National Aquaculture Sector Overview

Saudi Arabia

Replaces: Chinese version (2006)

Characteristics, structure and resources of the sector

Summary

The Kingdom of Saudi Arabia occupies 80 percent of the Arabian Peninsula land surface with a unique geographical location, with the length of its coastal belt along the Red Sea and the Gulf exceeding 2 400 km. Of the Kingdom's total of 7 572 km coastline, roughly 2 400 km is available for aquaculture development along the Red Sea in the west and the Arabian Gulf in the east. This makes the country a rich source of a wide range of fish and other marine products suitable for commercial exploitation, particularly marine species, attributed to favourable climate conditions, availability of water, good land and suitable environment. Due to the excellent potentially favourable environment for fish farming, the Ministry of Agriculture has identified aquaculture as a priority economic sector, as a result of rich finfish and shellfish resources, some of which have been identified as suitable aquaculture candidates.

Aquaculture in Saudi Arabia dates back to the early 1980s when Nile tilapia was reared in inland water bodies. The sector started to move toward shrimp aquaculture - giant tiger prawn first and Indian white shrimp after. The disease-hit with native species led to a Kingdom-wide crop holiday and meanwhile partial switch-over to Asian seabass in shrimp ponds. Ministry recognized the need for a new candidate species to lead the industry and after cumulative due diligent study, analytical discussions, factual and objective evaluation with Scientific peers and industry experts took the lead and embraced Specific Pathogen Free (SPF) Vannamei for commercial scale farming.

Whereas the bulk of freshwater aquaculture production is consumed locally, the shrimp production is exported in many countries like Japan, European and North American markets, once the domestic demand has been satisfied. There has been a rapid development of aquaculture in the last 5 years, as perceived from the rapid increase in the number of fish farms during this period. The development is towards increased production of whiteleg shrimp (*Penaeus vannamei*) and diversification towards the culture of marine fish species. This trend

is expected to continue in the coming years. 23 870 tonnes of total aquacultured production for the Kingdom was recorded in 2014 wherein the share of shrimp, freshwater fish and marine fish were 54.38 percent, 20.23 percent and 25.38 percent respectively.

History and general overview

Saudi Arabia with an area of 2.15 million km^2 is an arid and water deficit country, with limited freshwater-supplies. The Kingdom is a desert like country lying within the continental zone where temperatures are high in summer and low in winter. It is also characterized by low annual rainfall and lacks perennial rivers or permanent bodies of water. The climatic conditions pose a continual challenge, as does the depletion of underground water resources. Due to an acute deficit, water has always been an extremely valuable resource and occupies the prominent and prime position among the natural resources of the kingdom. Although water is a renewable resource, yet its availability is extremely low and to the society. In the situation, there is a tremendous pressure on the existing water resources due to an increase in population, and the rising living standards of the civil society (FAO, 1997; FAO, 2009). Scarcity of freshwater confirms that mariculture is the future for fulfilling Saudi's future fish-food demand, especially mariculture production from the Red sea coast.

In Saudi Arabia aquaculture has been practiced for the last three decades. During 1970 the Ministry of Agriculture (and Water) in cooperation with FAO and the White Fish Authority (WFA) of the United Kingdom made specific studies on the potential of aquaculture development providing a list of potential species suitable in fresh and marine waters in the Kingdom. King Abdulaziz City for Science and Technology (KACST) established a tilapia and common carp hatchery in Riyadh in 1980. Since then a substantial number of fingerlings were produced and distributed to fish farmers. To promote marine aquaculture, the Jeddah Fisheries Research Centre (JFRC). Erstwhile, the Fish Farming Centre in cooperation with FAO was established in 1982, in the north of Jeddah. JFRC has reached several notable and valuable results in its research activities. It provides farmers with seawater sabaki tilapia (*Oreochromis spilurus*) tilapia fry and Asian seabass fingerlings to farmers. Its results are continuously disseminated to investors interested in establishing aquaculture farms across the country.

Principled aquaculture amongst farmers thus began during the early 1980s when some farmers started culturing tilapia in freshwater bodies in inland areas. Nile tilapia (*Oreochromis niloticus*) has been the major fish produced in aquaculture until 2000 when shrimp began to be produced in large quantities. Initially, the activities on shrimp culture were mainly on giant tiger prawn (*Penaeus monodon*) where the breeding and culture technologies developed in Southeast Asia were brought to Saudi Arabia. However, because of the high saline waters around the country, *P. monodon* culture was not successful. Instead, it was replaced by the Indian white shrimp (*Penaeus indicus*), which was found to survive and grow well in the high saline waters around the country. Indications of a viral disease led to the closure of all shrimp farming projects and the industry had a renaissance, recovery and revival with SPF Vannamei sourcing from specialised facilities in the Americas. Special attention has been directed at boosting a Biosecure commercial aquaculture production now. The Ministry of Agriculture strongly supports and encourages investment by facilitating the acquisition of project land and water under concession, as well as providing favourable loans. Experimental and show-case aquaculture projects have been established by the authorities to encourage local and foreign investments. Feasibility studies concerning aquaculture operations demonstrated the economic importance of investing in different aspects of this sector.

