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Research Paper

The Impact of Financial Assistance on Income: The Case of Women Fish Vendors in North Coast of Java

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Abstract

Subsidising or extending credit for fishing often has negative impacts on fish stocks and does not improve the income of fishermen, but little research has been conducted on financial assistance to fishermen's wives (fisherwomen). Fisherwomen have a very important role in helping the family economy but often face problems due to the lack of financial capabilities. Most of the fisherwomen who run fisheries small scale businesses, such as selling fish in baskets in markets on the north coast of Java, obtain financial micro-credit assistance from cooperatives, rural banks or from middlemen. This paper analyses whether financial assistance in the form of micro-credit affects fisherwomen's income. By using regression analysis, the impact of different types of existing microcredit on recipients compared to non-recipients is analysed with respect to socio-economic variables on income, return on investment, and expenditure. An efficiency analysis using Data Envelopment Analysis (DEA) was carried out to determine whether fisherwomen who received financial assistance (micro-credit) would be more efficient in terms of using their inputs compared to those who did not receive credit. The units of analysis were groups of fisherwomen who received micro-credit and those who did not avail of micro-credit. The inputs were measured by cost of capital, working hours and micro-credit, while outputs were measured in total revenue. The paper also analyses the optimum amount of credit for the fisherwomen studied.

Introduction

In the social structure of Indonesian fisheries communities, women have an important role, mainly due to the characteristics of fishing as an economic activity. Under conditions where the husband's income as a fisherman typically is erratic, the main person who can help to maintain a family livelihood is a fisherman's wife (fisherwoman). Besides having obligations as wives and mothers in domestic roles, fisherwomen also have a productive economic role to meet the needs of the household. In most coastal areas in Indonesia, fisherwomen help maintain the viability of

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fishing families through domestic activities, as well as economic activities. Fisherwomen basically have social roles as "sovereigns of the land", while their husbands work at sea.

In Indonesia, the coastal communities, dominated mainly by small-scale fisheries economic activities, still have to grapple with the serious problems associated with poverty. The depletion and degradation of coastal and marine resources has also had an impact on poverty. Some coastal areas in Indonesia have experienced severe over capacity in fishing, especially the Malacca Straits, Java Sea, Makasar Sea, and Bali Strait (Squires et al. 2003; Anna 2003). Even the northern coastal area of Java has fishing capacity that is 35% in excess of the optimal capacity (Fauzi and Anna 2012). Moreover, climate change has exacerbated the economic conditions of coastal communities in Indonesia (Fauzi and Anna 2010). This has been validated by the fact that some areas in the north coast of Java such as Tegal, Pekalongan and Semarang are the most vulnerable to inundation from sea water and sea level rise, locally known as flood or *rob*. The *rob* which has become more frequent over the years (50 cm rise due to sea level rise and land subsidence over the past 12 years in Semarang), has caused a drastic decline in the ability of fishermen to go fishing, resulting in their lower productivity (Diposaptono et al. 2009). The *rob* has also caused enormous losses of coastal infrastructure, including damaging fishermen's housing. Unfavorable economic conditions have encouraged fisherwomen to contribute to meet the needs of their families by resorting to economic activity. One of the economic activities that has been found to be promising for fisherwomen on the northern coast of Java is selling fresh fish in baskets. One important variable in running such businesses, and which often becomes an obstacle for fisherwomen, is the availability of finance. The need for capital is mostly met from small credit cooperatives, rural banks and middlemen.

Studies on the impact of micro-credit assistance to fishermen's economic performance, have been widely carried out, and found to be associated with productivity (McElroy 1991; FAO 1998; Millazo 1998; Munro and Sumaila 2002; Hempel and Pauly 2002). Almost all studies have indicated that micro-credit assistance to fishermen reduced operating costs and increased profits in the short run, and there was a natural tendency to increase effort resulting in over-capacity, leading to decline in per unit fish production in the long run. Studies have also revealed that direct subsidies are not very effective in combating poverty in fisheries or increasing production (Hempel and Pauly 2002; Bailey 1988). Mc Elroy (1991), noted that subsidy programs in the form of motorisation in the Java Sea fisheries had led to decreasing the long term catch per unit effort during the period from 1980 to 1990. Mc Elroy (1991) also observed that the effort (measured in number of trips) of the pelagic fisheries in Pekalongan was escalating. Fishers had to go further for fishing and increasing costs defeated the very purpose of the subsidy. Similar findings were found in Lombok, West Nusa Tenggara, where unsustained credit assistance provided by foreign NGOs such as Hivos and the German Agency for International Co-operation (GIZ) had no long term impact on the production and income of fishermen (Koreuber 1991).

