

Experiences of countries with new aquatic industries: the development of aquaculture in Iran

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Summary

Although caviar is the most significant and famous fishery product of Iran, in recent years the country has gained a lot of experience and had some significant success with other fishery and aquaculture products. Iranian fisheries and aquaculture production reached 522,000 metric tons in 2005, of which 75% originated from capture fishery and 25% from aquaculture activities.

Various fishery and aquaculture activities take place in Iran to help meet domestic demand for aquaculture products and to maintain the existing level of natural resources in seas and rivers (restocking natural sources). The ways in which Iran has been able to make progress in developing aquaculture – which could serve as a model for other countries in the region and for developing countries – are as follows: a) optimising the use of climatic diversity in raising various aquatic species; b) establishing the required governmental and non-governmental organisations for raising aquatic animals, and planning and creating appropriate relationships between those organisations and entities; c) training skilful manpower and educating specialists in the field of aquatic animal health and diseases; d) increasing per capita consumption of fishery products through sensitising public opinion; and e) meeting the requirements for raising the rate of aquatic animal culture and developing the export of fishery products, i.e. by supplying eyed eggs, feed, broodstock, etc.

Keywords

Aquaculture framework – Aquaculture industry – Aquaculture product – Aquatic animal health – Fishery – Iran.

Introduction

The Islamic Republic of Iran is a Middle Eastern country located in south-west Asia which covers 1,648,000 km². Its boundaries to the north are Azerbaijan, Armenia, Turkmenistan and the Caspian Sea, to the east, Pakistan and Afghanistan, to the south, the Persian Gulf and the Oman Sea, and to the west, Turkey and Iraq. Iran also controls about a dozen islands in the Persian Gulf. Its capital is Tehran (6).

Iran plays an important role in the Middle East and is a significant power. Its strategic position and vast resources, including petroleum and natural gas, mean that Iran has a substantial role to play in the modern world.

For many people 'Iran' is synonymous with high quality and tasty caviar. But Iranian fishery products are not limited to caviar. According to reports published by the Iran Fisheries Organization, Iranian fisheries and aquaculture production reached 522,000 metric tons (MT) in 2005, of which 75% originated from capture fishery and 25% from aquaculture activities. This rate of production was up 7.3% compared with a similar period in the previous year, demonstrating a clear increase in aquatic production and consumption in Iran. The fishery production rate from 1993 to 2006 can be seen in Figure 1.

Long extended shores in the north and south, thousands of small and big water sources, climatic diversity, and the commitment of producers and authorities to developing the aquaculture industry and the necessary planning all

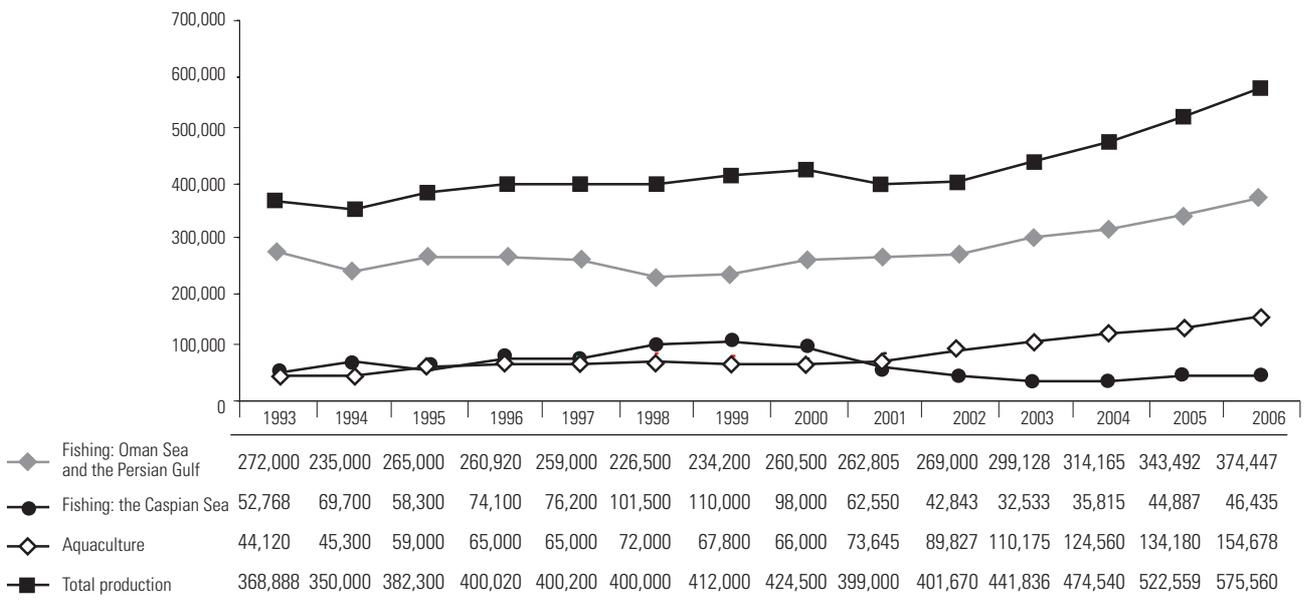


Fig. 1
Iranian fisheries production between 1993 and 2006 (metric tons)

over the country are leading to ever-increasing growth in the aquaculture industry in Iran. That is why fishery production rose from 33,443 MT in 1978 to 522,599 MT in 2005. This development is discussed in this article to

familiarise the reader with the framework of the aquaculture industry in Iran and the associated policies, which could serve as a good model to follow for developing aquaculture in the Middle East.

