

Full Length Research Paper

Disparities and influential factors to men's and women's involvement in freshwater aquaculture in Madagascar

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Received 10 August, 2019; Accepted 17 October, 2019

This research identifies the factors determining the individual decision to get involved in the aquaculture sector for both men and women through a case study in Madagascar. A rich body of scholarly literature shows that women play an important contribution in the aquaculture sector, particularly in South Asia and Africa. The literature shows that multiple factors, such as lack of access to assets and gender norms, hinder women's full participation. Data were collected through observations, interviews, and questionnaires in the northwestern part of Madagascar, where a Japan International Cooperation Agency (JICA) project was carried out to promote aquaculture. To reveal the difference between men's and women's involvement, the quantitative data on involvement variables were analyzed by the Mann-Whitney U test (U'), while hierarchical cluster analysis and random forest analysis were used to determine the factors influencing the involvement of men and women. This study confirms that men have higher involvement in aquaculture than women do. It suggests that decision-making power and gender norms prevalent in this region are the most influential factors that establish both men's and women's engagement in aquaculture.

Key words: Aquaculture, gender, involvement, roles, norms, factors, Madagascar.

INTRODUCTION

Aquaculture is the fastest-growing sector in the global economy. It contributes to poverty alleviation by improving the income and securing food (Subasinghe et al., 2009; Food and Agriculture Organization of the United Nations (FAO), 2005, Philips et al., 2016). Despite the increase in fish demand in Africa (Thurstan and Roberts, 2014), the productivity of this sector remains low (Subasinghe et al., 2009; Velu et al., 2009; Food and Agriculture Organization of the United Nations (FAO),

2005; Philips et al., 2016; Chan et al., 2019). Likewise, Madagascar, a southeastern African island, has an underdeveloped aquaculture, in freshwater in particular.

A wide body of literature has examined the significant contribution of women in aquaculture, particularly in Asia, Latin America, the Caribbean and Africa (Kusakabe, 2003; Food and Agriculture Organization of the United Nations (FAO), 2016, 2018) through their active involvement in the post-production nodes in the

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aquaculture value chain (Food and Agriculture Organization of the United Nations (FAO), 2016).

Despite their significant engagement, women particularly have more challenges compared to their male counterparts. The concept of gender is suggested to explain differences, hierarchies and divisions within society, between men and women (West et al., 2007). Gender is a globally used concept suggested to explain the expected roles assigned to men and women. Studies reveal the difference in involvement between men and women is primarily caused by the gender division of labor (Browne, 2002; Lambeth et al., 2002; Demmke, 2006). Evidence suggests that gender norms are the most important factors of the involvement in aquaculture especially women (Morgan et al., 2015).

There are a few studies on gender in aquaculture in Africa. In Madagascar, gender is gradually being integrated but not in the Fisheries and Aquaculture sector yet. Studies on gender in aquaculture are particularly scarce in the country. Aquaculture is generally considered as a male-dominated sector in Madagascar (Institut National de la Statistique (INSTAT), 2011). This research aims to reveal the enabling factors and obstacles that the females face when they aim to be involved in aquaculture by focusing on the gender norms in Madagascar.

METHODOLOGY

Study site

This study focuses on the three districts of the Boeny region located at the Northwest coast of Madagascar. The three districts comprises Marovoay, Ambato-boeny, and Mahajanga II. They were beneficiaries of a project on freshwater aquaculture development between 2011 and 2014 funded by a private entity named Japan International Cooperation Agency (JICA). Aquaculture is a secondary source of income in the region. Its productivity is comparatively less than marine aquaculture and fisheries. As of January 2014, 195 fish farmers, mainly men, were estimated.

Sampling and data collection

Firstly, field observations were conducted during the project implementation (2011-2014). Then in October 2016, qualitative and quantitative data were collected. By a snowball sampling method (Goodman, 1961), 31 men and 21 women from aquaculture households were interviewed. Respondents were asked about their demographic information, their involvement level, the factors of their involvement and their perceptions on gender norms on roles.

