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Do Cultural Capital and Social Capital Matter for Economic Performance? An Empirical Investigation of Tribal Agriculture in New Caledonia

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Do Cultural Capital and Social Capital Matter for Economic Performance? An Empirical Investigation of Tribal Agriculture in New Caledonia

Abstract

This paper proposes an empirical investigation of the impact of social relations, referred to as structural social capital, and cultural values, referred to as intangible cultural capital, on tribal agricultural production in New Caledonia. By using microdata from an original survey on tribal communities, we construct a simultaneous equations model to explore the mechanisms by which cultural values and social relations interact with agricultural performance. Several original findings emerge from this study. First, agricultural performance (production and yield) is a result and, simultaneously, an explanatory factor of social relations, highlighting the limited substitutability between these two sources of wealth (agriculture and social capital) is observed. Second, cultural values appear to be an explanatory factor of tribal social relations and thus indirectly affect economic performance. Moreover, our results suggest that the complementarity between the forms of capital is essential for the extensification—maintenance/scaling up—of tribal agriculture (crop production) and even more essential for the intensification (performance, i.e. crop yield) of this activity and the persistence of social ties. Our results thus show that the neoclassical hypothesis of perfect substitutability between the components of wealth is not valid for socioeconomic sustainability.

JEL Codes: A13, Q01, Q12, Z1

Keywords: cultural capital, social capital, intangible wealth, tangible wealth, sustainable development, tribal agriculture

Highlights:

- Tribal survey data allows the measurement of structural social and intangible cultural capital
- We develop a simultaneous equations model, estimated by using the GMM technique
- Our results reveal complementarity between social capital and economic performance
- Cultural values boost crop production and yield through their positive effect on social capital
- A ‘strong’ sustainability framework is necessary for communities’ welfare investigation

1. Introduction

According to the empirical literature, most of the comprehensive wealth¹ of nations has been explained by ‘intangible capital’, or ‘residue’ (Arrow et al., 2013; Hamilton et al., 2005). Intangible capital captures everything that increases the productivity of an economy, such as knowledge, institutions, and governance, and more broadly contributes to well-being, such as social relationships and cultural values, which are beliefs that define the lifestyle of individuals/social groups, in which the latter have an emotional investment (Hamilton and Hepburn, 2014; Hamilton and Liu, 2014; Ruta and Hamilton, 2007; Sanginga et al., 2007). Although the role of human, technological, and institutional capital in the creation of wealth has been the subject in the literature (Kucharčíková, 2011; Pelinescu, 2015; Romer, 1989; Roth and Thum, 2010), little attention has been paid to the importance of social and cultural capital. Relationships between tangible and intangible wealth have been demonstrated qualitatively in anthropology (e.g. Godelier 1984), but quantitative studies remain scarce, and all the more so in the economic sustainability literature. Notably, the empirical literature on sustainability has received much more attention regarding the economic and environmental aspects, and the interactions between these dimensions; sociocultural issues have often been neglected (Adebowale, 2002; Koning, 2001). More precisely, extensive attention has been paid to the existing thresholds of natural resources and the limited substitutability between economic and natural capital (e.g. Constanza and Daly 1992; Daly 1996; Ekins et al. 2003). Because social capital is generally examined as a vast concept including, for example, interpersonal relationships, attitudes, ethics, and norms, and generally measured by a flow rather than a stock variable, it is usually omitted from the models exploring irreversible exhaustion of resources (the capitals approach of sustainability).

The motivation for our empirical study is to complete this literature by showing that intangible capital plays a substantial role in community sustainability, as an essential source of wealth, and most particularly at the microeconomic level.² We demonstrate this by examining tribal agriculture in New Caledonia, which illustrates the socioeconomic relationship, and the role that cultural values play in this relationship. Tribal agriculture—an ancestral activity of the native population (Kanak)—is an example of traditional cultural practices that contribute directly and indirectly to the sustainability of the Kanak community

¹ Comprehensive wealth includes a country’s produced capital, natural capital, human capital, and net foreign assets. The World Bank calculates comprehensive wealth to provide information on the prospects of growth in the long term by systematically tracking a country’s assets and monitoring whether countries are on a sustainable growth path.

² If ecological sustainability takes on its meaning particularly on large scales (given the complexity of ecological services and frontiers), we assume that interpersonal relationships and the cultural values that strengthen them are essential factors for sustainability, and in particular at the micro level.

living in tribes. Tribal farming has a triple nature: economic, social, and cultural.³ At the economic level, it first ensures household food security and allows the Kanaks to sell part of their production on the market and generate income. At the social level, it plays a key role in strengthening social and family ties through daily donations of plant production and mutual aid in the fields. At the cultural level, this practice ensures the maintenance of customary traditions because it allows Kanaks to participate in customary ceremonies through donations of plant production (customary donations). Although tribal societies have specific characteristics, they can be generalised to different communities worldwide, when their relationship with nature is at the heart of their socioeconomic interactions and performances. In our view, our conclusions and the relationship between social capital and economic development, particularly agricultural production, highlighted in this study, could be relevant to other situations especially in the rest of the South Pacific – for instance Papua New Guinea, the Solomon Islands and Vanuatu – where non-market practices, gifts and counter-gifts are still very much alive and play a structuring role for households. However, the effects indicated by our study are observable *per se* in a small number of communities based on mutual aid between individuals, and are less ‘visible’ in other societies where mutual help at community level is being substituted (replaced) by public social support systems (in particular in developed countries). Nevertheless, the recent health crisis (COVID-19) puts social solidarity between individuals back at the heart of socio-economic issues, including in industrialized countries. That said, we consider that our study is a pioneering illustration, in a holistic-inductive approach, of the mechanisms of interaction between cultural and social capital and material wealth at community level which should apply in more general contexts (albeit for other forms of social and economic wealth).⁴

The reason why few empirical studies have linked cultural and social capital to economic performance could also be that intangible wealth remains a very broad and multidimensional concept that is difficult to measure. The distinction between social capital and intangible cultural capital is unclear in the literature because these two forms of capital are generally mutually reinforcing, and their measures often are within a vast concept that mixes, for example, social relations and norms, ethics, customs, and beliefs. In this paper, we design operational measures that distinguish between ‘social relations’ between individuals, what we refer to as **structural social capital**, and ‘cultural values and norms’, what we refer to as **intangible cultural capital**, which is a foundation for these social interactions.⁵ More precisely, we use

³ Though we focus here on the social and cultural dimensions of sustainability, it would have been valuable for the analysis to incorporate environmental data. Unfortunately, we had no data on natural resources and the environment at the community level.

⁴ Further testing of this generalisation should be a valuable avenue for future research.

⁵ See Section 2 for the forms of social capital and cultural capital discussed in the related literature (e.g. structural and cognitive social capital, and tangible and intangible cultural capital). These concepts were too vast; thus, we focus on specific dimensions of their definitions to obtain distinct notions with operational measures. For instance, and for the purpose of this paper, we

data from an original survey conducted in 2011 by the New Caledonian Agronomic Institute (IAC) and the Center for International Cooperation in Agronomic Research for Development (CIRAD), which assessed the contribution of families living in tribes to agricultural production in New Caledonia. The survey also provided an improved understanding of the market/nonmarket and material/immaterial dimensions of agriculture activity by providing insights into the noncommercial crop production volumes destined for self-consumption and gifts. Its dataset allows us to distinguish between variables and/or characteristics referring to social relations (represented by daily gifts) from those referring to cultural norms and values (captured here by customary donations of specific products embodying a symbolism linked to ‘the gifts of nature’).

The contribution of this paper is therefore twofold. First, we construct an operational framework to delimit and thus independently measure the cultural and social capital. Second, by designing an empirical (simultaneous equations) model that investigates the socioeconomic relation and the links between different forms of intangible wealth, we obtain original, notable results. More precisely, we show that cultural capital (limited here to Kanak norms and values) directly affects the formation of social capital (by strengthening social relations) and indirectly affects economic tangible capital (by strengthening crop production and yield) and that social relations and economic performance are mutually reinforcing. According to our review of the literature, this is the first empirical study to demonstrate econometrically the complementarity (virtuous circle) between tangible and intangible wealth at the microlevel by considering simultaneously economic, social, and cultural assets. Hence, our results show that the neoclassical hypothesis of perfect substitutability between capitals is not valid for sustainable socioeconomic development. That is to say that our results do not support the unconditional substitutability between different forms of capital suggested in the Hicks-Hartwick-Solow ‘weak’ sustainability model, in particular focusing on natural capital (Kenneth J. Arrow et al., 2012; Asheim et al., 2003; Dasgupta, 2009a; Hartwick, 1977; Pearce and Atkinson, 1993)⁶, and therefore require a ‘strong’ sustainability framework (Constanza and Daly, 1992b; Daly, 1996; Ekins et al., 2003), extended to intangible capital, for an adequate investigation of a community’s total welfare.⁷ Another notable result

focus on the intangible dimension of cultural capital, not the tangible cultural artifacts associated with it. Hence, when referring to cultural capital throughout the paper, we mean only its intangible dimension.

⁶ In the neoclassical view, in particular based on the total capital theory incorporating the idea that the level of overall capital stock should be non-decreasing, an economy is considered sustainable if its savings rate is greater than the combined depreciation rate on human-made and natural capital. This is called ‘weak’ sustainability because no restriction on the degree of substitutability between natural and manufactured capital is introduced.

