

Human Resources, Social Capital and Income Structure of Seaweed Farmers in Indonesia : A Path Analysis for Poverty Causal Model

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Key Words : household characteristics, human capital, migration, social capital

Abstract

Although seaweed farmers have made a significant contribution to the promotion of fishery products, aquaculture in particular, and made Indonesia the second largest seaweed producer in the world after the Philippines (FAO, 2010, pp. 13-19), the ratio of those seaweed-farmer households which fall below the National Poverty Line (NPL) is still high. A critical question to be raised is what factors determine the household income of the seaweed farmers? The main objective of this paper is threefold : (1) to identify and analyze such factors within two dimensions : the dimension of human resources, which include household characteristics, human capital, and household migration, and the dimension of social capital, both of which foster economic activities and raise the overall income of those farmers ; (2) to construct poverty causal models among the factors identified ; and (3) to examine the effects of influential factors on poverty of the seaweed farmers in Indonesia. Poverty indices, such as those provided by James E. Foster, Joel Greer, and Erik Thorbecke, (i.e. Poverty Head Count Index, Poverty Gap Index, and Poverty Severity Index) are employed to estimate household income of the seaweed famers who fall under the NPL and measure the gaps between the NPL and poverty lines lower than the NPL. In order to conduct this research, *Factor Analysis* and *Multiple Regression for Path Analysis* are employed to construct factor and causality models of the seaweed famers' poverty. The important findings are as follows : (1) Seaweed-farmer households having school-aged children has a moderate impact on the poverty ; (2) the seaweed farmers' migration for employment and their guild activities have moderate and weak, positive, and direct impacts on the poverty. While other findings indicate that both human resources and social capital have indirect impacts on the poverty, fishery income and non-fishery income have strong positive direct impacts on the poverty. This paper reveals that among all other variables, the income of not only seaweed related jobs but also non-fishery, seasonal jobs of the seaweed farmers has the greatest impact on the poverty.

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1. Background of the Research on Seaweed Farmers and Poverty Nexus

Seaweed is considered as an essential commodity in Indonesia that contributes to the economic growth. There are four reasons for this. *First*, it boosts investment. Seaweed is produced not only as fresh food consumed directly but also widely used by various industries as raw materials to produce particular products. The industries produce the raw materials, such as phyco-colloids, gelling, thickening, emulsifying, binding, stabilizing, clarifying, and protecting agents (Chopin, T., & Sawhney, M., 2009). These seaweed-derived products are known as carrageenans, alginates and agars. This potential demand for seaweed-derived products allows the commodity to have close linkages in the production chain among related industries, both backward linkages and forward, and enhances the industries' capacity, which in turn triggers the necessities of capital accumulation and the investment expansion of the industries. *Second*, the seaweed production creates jobs. Seaweed, which is an aquaculture product within the fishery sector, is a main source of income and livelihood for millions of people in Indonesia. Processing industries of seaweed products, such as agar, are one forward linkage of seaweed farming which creates job opportunities. *Third*, it is a significant source of income. Seaweed commodities have a significant share not only within the aquaculture products' sector and the Gross Domestic Product of Fishery sector, but also its share contributes to the export of aquaculture commodity and boosts the total national export. In 2010, 47.0 percent of the total value of aquaculture export products was made possible by the export of seaweed (Marine and Fisheries Statistics, Indonesia, 2011). *Fourth*, seaweed farming is an aquaculture that has unique characteristics. It promotes the use of feeds for fish, and requires only low technology and a small amount of capital. In addition, the seaweed's growth cycle, the process of planting and harvesting, is short, normally lasting less than two months, and it can be harvested six to eight times a year. In coastal communities, seaweed farming has generated socio-economic benefits and become the most vital livelihood.

Seaweed farmers have made a significant contribution to the promotion of fishery products, particularly aquaculture products, and its contribution had made Indonesia the second largest seaweed producer in the world after the Philippines since 2007 (FAO, 2010, pp. 13-19). Geographically, Indonesia, an archipelagic country with 17,000 islands and approximately more than 81,000 k.m. coastlines, is noted both as one of the largest aquaculture producers and the second largest seaweed producer in the world. Farming

production is dominated by two species called *Eucheuma cottonii* and *Eucheuma spinosum* (*Eucheuma denticulatum*). The products have two categories, i.e. raw dried seaweed and carrageenan of seaweed. Moreover, in 2009, Indonesia's production was estimated at 85 thousand tons of dried seaweed (Valderrama, D., 2012).

Although Indonesia is now the second largest seaweed producer in the world, the majority of the seaweed farmers in Indonesia have the income below the National Poverty Line. A critical question to be raised is what factors cause the poverty among the seaweed farmers and why they are staying poor? Since poverty is a multi-dimensional social phenomenon, there will not be a clear solution to the poverty problem suffered by the farmers without understanding the important causal factors, such as where and what specific economic activities they are engaged in. The majority of the poor farmers and fishermen in Indonesia are living in coastal areas, and engaged both in small scale fishing and aquaculture farming activities, including seaweed cultivation activities.

The poverty is a critical problem in Indonesia. In 2011, 12.38 percent of 241 million Indonesian people were poor (Statistics Indonesia, 2012). Among them, 9.09 percent were urban poor and 15.59 rural poor that include the population of seaweed farmers and fishermen. In addition, the ratio of seaweed farmers' households whose incomes fall below the National Poverty Line is still high. The problems of poverty concerning seaweed farmers' households are (1) they have been poor over generations, (2) they are mainly engaged in small-scale, not profitable aquaculture farming, which includes seaweed cultivation, (3) seaweed farmers have to compete with other farmers who are engaged in aquaculture farming, such as pearl farming and fishing, which makes it difficult for them to secure seaweed farming jobs, (4) income generation is seasonal and not active.

More problems stated above can be explored by internal and external conditions of the seaweed farmers' households. The internal and external conditions are categorized into two dimensions: human resources and social capital. Regarding human resources, the level of farming skills of seaweed farmers is strongly reflected by their household characteristics (such as the household' structure, its members' age and sex, the level of dependency with one another, and the number of school-aged children). More specifically, seaweed farmers with a large number of household members and those with school-aged children are the poorest among the seaweed farmers. In terms of human capital, the majority of seaweed farmers do not obtain a high education, and thus do not have knowledge and skills other than the seaweed farming and fishing. The seaweed farmers acquire social capital through their traditional associations' activities. Seaweed farming in Indonesia depends on these activities, and their cross-household ties have

helped them increase opportunities for interaction and triggered collective actions. Nevertheless, the ties have not been used effectively to solve the poverty problem.