Data analysis

A general description was generated through the results of the qualitative data. R software version 3.4.4 was the tool used for quantitative analysis. To reveal the difference in involvement between men and women, Mann-Whitney U test (U) was conducted since the data was non-paired and non-parametric. The p -value was deemed at 0.05. After running the cluster analysis, random forest analysis (RFA) (Breiman, 2001) was independently

operated to determine the most influential variables of involvement. RFA, one of the machine learning techniques, is a method to generate a classifying model with certain number of groups, and it has the advantage of accuracy even for small-sized data. The most important variables to involvement were generated by the calculations of the Mean Decrease Gini (MDG) (Calle et al., 2011), the mean minimal depth and the p -value of each dependent variable. A variable is important when simultaneously presenting a high value of MDG, a low value of mean minimal depth and a p -value less than 0.01. At last, the negative/positive influence of the most important variables was reflected in the clusters.

RESULTS AND DISCUSSION

Characteristics of the respondents

Table 1 summarizes the characteristics of the respondents. Only one female respondent was a widow. Most of the women were having an elementary education and a higher rate of illiteracy (14.3%). Rice cultivation was found the main livelihood activity of the respondents. About 38% of women had house chores as their main job. Only six male respondents have aquaculture as their main income-generating livelihood. The sample of this study revealed that 83.9% of men and 47.6% of women attended training provided by the JICA project.

Difference in involvement in aquaculture

Men presented a significant involvement compared to women. Table 2 shows that men were more active in land preparation, pond management, feeding fish, harvest work, fish marketing, and decision-making roles. Women have no considerable involvement but partly involved. Moreover, the qualitative study adds the wider involvement of men such as working as trainers for other farmers or as teachers for students. These men were in close collaboration with the local extension staff and the JICA project. As aquaculture is a family business, women and children both partially play a supporting role as helpers or assistants to men. Women only become fully involved when their husbands are absent from home. Two male interviewees described how they were involved in aquaculture as follows:

My wife works as a teacher in an elementary school in Mahajanga II. She is also taking care of our children. We do not live together and she does not know anything either involved in this business at all. I am in charge of all livelihood activities of the house including aquaculture and rice cultivation (Male interviewee in Ambato-boeny district, October 2016).

I work every day for our farm ponds and I mainly decide on everything about their management. I also decide on agriculture but sometimes my wife has her opinions. My mother attended training from the project; however, my wife only supports me when I have worked elsewhere (Male interviewee in Mahajanga II, October 2016).

Table 1. Characteristics of the men and women respondents in aquaculture in the three districts.

Indicator	Variable	Men (%)	Women (%)
		n=31	n=21
Age (years)	15-24	6.5	9.5
	25-34	6.5	14.3
	35-44	41.9	23.8
	45-54	22.6	28.6
	55-64	16.1	14.3
	65-74	6.5	9.5
Aquaculture household category	Seed producers	35.5	33.3
	Grow-out fish farmers	64.5	66.7
District	Ambato-boeny	32.3	28.6
	Marovoay	35.5	38.1
	Mahajanga II	32.3	33.3
Marital status	Single	6.5	9.5
	Married	93.5	85.7
	Widow	0.0	4.8
Education attainment	Elementary	22.6	42.9
	Middle school	29.0	23.8
	High school	29.0	19.0
	University	9.7	0.0
	No education	9.7	14.3
Land ownership	Man	77.4	47.6
	Woman	6.5	23.8
	Parents in law	22.6	28.6
	Others	0.0	9.5
Main job	Agriculture	58.1	33.3
	Farming	16.1	9.5
	Aquaculture	19.4	4.8
	Shop	0.0	19.1
	Milling rice	3.2	0.0
	Household chores	0.0	38.1
	Others	25.8	14.3
Source of knowledge in aquaculture	Previous Japanese project	83.9	47.6
	Spouse	3.2	42.9
	Others	12.9	9.5

Men remain the dominant actor in the aquaculture business in the study site. In numerous cases in Asia and Africa, both men and women are involved in aquaculture (Kumar Barman, 2001; Thomas-Slayter and Sodikoff, 2001). In contrast of the finding of this study, women are active particularly in processing and marketing in Asia and West Africa (Brugere et al., 2001a; Kumar Barman, 2001; Velu et al., 2009; Weeratunge et al., 2010; Allison, 2011; Food and Agriculture Organization of the United Nations (FAO), 2016). This may be because the

aquaculture is yet being developed in the case of the Boeny region. The substitute role of women when their husbands are engaged in other businesses, such as rice cultivation, is often cited in the literature (Kumar Barman, 2001).