⁷ A ‘strong’ sustainability framework requires non-decreasing natural capital due to the existence of critical thresholds, beyond which any decrease in a physical unit of natural capital cannot be replaced by an increase in the quantity of other forms of capital. A sustainability study should of course include natural capital, which is unfortunately omitted in our study due to an absence of any such data at the household level. We nevertheless expand the ‘strong’ sustainability framework to intangible wealth, admitting restrictions on the degree of sustainability between tangible and intangible forms of capital due to the existence of critical thresholds beyond which any decrease in intangible wealth (e.g. social ties, cultural values) cannot be replaced by an increase in the quantity of other forms of capital.

is that complementarity, and thus the essential role of capital, may be revealed even with a flow variable, and in particular when it refers to intangible wealth.⁸

Our study contributes to the social literature, by insisting on the conditions of sustainability (complementarity between the various forms of wealth), and to the economic literature on sustainability, by reintegrating the missing puzzle (intangible wealth) in the conceptual and operational frameworks.

This paper is structured as follows. After the introduction of our research question, Section 2 presents a synthesis of the literature on social capital and cultural capital and the links between these two components of intangible wealth. Section 3 describes the database used and the (unique) variables that allow us to measure intangible wealth. Section 4 presents our theoretical hypotheses and the empirical strategy that allow us to highlight the relations between our measures of cultural capital, social capital, and tribal agriculture production. Sections 5 and 6 present our empirical results and robustness tests, respectively. Section 7 is a discussion of original findings and caveats, by highlighting avenues for future research. The last section concludes.

2. Literature review

2.1. Intangible wealth, the least studied ‘bottom line’ of sustainability

Only recently explicitly acknowledged as a ‘bottom line’ of sustainability, but extremely difficult to measure and integrate in the economic, theoretical models, the social dimension has received far less attention than the economic and environmental aspects. The economic literature on sustainable development is traditionally based on approaches that centred on capacities (capital stock) and results (genuine savings). For instance, Hanley, Dupuy, and Mclaughlin (2015) cite the World Bank’s preferred measures for sustainability, which are ‘comprehensive wealth’ and ‘genuine savings’, by suggesting their ability to assess, under certain assumptions, both capacity-based and results-based approaches to sustainability. The underlying logic of this vast literature is that future consumption can be considered a form of interest in the stock of accumulated wealth, genuine gains being equal to gross savings (gross domestic product minus consumption) minus the depreciation of physical capital, the depletion of natural resources, and the marginal social cost of pollution, plus investment in human capital. Savings are considered genuine when they exceed the value of consumption of assets (Atkinson, 2000). In theory, the savings would translate into the reinvestment of exhausted natural capital in other forms of capital, which would translate into net investment in the total capital stock from one country (Dietz et al., 2007;

⁸ Compared with natural capital, which produces flows of income because of an existing stock/infrastructure, it has been stressed (especially in the business literature; e.g. Andriessen, 2004) that intangible capital stock is an accumulation of historical flows, most recent playing the largest role.

Hartwick, 2003). According to neoclassical theory, total capital and its evolution over time would define the possibilities of future consumption and thus the level of well-being of future generations.

Notably, what constitutes sustainable development also depends on the perception of total capital (or total wealth). One of the visions (neoclassical theory)—the *weak sustainability* approach—is that sustainable development requires nondeclining total wealth, which implies perfect substitutability between types of capital (Kenneth J Arrow et al., 2012; Dasgupta, 2009b; Hartwick, 1978). According to an alternative vision (ecological economics), sustainable development requires nondeclining natural capital because of the critical thresholds beyond which any decrease in a physical unit of natural capital cannot be replaced by an increase in the quantity of other forms of capital—the *strong sustainability* approach—the different forms of capital thus being complementary in the accumulation of wealth (Constanza and Daly, 1992a; Daly, 1996; Ekins et al., 2003).

However, these analytical frameworks generally omit the social dimension and the other forms of intangible wealth, particularly important elements at the (micro) community levels. Moreover, Markandya and Pedroso-Galinato (2007) mention the difficulty of empirically establishing the degree of substitutability between capitals. According to the authors, how to choose sustainable development, from a weak or strong perspective, is a question of preference based on social values, which we note are anchored in a long, context-specific trajectory. Although generally associated with an environmental approach, sustainability should nevertheless describe a field of investigation based on a socially oriented definition of local problems. Sustainability can therefore be a fundamentally sociological concern (Becker, 1999; Robinson, 2004). More specifically, Akgün, van Leeuwen, and Nijkamp (2012) show in a multiagent, multicriteria study that one of the most sustainable, desirable regional development scenarios would be an ecological system that coexists with strong social cohesion⁹. The quality of social relations is an indispensable instrument in the protection of ecological systems. Finally, interest in cultural capital has also recently increased, especially after its recognition as the fourth pillar of sustainable development (Dessein et al., 2015; Nurse, 2006). Notably, Costanza et al. (2017) suggest that cultural services represent the least studied category of ecosystem services. These services, combined with natural, built, human, and social capital can create an aesthetic, scientific, and cultural identity and a sense of belonging.

⁹ This scenario is plausible for New Caledonia (our field of study), where total welfare is mostly intangible (Couharde et al., 2011) and the tribal agriculture corresponding to the value of plant, animal, hunting, and fishing production (sold value, self-consumption, and donations) represented 12.5 billion Pacific francs in 2010 (the reference year in our study), compared with the total agricultural market production in the country amounting 10.337 billion Pacific francs (see Apithy et al. 2016, page 345).

2.2. Social and cultural capital: from conceptual definitions to operational measures

The environment-economy framing is common in sustainable development research, but the connections to issues of social inclusion are not understood (Adebowale, 2002; Vallance et al., 2011) because there is no suitable framework to operationalise the concept of social sustainability (Koning, 2001; Woodcraft, 2012). The lack of empirical studies is thus at least partly explained by the following: Social and cultural capital remain broad, multidimensional, difficult-to-measure concepts. Culture, and the cultural argument, is omnipresent and thus belongs to all the disciplines of the social sciences, which makes it difficult to identify the channels through which ‘cultural capital’ can contribute to the economy (Guiso et al., 2004). In addition to this difficulty of measurement is the ambiguity in the literature between cultural capital and social capital. In general, cultural capital in its intangible component is either considered a subcomponent of social capital or assimilated into social capital (Dessein et al., 2015). This overlap between intangible cultural capital and social capital blurs the boundaries between the cultural and the social dimensions.

The literature provides several definitions of social capital, and thus far, no consensus has been reached (Keeley, 2007; Uphoff and Wijayaratra, 2000)¹⁰. Two forms of social capital have been distinguished: *structural social capital* and *cognitive social capital* (Dasgupta and Serageldin, 2000; Krishna and Uphoff, 1999; Uphoff and Wijayaratra, 2000).

- **Structural social capital**, an objective form of social capital, refers to social networks and social structures (e.g. sports clubs, neighbourhood associations). Putnam (2000) differentiates between two forms of structural social capital:
 - *Bonding social capital* reflects the social relationships between individuals in the same social group (family members and friends)
 - *Bridging social capital* refers to social relations between heterogeneous social groups.
- **Cognitive social capital**, a subjective form of social capital, refers to the norms, values, attitudes, beliefs, and trust shared by members of a group, a network, or a society, which are also attributes that define intangible cultural capital (Throsby, 1999). We distinguish two components of cognitive social capital:
 - The first refers to *cultural values and norms*. These values and norms pass from one generation to another and represent the intangible cultural capital defined by Throsby (1999) as the set of norms, values, and customs of a society.

¹⁰ Notably, social capital has been discussed for more than a century (Keeley, 2007). The first author to do so was Lyda Judson Hanifan in his 1916 paper, which explained how neighbors help each other administer schools in the United States (Keeley, 2007; Woolcock, 1998). Hanifan referred to social capital by discussing the goodwill, sympathy, friendship, and social relationships that people have with their families and with each other. For Hanifan (1916), these elements represent the most important matters in people's daily lives.

- The second component of cognitive social capital relates to the individual characteristics of every person (personality, mentality, intelligence, way of thinking and seeing things) (Jeannotte, 2003) and, therefore, a subjective element specific to each person. Complemented by more or less objective skills acquired by the individual during his or her existence (knowledge, education, expertise), these elements form *human capital*.

The literature recognises a close link (or even confusion) between cultural, human, and social capital. For instance, Throsby (1999) criticises Bourdieu's 'embodied cultural' capital, which would overlap with the economists' definition of human capital.¹¹ Although divergent definitions would blur the boundaries between these forms of capital¹², the causal links between them are more or less identified, in particular between cultural capital and social capital. Because norms (e.g. reciprocity) are culturally constructed (Hofstede, 1980), social networks are not a natural, or even a social given, but a product of deliberate investment of cultural (and/or economic) resources (Bourdieu, 1986). Similarly, Fukuyama (1999, 2001) says that social capital is a 'by-product of religion, tradition, shared historical experience and other types of cultural norms', thus reinforcing cooperation between members of society. Trust and cultural norms—shared expectations and rules that guide individuals' behaviour within social groups—appear to be mechanisms by which exogenous factors can affect participation in social networks (Katungi, 2006). Robinson and Williams (2001) and Gould (2001) have argued that cultural capital is a critical aspect of social capital and that the latter is an expression of cultural capital in practice. Throsby (1995) evokes the link between cultural capital and social capital (without specifying it) by saying that cultural capital is essential for the maintenance of social relations, for promoting cooperation and mutual aid between members of society, to finally achieve social cohesion. For Agovino et al. (2017), cultural capital can become a vector of 'social emancipation', especially when cultural experiences aim to strengthen social inclusion rather than social discrimination. According to UNESCO, intangible cultural heritage is a vector of social cohesion and is mobilised to prevent and resolve conflicts through social practices, rituals, and festive events that strengthen the social fabric. Manterys (2018) also claims that 'cultural practices' represent a means of becoming a part of social circles and networks. Likewise, Putnam (1993) and Fukuyama (1995) establish that social capital has its origins in cultural evolution. Notably, a society

¹¹ According to Bourdieu (1979, 1986), cultural capital has three forms: objectified, embodied, and institutionalized. The objectified form includes cultural goods (e.g. paintings, books, dictionaries, musical instruments). The embodied form refers to the intellectual capacities, knowledge, and skills of individuals. The institutionalized form represents the certifications or diplomas that legitimize the incorporated cultural capital.