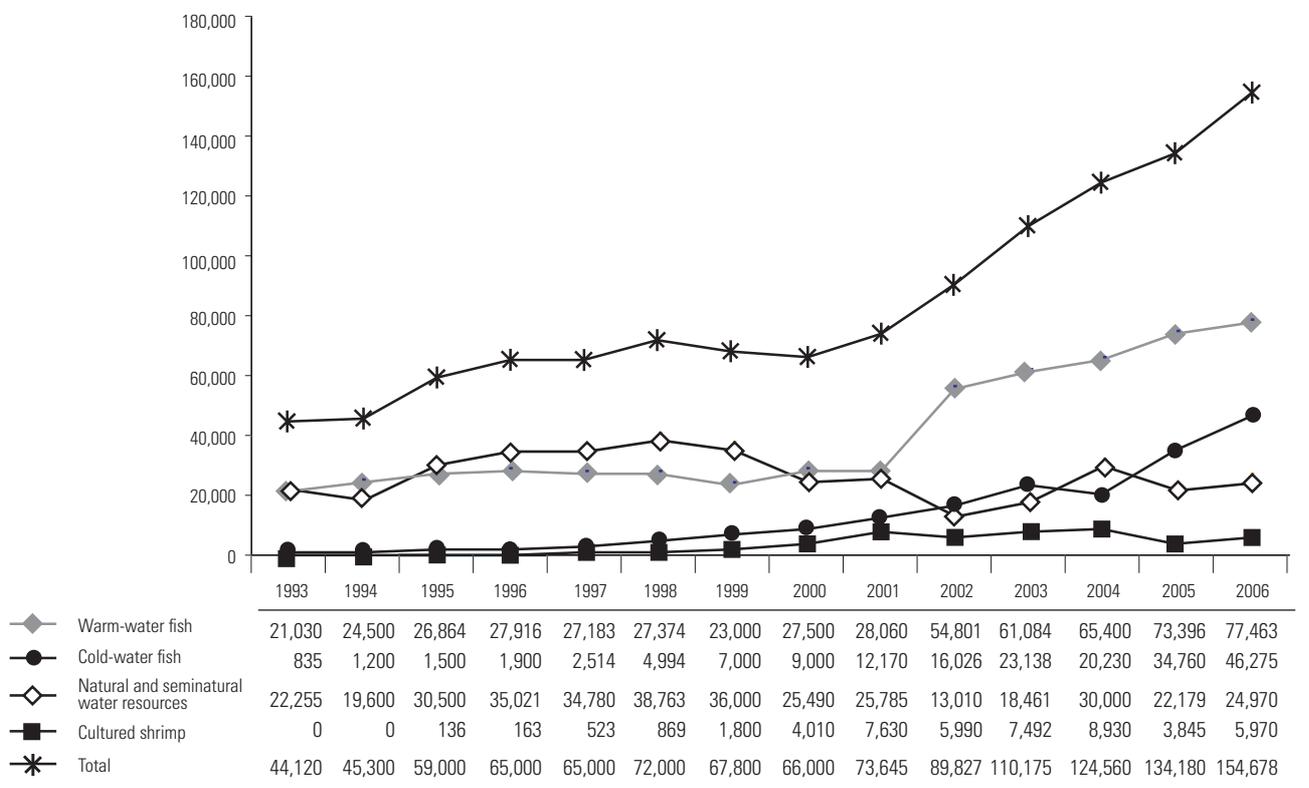


Fig. 2
Aquaculture production in Iran between 1993 and 2006 (metric tons)

The history of aquaculture activities in Iran

The history of aquaculture in Asia goes back thousands of years, especially in Southeast Asia, but in Iran no attention was paid to this important activity until the 20th Century. In Iran, aquaculture started with sturgeon breeding and rainbow trout farming in 1929 and 1959, respectively (7). There are five main aquaculture activities: warm-water fish farming (mostly carp), cold-water fish farming (mostly trout), fish farming in natural and semi-natural water resources, fish stock enhancement, and shrimp farming.

Warm-water fish farming

The following fish species are farmed: common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*). They are mostly obtained from abroad. Production of these species on fish farms has increased by 46% since 1989.

Cold-water fish farming

Trout farming started in 1959, and production increased from 599 MT in 1978 to 46,275 MT in 2006. Rainbow trout (*Oncorhynchus mykiss*) is the main cold-water fish species farmed in Iran.

Fish farming in natural and semi-natural water resources

The total area of inland water bodies including lagoons, lakes, reservoirs, rivers, etc. in Iran is estimated to be about 1.5 million ha (1, 3, 4). Some of the water bodies are stocked with common, bighead and silver carp. Production from freshwater and Caspian Sea capture fisheries (including waters enhanced by stocking) has levelled off at around 34,000 MT/year, with a steep drop in 2000, probably due to the continuing drought conditions.