Considering these problems, it is important to examine factors behind the lack of nexus among the seaweed farmers. The study focuses on seaweed farmers' activities that generate income and the movements of income poverty. Basically, the study identifies major factors of poverty among the seaweed farmers. Specifically, there are two questions to be examined :

1. What are the effects of household human resource and household social capital on the seaweed farmers' income and poverty?
2. What are the influencing factors on income and its impact on poverty of the seaweed farm households?

2. Objectives of Study and Hypothetical Model

The main objectives of this study are (1) to identify important factors in improving economic activities and income structure within the communities of seaweed farm households, (2) to construct a poverty causal model among factors identified, and (3) to examine the effects of influential factors on income and poverty of the seaweeds farm households in Indonesia.

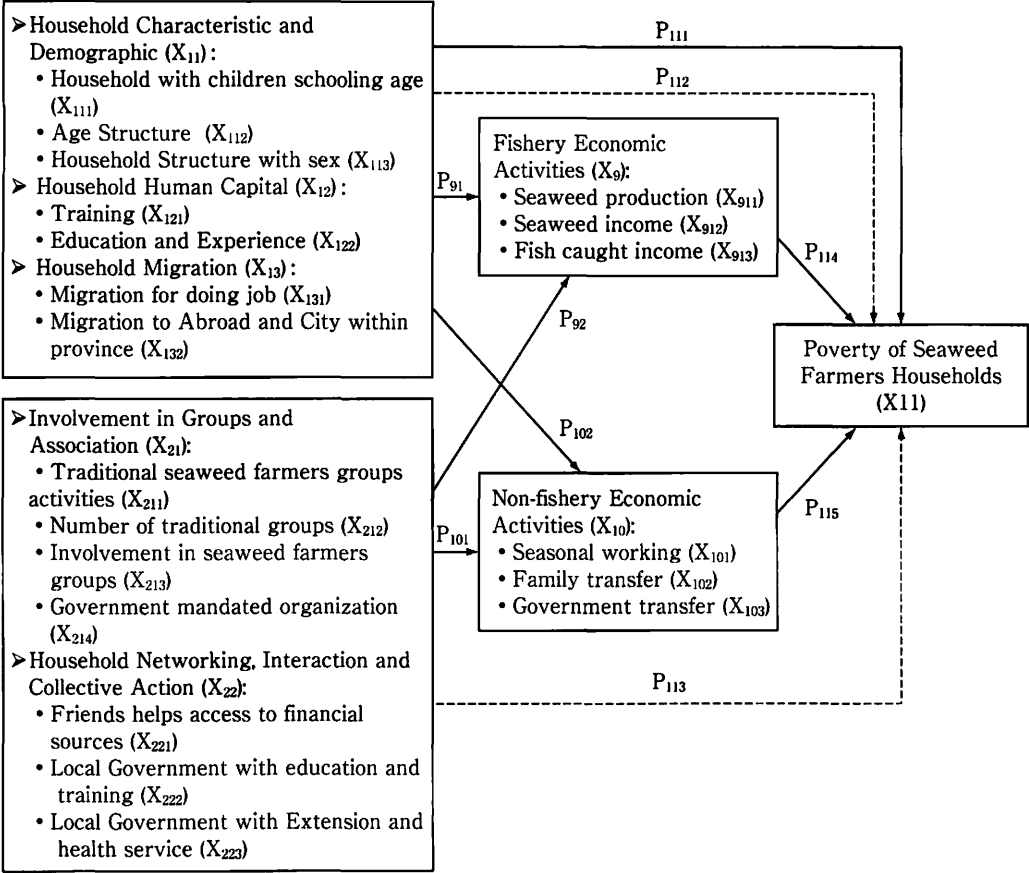
It is hypothesized that household human resources, defined as seven variables and social capital as eight variables, have both direct and indirect impacts on fishery economic activities, non-fishery economic activities, and household poverty. All variables within fishery and non-fishery activities have strongly direct impacts on the household poverty.

3. Research Methodology

3.1. Research Site and Data Collection

The research was conducted at sub-district of Lealea, Southeast Sulawesi in Indonesia (Figure 2). Lealea is located in the northern part of Baubau City and about 28.93 km² or 12.75% of the total area of the city, lying between 5.33°S-5.34°S latitudes and 122.67°E-122.69°E longitudes. This sub-district has five villages, topographical conditions, long coasts, and watershed areas. The villages with the coastal area include the villages of Kolese, Lowu-lowu, Palabusa and Kalialia. The village with watershed areas is Kantalai. Total population of Lealea is 6,630 in 2010 (among whom there are 1,516 households). Two villages, Lowu-lowu and Palabusa, are chosen as the site area of the research by the

Figure 1 : Hypothesized Framework of Poverty Causal Model of Seaweed Farmers in Indonesia

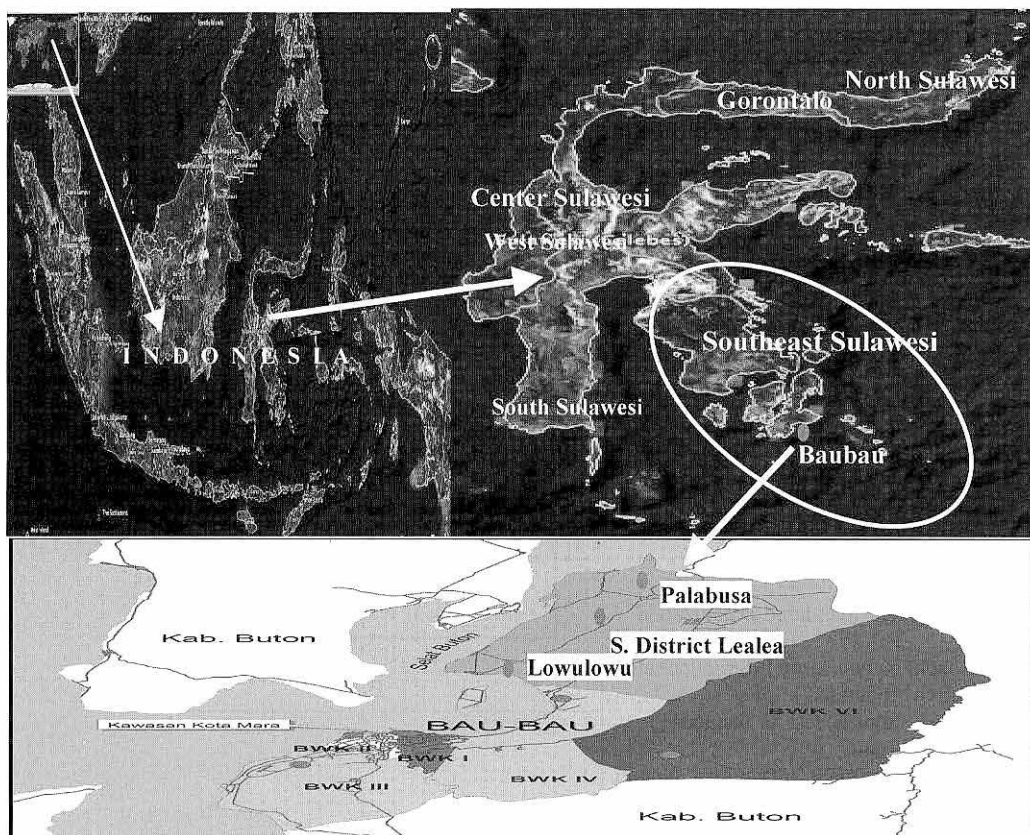


* Bold arrow lines indicates direct association, and dot arrow line indicates indirect association