¹² When Bourdieu's social capital resides in the individuals as the result of their investment, to gain power/recognition, Putnam's and Coleman's social capital resides in social infrastructure or organizations (networks) that become a collective trait functioning at the aggregate level. Notably, Bourdieu's social capital does not include attributes of collective property, which Bourdieu instead calls cultural capital. Culture is also a collective attribute in Hofstede's definition (Hofstede 2011, p.3).

improves its social network and thus develops its social capital when its members share a common cultural life (through celebrations, rites). In other words, social capital stems from cultural capital.

We observe that measuring social capital should be a difficult task because this concept is broad and still debated. The variables used in the literature to measure social capital have often been outcome-based (Guiso et al., 2004). The most common outcome-based measure used as a proxy of social capital is the level of trust (Coleman, 1994, 1988; Falk and Kilpatrick, 2000; Halpern, 2005; Hooghe and Stolle, 2003; Putnam, 2000, 1993; Putnam et al., 1994). Other outcome-based measures of social capital are, for example, electoral participation (e.g. Guiso, Sapienza, and Zingales 2004), volunteering (Putnam 2000), and donations/gifts (e.g. Guiso, Sapienza, and Zingales 2004). However, some of these variables do not differ much from the most familiar measures of culture—Hofstede’s dimensions of national cultures: ‘power distance’, ‘collectivism versus individualism’, ‘femininity versus masculinity’, ‘uncertainty avoidance’, and so forth.¹³ By defining culture as ‘the collective programming of the mind that distinguishes the members of one group or category of people from others’, Hofstede (2011, p.3) points out that the term ‘culture’ can be applied to collectives at different aggregation levels: nations, organisations, tribes, genders, generations, professions, or social classes. He also stresses that ‘changing the level of aggregation studied changes the nature of the concept of ‘culture’’: for instance, when societal culture resides in values, the organisational culture resides in practices.

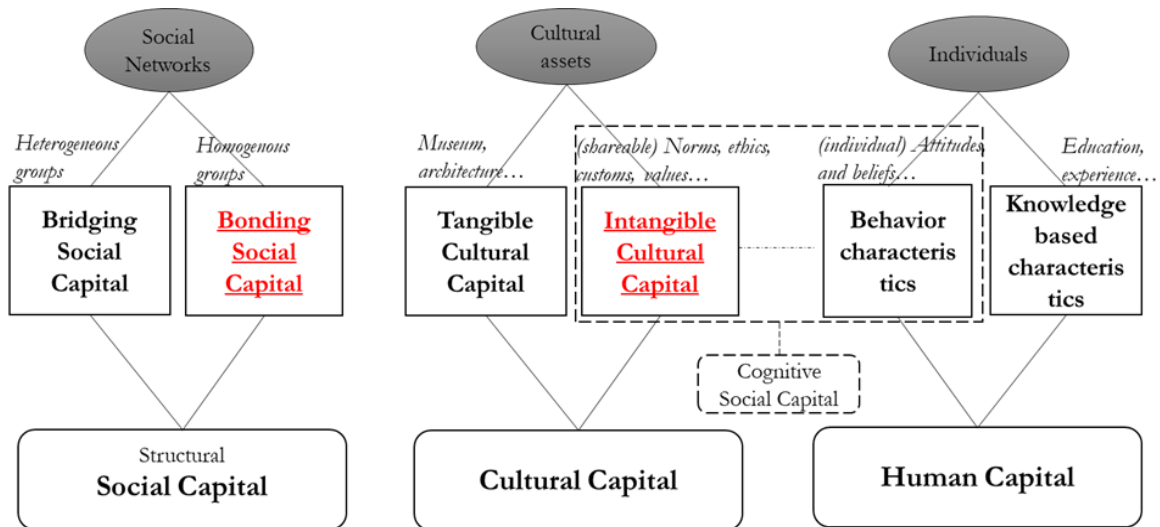
If the conceptual definitions reviewed allow us to understand the deep (theoretical) meaning of the constructs of social and cultural capital, and the links between them, their complexity and overlap add vagueness to possible operational measures. Hence, one of the central issues of this study is to measure social and cultural capital distinctly and explore them in an econometric study (to put them into operation when explaining economic performance), by avoiding at best the problems of endogeneity or double counting. Thus, we propose an operational framework that delineates the boundaries between forms of social and cultural capital (Figure 1). More precisely, our literature review suggests that definitions of intangible capital are characterised by ambiguities regarding its ‘support mechanism’. Hence, to obtain operational measures of ‘invisible’ concepts, we assume the following:

- **Social capital** is in relationships, or social networks (homogeneous or heterogeneous), that require at least two individuals (hereafter also called ‘*social relations*’). It could be measured by indicators, for example, social (interpersonal) trust level, social distance, membership in voluntary associations, willingness to express (political) opinions, and influence in internal family decisions.

¹³ ‘Long-term versus short-term orientation’ and ‘indulgence versus restraint’ were added later to the original four measures proposed in 1980 (see Hofstede 1980, 2001; Hofstede, Hofstede, and Minkov 2010).

- **Cultural capital** is in tangible or intangible assets. When measured by physical heritage, for example, historical, archaeological, architectural, or artistic material, and urban construction, it refers to tangible cultural capital. The intangible cultural capital, on which we focus our analysis, relies on (shareable) subjective attributes, for example, ethnic values, ideologies, myths, religious attitudes, norms, and customs, and is called hereafter ‘*cultural values [and norms]*’,¹⁴
- **Human capital** is in individuals. It can be measured by variables, for example, educational degree, social professional category, years of professional experience, and temperament profile.

Figure 1. An operational framework delimiting social, cultural, and human capital



Source: Authors

Each form of capital, namely, social, cultural, and human, vanishes when its supporting mechanism, namely, network, tangible/intangible asset, or individuals, respectively, disappears.

In this study, we focus on the Kanak tribal society (comprising homogeneous domestic groups) and the social and cultural ties between its individuals to provide insights into the relations between intangible cultural capital (*cultural values and norms*) and bonding social capital (*social relations*; Figure 1, red areas with underlined text). The structural form of social capital is relevant to our study of tribal agriculture because it enters directly into all the determinants of the economic performance of this agriculture. This form of capital is concerned with facilitating collective action and information sharing that would lower transaction costs and mitigate risks. Intangible cultural capital should affect economic performance only

¹⁴ We have retained from our documentary analysis that measures of cultural capital are difficult to generalize or reproduce, and are therefore context specific. For instance, Bedate, Herrero, and Sanz (2004) propose an economic valuation of four cultural festivals in Spain by using the travel cost method, widely used to account for natural capital. Bostedt and Lundgren (2010), by using a simple dynamic growth model and the concept of a social accounting matrix, estimate the cultural value of the Sámi Reindeer husbandry, an activity of the Sámi people in Sweden with significant cultural heritage value.

indirectly, through its impact on structural social capital, by predisposing individuals to cooperation and collective decisions (Uphoff, 2000).

With our operational framework, we distinguish two original variables that we identified in a representative survey conducted in 2011 with the tribes of New Caledonia (Section 3 provides more details on this survey). In particular, this survey provides information on tribal donations. By examining the nature of these gifts, we distinguished daily gifts, devoid of symbolism but necessary to maintain interpersonal connection (say ‘social networks’), and customary gifts that are more than an ordinary act of relationship. The value of customary gifts is generally symbolic of the tribal ethical relationship with nature because the products donated are rooted in tradition, rare, and specific to local natural environments. Therefore, tribal gifts could measure forms of intangible (social or cultural) capital, depending on whether they are ordinary, daily, or customary.

Notably, our study provides no measures of structural social capital and intangible cultural capital in the common view of the term capital, which refers to the stock of resources accumulated over years.¹⁵ Because we have data only for perishable agricultural products in one year (2010)¹⁶, we use a simplified approach: intangible capital is approximated by the ‘flows’ that it generates or that contribute to the accumulation of this capital. Our measures of social capital and cultural capital, proxied by the value of donations (daily and customary), are close to the definition of capital by Fisher (1906). According to Fisher, any object that yields services (also subjective satisfactions in ‘the stream of consciousness’ of a human being) is capital, and the difference between consumption goods and equipment goods is a matter of time, during which the object yields services.

Because of data limitations, human capital received insufficient emphasis in our empirical investigation. We do, however, stress that the border between human capital, which is focused on individuals’ attitudes, beliefs..., and intangible cultural capital is blurry. That explains the common procedure of including all norms, values, attitudes, beliefs... into a black box usually called ‘cognitive social capital’ (Fig.1).

¹⁵ There is a consensus that social capital has characteristics that qualify it as ‘capital’ (Collier, 1998). Similar to other forms of capital, accumulating and maintaining a stock of social capital needs time and other valuable resources. Moreover, similar to physical capital, social capital depreciates if not used, but may enhance its stock with use. Thus, as other forms of capital, social capital may be characterised by structural persistence.

¹⁶ The survey used here supplies only quantities for crop production, consumption, and gifts within one year. An immediate question arises about the combination of different agricultural products, because the sum of weights or volumes is not significant. A general approach is to convert the plant production into monetary units. The monetary values were calculated a posteriori by affecting the prices observed in the local markets of the study areas. Notably, monetary values of gifts based on market prices remain quite reductive. Indeed, the symbolic dimension can always be considered immeasurable.

