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Cognitive Ethnopedological Bases And Soil Uses In Kpouebo (Toumodi), Central Region Of Cote D'ivoire

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ABSTRACT

Developing strategies for sustainable agriculture requires consideration of local soil knowledge. An ethnopedological study on the local perception of soils among the Baoulés (ethnic group of the central Ivory Coast) was conducted in the village of Kpouébo in November 2016. The study aimed to understand the semantic triptych of ethnopedology of which :

- The knowledge accumulated by the peasants (Corpus);
- The practices implemented on the ground (Praxis);
- Rites and beliefs related to soil cultivation (Cosmos).

To achieve these objectives, the study consisted of surveys of the peasant mass.

It appears that populations identify their soil using morphological criteria. The agronomic value of soils in terms of indicators of fertility, cultivation techniques, or soil protection has been identified. Much more than a medium of culture, the ground is at the origin of several beliefs and many divinities are attached to it. However, despite the wealth of corpus and praxis, local knowledge about the management and use of water for agricultural needs is insufficient or non-existent. This study presents previously unverified knowledge that can facilitate exchanges between farmers and the scientific community and help design sustainable agriculture.

Key words: *Ethnopedological survey, Kpouébo, Agriculture, Soil, Côte d'Ivoire*.

1- INTRODUCTION

Ethnopedology aims to understand and document local approaches to the perception, classification, appreciation, use and management of soil (Barrera-Bassols et al., 2006). This neo-discipline, is doubly enriched by its location at the interface of social sciences and natural sciences. In the perspective of developing strategies for sustainable agriculture, ethnopedological knowledge remains essential (Barrera-Bassols and Zinck, 2002 and 2003, Birmingham, 2003, Hillyer et al., 2006, Barrera-Bassols et al., 2006). In addition, local soil typologies are considered as the basis of a common language between scientists and farmers (Krasilnikov& Tabor, 2003). While in recent years several studies have been conducted in this field in many countries (Ettema 1994, Norton et al., 1997, Barrera-Bassols and Zinck 2002 and 2003, Osbahr and Allan 2003, Krasilnikov and Tabor , 2003, Ryder, 2003, Birmingham, 2003, Hillyer et al., 2006, Barrera-Bassols et al., 2006, etc.), ethnopedological studies seem to have left little trace in the soil science literature in Côte d'Ivoire.The studies conducted here and there cover, among other topics:

- The formalization of local knowledge of soils and soils in classification systems;
- Tnalysis of local land valuation systems;
- Evaluation of local agroecological management practices.

In view of the three major components of ethnopedology, it should be noted that until now, research has paid much more attention to local cognitive systems (Corpus) and local soil management systems (Praxis). The beliefs and rituals of the perception of the ground (Cosmos) are relegated to the background, if not ignored. While the insistence of ethnopedological research focused on the cosmovision of local populations, can further improve the contribution of ethnopedological studies in the formulation and implementation of rural development programs (Barrera-Bassols and Zinck, 2002).

These are all the reasons that justify the present study entitled Ethnopedological bases cognitive and land use in Kpouebo (Toumodi), Central Region of Côte d'Ivoire. Therefore, this subject poses the problem of understanding the perception of the soil in the local value system.

The study will therefore allow the understanding and documentation of endogenous knowledge on the ground.

2- MATERIAL AND METHODS

2-1- Material

2-1-1- Characteristics of the site

The sub-prefecture of Kpouébo with coordinates 4 ° 51'00"W and 6 ° 19'60 " N was used as a framework (Figure 1). It is accessed through a dirt road, from the Abidjan-Yamoussoukro highway, Moronou crossroads located about 172 km from the economic capital of Côte d'Ivoire (Abidjan). Geologically, the research work of Yao-kouamé (2007a, 2008), Kouakou et al. (2013), Camara et al. (1987), Yao-Kouamé et al (2010) show that the geological facies of the Toumodi region is varied. There is a whole range of rocks, from the most acidic to the most basic.

