localised collection of organisations, institutions and processes that create or adopt valuable new economic knowledge and commercialize it*". In order to truly understand the functioning of regional economies one should understand the behaviour of its human agents (Bristow & Healy, 2014). This behaviour is structured through formal institutions like e.g. a country's constitution, laws and property rights and its informal institutions like traditions, codes of conduct (North, 1991) and the cultures of work and the ways of doing business (Ewers, 2013). The role of institutions in pursuing a specific economic growth path is crucial as they're responsible for providing the economy's incentive structure (North, 1991).

Results

The Sultanate of Oman doesn't have an extensive or long history with conducting aquaculture. As the skill-relatedness of the existing fisheries industry is limited to post-harvest activities there are no real opportunities for labour matching when it comes to actual fish farming. As a result the development of aquaculture in Oman follows an exogenous growth path driven by the transplantation of knowledge and technology from elsewhere. Making use of this imported knowledge and technology attempts are made to make major leaps in technological advancement and catch up with technological leading countries. However a rather poor absorptive capacity of the existing aquaculture industry could prevent these leaps to successfully take place. Using the knowledge of foreign experts the country is fairly good in recognizing valuable new knowledge from outside to develop an aquaculture industry in the country, however assimilating and using this knowledge locally has proven to be quite problematic somehow. Weak collaboration between actors involved in the aquaculture industry and a general lack of coordination of aquaculture activities makes regional learning problematic and negatively influences the opportunities for a functional local innovation system. As the institutional framework is also clearly not geared towards innovation and renewal the development of aquaculture in Oman suffers from a lack of incentives for innovation and an 'innovation culture' in general.

With regards to the role of institutions it is most of all the role of the Ministry of Agriculture and Fisheries Wealth that is, in contrast to what one would expect considering the aim of developing a world-class aquaculture industry, rather constraining instead of enabling. The ministry has created an environment in which it for foreign companies is very difficult to do – but especially start their business, notwithstanding the financial incentives provided. The process of licensing private sector project proposals takes too long despite the existence of a '*one stop shop*' for aquaculture within the ministry. As a result the willingness of foreign companies to pursue their investments in Oman is seriously affected, which is problematic as the development of the aquaculture industry is dependent of foreign private sector projects. Additionally through strong government involvement in the labour market is also local private initiative very limited. Because of a lack of existing skills in aquaculture as well as a lack of both entrepreneurial spirit and a 'hands on' mentality is there no Omani workforce ready yet to work in the aquaculture industry.

Recommendations

Arising from the results of this research can be concluded that the current growth trajectory of the Omani aquaculture industry doesn't hold the potential to actually develop as a viable growth path in the economy. Major improvements are needed in order to 'turn the tide' and provide an environment in which the current infant aquaculture industry in Oman can thrive. Especially enabling learning opportunities, innovation and private sector activities need to be seriously addressed. In this research a set of several policy recommendations is being done. These are mainly to be addressed at the Ministry of Agriculture and Fisheries Wealth but are for practical reasons also useful for private sector actors and knowledge institutes. Among others these are some of the recommendations being done:

1. **Coordinate learning & innovation:** address a local aquaculture innovation system and emphasize the need for collaboration of a wide range of actors, integrate all projects in a wider context to ensure maximum learning opportunities, embedding and follow up of R&D projects. Emphasize the commercialization of knowledge.

2. **Focus on capacity building:** basic level knowledge and specific higher education require major improvements. Focus on increasing both the basic biological knowledge of students as well as specific aquaculture knowledge on master level. Additionally train existing staff at research centres and stimulate knowledge transfers between expats and local employees.

3. **Reform the labour market:** reforms are needed at both the supply and the demand side. Besides improvement of skills do work ethics need to be addressed, the Omanization policy should be reconsidered and the Ministry of Agriculture and Fisheries Wealth should stop expanding itself at the expense of private sector activity. Promote private sector activity and issue permits more rapidly to enable private sector projects to start.

1. Introduction

1. Introduction

"The Ministry of Agriculture and Fisheries Wealth is committed to building a world-class fish farming sector that will take advantage of Oman's natural aquatic resources and develop these resources to their potential." (MAFW, 2011)

1.1 Economic diversification

Figure 1.1 Map of Oman. Source: Ezilon Maps, 2015

Just like most of its neighbouring countries in the Gulf region, Oman has sailed economically well over the last few decades since the discovery of oil in the Sultanate. It first started exporting oil in 1967 and the revenues generated with this 'new' type of business have ever since enabled the country to develop from a poor agricultural society into a middle-income country. However, just like the other Gulf Cooperation Countries (GCC) Oman acknowledges the need to create economic development beyond oil. This means being less dependent on the external rent of natural resources and increasingly on human capital, productivity, efficiency and taxation (Ewers & Malecki, 2009; Hvidt, 2011). Economic diversification might be urgent when – like is the case with all oil-based GCC economies – the economy strongly depends on just one or a small number of sectors. First, the world's oil market is subject to high volatility. An unexpected or far reaching drop in oil-prices may have direct consequences for government's budgets, resulting in the reconsideration of expenses like major infrastructure projects, an increase in taxation and a decrease in subsidies (like on e.g. petroleum, cars and cigarettes). Which subsequently may lead to socio-economic problems, resulting in social and political instability (Mansfeld & Winckler, 2008). Second, an economy that is heavily dependent on natural resources is logically limited by the availability of these natural resources that by nature are finite. Especially in Gulf states like Bahrain and Oman the estimated oil reserves are not near as vast as in Saudi Arabia or Kuwait. Oman has an estimated reserve of 5,5 billion barrels, in comparison, Saudi Arabia has an estimated reserve of 268,35 billion barrels (The Global Economy, 2015). This means that depending on the production levels Oman's oil reserves could be depleted by the year 2022 (Campbell & Heapes, 2008). The 6 months of steep decline in oil prices between the end of 2014 and early 2015 demonstrates that the time of abundant '*oil wealth*' is over and that governments will be forced to reform and find new sources of income. Especially so considering that the future prospects for a recovery of the oil prices aren't that rosy either – a new equilibrium is expected to be far lower than the average price per barrel of over a $100 like in recent years (Bloomberg, 2015). With differing success among the region GCC governments have been able to reform and diversify their economies. Especially the Emirate of Dubai has proven to be effective in using hydrocarbon revenues to develop several other productive industries (Hvidt, 2011). Between 2012 and 2013

the number of tourists visiting the city increased with 10.6 per cent, reaching more than 11 million in 2013 (Gulf News, 2014). The financial sector has been developed to one of the worlds main centres of Islamic financial services (Bassens et al., 2011), and the transport and logistics sector, with driving forces as Emirate Airlines and the Jebel Ali Port pushing worldwide standards to next levels, is another major growing industry (Nataraja & Al-Aali, 2011). Consequently the financial, the tourism as well as the transport and logistics industry function as new industrial growth paths and as major sources of non-oil job creation. However, other policy initiatives around the Gulf and the Arab world have proven to be less successful. The promise of the knowledge-economy as a major source for non-oil job creation has so far not been successful in most of the region (Al-Roubaie, 2013; Schwalje, 2012). The high-skill and high-wage knowledge intensive industries never really, except from a few places, touched ground. Rapid modernization to diversify the economy through the creation of knowledge has not proven successful around the region (Al-Roubaie, 2013). Additionally, it has been proven that the GCC efforts of diversifying their economies have been rather counterproductive and ineffective between 1980 and 2005 – the only significant factor leading to an increased output per worker in non-hydrocarbon sectors was a decrease in oil-revenues and not increase of government expenditure in these sectors (Coury & Dave, 2010).

1.2 A new growth path: the aquaculture industry

The need for economic diversification in Oman has resulted in the identification of a few potential growth sectors by the government, one of which is aquaculture. Aquaculture is known as the breeding of marine creatures such as finfish, shellfish, crustaceans and aquatic plants in a limited aqueous environment that is controlled by man (FAO, 2015a). With a production level of 5 million ton of fish in 1983 and 63 million ton in 2013 it is considered as the fastest growing form of food-producing sectors in the world. Increasing populations and wealth and declining natural fish stocks in the world's oceans contribute to an expected continuation of this trend in the future (World Bank, 2013). The government of Oman is committed to developing a world-class aquaculture industry in the Sultanate. An aquaculture industry that contributes to increasing the non-hydrocarbon share of its GDP, as well as non-hydrocarbon employment growth and domestic food security. In economic development literature the growth of new industries is often, especially in the evolutionary economic geography, described by endogenous growth models. Scholars point to a region's DNA – its history and existing regional assets as the boundaries between which a region can diversify its economy and develop new growth paths (Boschma, 2014; Neffke et al., 2011). Examples of endogenous growth are the upgrading or revitalization of existing industries trough innovation, the use of core technologies in a declining industry as a major factor for the development of new, related industries or the development of complete new industries or technologies without any predecessors from within the region (Martin & Sunley, 2006). Exogenous growth models on the other hand describe the growth of new industries by external factors, which is the transplantation of new industries, firms or technologies from elsewhere into the region and from there on develop as new growth paths in the economy (Dawley, 2013). The huge amounts of hydrocarbon revenues that are generated over the last few decades have given rise to a specific economic structure in Oman and the other GCC countries. This economic structure is also known as the 'allocation' or rentier economy, which means that the state is mainly a distributor of wealth derived from the external rents of only one productive sector (Hvidt, 2011). It is due to this incredible amount of '*oil-wealth'* that in order to diversify their economies GCC states choose for rapid sectoral development via exogenous growth, which is the transplantation of industries and technologies into their countries. By tapping in to the international pool of knowledge and technology and taking advantage of the newest and improved technologies major leaps in technology levels can be made, it allows for 'passing by' industrial phases which most of the current post-industrial economies have gone trough (Ewers & Malecki, 2009). This way of rapid development is referred to as *technological leapfrogging*, or simply leapfrogging (Nilson, 2010).

It is within these confines that this research takes place. It investigates *how* the development of the aquaculture industry in Oman is taking place – and *if* this way of development holds the potential to continue to grow in the future and develop as a viable growth path in the economy.

1.3 Research questions

This research forms an exploratory study to the potential the aquaculture industry has to develop as a viable growth path in the economy and hence function as a source of non-oil job creation in the Sultanate of Oman. On the basis of both primary and secondary data it will analyse whether or not the aquaculture industry in Oman could possibly follow the success story of certain high growth industries in neighbouring Dubai. By doing so this research will contribute to the pool of literature around new growth paths and the transformation of oil wealth in to sustainable economic growth. Additionally the results of this research will serve both the public and private sector, and both domestic and international parties in their operations in the aquaculture industry in Oman. To structure the research a set of research questions is proposed consisting of one main question and four sub questions. The main research question within this research is as follows:

Does the current growth trajectory of aquaculture in Oman hold the potential to create a viable new growth path in the economy?

To answer the main research question a set of four sub questions is formulated;

1. What are the main sources of the growth path of the aquaculture industry in Oman, and to what extent do these sources influence the paths potential for success?

2. Considering the ability to recognize, assimilate and use relevant external knowledge, how could the absorptive capacity of the Omani aquaculture industry be characterized?

3. To what extent has developed a specific local innovation system for the development of the aquaculture industry in Oman?

4. To what extent do human agents through formal and informal institutions influence the development of the aquaculture industry in Oman positively or negatively?

1.3 Relevance

1.3.1 Scientific relevance

Whereas essentially unique, this research endeavours to add new insights to the broader pool of literature around path creation, path development, regional resilience and the transformation of oil-wealth in to sustainable economic growth. To understand the concept of regional resilience it is important to understand how regional economies are shaped by their agents (resp. firms and institutions), who constantly interact with each other in shaping economic development paths trough learning, innovation and trial and error (Bristow & Healy, 2013). The processes and behaviour of these agents, how they operate in their regional context and how they relate to – and shape new macro-economic structures is a complex matter. More empirical research is needed to fully understand these processes (Bristow & Healy, 2013, p.933). Due to its multi-actor approach this study attempts to generate new insights in the role of different agents in enabling new development paths and regional learning.

Beside the fact that no prior research is done on the development path of the aquaculture industry in Oman, is there an overall a lack of models explaining the transformation of sudden oil-wealth into knowledge and knowledge intensive industries (Ewers & Malecki, 2009). This

research does not attempt to formulate a generic model, but it does attempt to better understand the obstacles and opportunities imposed by the oil-wealth in developing new industries. Additionally, much more work is required to understand which specific actors and mechanisms in specific regions lead to the development new growth paths, and subsequently to a more diversified economic structure (Dawley, 2014). It is not yet known whether or not GCC economies will be successful in bypassing industrial phases in becoming competitive knowledge economies (Ewers & Malecki, 2009). The explorative nature of this research allows it to analyse and predict to what extent it is possible that the aquaculture industry, essentially knowledge intensive, in Oman can contribute to economic diversification of the Omani economy.

1.3.2 Societal relevance

The societal relevance of this research is derived from the assumption that diversification of the economy has a positive effect on the wealth of the people of Oman. The presence of foreign investors in the Gulf countries is positively correlated to the price of oil. When in 2008 the prices dropped from US$ 145 per barrel to US $39 per barrel a vast amount of investors left the region taking their labour, knowledge and technology (Ewers, 2013). This vulnerability of the Gulf economies justifies the choice for diversification and the research that leads to a better understanding of this. A more wide economic structure is better able to cope with externally generated shocks (Bristow & Healy, 2013) like a drop in the world's oil prices. A broader employment base will leave less people unemployed when this kind of shocks occur. Hence this research, contributing to the diversification of the Omani economy, contributes to ensuring long-term employment stability in Oman. Additionally it will attempt to understand how the development of aquaculture can contribute to the employment rate of Omani nationals. In this way it is in line with the current *Omanisation* strategy of the government, with which it is trying to reduce the number of unemployed Omanis. This study furthermore attempts to understand how state-led capitalism affects new industrial development paths. By doing so it will provide insights in the heavy government involvement at all levels in the economy and the result this has on the creation and redistribution of wealth. Due to heavy government involvement private initiative is very limited in Gulf countries (Porter, 2003), often resulting in strengthening the position of the current bureaucracy. This study will attempt to shine a light on the role of a central government in developing a new industry and on how a more bottom-up approach can result in a more even creation and distribution of wealth.

Besides the socio-economic arguments for this research as described above, is the implementation justified by a more environmental focussed argument. Many authors argue that since the mid 1980's worldwide fish stocks are declining, resulting in a current situation of 75% less fish in the oceans than in the 1980's (The Economist, 2013). The consequences of such a depletion are felt by both humans as well as the ocean's ecosystems which are being disturbed up to a level where there is no way back. With a growing world population and increasing welfare fish consumption will keep on growing (Sachs, 2007; The Economist, 2013). The transition to sustainable high productivity aquaculture activities is in popular terms referred to as the 'blue revolution' (Sachs, 2007). This research will plea for the development of a sustainable system in which wild catch is reduced and replaced by aquaculture.

2. Literature review

2. Literature review

"Existing regional assets, being it used or unused, define the limits or boundaries in between which a region can diversify it's economy." (Boschma, 2014; Neffke et al., 2011)

This theoretical framework consists of a literature review relevant in understanding the processes of new path creation and path development. It starts with explaining the concepts of path creation and path development both with perspectives from endogenous growth theory as well as exogenous. It elaborates on the different sources of new growth paths and explains how new growth paths contribute to enhancing regional resilience. Paragraph 2.1.2 provides a model that is guiding in answering the main question of this research, which is to what extent the current growth trajectory of the aquaculture industry in Oman leads to a viable growth path in the economy, or in other words, extended growth in time. This chapter then continues by explaining *regional absorptive capacity* and *local innovation systems,* two major factors that influence the ability for growth path development. Understanding the role of absorptive capacity and innovation allows for a critical analysis of the possibilities of different growth paths, like aquaculture in Oman. Thereafter the chapter continues with elaborating on the role human agents play in developing new growth paths. It is the massive oil-wealth in GCC states that has resulted in a specific institutional context, paragraph 2.4 elaborates on several main features that occur in *rentier economies*. Chapter 2 finishes with a conceptual framework that provides the structure for empirical research.

2.1 Path creation & path development

2.1.1 Path creation: endogenous and exogenous growth theory

Building regional resilience is an on going dynamic process that requires the reconfiguration of existing structures to develop new growth paths (Boschma, 2014, p. 2). By diversifying the economic structure of a regional economy the possibilities for developing new growth paths is increased, thus enhancing regional resilience. In the basis economic diversification can be reached via two ways, trough endogenous growth of new industries, or trough exogenous growth. Especially in the evolutionary economic geography the broader pool of literature is around endogenous economic growth. "*The purpose of endogenous growth theory is to seek some understanding of the interplay between technological knowledge and various structural characteristics of the economy and the society, and how such an interplay results in economic growth*" (Aghion & Howitt, 1998, p.1). The endogenous approach assumes that developing new industries is stimulated and enabled by "*pre-existing resources, competences, skills and experiences inherited from previous local paths and patterns of economic development*" (Dawley et al., 2010, p. 656, after Simmie & Martin, 2010, p. 6), and hence are imbedded in a regions' DNA (Bristow & Healy, 2014). A regions history therefore is crucial in understanding the conditions available for new path creation. Existing regional assets, being it used or unused, define the limits or boundaries in between which a region can diversify it's economy (Boschma, 2014; Neffke et al., 2011). The optimal degree of variety between firms and industries and the effect this has on new path creation and regional resilience has been subject to discussion in recent regional development literature. Whereas diversity enhances path creation and regional resilience at first sight, should one make a division between related and unrelated variety which both have different effects; "*related variety is seen as a source of regional knowledge spillovers, and unrelated variety is seen as a portfolio protecting a region from external shocks*" (Hassink, 2010, p. 50). Related variety therefore holds the ability that allows for regional learning, knowledge spillovers and further specialization on existing economic activities. Unrelated variety, or firms being disconnected in cognitive terms, on the other hand ensures that by the fall or exit of one industry in a region other industries are not affected (Boschma, 2014). Consequently there seems to be a trade off between specialization and short-term economic

growth versus diversity causing a continual regional adaptability (Hassink, 2010, p. 50). But there is also evidence that external shocks are best absorbed trough industrial variety when different industries in a region have a high degree of skill-relatedness. This means that similar skills are used in different industries, hence leading to regional labour matching. When a shock in one specific industry occurs, it will be easier for the surplus of employees to find another job in the region in a skill-related industry (Neffke & Henning, 2013). Thus decreasing the impact of a shock on a region and enhancing a rapid recovery. The benefits that regional industries have from each other's co-presences by using similar skills and capabilities are also referred to as 'local related externalities' (Boschma, 2014), favouring also the regional embedding of industries. Additionally do skill-related industries stimulate labour mobility within the region, having a positive effect on the learning ability of the region trough knowledge-transfers (Neffke et al., 2011). Boschma (2014, p. 7) furthermore emphasizes the power of related industrial variety by stating that more than a unrelated industrial structure it is better in enhancing regional resilience: *"… related variety in a region has the potential to secure both adaptation and adaptability, and thus, may make a region more resilient. Related variety means that a region has a wide range of related industries that provide potentials for inter-industry learning and new recombinations: the higher related variety is, the more opportunities for local industries to learn from each other, and the more potential combinations across industries can be made."* Summarizing the above can be stated that by branching out from existing industries new industries are developed trough recombining existing resources and developing new growth paths. A high level of related variety thereby stimulates the opportunities for developing new growth paths.

Exogenous growth models on the other hand assume that economic growth is determined by external rather than internal factors, this is, factors outside the country or the company. Economic growth will decline at some point in time due to fixed numbers of labour and the stateliness of technology, as production continues at the same rate it will eventually lead to a certain equilibrium, based on demand factors (internal). Exogenous growth is based on the transplantation of industries, firms or new technologies from elsewhere to create or develop growth paths in the economy (Dawley, 2013). The import of external, new knowledge into a regional economy can be a major source for innovation. To illustrate this, the UK spends about €27 billion on the creation of new knowledge every year through their universities, research institutes and companies. This accounts for only 3.5 per cent of the total newly created knowledge of all the OECD countries. Thus, identifying, accessing and assimilating new knowledge from external sources can bring a fair share of novelty into the regional economy (Simmie et al., 2008).

2.1.2 The origin of growth paths

To understand the mechanisms of path creation it is at first essential to understand where new growth paths find their origin. This origin is something that until recently was quit a 'grey area' in the path creation literature (Martin & Sunley, 2006), but lately got more attention in the form of case studies to origin of the growth paths of the offshore wind industry in North East England and Northern Germany (see for example Dawley, 2013 and Fornahl et al., 2012). Three different viewpoints on the origin of new growth paths can be distinguished (Fornahl, 2012).

1. The development of a new growth path is a matter of pure chance. The only reason behind the development is one, or a series of, small accidental events.
2. New industries and firms are less dependent on regional conditions than older ones. Hence, as long as the basic requirements in a place are met, these new firms and industries enjoy an enhanced locational freedom that is also referred to as 'windows of locational opportunity' (Martin & Sunley, 2006). Since a large number of places possess the basic requirements regional conditions play a rather unimportant role in the early stages of new industries (Boschma & Frenken, 2006).

3. Not chance but strategic actions of actors in a region are the main forces behind new path creation. Existing skills and knowledge determine the location of early entrepreneurs who in turn develops new regional growth paths.

Path creation does not necessarily mean the actual creation of new paths, 'path renewal' is also understood as being path creation as long as the renewed path is different from existing paths (Boschma, 2014). This renewal could be a sudden break with existing technologies, products or organizational forms, or the existing technology plays the same role in a new or different industry (Fornahl et al., 2012). Anyhow, path creation is commonly understood as being a path dependent process (Boschma, 2014; Dawley, 2013; Fornahl et al., 2012 and Martin & Sunley, 2006), meaning "*a process or system whose outcome evolves as a consequence of the process's or system's own history*" (Martin & Sunley, 2006, p. 399). Path dependency is commonly referred to as a limitation by past events and experiences to the available options for current decisions (Fornahl et al., 2012). In a more optimistic way though one can look at path dependency as a set of pre-existing experiences, skills, resources and competences inherited from previous economic trajectories as stimulators or enablers for new growth trajectories (Boschma, 2014; Martin, 2010). These crucial assumptions are the starting point of the path dependence model of industrial revolution, as shown in figure 2.1.

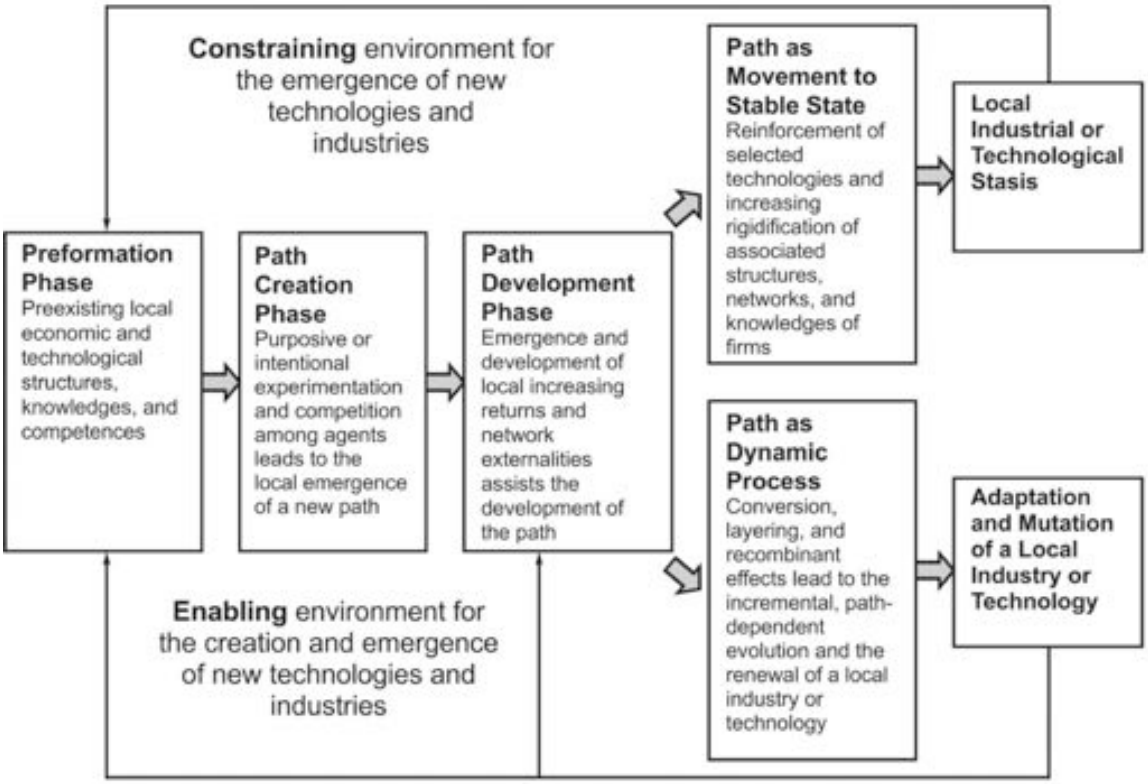


Figure 2.1. Towards an alternative path dependence model of industrial evolution. Source: Martin, 2010 p. 21

In figure 2.1 the renewal of previous economic paths can take place on the basis of endogenous factors. The reorientation and gradual change of institutions ('conversion' and 'layering' respectively), and the recombining ability of human agents lead to new growth paths gradually evolved from existing structures (in figure 2.1: Adaptation and Mutation of a Local Industry or Technology). This opposed to a situation in which increasing institutional rigidification leads to a lock-in or equilibrium caused by the reinforcement of existing technologies, lack of innovation, no endogenous change and the lack of entrepreneurial activity and experimentation. Additionally, this option (in figure 2.1: Path as Movement to Stable State) is highly sensible to sudden market changes and competition from cheaper and more productive competitors

elsewhere. The equilibrium or lock-in state might eventually lead to a situation of regional economic decline (Martin, 2010, p. 21).

In addition to the model shown in figure 2.1 four different factors can be identified that influence the dynamic process of new path creation. They can be regarded as 'enablers' instead of 'constraints' of new industrial paths and hence are in line with the thought of positive path dependency. The first factor is the current market condition, which needs to be stable and positive. If this is not the case it will be hard for firms and entrepreneurs to be interested and enter the market. Second come the long-term stability characteristics of a region. In this respect one might think about socio-economic and political stability but also about regional assets such as a strategic location (e.g. coastal or weather-wise). Human capital, networks and research institutes are varying characteristics that are the third factor. Skills and capabilities of individuals and the interaction between actors in a region are crucial for recombining (latent) regional assets that lead to new growth trajectories. Paragraph 2.3 will elaborate more on the essence of interaction and collaboration between human agents. The fourth factor is the crucial one of the occurrence of triggering events. These triggering events are necessary to create awareness and realization of the actual industrial potentials of a region. Examples of triggering events can be new industrial policy incentives by a local government or the location of a leading company within an industry in a region (Fornahl et al., 2012). Obviously leaving an existing path, that often has proven to be successful in the past, to develop new growth paths comes with certain challenges. Decisions to leave an existing path for an alternative trajectory are often politically unpopular and lead to cognitive uncertainties and (at first) economic inefficiencies (Dawley et al., 2010).

Building further on the three viewpoints on the origin of new growth paths and the understanding of path creation, Martin and Sunley (2006) elaborate more on the characteristics and sources of these new paths as shown in table 2.1. The breaking of specific paths or structures to make place for new ones can also be seen as an instrument for escaping regional lock-ins, or in other words as 'de-locking mechanisms' (Fornahl et al., 2012; Martin & Sunley, 2006). Table 2.1 shows five different sources of new growth paths and their characteristics.

Sources of new path	Characteristics
1. Indigenous creation	Emergence of new technologies and industries from within the region that have no immediate predecessors or antecedents there
2. Heterogeneity and diversity	Diversity of local industries, technologies and organizations promotes constant innovation and economic reconfiguration, avoiding lock-in to a fixed structure
3. Transplantation from elsewhere	Primary mechanism is the importation of a new industry or technology from elsewhere, which then forms the basis of new pathways of regional growth
4. Diversification into (technologically) related industries	Transition where an existing industry goes into decline but its core technologies are redeployed and extended to provide the basis of related new industries in the region

5. Upgrading of existing industries	The revitalization and enhancement of a region's industrial base through the infusion of new technologies or introduction of new products and services

Table 2.1. Escaping regional 'lock-in': some possible scenarios. Source: Martin & Sunley (2006, p. 420) after Lester (2003, 2006)

The reinvention of local resources or the economic reinvention of a region is the main criteria for the first source of new path creation, namely indigenous path creation. This reinvention is highly dependent on human capital, research institutes and the capabilities of actors to innovate rather than fleeing for economic crisis. The second source, heterogeneity and diversity, argues in line with the thought of evolutionary economic geography that a high level of diversity leads to new structures or paths. Especially in the case of a high level of related industrial variety new growth paths are stimulated trough knowledge spillovers, risk reduction and labour market stability (Fornahl et al., 2012). Transplantation, or knowledge acquisition, is the third de-locking mechanism and is especially relevant in the context of GCC economies, which are highly dependent on foreign human capital and technology (Ewers & Malecki, 2009). Martin and Sunley (2006, p. 422) refer to *transplantation* as "*…the importation and diffusion of new organizational forms, radical new technologies, industries, firms or institutional arrangements*". Trough the importation of firms from elsewhere, e.g. trough FDI, mergers or takeovers, a region can acquire new knowledge that will enable it to develop new industrial growth paths. The success of this third de-locking mechanism though, depends on the regions capacity to synthesize the acquired knowledge with the existing capabilities and competences of the current industrial base. In other words, the successful transplantation of knowledge from elsewhere into the region heavily depends on the absorptive capacity of the region (Fornahl et al., 2012; Martin & Sunley, 2006), which especially for developing economies might be a significant obstacle (Guimon & Filippov, 2012). The fourth de-locking mechanism is the diversification into technologically related industry. Different than the second de-locking mechanism, key is here that existing core industries are used to develop new growth paths. In this case core industries are used as the basis for new trajectories. Upgrading and enhancement is the fifth and last de-locking mechanism. The revitalization of existing technologies can be used when they're still relevant, but somewhat outdated and hence less productive. By using new technologies to upgrade the existing industries a lock-in situation might be overcome and new growth paths developed. This has been proven the case in the four Newly Industrialized Economies (NIE's) in Asia – namely Singapore, Hong Kong, South Korea and Taiwan – where trough continuous technological innovation and industrial upgrading economic stability and growth were demonstrated (Das, 2014).

From the five sources of new growth paths as described above only the third one, transplantation, is regarded to as an exogenous source of new growth paths. The other four are all based on and mainly determined by internal factors of the economic system and hence are regarded to as endogenous growth sources.

2.1.3 Path development

The phase from which a path is created and a new industry starts to acquire some market influence and sees its number of actors involved increase, till the moment where cumulative self-reinforced development along a new path is ensued is called the path development phase (Simmie et al., 2008). Essential for the outcome of a viable industry is the development of a critical mass in this phase. Only when this critical mass reaches a certain momentum the path will be able to reinforce itself, if not the path will most likely turn in decay and might eventually even dissolve (Simmie et al., 2008). Figure 2.2 shows two different growth paths; path A corresponds to a basic path dependence model where a negative lock-in leads to decay or even abandonment of the path (the 'rise, lock-in and decline' life cycle). Path B on the other hand

corresponds with a growth trajectory where decay is avoided and the created, or existing path is renewed and extended.

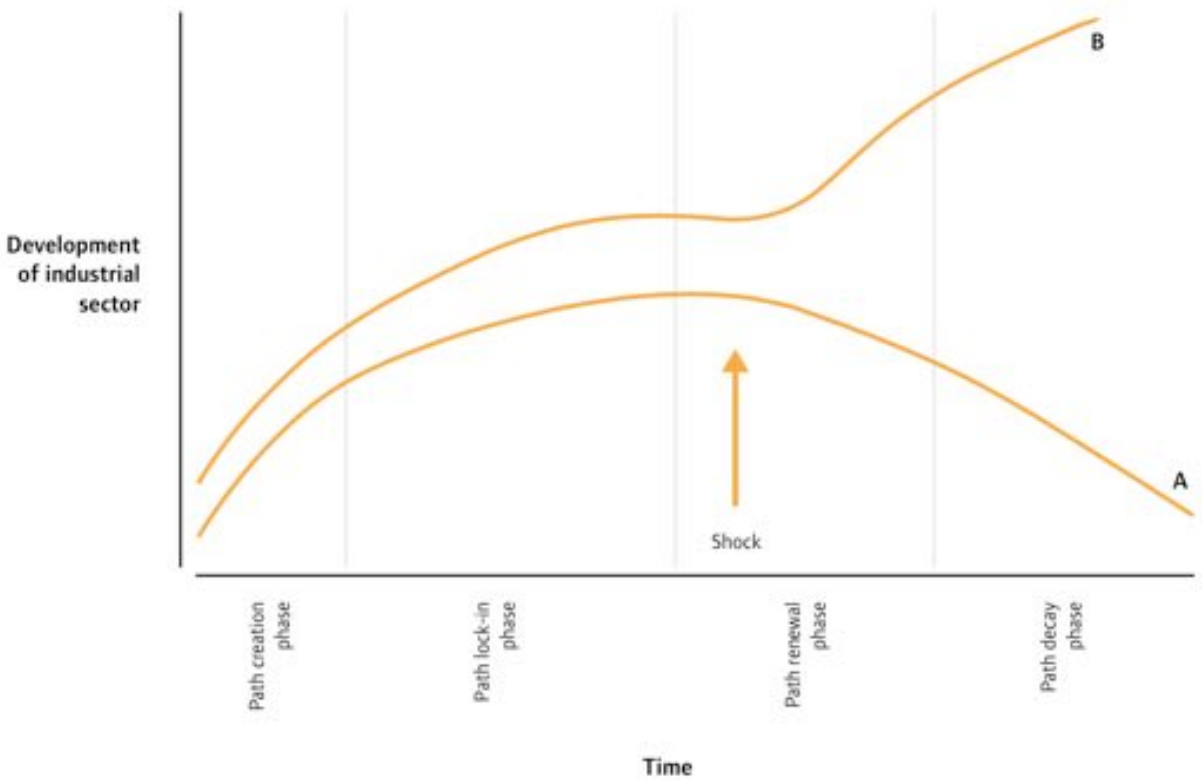


Figure 2.2. Two alternative paths. Source: Simmie et al., 2008, p. 14

The loss of momentum and the decay of the growth path can have several explanations. It can for example result from the emergence of external competition, innovation, new technologies or a comparative advantage elsewhere. Lin (2010) argues that the surest growth path an economy can choose, at least for developing economies, is to follow its comparative advantage. Different than the neo-classical view on the comparative advantage, Lin rather views it as a dynamic comparative advantage – which changes in line with changing factor endowments and technological advancement. The government focus hence should be on the identification and support of those industries that have a comparative advantage at a certain point in time, and on overcoming obstacles that hinder the growth of these industries (Das, 2014). Paragraph 2.3 will further elaborate on the role of human agents in creating and developing new growth paths. Another reason why a loss of momentum could occur is simply because key actors in an industry relocate elsewhere, or the fact that innovation levels of the concerned industry are not sufficient (Simmie et al., 2008). Hence a major instrument for growth paths to avoid the decay phase and extend growth is through innovation. Innovation and development by a regions firms might lead to reinvention of the growth path, or simply to extended growth (Simmie et al., 2008). This requires an active and dynamic Local Innovation System (LIS) (Ewers, 2013; Hassink, 2010; Martin & Sunley, 2006; OECD, 2001, Simmie et al., 2008), which will be further discussed in paragraph 2.2.1. In both endogenous as well as exogenous growth theory innovation is allots major importance. As demonstrated in table 2.1 do all the endogenous growth sources depend, to different extent, on the creation of novelty and hence are essentially innovation based (Aghion & Howitt, 1990). It is a society's ability to create or cope with technological change that ultimately determines economic growth. This thought is often related to the Schumpetarian idea of 'creative destruction', which is that through on going quality-improving innovation older products become obsolete (Aghion & Howitt, 1990). The Schumpeterian thought is often considered as a framework for designing growth policy that is context specific. This means that

according to a country's or sector's distance to a technological leading country the allocation of education spending should vary. For the sake of economic growth and to stimulate renewal policy should be designed in such a way that it enhances a country's or a sector's R&D activities. The more complex technologies become, the more should be spend on R&D as to keep on innovating at the same speed at all times (Aghion & Howitt, 2006). The role of innovation for exogenous growth is further discussed in paragraph 2.2.

2.1.4 Path creation to enhance regional resilience

Since a lot of regions are slowly recovering from the global economic crisis, more attention is being given to the question on how to accommodate and overcome certain external shocks in the future. Besides a global economic crisis the notion of external shocks refers to a whole range of events that could cause disturbance, from terrorist attacks and natural disasters to the closing down of major plants and political transformations. Some shocks might occur as sudden events, others develop more gradually (Boschma, 2014). A major drop in oil prices, as is taking place at the time of writing (see figure 4.5), is such an external shock that poses a severe risk to national economies that strongly rely on oil revenues. The capacity to undergo an externally generated economic shock, recover from it and adapt to a new, different situation is generally referred to as regional resilience (Bristow & Haley, 2014).

The engineering conception of regional resilience emphasizes the speed with which the system overcomes an external shock and returns to a pre-shock state or equilibrium (Bristow & Haley, 2013). Moreover, the engineering conception of resilience, based on the elasticity of the system, does not attribute to what level the system returns to a pre-shock by retaining the same structures, or perhaps by changing the existing ones. Maybe moving to one of the multiple equilibria but then performing better. It's therefore that evolutionary economic geographers argue that additionally to the common 'engineering' understanding of regional resilience, which is the ability to accommodate shocks and recover from it, regional resilience should be seen in a more 'ecological' manner – which is that regions change over time (Dawley et al., 2010; Hassink, 2010). In this way regional economic development is seen as a constant dynamic process of adaption and change, and regional economies are seen as constantly evolving around open-ended trajectories that will not reach the state of an equilibrium (Dawley et al., 2010; Hudson, 2010). Following this ecological understanding, regional resilience can be defined by a regions long-term ability to *"reconfigure their socio-economic and institutional structures to develop new growth paths"* (Boschma, 2014, p. 2). To reconfigure existing structures and develop new growth paths is a complex task. A high level of governance and collaboration with different actors is required. Institutional coordination both vertically with a broad range of actors as well as horizontally between different spatial levels – supra national, national and local – is recommended (Dawley et al., 2010; Hassink, 2010).

2.2 Regional absorptive capacity & innovation

As being mentioned earlier in paragraph 2.1.1, the success of the transplantation of knowledge is heavily dependent on a regions receptive or absorptive capacity (Ewers, 2013; Martin & Sunley, 2006). In other words, when the transplantation of knowledge from elsewhere functions as the main source to escape a lock-in and create or develop a growth path, the absorptive capacity of a region determines whether or not the knowledge transplantation actually leads to the development of a growth path. A region's absorptive capacity is defined by Ewers (2013, p. 124) as "*the ability to attract, assimilate and integrate global knowledge in a local context*". Simmie et al., (p. 16, 2008) elaborate further on this thought by adding 3 different learning processes. They define absorptive capacity as "*the ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through*

transformative learning, and (3) using and assimilating knowledge to create new knowledge and commercial outputs through exploitive learning". Therefore, the acquisition of international knowledge needs to be accompanied by a regional system that enhances the existing skills and capabilities to actually serve the goal of economic development. This section will elaborate on the role of absorptive capacity and innovation through regional learning to describe how transplantation of knowledge can contribute to economic development.

2.2.1 Local Innovation Systems (LIS)

In high growth Asian economies technological diffusion as to promote regional learning has played a big part in their industrial policies. Consequently, regional learning and the accumulation of knowledge has made a significant contribution to the high GDP growth rates in these Asian countries (Das, 2014). But what does regional learning exactly comprise? Foster and Rosenzweig (2010, p. 13) define learning as *"…taking place when new information affects behaviour and results in outcomes for an individual that are closer to the (private) optimum"*, which means that without the influx or creation of novelty learning does not take place. This means that when there's a lack of innovative activity stimulating the learning process, the new knowledge will need to come from elsewhere trough transplantation. It must be understood that different types of knowledge require different types of learning. Four types of learning can be identified, namely experience based learning, or learning by doing – essential for the transfer of tacit knowledge (Al-Roubaie, 2013; Ewers, 2013), upgrading of skills via the adoption of new technologies, learning by hiring and learning trough feedback monitoring (Malecki, 2007). Gradually planned efforts to acquire new knowledge, experiment with it, develop new skills, capabilities and routines and initiate external relationships are needed to technologically advance (Ewers & Malecki, 2009).

Different scholars point to the roles of different actors in their relation to regional learning. The main consensus is over the role of local firms as major innovators – regional learning should be defined by the absorptive capacity and innovative activity of local firms since they are the main 'engines' of the economy (Alvarez & Molero, 2005; Inbal & Tzachor, 2013; Simmie et al., 2008). Innovation is often understood within a context of Schumpeter's notion of "creative destruction", Simmie et al. (2008, p. 16 after OECD 2005, p. 46) define innovation as "*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace or external relations*". Especially small and medium enterprises (SME's) play a crucial role in the learning process of regions, often SME's engage in high levels of innovative activity – contributing to the development of new technologies (Inbal & Tzachor, 2013). Additionally the private sector, including SME's, is better geared towards the adaptation of new, better, technologies than public research institutes. Others go beyond solely the role of firms and emphasize that a whole ensemble of place specific institutions is responsible for shaping and enabling a regions learning ability (Ewers, 2013; Hassink, 2010; OECD, 2001). In order to manage regional learning and to coordinate all the actors involved in the learning process scholars point to the guiding role of a Local (some scholars use 'regional') Innovation System (Ewers, 2013; Hassink, 2010; Martin & Sunley, 2006; OECD, 2001, Simmie et al., 2008). The learning region can be seen as a strategy to innovate and to technologically advance the region. In other words, a local innovation system can be seen "*a territorially bounded space of learning and innovation*" (Ewers, 2013, p. 125). Simmie et al. (2008, p. 14) define a LIS as "*a functionally localised collection of organisations, institutions and processes that create or adopt valuable new economic knowledge and commercialize it*". Innovation systems can be addressed at the national or regional level, but are most affective when specified on specific industries. In that way innovation systems can build industry-specific absorptive capacities in which 'engine' *innovative organizations* (key actors; either external or locally sourced) followed by other different *knowledge diffusing organizations* play key roles (Martin & Sunley, 2006). Through stimulating regional learning and coordinating

the actors involved in the learning process a region enhances its absorptive capacity. To what extent regional learning (being a result of the transplantation of knowledge) takes place can be seen as a function of it's absorptive capacity (Ewers, 2013). Trough innovation new paths are created and existing ones are kept commercially successful in national or international markets, hence innovation stimulates both path development as well as path creation (Simmie et al., 2008).