author. The number of population and household within the villages is respectively 2,109 people with 534 households and 1,693 people with 463 households. Lowu-lowu has 174 seaweed farmer households or 32.58 per cent of the total of its households while Palbusa has 271 seaweed farmer households or 57.53 per cent of the total of its households in the village.

Interview and group discussion are two methods used for the collection of primary data. Group discussions were held to obtain information from government officials and group leaders of the seaweed farmers : more specifically, general information regarding poverty profile, livelihood, and empowerment schemes provided by local government official who are serving for seaweed farmers. The discussions were held prior to in-depth interviews with the targeted respondents. Face-to-face structured interviews and discussions were conducted in August-September 2011. 52 households in Lowulowu and 74 households in Palabusa were interviewed.

Figure 2 : Map of Indonesia and Research Sites



3.2. Data Analysis Method

In this study, poverty indices measurement, factor analysis, and multiple regressions (as path analysis) are employed as data analysis methods. In order to maintain the reliability of the constructed models used in this study, the goodness of fit test and the significance of path coefficient are also applied. A brief discussion concerning those methods is successively described below.

(i) Poverty Indices Measurement

Poverty Head Count Index, Poverty Gap Index, and Poverty Severity Index are employed as quantitative poverty measurements of the study. Those indices are basically used to interpret the poverty state. These indices were developed by James E. Foster, Joel Greer, and Erik Thorbecke (FGT), (The World Bank, 2007).

Poverty Headcount Index

Poverty Headcount Index (PHI) is employed to explore a number of household of the seaweed farmers who fall under the National Poverty Line (NPL). The index is also

named Poverty Incidence Index. It can be calculated based on both income base and consumption base. We employ the income base measurement to calculate PHI in order to indicate the proportion of the respective poor households which are living below the NPL. The PHI is expressed as follows :

$$PHI = \frac{A}{N}$$

where :

A refers to the number of households below the NPL

N refers to the number of total households

In this research, we employ the 2010 NPL for rural areas in Southeast Sulawesi Province, Indonesia, of IDR.161,451.00/capita/month (BPS, Indonesia, 2010). Although PHI is a popular poverty measurement, it also has a limitation. For instance, when the figures of PHI change, they do not clearly give information to identify both the deference of sub-group of the poor and its range of poverty level. As long as those people are living below the NPL, the measurement of the PHI does not change, even though poor people are becoming either poorer or wealthier (The World Bank, 2007). In short, PHI only indicates the incidence of poverty, but it fails to explain both the depth of poverty and the relative severity of poverty. Therefore, we employ another FGT poverty measurement to figure out the depth of poverty state of the seaweed farmers.

Poverty Gap Index

Poverty Gap Index (PGI) complements the poverty measurement of PHI. PGI accounts for the extent to which poor seaweed farmers fall below the NPL. Specifically, it measures the average proportion of poor farmers from the NPL. For instance, if the poverty gap is 15 percent, this implies that the average income of the household is 85 percent below the NPL. This implies that the index is closer to the depth of poverty. The PGI is calculated by the following formula :

$$PGI = \frac{A}{N} \sum_{i=1}^A \left[\frac{Z - \bar{I}_i}{Z} \right]$$

where :

A refers to the number of households below National Poverty Line (NPL)

N refers to the number of total households

Z refers to the NPL

$\bar{I}_i$ refers to the income of the households below the NPL

The PGI can lead us to know the depth of poverty suffered by the poor, even though this index still fails to explain the level of change in poverty state as the poverty gap changes

within poor households and the severity of poverty among poor households.

Poverty Severity Index

Poverty Severity Index (PSI) is basically square of Poverty Gap Index. This measurement, weights the number of households that are below the NPL with the gap of the poverty line squared. Specifically, the index calculated with the average of per capita income squared is divided by the number of total households. The greater the gap, the deeper the poverty is. If $(PGI)_\alpha$ is Poverty Gap Index as expressed below :

$$(PGI)_\alpha = \frac{A}{N} \sum_{i=1}^A \left[\frac{Z - \bar{I}_i}{Z} \right]^2$$

where :

α is the parameter of poverty index sensitivity on poverty line

if $\alpha=0$, it indicates the index equal to poverty headcount ratio

if $\alpha=1$, it indicates poverty gap

if $\alpha=2$, it indicates poverty severity

(ii) Factor Analysis

Four subsequent steps are undertaken in the factor analysis of the study. They are (1) preparing for the relevant covariance matrix. The covariance matrix plays a crucial role in providing initial information about what variables can join together in an extracted factor. (2) Extracting the initial factor is determined. Principle Component Analysis is executed. In this step, initial solutions or initial decisions regarding the number of extracted factors underlying a set of variables within each of the dimensions studied is determined ; (3) rotating factor to the terminal solution is determined. Varimax is used as a method for rotating the factors. In this step, the unrotated factor matrixes are rotated with Keiser Normalization and orthogonal rotation method to make underlying factors more meaningful. The variables with communalities greater than or equal to 0.5 ($h^2 \geq 0.5$) are retained and kept for further analyses, and (4) constructing factor matrix is determined, and this use is employed in further analyses. In this step, one factor as an Index is calculated and used as a representation of set of variables within an extracted factor. Simply, the index is calculated as the following :

$$Index = \frac{A}{N} \sum_{i=1}^m fSC_j \cdot Z_j$$

where :

fSC_j refers to a factor-score coefficient of the j^{th} variable

Z_j refers to a standardized variable of the j^{th} variable.