However, research on the impact of financial aid for fisherwomen has not been widely looked into. Available studies are mostly related to the performance of loan repayments and also the impact of micro-credit loans on income and empowerment. Studies of Jayaraman (2008) in India showed that contrary to the common belief, poor women were credit worthy, honest and

most importantly 'bankable'. The study showed that the Fisherwomen's Self Help Groups (SHGs), a potential tool for rural development through micro-credit, did play a positive role in helping the fisher folk in their socio-economic development, emancipation and empowerment. The study by Suman (2007) indicated that women who use microcredit tended to even repay seriously delinquent loans if the frequency of women's group meetings were increased, because they could not bear the shame of a delinquent debt. Karmakar et al. (2009) suggested that micro-credit had an impact on fisherwomen's benefits by helping them in acquiring assets of their own, increasing their social status and decision making role within the family. The study also found that the income of the fisherwomen had actually risen from 2.8% to 12.2%, and microcredit programs encouraged women to attend meetings and this helped build their confidence, allowing them to handle money and become financial managers. Gopal et al. (2012), observed that micro-credit increased the income of fishermen and fisherwomen. The study revealed that they had renovated their houses, such as building toilets, and added household items such as refrigerators and furniture. The credit may not have been used entirely for production purposes and there was a possibility of it being diverted for household expenditure. Gopal et al. (2012) also stated that micro-credit had increased the social status of fisherwomen. Furthermore, Kabeer (2001) found that every 1% increase in loans to women micro-credit recipients of the Grameen Bank increased the probability of school enrolment by 1.9% for girls and 2.4% for boys.

Kabeer (2005) however observed that though financial assistance could make vital contributions to the economic productivity and social well-being of poor women and their households, it did not automatically empower women, because it does not bring about the radical structural transformation that true empowerment entails. Although micro-credit has the potential of empowering women, the connection is not always straight forward or easy to make (Kulkarni 2011).

While micro-credit for women may be beneficial in improving their living conditions, it is useful in helping them to efficiently carry out their businesses? From some of the studies reported above, the answer is still mostly qualitative. This paper will outline a more quantitative analysis of the impact of micro-credit on earnings and business economic efficiency using regression analysis and Data Envelopment Analysis (DEA). It also incorporates the assessment of different types of financial assistance provided by local private institutions and cooperatives. This is an aspect which has not been dealt with by various studies. The study also analysed the impact of credit assistance on the expenditure patterns of the fisherwomen, as it has long been of concern that the credit received is often used for daily household expenditure. The optimal credit requirement by applying efficiency analysis is also attempted.

Methods

This study was carried out in four steps. Firstly a qualitative approach was used to assess implementation regarding types of financial assistance or micro-credit for fisherwomen in Indonesia and how it is applied. Secondly, a quantitative approach by means of regression analysis was used to assess the effect of financial assistance (the local Rural Bank, cooperatives, and middlemen) on productivity of fisherwomen in comparison with those who did not get financial

assistance. Thirdly, efficiency analysis was carried out using Data Envelopment Analysis, to analyse the impact of financial assistance on the efficiency of the businesses. In the final part, policy implications of this analysis is spelt out.

Quantitative assessment based on regression analysis was carried out as follows. It was assumed that fisherwomen's income (rent) and Return on Investment (ROI) are functions of several socio economic variables including age, education, experience, working hours and financial assistance received. The role of financial assistance was captured using a dummy variable; D=1 if fisherwomen received financial assistance from different sources like a cooperative, middleman or rural bank and D=0 otherwise. Therefore, the general form of the function of this model is as follows:

$$y = f(age, education, experience, work\ hours, dummy\_ financial\ assistance) \quad \text{(eq. 1)}$$

The specific functions of this model are written in semi log regression model form, to capture the elasticity factor, i.e., unit of change in independent variable affects a percentage change in the dependent variable. The model then is written as:

$$\ln y = \alpha_0 + \alpha_1 age + \alpha_2\, education + \alpha_3 experience + \alpha_4 work\ hour + \ldots\ldots\ldots\ldots + \alpha_n D + \varepsilon \quad \text{(eq.2)}$$

Furthermore, the study also analysed the impact of socio economic variables and dummy variable of micro-credit on the performance of fisherwomen's household expenditure. The model is written as:

$$\ln E = \alpha_0 + \alpha_1 age + \alpha_2 education + \alpha_3 experience + \alpha_4 work\ hour + \alpha_5 Income + .. + \alpha_n D + \varepsilon \quad \text{(eq.3)}$$

In order to capture the effect of micro-credit and socio-economic variables, a similar regression was carried out. The level of credit is measured by the amount of money the fisherwomen received as financial assistance. This model differs with the previous one in that it uses credit as a dummy variable. Upon regressing the dependent variables such as ROI and income (y) over these quantitative and dummy dependent variables such as age, education and micro-credit, the individual elasticities were tested for their significance. The equation can be written as follows:

$$\ln y = \alpha_0 + \alpha_1 (age) + \alpha_2 (education) + \alpha_3 (experience) + \alpha 4 (work\ hour) + \alpha 5 (micro\text{-}credit) \quad \text{(eq.4)}$$