Figure 2 shows the production rate of aquaculture farms from 1993 to 2006 in MT, Figure 3 shows the aquaculture surface area, and Figure 4 shows the number of cold-water, warm-water and shrimp farms.

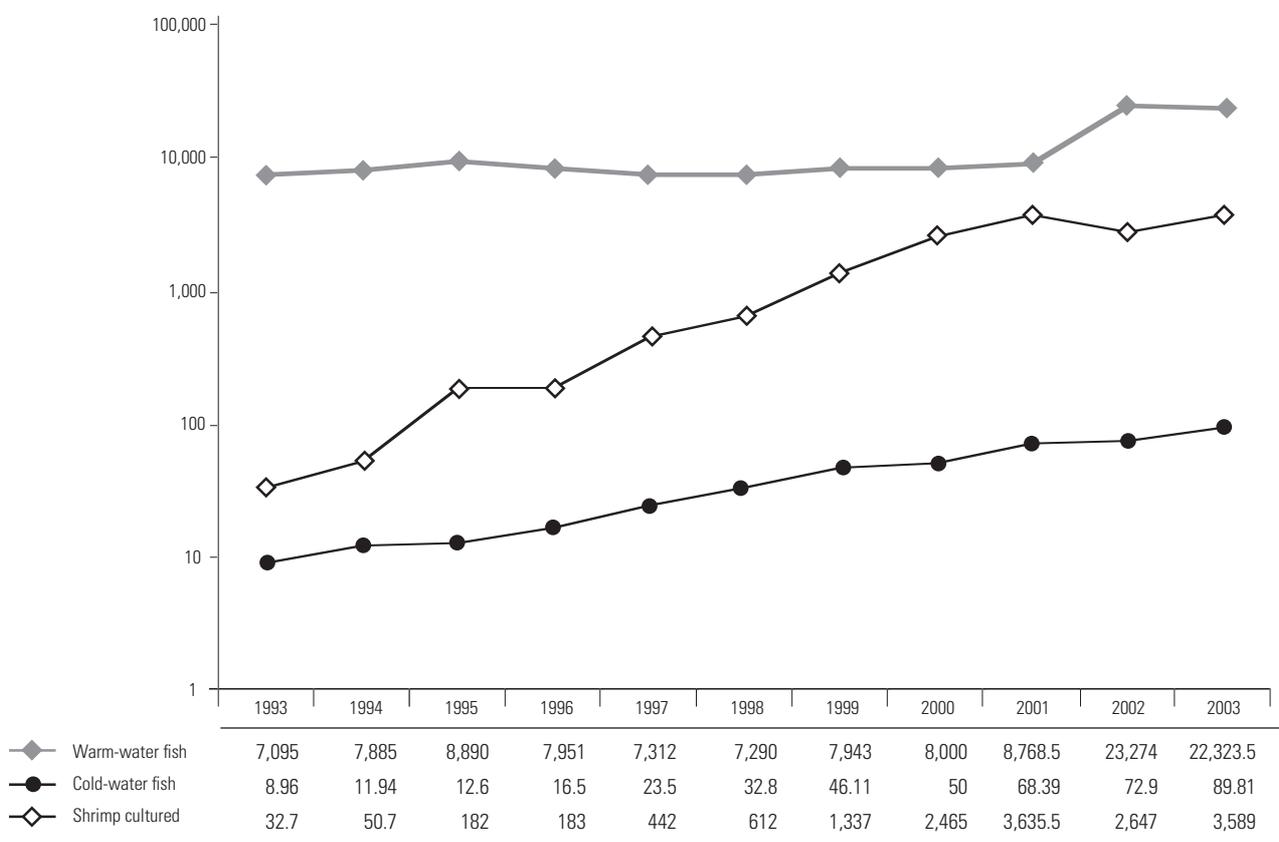


Fig. 3
Active farm area for fish/shrimp culture in Iran, 1993-2003 (Ha)