(iii) Multiple Regressions as Path Analysis

Path Analysis model is basically the same as general multiple regression analysis (GMRA) (Kawamura, 1978, 228). It is a model constructed by a dependent variable and a set of independent variables. It is used as a method of studying direct and indirect effects of variables while the GMRA model remains as a method of discovering causal relationship (Ahn, 2002). All variables used in the path analysis are standardized, and latent constructs are identified through factor analysis. As the extracted factor in terms of an index is calculated, and then multiple regression is run to examine the significant determinant factors of endogenous variable in the model. General model of path analysis is given as follows :

$$ZY_t = \beta_1 ZX_{1t} + \beta_2 ZX_{2t} + \beta_3 ZX_{3t} + \dots + \beta_k ZX_{kt} + E_t$$

Simply can be expressed as :

$$zY_t = \left(\sum_{q=1}^k \beta_q zX_{qt} \right) + E_t$$

where :

zY_t and zX_{qt} : are standardized dependent and independents variables

$t=1, 2, 3, \dots, n$

Based on the hypothesized framework as depicted in **Figure 1**, there are three components of variables utilized in the path analysis model. They include independent variables, intermediate variables, and dependent variable. The independent variables are X_{111} , X_{112} , X_{121} , X_{122} , X_{131} , X_{132} , X_{211} , X_{212} , X_{213} , X_{222} , and X_{223} . And the intermediate variables are X_9 , X_{911} , X_{912} , X_{10} , X_{101} , X_{102} , and X_{103} . The dependent variable is X_{11} . The direct impact of the independent variables on each respective dependent variable can be estimated by using path equations model as the following :

$$X_{1j} = E_{1j} \text{ (Path equation 1)}$$

$$X_{2j} = E_{2j} \text{ (Path equation 2)}$$

$$X_9 = P_{91j}X_{1j} + P_{92j}X_{2j} + E_9 \text{ (Path equation 3)}$$

$$X_{9j} = P_{91j}X_{1j} + P_{92j}X_{2j} + E_{9j} \text{ (Path equation 3j)}$$

$$X_{10} = P_{101}X_{1j} + P_{102}X_{2j} + E_{10} \text{ (Path equation 4)}$$

$$X_{10j} = P_{101j}X_{1j} + P_{102j}X_{2j} + E_{10j} \text{ (Path equation 4j)}$$

$$X_{11} = P_{111j}X_{1j} + P_{112j}X_{2j} + P_{119j}X_{9j} + P_{1110j}X_{10j} + E_{11} \text{ (Path equation 5)}$$

General form of above path equations can be expressed as follows :

$$X_j = \left(\sum_{q=1}^k P_{jq} X_q \right) + E_j \text{ for } (k < j)$$

where :

P_{jq} : is the Path coefficient of the independent variables

E_j : is the Error terms

The Estimated value of the path coefficients can be calculated with using the following formula :

$$\hat{X}_j = \sum_{q=1}^k \hat{P}_{jq} X_q, \quad (k < j)$$

where :

a hat (^) : indicate an estimated value

$\hat{P}_{jq}$: is a standardized regression coefficient

(iv) The Goodness of Fit Test and Significance of the Path Coefficient

The Goodness of Fit Test for poverty causal model is mainly aimed at evaluating how much variation in dependent variables is viably explained by a set of explanatory variables in the model. It tests the viability of the model applied. Properly fitted models can provide powerful explanation about the relationship between independent variables and dependent variables. The larger proportion of the variance of dependent variables is explained by independent variables and the goodness of fit test for the regression equation model. In addition, large residuals or error terms imply a poor fit, and on the contrary, small residuals or error terms reflect a good fit. In order to evaluate the validity and reliability of the constructed poverty causal model, or simply called the goodness of fit model test, we use F-value and coefficient of determination (R^2). Although the author expects the higher value of R^2 , in socio-economy cases, low R^2 in regression equation is not uncommon, especially for cross sectional analyses, but low R^2 does not necessarily mean that the regression equation is useless (Wooldridge, 2009). Furthermore, to test the significance of the path coefficient, the significance level of 10% ($\alpha=.10$) is applied.

4. Results and Discussion

4.1. Factor Analysis and Extracted Index

Household Human Resources (X_1)

There are three components defined within Household Human Resources. They are household characteristics and demographic (X_{11}), human capital (X_{12}) and household migration (X_{13}). Within the components of X_{11} there are seven variables. The principle components extract the variables with rotation converged in five iterations. Three out of

seven factors within the components of household characteristics and demographic with Eigen values greater than one is extracted. The Eigen values range from 2.06 to 1.31. This implies that three of extracted factors meaningfully represent household characteristics and demographics. They are the factor index of household with school-aged children (X_{111}), age structure (X_{112}), and household structure with sex (X_{113}).

Within the components of X_{12} there are five variables. The principle components extract the variables with rotation converged in three iterations, and extract two factors out of five factors. The Eigen values range from 1.79 to 1.67. This implies that two of the extracted factors meaningfully represent household human capital. The mentioned extracted factors are training (X_{121}) and education and experience (X_{122}). Within the components of X_{13} there are also five variables. The principle components extract the variables with rotation converged in three iterations, and extract two factors out of those five factors. Its Eigen values range from 2.85 to 1.09. It indicates that two of the extracted factors meaningfully represent household migration. The respective extracted factors are migration for seeking employment (X_{131}) and migration to foreign countries and cities within the province (X_{132}). All of the extracted factors within household human resources are defined as independent variables.

Household Social Capital (X_2)

There are two components within household social capital. They include Involvement in Groups- Association (X_{21}) and Household Networking, Interaction and Collective Action (X_{22}). Within X_{21} there are fifteen variables. The principle component extract the variables with rotation converged in five iterations, and extract four factors out of fifteen variables. Its Eigen values range from 4.81 to 1.82. It indicates four of the extracted factors meaningfully represent Involvement in Groups and Association. The components of X_{22} have ten variables. The principle components extract the variables with rotation converged in seven iterations. It extract four out of ten factors. The Eigen values range from 2.64 to 1.56, which indicates that four of the extracted factors meaningfully represent Household Networking, Interaction, and Collective Action.

The extracted factors of both components are respectively the traditional seaweed farmers' groups and activities (X_{211}), number of traditional groups (X_{212}), involvement in seaweed farmers groups (X_{213}), government mandated organization (X_{214}) for component of X_{21} and friends' help accessing financial sources (X_{221}), local government with education and training (X_{222}), local government with extension and health service (X_{223}) for component of X_{22} . All extracted factor within household human capital are also defined as independent variables.