The Ministry of Agriculture is especially focused on the activities and development of the aquaculture sector, so as to meet local needs and for the purpose of exports from such an important source of animal protein. Aquaculture projects in Saudi Arabia are either inland projects, established within agriculture projects or close to them, or coastal projects located along the Red Sea coast. The Department of Aquaculture is responsible for issuing licenses, for setting-up operations for aquaculture projects after the evaluation of due feasibility studies.

The first aquaculture farm in Saudi Arabia was established a little over two decades ago when the first license to operate this kind of business venture was granted in 1983. During this time, freshwater aquaculture was the main activity producing largely Tilapia. There were less than 20 fish farms in Saudi Arabia during the 80s until

the early 90s. The number of fish farms increased significantly to 109 in 2002 (Statistical Indicators for Fisheries in Saudi Arabia, 2002) and more than doubled in just 2 years to 227 in 2008 (Fisheries and Aquaculture Statistics, 2008). Licensing count swelled thereafter in recent years with focus onto cagefish farming also.

From a mainly freshwater aquaculture-oriented activity, it became a highly successful marine aquaculture venture dominated by only two aquaculture commodities, Tilapia for freshwater and white shrimp for marine aquaculture. After a total dependence on these two aquaculture species, farmers have now started to diversify their aquaculture operations into marine fish culturealong the Northern Red sea. Recirculation systems for finfish being is now prevalent among few producers but not with majority of farmers and still in the incipient stages.

Human resources

In 2003, the employment in the aquaculture sector reached 3 407 full time jobs (Fisheries Statistics, 2006). This figure is expected to increase because of the increasing number of farms in the recent past. Many of these workers, especially those working in the farm sites are unskilled workers doing routine maintenance labour. A few highly-skilled people are in-charge of the operation of the farms. Most of the skilled workers employed in the industry are non-Saudi nationals. It should be noted, that at present, no women are part of the working force in the industry except for the processing sector where labour permits have been granted in recent years. The involvement of Saudi nationals in the aquaculture technical workforce has projected a positive trend of training, learning and creation of new placements.

Farming systems distribution and characteristics

Saudi Arabia is a vast landmass. Wide tracts of land are available along the two coasts and in agriculture belts where non-arable lands may be used for aquaculture. The Kingdom also has a wide range of climatic conditions that allow culture of suitable temperate, subtropical and tropical species. The water quality of both groundwater and seawater is very good, unpolluted and highly suitable for aquaculture. In interior areas where groundwater is used, aquaculture farms are integrated with agriculture wherein nutrient-rich aquaculture effluents are used for irrigation. On the other hand, shrimp and marine fish farms are concentrated along the Arabian Gulf and the Red Sea, notable in which are the long coastline of suitable environment where climatic conditions are generally stable, characterized by the absence of severe weather problems and strong waves.

A marine fish cage culture industry is emerging within the territorial waters of the Kingdom with several projects and associated land-based hatchery facilities under current development. Furthermore, there is evidence of a growing interest among both national and foreign entrepreneurs to invest in this sector as a result of pristine waters and the vicinity of attractive markets. In view of this there is the opportunity to properly plan the development of this new sector in a responsible and sustainable manner, reducing potential and future conflicts and improving long-term socio-economic and environmental sustainability of this emerging industry (ADF, 2011).

Cultured species

Shrimps

Mainly the Indian white prawn, *P. indicus*, is present in the waters around Saudi Arabia and is tolerant to high water salinity. Because of its capability to breed and grow well in high saline waters, this species was found to be the best shrimp species suitable for aquaculture in the country. JFRC (formerly FFC) developed and demonstrated the successful culture of the Indian white shrimp *Penaeus indicus* under hypersaline conditions of the Red Sea. The domesticated strains are now maintained, while for gene pool expansion, the Center cultured a cross between wild breeders and FFC's domesticated breeders. FFC has remained the most important source of Red Sea strain domesticated broodstocks in the Kingdom, and it has distributed these breeders to shrimp farmers, and provided the impetus for the development of the commercial shrimp industry in the Country. The Ministry has planned a program now to purify the indicus broodstock, already bred for more than two decades at JFRC. Expert assistance will be sought to assess the level of genetic variability available in the existing

domestic *Penaeus indicus* population (for more than two decades under continual selection). Detecting any feeble heterozygosity reduction in domestic JFRC indicus stocks and evaluate if it is beneficially higher than in the wild gene pool of eastern Red sea is warranted. After a recent three years of whitespot disease problems with *Penaeus indicus*, the Kingdom switched to *Penaeus vannamei* in 2014 because of the availability of specific pathogen free *Penaeus vannamei* broodstock from certified central agencies in the Americas. 12 980 tonnes of shrimp were produced in the Kingdom during the year, 2014. The Ministry has defined a stringent biosecurity concerning the three spheres -the host, the environment and the pathogens keeping them from intersecting by either controlling environmental variables, securing all pathways of pathogen introduction, or simply keeping populations low at 50 individuals/ sq.metre.