3. Data from an original tribal agriculture survey

The choice of New Caledonia as the field of our study is not random and is original and coherent with the objective of our research. Tribal agricultural activity continues to play a key role in household food security and in nonmarket exchanges and promotes the local economy and the maintenance of customary, family, and social ties (Apithy et al. 2016; Bensa and Freyss 1994; Bouard, Apithy, and Guyard 2018; Bouard and Sourisseau 2010). In Kanak society, social relations are explicitly translated into mutual help in the fields among members of the clan and symbolically translated into gifts of vegetable production or animal production (e.g. fishing, hunting).

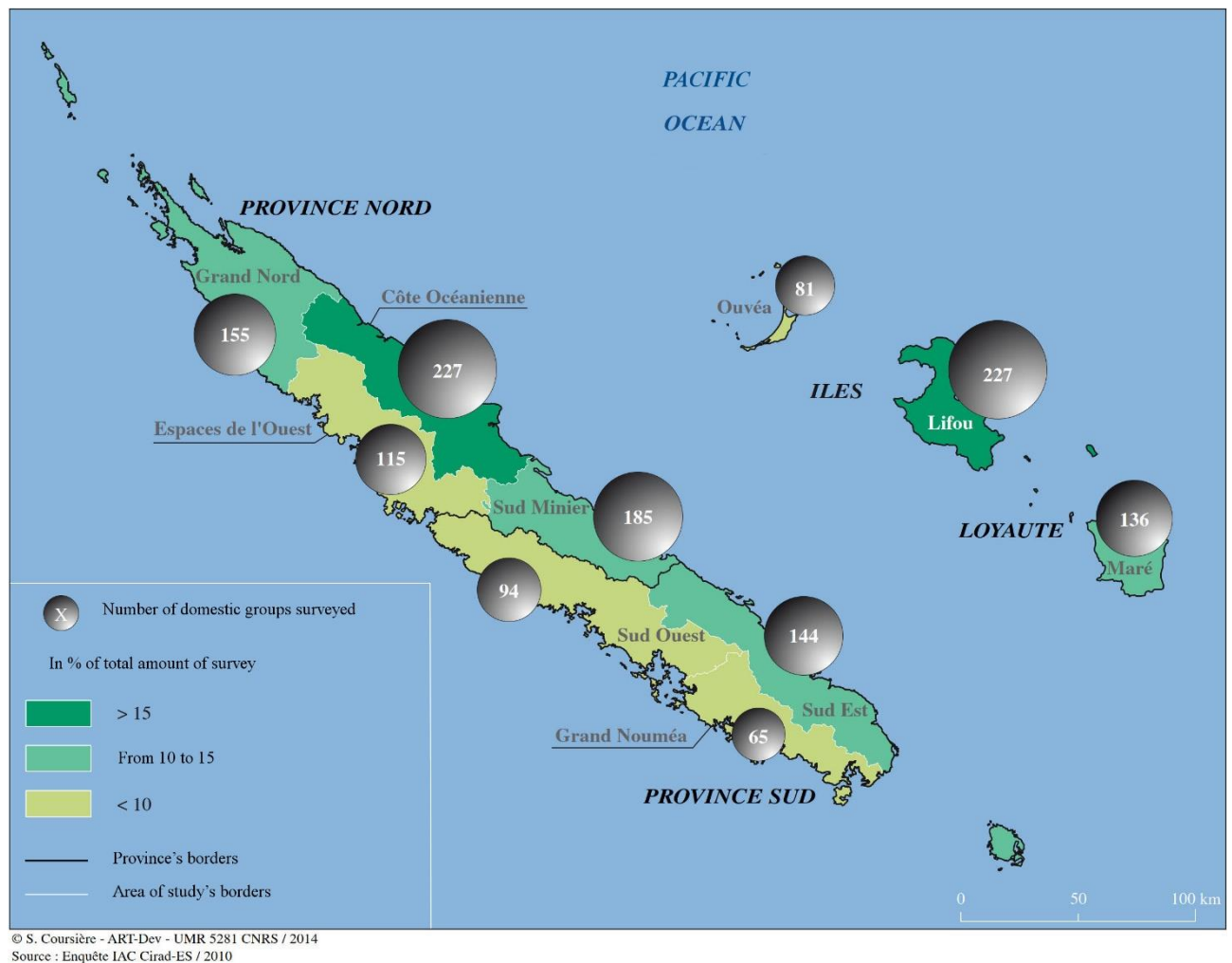
To econometrically explore the role of intangible wealth in the socioeconomic relationship, we thus adopt a microeconomic approach based on data from the tribal agriculture survey conducted by the IAC and CIRAD in 2011¹⁷. This original survey focuses on agricultural and harvesting activities of the Kanak population living in tribes in 2010 and highlights the economic contribution of their activities (agricultural production, fishing, animal husbandry, and hunting). In 2010, tribal agricultural production generated the equivalent of 65 million euros, of which 56 million euros were destined for self-consumption and donations (Guyard et al., 2014). Notably, the volume of crop production from tribal agriculture exceeds the volume of ‘officially declared’ crop production in the country. This original survey provides quantitative measures of the agricultural volumes (and their monetary value) produced by the tribal population in 2010 and the distribution of these volumes between self-consumption, daily gifts, ceremonial gifts, market sales, and intra-consumption¹⁸.

This survey is based on a multi-thematic questionnaire conducted on a representative sample of the population living in tribes in New Caledonia. The initial sample was drawn at random from the 2009 GPC database of households living in tribes, doubly stratified according to the geographic criteria (10 infra-provincial zones – Figure 2) and household size (7 strata). According to the expertise and practices of the National Institute of Statistics (ISEE), a standard survey rate of 14% of the households was applied in each of the 70 strata (10 geographic criteria crossed with the 7 household sizes). The final sample differs slightly from this survey plan, in part drawing on information not in the census lists.

¹⁷ For further information on the nature and quality of the data, please see the survey’s data paper (Apithy et al., 2018, n.d.).

¹⁸ This refers to products used for intermediate consumption, like seeds for the next crop cycle or the productions used for feeding cattle.

Figure 2: Map of New Caledonia, province, and areas of study, with the spatial distribution of surveys.



Finally, the survey covers 1,429 domestic groups (the main observation unit of the study) distributed among 288 tribes out of the 340 in the country, that is, 12.4% of the total population of households living in tribes in New Caledonia (Guyard et al., 2014). The domestic group represents the group of people who share a parcel of land, meals, and part of the agricultural activities in the fields (Leïla Apithy et al., 2016). The number of members in the domestic group corresponds to the number of individuals who were part of the same domestic group for at least six months during 2010, and individuals residing outside the domestic group on weekdays (often for professional reasons or school) but returning there during weekends and holidays. The choice of the domestic group as a statistical unit is adapted to the particular social and customary organisation of the Kanaks living in tribes. The domestic group recalls the notion of socioeconomic units because they represent collective entities expressing functionalities of residence, consumption, and agricultural production (Apithy et al., 2018, n.d.). Notably, if the domestic group represents 80% of the cases a single household, it can simultaneously group several households.

The interest of this survey is that it provides imperfect but original data, allowing us to explore the ‘informal’ flows of plant production, which can be related (at least in part) to intangible wealth produced by the Kanak economy. In particular, the survey investigators have constructed variables for the monetary value of donated and self-consumed crop production. Because the vast majority of domestic groups do not weigh their crops and do not maintain an accounting register, the investigators used daily practices to estimate the volumes harvested. They first identified the tools used by each household group for harvesting (e.g. plastic bags, baskets, shopping bags) and then the frequency of harvesting (weekly, monthly, or at a customary time). Investigators then converted the recorded volumes to conventional units of measurement by using specially constructed abacus. Finally, they estimated the monetary value of the harvested crops (consumed, commercialised, and donated) by affecting observed local market prices to each crop type. This method is imperfect for evaluating intangible flows because it strongly underestimates the real values of these flows; we would have preferred to have had additional variables to construct more complete indices of the ethical and social values reported. Notably, the object and the motivation of this article emerged posteriori from the data collection; therefore, we are limited to the indicators available in the dataset provided by the survey.

All variables used in our empirical work are from this survey.

Next, we present three variables of interest in this study:

- First, the crop production (**CP**) represents the sum of the monetary value of commercial crop production (regardless of marketing method) and noncommercial crop production (for self-consumption, donated production excluded) in 2010.
- Our second variable of interest is social relations (**Social**), proxied by the total value of *everyday crop gifts* donated by the domestic group during the year 2010. The social importance of these gifts is highlighted by Bensa and Freyss (1994), who postulate that daily gifts between Kanaks are simple signs of a social relationship. Likewise, according to the report of the New Caledonian Customary Senate published in 2013, ‘reciprocity and social relations are combined because social relations whether at the paternal or maternal level or between clans, are marked by gifts and counter-donations’. We posit that daily crop gifts represent a good outcome-based proxy of structural social capital because individuals have no legal or economic incentives to donate. The drivers for the decision to donate are social incentives and the desire of the domestic group to reposition itself in the tribe, or its social community. Daily gifts are, for example, gifts to an uncle or an aunt when returning from the fields or gifts of agricultural products for nephews who go to the city for the week. These daily gifts mark the daily life of Kanaks and strengthen the social bonds between tribe members.

- Finally, our third variable of interest in this study is Kanak cultural values and norms (***Culture***), measured by the value of *customary crop gifts* donated by the domestic group in 2010. Statistical apparatuses have had difficulty measuring intangible cultural capital, especially in the case of small islands, developing states, or developing countries. The intangible dimension of cultural capital includes activities and practices outside the economic sphere; therefore, it refers to the nonmarket dimension of cultural capital. Although the intangible dimension of cultural capital is difficult to measure, the income flows that result from it can be measured. Cultural practices in a community can result in the generation of income flows, reflecting traditions, beliefs, and customs. The tribal agriculture survey provides an original measure of tribal cultural values, namely, the monetary value of customary gifts representing income flows from cultural activities in tribes. These customary gifts—translated concretely into agricultural products such as yams, taros, and bananas—only occur in the context of cultural ceremonies (e.g. weddings, bereavements, births, or cultural festivals [e.g. the feast of the sea, the yam festival]). The donated varieties are highly symbolic; some varieties are donated only on specific occasions, and others are specifically associated with a clan (Bouard and D’Aquino 2007; Bouard and Sourisseau 2010; Haudricourt 1964; Leblic 2002). Thus, these customary gifts are within the scope of intangible cultural capital because they have a cultural rather than social significance.