Table 1. Complete Results of Factor

Dimension	Component of Dimension	Factor			Label of Variable	Description of Variable
		Extracted	Index	Code		
HUMAN RESOURCE (X ₁)	Household Characteristic and Demographic	Factor 1	Household dependency with children schooling age	X ₁₁₁	RATIO_CHILDNRN_SCHOL_AGE	Ratio of children schooling age
					HMEMB_DEPEND_RATIO	Dependency ratio of household
					HMB	Household member
		Factor 2	Age structure of household member	X ₁₁₂	AGE_WIFE	Age of household wife
					AGE_HEAD	Age of household head
		Factor 3	Household member structure with sex	X ₁₁₃	SEX_HEAD	Sex of household head
					RATIO_MALE	Ratio of male
	Household Human Capital	Factor 1	Training	X ₁₂₁	TRNG_ATTENDED	Attending training on seaweed promotion
					SWEED_NURSR_TRNG	Knowledge of seaweed nurseries gained from training
		Factor 2	Education and experiences	X ₁₂₂	EDU_WIFE	Household wife education
					EDU_HEAD	Household head education
	Household Migration	Factor 1	Migration for doing job	X ₁₃₁	RATIO_LENGTH_OCCUP	Ratio of household length of occupation
					MIGRT_JOB	Migrated for doing job
					CITY_OTHER_PROV	Migrated to city other province
		Factor 2	Migrated to abroad	X ₁₃₂	MIGRT_HMBR	Households' member migrated
					CITY_WITHIN_PROV	Migrated to city within province
SOCIAL CAPITAL (X ₂)	Household's Groups and Involvement	Factor 1	Traditional and Seaweed farmers groups activities	X ₂₁₁	MIGRT_ABROAD	Migrated to abroad
					RATIO_HMBR_MTN_SWEED	Ratio of attending meeting of farmer group
					RATIO_HMBR_MTN_PENGAJIAN	Ratio of attending meeting of the PENGAJIAN
					RATIO_HMBR_MTN_ARISAN	Ratio of attending meeting of the ARISAN
					RATIO_HMBR_ACTIV_SWEED	Ratio of participating on activities of farmer group
		Factor 2	Number of traditional groups	X ₂₁₂	RATIO_INVOLV_HHEAD	Ratio involvement of HHs' head in all groups
					HHEAD_PENGAJIAN_GRP	Households' head involvement in PENGAJIAN
					NGROUP_HMBR_INVL	Number of groups HHs' M involved
		Factor 2	Number of traditional groups	X ₂₁₂	HWIFE_PENGAJIAN_GRP	Households' wife involvement in PENGAJIAN
					NUMBR_ACTIVITY_PARTIC	Number of activities participated in all group

Fishery and Non-Fishery Economic Activities

Variables within fishery and non-fishery economic activities defined as intermediate variables. They include fishery income (X_9), seaweed production (X_{911}), seaweed income (X_{912}), non-fishery income (X_{10}), seasonal working income (X_{101}), family transfers (X_{102}), and government transfers (X_{103}). Dependent variable is poverty of seaweed farmers household (X_{11}). Entirely extracted factors index are depicted in Table 1.

4.2. Poverty State of Seaweed Farmers

The result of calculation for the poverty measurement indices is depicted in Table 2. It reveals that the Poverty Headcount Index (PHI) in sub-district of Lealea is 0.3270. This indicates about 32.70 percent of the seaweed farmers' households in the sub-district have income below the National Poverty Line (NPL). The ratio is greater than the poverty situation at the provincial level of Southeast Sulawesi, i.e. 17.05 percent < 32.70 percent. Their average income is IDR 144,297.42/capita/month or equivalent to US\$15.74/capita/month (at prevailing exchange rate 2010, US\$ 1=IDR 9,166.99).

Furthermore, the Poverty Gap index (PGI) for the same sub-district is 0.11 or eleven percent. It indicates that the average income of poor seaweed farmers' households in the sub-district 89.0 percent are falls below the NPL and approximately 11.0 percent are on the NPL. While, at the provincial level the PGI is 3.18 or 31.8 percent, which means that about 68.2 percent of poor people in the province are below the NPL, and 31.8 percent are on the NPL. These imply that the observed poor households suffered more poor than the poor in the provincial level. The comparison of the poor who felled below NPI for two regions is 89.0 percent > 68.2 percent, and for the poor who stayed on the NPL for the same two regions is 11.0 percent < 31.8 percent.

Table 2. Poverty Headcount Index, Poverty Gap Index, and Poverty Severity Index

Region	PHI	PGI	PSI
Southeast Sulawesi Province *)	17.05	3.18	0.89
Sub-district Lealea **)	32.70	11.00	1.46

Source : *) Statisitcs Indonesia ; **) calculated

Furthermore, the Poverty Gap index (PGI) for the same sub-district is 0.11 or eleven percent. It indicates that average income of poor seaweed farmers' households in the sub-district 89.0 percent are falls below the NPL and approximately 11.0 percent are on the NPL. While, at the provincial level PGI is 3.18 or 31.8 percent, which means that about 68.2

percent of poor people in the province are below the NPL, and 31.8 percent are on the NPL. These imply that the observed poor households suffered more poor than the poor in the provincial level. The comparison of the poor who felled below NPI for two regions is 89.0 percent > 68.2 percent, and for the poor who stayed on the NPL for the same two regions is 11.0 percent < 31.8 percent.

And last, the Poverty Severity Index (PSI) in the mentioned sub-district is 0.0146 or 1.46 percent. Meanwhile, the PSI of the provincial level of Southeast Sulawesi is 0.0089 or 0.89 percent. The ratio indicates the poverty gap within the observed households is greater than the poverty gap within provincial level of Southeast Sulawesi, that is, 1.46 percent > 0.89 percent. As the PSI indicates the poverty gap and the greater the gap, the deeper poverty they are in. Hence, the observed households suffered deeper in poverty than the poor within the provincial level of Southeast Sulawesi. In other words, the poor of the observed households are severer than the poor in the provincial one.

4.3. Multiple Regression Results as Path Analysis

The regression result of path coefficient is depicted in Table 3. For sake of interpretation and describing the meaning of the coefficient, and then those standardized path coefficients (β_i weights) were categorized into the interval below :

+ .800 or higher	“very strong positive impact”
+ .400 to + .790	“strong positive impact”
+ .200 to + .390	“moderate positive impact”
+ .060 to + .190	“weak positive impact”
− .060 to − .190	“weak negative impact”
− .200 to − .390	“moderate negative impact”
− .400 to − .790	“strong negative impact”
− .800 or lower	“very strong negative impact”

Fishery Economic Activities and Income

There are four variables within fishery economic activities. They include seaweed production (X_{911}), seaweed income (X_{912}), fish caught income (X_{913}), and fishery income (X_9). To identify what factors that bear significant direct impact on each of the mentioned variables, we run regression with factors within human resource and social capital as independent variables. The factors within household human resources include (X_{111} , X_{112} , and X_{113}) which represent the component of household characteristic and demographic ; (X_{121} , X_{122}) which represent the human capital ; and (X_{131} , X_{132}) which represent the component of household migration. While the factors within social capital include (X_{211} ,

X_{212} , X_{213} , and X_{214}) which represent the component of household involvement in group-association; and X_{221} , X_{222} , and X_{223}) which represent the component of household networking, interaction and collective action. We regressed each of path equation with “backward method”. The reason is that, regression with backward method produces more alternative viable models. Therefore, their products enable us to pick up one of the most viable among constructs model.