Quantitative assessment was also carried out to assess the level of economic efficiencies among fisherwomen (those who received financial assistance and those who do not). In doing so, an efficiency analysis was carried out using Banxia software for estimating frontiers by DEA. DEA is a Linear Programming based technique for evaluating the relative efficiency of Decision Making Units (DMU's). DEA is based on a non-parametric mathematical programming approach to frontier estimation, and needs relatively little technical detail (Seiford & Thrall 1990; Lovell 1993; Ali & Seiford 1993; Charnes et al. 1995; Seiford 1996). The DEA approach is used to estimate the efficiency scores of the DMU, (in this case the micro-credit group) based on Charnes, Cooper, Rhodes (CCR) constant return to scale model (Charnes et al. 1978). The CCR model is

applied because it is more suitable than the Banker, Charnes, Cooper (BCC) (variable return to scale) model and most studies in finance institutions are based on the input oriented constant return to scale model (Charnes et al. 1978 in Nawaz 2010). If the DMU_j has some inputs $x_{i,j}$ and outputs y_k, a relative efficiency measure is defined by:

$$Efficiency = \frac{\sum_k u_k y_k}{\sum_i v_i x_{i,j}} \qquad \text{(Eq. 5)}$$

where *u* and *v* are weights parameter for input x and output y, respectively. The optimisation problem for the equation is:

$$\max \theta_0 = \frac{\sum_k u_k y_{k,jo}}{\sum_i v_i x_{i,jo}}$$
$$\text{subject to } \frac{\sum_k u_k y_{k,j}}{\sum_i v_i x_{i,j}} \le 1 \forall_j$$
$$u_k, v_i \ge 0 \qquad \text{(Eq. 6)}$$

Description of studies

This study was carried out using cross-sectional data of fisherwomen who run small-scale business (selling fish in baskets), in the northern coast of central Java. Two fishing locations in the region were chosen, namely, Pekalongan and Tegal. These small scale fisherwomen are those who sell small pelagic fish like trevally, scad, tuna, mackerel, barramundi, anchovies, etc. in baskets. Financial assistance from government initiatives as well as private and individual financiers/middlemen is available to both fishermen and fisherwomen in both these coastal areas. In addition to the in-depth questionnaire, data were also obtained by focus group discussion.

Four groups of fisherwomen, who are selling fish in baskets, were selected. The first groups was the control group, namely fisherwomen who do not receive any financial assistance or in other words, fund their own business and capital investment. The second group is those fisherwomen who received financial support through micro-credit schemes channeled through the Rural Bank, the local private banking institution that channels micro-credit into small enterprises such as those in the fisheries sector. The third group was fisherwomen who received financial support from cooperatives. And the fourth group was that of the fisherwomen who received financial assistance from middlemen. The respondents were selected by purposive sampling, based on data from the local marine and fisheries office. The sample was determined using formula from Issac and Michael (1981), with 5% precision. For every group, the number of respondents are equal. In total 80 respondents were selected from the population of 257 fisherwomen fish sellers in Pekalongan city and 200 in Tegal city. The descriptive statistics of the samples from both area are provided in Table 1.

Respondents surveyed from the two study sites were aged between 23 years to 69 years, with an average education of 6 years equivalent of primary school. Their working experience was 9 years on average, and the average hours spent in fish marketing was 5.5 hours per day. Regarding the respondents' marital status, 68 were married, 3 were single and 11 were divorced. The married respondents who borrowed micro-credit revealed that the decision of borrowing micro-credit was as per their husbands' approval. The average income of respondents ranged from 630 thousand Rupiahs to 5.63 million Rupiahs per month, the cost of capital (capital to buy fish for sale per month) ranged from 0.7 million Rupiahs to 5.5 million Rupiahs, while their household expenditure ranged from 1.1 million to 6.63 million Rupiahs per month. The amount of micro-credit ranged from 1 million to 5.5 million Rupiahs for a period of one year mortgage loan. The Return on Investment (ROI) ranged from 32.4% to 95.7%.

Table1. Descriptive statistics of socio-economic variables (Pekalongan and Tegal).

