REGULAR ARTICLE

Weak levels of social capital as one of the causes of the fall of Mexican cacao production

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ABSTRACT

Cacao beans belong to key agricultural crops on global scale, yet their production faces a dramatic fall in the capacity coupled with increasing global demand, often denominated as "the cacao crisis". The fall of production of this crop in Mexican agriculture can be emblematic for global production. The country where cacao beans were first domesticated, is experiencing a vertiginous drop of plantation surface thus creating a serious concern not only for diversity of local production, but also for genetic and historical legacy as plantations are ebbing away due to substitution of cacao plantations with more rentable commercial crops. The paper tries to answer the question on the motives behind such a decrease on the base of data stemming from cacao producers of Tabasco region applying the lens of social capital and derives the conclusion that a collective action fuelled by social capital may be crucial for prosperity of the plantations. Collaboration and knowledge sharing thus may be of more importance for the future of cacao production than the fight against a single cause believed to be the fall of production such as the invasion of Moniliophthora roreri fungus.

Keywords: Social capital; Cacao; Mexico; Moniliophthora roreri; Mincerian function
Journal of Economic Literature (JEL) classification: 013, 017, N96

INTRODUCTION

Theobroma cacao (Food of the Gods) belonging to the family Sterculiaceae (alternatively Malvaceae) is one of the world's most important crop consisting of three types: Forastero, Criollo and Trinitario. Cacao trees are cultivated in 58 countries with 4.6 million tons cacao beans produced worldwide and generating about US$ 4.5 billion per year, while the world production is distributed as follows: Africa 66%, Americas 15%, Asia 18% and Oceania 1% (Faostat, 2015). Ivory Coast, Ghana, Indonesia, Nigeria and Cameroon are the first five countries in cacao producing (Table 1).

The production of Mexican cacao is concentrated mainly in states of Tabasco and Chiapas, where the domestication began during the era of Maya civilization and developed into agroforestry systems (Gomez-Pompa and Kaus, 1990). The agricultural strategy which was applied by old civilizations in Mexico was focused to preserve plant diversity in order to increase the production and resistance against diseases (Whitkus et al., 1998). The main challenge faced by cacao farmers in Mexico today is the moniliasis fungus which leads to decrease of cacao yields and reduces the competitive capacity of producers in international markets (Díaz-José, 2014), also being accompanied by an inefficient analysis and data collection (Rajasri and Ramachandra, 2017). The Mexican agricultural sector also in recent decades suffers from climate variation, also due to a high sensibility of cacao plants to rainfall and sunshine in addition to mentioned pest infestation, which is a phenomenon also noted in Western Africa (Ajayi et al., 2010; Adeniyi and Ogunsola, 2014). However, not only biological and atmospheric influences are responsible for reduced levels of cacao production. There are many studies documenting the effect of social capital in improving the income of rural cacao producers for example in Nigeria (Agboola et al., 2016; Balogun et al., 2011), having a significant influence on both productivity and credit access

Table 1: Top 10 Cacao producing countries

Rank	Country	Production (tons)
1	Cote d'Ivoire	1,448,992
2	Ghana	835,466
3	Indonesia	777,500
4	Nigeria	367,000
5	Cameroon	275,000
6	Brazil	256,186
7	Ecuador	128,446
8	Mexico	82,000
9	Peru	71,175
10	Dominican Republic	68,021

Source: Worldatlas. 2015

from different sources (Agboola et al., 2016). In addition, levels of social capital are related well known positive effects on household welfare (Adepoju and Oni, 2012) by improving the standard of living for both individuals and households, and maximization of household per capita expenditures (Yusuf, 2008; Omonona et al., 2014), which in turn increases the sustainability of rural production of cacao (Olalekan and Dolapo, 2015). Social capital also can play a vital role with human development and poverty alleviation strategy in rural area (Rupasingha and Goetz, 2007. One of the problems faced by cacao producers is the lack of market information and price fluctuation between markets in addition to the current weaknesses of rural markets (Teal et al., 2006). In this context, another study on cacao in Ghana had recommended the use of mass media, needed for dissemination of the necessary information about cacao production technology and innovation related information to the farmers (Nana Yaw et al., 2013), so that they could secure access to needed information flow leading to a more efficient cooperation. Social capital, being an alternative denomination for an intensity of a networked population, can be thus crucial for inhabitants of those isolated areas, whose means of livelihoods as well as of cultural values are dependent on biotic resources (Zeleke, 2016). The mentioned effects of social capital on cacao production were confirmed by several studies such as a Nigerian study by Nmadu et al. from 2015, related to adoption of new technologies with limited intervention from extension services or a study from Southern Philippines related to positive effects on soil conservation (Cramb, 2005). Besides, the increase of the role of cooperatives in the field of agricultural marketing could enhance levels of social capital which in turn could improve the economic performance and thus indirectly the care of cacao plantations (Valentinov, 2004; Luo and Wang, 2010; Liang et al., 2015), while playing a crucial role in the linkage of farmers to collective initiatives (Megyes et al., 2010). A study by Priyanath and Premaratne (2015) conducted in Sri Lanka referred to the important role of social capital leading to an increased access to necessary