Tilapia

Nile tilapia (*Oreochromis niloticus*) is the main freshwater fish cultured in the country with present production of 2 276 tonnes or about 20 percent of the total aquaculture production in 2004 (Fisheries Statistics, 2006). These are mainly cultured in inland waters, where freshwater is also used for agricultural crops irrigation. In the last 10 years, sabaki tilapia *Oreochromis spilurus*, a salt tolerant strain of tilapia was introduced from Kenya. This species is now bred and cultured in high saline waters of the Red Sea. The present production of *O. spilurus* is still very minimal at about 1 percent of the total aquaculture production in 2004 (Fisheries Statistics, 2008) and 1.5 percent in 2014. A Ministry of Agriculture study on 2014 cultured production evaluation of this marine species scored 370 tonnes which was 5.9 percent of the total tilapia production in the Kingdom. Freshwater tilapia production in 2014 was over 20 percent of the total aquaculture production for the year 2014.

The freshwater tilapia species which showed potential for aquaculture in Saudi Arabia were sabaki tilapia *O. niloticus*, blue tilapia *O. aureus*, and Mozambique tilapia *O. mossambicus*. Also for seawater tilapia species *O. spilurus* were cultured. Technique of freshwater tilapia culture was initially introduced from Taiwan. Tilapia farm sizes ranged from 3 000 to 50 000 m². Concrete and fibre glass tanks of different sizes and shapes are in use. The depth of these tanks ranges from 0.8 m to 1.50 m. Groundwater is used. The production method is mixed sex tilapia in a three phase system of brood, nursery and growout in separate tanks. The production varies from 5 kg/m³ to 20 kg/m³ in well managed farms where intensive aeration is provided and a large volume of water is used. The feeds are available in powder, crumble and pellet at reasonable prices. The feed conversion ratio ranges between 2 to 2.5. Farm raised tilapia weighing 200 g and above is marketed. KACST has established two research centres at Dirab, Riyadh and at Al-Qassim to carry out the research projects for culturing Nile tilapia for freshwater farming. More than 40 inland freshwater aquaculture farms using intensive system are involved in tilapia production. Aquaculture in 1986 constituted less than 1 percent of fish production in Saudi Arabia but has grown to 20 percent in 2005 and to about 25 percent in 2008. During the five years period of 2004 to 2008 production of tilapias grew from 2 276 tonnes reaching 3 673 respectively. 2014 assessments for tilapia cultured production stood at 6 291 tonnes of which 94.1 percent attributed to freshwater tilapia and the rest being marine tilapia species.

Other species

Research at the JFRC in earlier days demonstrated the successful broodstock management of the local Hamoors (Malabar grouper *Epinephelus malabaricus*, brown-marbled grouper *E. fuscoguttatus*, and camouflage grouper *E. polyphekadion*), hatchery and nursery. Growout to marketable sizes greater than 500g in ponds, tanks, pens and cages has also been shown feasible. During 2014, in the Kingdom, 140 tonnes of grouper were farmed through aquaculture practices. The other marine fish is the marbled spinefoot (*Siganus rivulatus*), known locally as safi or sigan, which has been identified as one of the local species with commercial potential in the Kingdom, having a big demand in the local market. Techniques are also available to produce hatchery-reared fry, and good results have been obtained with growout culture in tanks, net pens and cages, where they can reach marketable size in 6 months using artificial feed. During the year 2014 were produced in the Kingdom 50 tonnes of rabbit fish. JFRC also succeeded in developing and demonstrating domestication and full-cycle culture of the Asian seabass or barramundi (*Lates calcarifer*) also in hypersaline water. The culture of Asian seabass is now in the process of being adopted by several marine fish farms. In the Kingdom of Saudi Arabia, were produced 2 525 tonnes of Asian seabass during 2014. Technologies for production of the above marine fishes in land-based tanks, ponds and floating sea cages are indeed available, with offshore cages

showing better promise for commercial production. Some near shore islands in the Red Sea offer protected sites for sea cages, but many sites in the open sea are also available for offshore cage culture along Central to Northern Red sea as answered by GIS mapping techniques. Gilthead seabream (*Sparus aurata*) though considered an exotic species was bioinvasive in the Red Sea vicinity of the opened Suez Canal and established successful populations in this new ecotype and ecoclimatic conditions. However, Ministry imported fingerlings of gilthead seabream under strict biosecurity standards subjecting them to quarantine and after careful post-import behavioural evaluation were accessed for the private sector farming practices. Hatchery technology for gilthead seabream within the Kingdom is in its infancy and is under maiden trials with private sector with advances in broodstock management, systems design, nutrition, and disease management, and unit productivity through controlled Recirculation Aquaculture Systems (RAS). Ongrowing technology for gilthead seabream in the northern Red sea mirrors that of the tri-decadal Mediterranean experiences. Northern Red Sea has warmer winter growing temperatures than Mediterranean region thus accelerating the effective growth rates. In the Kingdom of Saudi Arabia were produced 1 685 tonnes of gilthead seabream in 2014.