Even though different definitions circulate, the OECD definition of the learning region is most commonly accepted and conceives it as "a *regional innovation strategy in which a broad set of innovation-related regional actors (politicians, policymakers, chambers of commerce, trade unions, higher education institutes, public research establishments and companies) are strongly but flexible connected with each other and abide [a] set of policy principles" (Hassink, 2010, p. 51 after OECD, 2001).*

	Inputs to the learning process
1.	*Ensure that high-quality and well-resourced educational provision is in place, on which effective individual learning throughout people's lives can be developed.*
2.	*Coordinate carefully the supply of skilled and knowledgeable individuals through education and training and the demand for them within the regional economy, so that the full benefits of individual learning may be reaped through its effects on*
3.	*Establish appropriate framework conditions for the improvement of organizational learning, both within firms and between firms and other organizations in networks of interaction, and demonstrate to firms the benefits of these forms of learning.*
4.	*Facilitate effective organizational learning not simply for a pre-selected set of conventionally defined "high-tech" sectors, but across all those industries and services within the regional economy that have the potential to develop high levels of innovative capacity.*
5.	*Identify very carefully the extent to which the resources currently available to the region (existing industries, educational provision, research facilities, positive social capital and so forth) constitute an impediment to economic development ("lock-in") or may usefully contribute in developing innovative strategies for the future.*
6.	*Respond positively to emergent economic and social conditions, especially where this involves the "unlearning" of inappropriate practices and bodies of knowledge (including policy makers' own) left over from the regional institutions of previous eras.*
	Mechanisms of the learning process
7.	*Pay close attention to mechanisms for coordinating policies across what have generally been separate departmental responsibilities (for industrial development, R&D, science and technology, education and training and so forth) and between different levels of governance (regional, national and supra-national).*
8.	*Develop strategies to foster appropriate forms of social capital as a key mechanism in promoting more effective organizational learning and innovation.*
9.	*Evaluate continuously the relationships between participation in individual learning, innovation and wider labour market changes, especially with respect to the social exclusion of groups within the regional population.*

10.	*Ensure that the regional strategy for learning and innovation is accorded legitimacy by the population of the region to be transformed.*

Table 2.2. Ten policy principles for creating learning cities and regions. Source: OECD, 2001, p. 120

Table 2.2 shows the set of ten policy principles the OECD definition of regional learning talks about. It must be noted that these policy principles are to be addressed at the level of economic policy makers. The actual content of a regional innovation policy depends on the place specific institutions and economic structure of a region (Hassink, 2010). It might be clear that more than merely the absorption capacity of local firms, regional learning and innovation require governance and a high level of collaboration between actors (Boschma, 2014; Bristow & Healy, 2014). Hence the coordination of the different inputs to the learning process as well as the mechanisms of the learning process is a complex task regional governments are burdened with. Close coordination is desirable for example to streamline the learning process within firms, between firms but also between firms and other organizational networks. Or to coordinate the demand of high skilled young individuals in the regional economy, to coordinate and facilitate cross-sector fertilization that might enable (latent) regional potential and initiate innovative activity. Furthermore should policies be coordinated across different, or separated, departmental responsibilities and between different spatial levels. In other words, to successful contribute to development of learning regional policies need to be horizontally and vertically coordinated and integrated. Boschma (2014) continues in line with the argument that regional learning depends on governance and a high level of collaboration between actors. He adds that regional resilience depends on the structure of knowledge networks, and that regions are "*ensembles of competences that emerge from social interaction*" (Boschma, 2014, p. 10). The creation of knowledge as well as learning depends on a regions ability to recombine existing knowledge within inter-organizational networks. The optimal level of proximity between actors, or agents, within these networks is derived from the need to keep some cognitive distance in order to develop new ideas on one hand. And on the other hand some cognitive proximity to enable effective communication needs to be secured (Boschma, 2014, p. 12). Consequently, to enhance regional resilience through the regional knowledge network, three key points can be identified (Boschma, 2014, p. 13):

1. *A core-periphery network structure, which means embedded relationships in the core, and more loose connections between the core and the periphery.*
2. *Optimal levels of proximity within the network structure.*
3. *Key agents who ensure the access to new external knowledge, and enable its diffusion to other agents.*

2.2.2 Regional absorptive capacity & knowledge complementarity

The notion of absorptive capacity originates in the organizational management literature and has more than on regions been applied to understand the absorptive capacity of firms. In this respect absorptive capacity can be defined as "*a set of organizational routines and strategic processes by which firms acquire, assimilate, transform and exploit knowledge for the purpose of value creation*" (Zahra & George, 2002, p. 198). But it can also be understood from an evolutionary perspective of organizational management: "[absorptive capacity is] *dependent on multiple factors, including a firm's past experience, knowledge complementarity, and diversity of knowledge sources*" (Zahra & George, 2002, p. 198). Figure 2.1 demonstrates the possible positive way of looking at path dependency, namely as an enabler (instead of a limitation) for new industrial path creation. Regions with a high level of absorptive capacity are due to their ability to recognize, assimilate and use new knowledge in their economies better able to develop new growth paths (Alvarez & Molero, 2005; Dawley, 2013; Simmie et al., 2008). As generally accepted the absorptive capacity of regions is made up from the existing human capital in addition to the complementarity between local and external, global knowledge. Knowledge complementarity is defined as "*the extent to which knowledge is related to and at the same time*

different from the knowledge of contacts in their information networks, is positively related to a firm's learning ability" (Zahra & George, 2002, p. 193). A mismatch between local and external knowledge is referred to as a technology gap and has a negative influence on the absorptive capacity of a region. When a technology gap exists between a technological lagging country and a technological leading country, the importation of knowledge from the leader country contributes to closing this knowledge – or technology gap between both countries. Thus, additionally to generating added value in a local economy (through employment and other macroeconomic goals – e.g. diversification) and contributing to a regions resilience, the transfer of knowledge contributes to closing technology gaps between regions with different levels of technology (Alvarez & Molero, 2005; Schimmelpfennig & Thirtle, 1999). It has been proven that foreign companies have a larger positive effect on domestic firms (in terms of knowledge spillovers) when the absorptive capacities of local firms is high, and the technology gap is small (Alvarez & Molero, 2005). This confirms the notion of complementarity between local and external knowledge, indicating that the latter needs to match and complement existing skills and capabilities, instead of crowding these out (Alvarez & Molero, 2005; Ewers, 2013).

Derived from its application to firms we can differentiate two types of absorptive capacity. The first one is the potential absorptive capacity. This is a firm's or region's capability to value and acquire external knowledge, but it does not necessarily mean the exploitation of the acquired knowledge. The second one is the realized absorptive capacity, which captures the transformation and actual exploitation capabilities of a firm or a region. The two types of absorptive capacities have different yet complementary roles; a high level of potential absorptive capacity does not guarantee a high level of realized absorptive capacity (Zahra & George, 2002). However it is necessary to actually make the above mentioned distinction because it allows to explain different levels in innovative capabilities between firms or regions. A region might be able to value and acquire external knowledge, when it doesn't hold the potential to transform this knowledge in to innovative product strategies or actual realized products, it impedes itself in economic development. The transformation of potential absorptive capacity in to realized absorptive capacity requires social integration mechanisms. These mechanisms are comprised of a set of routines promoting knowledge sharing (Ewers, 2013; Zahra & George, 2002).

2.2.3 Technological leapfrogging

Technological leapfrogging comes in the picture when a country that is lagging behind on technological leading countries endeavours to rapidly catch up with the leading countries and their level of industrial development. By 'buying' new technologies a country can make major leaps in their level of technological development, hence the term 'leapfrogging'. If a country will catch up, which is defined as "*the ability of a single country to narrow the gap in productivity and income vis-à-vis a leader country*" (Ewers & Malecki, 2009, p. 495), this equally depends like the transplantation of knowledge on the absorptive capacity of the importing country. Especially in developing countries the success or failure of technological leapfrogging is been most influenced by its absorptive capacity, "*in all cases, the problems of absorptive capacity are irreducible prerequisites for success in technological leapfrogging*" (Steinmueller, 2001, p. 206). Technological leapfrogging is described by Sauer & Watson (2009, p. 5 after Soete, 1985, p. 416) as follows:

"Far from developing factor proportions, appropriate industries and technologies both for the domestic and export world market, the opportunities offered by the international diffusion of technology to jump particular technological paradigms and import the more if not most, sophisticated technologies that will neither displace the capital invested nor the skilled labour of the previous technological paradigm, constitute one of the most crucial advantages of newly industrializing countries in their bid for rapid industrialization."

The most relevant question remains whether or not the factors that enabled rapid economic

growth in industrialized countries have the same affect on economic growth when imported and applied to developing countries. The following table provides a brief overview of the most relevant factors that influence the success of technological leapfrogging.

Dimension	Factors
Internal	• Absorptive capacities
	• Knowledge/technological capabilities (e.g. skills to both operate and maintain the imported technology)
	• Appropriate managerial, education and training levels
	• Risk readiness
	• Capacity to asses technology's value and profitability to adopt
	• Ability to deal with the cumulative nature of technical change
	• Long term vision/planning
External	**International technology market**
	• Buyers market / non monopolistic structure
	• Rapid growth in both labour and capital productivity
	• 'Deskilling effects' in industrialized countries

Table 2.3 Relevant factors for leapfrogging. Source: Sauer & Watson, 2009 p. 17

To conclude and summarize section 2.2, knowledge assets (universities, research institutes and R&D activity) are crucial for a region and the development of new industries as they stimulate the development of new growth paths. The success of regional economies has proven to be determined by a regions knowledge assets and the dynamism of their LIS, the cumulative development of local absorptive capacity and local innovation systems has enabled technological leading countries to maintain their positions (Simmie et al., 2008). To successfully import knowledge from elsewhere a regions absorptive capacity needs to be high. This means it will need the ability to recognize potentially valuable new knowledge, be able to assimilate this new knowledge locally, and use it to create new knowledge and commercial outputs (Simmie et al., p. 16, 2008). The absorptive capacity is influenced by the complementarity between local and external knowledge (Avarez & Molero, 2005) and the structure of formal & informal institutions (Ewers, 2013), on which the next paragraph will elaborate.

2.3 A human agency perspective on growth path development

As has become clear over the previous sections is neither path creation and path development, nor building absorptive capacity and regional learning a 'one man show'. A localized innovation system is a collection of institutions and organizations that work together in an on going process to create and commercialize new knowledge (Simmie et al., 2008). The change of institutions and the recombining ability of different human agents can lead to new economic growth paths or the reinforcement of existing ones. To understand and to influence the functioning of a regional economy, one will need to understand the behaviour of its human agents (Bristow & Healy, 2014). The behaviour of 'agents' is at the core of the adaptive systems approach, which describes economies, communities or socio-ecological environments as complex groups of individuals or agents who have dynamic relations with each other in shaping, for example, the economy (see e.g. Bristow & Haley, 2013 & 2014). This section explores the institutional framework within human agents contribute to the creation and development of growth paths.

2.3.1 Formal & informal institutions

Whereas increasingly used because of the growth of institutional economics, too often the conceptualization of *institutions* remains inadequate (Hodgon, 2006). North (1991, p. 97) defines institutions as "*humanly devised constraints that structure political, economic and societal interactions*". North (1991) emphasizes the role of institutions in pursuing economic growth, or specific industrial growth paths as institutions are responsible for providing the economy's incentive structure. Institutions can be divided between formal rules, or formal institutions, and informal constraints, or informal institutions. Speaking about formal institutions one should think about constitutions, laws, property rights (North, 1991) but also about education, training systems, and the labour market structure (Ewers, 2013). Informal institutions comprise social mechanisms, like traditions, the codes of conduct (North, 1991) and the cultures of work and ways of doing business (Ewers, 2013). The composition of absorptive capacity, being the ability to recognize, understand and assimilate external held knowledge (Simmie et al., 2008, p.16) can be extended by the role of formal and informal institutions. With the first mentioned, formal institutions, it is the role of individual education and training that shape the ability of regional learning processes long before foreign knowledge enters the region. The role of the government here is to prioritize types of knowledge and match these with the existing labour market structure, which is the eventual stage where individual learning and regional learning converge and manifest as a region's unique institutional structure. The informal institutions are also referred to as the 'soft' informal institutions. This is because the 'hard' formal institutions like the education system and the labour market structure actually need 'soft' conventions to function. "*The rules and incentive structures promoted by formal institutions need to be recognized and integrated within the conventions of actors in order to function successfully*". Trough conventions interaction as well as trust between actors is stimulated, furthermore do conventions facilitate collective learning processes (Ewers, 2013, p. 127).

2.3.2 The role of the state in developing new growth paths

Governments of different spatial levels can play an essential role in shaping resilient economic structures and enabling new growth trajectories, hence it is surprising that the importance of this role is only rarely addressed in the evolutionary economic geography (Bristow & Healy, 2014). This paragraph attempts to elaborate on the role of the state in developing new growth paths.

In understanding the process of building resilient regions special attention should be given to the role of the state, which clearly does not control all the factors responsible for resilience, but it does highly influence the ability to develop appropriate capacities for developing new industrial paths and self-organization, and thus to a more diverse, resilient, economic structure (Bristow & Healy, 2014, p. 97). This capacity for self-organization refers to the networked nature of governance; less decision making by one single leader or institution and more spontaneously by the interactions between different actors in the network (Bristow & Healy, 2013, p. 925). Das (2014) argues that the industrial policy of governments in high-growth Asian economies has made a significant contribution to their countries economic success. Within these Asian industrial policies three main elements can be identified. First, the protection of domestic firms until they become competitive on the international market – an instrument that is also referred to as *infant industry protection*. Second, promoting the role of foreign direct investment (FDI) to increase the economies' competitiveness on the international market. Governments are also responsible for defining the conditions under which 'foreign factors of production' may enter the country, thus this applies to both foreign human capital as well as technology (Ewers, 2013). And third, successfully planning and managing economic free zones to succeed in attracting multi-national enterprises (MNE's) (Das, 2014). Additionally the role of the state should be characterized by its abilities to gather and spread information on investment opportunities and eliminating certain bottlenecks that prevent investments to be made (Das, 2014). Like is the case with the high-growth Asian countries does the state play an essential role in collabourating with other regional actors in shaping a regions economic landscape (Boschma, 2014; Bristow & Healy, 2013 & 2014; Das, 2014). Thus, a high level of governance is required. Governance is defined as *"... creating the conditions for ordered rule and collective action [...] and the structures and processes by which people in societies make decisions and share power"* (Folke et al., 2004 p. 444). It is exactly this 'collective action' enabled by public-private interaction as well as with non-profit organisations that shape a regions economic landscape. Promoting the collaboration between actors in a region for the sake of industrial growth can be seen as evenly, or even more essential than the provision of financial incentives to an industry (Das, 2014). Subsequently, polycentric or decentralized governance is more likely to lead durable economic growth (Hassink, 2010; Bristow & Healy, 2014). First of all because a high level of centralized decision making is more likely to make wrong decisions which can have a long lasting impact on the economic policy of a region. On the other hand, redundancy and overlap between government bodies and other actors within the system make it less vulnerable for failure of a single institution or approach in the system – which can be compensated by different nodes or entities in the system who can still pursue the set out policy. Additionally, a large number of different institutional entities within the system promote experimenting with new approaches and the maximising of learning opportunities. And finally, polycentric governance is better in addressing issues of different geographical scopes at different spatial levels (Bristow & Healy, 2014).

Besides the importance of governance and the enabling role of the state, do others point out to the importance of having a long-term vision. A vision wherein long-term policy objectives and strategies are defined and give rise to new industrial paths contributing to the an going process of adaptive capacity, or resilience, of a region. Thus both a central task as a challenge for policy makers is to foster "*the renewal and 'branching out' of local and regional activities*" (Dawley et al., 2010, p. 661) by continuously formulating key interventions that enable the development of new industrial paths. Stimulating cross-sector fertilisation and facilitating industries to move 'up the ladder' towards more value adding activities can also be seen as developing paths away from the existing industrial structure (Dawley et al., 2010).

2.3.3 The role of firms in developing new growth paths

Whilst having an important role in re-shaping socio-economic and institutional structures, it is mainly the interaction between governments and other actors that develop new growth paths (Boschma, 2014; Bristow & Healy, 2013 & 2014; Porter, 2003). With regards to the role of the state versus the role of multiple actors Porter (2003) makes a clear division between the 'old model' and the 'new model'. In the old model it is the government that trough policy decisions and incentives is the main driving force behind economic development. In the new model he views economic development as a collabourative process in which companies, a decentralized government, research institutes and other institutions work together in re-shaping economic structures. In this same context, and that of the oil-rich Gulf States that Porter (2003) makes another division, the one between 'inherited prosperity' and 'created prosperity'. In the former, he argues, the government functions as "*central actor in the economy as well as being the main distributor and owner of wealth*" (Porter, 2003, p. 6). By exploiting and selling the natural resource the state generates revenues that it redistributes in the form of wealth. Consequently inherited prosperity is limited by the availability of natural resources. Created prosperity on the other hand, Porter argues, is created by firms and is based on their innovative capacity and productivity and hence is unlimited. From this perspective companies are the central actors in regional economies. The state's role is limited to create enabling conditions for innovation and productivity increase (Porter, 2003, p. 6). Companies, or entrepreneurs, are also often seen as important drivers behind diversification of the economy (Dawley, 2013, after Boschma & Frenken, 2009; Neffke et al., 2011). It's their ability to match latent regional assets as ideas, human capital and resources to new market opportunities and develop new industries or technological fields – or in other words, to create new industrial paths (Dawley, 2013; Martin & Sunley, 2006). Often the valorisation of these latent regional assets is supported or enabled by local governments. This is illustrated by Dawley (2013), in a case study to development path of the offshore wind industry. It demonstrates that the role of the government has been crucial by providing both market as well as broader technological conditions for the industry to develop. Dawley (2013, p. 109) uses the term "*niche management*" to refer to the governments efforts to develop targeted industries.

2.4 Path creation & development in perspective; GCC economies

As mentioned before has the discovery of oil in the Gulf states led to a specific macro-economic structure, which is referred to as the 'allocation' or 'rentier economy'. Rentier economies are characterized by the fact that the lion share of governmental revenues consists of external 'rent' from oil and gas revenues, this is when at least 40% of the state's income are attainted via oil or other foreign sources (Hvidt, 2011, p. 89). In the development literature the existence of major natural resources in poor countries is often referred to as the '*resource curse*' (James, 2014). Slow economic growth in these countries is regularly explained by a phenomenon what is called 'Dutch disease', which is the process of crowding out other high growth industries that promote regional economic development. Natural resource endowments give rise to highly unproductive rent seeking activities of economic actors. Hence, resulting from the existence of natural resources production and consequently consumption decrease (James, 2014, p. 56). Due to the massive revenues from oil and gas incomes the need for taxation is set aside, which has led to a very narrow tax base in rentier economies. There is a general consensus among scholars about the negative effects of rent seeking behaviour and thus are Gulf states forced to reform their economic structures (Hvidt, 2011). Section 2.4 elaborates on these negative effects in the light of path creation and development, and briefly describes the success with which several GCC economies are being reformed over the past decade.

2.4.1 Rent seeking behaviour & political lock ins

Beside the fact that in rentier economies the major share of governmental revenues is derived from oil and gas incomes, are they basically characterised by the fact that wealth creation is only centred around a small part of society, a non-existent or inefficient tax base and low productivity levels (Hvidt, 2011). A national tax system is not needed because of the large income derived from oil and gas. This allows the central government not to focus on an efficient and productive economic basis but rather on the distribution of revenues received on external rents. This position has given rise to what can be called the 'rentier mentality', which means that the normal link between work effort and the payoff of that is non existent or disconnected. Indeed the payoff in Gulf states is based on pure chance, which is, they all happened to sit on oil reserves (Hvidt, 2011). Several scholars argue that the easily earned oil incomes have resulted in the destruction of economic structures (e.g. Hvidt, 2011), which as mentioned before is also referred to as the resource curse (James, 2014). Hvidt (2011, p. 89, after Kubursi, 1999 p. 311) for example argues that "*the dependency on rent from oil has reduced Arab incentives to diversify their economies, develop alternative manufacturing capacities, promote export-oriented industries, encourage domestic savings, and anchor income on solid productive grounds*".

By becoming primarily a redistributor of wealth the central regimes in the Gulf states got increasingly autonomous and heavily involved in all levels of decision making (Ewers & Malecki, 2010; Mansfeld & Winckler, 2008). Due to this heavy government involvement a list of negative features have arisen within the macro-economic structure. These features are summarized in table 2.4. Rent seeking behaviour by governments is highly related to the failure of industrial policies. Rather than being an instrument to serve regional economic development and society at large, industrial policies in these countries are used to strengthen the position of the established regime and to favour the personal interests of the current bureaucracy (Das, 2014). Therefore rent seeking behaviour of human agents leads to the mutually reinforcement of each other, which will lead to what can be described as a political or institutional lock-in. This means that established institutions aim for the preservation of existing structures and thus hinder the development of new industrial growth paths (Grabher, 1993). Due to its preserving nature towards the existing industrial structure, a political lock-in hinders regional resilience and undermines the potential of the region for new industrial paths (Hassink, 2010). In the Gulf states the high levels of government involvement across the economy has led to a situation in which the state is the main driver behind economic development. This interferes with the notion of regional learning and innovation systems, in which the tasks of the state can be described as "*shaping the economic structures and institutions that promote learning in areas and breaking up structures and institutions that block learning or lead to a lock-in*" (Ewers, 2013, p. 136 after Lundvall, 2000, pp. 101-102).

Spiess (2008, p. 250) attributes the political system, or the established bureaucracy as the main limitation for the enhancement of knowledge networks and consequently the absorptive capacity: "*…the current political ideology of the GCC states has established a "rentier society" that rewards access to power (organized coercion, political authority and wealth) and glorifies material possessions, at the expense of knowledge, labour and altruism".* Spiess (2008, p. 250) continues by arguing that rather than investing in regional learning, innovation systems and regional absorptive capacity "*the GCC member states still believe that their financial resources will be sufficient to "buy solutions".* Often the acquisition of new technologies in the technological less developed GCC states means making major leaps in technological improvement, 'skipping' different development stages of industrial development.

2.4.2 Regional learning & knowledge transfers

GCC economies can be characterized as 'knowledge consuming economies'. To close the existing technology gap they rely on the transplantation from knowledge and technologies from elsewhere (Al-Roubaie, 2013; Spiess, 2008). It has been widely proven that unless the GCC's ability to attract high levels of foreign investments, the assimilation and integration of this external knowledge into there regional economies has been rather disappointing due to a lack of absorptive capacity (Ewers, 2013; Ewers & Malecki, 2009; Spies, 2008; Ramady, 2012). The absorption and assimilation of knowledge by local workers from expatriate workers remains a key challenge for the future. Two examples from the region illustrate this problem. The first one addresses the problems that arise with the informal knowledge transfers within companies through social interaction between expatriates and local workers. All GCC countries have nationalization policies of the labour force in the country, which means gradually replacing expatriates for nationals and creating private sector jobs for nationals. The question that arises here is, why would an expatriate (happy with his job, not planning to leave the GCC soon) train a local employee if this means that he will be gradually replaced and thus loose his job? Additionally, from a cost perspective it is more likely that a high skilled foreign worker will train a cheaper 'third country national' (like South Asians) than a more expensive GCC national (Ewers, 2013, p. 131). The second example addresses a problem with the condition under which external knowledge, or investments enter the region. The BOT system is a common system under which foreign companies agree with a local one on the terms of a project to Build, Operate and Transfer (of knowledge resp.), often in a joint venture-like structure. But reality has proven it actually doesn't work out like this. High-skilled expats are often hired to start up a functioning and profitable operation, training locals costs money, and if the contractor is not asking for this provision then why would a high skilled expat attempt to do so? Contracts are increasingly won by the lowest bidder, including extra budget for hiring and training locals leads to extra costs, which make it more likely for a foreign company not to win the contract. Additionally counts here as well that if training a local means losing your job, expatriates are not very motivated to do so (Ewers, 2013, p. 132). If the information on how to manage new technologies is not, or incorrectly transferred from expatriates to local workers, regional learning does not take place. The knowledge on how to optimally manage new technologies is essential for the learning process (Foster & Rosenzweig, 2010). In addition to the above mentioned examples of difficulties with the transfer of knowledge through both formal and informal institutions should be mentioned that often foreign firms adapt to the local cultural settings in a way that this actually reproduces human capital distortions. The lack of social interaction between foreign and local workers directly impacts to what extend experience based learning takes place, which is essential for the flow of tacit knowledge (Ewers, 2013).

As being mentioned in paragraph 2.1.1 and in table 2.1, the *transplantation* of knowledge from elsewhere is an instrument that can be used to develop new industrial growth paths and to avoid regional lock-in. Knowledge transplantation, or "*the importation and diffusion of new organizational forms, radical new technologies, industries, firms or institutional arrangements, from outside*" can cause regional economic renewal and technological upgrading (Martin & Sunley, 2006, p. 422). But as mentioned before as well, it heavily depends on the regions absorptive capacity. Foreign direct investment has traditionally played an important role in the technological upgrading of regions (see e.g. Alvarez & Molero, 2005; Das, 2014; Dawley, 2013; Guimon & Filippov, 2012). Also in the Gulf region vast amounts of FDI have been attracted and have contributed to technological upgrading, especially of the existing petrochemical industry, and economic renewal. The massive oil-wealth in the Gulf has enabled the member states to tap in to the international pool of knowledge and take advantage of the newest and improved technologies, or to 'buy solutions' (Ewers & Malecki, 2009; Spiess, 2008). This rapid technological development is earlier described as technological leapfrogging, or simply leapfrogging (Nilson, 2010). Paradoxically can leapfrogging be seen as both path breaking and path creating at the same time, whereas the action of knowledge acquisition itself is not quit

path dependent, the regional absorptive capacity – necessary for the assimilation, exploitation and diffusion of the new knowledge to other regional actors – is highly subject to path dependency (Boschma, 2014; Martin & Sunley, 2006). Thus should be mentioned that the transplantation of knowledge is not the short term process it seems to be at first sight, but rather is a long term process that involves a high level of regional learning (Ewers & Malecki, 2009).

2.4.3 Private sector activity & governance

Because of the innovative role of entrepreneurs and the supporting and enabling role required from governments to develop growth paths, one could find the content of table 2.4 rather concerning. The lack of entrepreneurial activity, the absence of strong governance systems and the heavy involvement of governments in procurement processes make the oil-rich Gulf States more vulnerable for external shocks and hence less resilient. Furthermore is the lack of domestic companies competing on international markets, partly due to government protection, a threat to their productivity increase as well as to innovative capacity of companies (Alvarez & Molero, 2005; Ewers & Malecki, 2009; Schimmelpfennig & Thirtle, 1999). The reason for this is twofold; international standards tend to be higher than domestic ones, by competing on an international market top managers and engineers of domestic companies become acquainted with international standards. Second, by having contracts with different international markets that demand high performance generally means receiving support in achieving this performance. One example of this is are Taiwanese companies that started exporting to Japan and the United States. By doing so they received support from both countries in achieving the high level of demanded performance (Ewers & Malecki, 2009). Subsequently achieving higher productivity levels and an increased innovative capacity.

Institutions and governance	• Heavy government involvement limits private initiative • Incentive structure not tied strictly to merit and productivity • Economies sheltered from competition • Free zones deter business environment improvements in the overall economy • Free zones focused on real estate rather than true cluster development • Limits on foreign ownership • Weak governance systems; lagging & restrictive legal system and architecture • Frequent conflicts of interest • Heavy government role in procurement

Knowledge and employment	• Low level of R&D, science and innovative capacity • Skilled citizens heavily employed in public sector • Dependence on highly-skilled foreign specialists • Lack of education for low-skill foreign workers • Lack of first-rate public schools and universities • Poor availability of data
Supply and demand structure	• Lack of sophisticated local demand from business customers • Sophisticated personal demand served by foreign companies • Lack of specialised suppliers and service providers • Few local exporting companies • Financial markets remain inefficient • Weak clusters in the non-oil sectors of the economy • Low integration between foreign investments and local industries

Table 2.4. Negative features of the business environment in oil-rich countries. Source: Ewers & Malecki, 2009 p. 499, based on Porter, 2003

2.5 Conceptual framework & hypotheses

Figure 2.3 demonstrates the key concepts proposed in the theoretical framework of chapter two, and their relation with each other as derived from the reviewed literature. These concepts form the theoretical basis on which the empirical results will be analysed in order to answer the main research question, which was proposed in paragraph 1.2 as follows:

Does the current growth trajectory of the aquaculture industry in Oman hold the potential to create a viable new growth path in the economy?

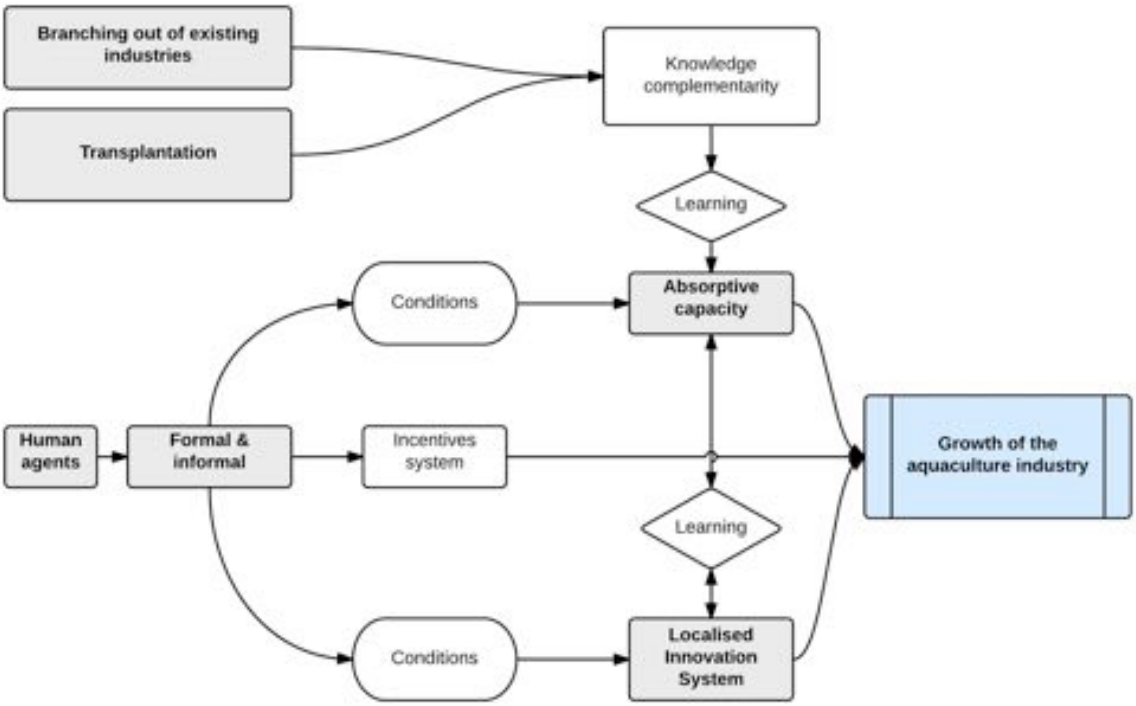


Figure 2.3. Conceptual framework. Source: author

This conceptual framework consists of statements linking abstract concepts, derived from the literature, to the empirical results that will be discussed in chapter 5, 6, 7 and 8.
The relations the different concepts are expected to have on each other are formulated within the hypotheses as proposed in the following paragraph. These hypotheses are mainly the outcome of paragraph 2.4, which describes the concepts proposed in paragraph 2.1 till 2.3 in the perspective of GCC economies.

2.5.1 Hypotheses sub questions

Regarding the framework proposed in figure 2.3 the hypotheses on the four sub-questions of this research can be formulated as follows.

Sub. 1. What are the main sources of the growth path of the aquaculture industry in Oman, and to what extent do these sources influence the paths potential for success?

H1. The main source of the current growth trajectory of the aquaculture industry in Oman is the transplantation of knowledge. Due to the existence of a technology gap and a low absorptive

capacity will the transplantation of knowledge as a source of new path creation be problematic in contributing to the development of a viable growth path.

Economic diversification of Gulf states, including Oman, is extremely dependent on the use of external, global knowledge. Hence the aquaculture industry in Oman is expected to follow an exogenous growth path with the transplantation of knowledge being the main source of the current growth trajectory. Due to the expected technology gap between the local existing knowledge and the global external knowledge there is no knowledge complementarity, which consequently has a negative impact on the regional absorptive capacity. Technological leapfrogging is only possible when the absorptive capacity of a region is high, hence in the case of the development of aquaculture in Oman is expected that the transplantation of knowledge as a source of new path development will only contribute to a limited extent to the development of a viable growth path.

Sub. 2. Considering the ability to recognize, assimilate and use relevant external knowledge, how could the absorptive capacity of the Omani aquaculture industry be characterized?

H2. The absorptive capacity of the Omani aquaculture industry is expected to be rather low. A knowledge gap might have resulted in the necessity of a better ability to recognize new knowledge than the ability to assimilate and use this knowledge locally.

As the levels of knowledge are low due to a lack of public schools, universities, science and R&D and the transfer of knowledge trough both formal and informal institutions is problematic the ability to recognize, understand and use relevant knowledge is expected to be low in general. But as there is expected to be a strong need for attracting foreign knowledge and technology the ability to recognize valuable new knowledge is most likely more developed than the ability to assimilate and use new knowledge locally.

Sub. 3. To what extent is there a specific local innovation system for the development of the aquaculture industry in Oman?

H3. A weak governance system and poor integration of foreign companies in local industries might result in a general lack of functional collaboration systems. As also innovation is of low importance for both public and private sector actors is there expected to be no functional local innovation system for the development of the aquaculture industry in Oman.

Heavy government involvement in all levels of society and a lack private sector activities leads to the hypothesis that innovation is of low importance for both public and private sector actors and that there is no functional local innovation system. Whereas the role of the state in innovation systems is to provide institutions to promote learning and break up structures that might lead to institutional lock-ins or block regional learning, the given that rent seeking activities take place in GCC economies is rather concerning. Innovation is renewal, and rent seeking is the establishment of the current bureaucracy and institutions and hence is contradicting.

Sub. 4. To what extent do human agents trough formal and informal institutions influence the development of the aquaculture industry in Oman positively or negatively?

H4. The development of the aquaculture industry in Oman is influenced negatively by human agents trough both formal and informal institutions. Formal institutions like the labour market and the education system are expected to be problematic, as are informal institutions like the ways of doing business negatively influenced by rent seeking behaviour.

Due to heavy government involvement and limited private initiative necessary to develop a critical mass in the industry, is the overall behaviour of human agents active in the aquaculture industry in Oman expected to have a rather disabling role. GCC economies are characterised by weak governance systems and an overall lack of collaboration processes between public and private actors. As the formal and informal institutions influence the absorptive capacity of a region, as well as the functioning of the innovation system their negative features influence both the absorptive capacity, the quality of the innovation system and the development of the aquaculture industry negatively.

3. Methodology

3. Methodology

"Developing new growth paths in the economy as a means of enhancing regional resilience can be seen as a dynamic process that may ultimately require a science that is by necessity localised and qualitative" (Bristown & Healy, 2013 p. 933, after Evans, 2011, p. 233).

The previous chapter has resulted in a conceptual framework in which the relation between theoretical concepts is clarified. Based on this framework hypotheses are formulated to express the expectations of the empirical research. How this empirical research is conducted will be explained in a few consecutive steps. Chapter 3 will first turn to the main suppliers of information; a selected number of key informants who have provided crucial in-depth information in order to test hypotheses. Subsequently paragraph 3.2 explains why a qualitative approach is best suitable to answer the research questions and how a case study design contributes to a better understanding of growth path development in Oman and GCC states in general. Paragraph 3.3 then operationalizes a set of theoretical concepts and describes how these concepts are measured in order to test the hypotheses. The chapter finishes with a critical reflection on the research and its method. Essentially this chapter will elaborate on the methods used in order to be able to answer the research questions.

3.1 Interviews – key informants

In order to obtain the information necessary for answering the research questions a number of interviews have been conducted. All of the interviews have taken place in Oman's capital city of Muscat. As a starting point to start the sampling of respondents 2 exploratory interviews have taken place to provide the researcher with general information on the current state of affairs of the development of aquaculture in Oman and the main stakeholders. From there on the selection of respondents has taken place according to purposive sampling; 20 specific individuals where selected because of the information they where expected to hold that could be of high importance to the research (Boeije, 2010; Bryman, 2012). In some cases purposive sampling was accompanied by snowball sampling; purposively selected participants proposed new possible participants on the basis of their relevance to the research (Bryman, 2012).

As chapter 2 emphasizes the importance of public-private interaction in shaping a region's economic landscape and the essence of regional learning in order to technologically advance, the key informants are categorised into three categories, namely; public sector (governmental and non-profit actors), private sector (including public-private investment funds) and education & research institutes. Understanding the individual points of view of the participants from each category, as well as inter-relation with each other has led to an overall and comprehensive understanding of the development of aquaculture in Oman and the potential aquaculture has to develop as a viable growth path in the economy. The sampling of respondents only stopped when this understanding was reached, which was after two separate phases of data collection in Oman in 2014 (March-August and October-December).

Using semi-structured interviews all key informants where asked to share their opinion with the researcher on a range of topics which can be found as appendix 2. The interviews where guided by a pre-selected set of relevant issues based on the concepts derived from the conceptual framework. Hence all interviews included a section on the sources of the aquaculture growth path in Oman, the absorptive capacity of the aquaculture industry in Oman, the role of innovation within the aquaculture industry in Oman and the role of institutions. Additional to these pre-selected topics, the participants were free to introduce new, relevant, issues into the discussions. The open-ended nature with which the interviews have taken place contribute to the iterative character of the research, allowing modification and refinement of questions and theory at all times.

Individual interviews vs. focus groups

During the research both in-depth group as well as in-depth individual interviews have taken place. This was initially not planned to but rather turned out that way. As for example an interview was planned with the 'feed section head' Ms. Aida al Kharusi at the aquaculture centre, surprisingly also her expat colleagues Dr. Dave Robb and Dr. Adrian Hartley would like to participate in the interview. A similar situation happened at the Industrial Innovation Centre and the Ministry of Agriculture and Fisheries wealth. The following names have participated in the research and have all in their own way contributed to finding the answers on the research questions.

Exploratory interviews

- **Mr. El Zein Mustafa El Muzamil** – Director – Food and Agricultural Organization of the United Nations Oman (FAO Oman)
- **Dr. Ir. Hans van der Beek** – Agricultural Counsellor – Netherlands Agriculture Attaché, Riyadh, Saudi Arabia

Public sector

- **Dr. Khalifa Salem Mohammed Al-Kiyumi** – Advisor of Agriculture Research in His Excellency's the Minister of Agriculture & Fisheries office – Ministry of Agriculture, Fisheries and Animal Wealth
- **Mr. Habib Al Hasni** – Director General of the International Cooperation Department - Ministry of Agriculture, Fisheries and Animal Wealth
- **Dr. Lorna Cork** – Innovation Consultant – Industrial Innovation Centre Oman
- **Dr. Khamis Al-Balushi** – Innovation Consultant - Industrial Innovation Centre Oman

Private sector

- **Mr. Raffael Jovine** – Managing Director – Feed Algea Ltd. Oman
- **Mr. Hesham Lofty †** Business Development Manager – Public Establishment of Industrial Estates (PEIE)
- **Mr. Shanmugham** – Managing Director – Oman Fisheries
- **Mr. Bas van der Steeg** – CEO & Founder – Orange Marketing
- **Mr. Mahfood Ali Al-Harthy** – Managing Director – Afkar Enterprises
- **Mr. Duran Bernard** – Managing Director – Al Marsa Fisheries (part of the Towell Group)
- **Mr. Hesham Ibrahim** – Senior Operations Manager – Sultan Centre Hypermarkets (former aquaculture investor)

Education & research institutes

- **Dr. Adel Gandy** – Director at the Al-Khabourah Fishermen Training Institute (former owner of the Quriat Aquaculture Company)
- **Dr. Stephen Goddard** – Director at the Centre of Excellence for Marine Biotechnology – Sultan Qaboos University
- **Dr. Michel Cleareboudt** – Research & Associate Professor Agriculture and Marine Sciences – Sultan Qaboos University
- **Dr. Marieke Bontenbal** – Researcher & Lecturer – German University of Technology Muscat (GU Tech Muscat)
- **Ms. Aida Al-Kharusi** – Aquaculture Feed Section Head – Aquaculture Centre Muscat, Ministry of Agriculture, Fisheries and Animal Wealth

- **Dr. David H.F. Robb** – Researcher & Aquaculture Nutrition Advisor – Aquaculture Centre Muscat, Ministry of Agriculture, Fisheries and Animal Wealth
- **Dr. Adrian Hartley** – Researcher & Aquaculture Advisor - Aquaculture Centre Muscat, Ministry of Agriculture, Fisheries and Animal Wealth
- **Dr. Lubna Al-Kharusi** – Researcher & Director – Marine Science & Fisheries Centre Muscat, Ministry of Agriculture, Fisheries and Animal Wealth
- **Dr. Abdulaziz Al-Marzouqi** – Researcher & Director International Cooperation – Marine Science & Fisheries Centre Muscat, Ministry of Agriculture, Fisheries and Animal Wealth

3.2 Qualitative data

A longitudinal quantitative study on economic performance of the growth trajectory of aquaculture in Oman would be suitable for demonstrating whether the development path pursuits option A or B in the model proposed in figure 2.2. However the aquaculture industry in Oman is still in its infancy phase and a lack of quantitative data (especially in English) won't allow for this kind of research. The development path of aquaculture is still 'under construction' and hence there is no real relevance of quantitative measuring on performance outcomes. Developing new growth paths in the economy as a means of enhancing regional resilience can be seen as a dynamic process that *'may ultimately require a science that is by necessity localised and qualitative'* (Bristown & Healy, 2013 p. 933, after Evans, 2011, p. 233). The literature review in chapter two has demonstrated that the central concepts this study attempts to understand are all influenced by the extent of collaboration between a variety of relevant human agents, or actors. It is the interaction between regional actors in recombining (latent) regional assets leading to the development of new growth trajectories (Boschma, 2014; Fornahl et al., 2012). Additionally both regional learning and innovation, and a regions absorptive capacity require high levels of governance and the collaboration between the state, companies, research institutes and other institutions (Boschma, 2014; Bristow & Healy, 2013 & 2014; Porter, 2003). To investigate and understand the dynamic systems and processes shaping the development path of aquaculture in Oman this research therefore uses a qualitative approach. With adapting the qualitative approach this study is unique in its contribution to the pool of literature around economic development since most studies apply quantitative approaches focussing on the input and output or regional economies, rather than on the underlying qualitative nature of development (Frenken et al., 2006). Qualitative research is commonly understood as most suitable for understanding social processes in the world and the interaction and motivation of participants in this world (Boeije, 2010; Bryman, 2012). The qualitative approach is assumed to be the best method for understanding the development of aquaculture in Oman due to the social – collabourative – phenomena that lie on its basis.

Making use of a case study design has allowed for an in-depth and comprehensive understanding of the unique characteristics of the case, namely the development of the aquaculture industry in Oman. This particular case can be seen as an exemplifying case that fits within the context of industrial path creation and development. The Gulf countries, not Oman in particular, are specifically interesting study objects in this respect since the generated oil-wealth has allowed them to develop new industries in a rapid pace and in a unique institutional context. On the other hand is the macro-economic goal of economic diversification to increase the regions resilience more relevant in the Gulf than perhaps anywhere else. The heavy dependence on oil revenues makes the countries extremely vulnerable to external shocks like a drop in oil prices. Hence a better understanding of how industries develop in the Gulf states and in what way this form of development contributes to an increased regional resilience leads to a better understanding of the reviewed literature. This understanding will be generated using the exemplifying case study of the development of the aquaculture industry in Oman.

3.3 Operationalization & measurement

This research uses a deductive approach to test the theoretical concepts against empirical findings. Hence it does not attempt to develop new theory but rather attempts to contribute to a better understanding of the existing literature by investigating one particular case in a specific context. From the broad pool of literature used for chapter 2, variables are selected which are commonly understood to be of major influence on the growth trajectories of industries, and hence are integrated in the conceptual framework. This research focuses on the likeliness of growth path B in the model proposed in figure 2.2, which is cumulative and self-reinforced growth and hence does not attribute as such the specific factors that lead to decline of an industrial path. The following set of concepts is derived from the literature proposed in chapter 2 and is commonly understood to be essential for the development of a growth path and hence is interrelated in the conceptual framework. All of them are complex and abstract concepts that in the literature are often not strictly defined, or there is no consensus on the definition. Hence this paragraph clarifies how these concepts are understood within the outline of this research, and how these concepts are measured using primary and secondary data in order to test the hypotheses and answer the research questions. First a brief reiteration of some of the definitions will be given, before explaining how the key concepts are measured.

Formal institutions

The abstract construct of formal institution can be considered a real catch all that is subject to difficult measurement. Consisting of a set of 'formal rules' the construct of *formal institutions* is made up of a country's regulatory framework like its constitutions, laws and property rights (North, 1991) and additional its education and training system, and the labour market structure (Ewers, 2013).

Informal institutions

As mentioned in paragraph 2.3.1 informal institutions comprise social mechanisms, like traditions, the codes of conduct (North, 1991) and the cultures of work and ways of doing business (Ewers, 2013). Based on this understanding the formal institutions will be evaluated.

Knowledge complementarity

Knowledge complementarity, defined as "*the extent to which knowledge is related to and at the same time different from the knowledge of contacts in their information networks, is positively related to a firm's learning ability*" (Zahra & George, 2002, p. 193), in the field of aquaculture between existing knowledge in Oman and external, international knowledge is evaluated by qualitative in-depth interviews to source primary data.

Absorptive capacity

In the introduction of paragraph 2.2 absorptive capacity is defined (after Simmie et al., 2008 p.16) as "*the ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning, and (3) using and assimilating knowledge to create new knowledge and commercial outputs through exploitive learning"*. In other words, absorptive capacity is a regions capability to recognize, assimilate and use valuable new knowledge.