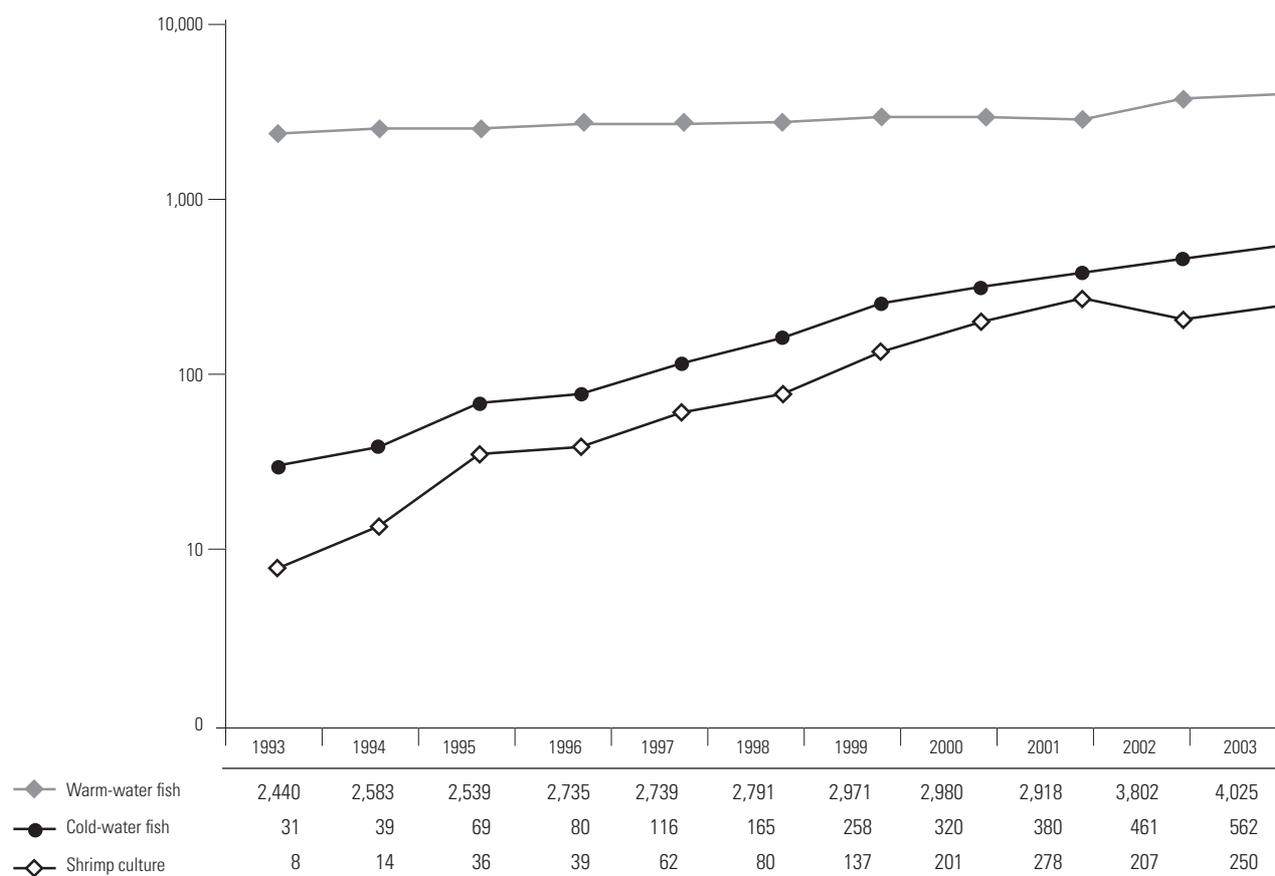


Fig. 4
Number of active aquaculture farms in Iran, 1993-2003

Fish stock enhancement

Fish fry, fingerlings and juvenile shrimp are produced under aquaculture conditions for stocking inland water bodies and the Persian Gulf, the Oman Sea and the Caspian Sea. This is to compensate for the losses resulting from fishing and to boost the existing fish and shrimp stocks. The following species were produced and stocked between 1993 and 2006:

- kutum (*Rutilus frisii*)
- sturgeons (great sturgeon [*Huso huso*], Persian sturgeon [*Acipenser persicus* Borodin 1897] and Russian sturgeon [*A. gueldenstaedtii* Brandt 1833])
- yellow fin seabream (*Acanthopagrus latus*)
- pike perch (*Stizostedion lucioperca*)
- several species of carp and shrimp (*Penaeus semisulcatus* and *P. indicus*).

Table I and Figure 5 show the number of fingerlings and juvenile shrimp that were released into inland waters, the Persian Gulf, the Oman Sea and the Caspian Sea between 1993 and 2006 by the Iran Fisheries Organization.

Shrimp culture

Iran enjoys the advantage of a 2,000 km of coastline in the south. An area of 16,000 ha has been identified there as suitable for shrimp culture. Shrimp culture operations in Iran started several years ago and their production has been increasing, reaching 5,970 MT in 2006. *Penaeus indicus*, a native species of Iran, is the main cultured species and it yields up to 2 MT/ha per year (5).

The extensive flat coastal regions and protected islands bordering the marine waters of the Persian Gulf and the Oman Sea in the south of the country have become, in recent years, areas for the farmed production of high-value marine shrimp for export and the specialist production of the pearl oyster. These are almost entirely private investments by licensed owners and operators (9). Total shrimp production increased from 15 MT in 1993 to 2,000 MT in 1999 (5).