The first caviar-producing project started by Dammam Abdallah Al Faris Group is based on inland recirculating aquaculture system by Cimbria aquatic of Denmark. This project started with ambitious plan to produce sturgeon (*Acipenser gueldenstaedtii*, *A. baerii* and crossbreeds) meat and Ossetra caviar. Initial production target is 5 tons per year Ossetra caviar and 200 tons of sturgeon meat. Actual production levels in 2014 for Sturgeon in the Kingdom stood at 35 tonnes as per Ministry of Agriculture estimates.

Studies on the higher-priced *Plectropomus* spp. (locally known as taradi and najil) are in the early stages at the Jeddah Fisheries Research Centre. Limited success has also been achieved in the hatchery of taradi (*Plectropomus areolatus*) and roving coralgrouper *P. pessuliferus* for the first time ever in the Kingdom and elsewhere, fingerlings were successfully produced and have been shown to feed and grow using artificial pelleted feed. Larval culture techniques are still being established but these recent results show great promise. Catfish production in the Kingdom through aquaculture showed 104 tonnes of farmed produce in the year, 2014.

Future focus onto economically significant species like golden trevally (*Gnathanodon speciosus*), mangrove red snapper (*Lutjanus argentimaculatus*), snubnose pompano (*Trachinotus blochi*), spangled emperor (*Lethrinus nebulosus*), greater amberjack (*Seriola dumerili*) and meagre (*Argyrosomus regius*) need comprehensive research for future development of breeding and farming expertise alongwith deciphering the nutritional requirements at different growth stages.

Practices/systems of culture

Virtually all kinds of aquaculture systems, such as extensive, semi-intensive and intensive, and culture facilities like earthen ponds, lined ponds, concrete/cement block tanks, fiberglass tanks, net pens and cages are feasible and have been practised in the Kingdom, and many species can be cultured successfully. Brackish and marine aquaculture is mainly undertaken in huge shrimp farms using ponds and raceways located along the Red Sea coast and the Gulf coastline but offshore cages are restricted to northern Red Sea only.

Tilapia farms employ the semi-intensive culture system. Most of the farms produced their own fry and fingerlings for stocking in growout ponds or tanks. The main source of water is from a well. Water is changed once a week and waste pond water is recycled after staying for some time in a settling pond. During the exchange of water, 50 percent of new well water and recycled water is introduced. Artificial feeds from commercial feed companies are used and some farmers produced their own feeds. Similarly for shrimp culture, the semi-intensive method is largely used. The size of the culture ponds is large, ranging from 1 hectare to 10 hectares per compartment. Stocking density in growout ponds ranges from 15-25 pcs/m^3. Approximately, 15-20 percent of water is changed daily.

Sector performance

Production

In 2004, aquaculture production comprised about 17 percent (11 172 tonnes) of the total fish production (66 591 tonnes) in Saudi Arabia. Production in freshwater culture systems was 2 306 tonnes or 20 percent of the total aquaculture production, whereas production in seawater culture systems was 8 866 tonnes or 80 percent (Fishery Statistics, 2008). Figures for total aquaculture production in freshwater and marine environment amounted to 12 980 tonnes in 2014 (Ministry of Agriculture estimates, Saudi Arabia)

The graph below shows total aquaculture production in Saudi Arabia according to FAO statistics:

Market and trade

The shrimp aquaculture industry is highly developed in Saudi Arabia. The production increased from only 20 tons in 1995 to less than 2 000 tons in 2000, then to 8 705 tons in 2004 and 15 000 tons in 2005, and become 40 000 tons 2010 production 95 percent exported to Japan, European countries, United States of America, Hong Kong and Singapore. In the Kingdom of Saudi Arabia 91 246 tonnes of fish and fishery products in live weight were produced (FAO, 2012). Saudi imports amounted to 266 in the Kingdom of Saudi Arabia 955 tonnes of live weight and Saudi exports figured at 38 613 tonnes live weight.

The majority of fish production in freshwater systems, mainly tilapia and catfish, are sold in the domestic market either live or in fresh form. The local marketing chain is very well established. Selling is done by whole sale in the farm site and the products are distributed to a chain of retail shops around the country.

Although fish is not truly a staple of the Saudi diet, demand for fresh fish is climbing up. Annual fish consumption per capita increased from 3 kg in 1977 to 6.5 kg in 1998 and touching around 8 kg in 2007. In 2010 per capita supply is just 11.5 kilograms in the Kingdom. (FAO, 2012).

