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Research Article

Human Capital Depreciation: Impoverishment of Mangrove Shellfishing in Tumaco, Colombia

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Abstract

This research studies a set of mangrove shellfishers on the South-Pacific Coast of Colombia. Results show the impoverishment and lack of human capital of shellfishers. Findings indicate that the age of shellfishers is negatively correlated to human capital formation. As a consequence, senior shellfishers exert higher levels of effort to maintain livelihoods. By estimating seemingly unrelated regressions, we identify that shellfishers with higher human capital harvest lower shellfish quantities, implying that the less educated shellfishers engage in the activity as a last resort. Furthermore, women are more frequent in the activity, though exhibiting non-significant differences in productivity compared to men.

Keywords: *Human Capital, Fisheries, Natural Resources, Rural Economics*

1. Introduction

Primary commodity sectors such as agriculture are generally related to low-skilled laborers with low human capital[1] accumulation (Blanco and Grier, 2012; Sitjins, 2006); partly because laborers neglect to ehance their skills, relying on natural resource abundance for their livelihoods and financing their consumption through rapid depletion of natural capital (Gylfason, 2008). This is partly because employers may see few reasons to expand educational opportunities or promote economic diversification (Wade, 1992); thereby demanding labor at lower wages. Despite the reasons, generally, low-skilled laborers in the natural resource sector cannot fulfill the requirements of firms looking for skilled labor force (Gylfason, 2001).

Moreover, some exceptions report positive and significant relationships when mining firms require a large amount of investment in human and physical capital (Blanco and Grier, 2012), and spend part of their revenue in capital-enhancing projects for procuring education and health care for their workers (Davis, 1995; Stijns, 2006). However, the evidence shows mixed findings over the impact of exploitation of natural resources on human capital accumulation; it depends on how

[1] *As a global consensus, years of formal education and schooling are considered a measure of human capital, although this may not necessarily translate into marketable skills (Becker, 1964); besides, formal education enhances the human capital stock by improving the cognitive skills for problem solving (Bowen, 1977; Pallas, 2000).*

natural resources are measured (Stijns, 2006), and whether they are divided into petroleum and non-petroleum categories (Blanco and Grier, 2012).

Nevertheless, there is a general consensus that agricultural sectors such as marine and inland small-scale fisheries tend to include non-skilled laborers (Townsley, 1998), reflecting a general lack of development of rural communities within these domains (Béné, 2004). These communities are often characterized by overcrowded living conditions and inadequate services (FAO, 2000). This impoverishment is dictated by circumstances such as lack of credit, poor organization and political representation, and lack of access to other natural resources (Béné, 2004). Such conditions fail to provide satisfying incomes and human capital enhancement, resulting in continued poverty and exclusion (Thorpe, 2004).

Thereby, small-scale fisheries are often considered last resort source of livelihood, implying that people easily involve in open access fisheries because they cannot make a living anywhere else, either due to limited experience, low capital investment capacity, or other obstacles for seeking a livelihood (Ikiara and Odink, 2000; Bailey and Jentoft, 1990).

Accordingly, this research aims to improve the general understanding of the nature of impoverishment in small-scale fisheries in Colombia. Based on data collected in fieldwork, this research will demonstrate that part of this impoverishment is caused by depreciation of human capital involved in fishing, where shellfishers with more depreciated human capital have to exert more effort in fishing. This document contains a Section 2 concerning the population context. Section 3 presents a theoretical framework explaining the dynamics of exploitation of a natural resource. Section 4 presents data analysis and estimations. Section 5 presents the conclusions and final remarks.

2. Context

2.1 Shellfishing activity

Tumaco is located 300 kilometers from Pasto, capital of the department of Nariño, Colombia. It has an area of 3,778 square kilometers, and its height is 3 meters above sea level (DANE, 2010). It is located on the border with the Republic of Ecuador and contains 21 kilometers of shore along the Pacific Ocean. It has an estimated 160,034 inhabitants, of which 84,668 belong to urban areas and 75,366 to rural areas. The average number of people per household is 4.3 people and the literacy rate is 76.9%[2] (DANE, 2005). According to Castiblanco (2002), approximately 600 persons are involved in *Anadara tuberculosa* shellfishing in the municipality of Tumaco.[3]

Shellfishing is performed by extracting the resource from the roots of the red mangrove in the marine estuaries, which are located on the mainland areas and offshore archipelagos. This activity, mostly performed by women (Borja and Cruz, 2003), lasts between 3 and 6 hours depending on tides.

The harvest per unit of effort for 1995 in Tumaco was 250 shellfish/person-day, whereas for 2005 it was less than 140 shellfish/person-day (González, 2006). The decrease in harvest per unit of effort is attributed to the significant increase in the amount of shellfishers involved in the activity (González, 2006).