information in suitable time providing positive effects by decreasing the transaction costs.

SOCIAL CAPITAL AS A SUBSTANTIAL ELEMENT OF THE CACAO PRODUCTION PROCESS

Cacao production has been noted as a contributing factor for the economic growth of Mexico. However, there has been a general decline in the production rate of cacao in the country (Díaz-José, et al., 2013). To analyse the declining nature of the cacao industry in Mexico and to ascertain the possible link between social capital and cacao production in Mexico, it is of enormous importance to understand the concept of social capital. Social capital has been identified as one of the most important powerful and emblematic topics in most social science research in current times (Durlauf and Fafxhamps, 2005). The notion of social capital is not new but limited research has been conducted to ascertain the relationship between social capital and development (Fafchamps, 2006). Many authors employing varied methodologies have tried to explain the nexus that exist between social capital and economic development (Yusuf, 2008).

The concept of social capital, described by Putnam (1995) connections among social networks and the trustworthiness as well as reciprocity of norms, is not new and its usage in social science research has been wide spread due to its importance in this research area. However, since its inception into the area of social science by Putnam (1993), there is not a vivid definition of the term as different authors in this research field have given varied meanings to the term since its inception (Durlauf & Fafxhamps, 2005). Coleman (1990), in his definition of social capital suggested that, social capital is part of a social organisation that enables such organisation to arrive at set goals that could only be achieved at a high cost in the absence of social capital (Coleman, 1990). Adding to this, Putnam et al., (1993) refers to social capital as organizational characteristics such norms, trust, and networking that can help a social organisation to achieve efficiency (Putnam, 1993). The two authors see social capital as an integral part of any social organisation that cannot be ignored for a successful operation of an organisation. Contrary to the above definitions, Fukuyama (1997) and Ostrom (2000) viewed social capital in a different dimension. Fukuyama opined that, social capital is not only the norms of an organisation but also it encompasses all informal rules and norms that exist in an organisation which enables cooperation between individuals in an organisation (Fukuyama, 1997). Also Ostrom expanding on the definition given by Fukuyama stated that, social capital includes all rules, norms, expectations and shared knowledge that exist in an organisation that facilitates interactions among individuals

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in an organisation on recurrent activities (Ostrom, 2000). More so, Bowles and Gintis (2002) expanded the notion of social capital from the organizational level to the community level. The authors stated that, social capital is the willingness of individuals to abide by the norms of a community and to push those who do not and encompasses trust and concern for one's associates (Bowles and Gintis, 2002). Based on the above definitions, it could be said that, social capital forms an integral part of any organisation and community as a whole. Many scholars have tried to analyse the relationship between social capital and development. Adepoju and Oni (2012) working on Investigating Endogeneity Effects of Social Capital on Household Welfare in Nigeria and employing the Control Function Approach found out that, social capital is significantly affect the welfare of farm households in Nigeria and it is endogenous to household welfare (Adepoju and Oni, 2012). Also, Lawal et al. (2009), using Tobit regression analysis on the determinants of access to credit among cacao farmers in Nigeria concluded that, social capital affects the accessibility of credit by cacao farmers in Nigeria. The age of the household, gender and experience were the most found factors affecting the ability of cacao farm households to have access to credit (Lawal, et al., 2009). Adding to this, Agboola et al., (2016), in their study on effects of Social Capital and access to Microcredit on productivity of arable crop farmers in Nigeria, concluded that, social capital has a positive influence on productivity and is an important factor in improving the income of members of local institution (Agboola, et al., 2016). Social capital was also found to have a positive influence on asset generation by cacao farmers in Cameroon (Cosyns, et al., 2013). The authors suggested that, social capital is important for the sustainability and development of farming households and has a complex influence on capital generation. The Abia State research which was done in South-Eastern Nigeria confirmed that female cacao producers were positively affected by organization and extension of collaborating institutions (Obinna and Ifenkwe, 2013) and that that education as well as farming experience increased cacao production through adoption of modern technologies as well through dissemination of information on cacao technologies (Nmadu et al., 2015). These findings were later on confirmed by Adeogun in 2010. The study of Yahaya et al. done in 2015 confirmed that demographic characteristics influenced significantly cacao production. Social capital, which as described in words of Wollcock (2001) facilitates a collective action through networked relationships thus seems to affect in an important the economic growth and in this regard also the cacao production, while trust and networking demonstrate positive spill-overs that could be one of the crucial factors which possibly stand behind the falling cacao production in Mexico.