Innovation systems

Localised innovation systems are defined in paragraph 2.2.1 (after Simmie et al., 2008, p.14) as "*a functionally localised collection of organisations, institutions and processes that create or adopt valuable new economic knowledge and commercialize it*".

Measurement

After having provided definitions of the key concepts this study evaluates paragraph 3.3 now turns to how exactly these concepts are measured. It must be noted however that due to the level of abstraction of the key concepts real '*measuring*' is difficult, as is in general with qualitative research. Perhaps 'evaluation' of key concepts would be more suitable, even more so considering the explorative nature of this research. The following section attempts to provide the reader with the necessary information in order to validate the quality of the results presented in later chapters of this study.

Sub. 1. What are the main sources of the growth path of the aquaculture industry in Oman, and to what extent do these sources influence the paths potential for success?

H1. The main source of the current growth trajectory of the aquaculture industry in Oman is the transplantation of knowledge. Due to the existence of a technology gap and a low absorptive capacity will the transplantation of knowledge as a source of new path creation be problematic in contributing to the development of a viable growth path.

This first sub-question concerning the sources of the growth path of the aquaculture industry and the effect these sources have on the future potential of the growth path will be answered on the basis of primary qualitative data combined with extensive desk research to the evolution of the aquaculture industry presented in chapter 5. 22 Key informants have provided sufficient information in order to answer the research question. Topics discussed with all informants comprise different factors that either indicates an endogenous or an exogenous growth model. For endogenous growth these factors are a characterization of pre-existing resources, competences and skills – existing regional assets that form the basis of the development of an aquaculture industry (Dawley et al., 2010). Desk research, that has resulted in the first part of chapter five, attributes the history of aquaculture in Oman as well as current public and private sector activities. As a result of existing skills and competences one would expect start up activity in the aquaculture industry, hence this topic is also discussed with the informants. Data on start up activities was not made available by the Oman Chamber of Commerce and Industry, which only publishes the number of licences it has issued for aquaculture projects. However, this number seems not to correspond with real start up activities, hence primary qualitative data is considered most suitable to address this topic. Exogenous growth is driven by the transplantation of technologies, companies or industries from elsewhere to create or develop growth paths in the economy (Dawley, 2013). Hence topics discussed with all informants comprise the role of foreign investors and the role of – and the need for new, foreign, technologies. Additionally provides chapter 5 an overview of the involvement of foreign actors in private sector activities in the aquaculture industry. On the basis of all the interviews an inventory of the influence of different actors involved in the development of the aquaculture industry in Oman will be made. By doing so can be analysed whether the decision making functions in the private and public sector as well as the knowledge institutes are filled with Omani nationals or with expatriates.

Sub. 2. Considering the ability to recognize, assimilate and use relevant external knowledge, how could the absorptive capacity of the Omani aquaculture industry be characterized?

H2. The absorptive capacity of the Omani aquaculture industry is expected to be rather low. A knowledge gap might have resulted in the necessity of a better ability to recognize new knowledge than the ability to assimilate and use this knowledge locally.

As a regions absorptive capacity requires a high level of governance and collaboration between the state, companies, research institutes and other institutions (Boschma, 2014; Bristow &

Healy, 2013 & 2014; Porter, 2003), the level of absorptive capacity of the current aquaculture industry in Oman is studied trough qualitative in-depth interviews with key informants. A variety of topics is discussed with the aim to evaluate the capacity to recognize, assimilate and use new valuable knowledge of both important individual organizations (e.g. the Ministry of Fisheries, Agriculture and Animal Wealth) as well as the sum of actors. These topics include recognizing, understanding, assimilating and using externally held knowledge, the mechanisms by which knowledge transfers take place, the barriers these knowledge transfers oppose, the level of knowledge complementarity between existing and external knowledge (characterization of knowledge in technological leading countries). As the absorptive capacity in general is understood to be the result of the existing base of human capital, this investigation really focuses on the consecutive processes of recognizing, assimilating and using external knowledge locally. Measuring these processes qualitatively is believed to be most suitable for this research, as again the availability of and access to quantitative data proved to be quit problematic. Additionally chapter 4 and 5 attribute the level of knowledge and innovation of Oman in general according to Oman's scores on the Global Innovation Index 2014 and available secondary data on the percentage of the GDP that is spend on R&D. Chapter 5 will specifically address knowledge and innovation levels in the aquaculture industry on the basis of extensive desk research. This information forms input for both hypothesis 2 and 3. By combining both primary and secondary sources an overall assessment is made of the ability to utilize externally held knowledge in the Omani aquaculture industry. Doing so allows for either accepting or rejecting the second hypothesis.

Sub. 3. To what extent has developed a specific local innovation system for the development of the aquaculture industry in Oman?

H3. A weak governance system and poor integration of foreign companies in local industries might result in a general lack of functional collaboration systems. As also innovation is of low importance for both public and private sector actors is there expected to be no functional local innovation system for the development of the aquaculture industry in Oman.

This research uses primary qualitative data to investigate to what extent a LIS is in place for the aquaculture industry in Oman. In-depth interviews are used to get insights in the innovative activities and ambitions of both private and public sector parties (like the Industrial Innovation Centre). Topics discussed to test this hypotheses include the need for innovation, innovative activity, R&D spending (compared to other expenses) and the efficiency of this and the role of SME's. In these interviews special attention is given to the forms and the level of collaboration between the different actors within the aquaculture industry, as Localised Innovation Systems require a high level of collaboration between the actors involved in order to create and commercialize valuable new knowledge. Chapter 4 and 5 provide secondary data derived from the Global Innovation Index 2014 and desk research and addresses, like mentioned before, R&D spending as a percentage of the GDP. Chapter 5 also makes an assessment of investments in innovation in the aquaculture industry, as well as provides an overview of the capabilities of different knowledge institutes doing research or teaching on aquaculture. Combined the primary and secondary data are believed to provide sufficient input for answering the third research question and to either accept or reject hypothesis 3.

Sub. 4. To what extent do human agents trough formal and informal institutions influence the development of the aquaculture industry in Oman positively or negatively?

H4. The development of the aquaculture industry in Oman is influenced negatively by human agents trough both formal and informal institutions. Formal institutions like the labour market and the education system are expected to be problematic, as are informal institutions like the ways of doing business negatively influenced by rent seeking behaviour.

Hypothesis 4 is because of the abstraction level of the constructs of 'formal' and 'informal institutions' best analysed using several indicators. Hence a wide variety of both secondary and primary sources is used in order to form an adequate and comprehensive image on how human agents trough both formal and informal institutions influence the development of aquaculture in Oman. The first part of the analysis is based on secondary sources presented in chapter 4 and 5 and consists of the following items comprising 'hard', formal institutions.

- Regulatory framework
    - World Bank Group – Doing Business Report 2006-2014
    - Fraser Institute – Economic Freedom of the World Report 2002-2012

- Labour market, education and training systems
    - Chatham House (Ennis & Al Jamali, 2014) – Research paper: *'Elusive employment, development planning and labour market trends in Oman 2014'*
    - KNOEMA – online database using data from multiple international organizations (e.g. IMF, World Bank, Eurostat, FAO, EIA, OECD, WTO)

- Incentive structure
    - Ministry of Agriculture & Fisheries Wealth – *'Investment guidelines for aquaculture development in the Sultanate of Oman'*

To examine the regulatory framework two secondary sources are used. The category '*Legal structure and security of property rights*' in the Economic Freedom of the World Report comprises 9 different components on which each individual country is evaluated and ranked. Additionally the World Banks' Doing Business Report scores for Oman are used as they measure regulations that both enhance and constrain business activity in 11 areas of business. The scores for Oman on both indexes are used to indicate the quality of Oman's regulatory framework. Information on the labour market structure is derived from a research paper *'Elusive employment, development planning and labour market trends in Oman 2014'* by the Chatham House in addition to several labour market statistics sourced at the KNOEMA online database. Combined these sources uncover labour market trends, issues and formal training and education systems. In order to get an overview of the incentives offered by the government of Oman to attract foreign investments in the aquaculture industry the *'investment guidelines'* are studied.

Combined the secondary sources form the starting point of, and framework for the second part of testing the fourth hypothesis. Because except from the *'investment guidelines'* all other secondary sources used for this hypotheses address Oman in general – not the aquaculture industry in particular. In-depth interviews with 22 key informants have provided the insights of the functioning of 'hard' formal institutions, as well as the functioning of 'soft' informal institutions in the aquaculture industry in particular. Topics discussed to test hypothesis four include the labour market structure, education and training systems (knowledge transfer mechanisms) and incentives. During the research became clear that the reality of education and training was different than evaluated in policy documents. Hence to really understand the level of education and training systems the qualitative data on these topics has provided valuable information. This same method is used for the Global Competitiveness Report, where business leaders evaluate the quality of education (World Economic Forum, 2014). Topics discussed to study the informal institutions include the cultures of work in Oman, the ways of doing business, the level of interaction and collaboration as well as trust between actors relevant in developing the aquaculture industry in Oman and the likeliness of rentier activities by specific actors.

The input from both primary and secondary sources is believed to be sufficient for answering the fourth sub-question and either accepting or rejecting the fourth hypothesis.

3.4 Validity, reliability & reflexivity

3.4.1 Validity & reliability

The validity of a research means the extent to which the data (in this study both primary and secondary) indicate what has to be measured. To ensure the validity of this research it has used similar methodology as previous studies have done, as well as in-depth interviews with a wide range of informants, which additional to asking the right questions and addressing the right topics enhances a research's validity (Bryman, 2012). By doing so the research has attempted to enhance the internal validity by matching empirical findings with theoretical concepts. The concepts described above are derived from a broad pool of literature on industrial path creation and development and regional resilience. They're all understood to have a major impact on the development of new growth paths in an economy. Hence to explore the future potential of a current growth trajectory these are the concepts to be measured and evaluated. Using a wide range of respondents is crucial for the reliability of the research. Topics discussed are very sensitive and often even taboos (like rentier practices or insufficient knowledge levels). To increase the quality and the reliability of the research findings are checked and double checked during the course of the research with multiple informants. As external validity, or transferability of qualitative research is often a critical issue (Shenton, 2004) this study endeavours to contribute to a better understanding of how sudden oil-wealth can be translated into the viable development of industries that enhance economic diversification. For this reason this study uses theoretical concepts from literature on GCC economies to test it against empirical findings, and to increase the extent to which the results of this research are useful in similar situations. Nonetheless it goes without saying that this research addresses only specific individuals in their specific environment in time and that hence conclusions and results are hard to apply elsewhere. Additionally, reliability in qualitative research is always difficult to determine because it is never certain that the respondents tell the exact truth and because of the position and opinion of the researcher (Bryman, 2012). Because of the social setting, which is of a very dynamic nature, to redo the research on another moment might lead to different results.

3.4.2 Reflexivity

To evaluate the implementation of this research and consequently its quality it is important to know the position of the researcher as this has definitely influenced the level and the quality of the data required. During the course of the study the researcher moved from an outsiders position into an insiders position. Whereas at first a master student in the Netherlands the researcher moved to work fulltime on the Netherlands embassy in Muscat, Oman, on the dossier of aquaculture and fisheries development and the possibilities for bilateral collaboration between Oman and the Netherlands in these fields. By having a position on the Netherlands embassy in Muscat doors opened to gather information that otherwise would have remained closed. For example to interview officials from within the Omani government is extremely difficult and requires several time consuming procedures, something that would have been impossible as a complete outsider. Additionally a relation of trust could be build with several informants from the private sector as well as from different knowledge institutes who had or who aimed for collaboration with the Netherlands. Due to the professional relationship between informants and the researcher confidential and sensitive information could be shared, which for a complete outsider would not be the case in a country where there is no real freedom of speech. Consequently as a result of an insiders position during the study it is of vital essence for the quality of the analysis and results that the researcher preserves its objective position at all times. This is something taken into account with great care, and at all stages during the research.

Anonymity

After having provided a list with key-informants in paragraph 3.1 the remaining part of this research will for the major part be anonymous. This means that quotes used in the result chapters 5, 6, 7 and 8 will most of the time only address if the informant was from the group of public, private or knowledge sector informants. As the author I recognize that this decision does influence the scientific accuracy of this research, however the privacy of the informants who have made this research possible should be of highest priority. It must be understood that there is no 100% freedom of speech in Oman and that criticism of the central regime is not tolerated and even prosecutable. The fact that some of the informants have completely opened up and have been willing to share their honest, critical thoughts about the behaviour and functioning of the Omani government I consider extremely valuable. As such the least I can do is respect their openness and honesty by preserving anonymity for the remaining part of this master thesis.

3.5 Data analysis

3.5.1 Content analysis

To systematically analyse and structure the obtained data in order answer the research questions this research uses a content analysis. Qualitative content analysis is used as a method to systematically describe the meaning of qualitative data (Flick, 2013, p. 171). This method suits this research because of the nature and size of the data, using content analysis the amount of data is reduced and structured. Preselected categories form the basis of a coding frame, which is the backbone of the analysis. Subsequently consecutive parts of the data are assigned to the categories in the coding frame. The focus is on taking into account all aspects that somehow relate to the research questions and assign these to the categories, by doing so the content analysis is extremely systematic (Flick, 2013). Whereas the coding frame is initially driven by theoretical concepts, it has always been open for categories that are driven by the data. Respondents have been allowed to elaborate on topics other than the proposed ones by the researcher. Hence a second layer of analysis was based on open coding, which introduced new nodes into the coding frame and added in an inductive manner new insights to the existing theoretical concepts. This makes the coding frame valid for the analysis. The initial coding frame based on theoretical concepts as derived from the conceptual framework is as shown underneath, the final coding frame is presented as appendix 1.

- Formal institutions
    - Regulatory framework
    - Labour market
    - Training & Education system
    - Incentives

- Informal institutions
    - Cultures (of work)
    - Ways of doing business
    - Interaction, collaboration & trust
    - Rentier activities

- Knowledge complementarity
    - Technology gap
    - Characterization existing knowledge & technology
    - Characterization external knowledge & technology

- Absorptive capacity
    - Recognizing, understanding, assimilating and using external knowledge
    - Technology transfers
    - Barriers to technology transfers

- Localised Innovation Systems
    - Innovative activity
    - R&D spending
    - SME's
    - Interaction, collaboration & trust
    - Commercialization

3.5.2 NVivo analysing software

Based on the obtained data this frame is modified and extended to the final coding frame which is added in appendix 1. This final coding frame forms the input to interpret the results. To streamline the analysis this research uses Nvivo 10 Qualitative Data Analysis software. All the separate transcripts of the in-depth interviews can be added to the program, from where the coding frame can be created, and modified/extended accordingly. Using data analysis software increases the reliability of the analysis (Boeije, 2010). Additionally for the first part of chapter 5 Nvivo is used to analyse secondary non-scientific data to provide a brief description of current aquaculture activities and initiatives in Oman. The sources used here are mainly (international) media sources but also relevant policy documents. The Thomson Reuters webpage of Zawya, which is a (paid) online database of Middle East news on business and finance, is used to gather all articles published on 'aquaculture' AND 'Oman' between 2010 and 2014. Nvivo is used to analyse these articles as well as the policy documents. The result of this analysis is the first part of chapter 5.

The following chapter will address the economic context within which the development of aquaculture in Oman is taking place.

4. An economic review of the Sultanate of Oman

4. An economic review of the Sultanate of Oman

"Beginning with the generation of massive and distorting economic rents, through the recycling of this windfall into several social benefits, what has emerged after four decades of petro-development is an oil society rather than an oil economy" (Ennis & Al Jamali, 2014, p. 16)

After having elaborated on the main theoretical concepts around new path creation and path development in chapter 2, chapter 4 will provide the adequate economic context within which the hypotheses around the growth path of the aquaculture in Oman are tested. Chapter 4 mainly attributes specific economic and institutional characteristics at the national level, subsequently chapter 5 zooms in at the evolution of the aquaculture industry. Derived from its importance for the national economy paragraph 4.1 elaborates on Oman's hydrocarbon sector, and the Sultanate's dependency from hydrocarbon revenues in particular. Subsequently paragraph 4.2 will address the existing capture fisheries industry. As in this part of the research it is unclear yet whether aquaculture follows an endogenous or an exogenous growth path it is highly relevant at this stage to briefly discuss the fisheries industry. After that paragraph 4.3 and 4.4 address some items of the country's institutional framework based on secondary sources, starting with several factors that influence doing business in Oman. By elaborating on Oman's scores on the World Bank's *Doing Business Index* and on the Fraser Institute's *Economic Freedom Index* insights are provided on Oman's formal institutions. Consequently paragraph 4.4 continues with a description of the labour market mainly based on a *Chatham House's* report from 2014. The chapter finishes with a brief description of national innovation efforts, based on Oman's scores on the *Global Innovation Index*.

4.1 Dominance of the hydrocarbon sector

Strategic location

The Sultanate of Oman is situated on the southeastern tip of the Arabian Peninsula and is neighboured by the United Arab Emirates to the north, Saudi Arabia to the west and Yemen to the south. This strategic location with proximity to the Arabian Sea, the Gulf of Oman and the Persian Gulf, provides Oman access to one of the world's major energy corridors and oil choke points: the Strait of Hormuz (figure 1.1). With this location Oman enhances it's position in the world's energy supply chain. The Strait of Hormuz accounts for 17 million barrels of oil per day, which is almost 20% of the world's daily total oil supply and 30% of all maritime traded oil.

Economic performance

Economic growth in Oman has been relatively high for the past few years. With average GDP growth rates of over 5% for the last decade (figure 4.2) the country can be considered as a high growth country. The strength but also the vulnerability of the Omani economy lies in its dependence on the revenues derived from

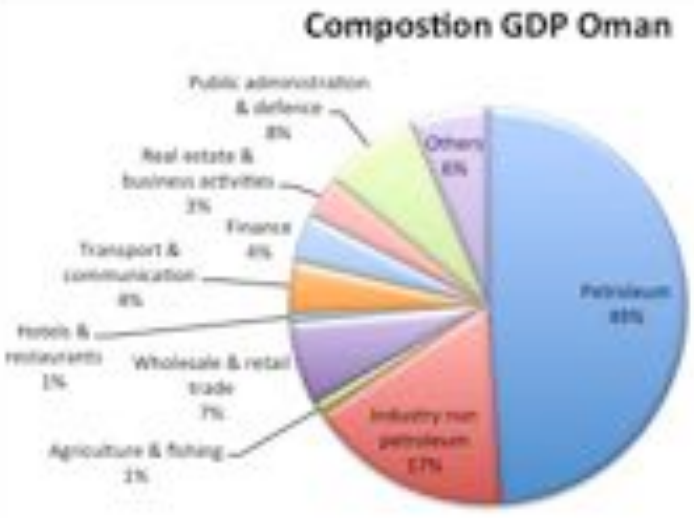
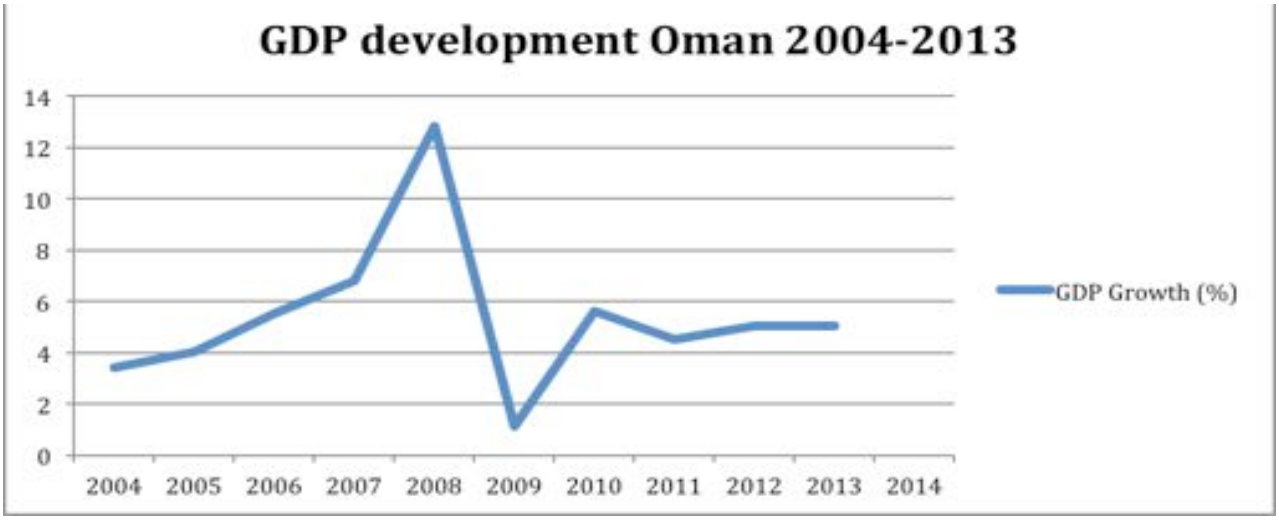


Figure 4.1. Composition of the Omani GDP 2012. Source: Central Bank of Oman Annual Report, 2013 – edited by the author



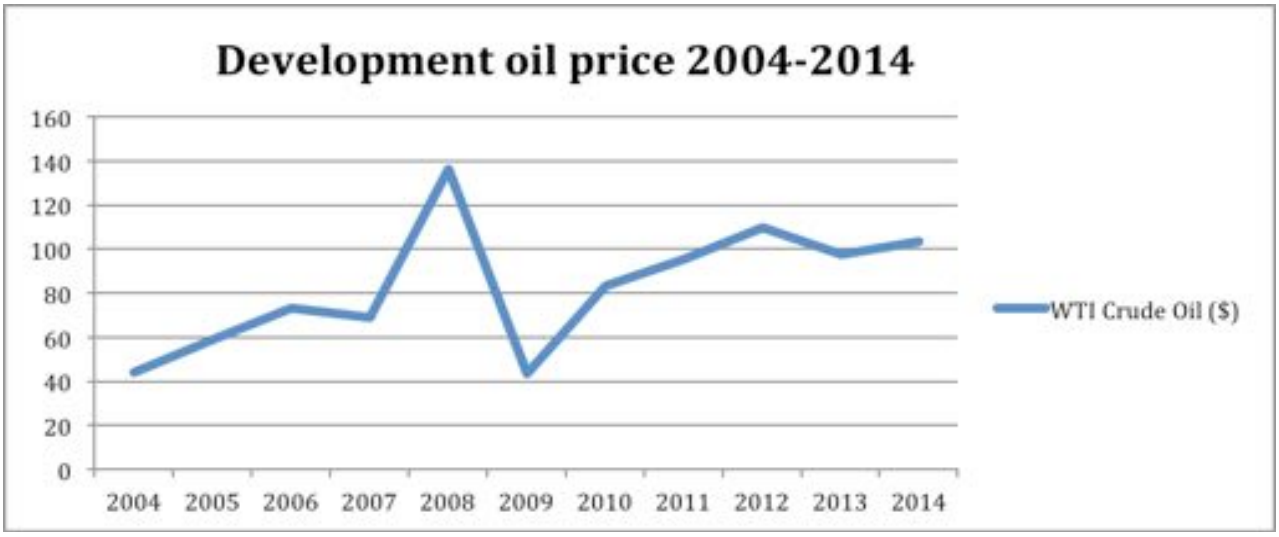


Figure 4.2. Development of the GDP in Oman, from 2004 till 2013. Source: The Global Economy, 2015 [online]

Figure 4.3. Development of the world's oil price (WTI crude). Source: Macro Trends, 2015 [online]

the production and export of oil and gas. As figure 4.2 and 4.3 demonstrate does the volatility in worlds' oil prices display a similar pattern as the development of Oman's GDP growth, indicating the major dependence on the export of hydrocarbons. In 2012 the hydrocarbon sector accounted for 86% of the government revenues, which was approximately 51,6% of the total GDP according to the national's bank year report of 2013. However variations occur (as seen in the difference between figure 4.1 and 4.3) probably due to differences in calculations. The total GDP amounted $78,29 billion in that same year, with a per capita GDP of $21.929. In 2013 the contribution of the hydrocarbon sector to the GDP slightly decreased, due to a decline in oil prices, to 49,7 % - remaining the country's most dominant sector. Figure 4.1 shows the total composition of Oman's GDP and figure 4.4 shows the distribution of the contribution of the hydrocarbon sector to the GDP versus the non-hydrocarbon sector from 2007 till 2013. Besides the major direct influence the hydrocarbon sector has on Oman's economic performance does it also have an indirect effect on industries for which oil and gas are major inputs. These are for example other big industries in Oman like aluminium, power generation, water desalination and petrochemicals. Considering the fact that Oman's economic

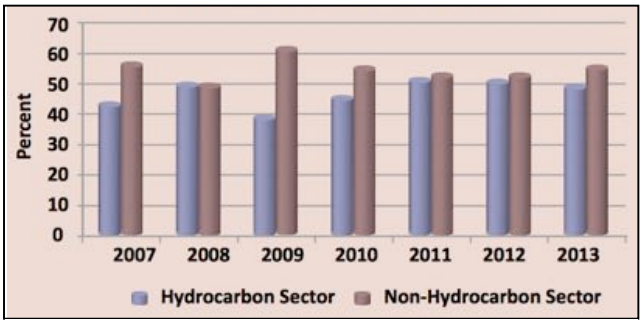


Figure 4.4. Share of hydrocarbon and non-hydrocarbon sector in GDP. Source: National Bank of Oman Annual Report 2013

performance is highly dependent on world oil prices, a closer look at the development of the oil price over mid 2014 and early 2015 is rather concerning (figure 4.5). Oman's government budget for 2014 was based on a crude oil price of $105,50 (EIA, 2015). This means to breakeven the oil needs to sell for that price, when it doesn't government spending will need to be compromised, which consequently can have a severe impact on the public facilities and the realization of major infrastructure projects. So where the balance of payments over 2013 was a comfortable one, the 2014 balance is more concerning.

Figure 4.5. Development of the oil price (WTI crude) March 2014 – January 2015. Source: Nasdaq, 2015

As figure 4.5 demonstrates did 2015 start with a crude oil price of around $50, not even half the price for the government to breakeven. The oil prices shown in figure 4.3 and 4.5 are based on the West Texas Intermediate (WTI), which is one of the major benchmarks for buyers and sellers of crude oil worldwide. Crude oil, or more commonly known as petroleum, is for the majority share (50-97%) comprised of hydrocarbons. Other components include different organic compounds and a small share of metals. Crude oil is refined into a large number of other products, including diesel, gasoline, kerosene, asphalt, lubricants, liquefied natural gas (LNG) and a wide variety of petrochemicals, e.g. plastics and medicines. In 2013 Oman ranked the world's number 20 largest oil producer, behind major oil producing countries are Saudi Arabia, the United States, Russia and Iran. The main oil consuming countries are the United States, China, Japan, Russia and Germany. In comparison, Saudi Arabia produced an average of 9,6 million barrels per day in 2013, making it the largest producer of crude oil in the world. Oman produced an average amount of barrels per day of 941,9 thousand. The total crude oil production in Oman over 2013 was 343.8 million barrels, of which 304.2 million barrels where exported. On average between 2008 and 2013 Oman exported about 80% of it's total produced oil. When looking at future

Country	Oil reserves (in billion barrels)
Saudi Arabia	268,35
Kuwait	104
United Arab Emirates	97,8
Qatar	25,24
Oman	5,5
Bahrain	0,12

Table 4.1 Oil reserves GCC countries (January 2014). Source: The Global Economy, 2015 [online]

production, Oman's oil reserves are (except from Bahrain) not near as abundant as its GCC neighbours (table 4.1). This also requires a more strategic production that prevent rapid over exploitation of the oil reserves. Additionally does it fuel the need for economic diversification more than in other GCC states, which Oman recognizes with its 'Vision 2020' economic diversification plan. According to different estimates depending on the level of production will Oman's oil reserves be depleted by the year 2022 (Campbell & Heapes, 2008). Oman's ambition is to reduce the share of the hydrocarbon sector to the GDP from the 49,7% in 2013 to 9% in 2020. Export of products in non-hydrocarbon industries is expected to be the main contributor to this decrease. An increase in productivity in non-hydrocarbon industries will be need to accompanied by a more wider tax base to decrease the central governments position as the main distributer of wealth. As mentioned in paragraph 2.4 has the massive oil and gas incomes set aside the need for taxation in rentier economies. Where a wide tax base characterizes economies like e.g. in western Europa, are rentier economies characterized by a very narrow one. Where around 50% of Oman's GDP was derived from hydrocarbon revenues in 2012, tax accounted for only 2,55%. Table 4.2 demonstrates the tax as percentage of the total GDP for 6 different countries, 3 GCC economies and 3 economies in Europe. To become less dependent on hydrocarbon revenues asks for economic reforms in general and tax reforms in particular.

Country	% tax of GDP (2012)
Oman	2,6
Qatar	4,9
UAE	1,8
Netherlands	36,9
Germany	40,6
Norway	42,3

Table 4.2. Tax as percentage of the GDP (2012). Sources: Economy Watch, 2015 & OECD StatExtracts, 2015

4.2 Capture fisheries in Oman

Unless agriculture and fisheries combined contribute only for about 1 percentage to Oman's GDP, in the context of this research and the possible skill-relatedness with aquaculture it is highly relevant to briefly discuss the fisheries industry at this stage of the research. Capture fisheries provides employment to over 36,000 Omanis, and provides significant fish supply for domestic consumption (Omanis are the biggest consumers of fish in the world with 27 kg/p/yr) as well as for export to markets within the region and worldwide. The major export countries for Omani fish are the United Arab Emirates (50%) and Saudi Arabia (16%). As illustrated in table 4.3 is there a general decline in the total per year catch of high demand fish in Omani waters.

Figure 4.6 Boats used for fisheries in Oman - the left one (fiber glass boat) is with almost 20.000 boats by far the main used. Source: Author

Species	2008	2012
Yellow fin tuna	7046	5582
Grouper	5536	3946
Sea bream	7400	3352
Emperor	8954	8962

Table 4.3. Total landing (metric tons). Source: MAFW, 2012

The decline of certain high demand species like tuna and demersal fish species like groupers is caused by the fact that they have been highly overfished over the last decades. That's why it seems that the ministry now has decided on a new way forward with a major role for aquaculture, new fishing technologies, new fishing vessels and strong environmental awareness. The current status of the fisheries industry is characterized by traditional fishing techniques – it is dominated by, mainly rural, fisherman with artisanal fisher boats that fish close to the shore or traditional '*dows*' and more industrial ships that are able to fish further out on the sea (figure 4.6). The boats land in either small scale fishery ports or simply on the beach, from which the catch is directly loaded into small trucks and transported to distribution hubs elsewhere in the country where it is traded for local use or export. Several major fishing companies do operate in the sector, working along the entire value chain from catch to processing, storage and marketing. Oman's main fishing companies include Oman Fisheries, Dhofar Fisheries, Al Hamadi Fisheries, Al Marsa Fisheries and Al Ainkawi Fisheries Division. Most of the industry is located in the capital city Muscat, where the main processing and storage facilities are. Dhofar Fisheries has its entire operation in the capital of Dhofar, Salalah, from where it also organizes its exports. The fish processed in Muscat is either exported via air (from Muscat Seeb International Airport) or from the port of Sohar in the north of the country. Partly due to a lack of cold storage both onboard of the boats as well as on landing sites, the quality of the fish is too often very poor once it arrives to it's destination – being it for direct domestic trade, or processing and export. Additionally due to the lack of proper storage facilities fishermen are often forced to sell their catch at throwaway prices since all the catch has to be sold on the same day. Processing and cold storage of fresh fish will be a continuous point for improvement over the near future. Consequently the whole fisheries value chain is a rather traditional; from fishing vessels and techniques, to (cold) storage facilities, landing sites, ports, transportation, processing, value adding activities and marketing.

Capacity building

Modernization of the fisheries industry also requires sufficient investments in training facilities. The Fishermen Training Institute is the main centre for vocational training and preparing the national labour force for current and future developments in fisheries. The institute, under the Ministry of Manpower, has two locations; one of them in Al Khaboorah, in the Al Batina region, and the other one in Salalah, in the Dhofar region. Courses differ from 2 week specific training for local/rural fisherman up to 2-year degrees for students between 16 and 25 years old. The longer courses of the institute are being given in English and based on up-to-date international material. Quit problematic is the low level of young, male, applicants at the institute, of which the far majority of the students is female. Mainly because of an economic motivation young men prefer a career in the army rather than one at sea. Girls, when finished with the degree, prefer a comfortable and well-paid career at the Ministry of Agriculture and Fisheries Wealth instead of one at sea. Even though the Fishermen Training Institute consults with foreign experts on a frequent basis, it has no official agreements with foreign institutes. At the time of writing a new private applied science university is planned with a department on aquaculture and fisheries. The department will most likely seek cooperation with foreign institutes (basic/applied sciences).

Fisheries research is conducted at the Marine Science and Fisheries Center (MSFC), under the Ministry of Agriculture and Fisheries Wealth, and at the College of Agriculture and Marine Sciences of the Sultan Qaboos University (SQU). Research in the latter focuses on several

main areas, e.g. marine sciences, oceanography, fisheries, aquaculture and marine biotechnology. The MSFC has a major focus on stock assessment and the monitoring of (overexploited) fish populations. Additionally the centre conducts research on the reproduction of finfish, crustacean and molluscs, on growth evaluation and on quality control of both the environment and the fish. Algal blooms are a big threat for both the fisheries industry as well as to fresh water supplies, since as a result of algal blooms desalination plants can shut down. In 2007 the red tide killed such a substantial amount of wild abalone in Sharbatat (in the Dhofar region) that the local government decided on a total ban on abalone fishing for 3 years. Additionally in 2008-2009 algal blooms led to, besides having a severe impact on marine resources, the shut down of several desalination plants, of which one was shot down for nearly 2 months.

Environmental awareness

The decline in the natural fish stocks has led to an increasing environmental awareness in the Sultanate – which besides its own natural marine resources is highly dependent on the import of foods. As a result of extensive studies people have realized the severe impact unsustainable fishing practices can have on the people who's daily lives are dependent on resources from the sea. Hence strong regulations and new more sustainable techniques are being implemented. It goes without saying that unsustainable practices still take place – though authorities are looking for any way they can to limit this. A direct outcome of these stronger regulations are the strict time frames within certain species are allowed to be caught and sold, and the specifications in size of certain species that are allowed to be caught and sold. To give an example, recently announced in a ministerial decree was a total ban on the catch and selling of kingfish with a size of 65cm or less. This would allow the species to reproduce itself during this period. Another result of an increased environmental awareness and the necessity to enhance marine resources and biodiversity is the development of artificial coral reefs at several areas along the Omani coast. At time of writing 400 balls have been installed in front of the Liwa coast, in the North of Oman (figure 4.7). Which is the result of cooperation between MAFW, local fishermen and the Brazilian company Vale (the project is part of the iron ore giant's CSR strategy for Oman). Also for other places like The Wave (Muscat) and Sur are serious plans for developing artificial reefs. The project in Sur is, like the one in Liwa, part of a CSR strategy of a multinational company (Oman India Fertilizer Company) that would like to give something back to the local community. To illustrate the power of environmental sustainable solutions (or that lack of this) should be mentioned that the Norwegians have come to Oman for many years, but still haven't been able to get there 'feet on the ground'. Reason for this is simple; the Ministry of Environment is refusing the applications from Norwegian companies that want to establish sea cages to conduct cage farming in Omani waters. The general opinion, under influential opponents of the Norwegian cage systems, is that these are too polluting and harmful for the environment and hence the Environmental Impact Assessments (EIA) are not being approved.

Figure 4.7 Concrete 'balls' as artificial reefs. Source: Muscat Daily

Chapter five will based on primary research address the skills used in the Omani fisheries industry, and will hence assess the skill relatedness between capture fisheries and aquaculture.

4.3 Doing Business in Oman

4.3.1 Doing Business index

Considering the fact that for economic diversification Gulf economies mainly depend on foreign expertise and technology to make the transition from a rentier state towards a more production based economy, one would expect that foreign companies are welcomed and stimulated in starting up operations in the Gulf states. The negative features of the business environment resulted from a rentier structure require substantial economic reforms in order to become diversified economies competitive on a world market (Hvidt, 2011). The extent to which economic reforms are achieved can be seen as a demonstration of ambition to actually transform the economy towards a more productive one, less dependent on oil and gas incomes. Hvidt (2011, p.92) assumes that *"only a motivated government will be bothered to create a business environment that allows for efficient private sector operations and investments, transparent lending markets, efficient procedures and decision making structures, lowered tariffs and other factors that facilitate cross-border trade".* Table 4.4 shows the '*Doing Business*' scores from the World Bank Group's Doing Business Report for all GCC countries between 2006 and 2014. The DB index is based on 11 parameters that compare business regulations in 189 countries and uses both quantitative and qualitative data. The DB index "*investigates the regulations that enhance business activity and those that constrain it*" (Doing Business Report, 2014, p.1). The 11 parameters the index is based on are the ease of starting up a business, access to credit, dealing with construction permits, property regulations, investor protection, paying taxes, getting electricity, trading across borders, enforcing contracts, getting credit, resolving insolvency and employing workers. By analysing the development of a country's score over multiple years one can see to what extent these countries have been successful in implementing economic reforms. Looking at table 4.4 especially the remarkable achievement of Saudi Arabia (KSA), ranking 35 in 2006 and number 11 in 2011, and the improvements of the United Arab Emirates (from 68 in 2006 to 22 in 2014) really stand out. Saudi's impressive achievement up till 2011 for example was partially the result of a decrease in amount of days it took to start up a business (from 39 days to 15) (Hvidt, 2011). On the other hand, Kuwait has instead of improving it's business environment rather worsened. Gulf states score mainly low on investor protection, enforcing contracts, employing workers and closing a business, additionally Oman scores particularly low on enforcing contracts (rank 107), investor protection (rank 98), getting credit (rank 86) and dealing with construction permits (rank 69). The main factors responsible for Oman's relatively high overall rank (rank 47) are paying taxes (rank 9) and registering property (rank 21).

Country	2006	2007	2008	2009	2010	2011	2012	2013	2014
KSA	35	38	23	16	13	11	12	22	49
Bahrain	n.a.	n.a.	n.a.	18	20	28	38	42	53
UAE	68	77	68	46	33	40	33	26	22
Qatar	n.a.	n.a.	n.a.	37	39	50	36	40	50
Kuwait	40	46	40	52	61	74	67	82	86
Oman	52	55	49	57	65	57	49	47	47

Table 4.4 Ease of doing business ranking 2006 tm. 2014. Source: The World Bank Group

Additionally does Oman have a good reputation of encouraging and facilitating private companies in public projects, in the utilities sector in particular. The process of tendering in Oman is a competitive one, and most of the larger projects attract a wide range of international companies, who often gear up with local companies to bid for a tender. But Oman's tendering process is being criticized as well. Due to limited capacity at the tender board the process often takes too long. Low barriers to prequalification means that each tender receives a lot of bids. Furthermore, allowing poorly qualified companies to enter the tender process also enables them to drag down the contract prices. At the moment of writing there seems to be a tendency in

different sectors of tenders being awarded to poorer qualified companies in the lower price categories. This resulting in a situation where training and education of Omani staff becomes even more subordinate to other activities to successfully implement a project.

4.3.2 Economic Freedom – legal structure

The category '*Legal structure and security of property rights*', or simply legal structure, in the Economic Freedom of the World Report comprises 9 different components on which each individual country is evaluated and ranked. The Economic Freedom of the World reports use a wide variety of data from the WTO, the UN, the IMF, the World Bank and the World Economic Forum and is used as a common source in international and institutional economics and political economy (Wood & Demirbag, 2012). "*Protection of people and their rightfully acquired property is a central element of economic freedom and society – it is the most important function of a government*" (Fraser Institute, 2014). The 9 components of the '*Legal structure and security of property rights*' category are judicial independence, impartial courts, protection of property rights, military interference in rule of law and politics, integrity of the legal system, legal enforcements of contracts, regulatory restrictions on the sale of real property, reliability of police and the business costs of crime. Together these components are an indication on how protective governments operate, and how open and efficient markets are. Companies and individuals engage less in productive activity when contracts won't be enforced or innovative and productive efforts won't be protected. Hence the legal structure is a good indicator for the efficiency with which resources are being allocated and the protective climate that is created for (foreign) investors. Table 4.5 shows the development of Oman's score on legal structure. From a 30th position in 2002 to a 20th position in 2012 Oman ranks amongst the top countries. Oman scores well above average on 7 of the 9 components, with an 8,71 on the regulatory restrictions on real property and an 8,76 on the business costs of crime. On the other hand does it like in the Doing Business Index score very low (5,14) on the legal enforcement of contracts, indicating a biased enforcement of contracts based on family ties and social pressure rather than on legal procedures leading to a depersonalized market structure (Fraser Institute, 2004).

Year	Rank	Grade
2002	30	6,9
2008	23	7,36
2012	20	7,6

Table 4.5. 'Legal structures and security of property rights' scores for Oman. Source: Fraser Institute 2002 tm 2014

4.4 Labour market

4.4.1 Labour productivity

GCC labour markets in general are characterized by significant proportion of nationals that work in the public sector for good wages, and a large share of unskilled, cheap, foreign workers employed in the private sector. On a total population of 3.6 million Oman has 1.53 million foreign workers, almost all in the working age group of 15-64 years old. Its this group that is mainly responsible for the daily functioning of the economy (Ennis & Al Jamali, 2014). It is the abundance in supply of cheap labour that is one of the major differences between GCC economies and western, or OECD, economies. In GCC economies domestic firms have access to a large pool of foreign workers to choose from, and are able to employ the required number of workers against prevailing wages. Expansion of the firms in a later stadium simply requires hiring more workers, at the same prevailing rates. In many western economies on the other hand domestic firms are obliged to initially hire local workers. When companies expand and

want to attract more workers later, wages will increase. Simply because when the demand for labour increase this stimulates scarcity at the supply side, resulting in higher wages (Coury & Dave, 2010). Considering population sizes in countries like India, Pakistan and China, where Gulf countries get their cheap labour from, compared to population sizes of the Gulf states, one can notice that the inflow of low wage labour will constantly be in abundance. Working population growth has not significantly influenced the total output per worker, which is explained by the fact that abundance of cheap labour causes the redundancy of physical capital investments, and hence hampers productivity growth as measured by output per worker. Employment does increase alongside physical capital investments, but a growth in output per worker has so far remained nihil for the GCC overall (Coury & Dave, 2010), with Oman forming quit an exception in this case.

