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Full Length Research Paper

Analyzing biodiversity indicators in sustainable aquaculture development based on Iranian fisheries experts

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The purpose of this research was to assess the biodiversity indicators in sustainable aquaculture development based on Iranian fisheries experts. The research method employed was correlative-descriptive. The population consisted of fisheries experts in Khuzestan Province of Iran. A random sample of fisheries experts (n = 60) was selected. The questionnaire was developed to collect data. Content and face validity were established by a panel of experts. Questionnaire reliability was estimated by calculating Cronbach,'s alpha. Reliability of the overall instrument was estimated at 0.73. Data collected were analyzed using the statistical package for the social sciences (SPSS). Appropriate statistical procedures for description (frequencies, percent, means, and standard deviations) were used. Based on the results, different items were used for the assessment of biodiversity of sustainable aquaculture based on Iranian fisheries experts. For example, the situation of bio-security was between moderate and low level (Mean = 2.34, Standard deviation (SD) = 1.01). Linear regression was used to predict changes in fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture. Level of education, technical knowledge regarding sustainable agriculture, income, social participation, social status and job satisfaction may well explain the 56.2% changes (R^2 = 0.562) in fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture.

Key words: Bio-diversity, sustainable aquaculture, fisheries experts.

INTRODUCTION

By year 2050, the world will have an additional 2 billion people to feed. Since 1990, the global increases in fish production up to present-day levels have been achieved entirely through aquaculture production. Maintaining this growth in future will depend upon development and dissemination of specialized species and varieties adapted for low-cost pond culture and low protein diets (Pickering, 2011; Gemmell, 2001). A major challenge in the future is not only to adequately feed the burgeoning population of the world but also to improve the quality of life for those people living in poverty. To meet that challenge requires improvements in food security and in the economic status of many developing countries (Diana, 2009, p: 27).

Aquaculture is often seen as potentially having an effect on biodiversity through introduction of exotic species, escapes of selectively bred species or by impact on the wider environment through release of wastes. Both reproductive (genetic) and health (disease and parasites) aspects are associated with these issues. Conversely, carefully managed aquaculture may enable an increase in biodiversity of a particular area or ecosystem (Lane and Charles, 2005).

Internationally, there are conflicts between the need to produce more fish for food security through fisheries and aquaculture, and the potential effects of fisheries and aquaculture development on biodiversity. For example, international initiatives to protect aquatic biodiversity

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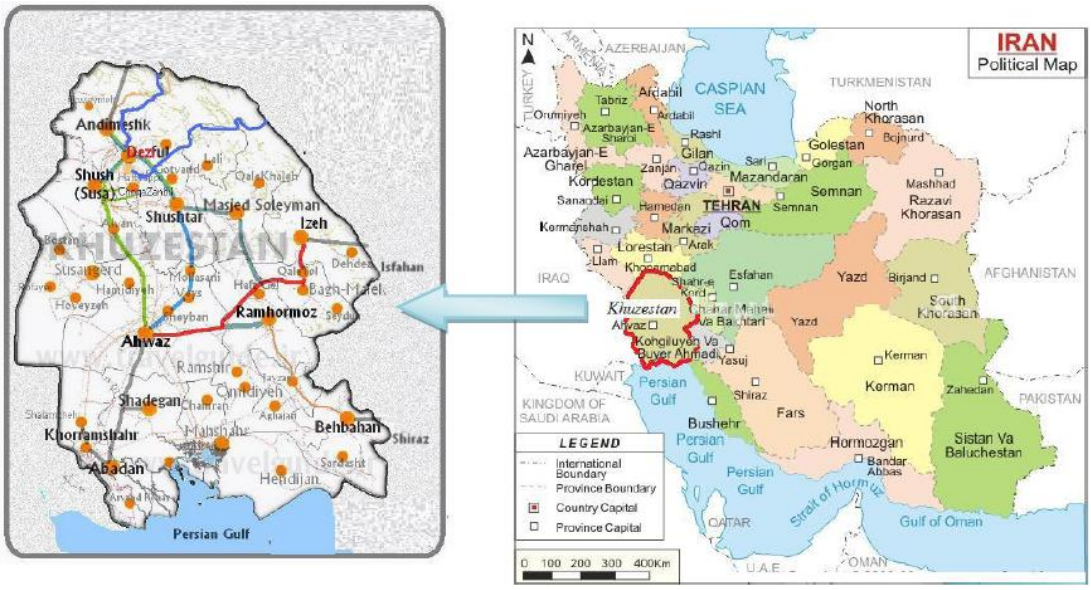

Figure 1. Site of study in South of Iran.

Table 1. Biodiversity of sustainable aquaculture based on Iranian fisheries experts.