Contribution to the economy

Because aquaculture is a three-decadal activity with gaining momentum for the past fifteen years in Saudi Arabia, its contribution to the national economy is not yet significant. Nevertheless, the commercial and economic importance of aquaculture so far can be summarized as follows:

- The annual investment income for aquaculture projects is relatively high reaching 20 percent.
- The production of fresh, safe and highly valuable animal protein for local consumption and for export.
- The production plan is not defined by specific seasons or standards, but it is linked to the consumer and marketing.
- The quality and quantity of production is controlled by market needs, consumer requirements and exports.
- Saudi Arabia is located close to European markets which are considered one of the most important consumer markets for seafood products, in addition to the availability of recent means of communication and governmental support to cargo services.
- The availability of research programmes and field experimental studies with respect to local fish and shrimp species, aquaculture systems and feed production.
- Providing jobs for an important sector of national qualified personnel.
- Strengthening the contribution of the agricultural sector in the national economy.

A recent report suggested that fish, along with poultry, are so-called ‘necessity goods’, with demand rising by nearly 5 percent per annum (Abdulaziz Al Shuaibi, 2011). The Saudi Arabian economy will undoubtedly be impacted development in marine aquaculture sector by the fact that more than 50 percent of the population of Saudi Arabia lives within 100 km of the Saudi coastline. The Kingdom enjoys the benefit of being centrally located. It is accessible for both input and output markets. The country’s convenient location favors the easy export of fresh aquaculture products to Europe, U.S.A. and Japan which are the world’s major consumer of aquaculture products. Master planners recognises the uniqueness of the Kingdom and the opportunities that it

offers. Excellent infrastructure facilities have been established, such as a modern roads and transportation network, world-class airports and seaports, good domestic water supply, cheap supply of fossil fuel and electricity and modern telecommunications, which are all essential for the country's growth and development. The infrastructure available for trade and marketing in general and of aquaculture inputs and products is excellent. All kinds of construction materials are readily available, cost of transportation is low, and cost of construction is also cheap due to the availability of low-skilled, low-cost laborers in the Kingdom.

Promotion and management of the sector

The institutional framework

The main agency tasked to regulate and supervise aquaculture development in Saudi Arabia is the Department of Aquaculture (DA), an agency under the Office of the Deputy Ministry of Fisheries Affairs within the Ministry of Agriculture (MOA). Based in the capital city of Riyadh, the main task of the department is to control, regulate and supervise aquaculture operations in coastal and inland regions, as well as, to support research projects which focus on aquaculture and suitable fish and shrimp species for fish farming purposes in fresh and marine waters. The DA has the following objectives and specifications:

- Supporting and supervising activities dealing with site selection of coastal areas suitable for setting up aquaculture projects.
- Design and approval of short and long-term plans for updating current and future aquaculture performance in Saudi Arabia.
- Periodical revision of aquaculture production plans.
- Market analysis of aquaculture products, identification of critical marketing problems facing investors and proper means of correction.
- Applying the principles and practices of Aquaculture Biosecurity through the adoption of a documented code of conduct for regulation, implementation and validation through the Aquaculture Department of the Ministry of Agriculture (ADMA), the ministerial body for related governance.

The governing regulations

Because aquaculture is relatively new in the country, there are not many rules and regulations governing the sector. The law regulating fishing, investment and protection of living aquatic fisheries resources has been issued by the Royal Decree (No. M/9) on 18 November 1987, entrusting the MOA, the responsibility of regulating fishing, investment and protection of living aquatic fisheries resources in Saudi Arabia. The MOA supervises the development of this sector through the Deputy Ministry of Fisheries Affairs by the General Directorate of Aquaculture Department that plays a key role in establishing general policies, planning and designing short and long term programmes for the development of fish resources and staffing for inland and coastal aquaculture development in the country.

Investing in fish production is one of the best opportunities for any company since seafood products may be of high-value, and have high demand both in the export market and locally by both Saudi nationals and expatriates. Loans are provided to farmers by the Saudi Arabian Agricultural Bank for the development of aquaculture projects, purchase of many production requirements, equipment and other facilities. Such loans are normally with very low interest, and depending on the category (short-term, medium- term, long-term), the loans are payable within a period of up to 25 years. On the other hand, the Industrial Development Fund provides loans for the food industry, and aquaculture investors may utilize these loans for value-added aquaculture product processing. No excise duty is imposed for the import of farm equipment, fish feeds, instruments and chemicals related to the farming activities. While capital investment in aquaculture may be high, return on investment is usually high and payback period is short if properly planned, constructed, equipped and operated.