Variable	Non-recipient				Rural bank				Cooperative				Middlemen			
	Mean	**Min.**	**Max.**	**SD**	**Mean**	**Min.**	**Max.**	**SD**	**Mean**	**Min.**	**Max.**	**SD**	**Mean**	**Min.**	**Max.**	**SD**
Age	37.61	23.00	52.00	9.61	39.29	23.00	65.00	13.15	37.85	23.00	69.00	12.35	38.08	24.00	62.00	11.33
Education	6.45	1.00	12.00	2.54	5.00	1.00	9.00	2.83	6.75	1.00	12.00	3.45	5.67	1.00	9.00	2.46
Experience	9.58	4.00	17.00	3.31	8.36	5.00	20.00	4.40	10.90	4.00	30.00	6.60	7.75	5.00	12.00	3.22
Work Hours per day	5.70	4.00	7.00	0.65	5.29	4.00	6.00	0.73	5.40	4.00	7.00	0.82	5.58	5.00	6.00	0.51
Income (Million Rupiah) per month	2.04	0.63	5.63	1.33	1.14	0.61	2.10	0.52	2.21	0.98	4.35	1.03	0.66	0.59	1.05	0.13
Cost of capital per month (Million Rupiah)	2.44	0.80	5.50	1.71	1.37	1.00	2.00	0.39	2.41	1.20	5.50	1.29	0.95	0.70	1.25	0.15
Expenditure per month (Million Rupiah)	2.71	1.38	6.63	1.25	2.06	1.11	3.10	0.60	2.97	1.73	4.75	0.95	1.66	1.35	1.93	0.20
Amount of Micro-Credit (Million Rupiah)	-	-	-	-	1.55	1.00	2.00	0.30	2.41	1.20	5.50	1.29	1.40	1.00	1.50	0.17
ROI	71.86	38.75	112.50	20.80	68.04	32.40	95.67	19.34	83.94	49.76	115.6	16.15	49.64	38.75	68.00	10.85

Results and Discussion

The regression was carried out using dependent variables which included income (economic rent), returns on investment as well as expenditure. The explanatory variables were age, years of education, experience of fisherwomen in the fish selling business, and the dummy variable (D=1 if fisherwomen receive financial assistance or micro-credit D=0 otherwise). Partial regression coefficients were tested in the log-linear form of the model. The following Table presents the general (overall) model for the purpose of model comparison. The general model for model 1 with income as an independent variable is:

$$\ln Y = 12.8 - 0.00047x_1 + 0.0815x_2 + 0.0361x_3 - 0.0313x_4 + 0.505D_1 + 0.912D_2 + 0.743D_3$$

While for model 2, the general model is:

$$\ln Y = -0.29 - 0.00105x_1 + 0.0080x_2 + 0.0034x_3 - 0.0975x_4 + 0.266D_1 + 0.490D_2 + 0.503D_3$$

And for model 3, the general model is:

$$\ln Y = 13.7 - 0.0086x_1 + 0.0569x_2 + 0.007x_3 - 0.0422x_4 + 0.00000022x_5 + 0.0847D_1 + 0.106D_2 + 0.037D_3$$

Table 2. Regression results for all models.

Variable	Model 1 (Y=ln*income*)		Model 2 (Y=ln*ROI*)		Model 3 (Y=ln*expenditure*)	
	Coef.	p-value	Coef.	p-value	Coef.	p-value
Constant	12.8	0.000	-0.29	0.422	13.7	0.000
Age (x_1)	-0.000473	0.957	0.001052	0.804	0.00863	0.010*
Education (x_2)	0.08154	0.026*	0.00795	0.643	0.0569	0.000*
Experience (x_3)	0.03611	0.029*	0.003418	0.659	0.00733	0.236
Work Hours (x_4)	-0.03130	0.737	-0.09745	0.032*	- 0.0422	0.222
Income (x_5)	-	-	-	-	0.00000022	0.000*
Rural Bank (D_1)	0.5046	0.011*	0.26553	0.005*	0.08472	0.243
Cooperative (D_2)	0.9122	0.000*	0.49087	0.000*	0.10564	0.166
Non-recipient(D_3)	0.7427	0.000*	0.50275	0.000*	0.03739	0.611
R^2	50.3 %		48.6%		79.6%	
Adj R^2	44.5 %		42.6%		76.9%	
$F_{statistic}$	8.67		8.11		28.81	
Prob ($F_{statistic}$)	0.000		0.000		0.000	
$DW_{statistic}$	1.58		1.94		1.64	

* Significant at the interval confidence 95 %.

As can be seen from Table 2, the model with expenditure as dependent variable performed better than those with income and Return of Investment (ROI). The model indicated that 77 % of the variation in revenue could be explained by the socio-economic variables, including financial assistance. On the other hand, even though the model with income as dependent variable performed seemingly well, the explanatory variables only accounted for 50% of the variation of income.