Factors of involvement

The cluster analysis suggested four clusters based on the

Table 2. The difference between men and women's involvement in aquaculture.

Parameter	Scale of involvement n=52 (m=31, f=21)		1	2	3	4	5	Mann-Whitney U value (p-value)	
Land preparation	Men	n	3	3	1	7	17	0.00	*
		%	9.68	9.68	3.23	22.58	54.84		
	Women	n	10	4	0	3	4		
		%	47.62	19.05	0.00	14.29	19.05		
Pond management	Men	n	2	0	2	5	22	0.00	*
		%	6.45	0.00	6.45	16.13	70.97		
	Women	n	5	6	1	6	3		
		%	23.81	28.57	4.76	28.57	14.29		
Feed preparation	Men	n	6	2	0	3	20	0.05	
		%	19.35	6.45	0.00	9.68	64.52		
	Women	n	4	0	2	10	5		
		%	19.05	0.00	9.52	47.62	23.81		
Cooking for hired workers	Men	n	29	0	1	0	1	0.16	
		%	93.55	0.00	3.23	0.00	3.23		
	Women	n	17	0	2	0	2		
		%	80.95	0.00	9.52	0.00	9.52		
Fish feeding	Men	n	3	3	2	4	19	0.01	*
		%	9.68	9.68	6.45	12.90	61.29		
	Women	n	4	2	2	9	4		
		%	19.05	9.52	9.52	42.86	19.05		
Harvest	Men	n	1	0	3	7	20	0.00	*
		%	3.23	0.00	9.68	22.58	64.52		
	Women	n	5	2	2	8	4		
		%	23.81	9.52	9.52	38.10	19.05		
Marketing	Men	n	5	3	1	5	17	0.00	*
		%	16.13	9.68	3.23	16.13	54.84		
	Women	n	10	3	1	2	5		
		%	47.62	14.29	4.76	9.52	23.81		
Frequency of working hours	Men	n	2	4	0	4	21	0.34	
		%	6.45	12.90	0.00	12.90	67.74		
	Women	n	0	3	2	4	11		
		%	0.00	14.29	9.52	19.05	52.38		
Decision-making role	Men	n	0	2	3	4	22	0.00	*
		%	0.00	6.45	9.68	12.90	70.97		
	Women	n	2	5	2	8	3		
		%	9.52	23.81	9.52	38.10	14.29		

*Significance level at $p\text{-value} < 0.05$.

involvement variables. Two clusters were focused on here: Cluster 1 as a male dominant group with high involvement and, cluster 4 composed by mainly women with the lowest involvement.

Figure 1 shows the most influential variables. Ten of

them were highlighted such as "type of mother", "type of jobs", "knowledge", "decision-making" power, the perception of "fish farming", "University" education, "Mahajanga II", "women work", "experience in aquaculture", and the "support" of the JICA project. The