METHODOLOGY

Data
The collection of data set was organized to take place in February 2016 in the C-16 Gral. Emiliano Zapata region close to city of Cardenas in Central Tabasco, in South-eastern Mexico. There were 101 semi-structured questionnaires combining 50 principal questions with 230 sub-questions to be distributed among local cacao smallholders. The questionnaire comprised of closed as well as open ended, dichotomous as well as contingency types of questions and was intended to measure agricultural and socio-economic standing of smallholders. The collection was executed by agronomists and economists in a joint collaboration between Czech University of Life Sciences Prague, Autonomous University Chapingo, the Municipality of Cardenas with the support of Tabascan Association of Cacao Producers. Unprecedented in Cardenas, the region was chosen for data collection for its historical importance in cacao production and the fact that the production of cacao in Tabasco State ranks 3rd in its economic importance on state level, while reaching 1st in terms of cacao plantation surface on national level. The principal cacao production in Tabasco is distributed between four municipalities of Cardenas, Comacalco, Cunducan and Huimanguillo (Ramirez-Meneses et al., 2013). C-16 Gral. Emiliano Zapata, positioned on a coastal plateau at altitude of 10 meters is the most important cacao plantation in Cardenas. According to the 2010 censusi, there were 3684 inhabitants in the C-16 municipality, with 7.7% occurrence of illiteracy, scattered presence of indigenous tribes (0.11%) with cacao being a principal cash, with 818 producing farms, out of which only 0.71% were equipped with computer as per data provided by municipality of Cardenas from 2010. The descriptive statistics of highlighted variables that formed the questionnaire is described in Table 2 and 3 below.

Theoretical framework applied and definition of social capital variables
The inconsistent and wide open definitions of social capital resulted in definition of several dimensions of social capital, tailored for this specific work. As to the social capital characteristics, the concept can be grouped into relational dimensions, resource dimensions and structural dimensions, However, other dimensions of social capital exist as per concepts of Molina-Morales and Martínez-Fernández, (2010), including expressive and instrumental ties, relational dimensions as well as cognitive and structural dimensions. On individual level is social capital to be divided benefits or potential benefits enjoyed by protagonists due to social networking, while communal level of social capital includes civic spirit, adherence to beneficial norms and community trust (Kilduff and Krackhardt, 1994). The trust is one of the key dimensions,

Table 2: Descriptive statistics of chosen collected variables

Descriptive statistics variables	Age	Years of experience	Family members			Surface of cacao plantation	Number of trees	Age of trees	Height of trees
			Men	Women	Children				
Mean	58.41	26.37	1.85	1.87	1.44	2.21	1266.24	29.07	4.43
Standard error	1.41	1.12	0.1	0.1	0.14	0.18	94.36	1.3	0.13
Median	58	25	2	2	1	2	1200	30	4
Mode	50	30	1	1	1	1	600	30	5
Standard deviation	14.1	10.85	0.96	0.97	0.8	1.84	948.35	13.06	1.26
Sample variance	198.73	117.7	0.92	0.94	0.64	3.37	899371.7	170.69	1.58
Kurtosis	−0.54	−0.45	1.61	1.3	−0.23	11.1	13.55	28.49	4.82
Skewness	0.13	0.02	1.3	1.22	0.22	3.19	3.26	3.82	1.39
Range	70	50	4	4	3	9	5720	120	8
Minimum	26	5	1	1	0	1	480	5	2
Maximum	96	55	5	5	3	10	6200	125	10
Count	100	94	92	93	32	100	101	101	100