From Table 2 it can be seen that for model one, the explanatory variables that significantly affected the natural logarithm of income at the level of significance of 5% (or 95% level of confidence), were education, experience, Rural Bank, Cooperative and non-recipient dummy. Age and work hours did not significantly affect the income of fisherwomen. It can also be inferred that the increase of one year in education could increase the income by 8%, while the increase of one year in experience could increase income by 3%. For the dummy variable 'micro-credit', the coefficient of Rural Bank is 0.505 which means that the income of fisherwomen who availed of micro-credit from Rural Bank was 1.66 times higher than that of those who took micro-credit from middlemen. The income of fisherwomen who had availed of micro-credit from cooperatives was

2.49 times higher than that of those taking micro-credit from middlemen. The non-recipient fisherwomen had an income 2.10 times higher than those who had taken credit from middlemen. In the case of loans from middlemen, probably the high cost of credit effectively reduced the fisherwomen's income. Compared to cooperative borrowers and non-recipients, the Rural Bank borrowers had lower incomes, by 0.665 times and 0.788 times respectively. While compared to non-recipients, cooperative borrowers performed better with income 1.19 times that of the non-recipients. The model with ROI as the dependent variable had an R^2 of only 48.6%. The model for each type of micro-credit presented in Table 3.

From model one it can be concluded then that cooperative micro-credit for fisherwomen provides the best income. The reason for this performance is that cooperative micro-credit has more conventional mortgage interest levels compared to other micro-credit schemes. Interest for the Rural Bank, Cooperative, and middlemen were 8%, 12%, and 60% respectively. Besides, fisherwomen who borrowed finance from Cooperatives were members of the Cooperative and as such had more advantages than others, i.e. they often have the opportunity to get education and training in the field of entrepreneurship. They also had more opportunities to exchange information about their business in Traders' Cooperative meetings, so that they can run their businesses better.

Table 3. Models for micro-credit using income, ROI and expenditure as dependent variable.

Model	Micro credit	Equation
Model 1 (*y*=ln*income*)	**Rural Bank**	$\ln Y = 13.30 - 0.00047x_1 + 0.0815x_2 + 0.0361x_3 - 0.0313x_4$
	Cooperative	$\ln Y = 13.71 - 0.00047x_1 + 0.0815x_2 + 0.0361x_3 - 0.0313x_4$
	Non Recipient	$\ln Y = 13.54 - 0.00047x_1 + 0.0815x_2 + 0.0361x_3 - 0.0313x_4$
	Middlemen	$\ln Y = 12.8 - 0.00047x_1 + 0.0815x_2 + 0.0361x_3 - 0.0313x_4$
Model 2 (*y*=ln*ROI*)	**Rural Bank**	$\ln Y = 0.02 + 0.00105x_1 + 0.0080x_2 + 0.00342x_3 - 0.0975x_4$
	Cooperative	$\ln Y = 0.20 + 0.00105x_1 + 0.0080x_2 + 0.00342x_3 - 0.0975x_4$
	Non Recipient	$\ln Y = 0.21 + 0.00105x_1 + 0.0080x_2 + 0.00342x_3 - 0.0975x_4$
	Middlemen	$\ln Y = -0.29 + 0.00105x_1 + 0.0080x_2 + 0.00342x_3 - 0.0975x_4$
Model 3 (*y*=ln*Expenditure*)	**Rural Bank**	$\ln Y = 13.78 + 0.00863x_1 + 0.0569x_2 + 0.00733x_3 - 0.0422x_4 + 0.00000022x_5$
	Cooperative	$\ln Y = 13.81 + 0.00863x_1 + 0.0569x_2 + 0.00733x_3 - 0.0422x_4 + 0.00000022x_5$
	Non Recipient	$\ln Y = 13.74 + 0.00863x_1 + 0.0569x_2 + 0.00733x_3 - 0.0422x_4 + 0.00000022x_5$
	Middlemen	$\ln Y = 13.7 + 0.00863x_1 + 0.0569x_2 + 0.00733x_3 - 0.0422x_4 + 0.00000022x_5$

Age(x_1), education(x_2), experience(x_3), work hours(x_4), income (x_5)

For model two, the variables that affected ROI at 5% level of significance were working hours, and the dummy variables viz. Rural Bank, Cooperative and non-recipient. The variables age, education and experience did not affect ROI. From the coefficient for working hours, it can be seen that if the working hours increased by 1 hour, then the ROI would decrease by 9%. Compared to the other dummy variables for Cooperative, middlemen and non-recipient, the dummy variable of Rural Bank was respectively 0.798, 1.304, and 0.789 times, while the dummy

variable of Cooperative compared to middlemen and non-recipient was respectively 1.63 and 0.99 times. The dummy variable of non-recipient compared to middlemen was 1.65 times. This means that for the ROI model, the best performance was by the non-recipient group, followed by those supported by cooperatives.

From the results of the regression analysis for model three, (Table 2) only the variables of age, education and income affect expenditure and are significant at the 95% level of confidence. For every one year increase in age, expenditure will increase by 0.8%, while with every one year increase of education expenditure will increase by 5%. Moreover, an increase of income by one million Rupiahs will increase expenditure by 22%. In contrast to the results of the study conducted in Kerala, India by Gopal et al. (2012), micro-credit recipients did not divert loan funds for household expenditure. In the interviews of the present study nearly 92.3% of respondents said they did not use the loan money for daily household expenditure needs. In fact, nearly 86% said they wanted to save money for shopping needs instead of their primary needs. Even though they had extra income from their businesses, they said that the credit would not change their spending patterns. These results are in line with research in Indonesia from Suman (2007), which showed that women tended to be more disciplined and avoided the temptation to use the loans for things that did not fit the original purpose, in this case their business.

