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Original Article

A SWOT analysis of aquaculture development in rural areas of Iran, an application to Rainbow Trout (*Oncorhynchus mykiss*)

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Abstract: In this study various important indices were selected to assess the sustainable aquaculture strategies in rural areas of Iran. In addition the government officials, consultants and managers were surveyed to assess the indices of aquaculture development. The strengths, weaknesses, opportunities and threats analyses were used to make a comprehensive evaluation on internal and external factors, participating the development of aquaculture strategies. The sum of the attractiveness scores from the Internal Factor Evaluation Matrix was approximately 2.55, being larger than 2.5, indicating that the strengths exceed the weaknesses. The sum of the External Factor Evaluation Matrix scores was 3.49, indicating that opportunities were higher than threats. This analysis showed that the development of aquaculture, promotion of new cold-water species production, productivity enhancement, establishment of hatchery facilities and formation of an effective support organization are the most important strategies that should be considered in the studied area. Results obtained on this research help decision makers on work of the aquaculture sector in rural areas of Iran.

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Introduction

In many areas rapidly growing populations have increased demand for expanded food production capabilities which, in turn, places pressure on environmental resources. Both terrestrial and aquatic environments have experienced severe degradation. Various post-1996 studies have suggested that fish species are threatened with extinction (Perman et al., 1996; Gilvear et al., 2002; Keith et al., 2004; United Nations Environment Programme, 2010). Despite threats to marine fish populations, capture fisheries continue to supply a large quantity of food to local and world markets. Aquaculture has increasingly become important in supplying fish and shellfish, and dominates all other animal food-production sectors in terms of growth rate. With an annual average growth rate of 8.9% since 1970, aquaculture had exceeded capture fisheries (1.4%) and terrestrial farmed meat production operations (2.8%) over the same period (Gopal Paul, 2013). Numerous fish species are used in small and large aquaculture operations. Some salmonids, such as rainbow trout (*Oncorhynchus mykiss*), are an oft-cultured fish because of their popularity as a food item and knowledge appropriate rearing methods (Johansen and Overturf, 2005; Larsen et al., 2012). Even though Iran, with a population of more than 70 million, is one of world's most populous countries, its aquatic meat consumption is only 7.32 kg per capita (Iran Fisheries Organization, 2012) which is very low compared to the rest of the world mean consumption rate of 17.2 kg (per capita food fish supply) Food and Agriculture Organization (2012). The primary objective of this research was to evaluate the current status of aquaculture farms in terms of its strengths, weaknesses, opportunities and

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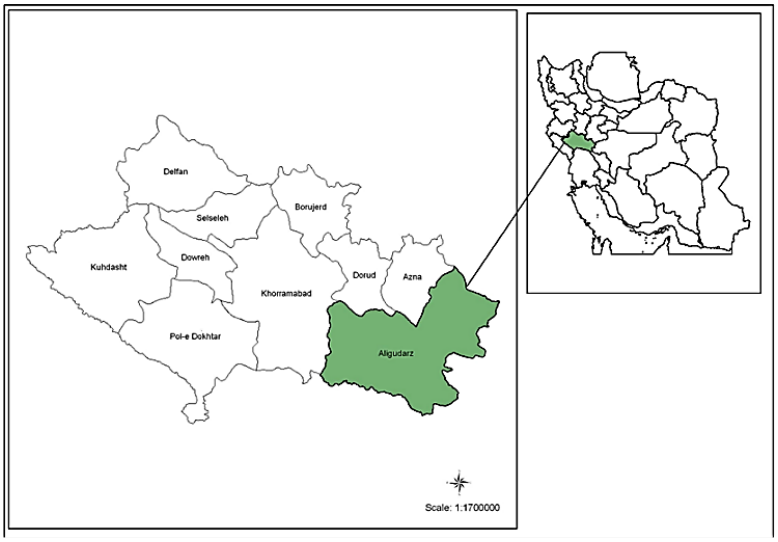

Figure 1. Sarab Gerdu area in Aligudarz city in Iran.