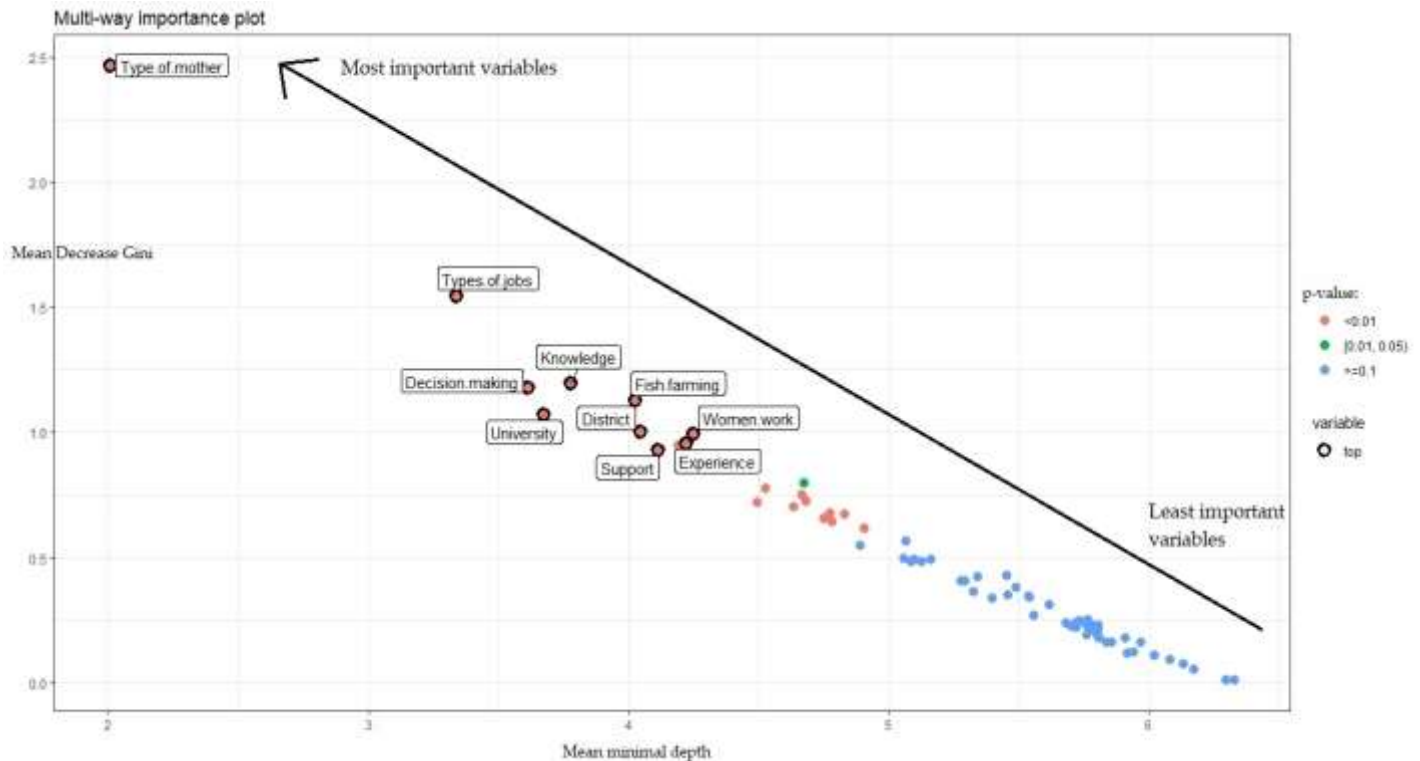


Figure 1. The measure of the influence of variables to involvement in aquaculture (x-axis as mean minimal depth, y-axis as Mean Decrease Gini (MDG) and z-axis as *p-value*). Dots represent the dependent variables. The arrow illustrates the level of importance of the variables from least to most important. The most important variables are located at the top left side of the figure (red dots with black outlined). They simultaneously showed a low mean minimal depth value, a high MDG value and a *p-value* < 0.01 . In contrast, at the right lower side of the figure, the least important variables were presenting a low MDG value, a high mean minimal depth and a *p-value* > 0.01 .

variables on “type of mother”, “type of job” and “women work” are about gender norms on roles.

Further analysis indicated that these important variables have different influence in clusters 1 and 4 (Table 3). Findings show that home duties and paid jobs are ideal characteristics of a mother. However, the typical jobs for men and women in the community negatively influence the involvement of women in aquaculture (cluster 4). Low-involved women were negatively influenced by their experience in aquaculture. Fish farming as a less time-consuming activity negatively influenced the involvement in both clusters. In contrast, the knowledge, the university degree, the district of Mahajanga II and the decision-making power at home present a positive influence on their involvement. Respondents in cluster 1 are surprisingly less influenced by the support from the JICA project. Besides, the qualitative result reveals monetary and non-monetary factors for both men and women. They consider aquaculture not just as means to gain additional income but also as a dream, love, hobby, for peace of mind, and for relaxation. In addition, men were also interested in improving the fish consumption of the household. They were very motivated by the support of the JICA project,

and have technical knowledge through trainings.