In the region, there are many studies regarding the *Anadara tuberculosa*. These studies present evidence regarding its biology, population structure and its growth and mortality rates (Squires, Estevez, Barona and Mora, 1975; Portilla, 2005; Borda and Cruz 2004a). In addition, they present evidence on how the shellfishing activity and its commercialization are performed (Ardila

[2] *Literacy rate for urban area is 84,1%; for rural area is 56,2% (DANE, 2005).*

[3] *Anadara tuberculosa is a bivalve shellfish that lives and reproduces in the muddy areas of the mangroves. It is buried up to 25 centimeters deep and adhers to the roots of the red mangrove (Von Prahl et al., 1990). Shellfish sizes range from between 36 millimeters (Contreras, 1985) to 56 millimeters length (Ardila, 1989). The shellfish reaches its commercial size of 44 millimeters after 12 months, when it is considered an adult, since it has accomplished its first reproduction cycle (Borda and Cruz, 2004a). WWF et al. (2005) estimated that this municipality provides 94 million of Anadara tubeculosa shellfish/year and represents 31.65% of this species exported from Colombia to Ecuador.*

1989; Contreras 1985; Borda and Cruz 2004b). Other studies evaluate the degree of its exploitation and the effect of human pressure on the resource (Portilla and Arizala 1997; Borda and Cruz 2004c); finally, the evidence also presents findings on gender issues and child employment (Borda and Cruz 2003). However, there is not evidence explaining the relationship between the low levels of schooling and the age of shellfishers with the increase in their daily fishing effort. Due to this, our motivation is to explain that this phenomenon arises from the depreciation of shellfishers' human capital.

2.2 Population aging and human capital depreciation

According to some authors, cognitive abilities, inductive reasoning, and retentiveness start to decline around the age of 50 along with physical capabilities. Thus older laborers require more time to receive and act on signals, accelerating the loss in productivity due to aging. Nevertheless, interactive skills do not depreciate with age (Maitland, Intrieri, Schaie, and Willis, 2000; Park et al., 1999; Skirbekk, 2002; 2003; Verhaegen and Salthouse, 1997; Waldman and Avolio, 1986;).

Besides, every day older laborers turn less competitive compared to middle-aged and younger because the continuous technological progress and the change in educational systems (Autor et al., 2003). This situation denominates *human capital depreciation*, which constitutes a negative change in the value of an assets used for production. This value declines because of their physical deterioration, obsolescence and accidental damage; this value also depends upon the expected benefits from using it in production over the remainder of its service life (Ahmad et. al, 2005; Graham and Webb, 1979; Wei, 2008)

Nevertheless, laborers may undertake additional education for obtaining new skills, improving their health, or searching for better working and reward conditions (Wei, 2008). However, improving human capital differs from improving physical capital because an additional year of capacitation improves productive capacity, but comes at the cost of one less year available to work, as every worker has a finite working life.

When capital becomes obsolete it cannot move to another activity or is too costly to move. This mobility, that captures the idea that workers do not last forever in a position, encourages workers to find themselves a new job, either as a result of their old position being terminated, or as a result of receiving another more profitable position. Accordingly, the empirical evidence has demonstrated that younger laborers tend to be more mobile than older laborers, having also different returns to human capital (Rubinstein and Weiss, 2006).

As a consequence of deterioration of intellectual ability to perform more complicated and productive tasks, and having little or no education, older laborers with little hope of shifting to other occupations (Bailey, 1988; Smith, 1979) become involved in shellfishing, which constitutes a last resort (Bailey and Jentouf, 1990; Panayotou, 1988). Those unlikely to subsist by other activities rather than fishing (Dunn, 1989) are expected to work longer (Ruzik-Sierdzinska et al., 2013) and to exert higher levels of effort; whereas young shellfishers migrate to other more profitable economic alternatives outside fishing.

3. Theoretical Framework

The model presented is proposed by Blanco-Ortega and De-Gregorio (2007) and its framework considers a small open economy with a natural resources and an industrial sector. However, natural resources are not considered essential for the production of industrial goods. Both sectors utilize human capital along with other specific inputs required for each sector. The natural resources sector presents decreasing returns to human capital, and the industrial sector presents constant returns to scale. All production is sold on the international market. The prices of the commodities are exogenous and determined by the market. The price of the industrial commodity for consumption is p_I and the price of the natural resources commodity is p_R. Production functions for both sectors are expressed as follows:

$$Y_R = RH_R^{\varphi} \quad Y_I = aH_I \qquad (1)$$

The capital in the natural resources sector is *R*. It measures the endowment of natural

resources, considering many factors such as the quality and abundance of fishing banks, soil, and even climate conditions. The capital in the industrial sector is interpreted as technology and denoted by *a*. The subscripts on *H* and *Y* indicate the productive sector to which inputs are allocated. Then, the economy faces the following constraint:

$$H = H_R + H_I$$

L represents the total labor in the economy. This is constant and normalized to 1. The remaining variables are expressed in per capita terms. $L_R = H_R/H$ is the proportion of inputs allocated to the natural resources sector and $L_I = 1-L_R = H_I/H$ to industrial sectors. Thus the laborer solves the following problem and decides how to distribute the labor across sectors and how much to invest in human capital:

$$Max \int_0^{\infty} u(c_t).e^{-\beta t}\, dt$$

$$\dot{H}_t = Y - p_I c_t$$

$$Y = aH_I + p_R R H_R^{\varphi}$$

$$LH = H = H_R + H_I$$

Obtaining H_R from the first-order conditions and solving for L_R[4]:

$$L_R = \frac{1}{H}\left(\frac{p_R R\varphi}{a}\right)^{\frac{1}{1-\varphi}}$$

Where L_R is a proportion of the labor force employed in natural resource sector. This is inversely proportional to *H*, which is the level of human capital per capita. Now, transforming into natural logarithms:

$$lL_R = l\left(\frac{p_R R\varphi}{a}\right)^{\frac{1}{1-\varphi}} - lH \qquad (2)$$

As a conclusion, as long as human capital increases in the natural resource sector, the labor force decreases proportionately, and the total output obtained from this sector will decline.

4. Methodology

4.1 Data and Descriptors

This research is based on the capture record of shellfish registered during January to November 2009. These records contain information from 59 shellfishers - 32 women and 27 men - during 261 days of activity. Socioeconomic characteristics such as schooling and age were also obtained; although, by the time information was collected, 21 of shellfishers were enrolled in school, whereas the other 38 were not attending any kind of schooling. In order to take into account the active shellfishers, the records containing information of people who harvested at least once a month on average were used.

Table 1: Descriptors of information

Variable	Description	Average[a]	Min.	Max.
y	Harvest	12,014	447	38,973
L	Effort	104.56	11	244
ag	Age	34.39	9	77
sc	Years of schooling	3.27	0	11

[a] Average calculated per person-day during 261 days of harvest.

Source: Own elaboration.

The harvest per unit of effort calculated is 114.1 shellfish/person-day. When disaggregating this information, we observe that the evolution of effort exerted varied according to the age of shellfishers. Figure 1 presents how average effort increases from 58.9 to 157.91 days as the age of shellfishers increases.

[4] *The complete analysis for solving the model is presented in Blanco-Ortega and De-Gregorio (2007).*

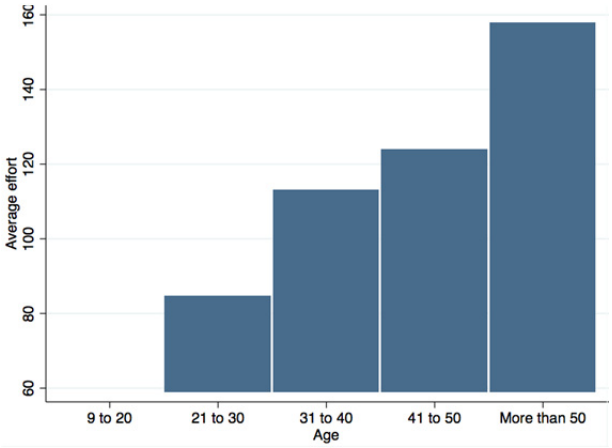

Figure 1: Effort applied according age of shellfisher
Source: Own elaboration

4.2 Human capital formation in shellfishing

According to Diewert (2003), the *cross-section depreciation* per unit of an asset is defined as:

$$\delta = V(k_i) - V(k_j) < 0 \quad (3)$$

Being k_i an asset acquired in t-1 with similar characteristics than k_j acquired in t. Thus, cross section depreciation captures the difference between the value of an asset purchased at t and another asset with similar characteristics but purchased one year earlier. This analysis relies on comparing the value of several assets of different age at the same point in time. It is important to recognize that this analysis is only possible when assets are similar except for their age (Ahmad et al., 2005).
For analyzing the accumulation of human capital among shellfishers, we run a local regression of schooling against their age, then identifying the net formation of core and cognitive-analytic skills. The non-parametric analysis indicates that the human capital tends to increase up to when shellfishers turn around 20 years of age; nevertheless from this age, human capital tends to decrease. Figure 2 shows a negative trend, as shellfishers get older.