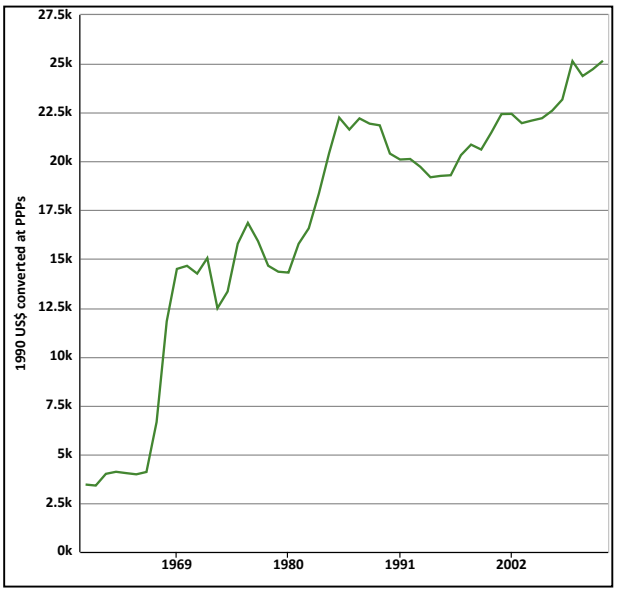


Figure 4.8. Labour productivity development Oman 1960-2011. Source: Knoema, 2015a

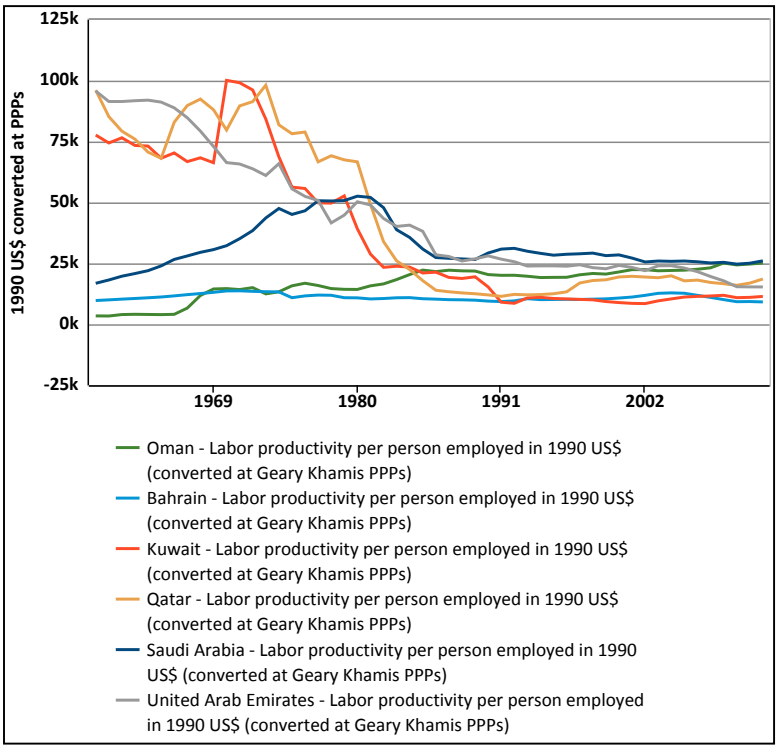


Figure 4.9. Labour productivity development GCC economies 1960-2011. Source: Knoema, 2015b

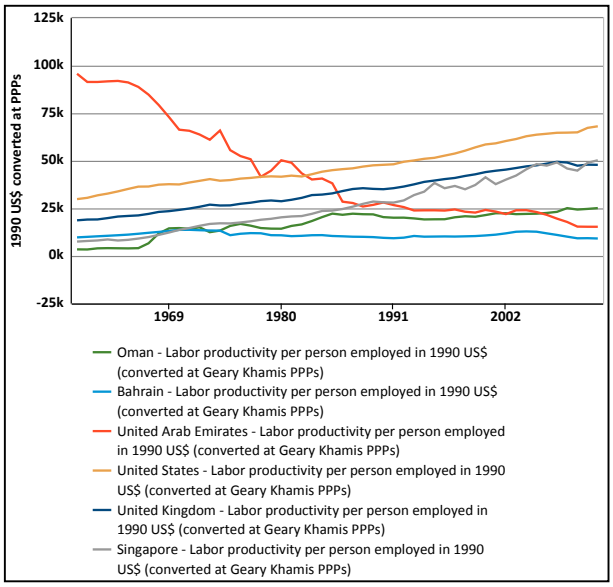


Figure 4.10. Labour productivity development Oman, Bahrain, UAE, US, UK & Singapore 1960-2011. Source: Knoema, 2015c

The figures on the previous page demonstrate the development in the output per worker in Oman (figure 4.8), in the GCC states (figure 4.9) and in Oman, Bahrain, the UAE, the United States, the United Kingdom and Singapore (figure 4.10).

Figure 4.8 demonstrates that as only GCC state Oman has been able to sustain growing labour productivity over time, with which it appears more similar to OECD countries like the United States and the United Kingdom and non-OECD member Singapore than its fellow GCC economies (Figure 4.10). Qatar, the UAE and Kuwait show extremely high labour productivity in the early 60's, which coincides with the early exploitation of oil in these countries, but then declining steadily towards the early 90's due to a slow down in population growth rate (mainly caused by the inflow of low skilled low paid workers). Oman's population growth has between the 1960's and early 2000 averaged around 3% a year, but has made an incredible growth from 2006 to 2013 (Figure 4.11 – demonstrates growth till 2011). Which is the opposite figure the UAE for example is demonstrating. Between the 1960's and early 2000 the UAE's average population growth rate amounted about 8%, ranging from 17.1% population growth in 1973 to 4.5% in 2000, and 1.5% in 2013 (Knoema, 2015d). Due to it's recent increase in 'hunger' for foreign labour (a staggering 17.7% increase in labour demand) Oman had the world's strongest growing population in 2012.

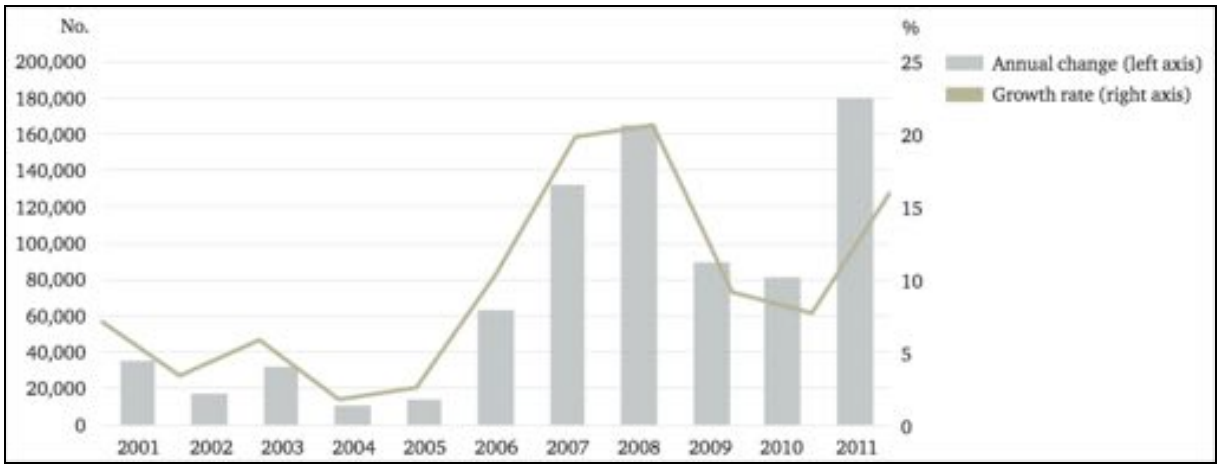


Figure 4.11. Phases of expatriate labour growth. Source: Ennis & Al-Jamali, 2014. P.7

4.4.2 Government policy

Oman was the first Gulf country to draft a national development plan in order to direct its economy. The first five-year development plan (FYP) was issued for the period 1976-1980, and had a specific focus on keeping the numbers of expatriates as low as possible. By doing so the state could limit the high remittances that flowed out of the country every year. But the main objective of the early FYP's was to develop a good infrastructure that was able to cater with the expected economic growth as a result of the oil boom (Ennis & Al Jamali, 2014). The term '*Omanization*' came first into place in the 4th FYP from 1991 to 1995. Omanization is a set of policies promoting the participation of Omani nationals on the labour market by setting quotas and establishing training and education opportunities. For it's implementation between 1991 and 1995 was a budget of $104 million allocated, but no real work was done until 1995 when Oman published its '*Vision 2020 Development Plan'*. This was the first and only in its kind long-term development strategy in the entire GCC. The Vision 2020 was based on 3 main pillars;

- Human resource development
- Diversification of the economy
- Private sector development

These pillars meant educating and training Omani nationals and create jobs for them, especially in the non-hydrocarbon sectors, a revision of the dependency on the hydrocarbon sector, and a repositioning of the private sector as a major vehicle for job creation – additionally is the aim for

Omanization grade in the private sector set at 75% by 2020. But whilst set in 1995, nowadays' reality is one far from achieving these 'Vision 2020 – goals'. As seen before is the economy still heavily dependent on revenues from the hydrocarbon sector and hence does economic growth strongly rely on worldwide oil prices. Omanization efforts have recently even led to a steady decrease in private sector labour market participation of Omani nationals to about 11.6% (figure 4.12).

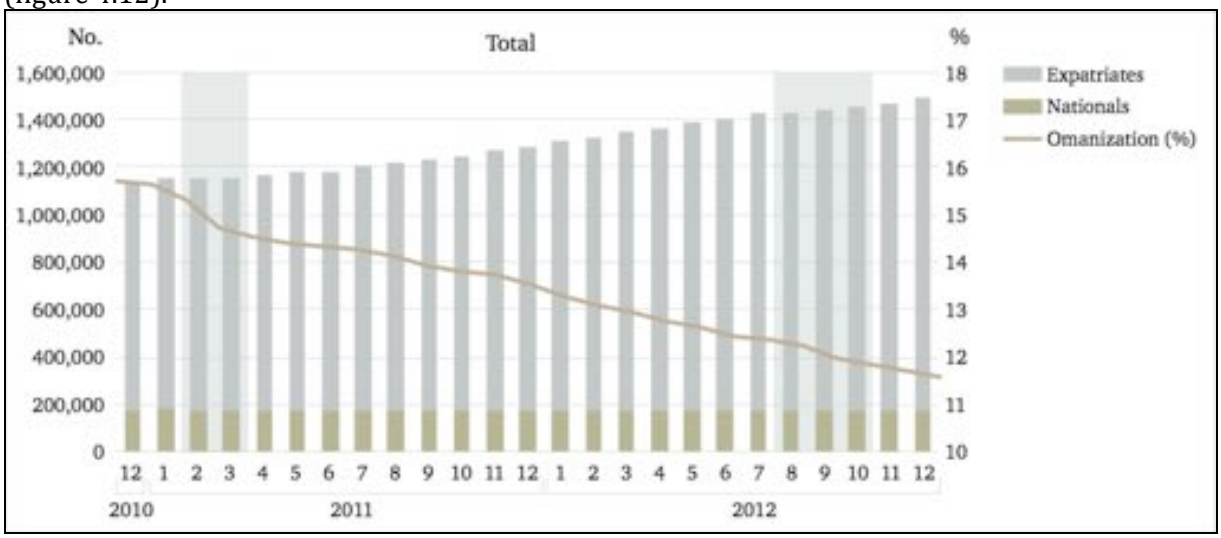


Figure 4.12. Omanization in the private sector. Source: Ennis & Al Jamali, 2014

The stand outs in this respect are the banking sector, with an Omanization grade of 85,4% and the hydrocarbon sector, with an Omanization of 90%. The public sector still shows high Omanization grades of about 85%, which still isn't the 95% Omanization grade set for 2020.

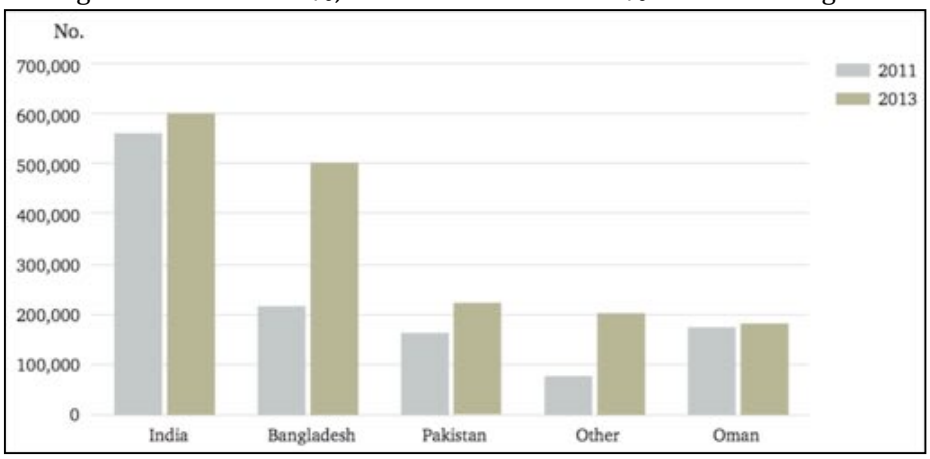


Figure 4.13. Labour market participation by nationality, 2011 and 2013. Source: Ennis & Al Jamali, 2014

Subsequently high Omanization grades are limited to only a few sectors, and especially in the private sector Omani's occupy specific functions that are highly capitalized but low on labour intensity. The lion share of the economy is still factor driven and heavily dependent on skilled low wage foreign labour. Additionally even though the creation of jobs is one of the governments' major aims, unemployment levels remain rather high, especially under the Omani youth (figure 4.14). This indicates the existence of a gap between the current labour market structure and the education system.

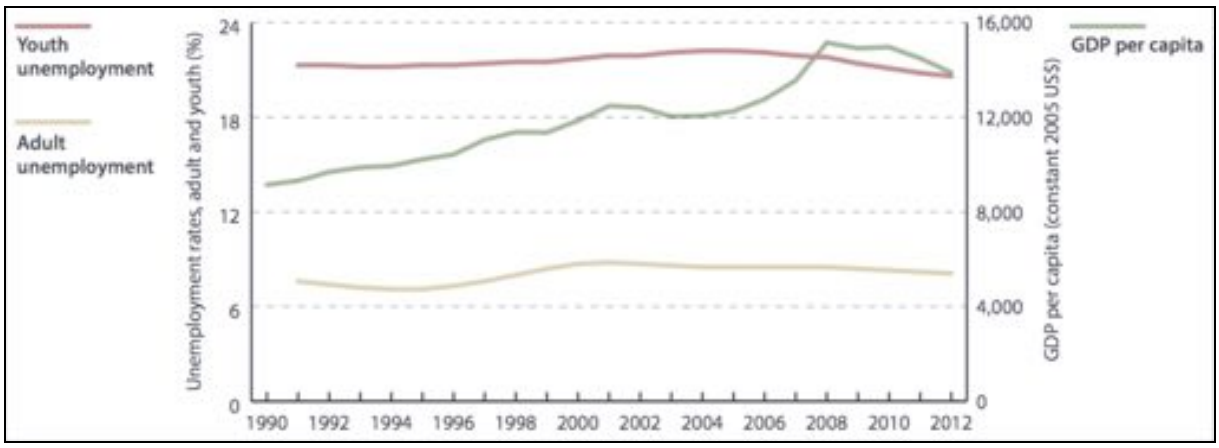


Figure 4.14. Unemployment rate (youth & adult) and GDP per capita development. Source: Ennis & Al Jamali, 2014

The fact that participation of Omani nationals in the private sector remains low can be assigned to several policy measures that have been taken, e.g. increasing minimum wages for Omani nationals. An increase in minimum wages for Omani nationals in combination with significantly lower minimum wages for non-nationals stimulated firms to employ non-nationals rather than Omani's. Early 2011 minimum wages for Omani's increased from 140 Omani Rial (OMR) to 200 OMR ($364 to $520). A second and even more substantial increase took place in 2013, bringing minimum wages to 325 OMR ($844,50). Minimum wages are still below public sector averages, and hence still encourage people to work for the public sector.

The high unemployment rates, especially under young Omani's, led to a strong feeling of dissatisfaction in 2011 and protests on the streets. The result of those protests were a set of short term, rather hasty solutions like increasing minimum wages (as described above), a monthly unemployment benefit and the establishment of 5000 jobs for young Omani's at the government with additionally more and improved social benefits from their public sector jobs. All these incentives again have only strengthened the position of the government as the main employer for Omani nationals and hence are only short term solutions that will have long lasting impacts. Summarizing paragraph 4.3.3 could be mentioned that short term solutions keep on underlying the structural problems Oman's economy is subject to, and its labour market in particular. Central within these structural problems is 40 years of massive revenues derived from the hydrocarbon sector, which has not just turned Oman into an oil economy, but rather into a whole oil society with deep rooted challenges for the future.

4.5 Innovation & R&D

In both endogenous as well as exogenous growth models the role of knowledge and innovation has been discussed within the literature review. Both types of growth require knowledge creation in order to create, develop new growth paths and to avoid a lock-in situation. From an endogenous growth perspective a society's ability to create or cope with technological change determines its ability for economic growth (Aghion & Howitt, 1990). As this ability is the result of learning processes, pre-existing resources, competences and skills enable the development of new growth paths in the economy (Boschma, 2014; Dawley et al., 2008; Neffke et al., 2011). And whereas exogenous growth is dependent on the transplantation of knowledge from elsewhere, the extent to which this transplantation actually leads to new growth paths in the economy is heavily dependent on a region's absorptive capacity (Ewers, 2013; Martin & Sunley, 2006). The absorptive capacity has been defined in chapter 2 as a region's ability to recognize, assimilate and use valuable external knowledge in order to create new knowledge (Simmie et al., 2008). Additionally does a mismatch between the local existing knowledge and valuable external knowledge in the form of a technology gap have a negative impact on a region's absorptive capacity (Zahra & George, 2002). Secondary data on Oman's innovation and education system is very limited and hence the focus of this study is on primary sources to investigate Oman's

existing skills and competences specifically for the aquaculture industry as captured in the absorptive capacity and a local innovation system (LIS). An example of the available secondary data on Oman's innovative capabilities is 'The Global Innovation Index' (GII), which is an annually published index that ranks 143 countries according to their enabling environments for innovation as well as their innovative outputs. Oman ranks 75 on the overall ranking of 2014 (Global Innovation Index, 2014). In comparison to countries with similar income levels the GCC states, including Oman, score relatively low on the GII. The lack of investments in productive sectors other than hydrocarbons is the main limitation for innovation, this has in chapter 2 been described as the 'resource curse'. Oman ranks among the group of 'inefficient innovators', which means that according to its innovation input (measured in factors enabling innovation) it's output (measured in knowledge, technology and creative outputs) is lagging behind. Oman ranks relatively high on input factors like e.g. tertiary education enrolment levels (rank 32, mainly thanks to a 38,9% enrolment in science & engineering), it's institutions (rank 43) and it's general and information infrastructure (rank 57). On the other hand does it rank relatively low on knowledge creation (rank 111, as a result of low levels of patent applications and scientific and technical publications) and knowledge diffusion (rank 107, as a result of e.g. low levels of high-tech exports and low levels of FDI outflows).

Secondary information on R&D expenditure of Oman is only available for the year 2011, when it spend 0,13% of its GDP on R&D. This is only a fraction when compared to leading innovating countries like the United States or the Netherlands, where in that same year respectively 2,8% and 2% of their GDP's where spend on R&D (Knoema, 2015e). On the other hand should be noted that Oman's R&D spending on agriculture and fisheries increased with 6,5% between 2007 and 2012, indicating major efforts to develop these sectors (ASTI, 2015). The next chapter will provide further insights in the current status and the development of aquaculture industry in Oman.

5. Evolution of the aquaculture industry in Oman

5. Evolution of the aquaculture industry in Oman

"The government strategy is to attract knowledge, technology and investment from outside. Not just technological knowledge but also managing capabilities as fish farming is a risky business – you need to have an experienced manager who can react in the right way." – After a British aquaculture expert at the Ministry of Agriculture and Fisheries Wealth.

After a brief description of Oman's economic structure, with a special attention to the dominant hydrocarbon industry, the fisheries industry and the institutional framework, chapter 5 continues with introducing an example of Oman's efforts to diversify its economy; the development of a world class aquaculture industry. For the first part of this chapter an extensive *desk research* has been carried out in order to provide general information on the evolution of the aquaculture industry in Oman. Subsequently the second part of this chapter will, based on primary qualitative data and using quotes from a wide range of informants, draw a clear image of what the main sources of the aquaculture developments are in Oman. As such will also be determined the extent to which skill-relatedness between capture fisheries and aquaculture allows for branching out in order to develop the aquaculture industry. The chapter will finish by answering the first sub-question; *What are the main sources of the growth path of the aquaculture industry in Oman, and to what extent do these sources influence the paths potential for success?* In order to create an overall understanding primary empirical results are integrated with secondary sources and with the provided literature from chapter 2.

5.1 Aquaculture in Oman

5.1.1 An introduction to aquaculture

With global populations expected to exceed 9 billion people by the year 2050 one of the current challenges facing the agri-food industry is to increase productivity and reduce waste to keep the world fed in the future. In the context of a strong growing demand the aquaculture sector has made an impressive growth over the last 30 years. With a total aquaculture production of 5 million tons in 1983, in 2013 the total produced amount of fish was 63 million tons, making aquaculture the fastest growing food-producing sector in the world. In comparison, during that same time frame capture fisheries production increased from 69 to 93 million tons. By 2030 aquaculture is expected to produce 62% of the world's fish consumption (World Bank, 2013). Figure 5.1 shows the average annual growth rates of both aquaculture and capture fisheries. Beside the fact that the world's overall population increases, do also incomes increase steadily. Especially growing middle classes in the traditional BRIC countries (Brazil, Russia, India & China) cause a growth in demand for high quality seafood. Currently fish accounts for 16% of global protein consumption, but this number is expected to increase as aquaculture is growing and due to increased productivity and efficiency the prices of fish are kept competitive (World Bank, 2013)

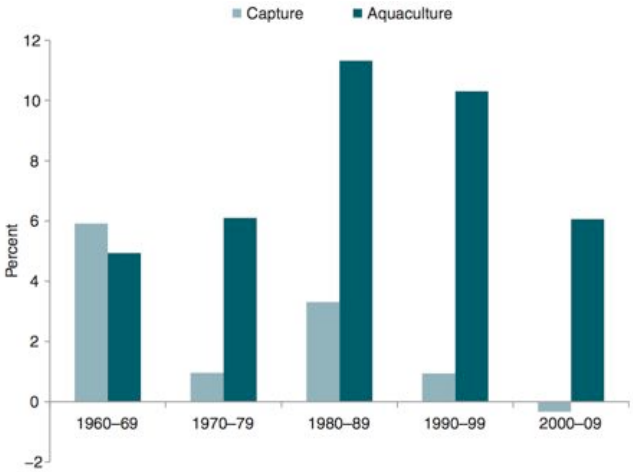


Figure 5.1. Average annual growth rate of aquaculture and capture fisheries. Source: World Bank, 2013 [online]

Aquaculture

Aquaculture is known as the breeding of marine creatures such as finfish, shellfish, crustaceans and aquatic plants within a limited aqueous environment and controlled by man and can take place in inland, coastal and marine areas (FAO, 2015a). Depending on the animal or plant species different amounts of fresh, brackish or salt water are used. Because the farming of several species is still relying on the collection of seed from wild fish it is usually advised to cultivate local species. On the other hand do certain introduced species have a large socio-economic impact because of strong worldwide demand. Especially shrimp and marine fish can have a significant economic impact because of their high market value. Currently different species of freshwater carp, molluscs, shrimps and oysters are the main contributors to the total aquaculture production (in tons) (FAO, 2015b).

5.1.2 Development of aquaculture in Oman – diversification

For a few years now the aquaculture industry in Oman is gaining more and more attention from both public and private sector decision makers. In an attempt to further diversify the Omani economy beyond hydrocarbons, aquaculture has been identified as a key pillar for regional economic policy (MAFW, 2011). This increased attention has been the main force to use the developing aquaculture industry in Oman as a case study for this research. Within the aquaculture development strategy a major emphasis is being put on the maximization of socio-economic returns of the industry. Hence the Omanization policy as described in the previous chapter also applies to the aquaculture industry. Through focus on education and training MAFW attempts to create a workforce of Omani nationals that will be able to work in the aquaculture industry. Additionally also direct jobs are created at the MAFW and related companies and research institutes. The development of aquaculture is besides its socio-economic motivation also driven by its contribution to food security in Oman. Even though statistics show different results, and the number of catch changes on a year-to-year basis the general trend is one of declining wild capture of popular species including yellow fin tuna and sea bream (table 4.3).

Figure 5.2. Yellow fin tuna on high demand at the Mutrah fish market, Muscat. Source: Author

According to aquaculture development the main objective formulated by the MAFW is the growth of a strong aquaculture industry in Oman. It is this main objective by the MAFW that is being questioned in this research; does the current growth trajectory of aquaculture in Oman hold the potential to create a viable growth path in the economy? Or in other words, will it continue to grow in to a strong aquaculture industry? Additionally a number of sub-objectives are identified by the MAFW;

- The maximization of socio-economic returns such as contribution to the gross domestic product (GDP), food-security, creation of employment, development of small and medium enterprises
- Promotion of cross-sectoral integration
- Promotion of technology and innovation
- Promotion of environmental efficiency and public image
- Production of best quality products and services
- Achievement of competitive advantage and global recognition

- Institutional capacity building and enhancement of the capacity of scientific research
- Encouragement of private sector led growth
- Maintenance of balance between key components of the sector

Combined the main objective and sub-objectives form the overarching framework within development initiatives from the Ministry of Agriculture and Fisheries Wealth takes place. Examples of these initiatives are the opening of the Aquaculture Centre in Muscat, the implementation of various preparatory studies (wild capture and aquaculture related), the establishment of the Oman Aquaculture Development Company, the establishment of an aquaculture development committee within MAFW, the preparation of a legal framework and investment guidelines for (foreign) investors in aquaculture and the development of an atlas with suitable sites for aquaculture at sea.

5.1.3 Current status of the aquaculture industry in Oman

Oman began conducting commercial aquaculture back in 1986, with the production trial of the giant tiger prawn on a private farm in the south of the country. Due to technological difficulties the production never reached the commercial stage. Since 1994 the government has recognized the need for improvements in the fisheries sector as a means of livelihood for a vast amount of the Omani coastal population by establishing the Aquaculture Laboratory at the Marine Science and Fisheries Centre (MSFC) in Muscat. Since about 5 years the development of a world-class aquaculture industry has received a priority status by the Omani government. The MAFW says to be committed to lay the foundations to build up the industry. Nowadays, due to research projects funded by the MAFW and subsequently the transfer of relevant technologies has stimulated the interest of local companies in commercial aquaculture ventures. Major focus points of these research projects have been on both fish and shellfish culture, like the hatchery of abalone, mussel and oyster culture, shrimp farming as well as cage and pond farming of finfish. At the moment different research programs are on going, like the development of hatchery technologies for enhancing natural abalone, the hatchery development for finfish (especially on breeding and culture technologies for native species like groupers and sea breams) and the production of sea cucumbers. Most of the research projects are open for collaboration with foreign experts in the concerned fields. Table 5.2 demonstrates the estimates of annual production by the years 2020-2025, it also displays where for now the emphasis in the development of aquaculture is being put. It should be mentioned that the abbreviation 'RAS' stands for Recirculating Aquaculture Systems, a high-tech closed land based aquaculture system that uses a minimal amount of water input whilst at the same time gaining a high productivity of hatched fish.

Figure 5.3. Algae pond, Feed Algae Ltd, Muscat Oman. Source: Author

Type of production system and principle species	Estimated annual tonnage output	Turnover in OMR millions
Marine RAS (breams)	5,000	9,6

Shrimp Ponds	19,000	41,9
Freshwater RAS	5,000	2,2
Marine RAS and restocking abalone	100	1,4
Sea Cages (breams)	2,300	4,5
Sea Cages (cobia)	2,000	9,9
Marine ponds and raceways restocking (sea cucumbers)	300	2,0
TOTALS	33,700	71,5

Table 5.2 Targeted output from aquaculture (2020-2025). Source: MAFW, 2011

Algae and seaweed

In addition to table 5.2 should be mentioned that more recent developments have seen an increased interest in items not displayed in this table, this is caused by more bottom up developments and initiatives from the private sector. An example of this is the interest in the growth and application of algae (micro resp.) and seaweeds (macro algae). The Aquaculture Centre has developed a feed strategy in which the application of algae and seaweeds in terms of their use for fish feed production is considered for research. The conditions in Oman for the production of algae are extremely suitable since the growth of algae is mainly depending on a high amount of sunlight and high quality (low polluted) seawater. So far this has only led to the location of the British company Feed Algae Ltd, which will start producing algae for the animal feed industry on a large scale in the near future (see figure 5.3).

Additionally, Oman Fisheries, as being the largest fishing company in the Sultanate is planning to start a pilot project for the commercial farming of seaweed. The supply of seaweed worldwide is still lacking behind the demand, which is subject to strong growth. Oman has recently noticed this trend and hence different parties are interested to invest in the marine plants. Another more recent trend is the interest in the different applications of aquaponics, for example integrated systems for the breeding of breams and growth of tomatoes in greenhouses. The Agriculture and Fisheries Development Fund (AFDF) recently (May 2014) announced that it has launched a program in which financial assistance is offered to initiatives that introduce new ideas and techniques that integrate agriculture and aquaculture. The program is to be rolled out nationwide since aquaponics is being considered highly suitable for Oman, hence aquaponics initiatives should be able to count on sufficient support.

Private sector activity

Despite major efforts to start and grow aquaculture activities, the industry is still in a premature, early stage of development in terms of basic and applied research and private sector activities. No real example of a successful aquaculture business is demonstrated yet. Such an example would be highly valuable, as it would showcase the possibilities for a viable aquaculture business and could take away hesitation at the address of foreign companies and domestic investors. Currently only a hand full of private companies is operational in the industry (see table 5.3 and figure 5.6 & 5.7). Bentoot Seafood Products runs a shrimp farm in the Al-Wusta Governorate currently owned by the Shanfari Group, which is already the third owner of the

Figure 5.4. Preview of the KAT/Hesy RAS facility at the Sur Industrial Estate. Source: PEIE, 2014

company since it started producing in 2007. The company is now also partly owned by the National Prawn Company from Saudi Arabia – mainly for technical and pathological assistance. In the Muscat area the Quriyat Aquaculture Company used to operate two cage sites with yellowfin tuna and sea breams as the main species being cultured. However due to the occasional red tide and bad management practices the company was not viable in Oman – which led to a total relocation of the production facility to the United Arab Emirates in 2012. More recently the British Feed Algae Ltd geared up with the Sultan Qaboos University to start commercially producing algae for the animal feed market in the nearby future (figure 5.3). The Dutch company Hesy is in an advanced stage of the procedure phase and is expected to start building their RAS facility in Sur soon. This facility is a partnership between Hesy and Knowledge Advanced Technology (KAT), which is an investment subsidiary of the Public Establishment of Industrial Estate (PEIE) (see figure 5.4).

Additionally several small agricultural companies in the north of Oman are rearing tilapias on their farms (initially in an effort to control the mosquitoes), but only one of them produces the Nile-tilapia on a commercial scale. In the south of Oman, the province of Dhofar, the production of abalones is a major source of income for the rural population. The annual wild abalone fisheries along the Dhofar coast has been part of the Omani fishing culture for decades, but due to overfishing stocks are declining. It should be mentioned here that private sector activities, including foreign investments, could have been higher when looking at the interest of foreign companies. Slow handling of the application procedures at the different ministries is seen as a main reason for slow growth, which is hampering viable future prospects of the industry. Although strong regulation is positive in the long run, and is necessary for ecological and biodiversity reasons, in the short run it has negative impact on the process of investments. Advice on applications is often difficult to receive and time-consuming. Improving the public services in this respect would enable economic growth and speed up administrative bottlenecks. The Environmental Impact Assessment (EIA) approval is key when considering investment in Oman, and technical assistance should be sought at local private companies who are familiar with the strict regulations. The long procedures have resulted in the withdrawal of many potential parties from doing the investment. To illustrate this, Norwegian cage farming projects have never been realised because of rejection of the EIA. Other projects with foreign participation find hinder of the regulation and long procedures, e.g. a major Asian shrimp company (Lim Shrimp Organization), who announced in 2013 to co-invest with local Omani partners in a $100 million dollar, 700-hectare, multispecies aquaculture farm (figure 5.5). But due to long procedures at the address of MAFW the company considered to withdraw from its investment by the end of 2014. Companies that are discouraged this way in Oman are likely to consider other GCC countries for their investment.

Figure 5.5. Preview of the Qurun Aquapolis Project by the Lim Shrimp Organization. Source: Shrimp News, 2013 [online]

Capacity building

As mentioned in chapter 4 has the R&D spenditure on agriculture and fisheries in Oman increased with 6,5% between 2007 and 2012 (ASTI, 2015), demonstrating an overall interest in capacity building in these fields. Different research and educational institutes form the 'backbone' of the Sultanate's attempts of achieving human resource development and capacity building objectives within the aquaculture industry. The recently established Aquaculture Centre is the main state institution conducting both applied and scientific research, and has some very specific and valuable knowledge in-house as well as several international

researchers/consultants. The centre is appointed as the main responsible institution for setting the country's research priorities as well as in supporting the private sector. Nevertheless besides certain guiding documents like '*the investment guidelines for aquaculture development*' and '*the atlas with suitable sites for aquaculture*' the coordinating role of the Aquaculture Centre is at present unclear. Thus, so far capacity building on aquaculture and fisheries in Oman takes place in a rather dispersed, decentralized way with often different entities in the network not being aware of the other's activities. The following are the main knowledge institutes in the field of aquaculture and fisheries in Oman:

1. **Marine Science & Fisheries Centre** (Muscat, under the MAFW)
2. **The Aquaculture Centre** (Muscat, under the MAFW)
3. **Sultan Qaboos University** (Muscat, under the Ministry of Higher Education)
    i. **Department of Marine Science and Fisheries**
    ii. **Center of Excellence in Marine Biotechnology**
4. **Fisherman Training Institute** (Al Khabourah & Salalah, under the Ministry of Manpower)
5. **Mirbat Aquaculture Station** (Mirbat, under the MAFW)

Figure 5.6. Fish tanks of the SQU Marine Science and Fisheries Department. Source: Author

Within MAFW as well as within the above mentioned institutes a number of international lecturers, researchers and consultants is employed in order to assist in the development of aquaculture in Oman. Both within the MAFW as well as within the SQU institutes the qualifications of the research staff increased. In 2009 8% of the MAFW researchers held a PhD, in 2012 this was 10%. At SQU this percentage increased from 16,2% to 17,7%. The most remarkable increase is the percentage of BSc level researchers working at the MAFW, this number increased from 15% in 2009 tot 32% in 2012. This increase is most likely to be contributed to the job creation efforts of the government in a response to the uprisings in 2011 resulting from the high youth-unemployment levels. Collaboration between the above mentioned knowledge institutes remains rather week. Collaboration and communication takes place on individual basis, resulting in lack of strategic approach, near sightedness and many implemented short projects without clear defined goals and follow ups. All have over the years developed their own specialisms and specific skills and capabilities. Both SQU as the FTI offer fisheries and aquaculture courses, with SQU offering bachelor and master degrees as well as post-graduate programs. A total average of around 25 students graduates from SQU (fisheries and aquaculture combined) yearly.

Integrated aquaculture-fishery clusters

At the moment of writing plans are made to develop 2 integrated clusters around the upgrading fishery port locations in Sur and in Duqm. The project in Sur is initiated by the Public Establishment of Industrial Estates (PEIE) and will be a bio-marine industrial cluster. The PEIE has sought collaboration with universities in the UK and in France for R&D projects, and the Dutch company Hesy, that is involved in the initial and core project of the cluster which is the development of a fish farm using RAS systems with an integrated aquaponics system (figure 5.3). After the establishment of this key project different related up- and downstream industries

will be developed. These activities run from food processing, value adding and retailing to the development of a related pharmaceutical industry.

The development of an Integrated Fishery Hub in the southern – yet to be build – city of Duqm is part of a large-scale port development project. The government of Oman is developing Duqm into a fully integrated export centre for upstream projects and later for downstream industries. The Duqm Refinery & Petrochemical Industries Company LLC (DRPIC) is developing a refinery project with an investment of around $5 billion, with which it is most likely to be Oman's largest industrial investment. Around 4 square kilometres of free-zone land has been earmarked for the integrated fishery hub and is now open to investors in fishing, aquaculture, processing and distribution of fish. A few major components of the Duqm Fishery Hub are:

- A commercial fishing port for servicing traditional-, multipurpose- and oceanic fishing vessels operating in the north Indian Ocean
- A fish market with electronic trading platform
- Fish landing, storage, selling and distribution facilities
- 40 plots available to investors to build their own processing plants
- A single-window for quick clearance of consignments for exports
- Wharfs for construction, repair & maintenance of fish gear and boats
- Aquaculture facilities
- Fish meal and fish oil plant for processing sardines and other small pelagic

More than the developments in Sur are the developments of the fishery hub in Duqm in a very early stage of implementation. Other than the Sur project, which is a clear public-private initiative, can the fishery hub in Duqm be considered as a prestige project of the Ministry of Agriculture and Fisheries Wealth.

Geographical distribution

When it comes to the geographical distribution of aquaculture activities in Oman most is centred in the capital area of Muscat. This in itself is not strange as by far the majority of the Omanis live in the capital as well as does it host most of the economic activities. Table 5.3 provides an overview with all current and (near) future aquaculture projects in Oman, which subsequently are demonstrated on the maps in figure 5.7 and 5.8.

Number	Item
1	Feed Algae Ltd.
2	Oman Fisheries Company
3	Quriat Aquaculture Company *(relocated to the UAE)*
4	Public Establishment of Industrial Estates
5	SQU Centre of Excellence in Marine Bio-Technology
6	SQU Department of Marine Sciences
7	Ministry of Agriculture and Fisheries Wealth
8	Marine Science & Fisheries Centre
9	Aquaculture Centre
10	Bio-Marine Industrial Cluster Sur *(not yet realised)*
11	Integrated Fisheries Hub Duqm *(not yet realised)*
12	Bentoot Shrimp Farm
13	Fishermen Training Institute Al Khabourah
14	Fishermen Training Institute Salalah
15	Mirbat Aquaculture Station

Table 5.3. Index aquaculture map Oman. Source: author

Figure 5.7. Aquaculture Oman, map 1 –Muscat area. Source: Author

Figure 5.8. Aquaculture Oman, map 2 - full country. Source: author

5.1.4 Aquaculture investment policy

As described in paragraph 2.1.2 is one of the four factors enabling the process of path creation the occurrence of triggering events like the location of leading firms within the industry or a local government industrial policy. These kinds of triggering events are necessary to create awareness and realization of actual industrial potential of a region. Because Oman has identified aquaculture as a key pillar to diversify its economy the Ministry of Agriculture and Fisheries Wealth (MAFW) has drafted a document with the available incentives for aquaculture investments, the '*aquaculture investment guidelines*'. This document provides useful information for both foreign as domestic companies willing to invest in the aquaculture industry in Oman. It elaborates on the incentives for aquaculture investors offered by the Omani government, as well as on the socio-economic obligations investors have when investing in Oman. The following list provides an overview of the incentives available for aquaculture and what Oman expects from investors in return. Oman offers the following to investors in the aquaculture industry:

1. Financial incentives

- No income tax on personal income.

- Free repatriation of capital and profit (*at the time of writing taxation of repatriation of capital is being discussed, as a means to increase non-oil government income*).
- 70% foreign ownership – which can be increased.
- Exemption from custom duties on machinery, equipment, raw materials for five years from commencement of production.
- Low corporate income tax rates of 12% above 30.000 Omani Rial when applicable or corporate tax holidays – available for five years and extendable up to ten years.
- Low energy and fuel costs.

2. Logistical support

- The MAFW offers a 'one stop shop' that helps investors analysing and formulating their business proposals.
- The Public Authority for Investment Promotion & Export Development (PAIPED) can provide information on climate, laws and procedures as well as project specific information. It can also organize visits and match-making meetings for foreign investors.

Depending on whether or not the investor meets several criteria an exemption from corporate tax income (normal rate at 12%) is additional. This could mean the company has met a milestone for fixed asset investments, exports and/or the hiring of Omani nationals. Both the exemption from corporate tax as the exemption from custom duties can be extended for another 5 years. In return for the offered incentives as described above Oman expects great business commitment from the investors on the following items of focus;

1. Employment opportunities for Omanis – The training and development of Omani nationals is one of the key objectives of the MAFW. Hence like all investments should aquaculture projects meet the Omanisation quota set by the Ministry of Manpower, which for the aquaculture industry is set at 35%. Companies are expected to hire, train and promote Omani workers actively.

2. Technical expertise – Foreign companies are expected to bring the highest level of technical expertise additional to a proven track record of the development of new species and aquaculture systems. This high level of technological know-how is essential in order to overcome local challenges and to develop high potential projects with indigenous species that are valuable in both the domestic as the international market.

3. Social commitment – Foreign companies are expected and encouraged to establish good relations with local communities by participating in community organisations and social development programs. Investors are expected to write a proposal on how they will train and integrate Omani employees into the corporate structure of the company. Companies presenting good proposals will be given priority above those who don't.

4. Business commitment – In order to develop a strong aquaculture industry for the future foreign companies are expected to demonstrate long-term ambition for their investment in Oman and a sufficient financial backbone to put a significant amount of own capital in the project.

5. Domestic food security – Being currently a net exporter of fish, investors are expected to be willing to contribute to Oman's future food security. Proposals are expected to address what percentage of the production companies are willing to sell in the domestic market and which concrete steps will be taken in order to contribute to local food security and the restocking of natural populations.

6. Quality commitment – In line with Oman's aim for a '*reputation of excellence*' and the top level technical expertise that is required are only '*world-class*' companies considered for approval of investments. Part of the quality commitment is the compliance with the highest standards for environmental care and safety.

5.2 Sources of aquaculture in Oman

The second part of this chapter will start with reviewing the existing skills and experience of Oman in the field of aquaculture before discussing to what extent traditional capture fisheries and aquaculture are related to each other in Oman. After doing so a brief assessment will be made of the possibilities for endogenous growth of the aquaculture industry in Oman. Consequently the chapter turns to the sources of the aquaculture growth path and examples of direct risks this type of growth brings along. To structure the argumentation line necessary for answering the first sub-question each paragraph will end with a short conclusion.

5.2.1 Oman's history with aquaculture

Existing skills and capabilities

The first part of chapter 5 has based on desk research and secondary data provided an image of the current status of the aquaculture industry in Oman as well as briefly described its history. This paragraph will further elaborate on this history and the specific existing skills and experiences in the field of aquaculture in Oman using primary qualitative data.

Looking at the history of aquaculture in Oman it is not possible to fill a hand full of commercial projects in the industry – let alone commercially viable projects, more about that later. It was the Quriat Aquaculture Company that was the first commercial project in 1992, operating several open water cages just south from the capital city of Muscat where they experimented with tuna fattening and growing the European sea bream. The Bentoot shrimp farm, which first started in 2007, is the second commercial aquaculture project and even though it changed ownership several times is still operating. A third commercial project is the growing of Nile tilapia at a farm in the Batinah region, which above all is very small scale. But unless these three projects all the informants emphasized the limited experience Oman has in the field of aquaculture. From both the public, the private and the education sector informants characterized Oman as an inexperienced country in the field of aquaculture, with no substantial existing relevant skills and capabilities for running a fish farm or aquaculture project. This indicates that Oman is in the early development stage of building an aquaculture industry, which until recently didn't have any history in the country. Among others the following statements of two different informants from the Ministry of Agriculture and Fisheries Wealth confirm this.

"We are working for the future – all of the aquaculture activities we are starting now, we are still lacking training, techniques and technologies." "Aquaculture is a new sector in Oman and it is in the initial stage."

Another informant, but then from the private sector, mentioned that due to the lack of experience with aquaculture in Oman his daily operations are impeded. In the following statement he compares the existing experience in aquaculture in Oman with the existing experience in aquaculture in Chili.

"*The fact is there is experience and a history of aquaculture in Chili, and a track record, wherever you go there you find people with a track record – there is salmon, there are fish feed companies, there's a lot going on. Here in Oman that's different, it is not there yet.*"

This same informant turned out to be pretty surprised by the low levels of knowledge he found upon starting operations in Oman. He illustrated this lack of experience and capabilities in Oman with the following example.

"*My 12 year old children are better at sampling algae than, honestly, any Omani that I could find. That is not because they're not competent or they cannot learn, but the system isn't there yet. It is still developing*."

Again this informant points to the fact the lack of skills and capabilities is the result of the only very recent history Oman has with aquaculture, but simultaneously that it is affecting is business activities in the country. This will later become clearer when reviewing the labour market and the education system. This similar point of view got confirmed by another informant from the private sector, and subsequently from a foreign expert within the research and education group of informants;

"*The level of knowledge in the field of aquaculture is very basic. There are several degrees which include aquaculture at the moment, but only back in 2011 the government announced to actively start developing the aquaculture industry, so there is knowledge, but it is still very marginal*."

"*You know we have a very young population here, there is not a lot of depth of expertise, and particularly there is no depth of expertise on aquaculture.*"

One informant mentioned that in addition to an overall lack of experience in Oman he was surprised by the specific knowledge, which is actually available here and there in the country. But even though he found that level of knowledge somehow surprising, he did miss any form of commercial application with that knowledge.

"Actually the level of knowledge of aquaculture here in Oman is as with so many things here – at one moment you're like 'that is actually pretty good', but the next you're like 'but there is totally nothing happening with it!' The knowledge that exists is quit dispersed – both within the ministry as well as at SQU specific knowledge exists, but it is isolated knowledge which is not further integrated – the application of knowledge is a real problem." – After a public sector informant

That missing step from possessing specific knowledge to transforming it in a commercial project is something heard more often during the interviews. This 'last step' however is not something limited to the commercialization of research projects, also in the context of institutional boundaries it has been proven that the 'last step' was too often too hard to take, but this will be discussed later. The following statement of an informant from the research and education group demonstrates that specific knowledge is acquired over the years through research projects, but that nothing was picked up and transformed in to a business case.

"*… we had a whole multi trophic survey done on the species here that would fit in to a multi trophic system, we had algae, we had seaweeds, we had some fish. It was a very nice system, but there was nobody who recognized it's potential, so it never went anywhere – and you know there is a lot of value in there*."