Between 1992 and 1993, post larvae (PL) and broodstock of *P. monodon* were imported from other countries, but in recent years, native species (*P. indicus*, *P. merguensis* and *P. semisulcatus*) have been used for PL production (9). Post larvae production in 1993 was 10 million, but it had

Table I
Number of fingerlings and juvenile shrimp released for restocking in the Persian Gulf, the Oman Sea, the Caspian Sea and inland waters of Iran, 1993-2006 (× 1,000)

Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kutum	100,047	142,734	117,919	142,092	154,367	143,361	147,879	147,437	232,018	225,198	155,000	179,365	229,110	174,300
Sturgeon	4,176	6,295	9,125	12,456	21,626	24,557	18,857	18,279	19,970	19,642	20,000	21,121	9,940	13,800
Marine carp	0	0	0	0	6,500	23,939	9,022	32,000	17,863	7,608	2,000	0	340	3,200
Carp	0	0	0	0	0	0	0	0	0	0	0	36,996	8,980	0
Salmon	335	640	800	424	349	510	412	450	363	344	325	350	306	550
Bream	5,524	10,350	11,217	8,478	12,995	13,792	14,231	14,325	15,538	16,529	17,000	16,332	27,140	19,300
Perch	1,160	2,888	2,270	2,414	3,800	3,615	4,257	3,931	7,413	5,576	11,000	7,535	13,520	12,900
Roach	0	0	0	0	15,800	13,896	10,677	16,200	19,120	12,236	12,000	10,414	3,810	3,300
Barbus	0	0	0	0	0	0	300	700	2,040	150	1,930	800	1,680	400
Total fingerlings released	111,242	162,907	141,331	165,864	215,437	223,670	205,635	233,322	314,325	287,283	219,255	272,913	294,826	227,750
Total juvenile shrimp released					7,000	2,080	4,200	1,900	4,600	5,700	13,500	62,723	3,800	24,500

increased to 400 million by 1999. Native species of the Persian Gulf and Oman Sea that have significant economic value and have been selected for culture are as follows:

– *P. indicus* occurs in the waters of Hormozgan Province and the coasts of the Oman Sea. Because of its tolerance of different culture conditions, this species has been

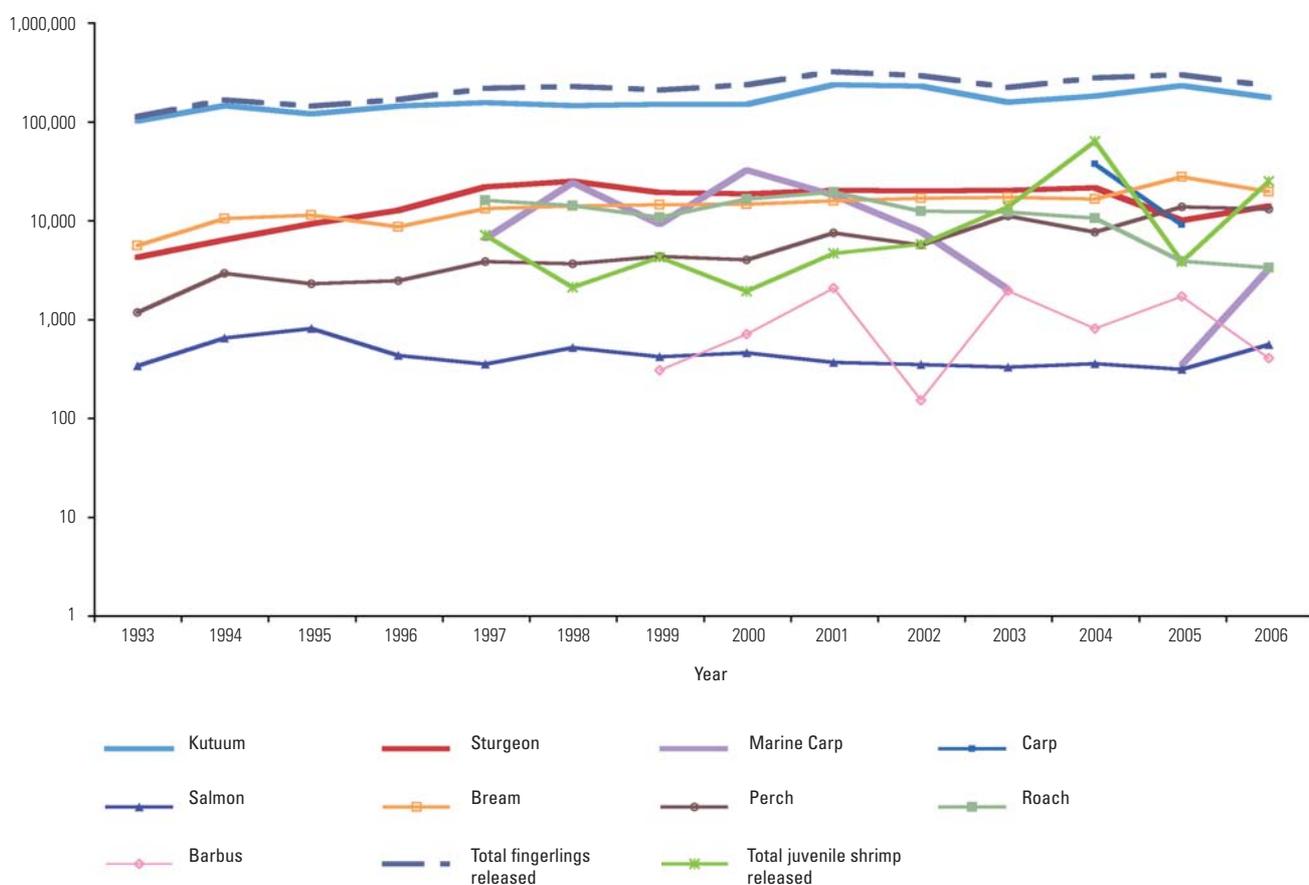


Fig. 5
Number of fingerlings and juvenile shrimp released for restocking, 1993-2006 (× 1,000)

considered the best species for culture in the provinces of Khouzestan, Hormozgan, and Sistan and Baluchestan

– *P. semisulcatus* mostly occurs and is abundant in the Persian Gulf, and its main habitats are the coastal waters of Bushehr Province, but this species is also used for shrimp culture in Khouzestan and Hormozgan provinces

– *P. merguensis* mostly occurs in the waters of Hormozgan Province, and is no longer considered for culture because of problems in providing broodstock and with reproduction.