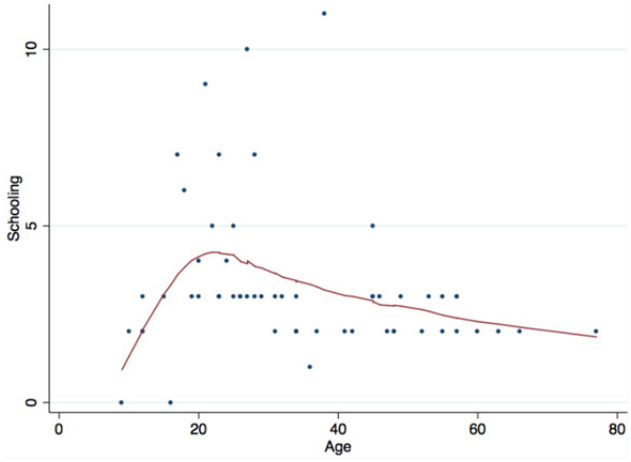

Figure 2: Human capital formation
Source: Own elaboration

In order to obtain to analyze the net human capital formation by education, we estimate the schooling-age elasticity. Following expression (4) we measure the change in the additional lifetime school qualifications.

$$lsc_i = \alpha + \delta lag_i + u_i \quad (4)$$

From expression (4) we estimate an OLS regression controlling for standard errors; the results are presented in table 2

Table 2: Human capital formation

Variable[a]	Description	Coefficient
lag	Nat. Log. Of Age	-0.281**
		(0.126)
Constant		2.063***
		(0.441)

[a] Dependent variable: Natural Logarithm of Schooling *lsc*; R^2=0.0823, *F*= 0.03.
Significance: *10%, **5%, ***1%.

Source: Own elaboration.

Then, considering the shellfisher to be a labor-intensive asset, and taking into account expression (3), when the age of a shellfisher increases by 1%, the human capital decreases. These results permit us to conclude that, as long as the population involved in shellfishing gets older, human capital diminishes, exhibiting evidence of cross-section depreciation. However, cross-section depreciation does not adequately capture obsolescence when shellfisher capacity cannot fulfill the requirements; then turning costly to upgrade their capacity and cheaper to replace them. Then, reaching the end of their service lives before they are worn out, because their actual service lives are less than their potential physical lives, they have a lower value than they would otherwise. Besides, cross-section depreciation as is defined and interpreted, assumes that the age-efficiency function of an asset is independent from its age, which is not entirely true due to comparing identical assets of different ages may be the cause of obsolescence (Ahmad et al., 2005).

4.3 Shellfishing and the effect of schooling

Figure 3 presents how shellfish harvest increases proportionally as long as effort increases. Notwithstanding this data are only for 11 months of performance, they allow us to understand how shellfishing harvest is performed.

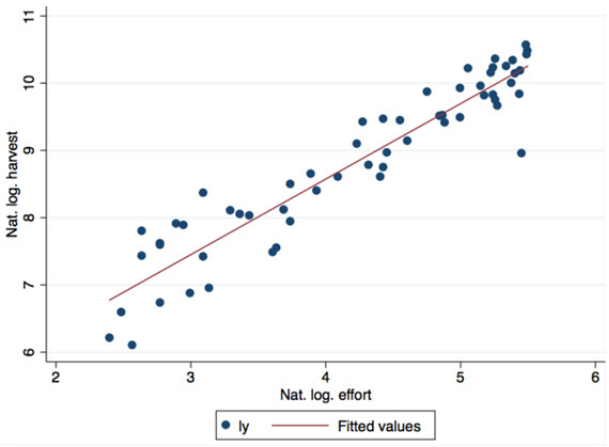

Figure 3: Shellfish harvest
Source: Own elaboration

Now, recalling the production function expressed in (1), and the solution expressed in (2), we proposed expression (5) for estimating the shellfishing production function.

$$ly = \beta_0 + \beta_1 lL_i f(l\hat{s}c_i, s_i) + \beta_2 s_i + v_i \quad (5)$$

The production function is estimated through a two-staged, seemingly unrelated, regression. First stage estimates the effect of human capital formation $l\hat{s}c$, which are fitted values from the regressions in expression (4), on the natural logarithm of effort *lL* applied to harvesting. For estimating the effect of motivation to be involved in shellfishing, a dummy variable *ds* is introduced taking value 1 when shellfishers are in school, 0 otherwise. The second stage estimates the production function of shellfishing, considering as independent the harvest *ly* transformed into a logarithm. Finally, estimations are controlled by a dichotomous variable *s* taking value 1 when the shellfisher is a woman, 0 otherwise. Results are presented in table 3.

Table 3: Shellfish production function

	Variable	Description	Coefficient
First Stage [a]	$l\hat{s}c$	Nat. Log. Human Capital Formation	-4.150***
			(1.098)
	ds	School attending	1.086***
			(0.321)
	s	Sex	0.673***
			(0.238)
	Constant		8.061***
			(1.167)
Second Stage [b]	*lL*	Nat. Log. Effort [c]	1.009***
			(0.127)
	s	Sex	-0.006
			(0.139)
	Constant		4.570***
			(0.497)

[a] Dependent variable first stage: Natural Logarithm of effort *lL*. R^2=0.293 *F*=0.0.
[b] Dependent variable second stage: Natural Logarithm of harvest *ly*. R^2=0.879, *F*=0.0.
[c] Linear test indicates $ß_i$ is not statistically different than 1.
Significance: *10%, **5%, ***1%.