In conclusion, the variables ***Social*** and ***Culture*** measure distinct concepts. When the daily donations of ordinary plant products help maintain interpersonal relationships, customary gifts reflect an ancestral tradition of belonging to the land, and of the tribal ethical relationship with nature.

4. Empirical model for the socioeconomic relationship

From an economic perspective, social capital is an input of the production function whose effects are modelled in such a manner as to reduce transaction or production costs (Dasgupta, 2005; Granovetter, 2005; Gugerty and Kremer, 2002). In this study, we assume that in terms of agricultural production, social relations are a vector of productivity and/or risk mitigation. The literature recognises that agricultural performance does not occur exogenously. Agricultural performance (or even innovation) results from the integration of the knowledge of various actors and stakeholders, allowing the adoption of improved agricultural practices (Bandiera and Rasul, 2006; Leeuwis and Ban, 2004; Narayan and Pritchett, 1999; Röling, 2009). Moreover, Knickel et al. (2009) suggest that agricultural performance is the result of collaboration networks that allow the exchange of information (reducing transaction costs) and the implementation of learning processes (improving productivity).

In rural settings, for example, the New Caledonia tribes' settlements, social capital may supplement inadequate formal information systems, providing valuable information on farm practices, new crop varieties, prices, and problems regarding agriculture in a specific area (e.g. soil erosion, plant diseases, inundations, drought, fire). Although most technologies are chosen and implemented on the basis of individual crop plots, the techniques managing the external environment operate more effectively at the landscape level and thus require coordination and collective action. In addition to productivity concerns (yield objectives), social capital should enhance agriculture production (scale objectives) by acting as a conduit for financial transfers (microcredit and 'implicit' insurance facilities).¹⁹ Following Fafchamps and Lund (2003), farmers engage in informal mechanisms to share risks and smooth their consumption. Actually, benefits from farm investments are uncertain and often made at the expense of current consumption. Social ties (guided by reciprocity norms) would thus fill the gap in consumption smoothing. A tribe's crop production may thus be presented as a function of social capital, proxied by its daily crop gifts to other tribes. Although we could suppose donations in a given year could (at least partly) be from the previous year's harvest (which is not generally the case in our database given the highly perishable nature of the main plant products donated), that would thus not be explained directly by the volume of contemporary plant production, and we recognise the possibility of simultaneity bias between crop production and daily gifts. First, our variable **CP** (crop production for sale and self-consumption) does not include daily gifts of crop production (explanatory variable **Social**). However, intensifying the former, thus favouring agriculture over any other activity, is likely to strengthen community spirit (social capital) in a community very attached to the land, for example, Kanak society. We can also assume that the wealthier the domestic groups, the more time they have for daily social interactions.

Two modelling options are then possible for endogeneity treatment: the instrumental variable (IV) and the simultaneous equations system using the generalised method of moments (GMM; or multiple-equation generalised method of moments). Although the IV technique can resolve the presumed endogeneity bias between crop production and daily gifts (our measure of social relations), it does not provide effective estimates in the presence of heteroskedasticity, even with robust standard errors (Baum et al., 2003). Thus, we favour GMM estimates, which in our case remain more efficient and reliable than the IV technique. In addition to being effective in the presence of heteroskedasticity²⁰, the simultaneous equations GMM estimation technique allows us to solve the problem of endogeneity through instrumental variables and provides the advantage of being able to estimate direct and indirect effects

¹⁹ See Katungi (2006) for a more extensive literature review.

²⁰ Because domestic groups do not all have the same profiles in terms of plant production and donations (daily or customary), we suspect a problem of heteroskedasticity, confirmed by the Breusch-Pagan statistical test.

and the magnitude of two-way links; the latter should highlight the nature of the socioeconomic relation (complementarity or substitutability).

Based on the insights into the link between agricultural performance and social capital, incorporated in Becker's (1965) theoretical approach²¹, and the role of cultural values as a key determinant of social relations (Section 2.2)²², our system of simultaneous equations may be written as follows:

$$\begin{cases} CP_i = \beta_0 + \beta_1.Social_i + \beta_2.Surface_i + \beta_3.AgrTime_i + \beta_4.Equipment_i \\ \quad + \beta_5.Scholar + \beta_6.NbPlots_i + \beta_7.Province_i + \epsilon_i \\ Social_i = \gamma_0 + \gamma_1.CP_i + \gamma_2.Culture_i + \gamma_3.FamHelp_i + \gamma_4.TribeHelp_i + \epsilon_i \end{cases} \quad (1)$$

where **CP** is crop production, that is the sum of (i) the monetary value of crop production sales and (ii) the monetary value of non-commercial crop production used for self-consumption, excluding crops for daily and customary donations; **Social** represents social capital and is represented here by the monetary value of daily crop donations; **Surface** represents the surface (in ares) of the exploited agricultural fields and **NbPlots** is the total number of plots²³ actually exploited during 2010; **Equipment** measures the inputs in terms of physical capital and indicates here whether the domestic group uses motorised agricultural equipment²⁴; **Scholar** represents human capital and is proxied by the number of educated individuals as a percentage of domestic group members; **AgrTime** denotes the input in terms of labour and is captured in our study by the time devoted to tribal agricultural activity; **Culture** represents Kanak cultural norms and values and is captured here by the total value of customary gifts donated by the domestic group during the year 2010; **FamHelp** is a dummy variable representing the free participation of the domestic group in the fields of other family members, and **TribeHelp** is a dummy variable representing the free participation of the domestic group in the fields of other tribe members. We also add the province of residence (**Province**), which we divide into three modalities (**North**, **South**, and **Islands**) to consider the geographical, climatic, and historical specificities of the territories when explaining crop production.

The treatment of the endogeneity problem (i.e. between **CP** and **Social**) requires that at least one of the explanatory variables of social relations (**Social**) be strictly exogenous for **CP**, that is, its effect on **CP** is indirect and passes exclusively through **Social**, for example, the variable **TribeHelp**. If self-help in the

²¹ Becker (1965) defines household production as a function of goods and services bought on the market or obtained for free and temporal inputs in the production process.

²² Although the general consensus is about a history-centered approach explaining the social capital as a result of a lengthy historical institutional development (Putnam 1993), we were constrained (because of data availability) to narrow our analysis by focusing on the actor-centred approach assessing decision-making within a short time period, through community face-to-face interactions. Economic restructuring (by influencing the elite commitment to civic participation), income distribution (and propensity to participate in social activities), and the type of occupations that bring individuals into interactions (needing specific skills, information) are important determinant factors of the strength of social networks (Alesina and Ferrara, 2000; Glaeser et al., 2002; Heying, 1997; La Ferrara, 2002), in addition to cultural values.

²³ The plots are not contiguous.

²⁴ Most tribal farmers are underequipped in terms of agricultural equipment, with only 4% of domestic groups equipped with a tractor (Guyard et al., 2014).

fields intervenes as a labour factor in the production function of the ‘assisted’ domestic group (additional labour), it would have no direct effect on the agricultural production of the ‘helping’ group (which brings its help to the fields of other domestic groups), except indirectly by strengthening social ties (the ‘helping’ domestic group can hope to be helped in return: i.e. reciprocity norm). The same reasoning could be applied to customary donations (**Culture**). The symbolic gifts of crop production during occasional cultural events would affect crop production only through social relations, when these particular donations make it possible to maintain and/or strengthen daily social ties.

We cluster our standard errors by the tribal affiliation of the domestic group to control for the unobserved characteristics linked to the domestic groups’ belonging to the same tribe and to consider the heterogeneity between domestic groups. The database distinguishes 288 tribes. Crop production and the volume of donations (i.e. daily or customary) depend on the circumstances of social life, or more precisely on the recurrence of cultural ceremonies (marriages, bereavements, births) that occurred in 2010 and whose variability manifests between tribes rather than within tribes.

In our basic model (Eq. 1) and the robustness tests (see Section 6), we performed the $\log(x+1)$ transformation on the following variables: crop production (**CP**), social relations (**Social**), Kanak cultural values (**Culture**), time spent on agricultural activity (**AgrTime**), hours worked in mining and metallurgy (**IndusTime**) and income originating from non-agricultural activities (**NonAgriRev**) because their absolute values are sometimes null (see Table 1 below for descriptive statistics).²⁵

Table 1. Descriptive statistics of variables used in our empirical model

	N	Mean	St. Dev	Min.	Max.
<i>CP</i>	1429	385,000	479,000	0	5,510,000
<i>Log(CP)</i>	1429	12.273	1.388	0	15.521
<i>Social</i>	1429	117,000	250,000	0	6,120,000
<i>Log(Social)</i>	1429	9.966	3.389	0	15.627
<i>Culture</i>	1429	153,000	242,000	0	2,721,643
<i>Log(Culture)</i>	1429	9.819	4.076	0	14.817
<i>Yield</i>	1429	9,008.704	15,446.96	1	177,000
<i>Log(Yield)</i>	1429	8.323	1.394	0	12.081
<i>Surface</i>	1429	116.075	790.575	1.47	28066
<i>Log(Surface)</i>	1429	3.961	1.078	0.385	10.242
<i>AgrTime</i>	1429	1,720.671	1,747.851	0	12,096
<i>Log(AgrTime)</i>	1429	6.763	1.658	0	9.401
<i>Equipment</i>	1429	0.044	0.205	0	1
<i>Scholar</i>	1429	1.523	1.434	0	9
<i>NbPlots</i>	1429	3.066	1.667	1	17
<i>ResidencePlots</i>	1429	1.255	0.657	0	7

²⁵ To avoid misinterpretation of the estimated coefficients, we do not take logs of count variables when standard deviation is small and the mean is large (see O’Hara and Kotze 2010) or of variables with relatively low mean values.