Efficiency analysis using DEA was conducted to determine whether fisherwomen who receive micro-credit would be more efficient in terms of using their inputs compared to those who did not receive credit. The first efficiency analysis model is for Decision Making Units (DMUs) in all groups of fisherwomen, with the inputs being the average cost of capital and work hours, while output was the average of total revenue. Result revealed that the highest score for efficiency (100% efficient) was achieved by fisherwomen who borrowed credit from Cooperatives, followed by non-recipients and women borrowing from the Rural Bank, while the fisherwomen who borrowed credit from middlemen tended to be the least efficient (75.76%) (Table 4). This result is in line with the results of the regression model results, which showed that fisherwomen who borrowed micro-credit from Cooperatives had better income than the fisherwomen who borrowed micro-credit from other institutions (Rural Bank and middlemen), and had a better performance than non-recipients.

Efficiency scores in Table 4 were derived from group averages data. From Table 4 it can be concluded that fisherwomen who received credit from the Rural Bank should decrease their cost of capital (reduce their credit) by 9.26% and working hours by 47.34% to achieve a fully efficient utilisation of inputs, while for the fisherwomen who borrowed credit from middlemen their costs of capital should be decreased by 24.24% and working hours by 71.10 % from the average. For non-recipient fisherwomen, to achieve full efficiency they should decrease their capital by 8.83% and work hours by 13.01% from the average. Since fish is a perishable commodity, decreasing working hours would mean conducting sale in a shorter time period, thus increasing efficiency.

Table 4. Efficiency frontier analysis and total potential improvement - results for groups of fisherwomen.

DMU	Efficiency score (%)	Total potential improvement		
		Capital (%)	Work hour (%)	Total revenue (%)
Non-recipient	91.17	-8.83	-13.01	0.00
Rural bank	90.74	-9.26	- 47.34	0.00
Cooperative	100	0.00	0.00	0.00
Middlemen	75.76	-24.24	-71.10	0.00

Further DEA analysis was conducted for all fisherwomen respondents (individual DMU's), with the inputs of work hour and cost of capital and output of total revenue. Detailed score and projection for efficiency improvement can be seen in Table 5.

Table 5. Efficiency score and input output projection for all respondents.

DMU	Score	Total revenue projection	Work hours projection	Cost of capital projection
Middle men				
Min.	0.47	-0.01	-0.48	-0.53
Max.	0.69	0.01	-0.36	-0.22
Average	0.56	0.00	-0.43	-0.43
Rural Bank				
Min.	0.38	-0.01	-0.48	-0.77
Max.	0.89	0.01	-0.44	-0.22
Average	0.66	0.00	-0.31	-0.45
Cooperative				
Min.	0.56	-9.12	-0.46	-2.40
Max.	1.00	0.00	0.00	0.00
Average	0.78	-0.48	-0.17	-0.52
Non-recipient				
Min.	0.50	0.00	-0.47	-2.48
Max.	1.00	0.01	0.00	0.00
Average	0.71	0.00	-0.27	-0.65

In line with the results of the model of average values of each group as a DMU, fisherwomen who get micro-credit from Cooperatives showed better scores (0.56 to 1), followed by non-recipients with score 0.50 to 1(Table.5). The projections for improvement for all DMUs varied with input and output. For borrowers from middlemen for example, to be efficient, working hours should be reduced in the range of 36% to 48% and the cost of capital (credit) should be reduced by 22% to 53%.

If DEA is carried out within the micro-credit recipients only, using credit as an input (Table 6), the scores are varied. Fisherwomen borrowing from middlemen are in the range 0.31 to 0.56, for credit from rural bank in the range 0.32 to 0.92, and for credit from Cooperatives they are in

the range 0.62 to 1 (efficient). From the input-output projection within micro-credit recipients, it could be inferred that reducing working hours from 8% to 80% is required to be fully efficient. This is due to the perishability of fish. The more the time spent in sale of fish, the more the risk of spoilage of fish resulting in lower prices and reduced profit.

Table 6. Efficiency score and input output projection DEA analysis within micro-credit recipients.