Source: Own elaboration

First stage estimation presents evidence to conclude that the population involved in shellfishing exerts higher levels of effort as long their human capital depreciates. It means that shellfishers with lower levels of human capital are more involved in shellfish activity than those with higher levels of human capital.

This result exhibits some evidence of the impoverishment of shellfishing, where people with low or little education, and with few non-fishing skills, have few opportunities of shifting to another occupation (Smith, 1979). Moreover, mobility declines quickly with experience and aging imposes substantial costs to mobility across sectors (Rubinstein and Weiss, 2006). Thus shellfishers are basically locked in to the activity exerting as much effort as possible to sustain their livelihoods.

Variable *ds* for schooling, indicates that shellfishers who are still receiving education exert more effort on shellfishing. This result exhibits findings regarding the behavior of shellfisher to be contrary to expectations. Here, the result shows that shellfishers who are in school perform more frequently the activity. This can be explained as being due to their need for earnings, to afford their tuition, school supplies and other expenditures such as transportation and food. .

Estimation regarding gender in the first stage shows that women exert more effort than men in shellfishing. This result is consistent with Borda and Cruz (2003), who state that women are more involved in the activity.

Second stage estimations present a positive relationship between individual effort applied to shellfish harvesting. The estimated coefficient for *lL* indicates that activity brings constant returns to

labor and will go on proportional increasing as long effort increases. Nevertheless, this function is estimated assuming efforts applied by shellfishers are independent and does not take into account the effort of competition, natural stock of shellfish and levels of autonomous regeneration of the natural stock.

Estimations regarding gender in the second stage show that men and women have no significant differences in shellfish harvesting. This means that there are no gender differences in productivity.

The conjoint results allow the conclusion that, as long as human capital is increasing, the total output obtained from shellfishing will decrease as Blanco-Ortega and De-Gregorio (2007) state.

5. Discussions and Final Remarks

5.1 Education and effort

The results presented in this research connect to the discussion proposed by Smith (1979) on whether education and training programs designed primarily for children of fishermen result in a reduction in fishing effort. However, fishing pressure has not only been expanded by increasing efforts. Accordingly, there is a consensus about the collapse of traditional fishery management structures, policy and regulatory failures, and about limited opportunities for alternative employment, being structural circumstances that promote depletive fish harvesting practices (Anderson 1980; Cunningham, 1993; Smith 1979; Panayatou, 1988).

Findings from these research reports indicate that fishermen are in their current activity because the unavailability of finding alternative employment and their lack of education. Then, fishing becomes their only source of income. Notwithstanding, fishing is not seen as a profitable activity that yields higher profits than the alternatives (Ikiara and Odink, 2000).

In particular, fishermen with higher level of education determine the better their opportunity cost and opportunities outside the fishing sector. This cost is crucial in the exit-from-fishing decision considering that the opportunity cost of remaining in fishing is very low (Ikiara and Odink, 2000), such that they will continue fishing even if they earn far less than their opportunity costs (Panayotou, 1982).

Thus, training programs do not necessarily reduce efforts in fishing. However, education enhances human capital and democratic rights that solve failures to provide satisfying incomes, and which alleviate poverty in fishing communities. Furthermore, fishermen with higher levels of education tend to diversify their livelihoods, reducing the risk of relying only on fishing (Guerrero, Franco-Jaramillo and Rosell, 2017). In addition, the beneficial effects of schooling promotes quality of life of fisher families (Smith, 1979), encourages labor mobility and knowledge of alternative occupations (Panayotou, 1982).

5.2 Education and natural resource exploitation

Although human capital may not necessarily translate into marketable skills, it plays a vital role in driving economic growth. However, some findings in literature conclude that resource-abundant economies tend to crowd out the human capital due to their dependence on the resource. This effect is mainly a crucial transmission mechanism of the resource curse (Gylfason, 2001; Papyrakis and Gerlagh, 2004; Sachs and Warner, 2001).

Somehow, in resource-abundant countries, the proportion of natural capital in national wealth is negatively related to indicators such as public expenditure on education, secondary school enrolment and expected years of schooling for girls (Gylfason, 2001). Countries that tend to invest on average less in education than other countries (Birdsall et al., 2001), seemingly have no incentive to invest in basic skills.