The government of Saudi Arabia has embarked on an ambitious reform program to encourage greater

participation by the private sector in economic development. Steps have been taken to implement genuine reform aimed at creating a more open and competitive economy. Furthermore, the Kingdom has eased the regulations governing freeing investment by endorsing the Foreign Investment law. Under this law, investment projects, including aquaculture, can be either fully-owned by foreign investors or owned jointly by Saudi and foreign investors. Foreign investors do not need a Saudi sponsor to establish a project in the Kingdom. Licensed firms will sponsor the investor and his expatriate employees, and will have the right to own the projects' land, buildings and housing complexes for its employees, and enjoy all the benefits and incentives offered to a national firm. An investor shall also have the right to transfer his share of profits outside the Kingdom as well as his entire share if the project is sold. These reforms are a forward drive to encourage foreign investors. The Saudi Arabian General Investment Authority will provide foreign investors all that they need to start projects in the Kingdom. There is an Investors Service Center, which is a one-stop shop where applications for license may be finalized within 30 days. If this period lapses without a decision taken on the application, the license will be issued to the investor. As additional incentive, the government would bear 15 percent of corporate tax imposed on foreign companies that have an annual profit of more than SAR 100 000 (USD 26 664); the companies can transfer losses to following years, and loss-making companies will get tax exemption until they improve their financial performance. Several other positive considerations to invest in Saudi Arabia include:

- A well documented Foreign Capital Investment Code.
- A dispute settlement machinery based on Islamic Sharia and the Kingdom's adherence to the 1965 Convention on the Settlement of Investment Disputes Between States and Nationals of other States, which ensures that foreign investment is sell protected.

Membership in regional and multi-national investment guarantee schemes, i.e., the Inter-Arab Investment Guarantee Corporation, the Islamic Corporation for Investment Insurance and Export Credit and the Multilateral Investment Guarantee Agency (MIGA) provide guarantee cover for foreign investments as per eligibility norms, and bilateral agreements with several countries on the protection of investment and avoidance of double taxation.

Applied research, education and training

The collaboration between the government, academies, research institutions and the private sector, has helped to develop aquaculture in Saudi Arabia. Early research activities on aquaculture were done by the Fish Culture Center of the Saudi Arabian National Center for Science and Technology now King Abdul Aziz City for Science and Technology, a government agency tasked to promote scientific research and technology development in the Kingdom. This agency manages a center for freshwater culture.

Seeing the potential of aquaculture as a means to provide food fish for the local people, the government established research centers to strengthening the development of the sector. These research centers are the Fish Farming Center in Jeddah, Fisheries Research Center in the Eastern Province and Fisheries Research Center in the Red Sea. Soon to be operational are the Fish Health and Safety Laboratories in Jeddah and Dammam. There are a number of universities that are offering courses on Fisheries and Aquaculture and the graduates from these universities find their way to work in the different research centers and the private farms around the country.

At present, aquaculture research and training is done mainly in the Jeddah Fisheries Research Center (JFRC) in Jeddah. The focus of research in JFRC is mainly on marine fish species. Very little aquaculture research is done elsewhere in the country. Grants for scientific research studies come mainly from the government and is administered by King Abdulaziz City for Science and Technology (KACST). There is no vocational training on aquaculture in technical or vocational colleges except for the fish farm of King Abdulaziz University (KAU), Obhur under the Faculty of Marine Science. There is a dedicated graduate training for aquaculture at King Faisal and King Abdulaziz Universities. However there is an apparent lack of segment-focused technique-oriented vocational training opportunities for Saudis wanting to work in aquaculture. Companies are directing their staff for in-house short term training or on-the-job training. There is a need for capacity building

in this area with the development of vocational training courses and materials in management, laboratory and technical skills (ADF, 2011). Under technical agreement with National Aquaculture Group (NAQUA), industry-linked problems, needs and requirements are experimented under field trials on pilot scale in the KAU aquaculture facilities for translating the solutions to commercial ponds for reproducibility of results. FAO in the current year-program (2011-2016) has conducted several aquaculture-based training workshops to improve capacities of the national technicians on these subjects.

Fisheries Research Centers

The Deputy Minister of Fisheries Affairs supervises several fisheries research centers in Saudi Arabia. These centers provide technical and extension services to the local aquaculture projects based on scientific and research studies. The research centers are:

- Jeddah Fisheries Research Center in Jeddah.
- Fisheries Research Centre located in the eastern province.
- Fisheries Research Centre in the Red Sea.
- Fish Health & Safety Labs in Jeddah and Dammam.

Jeddah Fisheries Research Center in Jeddah

The Jeddah Fisheries Research Centre in Jeddah was established in 1982, under an agreement between FAO and the Saudi Arabian government. The main targets of the centre are to focus on research and development programmes for marine fish and shrimp species suitable for fish farming operations, transfer and application of recent aquaculture techniques and training programmes. The centre lies on the Saudi Arabian Red Sea coast, 60 km north of Jeddah. It has been carefully selected to fit the establishment of models for different fish farming systems, e.g. cages, pens and ponds, as well as, other accessory facilities. The centre has the following objectives:

- Conduct of research programmes to select valuable local and foreign marine fish and shrimp species suitable for fish farming at commercial level under local environmental conditions of Saudi Arabia.
- Evaluate different means of fish farming systems and select those suitable for application in different regions.
- Develop standard fish and shrimp feed formula using locally available components.
- Conduct field and research studies in diseases of cultured fish and shrimp species.
- Execute quality control of water drainage from fish farms.
- Carry-out training programmes covering different aspects of aquaculture operations.
- Provide aquaculture projects with the required fish and shrimp larvae and fingerlings.
- Publish and distribute free extension books which cover all aspects of aquaculture operational techniques and offering technical extension to aquaculture projects.
- Selection of suitable coastal areas for aquaculture projects.
- Evaluate feasibility studies of aquaculture projects.
- Capacitate the library with updated references of aquaculture operations.