White spot syndrome (WSS) occurred in 2001 and 2002 in the Choiebdeh area of Abadan City and the Helleh area of Boushehr City, causing a massive decline in shrimp production. In 2006, a new species of shrimp, *P. vannamei*, was introduced by the Iran Fisheries Research Organization (IFRO). After conducting farm trials which demonstrated that the species showed resistance against environmental stresses, it was considered a substitute for existing species and at present is cultured in two provinces already affected by WSS.

Although WSS caused great economic losses in 2001 and 2002, the disease has been controlled by the adoption of logical policies and the establishment of a surveillance system for shrimp cultures and hatchery centres.

Organisations and associations relevant to aquaculture in Iran

Governmental organisations

There are five organisations in Iran that are relevant to the aquaculture industry, most of which are state run. Four out of the five are affiliated to the Ministry of Jihad Agriculture; they are as follows:

- the IFRO
- the Iran Fisheries Organization
- the State Forest and Pasture Organization
- the Iran Veterinary Organization (IVO).

The fifth organisation is the State Environment Protection Organization, whose General Director acts as one of the deputy presidents of Iran, under the supervision of the President of the Republic of Iran.

The Iran Fisheries Organization is trying to develop aquaculture by using national and international standards. Some regulations, such as the Food and Agriculture Organization/World Health Organization Codex Alimentarius and standards for aquaculture production

have been made available to some private organisations for certified production. There are several institutes and research centres that are involved in developing the main principles of aquaculture in Iran:

– the IFRO and the Iran Fisheries Organization have responsibility for technical issues such as the location of production units, breeding, nutrition, harvesting, handling and distribution, and the refinement of the rules and regulations for aquaculture

– the Environment Conservation Organization of Iran has introduced some regulations to prevent certain activities having a negative impact on the environment (recirculation of waste waters, filtration of waste, environmental impact assessment, etc.)

– the IVO contributes to this programme by preparing sanitary and welfare rules and regulations

– organisations such as the Environment Organization and related research centres are involved in drafting rules pertaining to pollution and the environment and environmentally friendly organic farming activities

– the Forestry Organization is involved because destruction of forests for pond construction is prohibited

– the Veterinary Organization and the Health Ministry are responsible for transgenic strategies and gene manipulation.

Guidelines and codes of conduct are provided by related departments of the Iran Fisheries Organization (Development and Planning Office, Aquaculture Extension and Training Office and Fisheries Research Organization). The Environment Organization and the Energy (Water) Organization are involved for issues surrounding water supply for marine culture and for inland aquaculture, respectively. For feed production, the Fisheries Organization, Veterinary Organization, and the Ministry of Industries are involved. Animal diseases, hormones and drugs are dealt with by the Veterinary Organization, the latter because chemicals are prohibited for use in breeding and farming. Prevention of any harm or stress during rearing and harvesting is the responsibility of the Iran Fisheries Organization, the Veterinary Organization, and the Health Ministry.

There are also some plans and programmes for promoting warm-water fish farming (carp culture) with an emphasis on silver and grass carp, which feed on nutrients that are low in the food web; these plans are supported by the Iran Fisheries Organization. One of the most important goals of the Organization is finding and supplying new markets, and to meet the public's demand for organic products one of the main policies is the production and marketing of non-transgenic, disease-free products that are free of chemicals and pharmaceuticals (8).

Non-governmental organisations

The Iran Fisheries Organization plays an important role in the development of aquaculture and in determining the framework and policies of aquaculture in Iran. However, associations dealing with cold-water fish, warm-water fish, ornamental fish and shrimp raising all have a part to play in aquaculture in Iran.

Among the most prominent tasks of these associations are:

- supplying the required inputs for aquaculture, such as eyed eggs, larvae, fingerlings, breeders, aquatic feed, feed supplements, vitamins, etc.
- providing suitable plots of land and appropriate maps to establish new aquaculture farms, and arranging banking loans
- marketing fishery products
- training and upgrading members' technical knowledge
- establishing connections between members and creating appropriate relations with government-related bodies.

Aquatic animal health in Iran

Iran Veterinary Organization policies for controlling white spot syndrome

The first case of WSS was reported in 2001 in the Helleh area of Boushehr Province, coinciding with the time that this young and newly established shrimp culture was attracting the attention of many farmers. Upon confirmatory diagnosis of WSS by the IVO Central Laboratory, emergency status was declared and the infected area and the farms within it were put under constant quarantine. Given that WSS was an exotic disease that was occurring in the country for the first time, IVO developed a policy for quarantine, the stamping out of infected farms, disinfection, and fallowing for one year.