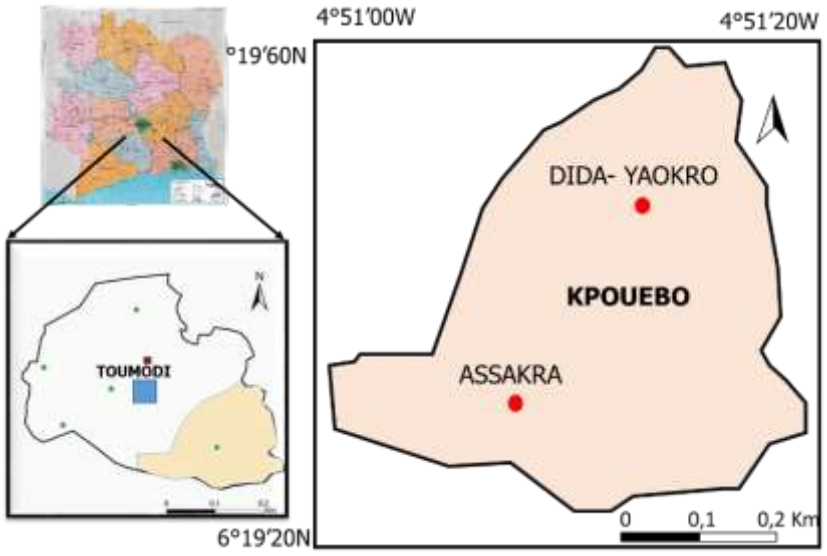

Figure 1: Location map of the study area

At the climatic level, the Toumodi region has an equatorial transition climate with two rainy seasons, of unequal importance, separated by a short dry season (July - August), Camara et al. (1987); Yao-kouamé (2007b) and N'guessan (1990). The region of Toumodi is a plain broken by low hills with heavy forms. The highlights of this area are Orumbo-Boka, Kokumbo and Mount Dodo (450-500 m) according to N'guessan (1990).

Soils in the Toumodi Department are browned soils (Cambisols), according to the work of Yao-Kouamé (2007b) and Kouakou et al. (2013). The soils are loose, coherent, porous, of subdangular polyhedral structure, and essentially clay-sandy texture. These soils seem favorable to a variety of crops, both food and industrial such as maize, yam, cassava, coffee, avocado, cocoa, and oil palm, etc. At the hydrographic level, this granitic plain belongs to the N'zi basin, itself a tributary of the Bandaman (Rieu, 1972). It is drained to the East by the N'zi and to the North by the Kan.

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2-1-2- Survey material

The investigation required the following equipment:

- **Dictaphone (mobile phone) for recording interviews;**
- **Fiche a survey form designed for the study;**
- **C**amera for capturing images;

2-1-3- Computer Hardware

The exploitation of the collected data was done thanks to:

- Office and computer Equipment for data collection and data entry;
- Software (Word and Excel), for data processing;
- Mapping software (Arcgis 10.2.2) and Google earth.

3-2- Methods

3-2-1- Choice of villages

The choice of the localities of the sub-prefecture of Kpouébo and two satellite villages, is motivated by the fact that the main activity of these populations is agriculture. This activity focuses on various crops (banana, yam, cocoa, cassava, peanut, okra, peppers). The inquiries were made in the presence of the sub-prefect of the said localities.

3-2-2-Sampling and Conducting Investigations

3-2-2-1-Sampling

The choice of respondents was made on the basis of their agricultural production and their knowledge of the soil. They are: the landowners; the major producers and custodians of the tradition.

Young farmers were also surveyed to verify the transmission of knowledge, without omitting women active in agricultural production.