Trends, issues and development

The shrimp aquaculture industry is developing very fast. This is expected to continue in the next 10 years as evidenced by the increasing number of farms that applied licenses to operate shrimp farms. In addition, the existing big shrimp farms are also expanding, acquiring more areas intended for production.The big shrimp farms are also diversifying their aquaculture operations. In the pipeline are plans to go into marine fish culture, especially the highly priced marine fish species such as groupers, seabreams and seabass reared in floating cages in the Red Sea.

Thus, the prospects for the farming of shrimp and fishes, particularly groupers and marine fish species, appear very bright. As with other commercial ventures, continuing research and development of cost-effective techniques to enhance production as well as to screen local species for future development are necessary, and are presently being addressed. The Red Sea coast has high potential for coastal and offshore fish farming. Coastal intertidal zone aquaculture is in the progressive stages of development.

Issues

R&D studies related to culture of local species, larval rearing, genetic improvement, aquaculture-agriculture integration, polyculture, organic farming, and low-cost feed formulation, disease control etc are essential segments today (Kitto and Regunathan, 2012). Issues like harmful algal blooms, biotoxins, episodic pollutants, global warming related issues etc. also deserve much attention. New driving forces are redefining the Saudi seafood consumer interests. Promoting subsistence farming is a must for Saudi coastal fish workers. Boundless growth of whiteleg shrimp farming is apparent today but without a domestic breeding program for the Kingdom. Greater recognition of traditional aquaculture fish like Sabhaki tilapia is needed in the Kingdom to sustain the poor farmers through biofloc approaches and sustainably higher yield per unit volume. Jeddah Fisheries Research Center is now preparing the protocols with FAO Consultant inputs for growing shrimp with lesser waste outputs by cleaning shrimp pond while under culture through biofloc culture systems.

Development

Saudi Arabia has considerable development potential for expanding coastal aquaculture - it has long coastlines with relatively few alternative economic uses, a range of water temperature regimes for culturing a mixture of fish and shrimp species, cheap energy and (albeit rising) labor costs and access to strong national, regional and international markets. Led by a number of pioneering Saudi companies, this potential is beginning to be realized. However there are a number of barriers and threats to this expansion. The predominant concern is the complicated and unpredictable planning and land allocation process which is a major disincentive to would-be investors in coastal aquaculture. This situation is exacerbated by uncertain jurisdictional boundaries and inter-sectoral competition and disputed user conflicts amongst permitting agencies. The situation offshore for cage farming is similar but lacks even the most basic development framework for sea area permitting which FAO has started filling this gap. At a technical level, there are also issues over the availability of specific and optimized feeds for the growing number of finfish species being considered for culture, difficulties in commercializing culture technologies for indigenous species with proven local markets and a lack of commercially-proven hatchery, nursery and growout technologies. This is compounded by the lack of graduate and vocational training opportunities in this increasingly complex subject for young Saudi resourcive manpower (ADF, 2011)

Outlook

The Kingdom still has tremendous potential for coastal as well as inland aquaculture development. Surveys conducted by the country’s Department of Aquaculture have shown the availability of many suitable coastal areas for marine farming operations. The Kingdom’s natural resources (highly suitable environment with unpolluted water, favorable climate, large areas of suitable land; in addition, there is no mangrove destruction) and well-established infrastructure (good road networks, airports, sea ports, communication system), together with the government’s full support (from MOA and other related government agencies; e.g., long-term lease of land at very low rent, long-term at zero interest loan by the Agriculture Bank, grants for work permits, investment incentives) and the availability of established technology are all contributing to the success of aquaculture in the Kingdom. The country will still more pursue the aquaculture of other unconventional locally now found species of fish (sherry, pompano, meagre, sobaity) algae (*Dunaliella*) and seaweeds (*Ulva, Gracilaria*), crustaceans (*P. vannamei*) and Mollusks (Oysters). At present, the Kingdom is in the process of revising the legal framework to regulate the aquaculture industry. Very recently, aquaculture practitioners adopted a Code of Conduct and Practices for Responsible Aquaculture in Saudi Arabia, which is in the process of being finalized for implementation. The Kingdom advocates responsible and sustainable aquaculture

projects that are environment-friendly, socially acceptable, and technically and economically viable. Greater participation by the private sector is encouraged, and aquaculture investments can be either fully-owned by foreign investors or owned jointly by Saudi and foreign investors.

Offshore aquaculture is the frontier ahead for redefining Oceanic property in the Saudi Arabian Red Sea. Fish are one of the few naturally occurring sources of meat available from the Arabian Peninsula. With natural resources under careful stewardship and production increased through innovative aquaculture, it will be possible to reverse the current dependence upon imported seafood and thus increase the food security of the Kingdom (ADF, 2011).