Nevertheless, lower levels of human capital are a conditional variable for the occurrence of the resource curse (Kurtz and Brooks, 2011), and investing in human capital enhancement mitigates the curse, promotes efficient management of natural resources, eliminates the negative effect caused by resource booms, and encourages technological improvement (Bravo-Ortega and

De-Gregorio, 2007; Kurtz and Brooks, 2011).

However, crowding-out of human capital and the resource curse are not inevitable, yet it is conditional on the possibility of substitution between production factors and economic activities (Shao and Yang, 2014). Basically, in a resource-based economy, human capital accumulation, economic growth, and resource abundance can go in the same direction if the rate of return of investment in education is increasing.

Finally, education is required for increasing the efficiency of the labor force, and thus creating better conditions for securing economic development (Barro, 1997) and reducing dependence on natural resource exploitation (Martin, 2007).

5.3 Conclusions

In this research we find that older shellfishers exert more effort in fishing for shellfish. For 261 observations, the average effort increases from 58.9 to 157.91 days as long shellfishers get older. Estimations provide evidence of the presence of cross-section depreciation among shellfishers in Tumaco.

First stage estimation indicates shellfishers exert higher levels of effort as long as their human capital depreciates. Shellfishers rely on this activity to compliment expenditures on schooling and supplies. Estimations on gender indicate that women exert more effort than men; this result is consistent with Borda and Cruz (2003).

Second stage estimations indicate that harvests increase as long as effort increases and the production function tends to present constant returns to scale. Estimation on gender in the second stage shows that men and women harvest equally.

Results are consistent to the theoretical analysis of Blanco-Ortega and De-Gregorio (2007); as long as human capital increases, the total output obtained from natural resource sector decreases.

Finally, discussions indicate that fishermen remain in the activity because it is their only livelihood source. This is a consequence of their lack of education and the unavailability of alternative employment (Ikiara and Odink, 2000). Moreover, fishermen with higher levels of education tend to diversify their livelihoods (Guerrero et al., 2017) and move to alternative occupations (Panayotou, 1982).

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References

Ahmad, N., Aspden, C. and Schreyer, P. (2005). Depreciation and obsolescence. *Proceedings of the meeting of the Canberra Group on Non-Financial Assets*, 29. March - April 2005, Canberra.

Ardila C.L. (1989). *Diagnóstico de la pesca artesanal de moluscos en algunas regions del pacífico colombiano*. Bachelor Dissertation. Faculty of Sciences. Universidad del Valle. Santiago de Cali. Colombia.

Autor, D.H., Levy F. and Murnane, R. (2003). The skill content of recent technological change: An empirical exploration. *Quarterly Journal of Economics*, 118(4): 1279–1334. DOI: 0.1162/003355303322552801

Barro, R.J. (1997). *The Determinants of Economic Growth*. MIT Press, Cambridge, MA. 145 pp.

Bailey, C. (1988). The political economy of fishery development. *Agricultural and Human Values,* Winter- Spring: 35-48. DOI: 10.1007/BF02217175

Bailey, C. and Jentoft, S. (1990). Hard choices in fisheries development. *Marine Policy* 14(4): 333–344. DOI: 10.1016/0308-597X(90)90055-V

Becker, G. (1964). *Human Capital*. Chicago: University of Chicago Press.

Béné, C. (2004). Poverty in small-scale fisheries: A review and some further thoughts. In Carney, D. ed., *Sustainable rural livelihoods: what contribution can we make?* London Department for International Development, pp. 61-82.

Birdsall, N., Pinckney, T. and Sabot, R. (2001). Natural resources, human capital, and growth. In Auty, R.M ed., *Resource abundance and economic growth*. Oxford University Press, pp. 57-75. DOI: 10.1093/0199275785.001.0001

Blanco, L. and Grier, R. (2012). Natural resource dependence and the accumulation of physical and human capital in Latin America. *Resources Policy* 37: 281–295. DOI: 10.1016/j.resourpol.2012.01.005

Bravo-Ortega, C., and De Gregorio, J. (2007). The relative richness of the poor? Natural resources, human capital and economic growth. In: Lederman, D. and Maloney, W. eds., *Natural Resources, neither curse nor destiny*. World Bank, Washington, DC, pp. 71–99.

Borda, C.A., and Cruz, R. (2004a). Reproducción y reclutamiento del molusco *Anadara Tuberculosa* (Sowerby, 1833) en el Pacífico colombiano. *Revista de Investigaciones Marina*s 25(3): 185- 195.

Borda C.A. and Cruz, R. (2004b). Crecimiento y tasas de mortalidad del bivalvo *Anadara tuberculosa* (Sowerby, 1833) en el Pacífico colombiano. *Revista de Investigaciones Marinas*. 25(3):177-184.