<i>North</i>	1429	0.477	0.5	0	1
<i>Islands</i>	1429	0.311	0.463	0	1
<i>FamHelp</i>	1429	0.612	0.488	0	1
<i>TribHelp</i>	1429	0.404	0.491	0	1
<i>IndusTime</i>	1429	350.312	860.377	0	6240
<i>Log(IndusTime)</i>	1429	1.341	2.866	0	8.739
<i>NonAgriRev</i>	1429	1,970,000	2,230,000	0	2.40e+07
<i>Log(NonAgriRev)</i>	1429	10.955	6.131	0	16.994

5. Empirical results

Model (1) in Table 2 displays the results of the estimation of our simultaneous equations system (1), following the production (scale) objectives. We express the variables crop production, daily gifts, customary donations, field surface, and time spent on agricultural activity in logarithmic form. Thus, their estimated coefficients represent elasticities. The empirical results for the first equation of the system show that daily crop gifts (***Social***) have a positive and significant effect on ***CP***. Ceteris paribus, a 10% increase in daily crop gifts is associated with a 4.6% increase in crop production. Social relations are observed to be the most important determinant of tribal agriculture performance, in terms of the marginal effect. Although the traditional production factors—land (***Surface***), time/labour (***AgriTime***), and physical capital (***Equipment***)—fulfil our theoretical expectations by reporting a positive and significant effect on agricultural production, their marginal effects reach a maximum of half of that of social relations. For instance, a 10% increase in motorised agricultural equipment is associated with a 2.5% increase in crop production. Ceteris paribus, a 10% increase in the cultivated area or the time spent on agriculture leads to a 1.7% and 1.5% increase, respectively, in agricultural production.

Regardless of the field surface, the number of exploited plots (***NbPlots***) is an indicator of land fragmentation, a strategy adopted by farmers to reduce exposure to risks (whether climatic or other) (Bentley, 1987; Blarel et al., 1992; McCloskey, 1976; Van Hung et al., 2007). Many researchers have assumed that land fragmentation can increase agricultural productivity. In a recent study on African countries, Veljanoska (2018) analysed the ability of fragmented lands to reduce the risk of agricultural production exposure to climatic variations. She found that fragmentation of cultivated land results in reduced losses in terms of agricultural yield when households experience rainfall differences. The number of educated members (***Scholar***) seems to have no significant effect on crop production. This finding might be explained by the relatively low number of educated members in the tribal community (see Table 1 for descriptive statistics). As for provinces, the islands appear slightly different in crop production. In the Loyalty Islands, paid work opportunities are lower, and agriculture remains one of the main activities on the islands, compared with the remainder of the territory. For example, on the island of Maré, the

production of tubers for customary ceremonies remains critical and highly valued socially, which could perhaps explain our result.

Table 2. Multiple-Equation GMM – Links between *Social*, *Culture*, and *CP*

Explained Variables Explanatory Variables	Model (1)		Model (2)	
	Log(CP)	Log(Social)	Log(Yield)	Log(Social)
Log(Social)	0.455*** (0.0905)		0.395*** (0.0742)	
<i>Log(Surface)</i>	0.165*** (0.0333)			
<i>Log(AgrTime)</i>	0.151*** (0.0385)		0.109*** (0.0351)	
<i>Equipment</i>	0.247*** (0.0680)		-0.0367 (0.0897)	
<i>Scholar</i>	-0.00444 (0.0133)		-0.0197 (0.0125)	
<i>NbPlots</i>	0.0671*** (0.0137)			
<i>North</i>	0.0881 (0.0786)		0.0936 (0.0659)	
<i>Islands</i>	0.144* (0.0851)		0.112 (0.0687)	
Log(CP)		0.705*** (0.0231)		
Log(Yield)				1.054*** (0.0371)
Log(Culture)		0.137*** (0.0252)		0.118*** (0.0275)
<i>FamHelp</i>		-0.0467 (0.0623)		0.0189 (0.0758)
<i>TribHelp</i>		0.185** (0.0905)		0.179* (0.0985)
Observations	1,429	1,429	1,429	1,429
Robust estimation	YES	YES	YES	YES
Sargan-Hansen p-value	0.1179		0.1798	
Tribe clustering	YES	YES	YES	YES

Standard errors in parentheses. Constant not reported.

*** p<0.01, ** p<0.05, * p<0.1

According to the results of the second equation of the system, *CP* has a positive and significant effect on daily crop gifts (*Social*), and its marginal effect is nearly two times higher than the effect of *Social* on *CP* in the first equation: A 10% increase in crop production leads to a 7% increase in daily crop gifts. Thus, what domestic groups produce (for market commercialisation or self-consumption) strongly affects what that they donate. Among other determinants of social relations in the second equation of

the system (Model 1), estimation results highlight the link between cultural customs and social relations. A 10% increase in customary donations (*Culture*) is associated with a 1.4% increase in daily donations (*Social*). The participation of members of the domestic group in fields belonging to other members of the tribe (*TribHelp*) appears significantly and positively associated with daily crop gifts. Mutual aid in the fields thus strengthens the social bonds between the members of the tribe. These results indicate that our exogenous instruments (*Culture* and *TribHelp*) are satisfactory in terms of explanatory power, which implies they are not ‘weak’ instruments. Regarding their ‘validity’, we do not reject the null hypothesis of the Sargan-Hansen test for overidentification, which indicates that our instrumental variables are exogenous or, in other words, uncorrelated with the error term (see the test results in Table 2). We can thus be confident with regard to the accuracy of our empirical results.²⁶

To summarise the empirical findings from Model (1), we highlight the two-way relationship between crop production and social relations. Crop production for the domestic group’s economic welfare is, therefore, the result and an explanatory factor of daily crop gifts. Hence, our empirical results suggest complementarity between crop production—a form of tangible wealth—and social relations—a form of intangible wealth. This finding confirms the limited substitutability between these two types of wealth. In addition, we found that Kanak cultural customs affect crop production indirectly through their effect on social relations. In particular, a 10% increase in customary donations increases crop production by 0.62% ($10 * [0.137 * 0.455]$). An increase in the level of intangible cultural capital results in an increase in the level of structural social capital, which implies an increase in the material wealth from Kanak crop production. Our empirical model emphasises the role of intangible wealth in creating and increasing the stock of tangible wealth, and the latter is indispensable for the maintenance of social relations. Thus, we observe a virtuous circle in the accumulation of different sources of wealth (tangible and intangible). These findings echo the ‘elastic model’ by Giraud and Loyer (2006), according to which all forms of capital are interdependent; the decline (or increase) in the level of a certain type of capital leads to a decrease (or increase) in the level of other types of capital. Thus, we observed that Kanak cultural norms and values—at least partly—represent tribal intangible cultural capital as the ‘glue’ that allows a collective accumulation of different types of capital.

Finally, as discussed in Section 4, the analysis of agricultural production can be studied from two perspectives: one oriented to the farmers’ decision-making (the main interest is to decide how many acres would be appropriate to seed)—investigated above using Model (1)—and another that analysed crop yields (based on technological and environmental conditions). Hence, we then check in Model (2) (Table

²⁶ In robust models such as GMM, R-Square is not the point of concern since it does not reflect the fit of the model. In general, there is no measure of goodness-of-fit in instrumental variable estimations except checking for the quality of the instruments chosen. With regard to the accuracy of estimates, one has to be sure that the instruments are ‘valid’, via the Sargan-Hansen test, and that they are also free from the ‘weak’ instrument hypothesis.

2), whether structural social capital affects crop yields²⁷ (*intensification* of tribal agriculture) in the same manner that it affects crop production (*extensification*/scaling up of tribal agriculture). The results indicate that social relations have a positive and significant impact on crop yield. However, the estimated elasticity is slightly lower than in the model of production. An increase of 10% in daily crop gifts is associated with an increase of 3.95% of crop yield. Farmers seem to engage in informal interactions to share risks and close the consumption smoothing gap (production scale) more than to seek economic performance (production yield). As in Model (1), when focusing on the production scale, **Culture** shows a positive and significant indirect impact on crop yield. Model's (2) results indicate that an increase of 10% in customary donations is associated with a 0.47% ($10 * [0.118 * 0.395]$) increase in crop yield. Finally, an increase of 10% in crop yield would increase daily crop gifts by 10.5%, which is a notable result. Yield performance seems to enhance social relationships to a greater extent than the scale of production does (as a reminder, elasticity of 0.7% found for crop production). We could suppose that being in contact with cultivated land makes it possible to maintain social relations (less than a proportional impact of **CP** on **Social**). However, the increase in yield performance would allow these connections to be more intensively improved (more than a proportional impact of **Yield** on **Social**). Economic performance would therefore strengthen the persistence of social interactions linked to tribal agriculture. These results might suggest that the complementarity between the different forms of capital is essential not only for the extensification—maintenance/scaling up—of tribal agriculture, but even more for the intensification (performance) of this activity and the *persistence* of social ties—socioeconomic sustainability.

6. Robustness tests

To ensure that we do not escape the effects of a trade-off between tribal agriculture and other wage-earning activities, we add the income originating from nonagricultural activities in logarithmic form (**NonAgriRev**) in the first equation of our system of simultaneous equations (1). The empirical results presented in Table 3, GMM(1), confirm the absence of a trade-off between tribal and nontribal activities.