The occurrence of WSS in the Choeibdeh area of the city of Abadan, Khuzestan Province, revealed that virus in wildlife can be transmitted to farms via water and that this transmission was one of the most significant factors in disease occurrence.

Below are the most important measures that were taken in shrimp culture establishments and hatchery centres to avoid the re-occurrence of the disease in the country:

- carrying out surveillance for World Organisation for Animal Health (OIE) notifiable diseases in shrimp hatchery and culture centres
- commissioning and equipping four provincial laboratories and one reference laboratory in the region

- monitoring the implementation of quarantine measures, using reservoir ponds, inserting filters along water flow toward ponds, and installing fencing around ponds

- exploiting *P. vannamei*, which is resistant to environmental stresses and the species of choice in infected areas.

National policies for the prevention, control, eradication and surveillance of aquatic animal diseases

Not observing the principles of animal health and of the prevention of aquatic animal diseases while pursuing growth and development in aquaculture can jeopardize a country's aquaculture industry and impose heavy and irreparable losses. To avoid just such a situation the Office of Aquatic Animal Health and the Campaign against Aquatic Animal Diseases was upgraded to General Directorate level. Thirty-two new jobs were approved at IVO headquarters, and four to five for each of the thirty provinces throughout Iran. The responsibility for establishing an aquatic animal disease surveillance system lies with the IVO as state-run body; non-governmental organisations (NGOs) have not played an important role in the surveillance of aquatic diseases.

The General Directorate for Aquatic Animal Health and the Campaign against Aquatic Animal Diseases consists of four groups:

- the aquatic animal health group for the campaign against diseases of cold-water fish
- the aquatic animal health group for the campaign against diseases of warm-water fish
- the aquatic animal health group for the campaign against diseases of ornamental fish, marine fish and sturgeons
- the aquatic animal health group for the campaign against diseases of molluscs and crustaceans.

In addition to their multiple tasks concerning aquatic animal health and the campaign against aquatic diseases all over the country, each group is obliged to implement a surveillance system for relevant species.

The surveillance system in aquaculture and hatchery centres

The surveillance system is composed of three components: training, screening and reporting. Currently, the surveillance system is implemented in all hatcheries and in

all establishments producing warm-water fish, cold-water fish, sturgeons, ornamental fish and shrimp. It includes a series of continuous and comprehensive surveys of aquatic populations in order to trace back disease occurrences and to enable control and prevention through conducting special tests.

The surveillance system has the following objectives:

- to study the health status of aquatic animals in aquaculture and in hatchery centres, identify infected foci and assess changes in the level or distribution of disease
- to identify and eliminate infected broodstock from the production cycle and replace it with healthy broodstock for producing specific pathogen-free (SPF) and specific pathogen-resistant (SPR) aquatic animals
- to identify endemic diseases and include them in the surveillance system and adopt the necessary measures to prevent the introduction of exotic pathogens
- to oversee the production of larvae and hatched eggs that are free from egg-borne diseases
- to establish supervisory and quarantine systems for the transportation of aquatic animals in and from infected areas
- to carry out monitoring on a continuous basis to establish a biosecurity system for aquatic animals and through this to ensure food security for consumers
- to assist economic growth through improving production and enhancing productivity in the aquaculture industry through the campaign against diseases
- to assist in the protection of national aquatic resources in Iran.

Diseases under surveillance

The aquatic animal health surveillance system generally covers OIE notifiable diseases and a few nationally important diseases. The diseases covered by the surveillance system can be categorised into two groups: endemic diseases and exotic diseases, for which control and eradication policies, respectively, are implemented.

Surveillance system functioning

As mentioned earlier, the surveillance system consists of three parts, i.e. training, screening and reporting. Holding various meetings and workshops provides the required information for executors at the provincial level, which by extension is then transferred to aquatic farmers in the training part of the surveillance system. The relevant forms are prepared for regular reporting from all over the

country; reports are analysed and, if needed, further required action is taken accordingly. This constitutes the reporting component of the surveillance system.

Each of the aquaculture and hatchery centres is visited regularly and required samples are taken at least once a year, and screening tests are performed on the samples. In accordance with the OIE *Manual of Diagnostic Tests for Aquatic Animals* (the *Aquatic Manual*) (10) and assuming 2% disease prevalence, samples are taken from every given batch or population and sent for laboratory analysis. The tests are to be conducted according to the *Aquatic Manual* (11). If there are positive results in the screening test, temporary quarantine measures are put in place, followed by immediate confirmatory tests. Confirmed positive results are followed by stamping out or quarantine until the end of the culture period, depending on the disease and the adopted IVO policy. If confirmatory testing gives negative results, quarantine measures are lifted and the establishment returns to normal status.