The result of regression reveals that there are only two factors out of eleven factors within constructed independent variables that significantly have a direct impact on fishery income (X_9). They are factors of the amount of traditional groups (X_{212}) and local government with extension service (X_{223}). The amount of traditional groups (X_{212}) has a moderate positive direct impact on fishery income (X_9) with $\beta=.349$ ($p<.01$). Equally, extension service provided by local government (X_{223}) also has a moderate positive impact on X_9 with $\beta=.208$ ($p<.01$). Despite the model produce coefficient determination with $R^2=.416$ which statistically considered is low, but it has a highly significant of F-value, i.e. $F=7.138$ ($p<.001$). Hence, the model is statistically a good fit to explain the variation changed in fishery income. With $R^2=.416$ indicate that only 42 percent variation changed in fishery income determined by X_{212} and X_{223} . It implies that greater than 50 percent the variation changed in fishery income is determined by other factors, which is excluded in the model. This is still plausible and can be accepted since other factors of production and market price were excluded in the path equation model.

Other results as showed in Table 3, there are four factors out of eleven factors within constructed independent variables that significantly have a direct impact on seaweed production (X_{911}). Age structure (X_{112}) has a strong negative impact on seaweed production (X_{911}) with $\beta=-.537$ ($p<.1$). To the contrary, the “Amount of traditional groups” (X_{212}) engaged in by the farmers has a strong positive impact on X_{911} with $\beta=.471$ ($p<.01$), and training (X_{121}) has a moderate positive impact on X_{911} with $\beta=.212$ ($p<.1$). Another factor that has a positive direct impact on X_{911} is local government with extension service (X_{223}). It revealed that extension service provided by local government (X_{223}) has a weak positive impact on X_{911} with $\beta=.151$ ($p<.01$). The model produce coefficient determination with $R^2=.502$, and $F=3.218$. It implies that more than 50 percent variation changed in seaweed production determined by the factors in the model and less than 50 percent by other factors excluded in the model. The F value is statistically considered highly significant. Hence, the model is a good fit to explain the changed in seaweed production as result the changed in the respective determinant factors in the model.

The last variable within fishery economic activities is seaweed income (X_{912}). The

regression result shows that there are four factors out of eleven factors within component of fishery economic activities that significantly have a direct impact on seaweed income. They include the factor of household with school-aged children (X_{111}), age structure (X_{112}), training (X_{121}), and education and experience (X_{122}). It was revealed that X_{111} and X_{112} both have a negative impact on X_{912} . Household with school-aged children (X_{111}) has a weak negative impact on seaweed income with $\beta = -.157$ ($p < .05$), while age structure (X_{112}) has a moderate negative impact on seaweed income with $\beta = -.305$ ($p < .1$). Other factors of X_{121} and X_{122} both have a positive impact on X_{912} . The factor of training (X_{121}) has a weak positive impact on X_{912} with $\beta = .153$ ($p < .01$), while the factor of education and experience (X_{122}) has a strong positive impact on X_{912} with $\beta = .406$ ($p < .1$). The model is good fit for explaining seaweed income variation since coefficient determination of R^2 is almost 60 percent and F-value is a statistically high significant with $F = 3.631$. R^2 is .586, which indicates that almost 60 percent variation changed in seaweed income determined by the changed in the respective determinant factors in the model.

Non-Fishery Economic Activities and Income

Like fishery economic activities, there are also four variables within non-fishery economic activities. They include seasonal working income (X_{101}), family transfer (X_{102}), government transfer (X_{103}), and non-fishery income (X_{10}). We run regression with the same method and the similar independent variables as like applied on the previous part of the fishery economic activities, to identify what factors those bear significant direct impact on each of the mentioned variables.

Regression results show that there are four factors out of eleven factors within constructed independent variables that have a significant impact on the non-fishery income (X_{10}). They are factors of households with school-aged children (X_{111}), migration for doing job (X_{131}), migration to abroad and city within province (X_{132}), and involvement in seaweed farmers groups (X_{213}). It shows that the factor of household with school-aged children (X_{111}) has a moderate negative direct impact on X_{10} with $\beta = -.223$ ($p < .01$). Factors of migration for doing job (X_{131}) and migration to abroad and city within province (X_{132}) both have a strong positive impact on X_{10} with $\beta = .790$ ($p < .01$) and $\beta = .411$ ($p < .01$), respectively. Last factor of involvement in seaweed farmers groups (X_{213}) has a moderate positive impact on X_{10} with $\beta = .235$ ($p < .1$). Coefficient determination of R^2 is 0.730. It indicates that 73 percent variation changed in X_{10} is determined by changed in X_{111} , X_{131} , X_{132} , and X_{213} . And the F-value is highly significant with $F = 24.400$ ($p < .001$). Hence, the model is considered a good fit for explaining the variation changed in X_{10} as the result of changes in the respective four independent variables in the path

equation model.

Further path coefficient results show that there are only two factors out of eleven factors that have a significant impact on seasonal working's income (X_{101}), i.e. factors of household with school-aged children (X_{111}) and involvement in seaweed farmers groups (X_{213}). Both factors of school-aged children (X_{111}) and involvement in seaweed farmers groups (X_{213}) have a strong positive impact on seasonal working income (X_{101}) with $\beta=.455$ ($p<.1$), and with $\beta=.423$ ($p<.1$), respectively. It is importantly to confirm that the factor of school-aged children (X_{111}) has a strong positive impact on seasonal working income, since the children help other household member worked. It contributed significantly impact on the seasonal earning. Equally important to household social capital in term of involvement in seaweed group (X_{213}) also has contributed a significant impact on the seasonal working's income (X_{101}). Coefficient determination of R^2 is .560, which implies that 56 percent variation changed in the seasonal working's income (X_{101}) is explained by changes in the independent variables in the model. And F-value is highly significant with $F=3.092$ ($p<.01$). Hence, the model is a good fit for explaining the variation changed in X_{101} as result of changes in the independent variables in the respective path equation model.