3-2-2-2- Conduct of investigations and examination of results

Three localities were investigated using a participatory approach (FAO, 2007). These are Kpouébo (sub-prefecture), Dida-yaokro (satellite village) and Assakra (satellite village). As per the guide, we filled out a survey sheet with open, closed and mixed questions through group interviews and individual interviews, whose areas of interest are the perception of the soil on the praxis aspects, the corpus and the cosmos. The group interviews were conducted according to the approach of Dubiez et al (2004), the first in Kpouébo and the second in Dida-Yaokro and Assakra. The first registered eleven participants including three women, five men over 40 years old and three young men. The second concerned notability. The individual interviews carried out according to the method described by Susan Glättli (2005), mainly concerned a sample of 17 individuals including 8 heads of agricultural households, 6 women and 3 young men. The data was collected using a dictaphone before being transcribed. The vernacular translation of local themes was carried out at the Department of Linguistics at the Félix Houphouet-Boigny University in Cocody. A correspondence between local endogenous knowledge and scientific knowledge has been made. Very often the peasants have been accompanied to their fields to appreciate the soil together.

4- RESULTS

4-1- Local knowledge of the soil (Corpus)

4-1-1- Logic of local soil classification

The classification relates to the cognitive aspect and the management of soil resources by the Baoulé people in the sub-prefecture of Kpouébo. Local knowledge of soils was approached according to the identification criteria and the criteria of distinction between "good and bad soils". The classification of soils in this locality is based on morphological criteria and follows a logic (Figure 2).

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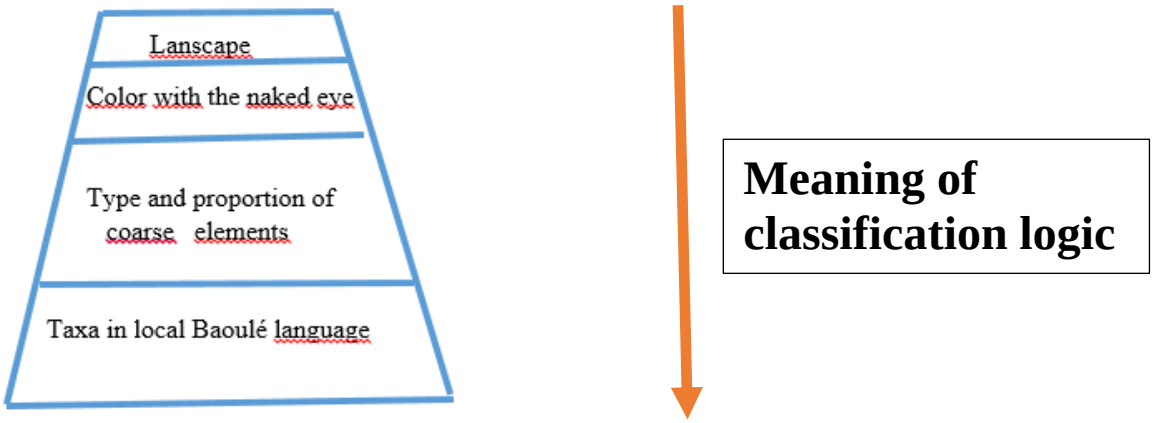

Figure 2: Logic of soil classification in the Kpouébo Zone

4-1-1-2- Soil typology

The identification of the horizons is based on the texture, the color, the ease to be worked and the position in the landscape. The name of the soil derives directly from the element that is most marked: the color or the presence of coarse elements. Farmers observe the first 20 cm The structure that guides the local classification of soils is summarized in Figure 3.

Floors rich in coarse elements (***Kpbangba-ma)***

(Kpbangba-ma bla)

Ocher soil(*Assièwoclè*)

Little clay ***(Yanqui-wa)***

Dark floor***(Assiè-blé)***

Very clayey***(Mantensou)***

Brown soil with a low proportion of coarse elements

Darkfloor(***ahouyan-blé***)

Clear ground ***(ahouyan- oufoué***)

Sandy soil(*ahouyan)*

Figure 3: Soil distribution according to the landscape

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4-1-2-4- Correspondence between local knowledge and scientific knowledge

The types of soils identified and described according to the perception of the farmers in the study area are grouped in Table I, with their corresponding WRB. A total of four major soil types have been identified, with two variants for each.