Figure 2. Raceways used for aquaculture in the area of Sarab Gerdu, Iran.

threats, (SWOT). In many organizations the internal strengths and weaknesses as well as the external opportunities and threats have been evaluated (Sarter et al., 2010). This study develops strategic planning for culturing of rainbow trout in a developing country such as Iran. In fact SWOT is a planning tool that is used to identify the major factors affecting the competitiveness and viability before creating a production strategy (British Columbia Ministry of Agriculture, Food and Fisheries, 2004). The SWOT analysis aimed to method was to identify the strengths and weaknesses of an organization and the opportunities and threats in the environment (Dyson, 2004; Chang and Huang, 2006). It is believed that SWOT is important for strategy formulation and development.

Material and Methods

Study area: The area of study is one of the most unstable tectonic plates in Iran, and is located between 46°50' to 50°01'N and 32°40' to 34°32'E (Fig. 1). The soil porosity is relatively high due to the presence of variously-sized sand (National Geoscience Database of Iran, 2007). The annual average maximum and minimum temperatures are 20.4°C and 7.6°C, respectively; annual average temperature is 14°C. Annual precipitation is 612.7 mm and the (annual) average number of sunny hours per month is 268 (Fig. 2). The number of cold (near or below freezing) days per year is 111 (Iran Management and Planning Organization, 2009).

Methods: In this research various important indices were selected to assess sustainable aquaculture strategies in rural areas of Iran. In addition, government officials, consultants and managers were surveyed to assess the indices of aquaculture development. This paper used SWOT analysis to make a comprehensive evaluation on strengths, weaknesses, opportunities and threats in the

Table 1. SWOT analysis of aquaculture in the Sarab Gerdu area

Strengths	Opportunities
1. Emphasis on aquatic protein consumption in the 4th five year economic, social and cultural development plans of the country. 2. Rural area development along with employment and economic prosperity. 3. Appropriate conditions for aquaculture practices. 4. Fish consumption effects on human health due to valuable foodstuff. 5. Availability of production factors such as labors, fish food production in the country, controlled and uncontrolled water resources. 6. Integrated agriculture aquaculture. 7. Food security; decrease of stress on the other food production resources like pastures. 8. Decrease of stress on the marine resources.	1. Standardization of cultured fish quality. 2. Promotion of productivity. 3. Support of culturing new species. 4. Decreasing food poverty due to valuable high caloric food production resources. 5. Availability of internal and external marketing 6. Marine ecosystem conservation through promotion of aquaculture. 7. Use of biotechnology with safety assessment such as risk assessment. 8. Possibility of aquaculture by-product processing industries establishment. 9. Presence of experts for aquatics hatchery and culture. 10. Possibility of endangered species culture. 11. Hatching possibility.
Weaknesses	**Threats**
1. Unavailability of waste water treatment system in the area of study. 2. Absence of electricity line in the area. 3. Damage to aquaculture race ways due to mud floods. 4. Unfavorable insurance coverage. 5. Absence of supportive rules and regulations. 6. Absence of hygienic supervising and quality control of foods production in relative industries. 7. Bad road conditions during snow fall periods. 8. Weak economic conditions prevail over aquaculture race ways. 9. High expenditures for transport of fish associated with cars equipped with refrigerator. 10. Abuse by middle-men for proper distribution. 11. Inconsistent fish price due to lack of storage facilities during different seasons. 12. Insufficient propaganda for consumption aquatics' foods.	1. Farms instability due to lack of ecological capability evaluation and environmental assessment. 2. Location of study area in earthquake zone. 3. Increase of fish food costs in total costs. 4. Incidence of fungi and bacterial diseases. 5. Native people misery in others' economical activities. 6. Aquaculture farmer have no information about new breeding and culturing methods. 7. No quality classification for food supplies that are used in fish feeding.

development of aquaculture strategies. The procedure is described in the following sections (Nikolaou and Evangelinos, 2010; Manteghi and Zohrabi, 2011).