Biodiversity	Mean	SD.	Cv.	Rank
Use of exotic species	2.98	1.02	0.342	5
Number of plant and animal species on the farm area	2.87	0.89	0.310	2
Establishment of polyculture operations	3.78	0.99	0.262	1
Bio-security	2.34	1.01	0.432	4
Negative impact of aquaculture on wild fish populations	3.01	0.94	0.312	3

1 = very low, 2 = low, 3 = Moderate, 4 = high, 5 = very high.

typically call for (i) reductions in the amount of fishing, and or (ii) only local species to be used for aquaculture. International initiatives to protect food security, on the other hand, call for (i) fisheries production to be sustained or increased, and (ii) use of the most efficient varieties for aquaculture (Pickering, 2011).

Biodiversity, a contraction of the phrase "biological diversity," is a complex topic, covering many aspects of biological variation. In popular usage, the word biodiversity is often used to describe all the species living in a particular area. Biodiversity has many interests, including conservation ecosystem function and protection of soil structure that provides a basis for agricultural production (Bynum, 2008).

METHODOLOGY

The research method employed was correlative-descriptive. The population consist of fisheries experts in Khuzestan Province of Iran (Figure 1). A random sample of fisheries experts (n = 60) was selected. The questionnaire was developed to collect data (Lazard et al, 2010; Lane and Charles, 2005). Content and face validity were established by a panel of experts. A pilot test was conducted. Questionnaire reliability was estimated by calculating Cronbach's alpha. Reliability for the overall instrument was estimated at 0.73. Data collected were analyzed using the Statistical Package for the Social Sciences (SPSS). Appropriate statistical procedures for description (frequencies, percent, means, and standard deviations) were used.

RESULTS

Different items were used for assessment of biodiversity of sustainable aquaculture based on Iranian fisheries experts. For example based on the results in Table 1, the situation of Bio-security was between moderate and low level (Mean = 2.34, SD = 1.01).

In this research, perception of fisheries experts with respect to biodiversity of sustainable aquaculture was measured by using a Likert-scale: (5) = Very Agree; (4) = Agree; (3) = Unsure; (2) = Disagree; (1) = Very Disagree

Table 2. Perception of Fisheries Experts regarding biodiversity indicators of sustainable aquaculture.

Item	Very agree (n)	Agree (n)	Unsure (n)	Disagree (n)	Very disagree (n)
Use of exotic species	24	22	13	1	0
Number of plant and animal species on the farm	18	12	15	12	3
Establishment of polyculture operations	19	25	9	4	3
Bio-security	25	18	10	6	2
Negative impact of aquaculture on wild fish	20	18	11	6	5

Scale: 5 = Very agree; 4 = Agree; 3 = Unsure; 2 = Disagree; 1 = Very disagree.

Table 3. Awareness with respect to sustainable aquaculture.

Item	Very high (n)	High (n)	Moderate (n)	Low (n)	Very low disagree (n)
Use of exotic species	12	11	15	12	10
Number of plant and animal species on the farm	11	9	10	16	14
Establishment of polyculture operations	10	8	18	14	10
Bio-security	6	9	12	23	10
Negative impact of aquaculture on wild fish	9	13	23	15	10

Table 4. Correlation between selected independent variables with fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture.

Variable	r[1]	P[2]
Level of education	0.732	0.000***
Social participation	0.539	0.000***
Income	0.648	0.000***
Age	0.028	0.61
Awareness with respect to sustainable aquaculture	0.777	0.000***
Job satisfaction	0.576	0.000***

*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$. 1: r = Correlation coefficient. 2: P= Probability

(Table 2). This research provides ranking of various items based on perception of fisheries experts with respect to biodiversity of sustainable aquaculture. Extension service training courses could be useful to teach fish farmers in this regard.

Also fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture was measured by using a Likert-scale: (5) very much; (4) much; (3) moderate; (2) little; (1) very little (Table 3). This research provides ranking of various items based on fisheries experts' awareness with respect to sustainable aquaculture. Extension service training courses could be useful to teach fish farmers in this regard. The relationship between some selected respondents' characteristics with perception of fisheries experts' regarding management of sustainable aquaculture is shown in Table 4.

There was a significant relationship between the levels of education, income, social participation, job satisfaction, awareness with respect to sustainable aquaculture with perception of fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture. The relationship between some selected respondents' characteristics with perception of fisheries experts' regarding management of sustainable aquaculture is shown in Table 5.

There was a significant relationship between the levels of education, income, social participation, job satisfaction, awareness with respect to sustainable aquaculture with perception of fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture.

Linear regression was used for predicting changes in fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture (Table 5). Level of education, technical knowledge regarding sustainable agriculture, income, social participation, social status, job satisfaction may well explain for 56.2% changes (R^2 = 0.562) in fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture. This

Table 5. Linear regression used for predicting changes in fisheries experts' awareness with respect to biodiversity indicators of sustainable aquaculture.