This study confirms that involvement is associated with gender norms. The perceptions of the norms of differentiation of men and women’s works and duties might explain the low involvement of the women. A strong relationship between norms and involvement has been reported in the literature. The normative roles of women importantly impede their involvement in aquaculture (Jahan et al., 2010; Samina et al., 2010) and in Nigeria (Fapohunda, 2005).

Fish-related activities in general, including the aquaculture, might be perceived as a male activity in the district because marine fisheries, which is a prosperous sector in Mahajanga II, is a male dominated industry (Boeny, 2016). The reason is why this specific district, aquaculture might be perceived as a male activity.

Unlike men, the lack of knowledge can lead to a low involvement for women. This finding corroborates with previous findings. Several works showed that restricted access to assets, particularly the lack of access to knowledge and training, constrains women’s involvement (Kumar Barman, 2001; Velu et al., 2009; Weeratunge et al., 2012; Ndanga et al., 2013). These restrictions are commanded by the norms, which also affect women’s

Table 3. Importance of the ten most influential variables (negative or positive influence) in the high involvement cluster (cluster 1) and the low involvement cluster (cluster 4).

Variable	Detail	Cluster 1	Cluster 4
Type of mother	A mother who stays at home and raises children is not the only ideal type of mother	+	+
Types of jobs	Women should enter into jobs traditionally held by men, those of pilot, engineer, taxi driver, and chef, diplomat, and mathematician	+	-
Women work	Women should work even if they are not in need	-	-
Fish farming	Fish farming is a less time-consuming activity than other major source of income	-	-
Knowledge	I have enough technical knowledge in aquaculture	+	+
Experience	I have enough experience in aquaculture	+	-
University	University education attainment	+	+
Support	I was supported, technically and/or financially, by the JICA project	-	+
Mahajanga II	The district of Mahajanga II	+	+
Decision- making	I have high decision-making power at home	+	+

mobility and responsibilities at home (Kusakabe, 2003; Seguino, 2007; Kantor et al., 2015; Morgan et al., 2015).

Education, mainly the university degree, significantly influences involvement. However, it is important to note that most of farmers in rural Madagascar only have an elementary education background. This result may be consistent with other authors' findings. The level of education affects the adoption of technologies in agricultural livelihoods (Osei-Adu et al., 2015). At this stage of aquaculture development in the study area, technical knowledge might be a more important factor than education.

Decision-making power as an important variable to involvement also matches those observed in earlier studies. For instance, in Bangladesh, men dominate the cage culture business by their decision-making power (Brugere et al., 2001b). Women are generally not privileged to decide. The lack of access to knowledge may affect women's decision-making power in Northeast Thailand (Kusakabe, 2003). However, as Morgan et al. (2016) suggested that decision-making power was not a constraint upon female household heads (Morgan et al., 2016) including widows.

Men expected money from aquaculture, whereas women expected poverty alleviation and food security for the household (Locke et al., 2017). The JICA project was initiated to improve the income of these farmers' households through aquaculture (PATIMA, 2011). As most of the farmers are men, they were encouraged on the monetary benefit of aquaculture. The non-monetary factors to involvement in aquaculture were not found in the literature. However, these types of factors might be related to the influence of norms. Norms may orient men to be involved in monetary activities (in agriculture) whereas women in non-monetary ones (in house care). Income from men might be more important (Viviana, 1989). These findings may help us to understand that the income-oriented business such as aquaculture may restrict women to be involved.

CONCLUSION AND RECOMMENDATIONS

The ten important variables influencing the involvement of men and women in this study were related to gender norms. Therefore, it was concluded that gender norms affect their involvement in aquaculture. The current norms allow both rural men and women in Madagascar to be involved in the aquaculture; however, they also determine the appropriate roles of men and women. The new finding on the non-monetary factor was also linked to its probable relationship to gender norms. Findings of this study are suggested to be useful for aquaculture development strategies and planning in Africa and in other islands. As both men and women are actors in development, both could contribute to aquaculture development, ultimately for sustaining their incomes and fish protein food. Suggestions can focus on the inclusion of women in training, introducing homestead technologies particularly for women and finding markets. To deepen the knowledge on the difference and inequality between men and women, social relations as an important feature of the structure of gender norms (West et al., 2007) warrant a particular study.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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