DMU	Score	Work hours	Micro-credit	Total revenue
Middlemen				
Min.	0.31	-0.80	-0.69	0.00
Max.	0.56	-0.65	-0.44	0.00
Average	0.38	-0.76	-0.62	0.00
Rural Bank				
Min.	0.32	-0.80	-0.68	0.00
Max.	0.92	-0.08	-0.08	0.00
Average	0.60	-0.55	-0.40	0.00
Cooperative				
Min.	0.62	-0.68	-0.38	0.00
Max.	1.00	0.00	0.00	0.00
Average	0.83	-0.27	-0.17	0.00

From the results of the DEA, it can be inferred that to be efficient, fisherwomen need to reduce their micro-credit borrowings by 62% if from middlemen, by 40% if from the Rural Bank and by 17% if from Cooperatives. In other words, the optimal microcredit for fisherwomen vending fish in baskets from the Rural Bank is around 900 thousand Rupiahs, from Cooperatives around 2 million Rupiahs, and from middlemen around 500 thousand Rupiahs.

Conclusion

On the northern coast of Java, Indonesia, fisherwomen play a major role in the household economy. One of the main problems for fisherwomen to develop their skills in business is the lack of financial capital. Access to micro-credit institutions by fisherwomen has grown in Indonesia. However pessimism about the schemes of financial assistance for fisherwomen's businesses still continues. Women are considered to have poor business skills, especially the illiterate or poorly educated fisherwomen.

This study shows that financial assistance in the form of low interest rate micro-credits or loans through different institutions such as the Rural Bank, Cooperatives and middlemen have different impacts on the economic performance of fisherwomen's economic activity, such as their income, ROI and expenditure. The study has also revealed that financial assistance in the form of micro-credit from Cooperatives has a greater impact on fisherwomen's income when compared to that of non- recipients, credit from the Rural Bank and credit from middlemen. Relative to other schemes analysed in this study, Cooperatives are also considered to be the most efficient agency

for providing financial assistance based on DEA. Fisherwomen who avail credit from Cooperatives are also members of the Cooperatives. It was also observed during this study that the fisherwomen in Cooperatives were becoming more competitive, gaining more self-confidence, had better market information and greater social bonding to help each other. Thus, the performance of their businesses was also more efficient, than were those of the other recipients (Rural Bank, middlemen and non-recipient) who were not members of cooperatives.

The study also revealed that to be efficient, the optimal amount of micro-credit for fisherwomen selling fish in baskets on the North Coast of Java differed according to the types of micro-credit institutions they used. The optimal amount of credit of Cooperatives was the highest compared with the Rural Bank and middlemen. This shows that the Cooperative sector is reliable as an institution that provides micro-credit for fisherwomen, and more credit can be distributed to the fisherwomen to make their businesses more profitable. This condition implies the need for the development of more fisherwomen cooperatives, and more credit disbursement from cooperatives, as the number of fisherwomen's cooperatives compared to fishermen's cooperatives is still very limited, limiting the opportunities for fisherwomen to access credit.

Financial assistance from middlemen was found to have less impact on fisherwomen's economic performance, including its efficiency. However, borrowing from the middleman is still an option for some fisherwomen, even though the interest is tends to be high. Women who are not members of Cooperatives and do not have collateral, as required by other institutions such as the Rural Bank, may need credit from middlemen. This implies that suitable policy changes are required such as reduction or removal of the collateral requirements insisted on by financial institutions, so that there are sufficient opportunities for more fisherwomen to get institutionalised financial assistance.

The study also shows that fisherwomen are basically disciplined in their borrowing behavior and their expenditure apparently had nothing to do with the financial assistance they received through micro-credit. Women become more thoughtful when dealing with money earned through businesses started using credit and women did not tend to spend the money earned from the micro-credit funded business for their consumptive needs. The information in this study could be used by decision-makers to develop suitable financial assistance schemes for the development of fisherwomen.

From the point of view of methodology, however, a limitation of the present study is that the regression could have been strengthened by adding other variables, for example, the husband's income, which could affect the fisherwomen's spending patterns. Also the DEA approach, which assumes only conditions of constant returns to scale, could be developed using variable returns to scale. Another deficiency of DEA is that the approach explains only the general relationship between input and output and hence is sensitive to the inputs and outputs chosen.

References

Ali, A.I. and L.M. Seiford. 1993. The mathematical programming approach to efficiency analysis. In: The Measurement of Productive efficiency (eds. Fried, H.O., A.A.K. Lovell and S.S. Schmidt), pp 120-159. Oxford University Press, New York.

Anna, Z. 2003. Dynamic embedded model economic interaction fisheries-pollution. In: Bahasa. Doctoral Dissertation, Bogor Agricultural University.

Bailey, C. 1988. The political economy of marine fisheries development in Indonesia. Indonesia, Southeast Asia Program Publications at Cornell University, Indonesia. 46:25-38.

Charnes, A., W.W. Cooper, A.Y. Lewin and L.M. Seiford. 1995. Data envelopment analysis: Theory, methodology and applications. Kluwer Academic Publisher, Boston. 513 pp.

Charnes, A., W.W. Cooper and E. Rhodes. 1978. Measuring the efficiency of decision making units. European Journal of Operations Research 2:429-444.