In later chapters will be elaborated on the research done and the level of education. In addition to the lack of history and existing skills with aquaculture is there a general lack of sufficient infrastructure for commercially running an aquaculture project, this means that within the industry both back- and forward linkages are missing. This already became clear in the first part of chapter 5 but is confirmed here with primary data. On the supply side for example there are no hatcheries, there is no fish feed being produced and there are no fish health services and quarantine facilities in the country. On the consumer side of the chain is especially the cold chain problematic, leading to poor quality products. An illustrating example of this problem is the

Mutrah fish market (figure 5.2), where fish can be displayed several ours in the heath of the day which in Oman can rise till over 50 degrees Celsius. So in general the understanding and awareness of fish quality is very poor, which is demonstrated in the following statement by an informant from the research and education group.

"The post-harvest processing is not controlled, there is absolutely no ice most of the time, the fish are not gutted, they're not bled, and so you end up with digestive enzymes which are working inside the fish for 5-6, 12 hours."

Knowledge & technology gap

Giving the fact that Oman is relatively inexperienced in the field of aquaculture it is likely to assume that there is a knowledge gap between the in Oman available knowledge, and the external, global knowledge. On the other hand is the question how advanced the global knowledge really is to determine the existence of a technology gap. In the first part of chapter 5 became clear that in the previous decades worldwide aquaculture productions increased tremendously. This is partially because aquaculture is in itself a relatively new sector which is still not fully mature yet.

"Farming fish is something that is simply not yet fully understood, even for companies with a lot of experience it is quit difficult from time to time to know what is the right place to conduct aquaculture, for what kind of species in what kind of farm, with what kind of feed etc. It is pretty precise work." – After a private sector informant.

"*The Norwegians we're very active in Oman, whenever there was a big event, you would find Norway there. So they went and spoke about the sea cages – so once one of them was speaking and saying 'oh, the sea in Oman is very clean', and I told him yes it is very clean because you didn't come yet. But if you come with what you want to do it will not be clean anymore. Norway is trying to push now with the ministry the matter of the sea cages, we are trying to fight it actually as much as possible. I told them already in the discussion, it was maybe one month ago, 'you have polluted your own seas, and now you're turning around the rest of the world to pollute it?' And they made disasters in Chile, here, there.*." – After a private sector informant.

In this second quote the informant talks about a major Norwegian company called Marine Harvest, which is global market leader in salmon production. Recent years have seen several cases where marine cage farms caused tremendous environmental problems due to the scale of the farms and the techniques used. As a result Marine Harvest is still developing new technologies towards a more sustainable and environmental way to carry out aquaculture activities at open sea. In other words, the two quotes mentioned above indicate the aquaculture industry itself is still experimenting, and developing new and better technologies to meet modern (environmental) standards. One of the more recent technologies adapted in the aquaculture industry is the Recirculating Aquaculture System (RAS), which is according to the MAFW plans the main aquaculture technology to be used in Oman in the future (table 5.2). Whilst a relatively new technology in itself, Oman doesn't have any experience with RAS at all, which is one of the points where a major technology gap appears. Table 5.4 provides an overview of the technologies Oman has experience with, and the technologies Oman intends to use in the future. Additionally to the existence of a technology gap is there amongst the major actors of the industry in Oman no consensus about the right way forward when it comes to the right technology. Hence there is no coordinated program towards building capacity of working with certain technologies, like the RAS system. There is not a single research or education institute working with RAS systems yet, even though there are plans of rebuilding the whole aquaculture centre which is now using a through flow system to change to RAS systems. Focus areas of education and research will be discussed in more detail in a later chapter.

Experience with	Future technologies (as of project proposals)
1. Semi intensive earthen pound	1. RAS marine (5 proposals)
2. Circular cage farming	2. Semi intensive earthen pound (1)
3. Integrated farming (tilapia)	3. Intensive earthen pound (1)
4. Aquaponics	

Table 5.4. Different technologies Oman has experience with, and what will be used in the future. Source: MAFW, 2014 (edited by author)

Additional to the technology gap as described above does a general knowledge gap exist with technological leading countries that have a long history with all the aspects of aquaculture like marine biology, fish feed, health and diseases and all the post-harvest activities as discussed before.

Relatedness of skills in capture fisheries

As mentioned in chapter four does the fisheries industry in Oman provide employment to about 36.000 Omani's and does the MAFW often in one breath mention the development of 'fisheries and aquaculture'. And as became clear previously that pre-existing skills and experience in the field of aquaculture are very limited in Oman, it is highly relevant in the context of this research to understand if capture fisheries and aquaculture share similar skills. If so this would indicate that aquaculture actually does have some sort of 'roots' in Oman, consequently leading to the option of a more evolutionary type of endogenous growth with the possibility of labour matching as a result.

Logically capture fisheries and aquaculture share several similar links on the fisheries value chain – which are essentially all post-harvest activities like transportation, processing, quality control, warehousing, and marketing of the fish. But whereas mostly similar, activities like quality control require additional proceedings and a slightly different set of skills. This is related to the traceability of e.g. antibiotics in farmed fish which you wouldn't necessarily expect in captured fish. Hence the quality control on farmed fish is stricter than on captured fish. Otherwise, the post-harvest activities on the value chain of fisheries are about it when it comes to similarities between fisheries and aquaculture. Additionally it goes without saying that actual 'fishing' or 'farming fish' are, whether or not related, essentially different than the processing of fish – they're a similar industry yet different activities, like farming potatoes and making French fries, really opposite sides of the coin. Having said that, not one informant could mention related skills between fishing at sea and farming fish in a controlled environment other than the post harvest activities as just mentioned. The following two statements illustrate this.

"*If you are farming fish you're more a farmer than a fisherman. A fisherman searches and catches wild fish, which is totally different from thinking about if a fish is healthy – what to do if it gets sick, what and when it needs to eat – if it needs more or less, what to do when algae come. Aquaculture really is more a modern way of farming rather than fishing. Additionally, aquaculture possesses a thread as it seems to take away jobs from traditional fishermen, who are definitely not suitable to work in a fish farm*" – After private sector informant.

"*Have you ever tried to do something with a fishermen to change fishermen into an aquaculturist? It doesn't work! Even in Europe, you have lots of aquaculture, but it's not done by fishermen. It is not the same job – it is a very different job.*" – After an expatriate from the research and education informants.

In addition to the above mentioned statements did another private sector informant emphasize the complexity of aquaculture in relation to the existing low skilled fisheries industry in Oman;

"*Especially aquaculture is highly skilled and highly scientific, there's not a lot of people with the right capabilities – you constantly need to check the quality of the water, hatcheries, so many things. It is not just an easy thing*."

Conclusion

Oman is a country that is definitely new in the field of aquaculture – no pre-existing skills and capabilities exist besides several commercial attempts and some specific, yet dispersed and isolated knowledge, and hence can be concluded that Oman doesn't have an extensive history with conducting aquaculture. Unfamiliarity with aquaculture and the insufficient skills in the context of this part of the research are mostly been attributed to the fact that Oman is just starting up its aquaculture activities. Later in the analysis another light will be shed on the characterization of existing skills in aquaculture. Besides sharing similar post-harvest activities in the fisheries value chain capture fisheries and aquaculture are complete different activities that require different set of skills. As a result of no direct predecessor in the form of earlier successful aquaculture activities in the past, nor an indirect predecessor in the form of sharing similar skills with the capture fisheries industry, endogenous growth of the aquaculture industry in Oman is nearly impossible and so are the possibilities of branching out of existing industries. Especially the rapid development the Ministry of Agriculture and Fisheries Wealth contemplates (table 5.2), requiring technological leapfrogging, seems rather unrealistic. Both a knowledge- as well as a technology gap exist between Oman and technological leading countries. In order to keep up with this leading countries Oman makes major attempts to tap in to the international network of aquaculture knowledge, the following paragraph will elaborate on this process.

5.2.2 Knowledge transplantation as a source of growth

A development strategy

As a result of the conclusion proposed in the previous paragraph it is more likely that the development of aquaculture follows an exogenous growth model by transferring external knowledge and technologies in to Oman, in order to develop the industry. This paragraph takes a close look at what the informants had to say about the growth source of aquaculture in Oman.

Only in the first exploratory interviews became clear that the development of aquaculture in Oman was not merely an Omani affair. On a request from the Omani government did the United Nations Food and Agricultural Organization (in short FAO) draft a sector overview of the back then current status of the aquaculture industry as well as a set of (technical) guidelines to further develop the industry. This event can be seen as one of the first policy interventions towards developing aquaculture, of which more followed in 2011.

"*Oman has made a strategy for aquaculture in 2007, as FAO we technically supported them to develop that strategy. In 2011 they organized a huge conference allowing for the investment in aquaculture. Companies from abroad will come up here with experience, also the ministry is doing that, they directly hire aquaculture experts from different countries around the world to get that knowledge coming down to them*." – After the FAO director of Oman.

The FAO director for Oman mentions here the conference that was held back in 2011, this year was characterized by more events, like the release of different policy documents. Several informants had something to say about the events in 2011, which sort of marked a new, or the first serious era of aquaculture in Oman.

"*Then in 2011 we had a major event here, an international symposium which was really designed to kick-start the industry, we had experts from all over the world.*" – After a research and education group informant.

"*There is a Frenchman working within the ministry. I think he worked for the French consultancy that published the Aquaculture Atlas for Oman in 2011, and that in the slipstream of that project he started working and selecting aquaculture locations for the ministry*." – After a private sector informant.

So 2011 also saw the publication of a site selection atlas for aquaculture, which was supposed to work as a mechanism for selecting suitable sites for conducting cage farming. Surprisingly under the informants there was no consensus on the usefulness of this atlas. Here a statement of an informant from the research and education group, followed by a private sector informant.

"*You know we have a site atlas which is very nice, it cost a huge amount of money, it's from a French company, if you understand aquaculture, a company that wants to start a fish farm will come and they'll do their own site survey work, they know exactly what they want, where they want to go*."

"*You know what has exactly been done by the aquaculture centre? Or by the Marine Science and Fisheries Centre? Nothing. The Atlas has been done by a Frenchman, like so many studies are being done by consultancies hired by these so called research institutes*."

Leaving the relevance of this atlas for where it is – point here is that in the very early stage of aquaculture development both the FAO (with foreign experts) and a French consultancy were involved in developing a sort of framework or strategy for future development endeavours of the aquaculture industry. When talking about the motivation of the Omani government to develop the aquaculture industry this is mainly driven by its expected contribution to the national economy in the future, rather than being based on historical assets Oman has in the field of aquaculture. Above all the growth of aquaculture is driven by the necessity for job creation, the following quotes underline this.

"*In general from government prospective it can be said that aquaculture is considered an important sector that can contribute greatly to food security, income and employment generation. As of private sector prospective it is driven by market and demand for a particular commodity*." – After a public sector informant.

"*The first article published about aquaculture in an Omani newspaper spoke about the possible contribution to the national economy in terms of employment generation, that is something really important for economic development here*." – After a private sector informant.

"In the process of diversifying the economy, the government sees an important role for the aquaculture and fisheries sector." – After a public sector informant.

Everything is outsourced

What became clear in an early stage of the research is that in Oman, not just specifically in aquaculture, as much as possible is being outsourced to foreign companies. This literally goes as far an as wide as designing an airport and subsequently also operating the airport, or designing a port and also operating the port.

"*What they really like to do here is outsourcing – so they work with these 'design & build' or 'design, build & operate' contracts. All the projects here are in the early stage assigned to an external consultant and afterwards are EPC contracts awarded to other companies; Engineer, Procure, Construct*." – After a foreign private sector informant.

In 2011 along with the organization of an international aquaculture symposium and the publication of an 'Aquaculture Atlas' another document called the 'Aquaculture Investment Guidelines' was released by the MAFW. In 2011 also the aquaculture centre first opened its doors. It has a lot alike that after this series of events in 2011 the ministry stepped back, in a more passive role (at first sight!), as a regulator rather than the initiator of development of aquaculture in the country. Under several informants there was the propensity to say that the ministry had done its homework and now let the actual developing to be done by foreign parties.

"*When the undersecretary of fisheries Al Oufie came to Holland for the first time he really was showing this attitude like 'we've got the Atlas, we have mapped our entire coastline, we have done the necessary preparation – bring it on.' But then you are still missing a lot, I heard from everyone around me in Holland that Oman was not interesting because it was missing all the right infrastructure*." – After a private sector informant.

The following statement, also after a private sector informant, confirms that the government has a clear attitude towards the division of work; they have outsourced the matter, and hence the problem is with the foreign party and not with the Omani government.

"*What they say in Oman is 'oke, we want someone who comes here to do that, and someone who knows what he is doing.' To give you an example, last year we talked to people within the ministry responsible for water supplies. I asked them about the algae, and the supply of water, which is a problem actually. But the ministry said 'no, that is not a problem, we don't import water. We have contracts with companies who run the desalination plants and it is their problem, we don't have a problem*."

When it comes to the development of aquaculture in the country it is clear that on all different possible levels efforts are taken to acquire external knowledge, technologies and capabilities. Every single development effort has, up to different levels, involvement from foreign knowledge, companies or expertise. An example of this are the recent developments of establishing a Bio Marine Industrial cluster in the small fishing town of Sur, about 200 kilometres south from the capital city Muscat (see figure 5.7 & 5.8). Initiator of the project, as was mentioned earlier, is the Public Establishment of Industrial Estates (PEIE) and some of its investment subsidiaries. For the development of the cluster a special committee is established, headed by the PEIE and further more consisting of the MAFW, the Ministry of Environment & Climate Affairs, the Ministry of Manpower and the Al Khabourah Fishermen Training Institute. In the initial stage the plan of the cluster is to develop into an international agglomeration for RAS technologies, and after the initial stage several other knowledge intensive related industries are about to be developed, these include among others a pharmaceutical industry, a nutraceutical industry and a perfumery industry. Several features about these plans raise question marks in the context of this research. First, Oman has almost no experience with aquaculture, but no experience with RAS systems at all – is it possible to develop a fully-fledged agglomeration of RAS systems without having experience? Second, how are you planning to do that? Leaving the answer on the first question in the middle for now, the answer on the second question is demonstrated in the following figure, figure 5.9.

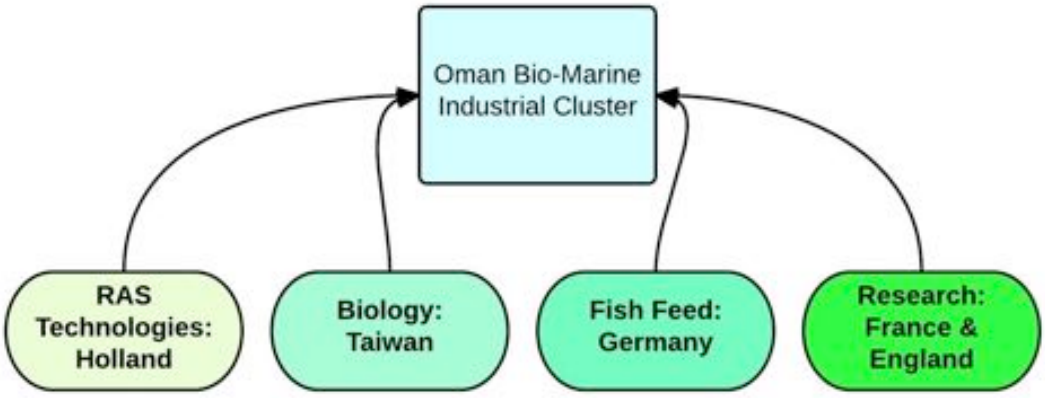


Figure 5.9. Development sources of the Omani Bio-Marine Industrial Cluster in Sur. Source: Author

What the figure attempts to illustrate is that for a specific project, but actually virtually for every development effort, the Omani counterpart (whether public, private or combined) does its benchmarking outside the country to figure out where in the world the best possible partners are located in the desired fields of collaboration. Hence to establish a RAS agglomeration the company certainly to do that with (because of its international track record) was Hesy, from the Netherlands. On the other hand did the PEIE find the right biology partner (including species, diseases etc.) in Taiwan. The following quotes are some of which figure 5.9 is based upon.

"*We're working with 5 universities in Taiwan, which are expert in this thing. The technology is coming from the Netherlands, and we are using the know how for the biology from Taiwan.*
We are also working sometimes with SQU, but there is no R&D here! And if you go to Taiwan, they have the ocean universities, that is working since 1910! They're doing incredible kind of research and which even the Netherlands can benefit from. In the area of the grouper there is nobody in the world that has done the amount of research they have done in Taiwan. So for us we're using them for the biology part. We are trying to create a network, the group from the Netherlands, the group from England and France, plus the group from Taiwan." After the PEIE business development director.

"Whoever we bring in, whether they are the best or not, as long as they know something – and we don't know much because we are new in the field – they will be a positive addition. So yes, Hesy (Dutch company with RAS technologies resp.) is very good to come in, there are also a few other Taiwanese companies they're coming in for different areas. Hesy is good in equipment and systems, these Taiwanese companies in biology, companies in Germany are good in fish feed I believe, so all of these are collected together to create one single model that will allow the industry to thrive." – After a public sector informant.

That for virtually all development efforts at all levels – from collaboration on institutional level, till the delivery of technologies to private parties – will be illustrated with the following quotes from all groups of informants.

1. "*We are working with international institutes, or international organizations to change our syllabus to international standards. We work with the German GTZ (German Technological Collaboration Agency resp.) and with some Dutch partners as well. The German GTZ developed, about 2-3 years back 60 vocational standards, for the Ministry of Manpower, vocational standards for 60 different jobs, nursery, everything. And there were 3 different jobs in fisheries, we started with boat handler, marine mechanics – all for wild capture fisheries.*" – After the Al Khabourah Fisherman Training Institute.

2. *"Many many international companies came already to Oman to do a lot of work. All of the aquaculture projects which have been applied for at the MAFW have a foreign partner."* – After a research and education informant.

3. "*The Quriat Aquaculture Company was a joint venture with a UAE company – Asmak, and a British company. We had some divers from Sri Lanka, and we trained some Omani divers, and some from India. For the position of farm manager we got expats, from India – they were educated and had experience in shrimp farming. They worked in the UAE before, 2 persons, they were supervisors. We also had some Greek for technical support, because the technical support came mainly from Greece, to Asmak, and to us after that.*" – After a research and education informant, who used to be a manager at the Quriat Aquaculture Company.

4. "*For aquaculture we need foreign investment and partnerships with universities, technology partners and marketing/processing partners – all of it*." After a public sector informant.

5. *"What I look for in a future (foreign) partner in aquaculture? Well basically they will have to provide the technological know how*." – After an Omani private sector informant.

6. "*See the problem is now there is competition from Korea, China, this is the problem now for Oman – to give some product from Europe, because the product from Europe is high quality, but it is expensive. But I need technology*." – After a public sector informant.

7. "*If you want to start a fish farm in Oman you need to bring skills, there is not enough skilled people in Oman. Actually they have constructed an aquaculture research center, but it still needs skilled technicians…*" – After a private sector informant.

For the aquaculture industry to develop Oman is looking outside the country for 'development-partners', on all different levels. To illustrate and schematically demonstrate the foreign involvement in the development of aquaculture in Oman does table 5.5 provide an overview.

Sector	Focus points	Example
Education	**Institutional arrangements**	Collaboration with GTZ for the development of the syllabus at the Fisherman Training Institute.
	Teaching & management staff	Of the academic staff at the 'Marine Science & Fisheries' department at SQU are 8 out of 11 not from Oman
	Student exchange	Several students each year use a scholarship to study at foreign universities - which is stimulated by the MAFW
Private sector	**Technologies**	Technological know how: RAS systems, sea cages, algal ponds & drying techniques
	Management/staff	Experienced expatriate managers work at the Bentoot Shrimp Farm and used to work at the Quriat Aquaculture Company.
	Partnerships	All the official aquaculture project applications at the MAFW involve a foreign partner. Other examples include: 1. Partnership between Hesy and Knowledge Advanced Technologies – Bio-Marine Cluster, Sur.

		2. Partnership between National Prawn Company (Saudi Arabia) and Shanfari Group – Bentoot Shrimp Farm
Public sector	**Regulatory framework**	FAO development strategy; The Aquaculture Atlas by a French consultancy
	Research	The British National History Museum has mapped all native species of algae in Oman; Omani ministry staff takes PhD's at foreign universities
	Consultants/experts	The MAFW hires foreign experts in the entire department, examples of these include: John Dallimore (technology & FDI advisor), Dennis Gaznier (Atlas), Adrian Hartley (R&D advisor) and Dave Robb (Feed Advisor)

Table 5.5. Foreign knowledge is used at various levels of aquaculture development in Oman. Source: Author

The risks of foreign involvement

As demonstrated earlier on in this paragraph is there a propensity within the MAFW that they have done the preparatory studies and work, and that the real development now has to be carried out by foreign companies and experts. This attitude does seriously affect the speed with which the development is taking place in several ways.

"*I don't want to be too negative on all these things, eventually things will happen but you know the ministry at the moment is waiting for some fantastic fish farming company to come in and do everything just right from day one and start the business, but I don't know if that can happen."* – After a foreign research and education informant.

This means that instead of actively conducting investor acquisition the MAFW rather sits back and waits till companies come to Oman – which in itself then does not guarantee a rapid development of the industry since many applications have been submitted but almost no projects started. But this issue will be discussed later. On the other hand does the reliance on foreign knowledge and expertise influence the pace of development since knowledge transfers (also described in more detail later) are rather concerning. Hence as specific foreign knowledge within research institutes and within the ministry sits rather isolated and doesn't flow on to Omani colleagues too easily, when the foreign expert or company leaves from Oman this leaves a gap in the aquaculture network or industry. The following quotes demonstrate and confirm this argument.

"*SQU had this facility, and I cannot describe you how deeply sad this facility was, I mean just look at that hole in the ceiling. They didn't use this lab for 10 years. This used to be a joint research project for desalination with some Japanese funding agency – a Japanese sponsor. Hurricane Gonu came along, this area flooded, and the Japanese picked up sticks and left. Ever since this place has been moth balled. There was the solar greenhouse which even preceded that, and which has also been abandoned for 10 years."* – After a private sector informant.

"There are satellite work stations, sitting at SQU, satellite uplinks, but not a single student, not one that you could interest or train or get them to participate. The person who's lab this sits in doesn't even know how to turn it on anymore, and there is a lot of stories like that!" – After a private sector informant.

What seems to happen here is that when at a certain moment in time a foreign expert implements some high tech application like satellite uplinks (in order to monitor the growth of algae in coastal waters for example) within the university, or when a foreign company is operating some sort of advanced laboratory – when the 'foreign involvement' leaves there is not enough capacity locally to maintain the activity. As a result of the absence of local embedding of

external knowledge and technologies do certain 'niche growth paths' within the growth path of aquaculture lead to nothing when the foreign party is not involved anymore. As a result this slows down the development process of the aquaculture industry, as time, effort and money has been put in this specific niche growth path.

Conclusion

When talking about the growth source, or the origin of aquaculture in Oman it seems that it was the Ministry of Agriculture and Fisheries Wealth who initiated the rapid development that was aimed for since several events in 2011. Several arguments for this rapid development were named, like the depletion of natural resources (oil and fish) and domestic food security but the major driver behind the developments is the creation of jobs. When it comes to knowledge, technologies and private sector activities the lion share is brought to Oman from external sources, examples of this can be found in table 6.2. This implies that from virtually having no aquaculture activities, Oman is intending to develop a world-class aquaculture industry using global knowledge and technologies. Tapping in to the international pool of aquaculture knowledge might allow for rapid development of the industry, it also has a downside. The risk of not embedding of knowledge is quit real, causing a 'gap' in the network when foreign experts or companies leave.

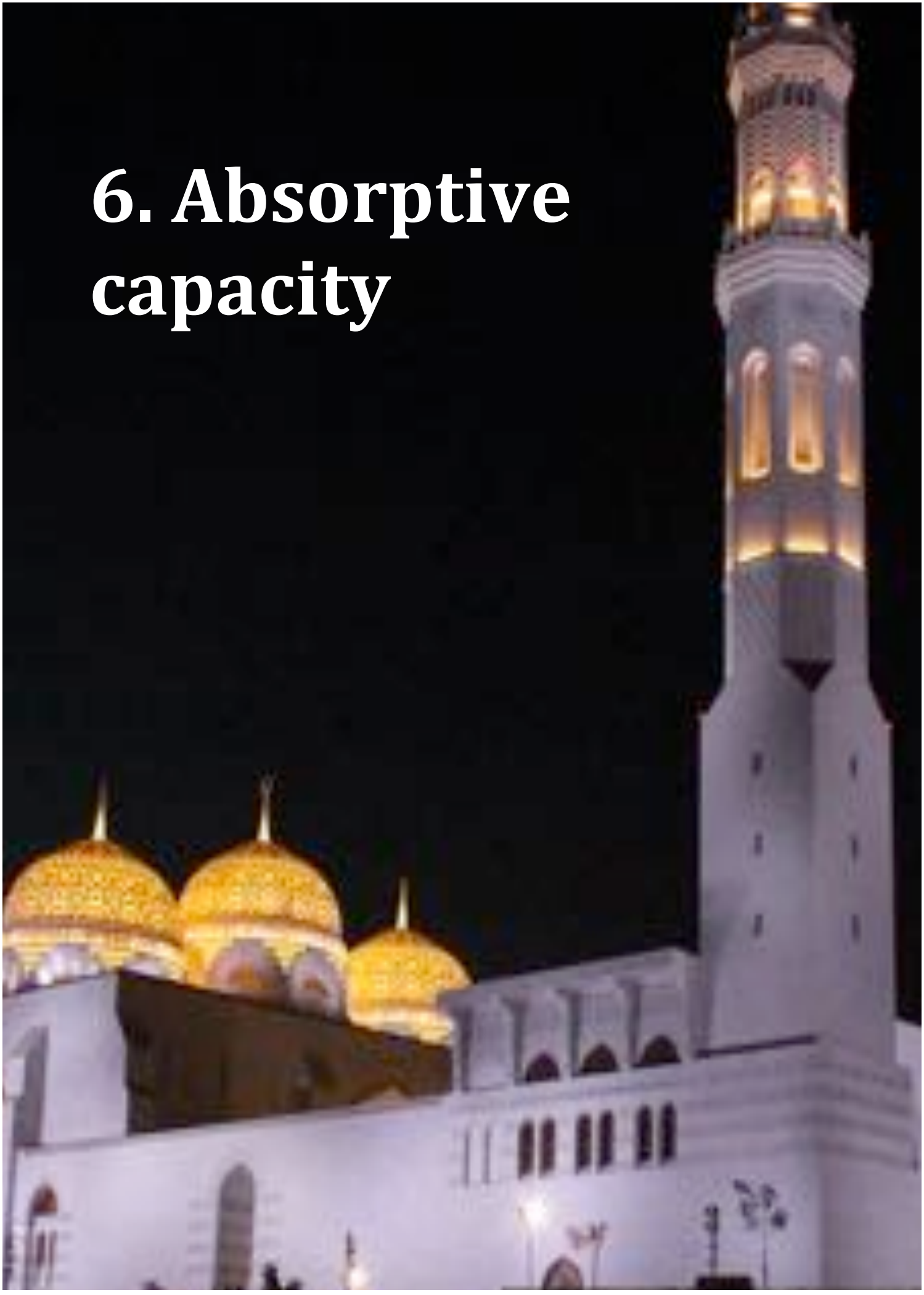
5.2.3 Answering the 1st sub-question

Sources of the aquaculture growth path

In order to understand the mechanisms that drive new growth paths it's essential to understand where these new growth paths find their origin. Therefore it's remarkable that until recently this origin had rarely been discussed in path creation literature (Martin & Sunley, 2006). For the sake of formulating policy recommendations in particular it does quit matter if, and which, endogenous or exogenous type of growth is taking place. Hence is the first sub-question of this research been formulated as follows: *what are the main sources of the growth path of the aquaculture industry in Oman, and to what extent do these sources influence the paths potential for success?*

As a result of no extensive history with aquaculture nor possessing sufficient skills and experience locally the type of growth the aquaculture industry in Oman is pursuing is essentially exogenous. Triggering events like the initiation of new industrial policy (Fornhal et al., 2012) back in 2011 have formed the starting point and foundation for the current development efforts, which are centred around the transplantation of knowledge and technologies at all levels as demonstrated in table 6.2. Based on these findings one can conclude that the transplantation of knowledge, being it *"…the importation and diffusion of new organizational forms, radical new technologies, industries, firms or institutional arrangements*" (Martin & Sunley 2006, p. 422) is the major driving force behind the development of aquaculture in Oman. This is in line with the results of previous studies that have demonstrated the believe in GCC countries that their financial (natural) resources are sufficient to 'buy' technological solution in order to develop new industries. Buying technological solutions subsequently leads to making major leaps in technological improvement (Spiess, 2008). But whether these 'leaps' can be made in the Omani aquaculture industry is highly questionable as the successful transplantation of knowledge and technology from external sources is heavily dependent on a region's absorptive capacity (Fornhal et al., 2012; Martin & Sunley, 2006). Mainly as a result of employing sufficient foreign aquaculture experts the ability to recognize valuable new external knowledge is fairly good. However the ability to assimilate and commercialize external knowledge locally is rather poor. As a result in order to successfully develop an aquaculture industry in Oman according to exogenous growth improvements should be made in the absorptive capacity, and in the ability to assimilate and commercialize external knowledge locally in particular. This matter will be extensively discussed in the next chapter.

6. Absorptive capacity



6. Absorptive capacity

"You know we had a whole multi trophic survey done on the species here that would fit in to a multi trophic system, we had algae, we had seaweeds, we had some fish. It was a very nice system, but there was nobody who recognized it's potential, so it never went anywhere." – After a research and education informant.

In this chapter the absorptive capacity of the current status of the aquaculture industry will be evaluated, this will be done in a few consecutive steps to shape an overall image based on the interviews with key informants. The first paragraph will describe how different actors within the industry are able to recognize valuable new external knowledge for aquaculture in Oman, and what vehicles are used to do so. The second paragraph goes one step further and will analyse what happens to the external acquired knowledge when imported to Oman. It will look at the different mechanisms that are used to recognize valuable external knowledge and subsequently assimilate this external knowledge in to the Omani economy. By doing so it will also briefly touch on barriers that might prevent knowledge to assimilate in the economy. This chapter will also look at the ability to develop new commercial aquaculture projects by making use of external knowledge, hence it evaluates the extent to which external knowledge is actually used locally. The chapter will finish with answering the 2nd sub-question of this research, in order to create an overall understanding empirical results are integrated with the provided literature from chapter 2.

6.1 Recognizing valuable knowledge

6.1.1 Capacity building

As has been demonstrated in the previous chapter is the experience Oman has with aquaculture relatively few. Hence logically one could say that recognizing valuable new knowledge and technologies is a rather difficult task. To cater this problem several measures are taken of which some can have a direct effect, and others are more long term investments. One measure which is bearing fruit at the moment is the change in language made from Arabic to English in several institutes like Sultan Qaboos University and the Fishermen Training Institute. By switching to English students are exposed to relevant up to date international literature and readings, which means they have an updated view on methods used and available techniques. Exposing them to international literature will help them both now and in the future in recognizing valuable new knowledge in order to develop aquaculture activities.

"*It was 2 years and in Arabic before, but now we changed it to 3 years and to the English language – which is a better foundation for the students. We are modifying our syllabus to international standards, we are trying very that very hard now.*" – After a Fishermen Training Institute Informant.

Another form of capacity building which also servers as a mechanism in order to recognize valuable external knowledge is to bring people from within the industry in touch with this external knowledge. Both at educational level as well as on ministerial level Omani's are send abroad to follow courses, do a master or a PhD in order to absorb international knowledge before returning back to Oman.

"*The Omani government sends around 1500 students per year around the world in order to study at foreign universities*." – After a private sector informant.

"*There must be 3 or 4 PhD's now probably in other Europe, Australia or the US, so there is a gradual building up of expertise I would say*." – After a research and education informant.

Also at the MAFW young employees have the opportunity of going abroad to do their PhD's as will become clear in the following quote, problem with this though is that it is not organized strategically – it is not coordinated. On this lack of organization and coordination will be elaborated in the following chapters.

"*For example if there are good graduates now coming out with very high grades, he then moves into the ministries as one of these junior administrators really. Then when he wants to do a PhD and has the qualifications, and maybe can find a scholarship somewhere, then you know the process would go ahead, but I don't know about anybody sitting in an office saying like, "okay we need urgently two fish pathologists", in fact I'm sure that's not the occasion, because it would have happened. So I don't think there's any coordination on that*." – After a research and education group informant.

Besides recent investments in – and a gradual build up of – capacity, it still appears to be quit a challenge to recognize valuable new knowledge, especially if it's about high tech applications, and even more so if these technologies come with a price tag.

"*Omani's can pay for quality, but it is certainly also something they want to save costs on – simply because they're not always able to judge what is quality and what not."* – After a private sector informant.

"*This German company developed a machine to do the operation simply with water rather than with a lot of chemicals. But, it comes with quit a price tag, also a good return on investment, but something like that is just really difficult to sell here*." – After a private sector informant.

The fact that it is difficult to recognize valuable new knowledge also become clear in the previous chapter, which demonstrated a quote by an informant from the public sector inviting all companies in the field of aquaculture to Oman; "*They will be a positive addition because we are new in the field, we don't know anything*."

6.1.2 Benchmarking & foreign experts

It must be said though that certainly there is capacity available in the country to recognize valuable knowledge outside the country – in various ways. The most common ways of recognizing valuable new knowledge as derived from the data are hiring foreign experts, travelling and benchmarking. As the previous chapter showed is there foreign involvement at all different levels in the current aquaculture industry in Oman, also within the MAFW (see table 5.5). Foreign experts within the ministry are hired for several reasons but mostly to advise, also on the necessary external knowledge and technologies that are suitable for Oman. One example of these foreign experts is John Dallimore, who works as a general aquaculture consultant within the MAFW but also is the head of the so called 'one stop shop' for aquaculture. This means that he is appointed to evaluate all incoming project proposals (of which all of them have a foreign technology partner) on the quality and value of their technologies for Oman.

"*The ministry knows if the knowledge a foreign company holds is valuable for developing aquaculture in Oman because they have John Dallimore, he supposed to be a consultant, to provide technical support to the ministry – maybe also in economics. They have 2 or 3 persons like him, they supposed to know it, because they are the ones evaluating the projects.*" – After a research and education informant.

After that this same informant continues with the following example on how this system will practically work out;

"*So lets say, there is technology from Norway, everybody in the field knows Norwegian technology – especially in cages, and some of them are closed systems. They have the technology, so when a consultant or expert within the ministry he will know for sure what they have and what they say, so he will advice the ministry like, this company is a bad one, this is a good one etc. He is supposed to do that, for that reason the ministry is hiring them – it is as simple as that.*"

Another way used by the MAFW and other actors to know the quality of certain external knowledge and technologies is by benchmarking and by travelling around the world, visiting companies and conference to first hand acquire knowledge about the technologies available. For the Bio-Marine Industrial Cluster as described in chapter 5 for example, RAS technology from the Netherlands was set as a benchmark;

"*From the start we have put the Netherlands as one of the main benchmarks, because by your law only RAS is allowed. Because Hesy produces so much they can produce at a way lower price – economies of scale you know. Each other company will claim to make 1 or 2 systems, but nobody has the experience of doing 100 systems. I called with other buyers of the Hesy systems to check how they were working there – as references.*" – After a private sector informant.

To identify the most suitable knowledge for the Bio-Marine Industrial cluster the PEIE prepared itself by carrying out 2 different studies; a 'technology foresight study' and a 'delphi survey'. By doing so an assessment was made of trends in aquaculture technology and the feasibility of implementing these technologies in Oman. Furthermore different informants from both within as well as outside the MAFW mentioned the travelling going on in order to acquire up to date, in depth aquaculture knowledge.

"*The MAFW travels around the world to see with their own eyes how technology works. For example the undersecretary is going around, technical people, to knowledge sharing conferences, a lot of things*." – After a research and education informant.

"*I think they read about it, but there's not a lot of updating with my colleagues in the ministry. But they do travel a lot – I am amazed how much travelling goes on, but whether you could classify this as real updating.*." – After a research and education informant.

"*I visited some factories in the Netherlands that are amazing really! So I went to this exhibition, and it was very good – high tech, for media, and design, many product and how to protect form insects and diseases plus some post harvest machines.*" – After a public sector informant.

One private sector informant praised the level of knowledge and support of the undersecretary of fisheries, Dr. Hamed Al Oufie, who was definitely aware of what the value was of his project for developing aquaculture in Oman;

"*The ministry, and clearly Dr. Hamed provided a strong bit of guidance. They thought well if we want to develop aquaculture, what is the single biggest cost factor of aquaculture? That is feed, that is the single biggest source.*"

In this context of recognizing valuable external knowledge it must, again, be said though that foreign knowledge or expertise in the country tends to sit rather isolated. Like was mentioned in a quotation starting this chapter, that so many different projects had been done on e.g. multi trophic systems, algae, seaweeds, different types of fish – all high value but at the time no one recognized the potential of it, they were all isolated research projects conducted by foreign researchers. Another issue as well is the unfamiliarity with aquaculture of secondary parties

involved in the development of projects. Different examples of this were named, like banks, the ministry of housing and the ministry of environment, all of them in different ways slowing down the process of aquaculture project development due to unfamiliarity with the industry.

"*You know one or two ministries are extremely – not opposed to aquaculture, but they have resisted it. The main one in my opinion, in the past whole number of years has been the ministry of housing. Who control building everywhere, and they've always, partially because there is no familiarity with aquaculture, partly because over the early proposals that came in, where shrimp farms – asking for 500 hectares, a 1000 hectares or that, as soon as the housing department, who was charged with the responsibility for buildings in all these places, as soon as they were hearing these figures they just jumped straight back and it never happened, because of the scale of what was being asked.*" – After a research and education informant.

"*We spoke to different people of you know the banking capital private equity world. Even though the economic foundation of what we are proposing is very very good, and has been demonstrated, for them it is just unfamiliar and difficult and strange.*" – After a private sector informant.

6.1.3 Conclusion

As a gradual build up of expertise in aquaculture in Oman is taking place the industry is still lacking sufficient in-depth expertise to fully recognize the potential of external knowledge and technologies. On the other hand it must be said that by taking sufficient measures like hiring foreign experts to do the technological evaluation of project proposals, travelling around the world to acquire updated knowledge on technologies and do proper benchmarking, Oman scores quit well on recognizing the potential a technology holds for developing the aquaculture industry in the country. This capacity will increase gradually as study programs are updated to international standards and ministerial staff is taking PhD's outside Oman. The following paragraph will evaluate the extent to which foreign knowledge is actually assimilated in to the local economy.

6.2 Assimilating & commercializing external knowledge locally

Logically does the assimilation and subsequently the commercialization of external knowledge locally involve substantial transfers of knowledge from external sources on the local, Omani staff. It turned out that these two consecutive processes are far more problematic than the process of recognizing valuable external knowledge as described in paragraph 6.1. As a result, many informants mentioned that despite of foreign input at various levels of the industry over the past few years 'nothing really happens'. Why nothing really happens can be mainly attributed to a few barriers that prevent knowledge transfers to take place.

6.2.1 Costs (part 1)

As was mentioned before does Oman in general aim for high quality products and services, on the other hand are high quality products, especially high tech solutions hard to sell in Oman because they're new (which comes with unfamiliarity of the product) and they're often costly. As the Omani tendering process is an open and highly competitive one projects are often awarded to the lowest bidder, hampering the room that is leftover for significant training and knowledge transfer – efforts within the contract.

"*So what happens with this EPC (Engineer Procure Construct) contracts is that you get one contractor who is assigned to design, purchase the materials, and do the construction work. So at the end of the road you actually have something build, they get the key, and that's it. But what happens when you do it that way, and you're really focussed on doing it as cheap as possible, chances are really high that everything is done according to minimal specifications.*" – After a private sector informant.

Another cost factor influencing the extent of knowledge transfers taking place is the fact that investors are looking for immediate returns from their investment. As in general and in Oman in particular aquaculture is a risky business (think about diseases and environmental threads), this interferes with investors aspirations of quick returns from their investments. Several examples where mentioned by the informants where aquaculture projects where shot down due to decision made by the investors as a result of disappointing (financial) results.

"*Because with fish farming either you are really convinced, dedicated, you really want to be involved, and understand that it is not a short term investment, or you're not. And this company was listed in the stock market in fact and the board was mainly from Abu Dhabi, they didn't understand the business, they thought that money should come immediately – which is what they believe in most of these countries – so they just gave up*." – After a private sector informant.

"*They shifted all the activities to the UAE – it doesn't exist here anymore – this is all financially minded, it is not related to the aquaculture activities, because if you are talking about how much money you can pump in. Asmak has a majority stake in the company, so they were able to decide to quit and to move.*" – After a research and education informant.

In the second quote the informant talks about the Quriat Aquaculture Company that relocated to the UAE as a result of major losses due to a red tide. Rather than continuing their activities in Oman, learn from mistakes and improve their operations and management – and consequently facilitate knowledge transfers over the longer run, they shifted the whole operation elsewhere. In the following quote another informant is talking about the same story, emphasizing that due to inexperience at one moment in time the company failed and had to cope with losses. Shutting down the whole operation due to foresightedness at the investors' side in this case is the least desirable option when it comes to a gradual build up-, and transfer of knowledge.

"*There's been very substantive farming here in the sea in the past, and they failed because the experienced managers where not there. So some of the main reasons of failure where avoidable, but they where not avoided*." – After a research and education informant.

Another respondent from the research and education group, an expat, described the core of the issues as described above very accurate;

"*The profitability of aquaculture projects is a real barrier to knowledge transfers. Most businesses here are extremely focussed on immediate return. If they have to compromise that return by sharing information or knowledge, they're not going to do it. Unless it is a leak, but on voluntary basis they're not going to do that.*"

6.2.2 Cultures of work (part 1)

Besides the matter of money issues affecting the extent to which external knowledge is assimilated in to the local economy have many informants spoke out negatively about the work attitude and the cultures of work in Oman. As this part will be described in more detail in chapter 8, it is also necessary to mention it briefly within the confines of this chapter. It is been mentioned by several informants that to meet the Omanisation standards companies hire 'fake staff' – which means that on paper they employ a certain amount of Omanis, but reality is these Omanis are sitting at home, still receiving their monthly salaries for work they haven't actually done. The real work is done by cheap labour from Asia and Africa who are willing to take up the work required. Obviously when the Omanis don't work, they do not gain experience and knowledge transfers don't take place. This issue becomes clear in the following quote.

"*So then I take the 15 Omanis, give them their salaries and they will stay at home – which is what a lot of companies are doing. But then the profitability turns very low. All companies are doing it! Even myself I'm doing this, I have fake staff – all companies do it. I'm still not reaching the target of Omanisation, but at least when the ministry comes to check I can show that I'm doing something for them.*" – After a private sector informant.

Talking about the attitude of Omanis towards working in the fish processing industry one expat private sector informant answers as follows;

"*They don't have the right skills because they don't want to do this, they don't want to do this type of functions. If you go to any kind of industry that requires this kind of manpower, you will not find any Omani. They all want to be managers*.."

Having this attitude got confirmed, among others, by one Omani public sector informant who was involved in the early development and design of the Bio-Marine Industrial Cluster in Sur. It is that similar attitude that was discussed before in the chapter 5, about the sources of aquaculture in Oman, an attitude that by simply outsourcing everything things will develop and no Omani has to do too much effort, because the work is done by expats.

"*Hesy is very good in building this equipment, this Taiwanese company is very good in building the food, the German is very good in biology, this guy is very good in that – put them together, create a very good strong team and tell them now we want an aquaculture that is cheap – work together. They come in as a development team, but eventually they are tasked with making the business viable*."

"*There is a real lack of an understanding that aquaculture is a practical 24 hour a day sort of occupation, and that is really not realized by many of the people in charge of it. It is like food production, like farming, there's this continuous process and to me that is really missing. And as long as there is money falling down that continuous*." – After a research and education informant.

Additionally this quote raises the question, why would anybody work hard or start their own business as a result of the knowledge acquired within a foreign aquaculture project in Oman, when 'money is falling down'. People rather have a well paid ministry job than actively working hard and learning for the sake of their own personal development. It's these work ethics, or attitude towards the division of labour that could possibly seriously affect the way knowledge transfers can take place and Oman really builds up 'hands-on' experience in aquaculture. Especially so could it seriously affect the development because the MAFW does not recognize the problem and merely looks at the contract between the foreign and an Omani party, and what's agreed upon in this contract;

"*There are no barriers to the transfer of knowledge in Oman, provided the two exchanging parties agree on the principles*." – After an MAFW informant.