Borda C.A. and Cruz. R. (2004c). Pesca artesanal de bivalvos (A*nadara tuberculosa* y A. *similis*) y su relación con eventos ambientales, Pacífico colombiano. *Revista de Investigaciones Marinas*. 25(3):197-208.

Borda C.A. and Cruz, R. (2003). Estado de explotación y pronóstico de la pesquería de *Anadara tuberculosa* (Sowerby, 1833) en el Pacífico colombiano. *Revista de Investigaciones Marinas* 24(3): 221-230.

Bowen, H.R. (1977). *Investment in Learning: The Individual and Social Value of American Higher Education*. Jossey-Bass, San Francisco. USA.

Castiblanco, C. (2002). Valoración parcial de los bienes y servicios que provee el ecosistema de manglar. *Gestión y Ambiente* 5(2): 21-43.

Contreras R. (1985). *Moluscos de importanciaeconómica y suexplotaciónartesanalen la costa pacíficacolombiana* (subfamilia *Anadarinae*: *Arcidae*). Bacherlor Dissertation. Faculty of Sciences. Universidad del Valle. Santiago de Cali. Colombia.

Cunningham, S. (1993). *Fishermen's incomes and fisheries management*. Research Paper No.61, Portsmouth. CEMARE, University of Portsmouth, 22 pp.

Departamento Nacional de Estadística Colombia, DANE (2005). CENSO de 2005. *Proyecciones de población*: 2005- 2010. Online source: www.dane.gov.co

Departamento Nacional de Estadística Colombia, DANE (2010). *Colombia en cifras. Información por departamentos*. Online source: www.colombiestad.gov.co

Davis, G.A. (1995). Learning to love the Dutch disease: Evidence from the mineral economies. *World Development* 23: 1765–1779. DOI: 10.1016/0305-750X(95)00071-J

Diewert, W.E. (2003). *Measuring capital. National Bureau Of Economic Research* Working Paper Series No. 9526.

Dunn L.G. (1989). *Development of inland fisheries under constraints from other uses of land and water resources: guidelines for planner*s, Rome: Food And Agriculture Organization (FAO), 53 pp.

Food And Agriculture Organization, FAO. (2000). *Poverty in coastal fishing communities.* Advisory Committee on Fishery Research Third Session 5-8. December 2000, Rome.

Graham, J.W. and Webb, R.H. (1979). "Stocks and depreciation of human capital: New evidence from a present value perspective." *Review of Income and Wealth* 25(2): 209–224. DOI: 10.1111/j.1475-4991.1979.tb00094.x

Gonzalez, J. (2006). *Reglas de manejo, percepciones y estadodelrecursopingua* (*Anadara tuberculosa*): Caso ASCONAR, Tumaco, Nariño (Colombia). Pontificia Universidad Javeriana, Bogotá. Bachelor Dissertation in Ecologics. Santafé de Bogotá. Colombia.

Guerrero, D., Franco-Jaramillo, M. and Rosell, J. 2017. The lack of alternative income sources: The case of ornamental fishing in the Inirida fluvial confluence, Colombian Amazon. *Economía Agraria y Recursos Naturales* 17(2): 81-103. DOI: 0.7201/earn.2017.02.04

Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review* 45: 847–859. DOI: 10.1016/S0014-2921(01)00127-1

Gylfason, T. (2008). *Development and growth in mineral-rich countries*. Center for Economic Policy Research. Discussion Paper No. 7031.

Ikiara, M.M. and Odink, J.G. (2000). Fishermen resistance to exit fisheries. *Marine Resource Economics* 14: 199–213. DOI: 10.1086/mre.14.3.42629265

Kurtz, M.J. and Brooks, S.M. (2011). Conditioning the resource curse: Globalization, human capital, and growth in oil-rich nations. *Comparative Political Studies* 44: 747–770. DOI: 10.1177/0010414011401215

Maitland, S.B., Intrieri, R.C., Schaie, K.W. and Willis, S.L. (2000). Gender differences and changes in cognitive abilities across the adult life span. *Aging, Neuropsychology, and Cognition* 7(1): 32-53. DOI: 10.1076/anec.7.1.32.807

Malmberg, B., Lindh, T. and Halvarsson, M. (2008). Productivity consequences of workforce aging: Stagnation or horndal effect? In Prskawetz, A., Bloom, D.E. and Lutz, W. eds., *Population and Development Review*, vol. 34, pp. 238- 256.

Martin, W. (2007). Outgrowing resource dependence: Theory and development. In: D. Lederman, D. and Maloney, W. eds., *Natural resources, neither curse nor destiny*. Policy Research Working Paper No. 3482. World Bank, Washington, DC, pp. 323-355

Ruzik-Sierdzinska, A., Lis, M., Potoczna, M., Belloni, M. and C. Villosio. (2013). *Age and productivity. Human capital accumulation and depreciation*. Center for Social and Economic Research, CASE Network Reports No. 114.