These econometric results thus confirm the qualitative results discussed by Bouard, Apithy, and Guyard (2018), who show that substantial financial capital, when at least one member of the domestic group has a paid job, vary only rarely when regarding the abandonment of tribal agricultural activities. Thus, the first qualitative analysis and the econometric results developed in this study confirm the importance and maintenance of tribal agriculture in its nonmarket dimension. From a cultural perspective, tribal agricultural activities remain fundamental even when the time spent 'in the tribe' is reduced and fragmented. This finding is also in line with Bensa and Freyss (1994), who explain that having at least

²⁷ Crop yield is the value of agricultural production (**CP**, for commercial or self-consumption uses, harvested per unit of cultivated area (Surface), i.e. $\log(\mathbf{Yield}) = \log(\mathbf{CP}/\mathbf{Surface})$.

one member of the domestic group as an employee provides the domestic group with cash flow that allows them to access consumer goods in the market and to donate (i.e. customarily or daily). They add that gifts increase in importance when an abundant monetary flow enters the Kanak community and ceremonial economy.

Table 3. Robustness tests

Explained Variables Explaining Variables	GMM(1)		GMM(2)		3SLS		2SLS	
	Log(CP)	Log(Social)	Log(CP)	Log(Social)	Log(CP)	Log(Social)	Log(CP)	Log(Social)
Log(Social)	0.454***		0.497***		0.486***		0.587**	*
	(0.0901)		(0.0893)		(0.0782)		(0.0850)	
<i>Log(Surface)</i>	0.164***		0.167***		0.170***		0.0703	
	(0.0330)		(0.0344)		(0.0308)		(0.0569)	
<i>Log(AgrTime)</i>	0.152***		0.164***		0.163***		0.0704	
	(0.0381)		(0.0398)		(0.0283)		(0.0491)	
<i>Equipment</i>	0.243***		0.229***		0.217**		0.245	
	(0.0687)		(0.0742)		(0.0879)		(0.255)	
<i>Scholar</i>	-0.00908		-0.00919		-0.00611		0.0247	
	(0.0137)		(0.0138)		(0.0145)		(0.0414)	
<i>NbPlots</i>	0.0667***				0.0665***		0.0294	
	(0.0138)				(0.0154)		(0.0369)	
<u><i>Log(NonAgriRen)</i></u>	0.00258		0.00243					
	(0.00321)		(0.00353)					
<u><i>Log(IndusTime)</i></u>			0.00594					
			(0.0113)					
<u><i>ResidencePlots</i></u>			-0.000569					
			(0.0238)					
<i>North</i>	0.0899		0.0675		0.0923		-0.136	
	(0.0776)		(0.0819)		(0.0579)		(0.146)	
<i>Islands</i>	0.147*		0.113		0.134**		-0.133	
	(0.0840)		(0.0732)		(0.0649)		(0.161)	
Log(CP)		0.705***		0.712***		0.709***		0.711***
		(0.0229)		(0.0228)		(0.0201)		(0.0211)
Log(Culture)		0.137***		0.132***		0.130***		0.117***
		(0.0251)		(0.0250)		(0.0222)		(0.0233)
<i>TribHelp</i>		0.187**		0.198**		0.121		0.419**
		(0.0904)		(0.0890)		(0.0823)		(0.201)
<i>FamHelp</i>		-0.0507		-0.0495		-0.0716		-0.120
		(0.0615)		(0.0598)		(0.0705)		(0.202)
Observations	1,429	1,429	1,429	1,429	1,429	1,429	1,429	1,429
Sargan-Hansen p-value	0.1663		0.1041					
Hausman test (2SLS vs 3SLS) p-value						0.1209		
Robust estimation	YES	YES	YES	YES	YES	YES	YES	YES
Tribe clustering	YES	YES	YES	YES	YES	YES	YES	YES

Standard deviation in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Constant not reported.

In the second step (GMM[2]), we add the number of hours worked in mining and metallurgy (*IndusTime*). We are specifically interested in work in the mine because the development of the nickel

industry in New Caledonia is likely to trigger a change in the spatial distribution of Kanaks, caused by migration from rural areas to nickel mining areas²⁸. This phenomenon could put social capital, customary traditions, and practices at risk of erosion or, in other words, lead to a trade-off between tribal agriculture and working in the nickel industry. According to our estimates, the time spent working in the mining industry did not affect *CP*, confirming the absence of a trade-off between tribal agriculture and mining. This finding is in line with the findings of Pestana and Pantz (2015), who reject the rural migration hypothesis. Notably, they believe that the reflections in the literature concerning the spatial distribution of New Caledonian economic development overlook that many rural areas in the territory are simply part of the ‘residential economy’ rather than the ‘productive economy’.

We also replace the total number of parcels (*PlotsNb*) with the number of parcels around the domestic group’s residence (*ResidencePlots*). The objective is to determine whether the proximity of the plots to the domestic group’s residence affected the volume of agricultural production. According to our dataset, 82% of domestic groups have at least one parcel of land near their residence. However, according to the empirical results, this did not affect crop production.

Finally, we change the estimation method by using a three-stage least squares (3SLS) regression, which uses an IV approach to produce consistent estimates, and generalised least squares, to account for the correlation structure in the disturbances across the equations. Given that our dependent variables from each equation appear as covariates in the other equation, we expect the residuals from the system equations to be correlated. The Hausman test indicates that all exogenous variables are uncorrelated with all disturbance terms. Both the 2SLS and the 3SLS estimators are consistent, but only the 3SLS estimator is (asymptotically) efficient. These alternative estimations lead to similar coefficients when compared with GMM base estimations. Our core variables maintain their sign and magnitudes. Notably, under conditional heteroskedasticity, GMM is more efficient than 3SLS.

The significance of our variables of interest, and their respective coefficients, remain robust with the addition of new variables, replacement of some proxies, and modification of the estimation technique. Our empirical results thus seem robust overall²⁹.

7. Discussion and avenues for future research

Our micro-empirical study highlights an indirect impact of Kanak cultural values and norms (measured by customary and/or ceremonial gifts) on tribal agriculture (represented by plant production for sale and

²⁸ With the construction of the Vale-NC and KNS plants in the 2000s, and then off-shore plants since 2010, jobs in mines and nickel processing plants (employees, subcontractors) have increased by 58% between 2002 and 2015 (ISEE source).

²⁹ Robustness test for models regressing *Yield* reveal similar results and are available upon request.

self-consumption). This impact is driven by social relations (measured by daily crop gifts), which exert a direct effect (e.g. through mutual help) on plant production and appear to be essential to the continuity and sustainability of the traditional practice of tribal agriculture.

One might wonder if the persistence of tribal agriculture due to intangible wealth (i.e. daily and customary donations) could lead to a ‘poverty trap’ for people specialising in a labour-intensive form of agriculture. In answer to this question, we first recall our empirical results. In particular, we have seen that intangible wealth has a higher marginal effect on production yield than physical capital. Farmers seem to engage in informal interactions in order to share risks, close the consumption smoothing gap and seek economic performance when the use of (access to) physical capital is not common (reduced). In our empirical investigation, physical capital appears to be an important factor of production scale (i.e. crop production), with an insignificant effect on production intensity/performance (i.e. crop yield). The influence of equipment in the New Caledonian tribes has recently been observed in a study conducted in 2019 (Sourisseau et al., 2020). It is important to understand that equipment is ‘rare’ in tribal farming; only 3% of the domestic groups have a tractor. Generally speaking, the plots are small (on average 2,500 m²) and sometimes located on sloping ground (especially in reserve areas), so investment in equipment is not always evident. Beyond our quantitative findings, qualitative studies (Bouard et al., 2020; Bouard and Sourisseau, 2010; Guyard et al., 2014) show that if a Kanak farmer wishes to invest in agricultural equipment to increase farmed areas substantially, he will probably have to farm land reallocated as part of the land reform and to do so, the farmer will surely benefit from mobilising his social capital through his participation in customary ceremonies and donations. In our model, intangible wealth does not therefore act as a substitute for physical capital in order to lock communities into labour-intensive activities. On the contrary, intangible wealth seems to be a ‘solution’ in order to avoid extreme poverty in the communities relying on traditional practices where physical capital is missing or difficult to mobilise.

While ‘traditional’ agriculture is not a high value-added activity, we do not believe that non-market exchanges of plant production (donations) would induce a ‘poverty trap’ by keeping farmers in labour-intensive forms of agriculture, but could on the contrary contribute to economic development through the reduction of inequalities. One way to obtain a quantitative estimate of the role of non-market resources from agriculture in reducing inequalities is to compare their impact with that of social transfers linked to public redistribution, the primary role of which is to offset part of the economic inequalities. Based on the IAC survey used in our study, Guyard et al. (2013) have shown that inequalities are in particular regulated in tribal communities through the domestic economy. For all domestic groups residing in tribes in New Caledonia, the Gini index estimated for total income (monetary and non-monetary) is 0.37. The index calculated by the Household Consumption Budget Survey in 2008 for the

entire population of New Caledonia is 0.43 for total household income (including social transfers). Despite the differences in the sample, which call for a degree of caution, this result would tend to show a more egalitarian distribution within the resident tribal population than for the country as a whole. The reduction in inequality is achieved through the contribution of social and non-monetary income. Indeed, the latter makes it possible to move from an initial Gini index of 0.52 (calculated on the basis of income from labour and capital, excluding non-monetary income and social transfers) to 0.37 for total monetary and non-monetary income (Guyard et al., 2013). While the focus of our study is limited to socio-economic sustainability, we would like to recall here that research has shown the importance of a high degree of cohesion and a low level of inequalities in managing environmental resources in small communities (Ostrom, 1990). The socio-economic sustainability of tribal communities would thus be a pre-requisite for their 'strong' sustainability in a broader sense.