6.2.3 Isolated knowledge and commercialization

Chapter 5 already described that foreign/external knowledge tends to sit quit isolated and experiences difficulties to 'flow' in to the local economy or on to Omani colleagues, also partially due to the existence of a knowledge gap between the available and the external knowledge.

"*There's almost no absorptive capacity, all companies here make use of knowledge workers from abroad, but if there's no interaction with the locals, there is no opportunity of facilitating knowledge transfers. So when foreign companies leave the country, they take their knowledge with them*." – After a research and education informant.

Additionally, when there is (and there is) specific knowledge in any kind of aquaculture activity, the step to commercialization of this knowledge is not easily been made. Reason for this is multiple but definitely one of the main reasons is the general lack of entrepreneurial spirit, or the incentives to start your own business.

"*The level of sort of curiosity in the students is very low, the entrepreneurial spirit is virtually none, people want a secure job a the ministry, preferably the ministry of oil, that is their ambition*." – After a private sector informant.

"*The Dutch was not the first seminar, I have been here 15 years, it must have been at least the 10th you know, we had many numbers of countries come – we had a really strong Norwegian meeting here which my colleague Delghandi organized, you know we had the head of two of the main labs from Norway who said we'll come, we'll do this – but there was never any follow up.*" – After a research and education informant.

Also here in this quote the lack of follow up on possibly good ideas from many different countries is emphasized. The counterpart of these seminars, held at the Sultan Qaboos University, is most of the times the ministry of agriculture and fisheries wealth. With the knowledge of at least 10 different seminars with different countries in 15 years being held, and never any serious commercial follow up at the ministry side is also indicating a serious lack of ambition, willpower or commercialization ability at their address. Chapter 7 and 8 will further elaborate on the commercialization of innovative ideas and the role different human agents play in this process.

6.2.3 Conclusion

A significant lack of external knowledge seriously assimilating in to the local economy influences the ability for the commercialization of this knowledge. Limited knowledge transfers from external sources are the main reason for this. Investors in Oman have a strong focus on immediate return from their investment, when the first results of aquaculture projects turn out to be disappointing this often results in cancellation of the whole project – leaving no space for serious knowledge transfers over a long term. Tenders are often awarded to the lowest bidder, implying that projects are executed according to the lowest possible specifications with no efforts of training and knowledge transfers between a foreign company and local employees involved. Another reason for limited knowledge transfers mentioned by the informants is the work attitude of Omani employees. Because they all want to be managers they often refuse hard or dirty work, which results in a situation where employers have 'fake staff' on their payrolls in order to meet the required Omanization rates imposed by the ministry. Obviously when you don't work, you don't gain experience, when the foreign company leaves no substantial knowledge will be left behind. Aquaculture is a 24 hour a day occupation which requires an work attitude accordingly. Looking at the efforts been done over the last decade, and looking at the stage the aquaculture industry in Oman is at this moment, one can only conclude that the commercialization of knowledge is seriously lacking.

6.3 Answering the 2nd sub-question

Characterization of the absorptive capacity

As the relevance of the regional absorptive capacity is already briefly mentioned when answering the first sub-question, this can be extended by the notion that regions with the ability to recognize, assimilate and use new knowledge in their economy are better able to develop new growth paths (Alvarez & Molero, 2005; Dawley, 2013; Simmie et al., 2008). Emanating from this relevance in the context of this research the second sub-question has been proposed as follows: *considering the ability to recognize, assimilate and use relevant external knowledge, how could the absorptive capacity of the Omani aquaculture industry be characterized?*

As mentioned above is the overall absorptive capacity of the Omani aquaculture industry rather poor. The only factor of the absorptive capacity which scores pretty good is the 'recognizing' part, but as for 'assimilating' and 'using' external knowledge locally that has up till this point proven to be quit problematic somehow. Foreign experts are hired to assist the MAFW in identifying valuable new external knowledge and to carry out the technical evaluation of project proposals. In this sense for recognizing valuable new knowledge the MAFW is highly dependent on foreign experts, which is something that characterizes the Gulf economies in general (Porter, 2003). In addition to that is a lot of international benchmarking taking place resulting in a good ability to asses, or recognize the value of new knowledge and technologies. The more it is actually remarkable that the output of these efforts in the form of assimilating and using new knowledge locally is rather poor, a few factors can be held accountable for this. First, there are clearly some institutional barriers that prevent (private sector) start-up activity in the sector. Second, investors are used to invest in oil and gas and in real estate, which in contrast to aquaculture only requires to 'press the button' to make money. As they have a too strong focus on making immediate returns on investment aquaculture projects have proven to be, and will be not interesting enough – leading to a lack of commercialization of external knowledge. Third, the urge to develop a new industry like aquaculture is communicated through public policy documents but not felt at all by the actors working in the field. Nor the Omani workforce, nor the MAFW seem to be actually committed to quickly develop the industry, which is reflected in the complexity and slow pace of all the procedures.

As the ability to recognize, assimilate and use external knowledge reflects the existing human capital in a region, the absorptive capacity is also strongly influenced by the complementarity between existing knowledge, skills and capabilities and external ones (Zahra & George, 2002). The existence of both a knowledge- and technology gap between Oman and technological leading countries in the field of aquaculture consequently has a negative impact on the absorptive capacity. Due to this problems with the absorptive capacity successful technological leapfrogging will be a difficult task (Steinmueller, 2001). Even more so as the education system doesn't cater for the new desired technologies and sufficient training opportunities are not there to provide a skilled workforce.

Concluding the characterization of the absorptive capacity of the Omani aquaculture industry can be said that the potential absorptive capacity is higher than the actual realized absorptive capacity. This means that the valuation and acquiring of external knowledge is better developed than the exploitation and transformation capabilities of the country, impeding the development of aquaculture in the country (Zahra & George, 2002). In order to transform potential absorptive capacity in to realized absorptive capacity substantial improvements should be made in the social integration mechanisms which are comprised by a set of routines promoting knowledge sharing (Ewers, 2013; Zahra & George, 2002). For the case of Oman this definitely makes sense as often existing knowledge is isolated, sits with only very few and is poorly integrated in a wider context – resulting in a lack of knowledge transfers and commercial follow ups.

7. Localised Innovation Systems

7. Localised Innovation Systems

"The Omani economy is not set for innovation, definitely not. That is something which characterizes all the Gulf States – as long as there is oil, there is no drive for innovation, as long as there is cheap labour, there is no drive for innovation." – After a research and education group informant.

As the previous chapter has analysed the absorptive capacity of the Omani aquaculture industry this chapter will further explore to what extent regional learning and innovation takes place within a functional organised system of different public and private sector actors. In order to do so it will start by analysing the extent and the content of public research taking place followed by the possibilities of public funding of innovative activities. The second paragraph explores the role of the private sector in engaging in innovative activities and the drivers that influence this. In the third paragraph the role of specific innovation and technology enhancing organisations is explored as well as the extent to which collaboration, interaction and coordination takes place within the aquaculture community. Each paragraph will finish with a short conclusion. Chapter 7 will finish with answering the 3rd sub-question in paragraph 7.4, in order to create an overall understanding empirical results are integrated with the provided literature from chapter 2.

7.1 Public research

7.1.1 The Aquaculture Centre and the Marine Science and Fisheries Centre

As described in chapter 5 does aquaculture training and education take place in several institutes, mainly in the capital area of Muscat (see map 1 & 2 in figures 5.7 & 5.8). This paragraph explores to what extend relevant research and innovative activities are taking place in these public facilities. The in 2011 opened aquaculture centre has been initiated to conduct basic and applied research as well as to organize the aquaculture R&D agenda of the country. But however on paper the centre has a clear mandate, reality turns out to be a different story. As was mentioned before in chapter 5 is the actual function of the centre rather unclear, and did many informants complain about the lack of actual tangible output of both the aquaculture centre and the marine science and fisheries centre (MSFC). First some quotes indicating the general position and the role of the aquaculture centre.

"*The aquaculture centre is a research centre where they will have all the knowledge. From there they should reach the people who want to do investments in aquaculture."* – After the FAO country director for Oman.

"*We're a research institution, so our task is mainly to develop research activities in order to develop aquaculture in the Sultanate. This is a government institution. Oman has a huge potential*." – After an expat at the aquaculture centre.

In the first quote, from an international perspective, it seems that the aquaculture centre has a central role in providing knowledge and skills to interested foreign investors looking to develop aquaculture activities in Oman. The second quote by an expatriate working at the centre clearly emphasizes the central role the centre has in developing an aquaculture research agenda in order to develop aquaculture in Oman. Conducting research it is expected to further elaborate on existing knowledge as well as creating new knowledge in order to develop commercial activities accordingly. From the hereafter following quotes becomes clear that at the moment the centre is only conducting research to further elaborate on the existing knowledge around the growth of tilapia, additionally it is *planning* to start other activities in the future.

"*The research we conduct here, is mainly for tilapia. We have like 3 species of tilapia; the white one, GMT and shetilla. But we have another section of marine research, with hamours – this is a species of sea bream*." – After an Omani employee at the aquaculture centre.

"*It is pretty much a wish to produce feed here. One of the things I've been doing is to develop a feed strategy where we develop local raw materials here and the biggest resource is the sea – so marine raw materials – algae, fishmeal, fishoil, fish waste processing as well, and so making better use of the local resources. And then having fresh raw materials would actually make very good feed. So the concept is making much higher quality feed then they can in Saudi Arabia, and in the region and creating jobs with it.*" – After an expat at the aquaculture centre.

The second quote confirms that the aquaculture centre is assigned to 'develop research activities in order to develop aquaculture in the Sultanate.' But what has happened is that since the opening it has mainly focussed on studying the growth of different species of tilapia, which is applied to small scale agricultural farms in the Batinah region without any significant commercial value. Since in early 2014 two new British expats joined the centre it seems that more and higher value activities are being developed, like the transition to - and experimentation with RAS systems and the development of a feed production strategy.

Nevertheless have many informants spoken out negatively about the current work done at the aquaculture centre and the lack of guiding it gives in the R&D agenda in the country.

"*I have never understood the role of the aquaculture centre. It's been build for at least five years, but it is not operating! There is no seawater connection, it has cost a huge amount of money – to me it is almost an embarrassment.*" – After a research and education informant.

"*I don't know who ever designed the aquaculture centre, the first time I went there I was just astonished, because every single room was just stuffed with huge tanks, and I thought, what's the whole point of this infrastructure? In the nutrition lab, the genetics lab – there's all kind of labs stuffed with equipment, but none of it connected. So is that a planning issue or what? I don't know, it is just a lack of connecting A to B.*" – After a research and education informant.

"Three tries, we tried the aquaculture centre first – there is clearly some internal politics, some of what I have now begun to understand, that was not going to work, and it didn't work." - After a private sector informant.

"*I mean sometimes it is called a research centre, well there is no research going on there. It should be designed to deal with the regulatory function*." – After a research and education informant.

No seawater connection since its commencement in 2011 means that doing research on marine environments has most likely not been taking place, or very minimal. Several informants from different informant groups mentioned the complete nonsense of having an aquaculture research centre without a seawater connection. In addition the third quote here indicates a mismatch between a foreign company seeking for collaboration and the aquaculture centre. Due to 'internal politics' no partnership could be established (more about this in the next chapter), so the company turned to SQU where it had more success. Chapter 8 will further elaborate on the functioning of the regulatory framework. Another informant also made the comparison between the aquaculture centre, the marine science and fisheries centre and SQU;

"*You know what has exactly been done by the aquaculture centre? Or by the MSFC? Nothing. The Atlas that has been drafted has been done by a Frenchman, like so many studies are being done by consultancies hired by these so called research institutes. They're called research centres but in fact the content and quality of what is being done there is far less than at SQU – the quality of research at SQU is pretty good actually, but the problem is these projects stand alone, it's not part of a bigger strategy. So by the end, nothing is being done with the knowledge, too often projects don't find a follow up*." – After a private sector informant.

Both the functioning of the aquaculture centre as well as the MSFC are criticized by several informants. Talking to staff at the MSFC as well as with a private sector it became clear that the research agenda at the MSFC is focussing on supporting the fisheries industry, which as described before has besides post harvest activities nothing alike with the aquaculture industry. Main focus (currently) at the MSFC is the stock assessment of several declining natural species;

'Focus of our research here at the MSFC is stock assessment, which is necessary because certain species are overfished and will need to be filled up to a healthy level.' – After the director of the marine science and fisheries centre.

'*When you go to the MSFC, with Dr. Lubna, there are people busy with fish control, cutting them, doing analysis – which is fine in itself, but that has nothing to do with running a fish farm. That knowledge is simply not there*.' – After a private sector informant.

7.1.2 SQU

As described in paragraph 5.3 does the Sultan Qaboos Universities have two related institutes working in the field of aquaculture, these are the Department of Marine Science and Fisheries and the Centre of Excellence in Marine Biotechnology. The prior one focuses on education, the growth of different types of fish and aquaponics, the latter one is a research institute where at the moment different studies are taking place – both applied as well as basic research. Current focus at the Centre of Excellence in Marine Biotechnology is on the genetics of the spiny lobster, which is of a high commercial value and about which not a lot is know yet and for which their using new RAS systems.

'*Now we have 2 faculties for almost 1 year; and so they're still developing their interest, one of them is very clearly, practically oriented, it wants to culture fish – different kinds. They're trying with hamour, barramundi, tilapia and shrimps.*' – After an expat at the SQU Department of Marine Science and Fisheries.

'*We build a small RAS system for our research with spiny lobsters, it's just being commissioned this week – we bought it from a company in the US called Penta*.' – After an expat at the Centre of Excellence in Marine Biotechnology.

As mentioned in a quote in the previous paragraph is the quality of the research at SQU actually pretty good, and have several topics been studied before, like the growth of different finfish, the quality of Omani waters, fish-biological issues, algae and seaweeds. So obviously there are clearly capabilities to conduct research, but what is problematic is the fact that these projects are not integrated in a wider research agenda - *'the problem is these projects stand alone',* as was mentioned in a quote before. High potential projects standing alone and not getting any (commercial) follow up is clearly a lack of coordination and collaboration between local actors. And this, in contrast to basic research, is something less easy transplanted from elsewhere;

'There's quit a lot that you can take straight from outside inhere. Starting from basic research, which is clearly what you have to do if you want to establish a viable industry within 5 years. And that's pretty much part of the government strategy.' – After a research and education informant.

Another issue in relation to having a serious functioning innovation system in the country is the absence of master degree or PhD opportunities, which are now taken outside the country. When it comes to research and education several informants mentioned that the focus at SQU is too narrow, and that aquaculture is not offered as a separate master degree but merely as (set of) different subjects.

'*At SQU aquaculture is only a subject within the department of Marine Science and Fisheries, so there's no purely aquaculture being taught.*' – After a research and education informant.

'*They have just the marine sciences, they don't have just aquaculture.*' – After a research and education informant.

'*The aquaculture department of SQU only sees biological issues, and that's it. They don't look into the marketing issues, they don't look into – perhaps – engineering issues, they don't look so much in to health issues or nutrition that much. I think there is a lack of understanding that aquaculture at the other day is an industry itself, that needs to be profitable.*' – After a research and education informant.

In essence it seems to be clear from this and other paragraphs that SQU does produce new knowledge in the form of basic and applied research. However, a serious lack of coordination, collaboration and integration often make these projects stand alone. Resulting in a situation where knowledge sits with very few and others don't even realise what knowledge is available due to a lack of documentation. Additionally as described in chapter 5 due to a lack of integration between foreign and local knowledge are activities not continued when the foreign involvement disappears, resulting in abandoned laboratories for example. Another issue with stand-alone projects is that on a later moment in time no one knows about them anymore, which is also strengthened by the fact that people change functions frequently within the ministries.

'*The ministry supported a large algae project trough an Italian company, they recruited a local algologist who produced a very nice report. In that project he was hanging algae from ropes and measuring them and all this data exists, looking at the species, we looked at the carrageen and contents and so on – I thought when your colleagues were presenting, where the hell is that report now? Because a huge amount, 100.000 rials went into it. I'm sure nobody even knows about it in the ministry because everybody's changing the whole time.*' – After a research and education informant.

Paragraph 7.3 will further elaborate on the collaboration between different actors of the aquaculture industry and the form of coordination that is taking place to secure regional learning. The next paragraph will briefly discuss the availability of research funding.

7.1.3 Research Funding

Considering the amount of research that is, or is not, going on at the different institutes as described above several informants mentioned something about the availability of research funds. Different funds exist with a different purposes and different levels of accessibility. The main relevant funds sit with The Research Council (TRC), the Agriculture & Fisheries Development Fund (AFDF) and Al Rafd Fund. The TRC is a more general fund available for different industries as opposed to the AFDF which locates funds specifically to agriculture and fisheries projects. The Rafd fund is a fund for Omani nationals focussed on stimulating SME development across different sectors. Different informants mentioned the TRC, but no examples of any affective fund allocation in aquaculture were given. Which is remarkable, as the TRC is supposedly the responsible R&D coordinating body in Oman;

'*So TRC is responsible for R&D in Oman, so they are supposed to be coordinating these things.*' – After a private sector informant.

'*We tried the Research Counsel, TRC, I really like Dr. Al Habs, really impressive, but again we are not Omani enough, we don't fit in their sort of obvious framework – so it just wasn't going to work.*' – After an foreign private sector informant.

'*If you want to do research the other major fund is the TRC, and if we submit a TRC proposal, as in any country, the running time is between one and two years really before getting any funding.*' – After a research and education informant.

The AFDF however seem to have supported SQU research activities, and is more easy to get funds from. Opposed to the running proposal time for TRC funding here funds are given more easily.

'*AFDF is a long standing fund, what it does for aquaculture is just a small part of it. But it is there and it can support applied research that has to do with aquaculture, for me it is quit a good fund really. AFDF generally is a million rials a year I think. So it is a significant amount, and this goes into applied research projects. I have one grand from them, on aquaponics they support the research we're doing. The fund is quit easy to get funds from if you have a half decent proposal, so it's quit a good idea*.' – After a research and education informant.

Additional to the Rafd fund several specific funds or organisations stimulate start up activity in one particular industry, like the ITA (Information Technology Authority) for example. For aquaculture such a specific fund isn't available yet, however, during writing of this thesis a new government company called the Oman Aquaculture Development Company (OADC) got established. Even though the board wasn't elected yet at the time of writing, and the mandate wasn't particularly clear defined, it will most likely be an investment fund particularly for aquaculture projects, in order to boost the growth of the industry. The general infrastructure for stimulating SME development follows from the following quote;

'If you're looking at ITA, they've got innovation hubs for new start ups and technology, if you look at the national business centre, they're providing a lot of programs, a lot of training, RAFD fund is providing finance, so there is actually an infrastructure in place that has been developed over the last five years which is really good to assist people who are wanting to start their own business, it is just up to the individual to go out and look for it.' – After a public sector informant.

Specifically for aquaculture however availability of funds and the allocation of government spending is being questioned by the informants. In contrast with massive port development to facilitate fishermen the aquaculture side, and then in particular the R&D side of that remains rather weak;

'*1.6 Billion will be spend on the development of aquaculture and fisheries. So then where the hell is it?! There's a massive amount of harbour development and fishing port site facilities for fishermen. But I also read in the paper that large amount of funds is available for aquaculture and fisheries, but I have no idea where the aquaculture side of it is. I've never seen an aquaculture fund anywhere. I know all my colleagues in the ministry seem to suffer from having no money, they seem not to have the funds. When I talk to the people in the aquaculture centre – they've been trying to ever since the centre was build to get a seawater connection of which the whole point is to do marine based research. But there is no connection to the sea!*' – After a research and education informant.

The understanding that specific funding is needed to stimulate the growth of the aquaculture industry, by establishing a specialized investment fund follows from the following quotes about the OADC;

'*A lot of people are interested, and they keep talking and talking and talking, but eventually no one puts their hands in their pocket. And this is the reason why OADC is being set up, to try and set that example*.' – After a public sector informant.

'*The OADC is formed under the Ministry of Agriculture and Fisheries – it is similar to the idea of KAT. They have formed the company, but it is still not active in doing anything. The study that was done for the formation of this company was a very general study. Till now they haven't done any project studies, it's only the general idea of forming the company.*' – After a private sector informant

'*The government company will help to establish the industry through setting-up and operating hatcheries, farms, fish feed factories, fish processing plants and providing equipment and essentials for aquaculture industry in the country. It will also help SEM's to establish their business and operate safely*.' – After a public sector informant.

It needs to be mentioned here that the KAT is an investment subsidiary under the Public Establishment of Industrial Estates which has a strong focus on R&D projects. This will be discussed in more detail in paragraph 7.3, which discusses the role of innovation and R&D for the private sector.

7.1.4 Conclusion

Currently no substantial research is been carried out at the aquaculture centre and the MSFC that might support commercial aquaculture activities. The aquaculture centre is due to 'internal politics' and the absence of a seawater connection not functioning properly since its commencement in 2011, the MSFC has a focus on restocking wild fish population rather than on aquaculture. Considering the malfunctioning of the aquaculture centre, which is charged with conducting research and providing a research agenda in order to develop aquaculture activities in the future, a total lack of coordination of research projects is taking place in the country. Hopeful is the arrival of two British experts at the centre, which are eager to develop a research strategy on e.g. fish feed. SQU has over the years implemented a range of different studies on different issues within aquaculture, in general the quality of these studies is regarded to as being good. However a total lack of integration of these projects has resulted in the loss knowledge, abandoned research sites and no available overview of what research has been done in the past. Different funds are available for establishing aquaculture research projects but until recently these funds were not specifically for aquaculture. Informants put question marks at the government spending on aquaculture and fisheries development in the country – infrastructure for fisheries seems to have a preference above R&D projects, which means that money follows the easy route. With the recent establishment of the Oman Aquaculture Development Company this might change in the future.

7.2 Private sector research

Chapter 5 has on the basis of extensive desk research in combination with primary data described the current status of the aquaculture industry in Oman. As mentioned has no real example been set of a successful and commercially viable aquaculture business, as such this paragraph won't be too comprehensive in the sense of current research activities in the private sector. As this chapter is essentially data-driven what it will elaborate on what the informants had to say about (the lack of) private sector research, recent developments and in more general what position innovation holds within the Omani private sector.

7.2.1 Lack of private sector activities & lack of R&D

Considering the current private sector R&D activities in aquaculture in Oman this is pretty much limited to the Feed Algae Ltd., which conduct applied research to investigate techniques that suits best the local soil conditions. But besides that the research activities in the private sector are very, very minimal.

'*It is not the right soil, which is unfortunate, but what we're doing now is actually the research to figure out what it would take to cover that soil, or to make membranes or to find other ways. So*

we've come from the sort of fundamental biology in terms of research and how to grow the algae cheaply.' – After a private sector informant.

'There is no innovative activity going on in the sector, nothing up till now.' – After a research and education informant

The lack of private sector activity and R&D projects was by several informants mentioned as a main barrier to regional learning. Without the involvement of the private sector the development of certain public research projects doesn't make sense either as will mentioned in the following quotes. What it turns out this way kind of looks like a 'chicken and egg story'; for private investors it is too premature to invest in Oman, partially due to low levels of local skills and knowledge, and on the other hand do public research institutes need the private sector to be in place to give sense to their research projects. As investors are reticent this actually forms a thread to the development of the aquaculture industry according to one of the informants.

'*So for the feed production to develop and be actually viable, we need private farms to be in place*.' – After a research and education informant

'*We need a lot of private companies to be in place, so we can improve you know, the feed stuff, all these acquirements*.' – After a research and education informant.

'*Investor reluctance is a major thread to developing the aquaculture sector in Oman. Investors are quit reluctant to go in because there's no example of a working project here. A lot of people are interested, and they keep talking and talking and talking, but eventually no one puts their hands in their pocket.*' – After a research and education informant.

7.2.2 No 'innovation culture'

Other than the Feed Algae projects, obviously also due to a general lack of private sector activity is there not much research going on based on private investments. Informants did speak about the more general 'innovation climate' in Oman though. As the quote underneath the title of this chapter stated is the Omani economy not geared towards innovation. As for SME's, which are in few numbers anyway, their engagement in innovative activity is rather low. As for the big corporates with R&D departments, these divisions are not located in Oman yet. The Industrial Innovation Centre is the main institution for supporting companies in their R&D activities, connecting research institutes to the private sector and developing an innovation culture in the country, which up till now is really in its infancy phase.

'*The innovative capacity of Omani SME's is low, I would say. Because in the beginning people were quit comfortable in the status quo, and there was a mind set of what they're doing is good*.' – After a public sector informant.

'*There is no specific structure for innovation in the country, in fact – I might be wrong about this – but from our understanding, we play the major or the only role in creating an innovation culture, so even the big companies or the so called corporates, much large companies have their own internal R&D team and labs, like Apple e.g., we don't have companies with that structure here in Oman*.' – After an IIC informant.

According to the informants at the IIC the slow growth of SME's in Oman is the result of lacking research capabilities and access to research facilities. Because this was and still is the case most of the times innovative activities remain absent.

'*I would say the slow growth for SME's would be because they didn't have the research capabilities, they didn't have the mind set within the company, they don't have R&D labs, they don't have access*

to universities who did have an R&D labs, there was no coordination there, so it was almost like an impossible task.' – After an IIC informant.

'*Do R&D, oke what with? I've got a pen and a computer, how am I going to be innovative? As a centre we have actually build that bridge, to enable the connection, the communication between people who were doing active practical research and people who within industries who need the expertise, who have not know where to approach, or how to get involved before.*' – After an IIC informant.

One way of increasing the competitiveness of local companies through innovation is by helping them to become more competitive internationally. By doing so more 'in country value' is generated because the bigger companies find suitable subcontractors locally, instead of having to import most of their needs.

'*What we are doing at the moment is developing an innovation program where we're actually working with some of the subcontractor companies from the oil and gas sector to actually help them become more internationally competitive, so that they are better local service providers, which means that a large oil company doesn't have to bring stuff in from overseas, because the quality is available locally*.' – After an IIC informant.

'*Vale is on discussion with us on that particular matter, Petroleum Development Oman is doing that, Shell is in discussion with us as well, where they want to look at ways where they can support their local suppliers – even on food for example – to be more innovative.*' – After an IIC informant.

By connecting the big multinational enterprises in the country to local subcontractors/SME's the IIC makes serious efforts in order to increase their competitiveness and create in country value. It's a model that would also be applicable to the aquaculture industry, however for the time being the IIC does have a specific programme to innovate in the fisheries industry, but it doesn't focus on aquaculture in particular.

'*The equipment of the factories in the fisheries industry, whether upstream or downstream needs to be improved, and the MAFW asked us to put a special focus on those industries. We are not really looking at aquaculture for them.*' – After an IIC informant.

That Oman is not accustomed to innovation and renewal was illustrated by an anecdote of one of the informants. As a research institute they we're asked to develop a new type of 'halwa', which is a traditional Arabic type of sweet. The request from the industry itself was to develop a new type of halwa that was more suitable for these times where people look for healthy diets – so less fat and less sugar, while maintaining the taste and quality of the traditional halwa. When the product was finished, the Ministry of Commerce blocked the actual commercialization of it because supposedly halwa had a cultural value, and could not be modified;

'*The industry spend some money, they contacted the IIC that put another part of the money into the system, which worked very well. And then after 1 year of research we came up with several recipes, with low fat and, or low sugar. But then the Ministry of Commerce stopped it, right there. They said halwa is a cultural value, it cannot be modified. That was the argument*.' – After a research and education informant.

Besides an occasional institutional/cultural barrier to innovation as described in the example above did other informants look for an explanation for the lack of innovation culture in the demand side of it. The absence of private sector R&D projects is mainly fuelled by the total lack of drivers for innovation. Because the development of employment opportunities is often the main driver of economic growth renewal through innovation is very rare for both the private and the public sector.

"*It is all about human development, offering an alternative because of the unemployment – offering an economic alternative for the people.*' – After a research and education informant.

This same informant continued to explain why the factor 'labour' in Oman could be held responsible for the absence of innovation;

'*The factor 'labour' has always been in abundance, cheap labour, this has hindered innovation in the country because there is totally no drive to develop technologies in order to save costs because there is a constant supply of cheap labour*.'

On the other hand are there special labour laws in Oman, like the Omanization law as described earlier, that form a major barrier to the access of knowledge and subsequently to the innovation that can take place in the country. This is different in for example Dubai, where they have fully opened up their borders to foreign knowledge workers to embrace the tertiary sector and innovation. In relation to the situation in Dubai an informant from the research and education group said the following;

"*This is something that pinches in Oman, on one side they have this innovation policy but on the other you have all these restrictions with regards to labour for example. I mean, here at the university we have major issues to attract qualified staff because our Omanisation rate is not good enough and we're not allowed to employ new expats, the quality of education is suffering enormously from that. They do want to innovate and attract FDI, on the other hand you've got total contradicting policies and labour restrictions*."

Additional to issues with labour regulations counteracting an innovation climate did chapter 4 briefly described Oman's scores on the Global Innovation Index 2014 – in which Oman was categorized as an 'inefficient innovator'. This is mainly the result of the relative high scores on innovation input, and relative low scores on innovation output like knowledge and technology creation. Several informants mentioned the weak patenting system in Oman as a barrier to major investments in R&D in the country. It seems reasonable that someone does not spend a lot of money and time on research and development of new products and services, as the outcome of it is very poor protected. The following quote addresses this problem in a question about knowledge transfers;

"*At the moment it would be very difficult, mainly for legal reasons. The Sultanate of Oman has a very weak intellectual property legislation in place, which means that foreign investors, if from scientific point of view, find new solutions, new systems, new plants, chemicals, processes – they find innovations, they are extremely week protected in the country, and therefore that slows down especially high tech, biotechnology and so on. You know if someone discovers a new chemical particle in seaweed that we can grow in aquaculture for instance, and the process to use these chemicals in a vitamin complex or whatever, there is a patenting process here but it is so so so week*." – After a research and education informant.

Future

Even though at present a real innovation culture in Oman doesn't exist, let alone in aquaculture, several R&D projects are on their way and the IIC is creating awareness of the importance of innovation. By doing so attempts are made to generate an innovation culture both with current and future generations.

"*I'm trying to sort of introduce the concept of innovation, and actually grow an understanding and an educational awareness and the importance of innovation. To start with we had some resistance,*

the one thing about Oman is, there is a lot of word of mouth. So once you have a couple of successes people will start to talk about it and that encourages other people to also do it." – After an IIC informant.

Another step forward is the establishment of investment funds that understand the aquaculture industry, are not focussed on immediate return on investment and are willing to invest in R&D. One example of this is the newly established Oman Aquaculture Development Company, as described before and another one is Knowledge Advanced Technologies, which is a PEIE subsidiary looking for R&D investments in across different sectors.

"*As an investment company you cannot go into a project except if these projects have a minimal amount of profits – but with Knowledge Advanced Technologies (KAT) we can go for R&D, we can go for venture capital, we can go for adventures with money, you can invest for things which are not profitable because they would be of value off the grid. The job of KAT is to invest in things which are of national benefit, it's not just a business company. So we're forming several companies out of it according for example one for aquaculture, one for solar energy, one for the water treatment. One we're working on now is KAT Hesy, the company from the Netherlands.*" – After a private sector informant.

This informant later continued to explain the content of the R&D project with Hesy. It is a project that focuses on growing native groupers, something that's never done before. As the grouper is a declining species in Omani waters (table 5.1) and it's of high value and on high demand in the entire Arab market this seems to be a project that, if successful, could have a positive commercial prospect.

"*The second stage will go to around 10 million rial, it's the most difficult stage because it is the first time that grouper from Oman is being hold to make eggs and fingerlings from it. The ones in the rest of the world are all infected with viruses, so it will be the first time to do it here in the Arab area. Within the upcoming 5 years we're talking about 1 billion euro. We have done a complete business feasibility study. The first area will be 4000 square meters. We have in Oman more than 50 types of grouper. This is an R&D project – we want to study what the present situation is of these 50 types, how many are left.*" – After a private sector informant.

Also on the ministry side one informant mentioned an upcoming R&D project, focussed on growing lobsters;

"*Another company would like to come and do some research on lobsters, you know they take the larvae from the wild life and then they will grow it in the tanks in the centre, and then to enhance in the Omani waters. So this will also take another 2 years.*" – After a public sector informant.

As for the last quote, it must be said though that statements made by the MAFW about upcoming projects and project application have not always turned out to be a hundred per cent accurate. The following quote of an informant who is both amazed and annoyed by the fact that never anything is really happening characterizes this issue;

"*I am endlessly told there is 50 projects just about to start, I mean I've been told that for 10 years, well then where the hell are they?!*" – After a research and education informant.

7.2.3 Conclusion

Except from one example there are no private sector R&D projects going on at the moment in the Omani aquaculture industry, which in itself is not surprising as chapter five already mentioned that private sector activity is very minimal. The lack of private sector R&D investments however is not particular for the aquaculture industry alone, in Oman there is a general lack of an 'innovation culture' as a result of absent incentives to innovate. Improvements

are being made though, and the IIC is making efforts to increase innovation awareness. For example through increasing the competitiveness of SME's to make them better local service suppliers to the bigger international companies located in Oman. As regards to aquaculture several R&D projects are in the pipeline, which would eventually lead to an increase in private sector innovative activity.

7.3 Collaboration & organization

As has been mentioned earlier in chapter 5, 6 and 7 is the specific knowledge in the field of aquaculture is quite dispersed, isolated and sits with only few – often foreign – experts. Projects often stand alone and don't find any follow up, let alone develop into a commercial stage. It's in this light that several informants made remarks about the level of collaboration between public and private sector parties and the overall coordination that takes place to develop research activities in the aquaculture industry. This paragraph will discuss these remarks.

7.3.1 Collaboration

Being a relatively new industry in the country and having limited resources in terms of available knowledge and expertise one would actually expect a high level of collaboration and coordination between the different actors; the MAFW, the research and education institutes and the few private sector initiatives. However this is not the case. The frequency of interaction is low and collaboration takes place on an individual basis rather than on a strategic level of different entities. The first quote elaborates on the relation with SQU and the difficulties encountered in the collaboration to get things done.

"*So - and again, I am not exaggerating – getting things like copper sulphate, which is globally available stuff, you can get it absolutely everywhere, even in the mountains in Nepal – getting it from the university, getting like 5 grams from the university requires an active state, everybody is just so hesitant to share. It is a very very difficult environment to get things done*." – After a private sector informant.

This same informant addressed the issue of lack of collaboration between the different ministries. In order to get approvals and move on with the (R&D) project different ministries have to give their approval, as they get together only very seldomly this also slows down the progress to establish projects;

"*We've gotten the understanding that we can apply for that land, but there are 1 or 2 meetings a year where all the ministries get together and actually sit down and discuss these things, and of course the ministry of housing trumps everything, and the military the same, and so the process is very murky at best and I am not sure if the ministry of fisheries can have a lot of influence on that.*" – After a private sector informant.

Under the informants there was no general consensus about the question if there was sufficient collaboration within the aquaculture industry or not. The answers ranged from 'no collaboration' to 'fairly good', the majority of the informants though would like to see an improvement in the collaboration. Especially so because the implementation and realization of projects has proved to be much more difficult. Now the collaboration is based on the interaction between individuals at different entities rather than on strategic collaboration. As people tend to change functions all the time within the ministry, and expat knowledge workers within the research institutes work on temporary contracts it is hard for R&D projects to really embed in a wider 'aquaculture development framework'.

"*No one coordinates the development of aquaculture. There is no collaboration, everybody stands alone*." – After a private sector informant.

"*I think there is a lack of understanding that aquaculture at the other day is an industry itself, that needs to be profitable. And regards all those elements to work together, not separately at all. So you need to develop research that links each one of them and their working together. And that is sure not enough right now*." - After a research and education informant.

"*I think the public-private-education collaboration is fairly good. I mean there is a sort of lack of program meetings and committees and so on, but you know generally when there is a need to have some collaboration between the private sector, between the universities and the ministry it is always been fairly positive*." – After a research and education informant.

Subsequently asking about how those positive collaborations would practically work out in the form of project implementation the informant was somehow less positive;

"*Oh no, implementing projects is a whole other issue. Implementation becomes a different issue because of the process of building a fish farm in Oman has proved to be, for whatever reason, extremely complex*."

The following 2 quotes indicate the individual basis on which the research takes place.

"*The research on aquaculture is carried out in part by the ministry and by the university. We worked sometimes in collaboration, sometimes in isolation – depending on the nature of the project. With the ministry we have individual collaborators, so individual researchers*." – After a research and education informant.

"*It is not organized. But you know we are cooperating, you know Stephen (Goddard resp.) is my friend! I know him very well, and a lot of them. So we are cooperating, but not on a regular basis. But we know each other from the old days, and we cooperate. But it is simply not the way it should be.*" – After a research and education informant.

Additionally is there a tendency towards criticism between different knowledge institutes, but also between the public and the private sector as has been described before (investor reluctance plus investor short sightedness versus general lack of knowledge and coordination from the MAFW). Even though the criticism is not very strong, it often does make sense. This means that through better collaboration within a more strategic approach different entities could function better within the industry as a whole and complement each other rather than have overlapping or contradicting agendas.

"*You will find the aquaculture department of SQU only sees biological issues, and that's it. They don't look into the marketing issues, they don't look into – perhaps – engineering issues, they don't look so much in to health issues or nutrition that much*." – After an aquaculture centre informant.

"*I can not say the government is not helping, but the technical people have not been much over the past years – only now they are increasing, this maybe can help later on. Secondly, with the construction of the aquaculture centre, I went to Dr. Lubna and talked to her – this centre, they should support the private sector and support research, that is the role of the aquaculture centre. But the number of researchers is not much so far, to do all these things.*" – After a research and education informant.

7.3.2 No coordination

As can be partially derived from the previous paragraph already is the coordination of aquaculture development poorly organized. It's surprising that despite major efforts by the MAFW no informant really praised their guiding role in developing the industry. On the contrary, the ministry seems to be the heart where project proposals sort of jam up hindering

private sector development. This can be derived from several quotes in this and previous chapters, for example the last quote in paragraph 7.2.2, where an informant mentioned to hear for years already that 50 project applications are about to be approved but that up till this moment almost nothing has happened. It is however important to understand that there's no freedom of speech in Oman – criticizing the functioning of the government is prosecutable. Though, here two quotes who additional to what is been said already in previous paragraphs demonstrates the week coordination of the MAFW;

"*The ministry does not officially play a role in the acquisition of foreign knowledge. If there is a company, would wants another company from the Netherlands, he is getting it.*" – After a research and education informant.

"I don't know if you've seen that, but there's a real lack of structure I would say. I don't want to be too negative on all these things, eventually things will happen but you know the ministry at the moment is waiting for some fantastic fish farming company to come in and do everything just right from day one and start the business, but I don't know if that can happen." - After a research and education informant.

As described before does the Industrial Innovation Centre does not have a specific focus on the aquaculture industry, hence no coordinating function on the development of research activities in the aquaculture industry either. The only organization (public/private) who actually seems to have a more wide approach to industry development is the Public Establishment of Industrial Estates (PEIE). For their Bio-Marine Cluster project in Sur they have gathered a wide variety of different actors to jointly organize the R&D project and embed it in a wider local and national context. Even though their plans technological wise contradict with what some of the public sector informants mentioned (the PEIE is a major opponent of open water cage farming; within the ministry however they still look into cage farming as a future possibility) they seem to have broad support.

"*As PEIE we started an initiative called the Omani Bio-Marine Industrial Cluster in Sur, we've formed a committee for this one, the Oman Marine Cluster Committee, PEIE is heading this committee, under the committee we have the Ministry of Agriculture and Fisheries, the Ministry of Environment & Climate Affairs, and the Ministry of Manpower – we have the training institute in Al Khabourah (Reps. The Fishermen Training Institute), so these are the three members now. One by one we're joining the other parties from Oman, like the research council, the Ministry of Education, we have a whole program to make a complete bio-marine cluster in the industrial estate in Sur.*" – After a PEIE informant.

7.3.3 Conclusion

Developing research activities is suffering from weak collaboration between different entities in the aquaculture industry and a poor organization in general. Even though different opinions have been heard about the forms of collaboration in essence collaboration takes place on individual basis with a general lack of coordination. Informants gave examples of collaboration, but even more so illustrated that there's an urge for improvement of collaboration at all levels. As the MAFW has more functioned as a strong regulator, declining many project proposals, rather than a facilitator or partner in R&D projects their functioning is being questioned. Additionally so because their role in coordinating the industry's development also remains weak. The Industrial Innovation Centre does neither have a specific innovation programme for aquaculture, but the PEIE has. For the Bio-Marine Cluster in Sur they handle a multi-actor approach, which is new and unique for the aquaculture industry in Oman.

7.4 Answering the 3rd sub-question

A Localised Innovation System

Considering the fact that Oman is new in the field of aquaculture it needs to technologically catch up with technological leading countries in order to develop a successful world-class aquaculture industry. A possible strategy to technologically advance the Omani aquaculture industry is by addressing a local innovation system (LIS). In this way a regional space of learning and innovation is created (Ewers, 2013) in which a functionally set of organizations and institutions create, adopt and commercialize valuable new knowledge (Simmie et al. 2008, p. 14). Moreover, a local innovation system can be addressed on a regional level but is more affective when specified on specific industries like the aquaculture industry in particular. In this way the industry specific absorptive capacity can be improved by key actors like innovative organizations (Martin & Sunley, 2006). Because of this relevance for developing the aquaculture industry in Oman the third sub-question is proposed as follows: *to what extent has developed a specific local innovation system for the development of the aquaculture industry in Oman?*

With regards to Oman in general the country is suffering from a structural lack of an innovation culture; the institutional framework is clearly not geared towards innovation and renewal but rather to strengthening the position of the current bureaucracy. As for aquaculture in particular there's not such thing as an innovation system in place. Even though several R&D projects are taking place these are poorly integrated in a wider innovation framework and hence are threatened by a lack of follow up or actual commercialization. Since the functioning of the Aquaculture Centre (responsible for providing and coordinating the aquaculture research agenda of the country) is highly doubtful the industry and innovation in particular suffer from a total lack of coordination. It's especially this coordination within the innovation system that is crucial in order to manage regional learning (Ewers, 2013; Hassink, 2010; Martin & Sunley, 2006; OECD, 2001, Simmie et al., 2008). As learning takes place as the result of new knowledge affecting the behaviour of individuals in the region (Foster & Rosenzweig, 2010), a total lack of coordination and organization limits the learning opportunities. Despite the fact of a 'one stop shop' for aquaculture being initiated in 2011 project proposals still need to pass several ministries and departments with as a result a structural lack of successful outcome and learning opportunities subsequently. In order to fully enable the learning process it's essential to coordinate the innovation policy across different separated departmental and ministerial responsibilities (think about R&D, education and training, industrial development, labour market) (OECD, 2001). Coordination and communication between the different Omani ministries like manpower, housing, education and agriculture & fisheries involved in the development of aquaculture has demonstrated to be quit problematic.

Additionally what is concerning is the fact that as a result of high government involvement at all levels private sector in general and start-up activity in particular is very limited. The innovative capacity of Omani firms is rather low, and the entrepreneurial spirit has ever since the discovery of oil not been the same as before – resulting in a general lack of start-up activity. This doesn't come as a surprise as this is characteristic for most Gulf economies (Ewers & Malecki, 2010; Mansfeld & Winckler, 2008; Porter, 2003). It is problematic though considering that local firms are often major innovators providing substantial learning opportunities (Alvarez & Molero, 2005; Inbal & Tzachor, 2013; Simmie et al., 2008).

8. Human agents and institutions

8. Human agents and institutions

"My opinion is that the Ministry of Agriculture and Fisheries Wealth should examine its role very carefully in the development of aquaculture and focus on the issues that have to do purely with development." – After a research and education informant.

This chapter will explore the empirical results in order to analyse the role of different human agents who through both formal and informal institutions influence the development of aquaculture. The chapter is roughly divided in to two parts; the first part is dedicated to the role of hard, formal institutions like the regulatory framework, the labour market and the education system. The second part is dedicated to the more soft, informal institutions like the ways of doing business, the cultures of work and the interaction between different entities in the aquaculture community of Oman. The primary qualitative data will be combined with secondary data provided in chapter 4 for several items, like the regulatory framework and the labour market structure. Both paragraph 8.1 and paragraph 8.2 will finish with a conclusion and an overview of positive and negative features through which human agents influence the development of aquaculture. Chapter 8 will finish with paragraph 8.3 in which the 4th sub-question of this research will be answered. In order to create an overall understanding empirical results are integrated with the provided literature from chapter 2.