Other path coefficients results revealed that there are only two factors out of eleven factors within independent variables that have a significant impact on family transfer (X_{102}). They are the factors of migration for doing job (X_{131}) and migration to abroad and to city within province (X_{132}). The factor of migration for doing job (X_{131}) has very a strong positive impact on X_{102} with $\beta=.836$ ($p<.001$), while the factor of migration to abroad and to city within province (X_{132}) has a strong positive impact on X_{102} with $\beta=.457$ ($p<.01$). The coefficient determination of R^2 is 0.890 and F-value is highly significant with $F=36.108$ ($p<.001$). Hence, the modal is a good fit for explaining the variation changed in family transfer (X_{102}) as results of changed in the factors of X_{131} and X_{132} . Last path coefficient result is government transfer (X_{103}). It shows the result that there are three factors out of eleven factors within independent variables that have a significant impact on the government transfer(X_{103}). They include the factors of age structure (X_{112}), traditional seaweed farmers groups (X_{211}), and local government with education and training (X_{222}). The factor of age structure (X_{112}) has a strong negative impact on government transfer with $\beta=-.696$ ($p<.1$). It indicates that households with more elderly household member received more transfer from government. The factors of traditional seaweed farmers groups (X_{211}) and local government with education and training (X_{222}) both have a strong positive impact on government transfer with $\beta=.336$

($p < .1$) and $\beta = .553$ ($p < .01$), respectively. Coefficient determination of R^2 is 0.467 and with F-value is highly significant with $F = 3.052$ ($p < .01$). It indicates that government transfers go to households because of social capital in term of their involvement in seaweed groups and for education and training purposes. The R^2 is low to indicate variation of the household in receiving government transfer, but since the F-value is highly significant, the model is plausible and a good fit for explaining the variation changes in government transfer as results of changes in X_{112} , X_{211} , and X_{222} .

Poverty of Seaweed Farmers' Household

The poverty of seaweed farmers' households is the final dependent variable in the path analysis model. We regressed path equation simultaneously took independent variables and intermediate variables to estimate final dependent variables. Like the previous one, in this stage regression was also run with a **"backward method"**.

The regression result reveals that there are seven variables out of eight variables within intermediate variables that have a significant direct impact on poverty. They include fishery income (X_9), seaweed production (X_{911}), seaweed income (X_{912}), non-fishery income (X_{10}), seasonal working income (X_{101}), family transfer (X_{102}), and government transfer (X_{103}). While variable of fish caught income (X_{913}) was excluded since its path coefficient was not significant and had very weak partial correlation with dependent variable. Furthermore, there are four factors out of eleven factors within independent variables have significant indirect impact on poverty. They include the factors of households with school-aged children (X_{111}), migration for doing jobs (X_{131}), migration abroad and to a city within a province (X_{132}), and traditional seaweed farmers group activities (X_{222}).

Figure 3 displays the Poverty Causal Model. It shows causal impact of the explanatory variables on the dependent variable. Specifically, it leads us to know either an explanatory variable has a direct impact on the final dependent variable or has an indirect impact on the final dependent variable. When an explanatory variable has an indirect impact on the dependent variable, it implies that the impact of the mentioned explanatory variable was transmitted through intermediate variable, and then the latter variable affect directly to dependent variables.

To the contrary, when an explanatory variable has a direct impact on dependent variable, its impact does not transmit through the intermediate variables. It is important to note that on the previous discussion, the respective intermediate variables were functioned as dependent variables in the path equation model.

Fishery income (X_9) has a strong positive direct impact on poverty with $\beta = .692$

Table 3 : Path Coefficient of Adjusted Hypothetical Model

Dependent Variable	Intermediate Variable							Independent Variable											R ²	F
	X ₉	X ₉₁₁	X ₉₁₂	X ₁₀	X ₁₀₁	X ₁₀₂	X ₁₀₃	X ₁₁₁	X ₁₁₂	X ₁₂₁	X ₁₂₂	X ₁₃₁	X ₁₃₂	X ₂₁₁	X ₂₁₂	X ₂₁₃	X ₂₂₂	X ₂₂₃		
X ₁₁	0.692***	0.211**	0.280**	0.547***	0.373***	0.061***	0.055***	-0.126***				0.313***	0.194***	0.17***					0.990	158.46****
X ₉															0.349***			0.208***	0.416	7.138****
X ₉₁₁									-0.537*	0.401*					0.471***			0.151***	0.502	3.218***
X ₉₁₂								-0.157**	-0.305*	0.331***	0.406*								0.586	3.631***
X ₁₀								-0.223***				0.790***	0.411***			0.235*			0.730	24.400***
X ₁₀₁								0.455*								0.423*			0.560	3.092***
X ₁₀₂												0.836****	0.457***						0.890	36.108****
X ₁₀₃									-0.06*					0.336*			0.553***		0.467	3.052***