Aquaculture of microalgae for pigments and algaemeal to replace fishmeal and their relative downstream processing forms a lucrative part of the sector (ADF, 2012). ADF speculates the 27 500 tonnes aquaculture production in 2009 is expected to touch 770 000 tonnes by 2024.

During the last four decades, the Kingdom of Saudi Arabia has witnessed rapid urban, industrial and agricultural growth. Diversification of the predominantly oil-based economy into other sectors as the core of the government's approach in recent years is well-evident and manifested. Unlike other Asian countries where there is a directed development approach to benefit smallholders, in Saudi Arabia it had been purely a private sector initiative involving large companies (Kitto, 2013). The Kingdom is currently oriented towards the development of small-scale aquaculture for providing a much needed boost to poorer coastal economies in Saudi Arabia.

In the future, producing seafood in Saudi Arabia through aquaculture practices and diversification is vital for the Kingdom in the new millennium.

References

Bibliography

FAO publications related to aquaculture for Saudi Arabia.

Abdulaziz M. Al-Shuaibi , 2011. An Economic Study of the Demand for Red Meat in the Kingdom of Saudi Arabia using Almost Ideal Demand System. Trends in Agricultural Economics, 4: 30-40.

ADF, 2011. Establishing entities to undertake marketing, processing and services for the aquaculture and fishery industries in the Kingdom of Saudi Arabia, Fisheries Sector review. The seventh Initiative, Agriculture Development Fund, Riyadh, Saudi Arabia, 387 pp.

FAO 2012. FAO Fishery and aquaculture Statistics Year Book, FAO, Rome, Italy.

FAO, 1997. Irrigation in the Near East Region in Figures. FAO Country Report Saudi Arabia 9 C. FAO Land and Water Division, Food and Agriculture Organization of the United Nations, Rome 1997.

FAO, 2009. Irrigation in the Middle East Region in Figures AQUASTAT Survey 2008. FAO Water Report 34, Country Report Saudi Arabia. Edited by Karen Frenken, FAO Land and Water Division, Food and Agriculture Organization of the United Nations, Rome 2009, pp. 325-337.

Fisheries and Aquaculture Sector statistics. 2004 . Deputy Ministry of Fisheries Affairs, Ministry of Agriculture, Kingdom of Saudi Arabia. (Pamphlet)

Fisheries statistics of Saudi Arabia. 2003 . Marine Fisheries Department, Ministry of Agriculture, Kingdom of Saudi Arabia.

Fisheries statistics of Saudi Arabia. 2006 . Marine Fisheries Department, Ministry of Agriculture, Kingdom of Saudi Arabia. 192 p.

Fisheries statistics of Saudi Arabia. 2008 . Marine Fisheries Department, Ministry of Agriculture, Kingdom of Saudi Arabia.

James, C. M., Al-Thobaiti, S. A., Rasem, B. M., Carlos, M H., 1997. Breeding and larval rearing of the camouflage grouper Epinephelus polyphekadion (Bleeker) in the hypersaline waters of the Red Sea coast of Saudi Arabia, Aquacult. Res., 28 (9), 671-681.

James, C.M., Al- Thobaiti, S.A., Rasem, B.M., Carlos, M.H. 1998. Comparative growth of brown-marbled grouper Epinephelus fuscoguttatus (forskal) and camouflage grouper E. polyphekadion (bleaker) under hatchery and growout culture conditions. Asian Fisheries Science, 11: 133-147.

James, C. M., Al-Thobaiti, S. A., Rasem, B. M., Carlos, M H., 1998. Growout production of camouflage grouper, Epinephelus polyphekadion (Bleeker), in a tank culture system, Aquacult. Res. 29 (6), 381-388.

James, C.M., Al- Thobaiti, S.A., Rasem, B.M., Carlos, M.H., 1999. Potential of grouper hybrid (Epinephelus fuscoguttatus x E. polyphekadion) for aquaculture, Naga, ICLARM Quarterly, 22 (1): 19-23.

Kitto M.R. 2013. Is blue revolution with shrimp in Saudi Arabia crossing the disease chasm ? World Aquaculture , 44 (1) : 56-59.

Kitto M.R. and Regunathan C. 2012. A potential for marine fish farming in Saudi Arabia, Aquaculture Asia-Pacific 8 (1) : 37-39.

Prince Abdullah Research & Consulting Institute. 2009 . Future Plan of agriculture in the Kingdom of Saudi Arabia (5th and 7th reports).

Statistical indicators for fisheries in Saudi Arabia. 2002 . Ministry of Agriculture, Kingdom of Saudi Arabia. (Pamphlet)

Zaharani K. H., M. Shayaa Al-Shayaa and M. B. Baig 2011. Water Conservation in the Kingdom of saudi arabia for better environment: impliCations for extension and eduCation, Bulgarian Journal of Agricultural Science, 17 (No 3) 2011, 389-395 Agricultural Academy.

Related links

FAO FishStatJ – Universal software for fishery statistical time series

Regional Aquaculture Information System (RAIS)