Table 3: Descriptive statistics of chosen collected variables

Descriptive statistics variables	Chemical protection cost per 1 Ha	Pruning cost per 1 Ha	Quantity produced - baba	Total monthly production					
				Jan	Feb	Mar	Oct	Nov	Dec
Mean	197.4	496.08	1044.55	214.65	218.27	211.14	232.17	237.32	235.74
Standard error	18.51	31.29	64.01	12.4	13.74	13.78	13.71	15.04	13.86
Median	166.67	425	1000	180	175	160	200	200	200
Mode	250	500	1000	300	300	300	300	300	300
Standard deviation	186.04	314.46	643.27	124.65	138.04	138.44	137.77	151.19	139.34
Sample variance	34611.32	98887.77	413795.05	15536.63	19055.22	19166.94	18979.8	22857.68	19414.69
Kurtosis	26.37	0.84	14.15	3.96	2.34	3.7	0.81	6.17	3.1
Skewness	4.33	1.01	2.95	1.48	1.41	1.48	0.99	1.84	1.43
Range	1474	1465	4900	785	685	840	680	980	780
Minimum	26	35	100	15	15	10	20	20	20
Maximum	1500	1500	5000	800	700	850	700	1000	800
Count	101	101	101	101	101	101	101	101	101

as well as rules and norms that govern social action along with information flow capacity and sanctions (Coleman, 1990), social interaction types and network resources. The framework upon which the interpretation of the analysis is based can be therefore described by the following and bellow mentioned illustrative hypothesis (a,b,c).

a. Participations in voluntary associations increases the social capital (Narayan and Pritchett, 1997)
b. Higher accumulation of social capital is propelled by networking (Coleman, 1990; Putman, 1993)
c. Social capital level is enhanced by interaction and mentoring as well as mutual support leads to higher social capital (Narayan and Pritchett, 1997; Wollcock, 2001)

The summarization of the abovementioned definitions thus permit creation of intersections with the available data, guided by the assumption that social capital is a sum of the variables collected in the questionnaire and putting put social capital prone qualities or Trust, Rules and Normes,

Types of social interaction and Network resources as described below in Table 4.

Objectives and hypothesis

The aim of this study is to demonstrate the apparent linkage between the cacao producers' behaviour which is possibly to be narrated as a function of social capital, which is a measureable concept despite its complexity - and production output. In case of and evidenced link, an explanation of one of the motives for the falling production of Mexican cacao, would provide an insight for a new paradigm of explanations of agronomic phenomenon, not related to market induced failures nor to biology based explanations, but rather stemming from insufficient or weak collaboration patterns between humans. In a more detailed view, the aim of the study is to prove a link between very concrete characteristics of variables of a cacao production such as the profitability per smallholder, annual production per hectare or a combination of production processes that include shortening of cacao trees or pruning and social capital

Table 4: Dimensions of social capital

Dimensions of social capital	Question number	Questions in the questionnaire
A. Trust	5	Years of experience
	44	Increased level of confidence
B. Rules and norms governing social action	3	Education
	6	Children studying university degree
C. Types of social interaction	16	Relative economic Importance of the activity
	29.34	Assessment by professional agronomists
	29.36	Group work participation
	29.38	Experience interchange
	43	Participation in the past year
	33	Technical assistance
D. Network Resources	7	Number of family members
	13	Number of families living the household
	29.35	Membership in an organization
	29.40	Institutional relationship

Table 5: Variables applied in Formula 1

y_i	A dependent variable y in market i related to cost of plantations cacao, where P corresponds to annual production cost, Ha corresponds to surface in hectars and S to number of trees per hectar $$y_i = \left[\Sigma \frac{P_i}{H_i} \right] / S_i$$
y_o	Average cacao cost of 20% producers with low social capital according to pareto principle
A_i, B_i, C_i, D_i	Be independent variables related to different type of social capital A as calculated in Table No. 1
$\beta_{1,2,3,4}$	Be the coefficient of χ: social capital A, B, C, D
α	Be the intercept of the regression line and the Y axis
ε_i	Be an error term - residual value describing market i
$\acute{\omega}_i$	$$\omega_i = \ln \left(\frac{AP * HP}{C_P * C_{Ch}} \right) / T_i$$ Be a performance variable of Cacao care per a tree unit where AP = Age of plants HP = Height of plants C_P = Cost of pruning C_{CH} = Cost of chemical care Ti = Number of cacao trees