Internal Factors Evaluation (IFE) matrix: Internal factors are consisted of strengths and weaknesses (Gallego-Ayala and Juízo, 2011; Zhao and Yan, 2012). Ten to twenty indices (strengths and weaknesses) that affect the productivity of management of rainbow trout raceways were selected. These indices were extracted from the review literature and interview with experts (Delphi method). All these factors were weighed using questionnaires and one variable statistical analysis (using SPSS software) so that the sum of the weights was equal to one. A score was calculated to each factor. These scores ranged from 1 to 4, with the following orders: 1-severe weakness, 2- common weakness, 3-common strength and 4-important strength. The chosen score was mode of the data obtained from questionnaires for each variable. The calculated weight of each factor was multiplied by the calculated score of the same factor to produce an attractiveness value, and all of the attractiveness values were added to each other. If the sum of all attractiveness values was less than 2.5, (mean of 1and 4) then it was concluded that weaknesses are more critical than strengths. The sums more than 2.5 indicated that strengths were the dominating weaknesses.

External Factors Evaluation (EFE) matrix: External factors consist of opportunities and threats. The steps used to complete the EFE matrix were parallel to those used to develop the IFE matrix.

Table 2. Internal Factors Evaluation Matrix of aquaculture in the area of Sarab Gerdu

Factor	Weight	Score	Attractiveness
Strengths			
2. Rural area development along with employment and economic prosperity.	0.02	4	0.08
3. Appropriate conditions for aquaculture practices.	0.07	4	0.28
4. Fish consumption effects on human health due to valuable foodstuff.	0.07	4	0.28
5. Availability of production factors such as labors, fish food production in the country, controlled and uncontrolled water resources.	0.06	4	0.24
6. Integrated agriculture aquaculture.	0.02	3	0.06
7. Food security; decrease of stress on the other food production resources like pastures.	0.04	4	0.16
8. Decrease of stress on the marine resources.	0.02	4	0.08
Weaknesses			
1. Unavailability of waste water treatment system in the area of study.	0.03	2	0.06
2. Absence of electricity line in the area.	0.03	2	0.06
3. Damage to aquaculture race ways due to mud floods.	0.10	1	0.10
4. Unfavorable insurance coverage.	0.02	2	0.04
5. Absence of supportive rules and regulations.	0.08	2	0.16
6. Absence of hygienic supervising and quality control of foods production in relative industries.	0.05	2	0.10
7. Bad road conditions during snow fall periods.	0.02	2	0.04
8. Weak economic conditions prevail over aquaculture race ways.	0.07	1	0.07
9. High expenditures for transport of fish associated with cars equipped with refrigerator.	0.06	2	0.12
10. Abuse by middle-men for proper distribution.	0.06	2	0.12
11. Inconsistent fish price due to lack of storage facilities during different seasons.	0.07	2	0.14
12. Insufficient propaganda for consumption aquatics foods.	0.04	2	0.08
Sum			2.55

Theory: SWOT, is an acronym presenting main components: Strengths, Weaknesses, Opportunities, and Threats (Glaister and Falshaw, 1999). In fact, SWOT is not an analysis but, like a tool, it can assist in efficiently performing an extensive analysis (Duarte et al., 2006). Data supporting the analysis are obtained from several channels including governmental reports, related laws and regulations, group meetings and literature reviews (Yuan, 2013).

Results

The IFE and EFE matrices for aquaculture in the Sarab Gerdu are shown in Table 1. Based on the governmental reports, related laws and regulations and questionnaire for each of the four analysis variables (strengths, weaknesses, opportunities and threats) several factors are listed, with weaknesses having the highest (12) and threats having the lowest (7). Scores for strengths were all 4, except #6, "Integrated agriculture aquaculture," which was scored as 3 (Table 2). Weakness scores were either 1 or 2. Scores for opportunities and threats had higher fluctuations (Table 3). Opportunity scores ranged from 2 to 4 while threat scores ranged from 1 to 4.