Diposaptono, S., A. Fauzi, Z. Anna, M. Helmi and D. Nugroho. 2009. Identification of coastal vulnerability due to climate change in Indonesia. In: Bahasa. Report to the Minister of Science and Technology, Republic of Indonesia. pp. 81-84.

FAO. 1998. Report of the technical working group on the management of fishing capacity. La Jolla, USA, April 1998. FAO Fisheries Report No. 585. FAO, Rome. pp. 15-18.

Fauzi, A. and Z. Anna. 2012. Growth and instability of small pelagic fisheries of the north coast of Java, Indonesia: Lesson learned for fisheries policy. China-USA Business Review 11 (6): 739-748.

Fauzi, A. and Z. Anna. 2010. Social resilience and uncertainties: the case of small-scale fishing households in the north coast of Central Java. MAST 9:55-64.

Gopal, N., P. Jeyanthi, V. Chandrasekar and B. Meenakumari. 2012. A Study on the availability and utilisation of microcredit in the traditional fisheries sector of Kerala, India. In: Gender in Aquaculture and Fisheries: Moving the Agenda Forward *(*eds. M.J Williams, M. Porter, P.S. Choo, K. Kusakabe, V. Vuki, N. Gopal and M.B. Reantaso) Asian Fisheries Science 25S:243-250.

Hempel, G. and D. Pauly. 2002. Fisheries and fisheries science in their search for sustainability. In: Oceans 2020: Science, trends, and the challenge of sustainability (eds. J.G.Field, G. Hempel and C.P.C. Summerhayes), pp. 109-135 Island Press, Washington D.C.

Issac, S. and W.B. Michael. 1981. Handbook in research and evaluation. San Diego Edits Publishers. 234 pp.

Jayaraman, R. 2008. Performance analysis of fisherwomen self help groups. Tamilnadu. Journal of Veterinary & Animal Sciences 4 (2):52-55.

Kabeer, N. 2005. Is microfinance a 'magic bullet' for women's empowerment? Analysis of findings from South Asia. Economic and Political Weekly 40 (44-45):4709-4718.

Karmakar, K.G., G.S. Mehta, S.K. Ghosh and P. Selvaraj. 2009. Review of the development of microfinance services for coastal small scale fisheries and aquaculture for South Asia countries (including India, Bangladesh and Sri Lanka) with special attention to women. Paper presented in the Asia Pacific Fisheries Commission (APFIC) Regional Consultative Workshop "Best Practices to Supporting and Improving Livelihoods Small Scale Fisheries and Aquaculture Households", 13-15 October 2009, Manila, Philippines. 70 pp.

Koreuber, K.H. 1991. Activities and its result of small scale fisheries development project in West Nusa Tenggara. Proceeding of Small scale fisheries Conference, Jakarta December 18-19. Center of Agriculture Research and Development, Department of Agriculture, Indonesia.

Kulkarni, V.S. 2011. Women's empowerment and microfinance: An Asian perspective study. Occasional Papers. Knowledge for development effectiveness. Department of sociology, Yale University. The thirteenth in a series of discussion papers produced by the Asia and the Pacific Division, IFA.

Lovell, C.A.K. 1993. Production frontiers and productive efficiency. In: The measurement of productive efficiency (eds. H.O. Fried, C.A.K. Lovell and S.S. Schmidt), pp. 3-67. Oxford University Press, New York.

Mc Elroy. 1991. The Java sea Purse seine fishery: A modern-day "tragedy of the common?" Marine Policy 15 (4):255-271.

Millazo, M. 1998. Subsidies in world fisheries: a re-examination, World Bank Technical paper No. 406. Fisheries series, The World Bank, Washington D.C. 99 pp.

Munro, G. and U.R. Sumaila. 2002. The impact of subsidies upon fisheries management and sustainability: The case of the North Atlantic. Fish and Fisheries 3:233-250.

Nawaz, A. 2010. Efficiency and productivity of microfinance: Incorporating the role of subsidies. Working Papers CEB 10/009. RS, ULB, Universitelibre de Bruxelles. 59 pp.

Seiford, L.M. 1996. Data envelopment analysis: the evolution of the state of the art (1978-1995). Journal of Productivity Analysis 7: 99-138.

Seiford, L.M. and R.M. Thrall. 1990. Recent development in DEA: The mathematical approach to frontier analysis. Journal of Econometrics 46:7-38.

Squires, D., I.H. Omar, Y. Jeon, J. Kirkley, K. Kuperan and I. Susilowati. 2003. Excess capacity and sustainable development in Java Sea Fisheries. Environment and Development Economics 8:105-127.

Suman, A. 2007.Women Empowerment, Micro credit and Poverty: An empirical Study (In Bahasa). Journal of Management and Entrepreneurship 9 (1):62-72.