8.1 Formal institutions

Some formal institutions have been discussed in chapter 4 and 5. Some of them about Oman in general like the 'Doing Business Report' and the 'Economic Freedom of the World Report', others more specific to the aquaculture industry, like different incentives available for aquaculture investments. What follows here is not an extended analysis of all the formal institutions, but those that matter in their relation to the development of aquaculture in the country; those that were mentioned by the informants.

8.1.1 Regulatory framework

Regulations that wring

With regards to the regulatory framework the informants made many comments that are best summarized in three different categories; environmental regulations, local partner restrictions and labour restrictions. It is these regulations and restrictions that wring with other existing policy or efforts to develop the aquaculture industry. The informants have addressed especially strict environmental regulations as a major institutional barrier for the development of aquaculture, especially in terms of pace of the development. The Ministry of Agriculture and Fisheries Wealth (MAFW) itself emphasized the importance of the natural environment as well as a key condition for developing the aquaculture industry.

"*Now during the licensing process we have strict measures for everything, to safeguard the environment. Even during the construction time we have a special monitoring team, to monitor right from the construction and the operation. The ultimate aim is to safeguard our environment, and to learn lessons from the rest of the world*." – After a MAFW informant.

"*The MAFW has very strong rules and regulations according to international standards before giving licenses*." – After a research and education informant.

One example of how these strong environmental regulations practically work out is that the Ministry of Environment is such an opponent of marine cage farming that it refuses all project proposals on this topic. But because no feedback is given upon refusal many companies that

have applied literally don't know it's because the Ministry of Environment won't allow any cage farming in the country anymore in the future. This also explains why several Norwegian companies have tried to start a cage farm in Oman, but never succeeded. What is remarkable here is that even within the MAFW several informants considered open sea aquaculture (cage farming) as a better option for Oman than the closed land based RAS systems. Indicating a lack of consensus on ministerial level what the best (technological) way forward would be.

"*The ministry of environment is against the cages. So the ministry of fisheries cannot do the cages without the ministry of environment. The ministry of environment is stopping all the licenses for the cages*." – After a private sector informant.

The second restriction that wrings with the ambition of the MAFW is the fact that all foreign companies that want to establish a project or start up a business in Oman are obliged to have a local partner, which is noteworthy in itself as is demonstrated that private sector activity in the Omani aquaculture industry is very limited yet.

"*The point in Oman is that you need to have an Omani partner, whereas in Dubai there are many exceptions to that*." – After a research and education informant.

"*There's the issue also that companies can't set up here without a shareholding from the Omani side, so this can also be a slow down factor in all of that. My own opinion is that the ministry should examine it's role very carefully in the development of aquaculture and focus on the issues that have to do purely with development*." – After a research and education informant.

Thirdly, the 'nationalization' of the labour market as described in chapter 4 turns out to be a major institutional obstacle for foreign companies. For example for one of the fisheries companies that has participated in this research;

"*On one side they increase the minimum salaries for the Omanis, they put a lot of burdens with Omanization and red tape and things like that and on the other side they ask you to sell for a very low price in the domestic market - so yeah that is very difficult*." – After a private sector informant.

So in addition to restrictions enforced by the Ministry of Environment the Ministry of Manpower is also restraining the development of aquaculture. An example given by one informant described the problematic neatly. On a recently established university the ministry want to conduct research, but due to Omanization restrictions no sufficient researchers could be employed to work at the university.

"This is something that pinches in Oman; at one hand you have an innovation policy, but on the other you have all kinds of restrictions when it comes to labour. So you have to operate within the restrictions enforced by the Ministry of Manpower. I think that really discourages potential investors." – After a research and education informant.

Paragraph 8.1.2 will further elaborate on issues with the labour market. Except from the environmental regulations the other two restrictions could be overcome entirely or partially with economic free zones, of which one (though in a very premature stage) is currently being developed especially for the aquaculture and fisheries industry in Duqm. In the interview with the Feed Algae informant was mentioned that the company is considering to hire a plot on the free zone, even though that comes with a price tag.

"*We would love to get a place on a free zone, we would love to. Maybe what we'll do is grow the stuff outside the free zone, bring it in and process and dry it in the free zone, bag it, whatever we need to do, to get advantage of the free zone. There's a 1% levy at the gate on aquaculture products, which we're happy to pay, don't get me wrong, that's not an unreasonable levy. But the*

point is rental for land in the free zone is 200.000 dollars per hectare per year, for us, that is hugely significant, that is phenomenal – for a piece of muddy sort of clay. So in that sense we are also very aware of the disadvantages of the free zone as well." – After a private sector informant.

Besides the fact that plots on the free zone are expensive (especially taken in consideration the time it takes for aquaculture businesses to be profitable and the problems with financing aquaculture projects) they don't eliminate labour and local partnership restrictions entirely. After all you still need your suppliers, outlets and sub-contractors – so as an industry as a whole you still operate within the restrictions of the different ministries.

Delays in licensing

As a result of the strong regulations as described above (mainly the environmental regulations) it has proven problematic for the MAFW to issue licenses in order for projects to start. As was mentioned previously does the ministry supposedly claim for years already to have a bunch of project applications ready for licensing, but after all what has happened is very limited (paragraph 7.2.2). Due to very slow licensing processes several foreign companies themselves have withdrawn from the application process – which is seriously problematic as has been demonstrated that for the industry to develop the private sector needs to develop.

"*Hesham has been working for 3 or 4 years in this project – now he just got his EIA last week when he was talking to me. After all the ministry studies and all these things, it took a lot of time, because of delays, there is no rush – and that is the problem. Only now he can start work.*" – After a research and education informant.

As a result of the slow licensing procedures by the MAFW there seems to be a major call for improvement in the speed with which applications are handled. Remarkable is the fact that one informant mentioned that the MAFW is so hesitant in issuing licenses that even the Bentoot shrimp farm, which has been in Oman since 2007, is still not running on a full licence but on an experimental licence.

"*I believe Bentoot is still working on an experimental license. I don't know if any farms have a full scale license. And that's a reflection on all the delays in setting up the process and the whole system of implementation of licenses.*" – After a research and education informant.

"*Everybody is escaping out of it, everybody is leaving because all the applications are delayed. Strong rules is not a problem, not by any means, BUT you need to make things faster."* – After a research and education informant.

"*If they give licenses, even with the strong rules, if they give licenses this will speed up the development of the industry, for sure. Because e.g. I know an American company that has been applying for three years now*!" – After a research and education informant.

One other informant, an Omani entrepreneur, told an anecdote about his experience with the slow licensing procedures in Oman that had almost got him bankrupt in a previous project;

"*For the greenhouse, the instructions came from His Majesty, imagine, and still it is very difficult, since 2009 till today I am working on it, imagine. Now basically we got all the approvals and it is a matter of finalizing the funding part and then to move forward, that's it."* – After a private sector informant.

Partially due to the long application procedures, the strict regulations and a lack of available skills he is now considering to start a shrimp farm in Sri Lanka rather than in Oman. This is characteristic for the vibe amongst potential investors; if it turns out to be so difficult in Oman,

why not invest elsewhere? This poses a serious thread for the development of the industry as companies literally pull back from application procedures.

"*Because in business you can not be so attached to, I am sorry to say, because it is my country, I love it, but there are certain things that can work, and there are certain things that can not work – and I need to be practical about it.*" – After a private sector informant.

Summarizing desk research

In order to fully be able to answer the 4th research question this chapter with empirical results is backed up by extensive desk research provided in chapter 4 and 5. What will follow is a brief summary of what's been said about Oman's regulatory framework in paragraph 4.2 in order to refresh the mind. On both the World Bank Group's 'Doing Business Report' as on the category '*Legal structure and security of property rights*' of the 'Economic Freedom of the World Report' Oman scores relatively well. This indicates that in general Oman's regulatory framework is well in place. What is remarkable is that Oman scores either *really high* or *really low* on the different indicators – resulting in overall generally high average scores. Table 8.1 provides an overview of the positive and negative features of Oman's regulatory framework based on both reports as mentioned before.

Positive features	Negative features
• Paying taxes • Registering property • Regulatory restrictions on real property • Business costs of crime	• Enforcing contracts • Investor protection • Employing workers • Closing a business • Getting credit • Dealing with construction permits

Table 8.1 Features of Oman's regulatory framework. Source: The World Bank Group, 2006 tm. 2014 and Fraser Institute, 2002 tm. 2014

8.1.2 The labour market

As the situation of the Omani labour market has been earlier described in paragraph 4.4, this paragraph will further elaborate on this matter based on empirical results. The labour market in general issues as described in paragraph 4.4 centred around a few different topics. After 25 years of Omanization policy today's reality is seeing a steady decrease in the Omani national private sector labour market participation, indicating the counter productivity with which the policy is being carried out. As being the main employer for Omani nationals and still expanding the government is mainly responsible for the failure of the Omanization policy. Second, Oman has seen a gradual increase in labour productivity since the 1960's, with which it holds quit a unique position in the region. On the other hand due to the inexhaustible influx of cheap low skilled labour the increase is nihil when compared to OECD countries. Thirdly, despite of employment generation being a major driving force behind regional economic policy, unemployment rates remain high especially under young Omanis. This indicates the existence of a mismatch between the education system and the demand of labour at the labour market. This paragraph will explore the extent to which these and other issues constrain the development of aquaculture in Oman.

Employment creation

The fact that employment creation is the main driving force behind economic policy possibly hinders the development of aquaculture in Oman. The reason for this is twofold. On the one hand people are afraid that developing the aquaculture industry will initially create jobs, but on the other hand threatens the craft of the traditional fishermen. It's a fear that makes sense when aquaculture products (steady supply, fixed price, good quality) replace wild catch (fluctuating supply, price and quality) in the local market. And as was demonstrated before are the current fishermen not able to take on aquaculture jobs other than the post-harvest activities both industries share. On the other hand don't all aquaculture activities provide a lot of employment, and if it does this is either high tech/high skilled (RAS systems; cages) or low tech/low skilled (shrimp farming). Both don't match the available Omani nationals, which means that (again) you would build an industry based on foreign experts and foreign cheap labour.

"Aquaculture actually poses a major thread because when you develop it you might take away the work of the local fishermen. And the problem is these local fishermen are not suitable to work on a fish farm." – After a private sector informant.

The following two quotes indicate the level of skills required for different types of aquaculture jobs. The first quote is talking about the culture of finfish in marine cages or RAS systems, and as chapter 5 and 6 have demonstrated is this problematic due to an inexperienced workforce and a general lack of knowledge. The second quote is about the type of labour required at a shrimp farm (in this case in Saudi Arabia), which as described in paragraph 6.2.2 doesn't fit the profile of Omani nationals either as they don't want to do this type of job (more about this in paragraph 8.2 about the informal institutions – cultures of work)

"*You need to bring foreign skills. Aquaculture is a skill oriented job, and it needs experts*." – After a private sector informant.

"*They have 17 labour camps that are fenced inside the company, and because of fire security there is no movement between them, so essentially it is very low wage captured labour, it is quit old school. They have people from Sudan, Bengalis – sort of labourers, you know very very low wage*." – After a private sector informant.

To further emphasize the difficulties of hiring skilled Omani nationals a private sector informant mentioned how he solved the issue, which is simply by hiring foreign employees.

"*We've interviewed multiple students, looking for somebody right now to try to run the ponds outside when I am not here, we can just not find an Omani to do that. We can not find the skills, it is just not here. Ines was our first local employee, she is Tunisian, she has had her training all over the planet, literally, from America to Malaysia.*" – After a private sector informant.

Summarizing the above, in the current situation aquaculture doesn't hold the potential to actually create employment opportunities for Omani nationals. In order to do so the workforce should be prepared to fill both high and low skilled functions.

Government jobs

At the moment the MAFW is the main employer in the field of aquaculture and fisheries. The government is still expanding and hiring most of the recent graduates from SQU and the FTI in order to provide them with a job. Obviously this is partially the result of the lack of private sector activities, on the other hand by protecting the youth from unemployment the MAFW is also expanding itself over the expense of private sector development, and the opportunity for Omani nationals to gain the necessary 'hands on' experience needed to develop the industry. The major role of the government in the labour market is actually twofold, as people (graduates) aim for a government job at one side, and on the other does the government keeps on expanding and hiring people. Hence this sort of functions like a self-sustaining process.

"*The general problem is that people who have studied expect to get a job as a government official at ministerial level, that has been the culture here up till now. The 'private sector' is actually a scary word, and is run by expats*." – After a private sector informant.

"*But this is a very delicate situation, simply because the MAFW cannot take all students! It is not acceptable at all, because they cannot take 40 or 50 students per year. So maybe in the future in fisheries and aquaculture when the private sector develops they can take them. But this is not an easy question…*" – After a research and education informant.

"*SQU graduates end up in the private sector, fisheries companies. But many more end up working in the ministry – the ministry is still expanding its tentacles all over the country so they still need people to go north and south*." – After a research and education informant.

Mismatch

With regards to the labour market two different 'mismatches' have arisen from the empirical results. One is a more general phenomenon for Oman and the other is specific to the aquaculture industry. As for the more general one, several informants made the observation that what the labour market is asking for is not met with the local supply of increasing university graduates. As a result a continuing appeal to the pool of expat workers is made, both for low skilled labour as for high skilled technical expertise.

"*I know that a lot of students don't find a job. There's simply a massive mismatch; everybody holds a bachelor degree nowadays, which is sort of a new right Omanis have acquired, so all quit academically schooled, but if you look at what the labour market is offering, those are only low skilled jobs.*" – After a research and education informant.

"*How the hell are you building a knowledge economy when 80% of the current jobs are low skilled? And when more of half the people working in the private sector have only been to primary school? That is not the labour profile you're looking for.*" – After a research and education informant.

As for aquaculture in specific an additional second mismatch seems to arise. The Fishermen Training Institute (FTI) is preparing both fishermen as well as aquaculturist for the labour market through vocational training. A problem they observe though is that with regards to the current system boys are not interested in subscribing for degrees at the FTI as they are more appealed to e.g. a job at the army rather than one at sea or as an aquaculturist. Girls do subscribe, but according to the informant they are less suitable for the tough work that aquaculture at sea (cages) and at shrimp farms require. On the other hand would they be suitable to work with the technologically more advanced RAS systems.

"*There are almost no boys at the institutes, but only girls. Boys are not longer interested in a career as fishermen/aquaculturist but rather choose a job at the army, which is more certain and significantly higher wages*." – After a research and education informant.

"*What we did was Quriat aquaculture, open sea – no ladies could work there. Now some ladies work in quality control of the fish, not in aquaculture – in fish factories. For the future, women can work in fish factories, quality control and hatcheries, and the closed system – but not on open water (cages or capture fisheries resp.). So actually there is quit a bit of potential for women, but so far its mainly in relation to the technical things of aquaculture. But for example they cannot work in shrimp farms, which of we have one – the Bentoot shrimp farm, and the other one is under construction. So this is not a simple thing."* – After a research and education informant.

Abundance of expatriates vs. Omanization

As was mentioned in chapter 4 is the Omani labour market characterized by the influx of cheap, low skilled foreign labour. Especially recent years have seen a tremendous growth in demand for foreign labour. As is discussed in paragraph 7.2.2 has the abundant supply of cheap low skilled labour hindered the need for innovation as the factor 'labour' has always been the cheapest and easiest option above others. Oman's ambitious Omanization policy has proven to be rather counterproductive, as a decreasing number of Omani nationals is working in the private sector. Many informants mentioned the issues that arise from the Omanisation policy, from companies having fake staff on their payrolls (paragraph 6.2.2) to universities not being able to employ sufficient qualified staff as a result of 'hard' Omanization restrictions (paragraph 7.2.2). It is really something that 'bites' in Oman and gives it a disadvantage to foreign investors in comparison to for example Dubai or the Kingdom of Saudi Arabia (KSA), where they have less hard labour and local partner restrictions and where procedures don't take so long.

"*It could happen that companies rather look at KSA or the UAE to invest in. I had a regional meeting with people from all the Gulf states, Saudi Arabia was here, I know them from long back. They have a strong support to the industry there, and strong rules, and they're working very hard – not as slow as what is happening here, they're working harder and encouraging the people, but they're putting strong rules.*" – After a research and education informant.

On one hand the minimum salaries for Omani nationals are increasing, the government is expanding and providing 'easy' employment opportunities to young Omanis and on the other is the private sector obliged to employ certain numbers of Omanis – whilst cheap labour from e.g. India or the Philippines is available in abundance, and often more experienced in the field of aquaculture. That's why private sector investors in aquaculture, even being aware of the Omanization rates, will try to negotiate this rate with the government in order to be able to run there business;

"*We are always keen on community engagement, we are very cognizant of the Omanization requirements, but we will clearly have to negotiate for that.*" – After a private sector informant.

As been quoted before by a very experienced expat informant in the field of aquaculture;

"*My opinion is that the ministry should examine it's role very carefully in the development of aquaculture and focus on the issues that have to do purely with development.*" – After a research and education informant.

"*You know if I want to take 30 more expat staff, I also have to take 15 Omanis at the same time.*" – After a private sector informant.

So what follows after the above mentioned quote is that either the company doesn't expand, it finds suitable Omanis and hires them, or it doesn't find suitable Omanis but still hires them and employs them as 'fake staff'. It is the last option that happened in this case, obviously this option diminishes the profitability of the business. As the current Omanization policy is clearly constraining people's businesses in Oman, also in aquaculture, the government should definitely reconsider the policy. Even more so as it's been proven to be counterproductive over the past years.

Labour productivity

Additionally as a last remark in this paragraph should be mentioned that one informant spoke about the missing link between labour and productivity. It turns out that in Oman it is not a matter of efficient division between labour and productivity, it's a matter of how to position yourself as favourable as possible relative to the distribution of wealth; which is mostly done by

having a government function. Hence there seems to be a total disconnection between the central government and the labour market, also partially because there is no tax system.

"*There is no productivity, it doesn't come from labour, there's also no tax system, so where does the government get its revenues from? From external rents. But there is totally no connection with the labour market, also because there's no tax system. The government earns it's money with oil and not because everybody is paying their taxes – so the link between productivity and labour is inexistent.*" – After a research and education informant.

After this the informant continued to illustrate this;

"*The public sector here is totally bloated to let people share in the oil profits. In a rentier economy it is not about how productive you are as a citizen, which determines your socio-economic position in society, its about how to position yourself relative to the distribution of wealth. So, if you are an Omani citizen you can get a job at the government, where you don't have to do anything but still get a nice salary*." – After a research and education informant.

8.1.3 Training & education system

With regards to training and education issues of the aquaculture industry in Oman have different features already been described in previous chapters, both based on secondary data and desk research (chapter 4 and 5) and on primary data (chapter 5,6,7 & 8). Which consequently leads to less new insights to mention at this place in the analysis. However, as the training and education system is part of the formal institutional framework it is (again) being discussed here, with the attempt though to place it in a wider context and to see the 'bigger picture'. Which is necessary in order to make the step towards policy recommendations later in this thesis.

Need for training

It might be clear at this part of the analysis that aquaculture is relatively new to Oman and that it has gained serious attention within the education system really only since 2011. This means that it's very recent and that as a result the availability of skills is rather low, as is the in-depth expertise in (the various fields of) aquaculture. Hence it doesn't come as a surprise that private sector companies encounter difficulties to find suitable candidates for basic functions; either the skills are simply not there or the skills required are not desirable by Omani nationals, which means they won't take the job.

"*I am not saying this as a disparaging comment, or as a criticism, but we have worked with the Sultan Qaboos University a lot now and the level of biological training is exceptionally low, it is very recent, it is very new. We've interviewed multiple students, looking for somebody right now to try to run the ponds outside when I am not here, we can just not find an Omani to do that.*" – After a private sector informant.

Because aquaculture is very recent and there are no full degrees specified on aquaculture (aquaculture is only taught as a subject within marine science degrees) there is definitely no Omani workforce ready at the moment to start when private sector activities pick up. Hence there is a strong need for more training opportunities for Omani nationals as well as a better organized, and a more in-depth education system.

"*We hired several Omanis at the Quriat aquaculture company, but we had to train them, like the divers, but also for feeding – but they didn't have a very scientific mind. But after training, they were 'oke', they worked*." – After a research and education informant.

"*The challenge though is to get the workforce ready, a lot of training and capacity building is needed to meet the demand for labour when the sector will grow and modernize*." – After a public sector informant.

"*We're just in the beginning of aquaculture, so we need more training and more education for our staff*." – After a research and education informant.

Capacity building

Several initiatives can be seen that demonstrate the efforts made to gradually build up aquaculture capacity in the country. The call for a specific university degree (bachelor and master level) is being picked up as plans are made for a private university that will provide this specific degree. At the other end, the early beginning of one's education career, attempts are made by the PEIE to place simple, basic aquaculture in primary schools in order for students to become acquainted with the matter in a very early stage.

"*There is another university going to start very soon, where they will teach fisheries and aquaculture – a private university. We expect people working in the field in Oman, we expect to be the future of aquaculture if they put a lot of effort to develop*" – After a research and education informant.

"*We have actually the problem now to put aquaculture in the schools. I'm meeting with the Research Council next week, I want to put it in the schools – kindergarden, primary schools and secondary schools, to put small aquaculture systems in the schools where children can learn physics, mathematics, water treatment, dealing with animals – it's a program coming from the USA.*" – After a PEIE informant.

In chapter 5 was discussed that on ministerial level staff is being send for master degrees or PhD's to foreign universities. But some of the staff is also send for training in Oman itself, to the Fisherman Training Institute (FTI). This is quit remarkable as this newly hired government officials are often fresh SQU graduates.

"The MAFW recently appointed some new people, whilst they come from SQU they're sending them for training to my lab, for 3-4 weeks time." – After the FTI informant.

But with regards to a connection between the ministry and the private sector this remains weak – so ministry staff is trained at foreign or Omani knowledge centres, but not in the private sector. And this is problematic because what's lacking is practical, hands on, experience on how to run a commercial fish farm, which is only learned by doing according to some informants.

"*In general you have to say that there are people with knowledge, also at the MSFC, but so far there are no enterprises, there is no link with the private sector, it is all on a government level.*" – After a private sector informant.

"*Here there's very little opportunities to develop experience. There's one or two examples where you can go and see real hands on life training, especially for the engineering equipment, and we can describe through power points and whatever, but it is not the same as actually going in and operating, or managing a farm, or with the diseases – you need to be doing it every day and not once a month*." – After a research and education informant.

The ministry itself sees itself preferably as a 'nursery' for future private sector employment of the aquaculture industry. According to one of the public sector informants until foreign companies start aquaculture operations people work within the MAFW. Once these companies start MAFW staff will be directed to work with them – with potentially sufficient knowledge, but definitely without any practical experience. Hence contract wise a major challenge will be for the

private sector to offer this former government officials the same (high) government wage, whilst the level of experience with these people is relatively low.

"*SQU graduates are employed in the ministry of Agriculture and Fisheries Wealth, the Royal Navy and in private sector. In the near future once the aquaculture licensed companies start the operation those graduates will be directed towards these companies where they will receive appropriate trainings and work as specialists in various specialties such as breeding, nursery, grow-out, fish processing plants, fish feed factories, and other laboratories such as aquatic diagnostic labs and nutrition labs*." – After a public sector informant.

8.1.4 Involvement of the Ministry of Agriculture and Fisheries Wealth

It might be clear that the Omani government, and the Ministry of Agriculture and Fisheries Wealth in particular, plays a central overarching role in the development of aquaculture in Oman. From being the main provider of employment opportunities, influencing the entire labour market, to directing the country's research agenda and controlling private sector activity; the MAFW is involved at all levels. This in itself wouldn't be problematic if this role the MAFW played was to create an enabling environment for the aquaculture industry to develop and prosper. But what it rather seems like is a constraining environment to do business in, and to do business with a government that is not in a hurry at all to develop new economic activities; the contrary seems to be the case. The MAFW is only expanding it's tentacles over the country to solidify it's position as being the main creator and distributer of wealth. By blowing up the government the aquaculture industry has so far only contributed to reinforcement of the existing bureaucracy rather than creating wealth through a productive growing industry in itself.

Involvement at all levels

The government is involved at all levels in the development of aquaculture. Whether organizing an international symposium or starting up a research project; nothing happens without approval of the MAFW. The government is heavily involved in defining the research and education agenda, in setting up private companies through its investment funds (public-private). Because foreign companies need local partners and a local private sector is not in place what you see is that everything turns in to public-private partnerships. Due to its role as the distributor of wealth are there for local Omanis no real incentives to start their own business, just because the government will provide. Hence private companies from outside are invited to form partnerships with either research and educations centres or some investment funds like the PEIE or the OADC.

"*No government in the world is putting pressure to participate by money in aquaculture, here however the government decided to do something here, which is they already have a company – the aquaculture development company, which will initiate private activities for hatcheries and fish feeds, it has been initiated a few months back*." – After a research and education informant

"*Why would you actually go to college when money grows in the trees? Why would you innovate, or start your own business? That's why in Oman there are no SME's, in Egypt you've got small companies everywhere just because these people have to survive. Here it's not like that*." – After a research and education informant.

"*The Ministry of Agriculture and Fisheries Wealth is regulating everything – nothing can happen without their involvement obviously*." – After a research and education informant.

As has been mentioned in chapter 4 is the process of procurement by tendering a competitive one in Oman. But besides the limited amounts of tenders that's being published in the past (think about the construction of the aquaculture centre and the publication of the aquaculture atlas) many more companies have presented themselves to the MAFW in order to get their

approvals and start a project/company in Oman. But so far this application process has turned out to be a 'black box'; many applications of foreign companies go in, only very few come out in the form of approvals. What happens in that black box remains pretty vague, but fact is that many informants complained about the delays in procedures, and the lack of private sector activity. In any case, it is the ministry that plays the only decisive role.

"*Foreign companies will go and visit the ministry, after that they will present what they have. And then the ministry can judge, they need to give their approval. They are coordinating those applications and approvals – so every company has to present their capabilities to the MAFW. The ministry is knowing all the situations.*" – After a research and education informant.

In addition to the main role for the MAFW have several informants pointed to other ministries as also playing a crucial role in hindering the development of aquaculture. These ministries were the ministry of housing, the ministry of manpower, the ministry of environment, the ministry of manpower, the ministry of tourism and the military. As for the government in general the main aim is to keep the people (read; the Omanis) happy. So it is not productivity increase that is central to the government efforts, but rather it is the ability to keep Oman's population happy and in there place (which is literally said by a MAFW official);

"*It is all mainly about job creation. So we have to develop agriculture/aquaculture and keep the people in their place, in stead of looking for a government job or working for small things.*" – After a public sector informant.

This statement got confirmed by a private sector informant, who by running a fishing company is obliged by the MAFW to sell a certain percentage of it's production for a low price in the domestic market. This adds another layer to the already know constraints on labour and local partnership, which is that the MAFW is controlling the supply (environmental regulations) and demand of fish domestically.

"*This is one of the issues with the MAFW, their concern is to give enough fish to the local population at a low price, we - all the fishing companies, are under the pressure of the ministry because they push us to sell on the local market, which is fine for us, no problem, but at low price also.*" – After a private sector informant.

Incentive system

Talking about the incentive system with the informants it were especially the financial incentives as described in paragraph 5.1.4 that seemed to be appealing, as e.g. the logistical incentives like the '*one stop shop*' don't really function. The one and foremost incentive is Oman's attractive tax climate, which above anything else was mentioned as a major pull factor to locate in Oman. Additionally low energy costs and the absence of export controls were mentioned. On the other hand, local SME's enjoy more financial incentives, which are not available to foreign companies. One informant mentioned that the rules for financing were not as rosy as they looked at first sight.

"*Of course the tax aspect is very important.*" – After a private sector informant.

"*Here, we had lots of indication that the business environment was going to be better, no export controls; so for example in South Africa you can not get the money back out of the county.*" – After a private sector informant.

"*There are sort of incentives for locals for SME's. First of all we can not make use of them, and second, they are microscopic. So incentive wise the only thing that is quit attractive is the tax regime.*" – After a private sector informant.

"*So the government says, oke, we will co-finance the project. But then if you look at the rules for financing they only finance up till 50% of an investment of 1 million, whilst a decent fish farm will require an investment of about 50 million, easily.*" – After a private sector informant.

By all means the incentive system is an outcome of the central government's efforts to develop new industries and attract foreign investors. Above all the incentives in place are designed to promote employment growth for Omani nationals in the non-hydrocarbon sectors. As a result foreign investors undergo major institutional barriers as the incentives are not designed to promote productivity increase but rather are focussed on employment growth. It is possible that certain high tech systems like the RAS system will not be suitable for Oman under the current conditions as they don't create much employment opportunities – especially not for the current level of skills available.

8.1.5 Conclusion

Overall the informants have mainly discussed negative features of Oman's formal institutions in their relation to the development of the aquaculture industry. The heavy involvement of the Ministry of Agriculture and Fisheries wealth is being experienced as a major constraining factor. It seems that the constraining environment the MAFW has shaped itself has so far been accountable for coming not even close to reaching their target, which is the development of a world class aquaculture industry.

Oman's regulatory framework is mentioned by the informants as posing a thread to the development of the aquaculture industry. The government has created a rather constraining environment for new businesses and projects to start, with especially strict environmental regulations and local partnership restrictions posing a thread before the actual start-up of projects, and labour regulations ('employing workers' in table 8.1) like the Omanization policy in the development phase. As a result of the regulations and slow application procedures within the MAFW only a very limited amount of licenses is being issued. Considering the negative features displayed in table 8.1 investing in Oman might be especially difficult for small and medium enterprises as they don't have the resources to stay in the business whilst waiting for commercial disputes to get resolved and often depend on external financing for projects. Free zones could be a solution to get around some of the regulations after the initial start up phase. However the costs of a plot on the free zone is relatively high for SME's plus at this moment there's no real 'aquaculture cluster' developed on a free zone yet, so whilst dealing with sub-contractors and suppliers companies are still limited by the restrictions of the different ministries.

Oman's labour market is characterized by a set of characteristics that might potentially impede the development of aquaculture. As employing skilled expats is limited by the Omanization policy imposed by the Ministry of Manpower, companies face serious issues when starting and running a business in Oman. Minimum wages for Omani nationals are way above that of foreign labour, whilst the level of skills and experience of these Omani nationals is way lower. Whilst training opportunities within private companies is very limited at the moment, the only training is taking place within the MAFW who sends its employees to do a MSc or a PhD abroad or some practical training locally. By still expanding and hiring new employees the MAFW is strengthening it's position as the main employer in the current aquaculture industry. As the general aquacultural knowledge is relatively low, hiring and training Omani nationals within the private sector when this picks up will be a major challenge due to an existing knowledge gap. The MAFW itself has claimed to facilitate in directing their own staff towards the private sector when needed. So far they haven't been successful in doing so as Feed Algae could literally find no Omani national to fill one job, whilst they were in close contact with the ministry.

Due to heavy involvement of the MAFW at all levels of the aquaculture and fisheries industry private sector is very limited and will most likely remain limited. No real aquaculture project has been successful so far, and the ones currently in Oman experience major institutional

struggles as the result of an incentive system that is designed to promote employment growth under Omani nationals rather than to promote productivity increase. The only real incentive mentioned by the informants was the favourable tax regime, which is an unsustainable incentive anyhow as the need for a serious tax reform is increasing with depleting oil reserves.

Table 8.2 summarizes features of Oman's formal institutions through which the behaviour of agents is both positively or negatively influenced in relation to the development of aquaculture in the country. Different features have a different affect on different agents, e.g. does a favourable tax regime stimulate foreign investors to come to Oman, on the other hand have delayed licensing procedures led to very limited foreign investments so far. Or another example, the planning of a private university might stimulate people to study aquaculture, resulting in a general increase of knowledge available and an improvement of the education system. On the other hand is it quit likely that the quality of the research and education at this university will suffer from labour restrictions. The table combines both primary and secondary sources.

	Positive features	Negative features
Regulatory framework	• Favourable tax regime • No export controls • Low energy costs • Business costs of crime • Registering property • Regulatory restrictions on real property	• Environmental regulations • Local partner restrictions • Labour restrictions • Delayed licensing • Enforcing contracts • Investor protection • Employing workers • Closing a business • Getting credit • Dealing with construction permits
Labour market		• Incentive system designed to promote employment growth under Omani nationals • Expanding public sector hinders private sector development • Mismatch education system & labour market • Abundance of expatriate workers
Training & education	• Realization need for training & improvement education system • Planning private university with aquaculture degree	• Lack of private sector activities means no training opportunities • No specialized aquaculture degree • Lack of basic, general knowledge

Table 8.2 Positive & negative features of Oman's formal institutions

8.2 Informal institutions

The formal institutions as described above have given rise to a specific business environment unique to Oman and essential to understand the development of the aquaculture growth path in the country. It will not come as a surprise that an incentive system focussed on generating employment opportunities provides another business environment than one focussed increasing production and market efficiency. It is the abundance of oil wealth to be distributed that leads to certain social mechanisms that are unique to oil states and unique to Oman. Or after one of the research and education informants; "*there is such an absurd amount of money here, the question is not how to make money, but how to invest it in the right way*." This paragraph will explore the social mechanisms in place in Oman that influence the way people do business. It will first elaborate on the individual cultures of work; the attitude towards work, people's ambition and cultural differences. The second paragraph will analyse the ways of doing business

between different companies and organizations. As in this stage of the analysis certain items have already been discussed in previous chapters it is insurmountable that there will be a slight overlap here. This will sure be kept to a minimum and only done when necessary for the argumentation line in order to answer the fourth research question correctly.

8.2.1 Cultures of work (part 2)

Managers & government officials

One of the most often mentioned issues in relation to the cultures of work in Oman is the attitude towards work, the division of work and the ambition of the people. As partially previously discussed does the majority of the Omani people aim for a government job, is there a general lack of entrepreneurial spirit and an understanding that aquaculture is a 24 hour a day sort of job, which is not done by purely administrative work. As mentioned by the informants too often Omani's want a managerial function, or a function with the government, other types of jobs (especially physical low skilled) are not desirable.

"*Here in Oman there's the idea that once you graduate from university you get a job as a manager immediately*." – After a private sector informant.

Referring to hard and dirty work in a fish processing plant one of the private sector informants mentioned; "*They don't want to do this type of functions. They all want to be managers*." He actually addressed this issue to the Ministry of Manpower, who burdened him with an Omanization grade impossible to reach due to a lack of motivation for this kind of job, but according to the Ministry of Manpower the Omanization grade was non-negotiable. The following quote also emphasizes the type of functions Omani's are looking for, which is definitely not the hard working, 24 hour type of function and mentality that is required to run a fish farm. It is this attitude that is actually quit problematic considering the non-negotiability of the Omanization requirements. In the following quote this is illustrated, the informant first explained he was talking to one of his former students who now works within the MAFW on developing aquaculture activities. The former student said that everything was fine, and things were going very well. But upon the question if there were any fish farms already the former student said 'no', notwithstanding everything was totally fine.

"*There is a perception within the Omani community that their role is purely administration all the time, administration is fine, it has to be done, be it doesn't always lead to action. In fact it doesn't. And people (Omanis) are quit happy with this continuous administrative role*." – After a research and education informant.

One informant mentioned that this kind of attitude towards work, this kind of ambition is only a recent thing in Oman. Only since the discovery of oil the government has grown tremendously and do people actually expect a government job simply because they're a citizen. But before the discovery of oil Omanis used to be more innovative, more entrepreneurial and water and food supplies were not as problematic as now, because the people took care of it.

"*Before the petroleum the Omani's were entrepreneurs, they were fishing, and they were using the 'falaj' (Arabic irrigation system resp.). Food security in Oman was way better before the petroleum, we had food, we had water*." – After a private sector informant.

But now the situation seems to be a total different one, which was also partially discussed before already;

"*The entrepreneurial spirit is virtually none, people want a secure job at the ministry, preferably the Ministry of Oil, that is their ambition*." – After a private sector informant.

As a result of the fact that Omanis want to sit on the managerial positions, highly educated and experienced expats always find themselves in subordinate functions in relation to their Omani colleagues with way less experience. "*Anybody to come and work in the ministry they find themselves working in a junior capacity quit often too young Omanis who have less, or no experience while they are organizing.*" This same research and education informant continued that the function these experts find themselves on is not the only issue they have whilst working for the Omani government;

"*They bring a person usually on a one year contract and expect him to work wonders. Usually these people are not supported very well, usually they struggle to find a house and get a place to live, the salaries are very low. So, it is very difficult to recruit the best people, the people we really need, it is very difficult to retain them for any length of time*."

Cultural differences

Some expatriate informants mentioned different cultural differences they observed between working in Oman and their (European) home country. It would be a bit exaggerating to label these differences as a thread to the development of the aquaculture industry in Oman. However they are definitely negative aspects of the cultures at work as experienced by the informants, and hence they should be discussed here. One of these aspects is the fact that people are very unpredictable, they either show up for work, or they simply don't show up for work. And as you're dealing with live animals or fresh products (fish) this can turn in to quit problematic situations, the following quote is an example of that.

"*The workforce is also too unpredictable – they're inexperienced at one hand, and second they also have a different approach to business. I know there was a big loss in tuna, a couple of years ago, when the captain of the boat just decided to not to go and make the collection when the airplanes from Japan Airlines was waiting in the airport. He just didn't show up for work, he had something else to do. There was 20 million dollar worth of tuna to be air shipped*." – After a research and education informant.

Another cultural difference is the fact that the family in Oman is very extended. Oman is a country of tribes with very large families, when one of the family members passes away the entire family is expected to visit the person who died. In itself wouldn't be a problem, but it's the fact that families are very large and this happens too often, and people just leave their jobs without saying it, which according to the following quote is simply 'in their system'.

"*A death in the family requires ALL the family to visit the family of the person who died, not just the sons and daughters, it's the whole family, so 200-300 people that go and say goodbye to the person past away. And of course they just leave their jobs, they just go, it is part of the system*." – After a research and education informant.

When running a business in Oman getting things done can be difficult during the Islamic holy month of Ramadhan, when people are fasting and often tend to leave their jobs very early. But this was actually mentioned by only one of the expat informants. Most of all the month of Ramadhan brings people together (locals and expats) in an informal manner during many festivities like the Iftars (the dinner of breaking the fast), which many companies and organizations organize for their employees and their friends and family. Another thing that makes it hard to get things done is the fact that people tend to not have any feel of responsibility, which means that they always pass things/files/requests on to colleagues or people above them in the organization. As such delays can occur in getting things done within the organization as well as with external parties.

"*No one feels like he or she is allowed to get things done, they will always need to check with someone above them. And that goes and that goes, it makes it really hard.*" – After a private sector informant.

8.2.2 Ways of doing business

With regards to the ways of doing business in Oman different informants had different experiences, several experiences and points of view though were shared by many of the informants. Bottom line of the different experiences is that somehow it turns out to be very difficult to get an actual aquaculture project off the ground. This paragraph analysis the ways of doing business in Oman as being mentioned by the informants in relation to developing aquaculture activities.

Great first hand support, no implementation

One of the major issues so far for the development of aquaculture is the lack of actual activities taking place – both public and private. Which is remarkable as according to several informants many project applications by foreign companies are being submitted. It's also remarkable because the Omani business environment at first is very welcoming; people speak English well, it's a small country with relatively short lines to decision-making people and perhaps most importantly there's this intangible vibe which is very welcoming to foreign aquaculture experts and investors. Policy documents like the aquaculture atlas and the aquaculture investment guidelines are the tangible prove of this intangible vibe. So at first hand people coming to Oman for aquaculture are being caught up with this positive vibe and get a sense of great support and endless possibilities in the country. This is actually kind of misleading because after that first acquaintance and first steps it comes to the actual delivery, or implementation of projects and that has turned out to be a far more complex story. The reason for this is not clear and no informant really understood it, fact is though that it's a structural problem occurring again and again.

"*When we came here everything initially sort of seemed very easy because you met people with a direct phone call, we went to the special authority, special economic zone authority or whatever it is called, and first we sort of met their business manager who introduced us to their CEO – you know, it is good. It is very quick. Same thing with the university, it took relatively few discussions before we ended up with the vice chancellor, same thing with the, sort of the ministry internally, and so we had quicker and easier access, it's not as much dependent on the introduction like the way it is in KSA for example*." – After a private sector informant.

This informant continued to talk about the great level of support they got from the ministry. The MAFW even personally took them on a tour to visit potential sites for their projects. Combining this with the atlas and the investment guidelines they encountered an impressive level of support which they hadn't encountered before in any other country. But then somehow in the implementation phase the support was gone and things turned out to be more difficult, despite the partnership they had established with SQU – still, as one of the few so far they were able to establish a pilot project.

"*It is really disappointing actually, and so on one level you find this very good environment – great enthusiasm, very responsive ministry, until you actually try to deliver it here with Omanis. We build the pilot site in 6 weeks, which by Omani standards is unprecedented. But that was not with Omani help, it was in spite of Omani help*." – After a private sector informant.

At least in this case as described above did something tangible came out of the effort, in many more cases this has not been the case. Paragraph 5.1 talked already about the 100 million dollar project by Singapore's Lim Shrimp Organization that got cancelled mainly due to indecisiveness

and slow procedures by the MAFW. But also several informants complained about the total lack of outcome, of project implementation, and because nothing can happen without the involvement of the ministry this issue is mainly attributed to them.

"*It is all for the blablabla – for the talking. If you read the newspaper last week they said to invest 100 million in one project. But if you read the newspapers from 2013, 2012, or 2011 it is the same! But what has happened? Nothing, they're just talking*." – After a private sector informant.

As for the talking same counts for the Oman Aquaculture Development Company (OADC); "*Till now they haven't done any projects, studies, it's just the general idea of forming the company*." – After a private sector informant.

"*Implementation becomes a different issue because of the process of building a fish farm in Oman has proved to be, for whatever reason, extremely complex*." – After a research and education informant.

"*I am endlessly told there is 50 projects just about to start, I mean I've been told that for 10 years, well then where the hell are they?!"* – After a research and education informant.

It is very hard to exactly put a finger on where things go wrong here, especially because people (the informants) cannot easily speak out against their government – some informants already said more than they actually wanted to. But after all the stories and quotes analysed that describe how hard it is to actually get approvals and start projects it seems to be that simply the urge to develop the aquaculture industry is not felt by the MAFW. There's no rush at all and pretty much everyone seems to be happy with the status quo, otherwise things would definitely move faster as there has been enough interest from foreign parties in investing in Oman. As is for innovation, renewal in general is not necessarily a solution when satisfied with the status quo. Especially not so when through this renewal existing jobs might potentially get lost (artisanal fisheries). In the southern province of Dhofar this could be the reason why up till now no abalone farm has been established. As the livelihood of fishermen in Dhofar is dependent on the income from harvesting high value wild abalones, farming abalones could seriously threaten their livelihoods.

"*Technically it is possible to cultivate abalones, but the challenge really is the marketing strategy and the fishermen, it is one of these species which is absolutely not necessary for them to eat, but indispensible for them to survive*." – After a research and education informant.

Rent seeking activities

Even though the occurrence of rent seeking behaviour by different actors is very hard to discover through interviews in a country where freedom of speech is really controversial, several forms have been encountered directly or indirectly. Directly by an informant pointing out to corruption taking place in current aquaculture development activities, especially through the unfair procedures of procurement of real estate and infrastructure projects – of which there are many in Oman, for dizzying amounts of money. Indirectly it is noticed by the fact the MAFW is the main employer in the aquaculture industry at the moment, and still expanding. By doing so the ministry increases its share of wealth (derived from oil) without actually creating new wealth. By 'building' an aquaculture industry within its own walls (read; increasing employment opportunities, the Oman Aquaculture Development Company, different research facilities) but with a total lack of any serious output one can only conclude that wealth is distributed to an increasing yet specific group of people, without the creation of new wealth.

"*You know we are living in a permanent economic holiday. The state earns a lot of money with oil and gas, and then hires people on government jobs, pays them a lot of money to keep them happy*

and their mouths shut and that's it. It is time now that we move on to a real economy! With a real competitive market and tax paying." – After a private sector informant.

One informant told a kind of remarkable story about the aquaculture centre, which definitely raises some questions. To this informant it was pretty clear though, the MAFW is corrupt. Together with a foreign company specialized in building RAS systems they tendered to rebuild the centre. But the tender got awarded to one of the few big construction companies in Oman, with no experience nor knowledge about aquaculture or RAS systems.