Discussion

The sum of the attractiveness scores in the IFE matrix was approximately 2.55, which was larger than 2.5 and showed strengths are more than threats. The EFE matrix sum of 3.49 was also more than 2.5, indicating that opportunities exceed possible threats. Consequently before establishing aquaculture facilities for commercial production it is appropriate to conduct an ecological impact assessment. To this end, an accurate estimation of available water resources and environmental impacts is very

Table 3. External Factors Evaluation Matrix of aquaculture in the area of Sarab Gerdu

Factor	Weight	Score	Attractiveness
Opportunities			
2. Promotion of productivity.	0.04	4	0.16
3. Support of culturing new species.	0.04	3	0.12
4. Decreasing food poverty due to valuable high caloric food production resources.	0.10	4	0.40
5. Availability of internal and external marketing.	0.08	4	0.32
6. Marine ecosystem conservation through promotion of aquaculture.	0.07	2	0.14
7. Use of biotechnology with safety assessment such as risk assessment.	0.07	4	0.28
8. Possibility of aquaculture by-product processing industries establishment.	0.05	3	0.15
9. Presence of experts for aquatics hatchery and culture.	0.05	4	0.20
10. Possibility of endangered species culture.	0.01	2	0.02
11. Hatching possibility.	0.10	4	0.40
Threats	0.10	4	0.40
2. Location of study area in earthquake zone.	0.01	1	0.01
3. Increase of fish food costs in total costs.	0.04	3	0.12
4. Incidence of fungi and bacterial diseases.	0.05	3	0.15
5. Native people misery in others' economical activities.	0.03	1	0.03
6. Aquaculture farmer have no information about new breeding and culturing methods.	0.04	4	0.16
7. No quality classification for food supplies that are used in fish feeding.	0.05	3	0.15
Sum			3.49

important (Smith and Liou, 2010). It is also vital to develop appropriate quality standards to promote purchase and use of aquaculture products by consumers. Establishment of an effective supportive organization can be useful to support aquaculture farmers, propose corrective measures towards more effective rules and regulations, furnish standard aquaculture raceways with a certification of quality, conduct educational training courses, reflect and verbalize to legal authorities and the difficulties faced by farmers, support the culturing of new species, and decrease shortages of food in rural areas. It is feasible and economically appropriate to use rural resources, including land and labor, to set up and run aquaculture facilities. Development of an aquaculture industry, using controlled and uncontrolled water resources and employing local expert residents, can decrease the stress placed on other resources. Integrating aquaculture with other agricultural practices in an area could potentially increase regional productivity although environmental impact assessment is necessary (Murshed-E-Jahan and Pemsl, 2011; Efole Ewoukem et al., 2012). Advanced biotechnology can be employed to develop species that are resistant to pathogens (Sabasinghe et al., 2007), thus decreasing the possibility of a significant stock that may destroy the production. This is in agreement with studies by other researchers (Johansen and Overturf, 2005). Establishing a waste water treatment system on the basis of environmental impact assessment is necessary (Lefrançois et al., 2010; Burridge et al., 2010). A steady and reliable supply of electricity is critical in order to maintain homeostasis within the culture system and thus prevent damage to stock. It is also necessary to prevent damage from mud floods through appropriate watershed management. Since roads are often blocked during the winter due to heavy snow fall, it is necessary to have an ample supply of drugs and food on hand. An important factor that would help makes aquaculture a commercial success would be the development of local markets, which would lower transportation costs for producers and

decrease costs. Direct sales to consumers would also eliminate the need for a separate distributor or "middle man" who would help keep costs low. Once local markets are developed, the need for refrigerator storage will also be minimized. Production of a new aquaculture species or variety and maintenance of an adequate and sustainable supply can encourage consumption of aquaculture products (BC Ministry of Agriculture, Food and Fisheries, 2004, Larsen et al., 2012) and also lead to the conservation of wild populations. It is not necessary to restrict aquaculture practices to rainbow trout many other species may be appropriate for culture and enhance the variety of products available to consumers. Generally, it is important to lower the costs of aquaculture foods and also to develop appropriate hygienic and quality control mechanisms. According to Philcox et al. (2010) many quantitative and qualitative methods are used to analyze management options related to aquaculture development. In the present study, to achieve the above goals, important strategies may be suggested. Strategies that must be considered within the study area in Iran are the development of an aquaculture industry, increasing production of a new cold water species (or variety of existing species) and conservation of endangered species, increasing productivity (Vilhelm Skov et al., 2011), establishment of hatchery facilities and establishment of an effective support organization.

Conclusion

The data used to evaluate the status of aquaculture in the area of study resulted showed in order to exploit its current status and maximize future strengths, the aquaculture system must use existing capabilities to utilize internal opportunities whenever possible, remove internal weaknesses, and avoid external threats.

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