Pallas, A.M. (2000). The effects of schooling on individual lives. In: Hallinan, M.T. ed., *Handbook of the Sociology of Education*, pp. 499-526. DOI: 10.1007/0-387-36424-2_23

Panayotou, T. (1988). *Management concept for small-scale fisheries*. Food and Agricultural Organization. Fisheries Technical Paper No.228. Rome, 53 pp.

Papyrakis, E. and Gerlagh, R. (2004). The resource curse hypothesis and its transmission channels. *Journal of Comparative Economics* 32(1): 181–193. DOI: 10.1016/j.jce.2003.11.002

Park, D.C., Nisbett, R.E. and Hedden, T. (1999). Culture, cognition, and aging. *Journal of Gerontology,* 54B: 75-84. DOI: 10.1002/9781118521373.wbeaa210

Portilla, E.G. 2005. *Algunos aspecto biológicos del recurso piangua (Anadara tuberculosa), con tallas comerciales de los centros de acopio de los municipios de Francisco Pizarro y Tumaco*. Tecnical Report. Ministerio de Agricultura, INCODER- GIEP, Tumaco. 24 pp.

Portilla, E.G. and Arizala. L.A. (1997). *Algunos aspectos biológicos-pesqueros de la piangua (Anadara tuberculosa y Anadara similis) realizada con la asociación de concheras de Nariño (ASCONAR) en la ensenada de Tumaco.* Tecnical Report. Ministerio de Agricultura y Desarrollo Rural, Instituto Nacional de Pesca y Acuicultura (INPA), Tumaco 28 pp.

Rubinstein, Y., and Weiss, Y. (2006). Post schooling wage growth: Investment, search and learning. *Handbook of the Economics of Education* 1: 1-67. DOI: 10.1016/S1574-0692(06)01001-4

Shao, S. and Yang, L. (2014). Natural resource dependence, human capital accumulation, and economic growth: A combined explanation for the resource curse and the resource blessing. *Energy Policy* 74: 632–642. DOI: 10.1016/j.enpol.2014.07.007

Smith, I. (1979). *A research framework for traditional fisheries*. ICLARM Studies Review (2), Manila. 45p.

Skirbekk, V. (2003). *Age and individual productivity: A literature survey*. MPIDR Working Pape*r* 2003-028. Max Planck Institute for Demographic Research, Rostock.

Skirbekk, V. (2002). *Variations in productivity over the life span: A review and some implications.* Laxenburg: International Institute for Applied Systems Analysis, Interim Report IR-02-061.

Stijns, J.P. (2006). Natural resource abundance and human capital accumulation. *World Development* 34(6): 1060–1083. DOI: 10.1016/j.worlddev.2005.11.005

Squires, H.J., Estevez, M., Barona O. and Mora., O. (1975). Mangrove Cockles, *Anadara* spp. (Mollusca: Bivalvia) of the Pacific Coast of Colombia. *The Veliger*. 18(1): 57-68.

Thorpe, A. (2004). The nature and causes of poverty: An overview. In Carney, D. ed., *Sustainable rural livelihoods: what contribution can we make?* London Department for International Development, pp. 9-36.

Townsley P. (1998). Aquatic resources and sustainable rural livelihoods. In Carney, D. ed., *Sustainable rural livelihoods: what contribution can we make?* London Department for International Development, pp. 139-153.

Verhaegen, P. and Salthouse T.A. (1997). Meta-analyses of age-cognition relations in adult- hood: Estimates of linear and nonlinear age effects and structural models. *Psychological Bulletin* 122(3): 231–249. DOI: 10.1037//0033-2909.122.3.231

Von Prahl, H., Cantera, J. and Contreras, R. (1990). *Manglares y hombres del pacífico colombiano*. Fondo Eléctrico Nacional FEN, COLCIENCIAS. Primera edición. Santafé de Bogotá. Colombia.

Wade, R. (1992). East Asia's economic success: Conflicting perspectives, partial insights, shaky evidence. *World Politics* 44(2): 270–320. DOI: 10.2307/2010449

Waldman, D.A. and Avolio, B.J. (1986). A meta-analysis of age differences in job performance. *Journal of Applied Psychology* 71: 33-38.

Wei, H. (2008). *Measuring Human Capital Flows for Australia: A Lifetime Labour Income Approach*. Australian Bureau of Statistics, Research Paper no. 1351.0.55.023

World Wildlife Fund Colombia, Fundación Ambiental Chonapi, Consejos Comunitarios, Alcaldías Municipales, UMATAS y Organizaciones de base y líderes comunitarios (2005). *Diagnóstico socioeconómico del sector piangüero y estado actual del recurso hidrobiológico Piangua en la costa Pacífica de Nariño*. Technical Report, Santiago de Cali.