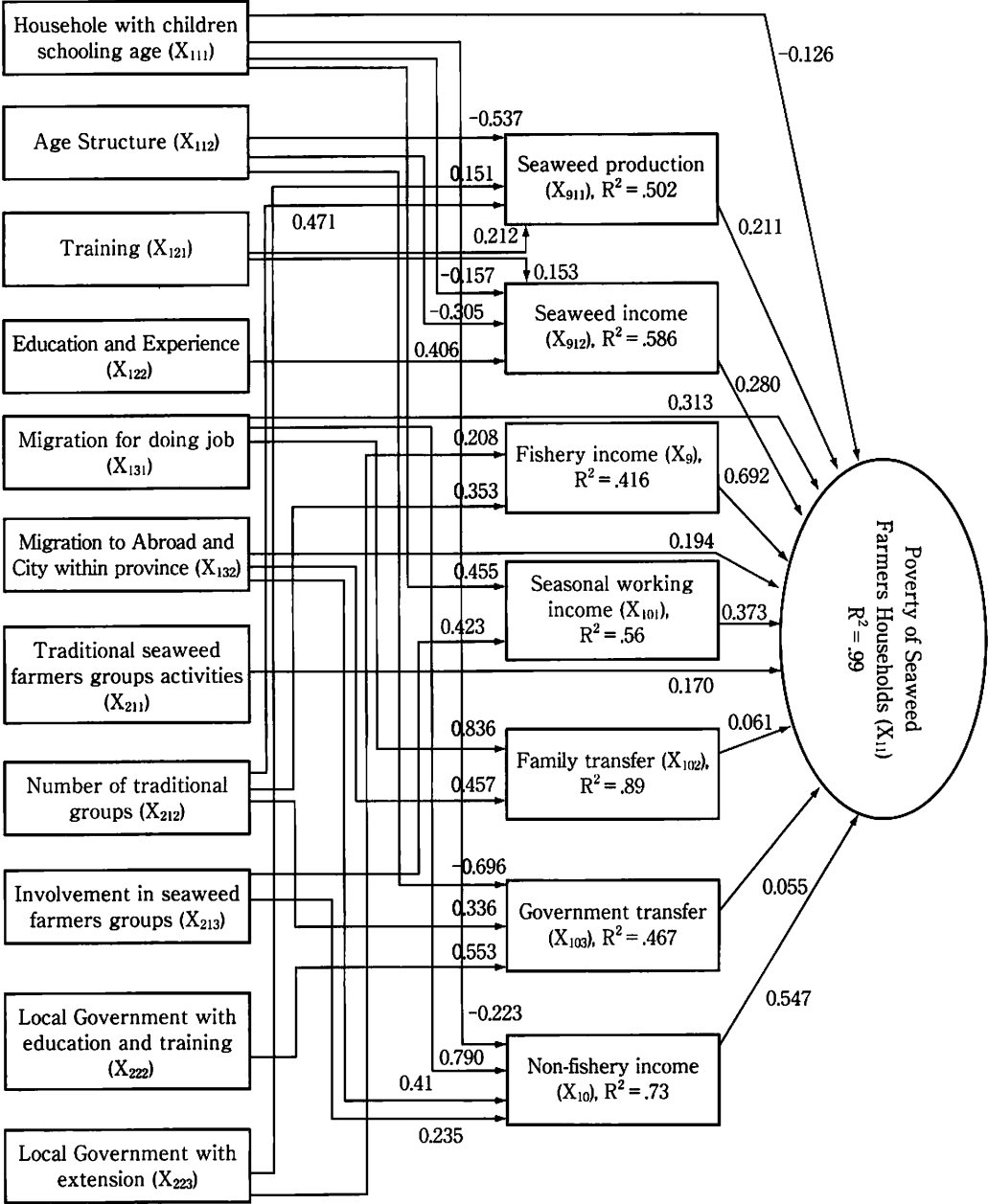
Significance level : ***p≤.001 ; **p≤.01 ; *p≤.05 ; *p≤.1

(p<.01). It indicates that fishery economic activities could be an important factor for getting out from a poverty situation. Equally, seaweed production (X₉₁₁) and seaweed income (X₉₁₂) have a positive impact on poverty but with a moderate direct impact, $\beta=.211$ (p<.05) and $\beta=.280$ (p<.08), respectively. It indicates that seaweed farming could be important factor for fighting poverty incident suffered by seaweed farmers' households.

Like path coefficients of fishery income, the path coefficient of non-fishery income (X₁₀) also has a strong positive direct impact on poverty with $\beta=.547$ (p<.01). It indicates that X₁₀ shared its impact almost equally to X₉ on poverty of the seaweed farmer household. Other path coefficient results show that seasonal working (X₁₀₁) has a moderate positive direct impact on poverty with $\beta=.373$ (p<.01). While family transfer (X₁₀₂) and government transfer (X₁₀₃) both have a weak positive direct impact on poverty with $\beta=.061$ (p<.01) and $\beta=.055$ (p<.01), respectively.

The last path coefficient associate with poverty is the path coefficients for the variables within independent variables. In the notion, that those respective variables have a direct impact on poverty either positively or negatively. There are four variables out of eleven variable have a direct impact on poverty. They include the factors of households with school-age children (X₁₁₁), migration for doing jobs (X₁₃₁), migration abroad and to a city within a province (X₁₃₂), and the activities of the traditional groups engaged in by seaweed farmer (X₂₁₁). While, the rest of other factors within the respective independent variables have indirect impact on poverty. In other words, the respective factors have direct impact on the intermediate variables and in turn directly affect poverty. Their impacts were transmitted through intermediate variables as shown in Figure 3.

Figure 3 : Human Resources, Social Capital and Poverty Causal Model of Seaweed Farmers in Indonesia



The factor of households with school-age children (X_{111}) has a weak negative direct impact on poverty with $\beta = -.126$ ($p < .01$). It indicates that although the households have more school-aged children, it has a weak negative direct impact on poverty situation. In other words, with more school-aged children is not likely severer poverty among the poor households. The factors of migration for doing job (X_{131}) and migration abroad and to a city within a province (X_{132}) both have a moderate and a weak positive impact on poverty

with $\beta=.313$ ($p<.01$) and $\beta=.191$ ($p<.01$). It indicates that the family ties of those who migrated contributed a moderate impact on battling the poverty situation. And last, the activities of the traditional groups engaged in by seaweed farmer (X_{211}) has a weak positive impact on poverty with $\beta=.313$ ($p<.01$). In spite the X_{211} has a weak impact on poverty, social capital in terms of involvement upon traditional seaweed farmer activities has contributed in battling poverty situation of the seaweed farmers in the country.

5. Conclusion

Some important findings on poverty alleviation for seaweed farmers' households in Southeast Sulawesi Province, Indonesia were identified ; (1) two dimensions of independent variables, household human resources and social capital, have both direct impact and indirect impact on poverty ; (2) income structures with five sources of earning indicate the average of seaweed farmers' households were not focused on specific job of activities ; (3) Fishery income (X_9) has a stronger positive direct impact on poverty than non-fishery income (X_{10}), i.e. with $\beta=.692$ ($p<.01$) and $\beta=.547$ ($p<.01$), respectively ; (4) Seaweed production and income (X_{912}) contributed a moderate impact on fishery income with $\beta=.349$ ($p<.01$). The factors of training (X_{121}), education and experience (X_{122}) both have a strong impact on seaweed income with $\beta=.331$ ($p<.01$) and $\beta=.406$ ($p<.1$), respectively. Hence, they can be considered as important factors for fighting poverty among the seaweed farmers in the country ; (5) migration for a doing job (X_{131}) contributed a strong impact on non-fishery income with $\beta=.790$ ($p<.01$). It also revealed that family transfer has a direct positive impact on poverty with $\beta=.061$ ($p<.01$). These findings confirmed that household social capital through family ties of those who migrated have contributed a significant impact on poverty ; (6) the factors of the households with school-aged children (X_{111}) and the age structure (X_{112}) have a negative impact on the poverty situation. In spite of this, the factor of households with school-aged children (X_{111}) has a negative impact on the poverty of the farmers ; it doesn't likely worsen the poverty among the poor households, since its impacts is weak, with a path coefficient of $\beta=-.126$ ($p<.01$).

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