Table 6: Variables applied in Formula 2

$\acute{\omega}_i$	Be a performance variable of Cacao care per tree as described in Table 1
A_i, B_i, C_i, D_i	Be the independent variables related to different type of social capital A as calculated in Table No. 1
$\beta_{1,2,3,4}$	Be the coefficient of χ: social capital A, B, C, D
α	Be the intercept of the regression line and the Y axis
ε_i	Be an error term-residual value describing market i and time t
$\acute{\omega}_0$	Average performance of 20% of producers with low productivity, according to pareto principle as per mincerian equation

derived characteristics such as trust, interaction between producers and auxiliary organizations, norms and rules, and network related effects. The following hypothesis were formulated in order to find an evidence between the social capital of smallholders as comprehended through the lens of the Theory of Social Capital, and its production impact due to information transfer, information access, collaboration as well as access to infrastructures and networks.

H₁: There is a significant relationship between Social Capital understood as a sum of Social Capital dimensions A+B+C+D associated with a producer and the cost of annual production of cacao per hectare.

H₂: Social capital of type A has higher impact than Social capital of dimension B, C and D on the productivity of the producers.

H₃: There is a significant relationship between an annual production per hectar associated with a producer and a combination of pruning, reduction of height of cacao trees and age of the producers.

Estimation method used

The chosen variables were compared with four chosen Social Capital indicators, looking for a confirmation of a relationship employing Mincer's regression model on cross sections of data analysis with fixed effects, within Ordinary Least Square (OLS) method, as in formula below. The convenience of framework of Mincer lies in its capture of two different economic concepts in parallel. While original the wage function reveals labor market rewards for assets such as experience, the rate of return of education gives a comparison used to determine the optimal human capital investments (Heckman, et al., 2003). The tailored substitution of the original Mincer was done through substitution of earnings (y) by cost variable of cacao production per tree and analogically of y_0, while years of schooling were substituted by Social Capital$_{A,B,C,D}$ and Cacao Care variable. In the first calculation of the Regression 1 (Formula 1) the statistical relationship between the annual cost of maintenance of cacao 1 ha and the Social Capital$_{A+B+C+D}$ sets was sought, while providing an answer to the H$_2$.

$$\ln y_1 = \ln y_0 + \beta_1 A_i + \beta_2 B_i + \beta_3 C_i + \beta_4 D_i + \omega_i^2 + \varepsilon_i$$

Formula 2. Regression 1: The relationship between selected types of social capital and cost of plantation care per tree unit.

In the second calculation of Regression 2, the Cacao Care variable and Social Capital$_{A+B+C+D}$ were provided, employing the Formula No. 3 below. The Cacao Care variable is provided in Formula No. 2.

$$\ln \omega_i = \ln \omega_0 + \beta_1 A_i + \beta_2 B_i + \beta_3 C_i + \beta_4 D_i^2 + \varepsilon_i$$

Formula 3. Regression 1: Relationship between the Cacao Care variable and Social Capital$_{A+B+C+D}$.

Statistic fit and F-test was applied for both calculations in order to confirm the robustness.

RESULTS AND DISCUSSION

The first calculation in Table 7 below reveals that there is not to be found a convincing relationship between social capital and cacao cost her hectare, as all p-values are above the required 5% threshold (A=0.47; B=0.16; C=0.43; D=0.91, CacaoCare =0.11).

In the second examination as per Table 8 below, in a similar tone most of the variables could not be considered as statistically significant as the p-values exceed the 5% threshold (A=0.19; B=0.37; D=0.80). However, the social capital of type C shows signs of statistical relationship with Cacao Care dependent variable due to p < 0.012.

The results show a surprising result of a low importance of social capital on cost of cacao plantation maintenance and therefore the hypothesis on a significant relationship between social capital associated with a producer and cost of plantation care could not be confirmed. In other words, producers with a low level social connectivity level are not necessarily tied to less efficient employment of means in their cacao production business. The result implies low certainty when regarding the interpretation of results of second hypothesis H$_2$, which therefore could not be confirmed. The third hypothesis however could be considered as confirmed due to the statistically significant relationship which appears between the variable of Cacao Care and social capital associated with a producer and his/her social interaction such as group work, requested technical assistance, interchange of experience or assessment by experts as described in C type of social capital. Selection of approaches which include pruning, age of the producers and reduction of height of cacao trees can be indeed boosted by incremented social capital. This type of social interaction thus may be important for the implementation of new practices and these in turn could be essential for the fight against moniliasis outbreak, with a higher importance than network resources, norms implemented through external action and trust related processes.