More generally speaking, we would like to stress that contrasting customary and economic development is too simplistic. In New Caledonian tribal communities, access to land is generally not problematic for the development of limited surface areas oriented towards consumption and small-scale local sales, although problems may arise when the agricultural activity is more commercial and concerns a larger surface area. However, this control does not only have negative effects; if legitimacy is respected and the individual concerned can justify the coherence of his project with the dynamics of his clan and tribe, collective control can become a means of support. Finally, methods of managing the articulation of market and non-market logics are implemented which allow for a negotiated coexistence. In an economic and individual approach, this situation is often perceived as a constraint as it limits the possibilities of market integration for individuals, although qualitative and [our] quantitative analyses show that the balance between market and non-market activities is sought in the global search for coherence between community social organisation and market constraints and opportunities. The relationship between market and non-market practices and their rationales are therefore complex: custom can facilitate economic development or even stimulate market activities, just as custom shuts out income by limiting excessive income accumulation strategies while at the same time reducing inequalities.

Our micro-empirical investigation suggests that socio-economic sustainability is not merely about modern (capital-intensive) or traditional (labour-intensive) practices; it should be mainly about mechanisms allowing for inclusive development which protect people from absolute poverty. Although based on a context-specific but holistic-inductive approach with empirical proof from a rigorous econometric study, our empirical results should apply to different communities, even those based on modern activities, provided social capital is acting through 'solidarity' (seeking synergies) rather than

‘charity’³⁰. In a socio-economic model, customary donations and, more broadly speaking, cultural values and norms are thus not limited to boosting aid ‘in the field’ but also enhance solidarity, which should ultimately overcome failures both in ‘traditional activities’ and in the ‘modern’ economic sectors based on physical (and/or financial) capital and free-market principles (the recent COVID-19 crisis has shown the limits of capitalist economies and the increased role of self-organized reaction / humanitarian responses)³¹.

Our model has been validated empirically for a community relying on a ‘traditional’ economic sector. Further research is needed to test the possibility of generalising our results, initially by extending data to other communities (similar to New Caledonian tribes), and subsequently by applying this model to a more generalised panel of households (or countries) around the world. In future research, we would first question whether the least developed communities (e.g. in Africa or on other Pacific islands), characterised by economic systems relying on both labour-intensive activities and insufficiently valorised intangible capital, are more likely to be locked in low income and unproductive activities. Another research question would be to test our model’s validity for communities specialising in other sectors which are more dependent on physical capital and thus with a higher value-added (e.g. arts and crafts, tourism, manufacturing, etc.) in order to provide additional insights into the link, if any, between intangible wealth, physical capital and [monetary] income. A comparative analysis of the relationships highlighted in our study for ‘traditional’ and ‘modern’ activities would be of great interest.

Finally, we recall that the variables we use in this study remain proxies for intangible cultural capital and structural social capital. The measures only partially represent these multifaceted concepts. We are fully aware of the probable bias of empirical results towards underestimation. Because of their intangible dimension, intangible cultural capital and structural social capital are difficult to measure, and little international data is available on these two forms of capital. In further research, the relationships measured in this paper between intangible cultural capital, structural social capital and crop production should therefore be supplemented and refined by using other variables which are currently missing, such as the number of speakers of the Kanak language within the domestic group; the presence or absence of specific cultural practices (e.g. yam staking, ridge / furrow farming); the presence of certain varieties of yams, taro or bananas with a high symbolic value; the presence of a traditional hut on the plot of land; and the measurement of counter-gifts. In addition, an update of the database used in this study (extended to data for other communities) would (i) facilitate an assessment, for more recent years, of the

³⁰ While ‘charity’ can lock people into unproductive activities, solidarity should boost performance by pooling synergies.

³¹ As reported by the OECD (2020), the COVID-19 crisis calls for a rebalancing of efficiency and resilience across the economies. While social capital was traditionally seen as a means of ‘fixing’ social problems (such as homelessness, exclusion from the labour market and other forms of social exclusion), it can play a much more important role in the post-COVID phase, inspiring transformation towards a more inclusive and sustainable economy.

relationships highlighted in this study for 2010, and (ii) make it possible to manage the problems of endogeneity and heterogeneity even more satisfactorily (e.g. fixed-effect estimates per year and/or domestic group, and Arrelano-Bond GMM-type regressions on panel data). Our empirical finding of a more than proportionate impact of crop yield on social relations merits further investigation, namely with panel data to capture the time dimension.

8. Conclusion

This paper highlights the role of intangible wealth in the creation of material wealth. We demonstrate the importance of intangible cultural capital (i.e. cultural values and norms) and structural social capital (i.e. social relations) through their impacts on an objectively measurable activity: the volume of agricultural production from customary lands in New Caledonia. Intangible cultural capital, which comprises a set of values and norms, is the foundation of the organisation of social relations and determines the way of life within the tribal community because it structures social relations. These norms and intangible values are maintained by the members of the tribal society and have been transmitted from generation to generation. Our results demonstrate a two-way relationship between social relations and tribal agriculture. Plant production is thus both the result and an explanatory factor of social relations. This simultaneity is empirical proof of the complementarity between intangible and tangible sources of wealth. Moreover, our results suggest that this complementarity is essential not only for the extensification – maintenance/scaling up – of tribal agriculture (crop production) but also, and even more so, for the intensification (performance, i.e. crop yield) of this activity and the persistence of social ties. Our results thus suggest that the neoclassical hypothesis of perfect substitutability between the components of wealth is not valid for socio-economic sustainability. We therefore expand the ‘strong’ [environmental] sustainability framework to intangible wealth, admitting restrictions on the degree of sustainability between tangible and intangible forms of capital. Such an approach is necessary for an adequate investigation of total tribal welfare, especially in terms of socio-economic sustainability which is particularly relevant at the community level. Further research is needed to verify the validity of the mechanisms revealed in this study for other economic activities and/or communities around the world.

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Appendix

Appendix A - Definitions and sources of variables

All data was collected declaratively from the head of the household and concern all of 2010.

Variable	Definition	Source
<i>AgrTime</i>	Overall time (in hours) devoted to tribal agricultural activities by all the members of the household in 2010	Survey on tribal agriculture conducted by CIRAD and IAC
<i>CP</i>	Sum of the monetary value (expressed in Pacific francs (FCFP)) of commercial crop production (regardless of marketing method) and non-commercial crop production (for self-consumption) in 2010. Survey conductors relied on the wide range of tools used for harvesting purposes (plastic bags, tote bags, palm-leaf baskets, etc.) and the harvesting practices (weekly, monthly, during periods of traditional customs) in order to measure quantities harvested. These quantities were then converted to kilograms using charts created specifically for the study based on measurement results taken from a sample of units used locally, and then to monetary values by affecting the prices observed on the local markets of the different study areas.	CIRAD and IAC: Survey on tribal agriculture for quantities.
<i>Culture</i>	Monetary value (expressed in Pacific francs (FCFP)) of the crops used for customary gifts in 2010. Monetary values calculated a posteriori by affecting the prices observed on the local markets of the different study areas.	CIRAD and IAC: Survey on tribal agriculture for quantities.
<i>Equipment</i>	A dummy variable indicating whether the domestic group detains motorized agricultural equipment.	Survey on tribal agriculture conducted by CIRAD and IAC
<i>FamHelp</i>	A dummy variable indicating whether the head of the household usually participates in agricultural activities in the fields of other family members for free	Survey on tribal agriculture conducted by CIRAD and IAC
<i>IndusTime</i>	Overall time (in hours) devoted to industrial activities by all the members of the household in 2010. Most often it relates to jobs in nickel refineries	Survey on tribal agriculture conducted by CIRAD and IAC
<i>Islands</i>	Geographic situation of residence of the household. A dummy variable taking value 1 for domestic groups in the Islands' region, 0 - otherwise	Survey on tribal agriculture conducted by CIRAD and IAC
<i>NbPlots</i>	Total number of parcels effectively used by the household for tribal agricultural activities in 2010 (non-contiguous)	Survey on tribal agriculture conducted by CIRAD and IAC
<i>NonAgriRev</i>	Monetary earnings (in Pacific francs (FCFP)) from all activities except tribal agriculture for all the members of the household in 2010	Survey on tribal agriculture conducted by CIRAD and IAC
<i>North</i>	Geographic situation of residence of the household. A dummy variable taking value 1 for domestic groups in the North region, 0 - otherwise	Survey on tribal agriculture conducted by CIRAD and IAC
<i>ResidencePlots</i>	Number of parcels used for tribal agricultural activities during the year 2010 that are adjoining the household's residence	Survey on tribal agriculture conducted by CIRAD and IAC
<i>Scholar</i>	Number of educated (scholarized) individuals from high school (including technical studies) to postgraduate studies	Survey on tribal agriculture conducted by CIRAD and IAC

	as a percentage of the number of individuals in the domestic group.	
<i>Social</i>	Monetary value (expressed in Pacific francs (FCFP)) of the crops used for everyday gifts in 2010. Monetary values calculated a posteriori by affecting the prices observed on the local markets of the different study areas.	CIRAD and IAC: Survey on tribal agriculture for quantities.
<i>Surface</i>	Surface (in ares) allocated to crop plantations for the household, in 2010, regardless of the crop type	Survey on tribal agriculture conducted by CIRAD and IAC
<i>TribHelp</i>	A dummy variable indicating whether the head of the household usually participates in agricultural activities in the fields of other members of the tribe for free	Survey on tribal agriculture conducted by CIRAD and IAC
<i>Yield</i>	Crop yield is the value of agricultural production (CP), for commercial or self-consumption uses, harvested per unit of cultivated area (Surface); that is, $\log(\text{Yield}) = \log(\text{CP} / \text{Surface})$.	Author's calculations using CIRAD and IAC Survey on tribal agriculture.