Variable	B[1]	SE B[2]	Beta[3]	T[4]	Tsig[5]
Level of education (x_1)	0.611	0.512	0.409	2.932	0.000
Technical knowledge regarding sustainable agriculture (x_2)	0.693	0.704	0.412	3.005	0.000
Income (x_3)	0.651	0.592	0.623	4.921	0.000
Social participation (x_4)	0.604	0.600	0.370	3.099	0.000
Social status (x_5)	0.612	0.590	0.486	4.541	0.000
Social status (x5)	0.612	0.590	0.486	4.541	0.000
Job satisfaction (x_6)	0.712	0.405	0.450	4.650	0.000
Constant	6.012	0.712	-	4.872	0.000

$F^6 = 12.091$, Signif $F^7 = 0.000$; $R^8 = 0.562$, $(R^2)^9 = 0.750$. [1]: Beta in the unstandarized coefficients are labeled "B"; [2]: Standard error of B; [3]: Beta or standardized coefficients refer to how many standard deviations a dependent variable will change, per standard deviation increase in the predictor variable; [4]: T test; [5]: Significant T test; [6]: F test; [7]: Significant F test; [8]: R is the multiple correlation coefficients which show the strength of the relationship between the dependent variable and the independent variable(s). It would be analogous to the correlation coefficient "r" which shows the strength between two variables; [9]: R^2 is of course the square of R and it gives the percent of variance in the dependent variable that is predictable from the independent variables.

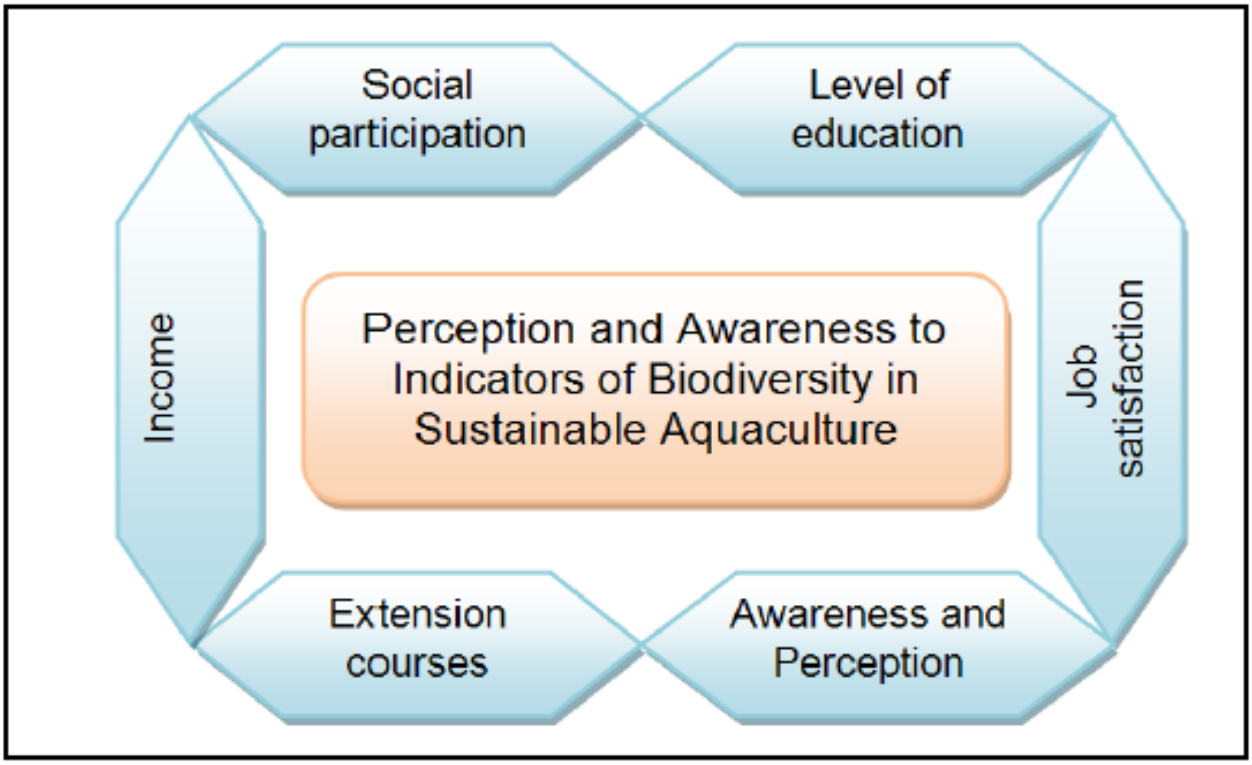

Figure 2. Filed Framework of Research (FFR).

relationship is described in the following formula:

$$Y = 6.012 + 0.611x_1\ 0.693\ x_2 + 0.651x_3 + 0.604x_4 + 0.712x_6$$

The results of correlation and regression were summarized by Filed Framework of Research (FFR) in Figure 2.

RECOMMENDATIONS AND EDUCATIONAL IMPORTANCE

This study has analyzed biodiversity of sustainable aquaculture based on Iranian fisheries experts. The study revealed that majority of the fisheries experts perceived that the level of biodiversity in aquaculture is moderate.

Based on the results of research on the level of technical knowledge and attitudes in biodiversity in aquaculture should be required to provide extension and education practices regarding development of biodiversity of the field.

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