CONCLUSION

The study proposed an enhancement of an agronomic approach related to solutions of complex agro industrial challenges through considerations of social capital as a crucial element within the agroindustry itself. Ecosystems of smallholders should be considered as vital for the success of agroindustry independently or rather in parallel with natural conditions for the respective crops. In this case, Mexican cacao produced in Tabascan plantations could be considered a role model and an example for such questioning in other agro industries. The demographic situation in the field, where the mean age of producers lies around 58 years, must have necessary implications on the state of the art of the production system, not speaking about more important algorithms embedded in the way communities interact, learn and collaborate with external stakeholders. The character of these ecosystems and social capital involved in the structures must inevitably impact on plantations of sensitive crops such as cacao. Possibly, this study opens a new chapter of analysis of social interactions between smallholders in developing agro industries that depend on the way they tackle their challenges on processing

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Table 7: Model 1: OLS with cost per unit of tree as the dependent variable

	Coefficient	Standard error	t-ratio	P value
constant	−0.1342	0.287635	−0.4666	0.6419
Cost of low productivity 20% of producers	1.96842	3.07944	0.6392	0.5243
A	0.00197668	0.00271783	0.7273	0.4689
B	0.0656093	0.0462887	1.4174	0.1597
C	0.0393758	0.05038	0.7816	0.4365
D	−0.00291805	0.0285317	−0.1023	0.9188
Cacaocare	−3.85136e-06	2.40703e-06	−1.6001	0.1130
Mean dependent variable	0.333647	S.D. dependent variable		0.308959
Sum squared resid	8.866742	S.E. of regression		0.310447
R-squared	0.061733	Adjusted R-squared		−0.009657
F (7, 92)	0.864726	P-value (F)		0.537478
Log-likelihood	−20.75072	Akaike criterion		57.50143
Schwarz criterion	78.34279	Hannan-Quinn		65.93631

Table 8: Model 2: OLS with the dependent variable of Cacao Care per tree unit

	Coefficient	Standard error	t-ratio	P value
constant	−7088.91	12274.3	−0.5775	0.5650
A	151.003	114.007	1.3245	0.1885
B	1757.45	1956.71	0.8982	0.3714
C	5355.59	2087.61	2.5654	0.0119 **
D	−307.757	1222.78	−0.2517	0.8018
Mean dependent variable	2345.673	S.D. dependent variable		13503.90
Sum squared resid	1.67e+10	S.E. of regression		13310.08
R-squared	0.086789	Adjusted R-squared		0.028499
F (6, 94)	1.488925	P-value (F)		0.190368
Log-likelihood	−1098.810	Akaike criterion		2211.619
Schwarz criterion	2229.925	Hannan-Quinn		2219.030

interchange between producers and which has got significant impact on the conditions of plantations. Collective work and frequent interaction according to the study are possibly a key to successful maintenance of plantations and could represent an explanation providing illuminating insight for the fall of cacao in Southern Mexico. Even if the paper can raise a question on the extent to the claim of the Mincer model on the exogeneity of the productive efficiency, the message of this result on pointing at social interaction as the most important class of social capital is distinct and could be a signal for the focus of subsidies in the cacao producing sector. This could be essential for the sectorial perspective, especially during an era of fight against a rapidly expanding plague that is according to cacao producers also fomented by ancient practices that naturally support the dissemination of spores of moniliasis, such as insufficient pruning and excessive height of the cacao plants.

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of information, which passes through community filter and which is subject to hesitant acceptation in case of rather less connected communities. The study employed the lens of Mincerian wage function, substituting variables proposed by Mincer by cacao cost being a function of cacao output in panorama with related data from Central Tabasco region, yielding a result that seems to confirm that a certain type of collective action has the potential to significant influence the adoption of new practices thus implementing of innovations in the countryside.

While the first group of results does not show any evidence on the relationship between different types of social capital and between the costs of maintenance of plantations which could be considered as a function of plantation output, according to the second group of results there is indeed a particular type of social capital that seems comprise of different algorithms such as the interaction between producers, periodic assessment by professionals, participation in community encounters and experience

Author contributions
T. Hes participated in the data conceptualization as well as collection, created the statistical model along with the theoretical framework, analyzed data and originated portions of all sections of the paper. H. Sulaiman and S.Mintah provided literature reviews and sectorial background information. S. Banda Arrieta, B. Ramírez Esquivel, T. Martínez Saldaña and J. A. Ruiz Hernandez conceived and organized the data collection, contributed theoretically and participated in the data analysis.

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