Future plans for aquaculture

The aquaculture framework

The Ministry of Jihad Agriculture recognises the Iran Fisheries Organization as the body responsible for determining the framework for developing aquaculture in Iran. The following actions need to be carried out with assistance from other relevant bodies:

- identification and assessment of farm sites and control of farm construction
- reproduction and stock enhancement in the sea, with an emphasis on the mass production of fry and fingerlings used for pond culture and stocking of inland waters, including the Caspian Sea
- study of inland waters and aquaculture development for pond culture and inland waters
- nutrition and disease control in food preparation and the prevention and containment of disease
- development of the shrimp industry
- extension and training for farmers (2).

Policies and programme

Policies and plans for developing aquaculture in Iran follow the country development plan, which is laid out in a five-year planning framework. The fourth five-year plan, which started in 2005 and will end in 2009 aims to increase the production of cold-water fish, warm-water fish and shrimp to 60,361; 133,277 and 15,787 MT, respectively.

Conclusions

This paper shows that there has been significant growth within the aquaculture and fisheries sector in Iran. This growth has been the result of governmental decision-making and subsequent efforts in the private aquaculture sector. The most important aspects of the development of the aquaculture model in Iran, which could be applied in policy-making in other countries in the region, are as follows:

- proper exploitation of climatic diversity and access to water resources such as rivers, lakes, sea, etc.
- forming state organisations and NGOs and aligning the policies of these bodies and entities with plans for the development of aquaculture
- improving higher education instruction and increasing the number of graduates for disciplines related to aquatic animal health and diseases
- increasing per capita consumption of fishery products, establishing packaging and processing plants for fishery products
- training young, skilful staff and providing land, bank loans, etc., for establishing and developing aquatic animal rearing and multiplication centres
- ensuring the supply of the basic products that the industry requires in order to help increase production and exports, e.g. larvae, breeders, pharmaceuticals, biological products and feed supplements from abroad and improving export of fishery products.

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Les expériences nationales en matière de nouvelles productions aquacoles : l'exemple de l'aquaculture en Iran

M. Rajaby

Résumé

Si le caviar représente le plus important et réputé des produits de la pêche en Iran, depuis quelques années ce pays s'est lancé avec un certain succès dans de nouvelles productions piscicoles et aquacoles. En 2005, le volume de production iranienne dans ce secteur a atteint 522 000 tonnes métriques, dont 75 % issues des pêches et 25 % issues de l'aquaculture.

L'Iran a développé des activités diversifiées de pêche et d'aquaculture afin de répondre à la demande intérieure en produits aquacoles et de maintenir ses ressources naturelles marines et fluviales au niveau actuel (repeuplement des sources naturelles). Le développement de l'aquaculture en Iran s'est fait de la manière suivante (qui pourrait servir de modèle pour d'autres pays de la région ainsi que pour les pays en développement) : a) mise à profit optimale de la diversité climatique à travers l'exploitation de plusieurs espèces aquatiques ; b) création d'organisations gouvernementales et non gouvernementales dédiées à la culture des espèces aquatiques, planification de leurs activités et mise en place de partenariats appropriés entre ces organismes et institutions ; c) formation de personnels qualifiés et de spécialistes de la santé et des maladies des animaux aquatiques ; d) augmentation de la consommation des produits de la pêche à travers des campagnes de sensibilisation du public ; e) mise en place des conditions nécessaires à l'accroissement du taux de culture d'animaux aquatiques et au développement des exportations, notamment à travers la fourniture d'œufs embryonnés, de stocks de géniteurs, etc.

Mots-clés

Iran – Pêche – Produit de l'aquaculture – Santé des animaux aquatiques – Secteur aquacole – Structure de l'aquaculture.

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La experiencia de algunos países con las nuevas industrias acuícolas: el desarrollo de la acuicultura en Irán

M. Rajaby

Resumen

Aunque el caviar es el producto piscícola más famoso y valioso de Irán, en los últimos años el país ha adquirido gran experiencia y obtenido importantes éxitos con otros productos de la pesca y la acuicultura. La producción pesquera y acuícola iraní alcanzó 522.000 toneladas métricas en 2005, de las que un 75% correspondía a capturas pesqueras y un 25% a actividades de acuicultura.

En Irán hay varias actividades pesqueras y acuícolas que ayudan a satisfacer la demanda interna de productos de acuicultura y a la vez mantienen el nivel de los recursos naturales presentes en aguas marinas y fluviales (repoblación de las fuentes naturales). El desarrollo de la acuicultura en Irán (que podría servir de modelo para otros países de la región o países en desarrollo) reposa en los siguientes principios: a) aprovechar al máximo la diversidad de climas para criar diversas especies acuáticas; b) establecer las instituciones gubernamentales y no gubernamentales necesarias para criar animales acuáticos y planificar y forjar los vínculos adecuados entre todas ellas; c) formar a trabajadores cualificados y a especialistas en sanidad y enfermedades de los animales acuáticos; d) incrementar el consumo "per capita" de productos piscícolas sensibilizando a la opinión pública; y e) cumplir los requisitos para producir un mayor porcentaje de animales acuáticos de vivero y desarrollar la exportación de productos piscícolas, por ejemplo introduciendo huevos embrionados, piensos, ejemplares reproductores, etc.

Resumen

Irán – Pesca – Producto de la acuicultura – Programa general de acuicultura – Sanidad de los animales acuáticos – Sector de la acuicultura.



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