"*You see this is the problem – it is all corrupt. The Aquaculture Centre that opened in 2011, you know what? They're going to break it all down and build a total new one! They awarded the tender to a construction company! One of the big ones, they just hand over the total sum of money to this company, and then it disappears – no one has an idea what happens with it. The new centre will come, but this construction company has no knowledge at all about aquaculture systems, or about closed aquaculture systems. Supposedly that doesn't matter, it is all corrupt*." – After a private sector informant.

Another informant gave another example of some very remarkable infrastructure projects. Remarkable in the sense that a lot of money goes into the project, but with a rather poor outcome.

"*Go to Seeb, and you will see this new harbour, several million rials are invested in it. You go there and you see there is no jetty, there are no boats, and more surprisingly there is no fish. So the question here is why they invest so much money for nothing – for something unused?*" – After a private sector informant.

With investing in real estate and infrastructure it seems that the MAFW chooses for money to go the easy route, more than strategically investing in R&D and learning processes for example. Additionally harbours can count on sufficient political support – keeping the people happy is very important – as they serve local fishermen, the more the merrier. Obviously aquaculture investments would be more controversial and would make less people happy as there is no workforce ready to work in the aquaculture industry yet. Constructing harbours also takes lots of funds, which means that a lot of money can easily be spend at ones without too much effort from the MAFW. As for the available funds for aquaculture it still remains the question where they are as has been demonstrated in earlier quotes. Possible conclusions that one could draw from this information is that either there are no real funds available for aquaculture, or the funds are only 'made available' within the walls of the ministry itself. Which would mean that instead of being invested strategically in order to create more wealth on the long run for the society at large, it keeps on circulating within the established bureaucracy – leading to strengthening its position. However, caution is needed when drawing such conclusions as they are subject to speculations.

Changing positions

Several informants experienced difficulties when doing business in Oman as a result of the fact that people tend to change functions all the time within organizations, especially within the government. As a result what can happen for example is that a foreign company can verbally agree on a certain follow up of a visit with some government official. But when this official changes to another function, at another department or even to another ministry the agreement is useless and all time and effort are wasted. As a result no follow up is given, or all the effort has to start over.

"*People often change positions, and there is simply no pressure to make real steps quickly, everything goes very slow*." – After a research and education informant.

One informant illustrated this issue by mentioning an experience he had with the MSFC. When coming to Oman he had made an appointment with somebody at the centre, but upon arrival at the centre this person had changed positions already, and hence was not there to talk to them anymore.

"*Then in September it turned out that Dr. Lubna had already moved to another position, and that Marzouki had become the director. That is typically Oman, people are changing all the time.*" – After a private sector informant.

Due to people changing positions all the time a lot of information often seems to get lost. At one moment the ministry can hire a foreign consultancy to draft a report on a specific topic, but years later when everyone has changed positions no one knows this report has ever been made. This exactly happened with an Italian company that wrote a report on the possibilities for growing macro algae using special hanging techniques.

"*But where the hell is that report now? Because a huge amount, 100.000 rials went into it. I'm sure nobody even knows about it in the ministry because everybody's changing the whole time*." – After a research and education informant.

What doesn't help either here is, as described in chapter 7, the general lack of coordination and integration of projects in a wider context. The MAFW is highly involved in procurement procedures – from advisory services to public infrastructure – and other parties are not, additionally what has been done, what's being done and what will be done is poorly documented. Moreover are procedures not transparent. As a result of this centralised decision making other parties are too often not involved which means that when the ministry doesn't give follow up on certain projects the information is literally lost.

Old processes

When used to doing business in Europe or the US doing business in Oman is somehow taking place a few steps back in time. Whilst the country likes to see itself as a modern, prosperous country, many procedures are actually pretty outdated. This definitely means that doing business can be impeded. "*Oman is still a very young country, with very old processes*", according to one of the private sector informants. One example of these old processes is the struggles foreign companies encounter when arranging their financial affairs with the local banks. Things like internet banking or credit cards are not possible or not available for expats. Here some examples given by one of the private sector informants

"When you want to get a thing like a credit card, even though you have nearly half a million dollar sitting there, you can not get a credit card! Not for a corporate account."

"Then you get a cheque book, you can not cash the cheques, it is only for being bills, invoices, that have to be stamped with a company stamp – which is in itself a huge process to get a company stamp. Weeks of silliness about this stamp."

"You want to do something like internet banking, all it does is show you your account balance – you cant actually make any transactions with it, so it is useless!"

Costs (part 2)

The last factor mentioned by the informants influencing the ways of doing business in Oman is the problem of awarding tenders to the lowest bidder, and the fact that investors are too much focussed on immediate return on investments. Both items have been mentioned before in paragraph 6.2.1 and hence will only be briefly mentioned at this place. With regards to contract types a general shift is being seen from EPC (Engineer, Procure and Construct) to 'EPC & own' contracts, meaning that foreign companies also will have to run a facility for a certain number of

years. As a result many companies will increase their specifications in order to be able to ensure the best quality of the infrastructure and training opportunities for locals. But some companies handle lower specifications, for lower prices (often companies from cheap labour countries), often leaving no room for proper training within the contract. Secondly, as aquaculture is a new industry and investors are not acquainted with the business it is hard to make them realise that profit won't come overnight. Aquaculture is a risky business in which a project can only succeed through a long phase of trial and error. If with the first error the investors pull out of the project already it is very hard to ever make projects successful. Many investors in Oman are used to invest in oil or real estate, with which way bigger profits are made very quickly. As for aquaculture this is another story, investors will need to understand the business and have a long term vision.

"*I would say that you need a bit of love for the aquaculture as well. The problem is that these investors used to just press a bottom and they make money, whereas here with aquaculture it is not like that. So you need to wait and with waiting there are a lot of risks that can change your outcomes.*" – After a research and education informant.

8.2.3 Conclusion

Doing business internationally obviously always requires overcoming some cultural differences, like is also the case in Oman. On the other hand would one expect that when foreign investments are of major importance in order to diversify the economy away from hydrocarbon revenues a conducive, enabling environment for these investments would be created. With slow and untransparent procedures, a lack of motivated workforce and corruption this is definitely not the case for the aquaculture industry in Oman. Which is unfortunate as at first sight a lot of things seem to be in place, welcoming even, in order to stimulate aquaculture investments. But when it comes to the delivery and implementation of projects nothing really happens. It will be impossible to develop an aquaculture industry with Omani nationals who are only willing to work as a manager or fulfil a government position. Neither will it develop if all Omani nationals want purely administrative jobs. It seems to be a structural problem that people are to comfortable in their status quo, you definitely notice this more when analysing the informal institutions, or social mechanism than when looking at certain policy documents and regulations which are focussed on change and renewal. When people are happy with the status quo, there is no urge for development or change at all. It's exactly this attitude that could eventually be a serious thread to developing an aquaculture industry in Oman. Mainly so because foreign companies come somewhere to make money, to utilize the business opportunities they expect somewhere. If these companies get the sense that their Omani counterparts don't share the same ambition they will surely reconsider their investment in Oman and possibly invest elsewhere. This has happened before and will continue to happen if no reforms are made.

	Positive	Negative
Cultures of work	• Welcoming • Language skills (English)	• Lack of entrepreneurial spirit • Aim for administrative jobs • Lack of responsibility • Unpredictability employees • Position of expats
Ways of doing business	• Welcoming • Language skills (English) • Short lines/easy access • Aquaculture 'vibe'	• Lack of implementation/follow up • Lack of motivation • Rent seeking behaviour • People changing positions • Old processes • Focus on immediate return on investment

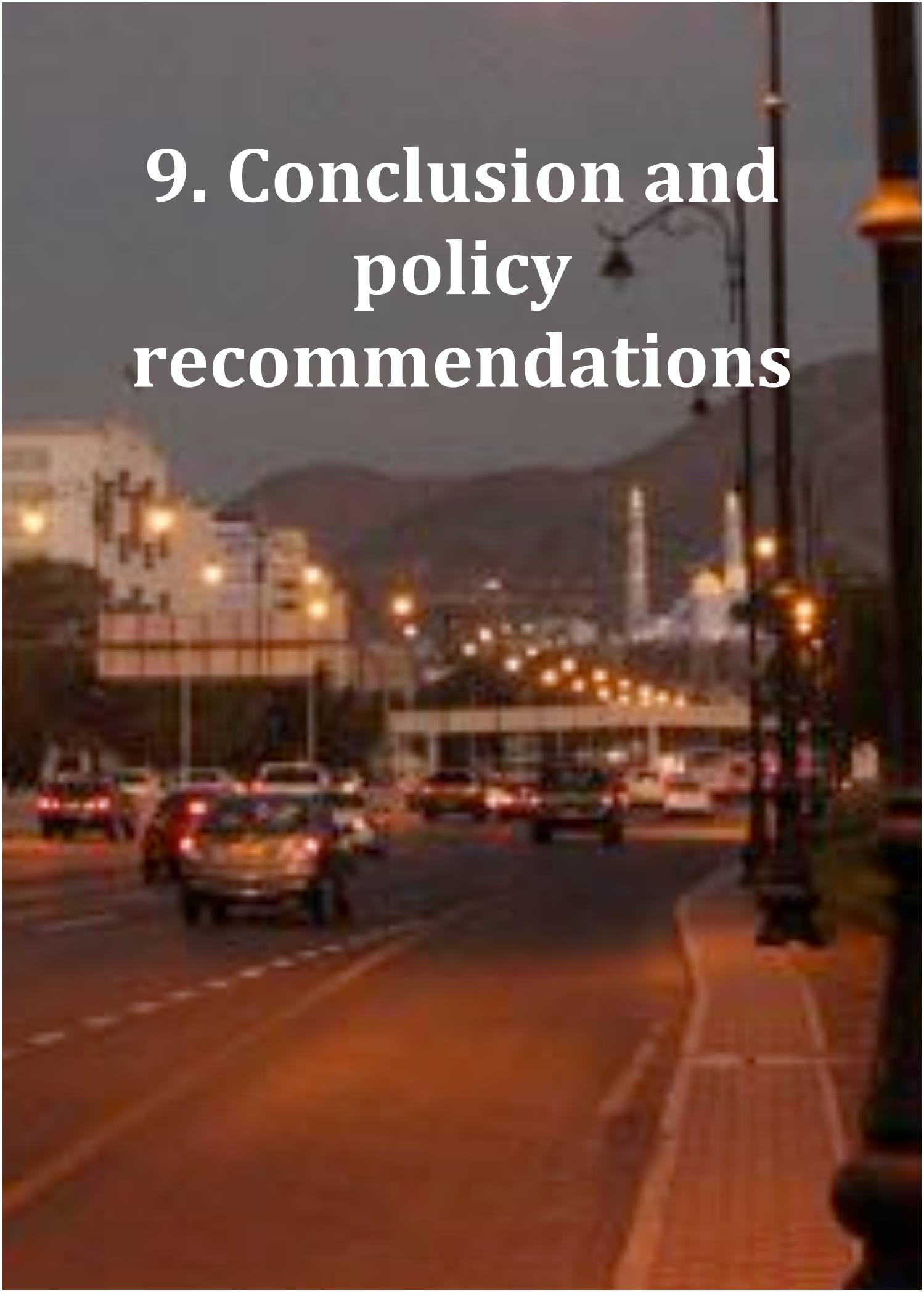
Table 8.3 Positive & negative features of Oman's informal institutions

8.3 Answering the 4th sub-question

The behaviour of human agents, formal and informal institutions

In order to understand and be able to influence the functioning of a regional economy one will need to understand the behaviour of its human agents (Bristow & Healy, 2014). New industrial growth paths can evolve from existing structures as a result of the recombining ability of a region's agents (Martin, 2010). However, human agents don't act and behave in a vacuum, instead they behave and interact according to humanly devised constraints, both formal and informal (North, 1991). Hence in order to understand the influence of human agents on the development of aquaculture in Oman this research has studied the formal and informal institutions affecting this development led by the following research question: *to what extent do human agents through formal and informal institutions influence the development of the aquaculture industry in Oman positively or negatively?*

Based on the empirical results of this research the behaviour of human agents through both formal and informal institutions has a negative impact on the development of aquaculture in Oman. It's especially the all-decisive role the Ministry of Agriculture and Fisheries Wealth (MAFW) plays in providing a rather constraining instead of an enabling environment for aquaculture growth. Without licensing companies to start activities the behaviour of the MAFW directly precipitates on the (possible) behaviour of private sector agents – both foreign and domestic. Clearly the Omani government and the MAFW are both the main drivers as well as major limitations behind the development of aquaculture. Rather than re-shaping economic structures by a decentralized government in strong collaboration with companies and research institutes it's merely MAFW policy and tax incentives in order to attract FDI that drive the development of aquaculture. According to Porter (2003) this inherited type of prosperity is limited by the availability of natural resources, as opposed to created prosperity, which is limited by the productivity and innovative capacity of local firms. This state-led type of development completely interferes with the notion of regional learning and innovation systems, in which the state is promotes learning and breaks up with structures and institutions that block learning (Ewers, 2013). This is clearly not done by the MAFW, instead of breaking up with existing structures and institutions it's continuing to expand its reach pretty much at the expanse of private sector development. By doing so, and by different signs of corruption, the MAFW displays rent seeking behaviour. Rent seeking behaviour is inherently tied to the failure of industrial policies. Instead of serving regional economic development at large industrial policy is used to strengthen the position and favour personal interest of the current bureaucracy (Das, 2014). As is also demonstrated with the absence of an innovation culture in Oman and the total lack of a real urge for renewal, formal institutions like the regulatory framework and the labour market are designed to preserve existing structures, thus actually hindering the development of new industrial growth paths (Grabher, 1993). This might especially be true considering the friction that exists between developing aquaculture initially run by expats, and taking away jobs from local Omani fishermen. At the moment the work ethics and ambition of Omani nationals don't seem to overlap with those required to grow an industry like aquaculture. As long as people aim for purely administrative jobs and government positions the industry will either be run entirely by expats, or, considering the current Omanisation policy, won't be able to thrive at all. It's these cultures of work through which the Omani workforce negatively influences the development of aquaculture.



9. Conclusion and policy recommendations

9. Conclusion and policy recommendations

After decades of economic growth as a result of the discovery of oil in Oman the Sultanate is increasingly feeling the urge to diversify its economy beyond hydrocarbon revenues. Both a high volatility of the world's oil market and depleting oil reserves are contributing to an increasing realisation of the importance to create economic development beyond oil. Considering this realisation it is remarkable that unless a focus on diversification the non-hydrocarbon share of Oman's GDP has slightly decreased between 2009 and 2013 (figure 4.4). In order to diversify the economy several new industries are being developed, one of which is aquaculture. By increasing the share of these new industries to the GDP Oman attempts to become less dependent on finite natural resources, and affected by volatile oil prices. As a result of developing new growth industries a more diversified economic structure will increase the Sultanate's resilience. As mentioned in the introduction is the goal of this research twofold; investigate *how* the development of the aquaculture industry is taking place and *if* this way of development holds the potential to continue to grow in the future and develop as a viable growth path in the economy. It's this research's intention to fully understand the current development path of the aquaculture industry in the Sultanate of Oman. By applying a qualitative multi-actor approach this research is essentially unique in the pool of international literature in trying to understand the transformation of oil-wealth into new, knowledge intensive, industries. The main research question proposed in the introduction is as follows:

Does the current growth trajectory of aquaculture in Oman hold the potential to create a viable new growth path in the economy?

What will follow is an extensive answer to this question using the filled in conceptual framework as demonstrated in figure 2.3 and based on the empirical results of this research as described in the previous chapters. After having answered the main research question a set of policy recommendations will be proposed. These recommendations are based on empirical results in the light of existing theory as described in chapter 2.

9.1 The filled in conceptual framework

As for the reviewed literature around path creation, path development, regional resilience and GCC economies several concepts have turned out to be of a major influence on the actual development of new industries within economies. These concepts have been proposed in the conceptual framework and are all understood to have a stimulating affect on the growth of new industries and hence on pursuing option b in the alternative paths model (Simmie et. al 2008, p. 14) proposed in figure 2.2. This option corresponds with a growth trajectory where decay is avoided and the created, or existing path is renewed and extended. Through extended growth of the path the industry increases it's share to a regional GDP. Figure 9.1 forms the filled in conceptual framework in which the empirical results as described in the previous chapters are integrated in the conceptual framework as proposed in chapter 2. As the figure demonstrates with multiple red arrows (negative relation) have all three theoretical concepts proven (namely absorptive capacity, a localised innovation system and formal and informal institutions) to be mainly of a negative influence on the growth of an aquaculture industry in Oman. As a result without major improvements at certain points in the model as shown below the growth path will most likely turn to decay rather than it will continue to grow in the future.

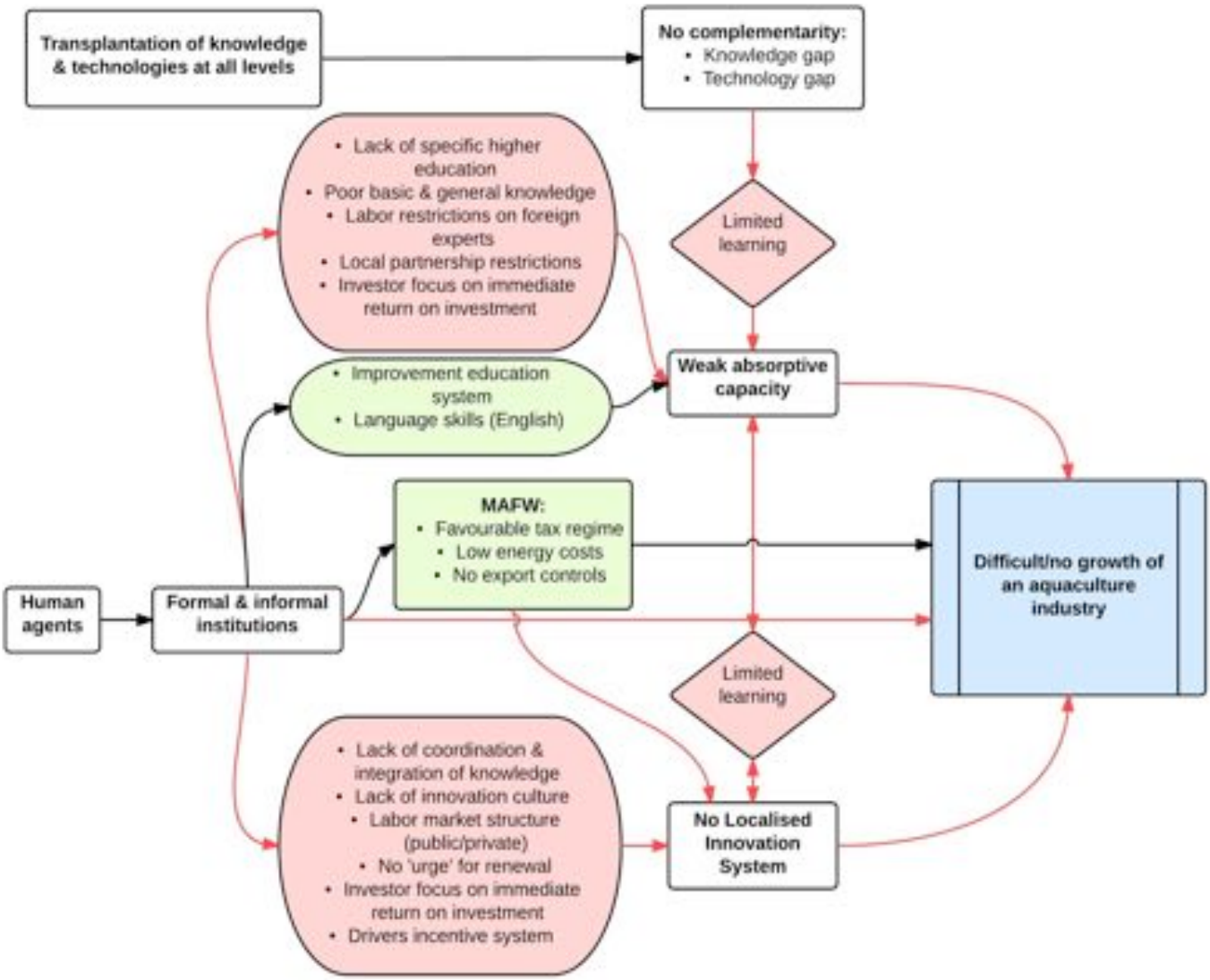


Figure 9.1 Empirical results in the conceptual framework.

On the other hand does it need to be mentioned that there do exist some positive features in the model as well. These are some conditions that arise from the institutional framework that have a positive influence on the absorptive capacity, but compared to the impact of the negative conditions are these positive ones fairly negligible. Less negligible is the incentive system, which works as a stimulator for the growth path in general. This mainly means that the favourable tax regime functions as a major pull factor for foreign investments. Yet at the same time does this incentive system hamper the development of innovative activity as its focus is on job creation rather than on productivity increase through innovation.

As aquaculture in Oman follows an exogenous growth path, and the transplantation of knowledge and technology is the major source of growth, it is remarkable that there is a tendency in Oman to think that the transplantation of knowledge directly leads to growth of the aquaculture industry. However, as the model above demonstrates do other factors limit the ability to 'leapfrog' in a more advanced stage of aquaculture development directly. In order to actually technologically advance it's these factors that need to be addressed. In practical sense, there seems to be a too strong focus on the outcome – which is a world-class aquaculture industry – than on the learning processes that enable this outcome. The aim is leapfrogging in to an advanced level of technological development, but due to a serious lack of learning opportunities limiting the absorptive capacity and an innovation system subsequently this will

be very hard to achieve. Yet essentially through learning processes the Omani aquaculture industry could technologically catch up with leading countries as there are no prior industries or growth paths with skills related to what is necessary for the aquaculture industry. It has been proven that of the value chain of capture fisheries only activities on the post-harvest side of the chain are shared with aquaculture, which means that for actual 'fish farming' which aquaculture is a whole set of other skills is required. Additionally through learning processes and collaboration between different actors like innovative organization a local aquaculture innovation system can enhance the specific aquaculture absorptive capacity. The current situation of the Omani aquaculture industry however, in which R&D projects are very poorly embedded in a wider industrial context and there is a total lack of coordination, prevents learning to take place.

When comparing the outcome of this research with the '*alternative path dependence model of industrial innovation*' proposed in figure 2.1 the Omani aquaculture industry most likely seems to pursue the option of the '*path as movement to stable state'*. This as the result of institutional rigidification, lack of innovation, entrepreneurial activity and experimentation. It is more likely the path leads to an equilibrium or lock-in state with decay, or decline as a result rather than that it continuous to grow over time. Additionally is this path vulnerable for sudden market changes and for competition from cheaper or more productive competitors elsewhere (Martin, 2010, p.21). Considering the low productivity of the Omani economy in general hence for the future of the aquaculture industry in the Sultanate this is highly questionable.

The central government is the main driver of aquaculture development through industrial policy and tax incentives in order to attract foreign investments that build the industry. This type of development has earlier been described as inherited prosperity and is limited by the availability of natural resources. As opposed to created prosperity, which is limited by the productivity and innovative capacity of local firms. At one moment in time, and the sooner the better, the aquaculture industry in Oman will need to make the transition to an industry driven by private sector initiatives, innovation and productivity as clearly otherwise it will not thrive. The role of the central government here is clearly to step back from its all-decisive role and create an enabling rather than a constraining environment.

9.2 Policy recommendations

Based on the results of this research the following page will address seven policy recommendations that will contribute to paving the way for the aquaculture industry in Oman to develop. As currently the Ministry of Agriculture and Fisheries Wealth plays *the* key role in the development of the aquaculture industry these recommendations are mainly centred around influencing their actions and behaviour, yet also knowledge institutes and the private sector, both domestic and international, can take advantage of them. As the results have shown are especially learning processes very problematic and hindering the development of aquaculture. Hence all the ten OECD learning principles presented in table 2.2 are relevant for the situation in Oman. The following recommendations will not repeat these learning principles even though having a closer look at them is highly recommended for economic policy makers in Oman. The OECD learning principles are more general and the following recommendations resulting from this research are more content specific. Underneath the box text with recommendations are some short remarks for each of them to give them some better understanding.

Policy recommendations for the development of an aquaculture industry in the Sultanate of Oman

1. **Coordinate learning & innovation**

   Address a local aquaculture innovation system and emphasize the need for collaboration of a wide range of actors, integrate all projects in a wider context to ensure maximum learning opportunities, embedding and follow up of R&D projects. Emphasize the commercialization of knowledge.

2. **Capacity building**

   Basic level knowledge and specific higher education require major improvements. Focus on increasing both the basic biological knowledge of students as well as specific aquaculture knowledge on master level. Additionally train existing staff at research centres and stimulate knowledge transfers between expats and local employees.

3. **Reform the labour market**

   Reforms are needed at both the supply and the demand side. Besides improvement of skills do work ethics need to be addressed, the Omanization policy should be reconsidered and the Ministry of Agriculture and Fisheries Wealth should stop expanding itself at the expense of private sector activity. Promote private sector activity and issue permits more rapidly to enable private sector projects to start.

4. **Reform the incentive system**

   The incentive system should merit productivity instead of emphasizing employment generation of Omani nationals. Employment opportunities should result from their suitability for a specific function rather than merely from their nationality.

5. **Create awareness amongst investors**

   Prevent from investor reluctance, local investors should be aware that aquaculture doesn't provide a quit return on investment. Awareness should be raised about the nature of aquaculture investments and the long-term horizon that comes along with that.

6. **Monitoring productivity growth (follow a comparative advantage)**

   As the current situation is prone to competition from elsewhere it is recommendable to specialize in a certain niche within aquaculture and become internationally competitive at it. Obviously specialization is only recommendable after having identified the most productive niche, hence monitoring productivity growth is crucial here.

7. **Address rent seeking behaviour & promote transparency**

   Move away from unproductive behaviour of the current bureaucracy. Seize the opportunity for governmental bodies to increase their share of the existing wealth, without the actual creation of new wealth for society at large. Additionally improve tendering processes by making them more transparent.

Coordinate learning & innovation

As mentioned in the introduction, all the then learning principles presented in table 2.2 are highly relevant for the situation of the aquaculture industry in Oman but won't be repeated here. Both the inputs to the learning processes as well as the mechanisms through which learning processes function require major improvement, yet well organized coordination of these

processes would be a major improvement in itself. By coordinating regional learning and innovation through strong collaboration with all relevant regional partners the step needs to be made from relatively high potential absorptive capacity and a low realized absorptive capacity to both high potential- and realized absorptive capacity. Too often research projects in the past haven't led anywhere whilst the ideas and the knowledge in itself had great potential and commercial value. Just because no one recognized this potential it never got anywhere, through better coordination and collaboration this can be avoided in the future – stimulating both learning and innovation. As regional learning requires high levels of governance and collaboration between actors this first recommendation is of high importance. Since the Aquaculture Centre in Muscat is (on paper) responsible for developing the aquaculture research agenda for the country it is most presumably this centre that takes on the coordinating role, especially because it stands closer to the actual working field than the Ministry of Agriculture and Fisheries Wealth itself. As GCC economies in general are characterized by weak governance systems and the Omani aquaculture has proven to be too, emphasizing governance systems could stimulate aquaculture development. By actively applying strategic 'golden triangle' collaborations with the (domestic and international) private sector, the public sector and knowledge institutes in the form of specific consortia a major improvement would be made. This requires a major change in the current '*anyone who would like to work with us can come*'-attitude resulting in one-on-one partnerships between often an Omani and a foreign partner. More partners or actors involved stimulates regional learning and embedding, and hence decreases a total lack of follow up after initial stages of projects. Additionally does it increase the chance that projects reach commercialization and profitability, which means a more likeliness of return on investment.

Whilst this study has shown that the skill-relatedness between aquaculture and fisheries is only limited to post-harvest activities doesn't this mean that fisheries companies should not be incorporated in the development of aquaculture. During the research several fisheries companies have spoken out negatively about the development of aquaculture in Oman and aquaculture in general. This whilst at the same time their very own fish processing plants and export facilities were working on only half or partial capacity. The growth of an aquaculture industry means more fish processing locally and export subsequently. As such the existing fisheries companies could and should actively participate in the development of aquaculture. As they have their export ties, know the market, and constantly monitor developments at the demand side their knowledge can be a valuable asset when aiming for the development of an viable aquaculture industry. Incorporating fisheries companies in consortia of public and private sector actors stimulates regional learning and additionally increases the likeliness of embedding of projects.

Capacity building

This recommendation sure is very important – especially so since it comes forth from the results of this research. However it is somehow superfluous since the need for improvements in the educational system is being realized already in Oman. Yet also here is it important to transform this realization in to actual actions; the educational system needs improvements in order to create a workforce that is ready to work with high level aquaculture technologies, within aquaculture companies that are internationally competitive. Since the existing capture fisheries industry requires a total set of different skills than required for fish farming there are no opportunities for labour matching – confirming the importance of major investments and improvements in capacity building to get an actual workforce ready. This point is especially relevant since the Omani government wants to employ Omani nationals rather than expats. In order to technologically advance and really become a competitive player on the world (or regional) market, which means catching up with technological leading countries, major improvements in the educational system are required. An additional focus of capacity building should be on training existing staff at research centres and stimulate knowledge transfers between local and expat staff. One way of doing so is by simply increasing the amount of research being done as to create more learning opportunities for local staff. For the sake of

preparing a workforce for an aquaculture industry capacity building and research should be adapted to technological and market developments. That is, if RAS systems have the future, train and educate students and staff to work with RAS systems instead of with aged technology.

Reform the labour market

For the Omani economy in general short-term solutions that have been taken in the past form structural problems today. Due to previous piecemeal reforms the number of Omani nationals participating in private sector activity has only decreased in recent years – Omanization policy has so far not proven to be efficient. The 35% Omanization that is set for aquaculture is unrealistic, simply because the required skilled labour is not available locally. So either companies will come and hire skilled, cheap labour from elsewhere – with 'fake Omani staff' on their payrolls – or companies won't come at all. To really develop aquaculture the Omanization grade needs to be, especially at this stage of development, a 'soft' one. That means negotiable at least and perhaps increasing over time – only when possible and skilled Omani staff is available. Furthermore should national labour be encouraged to work in the private sector, and should become acquainted with and motivated for the type of functions aquaculture requires. This could mean the introduction of an actual 'hands on', more practical mentality and a mind set that anticipates on the 24 hour a day sort of occupation that aquaculture is. Additionally should the private sector simultaneously be *rewarded* for hiring Omani nationals rather than being burdened with incapable staff for too high salaries. In other words, rather than creating jobs at ministerial departments all the time encourage labour (and especially newly graduates) to work in, and guide them towards the private sector. To create an extra incentives for foreign companies to locate in Oman it would even be thinkable to provide slightly under qualified Omani staff subsidised by the central government for training within the company. Providing subsidised staff to foreign companies should on the long run stimulate learning processes and private sector participation of Omani nationals. Now, it is not a question whether or not these companies are available. It more seems to be a matter of speeding up the process of issuing permits so that foreign companies can start their activities in Oman. It is highly recommendable to speed up the process of issuing permits and to critically examine the functioning of the so called 'one-stop-shop' at the Ministry of Agriculture and Fisheries Wealth. This 'one-stop-shop' could be a valuable addition to promoting private sector activity, wouldn't it be that currently it does not function as a real one stop shop.

Reform the incentive system

The current incentive system provided by the Omani government in order to attract foreign investments is mainly centered around a highly favorable tax regime and extremely low energy prices. In return the government expects foreign companies to (amongst others) generate employment opportunities for Omani nationals. This hampers both productivity and innovation and can be seen as a short term solution – which is to keep the Omani people happy. On the long run it is non-sustainable to retain foreign companies from paying taxes simply because there is no need for taxation. However this is strictly tied to the availability of natural resources and hence is finite, just as is the provision of cheap energy. In order to become internationally competitive in industries other than oil and gas Oman needs to step out of its permanent 'economic holiday' and introduce a 'real economy' where people and companies pay taxes and the incentive system is tied to merit productivity (through innovation and technological advancement) rather than employment growth.

Additionally should the incentives for training and education be (re)considered. In order to fully enable learning processes and capacity building the government should find a right balance between work and learning efforts and rewards for that. Simply having the '*right*' to get a government job for being an Omani citizen hampers capacity building goals as it eliminates incentives for learning.

Create awareness amongst investors

One of the results of this research is the fact that investors in Oman are both reluctant to invest in aquaculture and that in general their knowledge of the business is insufficient to retain in it long enough to achieve return on investment. Partially as the result of impatient investors different projects have been stopped before even getting the chance of making any profits. It would be of national interest – or at least for the sake of developing the aquaculture industry – that local investors become more acquainted with the aquaculture business and the (long term) financial strategy that comes along with it. Aquaculture is a global growth market, however return on investment doesn't come easy and in any case doesn't come quick at all. In order to successfully implement aquaculture projects it is of vital essence that the financial backbone supporting the project is not being pulled out after only a few years of not making any profit. Therefore it is recommendable to develop a national program on aquaculture investments in which potential investors become acquainted with the business and are being encouraged to invest in it at the same time.

Monitoring productivity growth (follow a comparative advantage)

This recommendation is closely related to the overall coordination and monitoring of the aquaculture development in Oman. As Oman is new in terms of aquaculture at the moment it doesn't hold a comparative advantage in neither aquaculture in general, nor in a specific aquaculture niche. However, as the aquaculture industry in itself is relatively new and certain niches are as we speak being developed it is essential to closely monitor in what aquaculture activities the highest productivity (and export value) can be achieved. To give an example, the worldwide market potential for algae (micro and macro) is expected to be massive. As Oman doesn't have a comparative advantage in this niche at the moment, this doesn't mean it can't develop this comparative advantage over time. It is thinkable that Oman does develop a comparative advantage for the production of algae, but it doesn't for small pelagic using RAS systems. Being able to identify the comparative advantage and define well founded industrial policy accordingly will prevent for investments in less productive and successful niches. As for the current situation, different things are done or planned but without any integration or strategic vision. For the sake of developing a comparative advantage it would be possible to run strategic pilots with different actors involved on different types of aquaculture – e.g. marine cages, RAS, earthen pounds, macro and micro algae and/or shellfish. Evaluate these pilots and specialize in 1 or 2 options and stimulate these niche growth paths within the aquaculture path to flourish. Anyhow, closely monitoring productivity growth of the aquaculture industry in the future is crucial in order to develop policy accordingly – this is something not done at the moment and hence it is recommended to do so.

Address rent seeking behaviour & promote transparency

Even though within this research proof for it has been relatively scarce, several signs of corruption have been picked up. Tender processes should be open, transparent and market conform. In not a single case should awarding tenders benefit specific groups personally, especially not if awarding this tender means increasing ones share of wealth without actually creating wealth. Examples of this have been given in this research. These kinds of practices deserve immediate attention and elimination in order to benefit the growth of the aquaculture industry. Corruption and rent seeking behavior is strictly tied to the failure of industrial policies and is, as it seems to have been the case in Oman, is used to serve personal interests and strengthen the position of the current bureaucracy. By promoting transparency on awarding tenders Oman will improve its business environment, making it more attractive and understandable to invest in.

9.3 Discussion

9.3.1 Limitations of the research

Reflecting on the research done several items arise that are worth mentioning as they might have influenced the found results. As has been mentioned in the beginning of this research has it only addressed human behavior and internal socio-economic factors influencing the growth of

the aquaculture industry in Oman. However, factors that lead to decay in the alternative paths model (figure 2.2) have not been addressed whilst potentially forming a thread to the actual development of the aquaculture industry. Amongst others these factors could be found in the Omani environment (e.g. varying water quality) and external competition. Assessing the suitability of the environment however would have been a study on itself, which didn't fit within (the qualitative nature of) this study. Also a study to external competition in the field of aquaculture, even within the region, would have required a vast amount of additional research which didn't fit within available time for this master thesis. Not taking in consideration the factors influencing the option of decay and decline in the alternative paths model in any way is a shortcoming of this research.

Measurement has from an early start been a discussion point in the design of this research. Due to limited availability of resources (mainly time and data) several key decisions have been made, e.g. operationalizing abstract concepts like 'absorptive capacity' through in-depth interviews. As a result of such decisions plenty of room was left for interpretation of the research results. Notwithstanding the quality of the empirical results, perhaps quantifying certain factors resulting in a mixed method research design would have strengthened the validity of this research.

In chapter 3 has the position of the researcher already briefly been addressed. It's been mentioned that due to an insiders position in the course of the research doors opened to interview key figures (especially within the Omani government and related institutes like the Aquaculture Centre), which would for a complete outsider, have remained closed. However, doors still remained closed to the highest decision making figures within the Omani government – e.g. the undersecretary of fisheries Dr. Mohamed al Oufi. He is regarded to as the main influential person with regards to the implemented policy on aquaculture and fisheries but could despite several attempts not be reached for a one-on-one in depth interview. As decision making in Oman is subject to a high level of hierarchy not being able to speak to the main decision making person is a shortcoming of this research.

9.3.2 Future research

This research has in line with the existing knowledge around Gulf economies found that many of the characteristics of Gulf economies as described in paragraph 2.4 are also true for the Omani economy, and the problematic development of new industries. It is demonstrated for example that rather than being really committed to developing a productive and efficient aquaculture industry the Ministry of Agriculture and Fisheries wealth redistributes wealth through creating an unnecessary amount of jobs at the ministry against excessively high wages. As such the findings in this research demonstrate many similarities with previous studies in the Gulf region. However, also new insights have been generated which consequently lead to new questions and possibilities for future research.

1. Behavior of human agents in developing resilient economic structures

Due to the qualitative nature of this research have new insights been generated in the behavior of human agents in shaping or determining new growth paths within the economy of Oman. This research has attempted to contribute to a better understanding of how complex collaboration processes shape new economic structures and enable new growth paths for the sake of economic diversification and consequently a higher regional resilience. As such this research has provided an example of how the development of a specific growth path turns out to be rather problematic within a specific economic and institutional context. Additional research is needed to better understand how the behavior of human agents and multi-actor processes contribute to developing new growth paths and increasing regional resilience.

2. The role of foreign experts

Second, having interpreted regional absorptive capacity as the ability to recognize, assimilate and use relevant external knowledge this research has demonstrated that the capacity to

recognize relevant external knowledge was significantly higher than the capacity to assimilate and use this knowledge locally. This difference is for a big part explained by the fact that a number of foreign experts work within the ministry on advising positions. However unless these experts on those positions does actual private sector aquaculture development not take place. Future research is needed to determine the role and influence of foreign experts advising local economic policy makers in order to fully understand their contribution to the development of new industries.

3. The inability of implementing economic policy

Third, this research has provided some valuable, not so flattering insights in the inefficiency with which the Omani government is attempting to develop the aquaculture industry. Rent seeking behavior has previously been demonstrated to highly relate to the failure of industrial policies, as such rent seeking behavior and transforming oil wealth in to knowledge intensive industries don't go hand in hand. This research has proven that due to behavior of the central government private sector initiative is limited and learning processes and innovation are problematic. More research is needed to fully understand the constraining role of central governments in implementing their own economic policy.

4. Redo this research

Fourth, it would be very interesting to conduct the same research as this one elsewhere. As also other GCC countries are trying to develop an aquaculture industry from without having any previous history with it. It would be interesting to see whether or not similar results can be obtained elsewhere. If so this would contribute to the generalizability of the results and recommendations done. Additionally, Oman does for it's 'best practices' mainly focus on technologically leading countries in the field of aquaculture – like Taiwan, the Netherlands and Norway. However due to the economy's similarities with other GCC countries it would be highly relevant to redo this research within the Gulf as the outcome could definitely benefit the development of aquaculture in Oman. Especially when talking about improvements in the institutional context. Additionally, this research has studied the development of aquaculture in Oman and has by doing so extensively addressed the behavior of the Ministry of Agriculture and Fisheries Wealth. It could be very interesting conduct a similar research to see whether other industries, with other ministries experience similar problems, or that these are unique to this one specific ministry.

Besides doing this research elsewhere it could also be very interesting to redo the same research in Oman on another moment in time, let's say in 10 years from now. As this research is of an explorative nature it could be valuable to redo this study and evaluate the then current situation of the aquaculture industry in Oman, and measures that might have led to improvement. Or if, as this research predicts on the basis of the current development efforts, the growth path turns to decline, why this happened to be so.

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Appendix

Appendix 1 - Nvivo code tree

Name	Sources	References	Modified By
Formal institutions	18	157	TP
Regulatory framework	15	31	TP
Labour market	14	44	TP
Omanization	5	11	TP
Training & Education systems	14	48	TP
Incentives	7	8	TP
Development efforts MAFW	9	18	TP
Informal Institutions	15	98	TP
Cultures (of work)	10	27	TP
Ways of doing business	10	28	TP
Slow handling procedures	10	26	TP
Finance & viability aquaculture	9	16	TP
Interaction, collaboration & trust	12	32	TP
Rentier activities	5	8	TP
Sources of aquaculture development	18	135	TP
Technology gap vs. knowledge complementarity	10	13	TP
Existing & desired technology	14	44	TP
External knowledge & technology	3	3	TP
Current state of affairs	10	17	TP
Absorptive capacity	12	23	TP

Recognizing & understanding external knowledge	9	26	TP
Using external knowledge	5	5	TP
Technology transfers	6	7	TP
Barriers to technology transfers	8	14	TP
Localised Innovation Systems	6	11	TP
R&D & Innovation	11	31	TP
Private sector	5	11	TP
Interaction, collaboration & trust	10	29	TP
Commercialization	4	6	TP
External & internal threads & opportunities	4	9	TP
Environmental & infrastructure (intern)	8	18	TP
Competition (extern)	5	8	TP

Appendix 2 – Topic list aquaculture

The following topic list has been used to interview the informants who have participated in this research. Due to a great variety of informants not all topics have been discussed with all actors. Different topics have been used as 'icebreakers', these often news related items are not mentioned down here. Also due to the open end of the interviews informants were free to address whatever topic they felt was relevant, which sometimes meant an extra focus on e.g. innovation or the need for FDI.

Oman & aquaculture in general

1. Current structure of the sector (triple helix/golden triangle) – major actors
2. History of aquaculture in Oman
3. Why aquaculture (diversification/omanisation) – what is it's contribution to national economy?
4. Oman Aquaculture Development Company (OADC) Mandate? Specific need for OADC?
5. Barriers to business relations with Oman: Institutional, cultural, economic and other hurdles companies might come across
6. Specific barriers affecting aquaculture?
7. Need for foreign partners in developing efforts of aquaculture

Behaviour agents

8. Characterization of the collaboration between government, universities & research institutes and the private sector? Who coordinates the development of aquaculture?
9. What is the role of the Ministry of Agriculture and Fisheries Wealth (MAFW) in the development of aquaculture?
10. How does this role influence the development of aquaculture?
11. Is the Ministry of Agriculture and Fisheries Wealth (MAFW) in Oman supportive in the investment procedure?
12. Why if the Ministry want to develop the industry, do procedures take so long?
13. $1.6 Billion is allocated to invest in development aquaculture and fisheries – where does this money go to? How effective is it being spend?
14. What is the main focus of the government in this development and why? E.g. Infrastructure, or R&D? Is R&D spending sufficient??
15. Government incentives: what incentives does MAFW offer for the development of the sector?
16. What is the role of universities in supporting aquaculture activities?
17. How would you describe entrepreneurial activity in Oman? And what about start-up/private sector activity in the aquaculture industry?

Absorptive capacity

18. What are the main knowledge institutes in the field of aquaculture?
19. What are the focus points of research at research/knowledge institutes?
20. Where is aquaculture education conducted and what are the focus points? Does this match labour market requirements?
21. Where do (aquaculture) graduates find employment?
22. Characterization existing knowledge in the field of aquaculture. (technologies used/characterization knowledge workforce/ characterization knowledge graduates)
23. To what extend does this knowledge match external knowledge? (characterization external knowledge)
24. On the basis of which factors do you measure the value of new, foreign technologies for their usage in Oman?

25. How is the acquisition of new knowledge and technologies organized?
26. How does this new knowledge assimilate into the economy? What are the vehicles, and what are the barriers? And to what extend is external knowledge combined with local knowledge for the purpose of innovation and commercialization?
27. Need of foreign technology/Importance technology transfers
28. Knowledge gap – characterization existing and external knowledge
29. Barriers to knowledge transfers

Innovation

30. Need for innovation
31. Collaboration for innovation
32. Role ministry and innovation – aquaculture innovation policy?
33. Private initiative – innovative activities and capacity of local firms
34. Biggest challenges to adopting new technologies in the country

Others

35. External competition **-** Comparative advantage of aquaculture in Oman?
36. Environmental issues