Table I: Local names of Kpouébo soils and their correspondences in WRB

Local classification (prefix +suffix)		Floor color in the wet state	Texture	WRB
Kpangba-ma	*Bla*	Reddish-brown (7,5YR) to Brown (10YR)	Sablo clay + GL	Manganiferic plinthic cambisol
	Yassouha		Sablo clay +GL+C	Manganiferic plinthic cambisol
Assiè-blé	*Yanqui-wa*	Blackish brown (2,5YR) to Black (GLY2)	Clay loam	Cambisol
	Assa ou *fohko*			Gleysol
Assiè-Woclé	*Yanqui-wa*	Brown-reddish (7,5YR) to brown Ocher (10YR)	Silty Sablo clay	Cambisol
	Mantensou		Clayey	Cambisol
Ahouyan	*Oufoué*	Beige (GLY2) à	Sandblaster	Arenosol
	Ble	Black (GLY2)	Sandblaster	Humic Arenosol

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4-1-3-Assessment of soil fertility

In the value system of the study area, the assessment of the quality of a soil is based on many indicators. The culture that we want to put in place guides the farmers in the choice of plots to clear. In addition, local indicators of soil fertility vary by type of vegetation cover. Present and past crop yields are soil fertility records (Tab II).

Table II: Observations indicating fertility

Leaf color	Vigor of the stems	Fertility of the soil
Dark green	Very vigorous	Very fertile soil
Green	Vigorous	Fertile soil
Yellowish green	Not vigorous	Less fertile soil

The assessment of soil fertility under forest cover is based on the observation of varietal species. The users are the big producers and the landowners. Four indicator plants of fertility have been identified: they are: *Nesogordoniapapaverifera* « kotibé » ; *triplochitonscleroxylon* « samba » *; milliciaexcelsa* « iroko » and *celtisintergrifolia* « assann ».Their presence informs about a potentially fertile soil. Scholars very often explore the depth of soil and the pace of the roots to gauge the cultural suitability of soils.

4-1-4- Fertility related to soil types

Local knowledge directly relates fertility to different types of soil, which is determined by crop. The ability to conserve useful water, texture, structure and tillage are the aspects on which this assessment is based. The rationale for assessing soil fertility is summarized in Table III.

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Table III: Fertility related to soil type

Local name of the horizon		Conservation and circulation of water	Ground work	Appreciation	
				P.C.	F.C.
Assiès	*Yangiwa*	Good	Easy	Very fertile	Very fertile
Blé	*Assa /fohko*	Bad	Difficult	Not fertile	Fertile
Bla		Good	Acceptable	Fertile	very fertile
Kpkangba-ma		filtering, poor water retention	Difficult, manyconstraints	Verylittle fertile	Little fertile
Yassoua					
	ouffoué	filtering, poor water retention	Easy, little or no constraints	Not fertile	Fertile
ahouyan		Less filtering,	Easy, little or no constraints	Fertile	Very fertile
	ahouyan	Prettygood conservation			
Yangiwa	*blé*	Very good	Easy	Very fertile	Very fertile
Assièswoclé		Bad	Difficult	Little fertile	Fertile
Mantassou					

P.C. : Perennial culture ; F.C. : Food-producing cultures

4-2- Village system for land use and development (Praxis)

4-2-1- Village operating system

The production systems practiced by all farmers are manual, extensive and mobile slash-and-burn. Several agricultural crops are produced in traditional cropping systems marked by clearing and prolonged fallow (fallow) land to improve fertility. Crop production consists of perennial crops (coffee, rubber, cocoa), food crops (yam, cassava, maize, banana, rice and groundnuts, etc.) and vegetable or vegetable crops (tomato, okra, pepper, pistachio). .

In the local production system, yam occupies a place of first choice, the other speculations coming in second place. According to the farmers, the field of yams offers good conditions for the development of other speculations. The cocoa, coffee, banana, tomato, pepper, eggplant and cassava are found in cultural combination with yam.

Long relegated to the background, export crops have risen to the same level of importance as yam in the current context of climate change. Indeed, the scarcity of land in the forest area, pushing non-native populations, to return to their land long left fallow forest savanna transition zone to install perennial crops.

4-3-Rites and beliefs related to soil cultivation (Cosmos)

4-3-1- Ground Beliefs

People consider the soil much more than a mere support for production. Spirits, divinities, taboos and many beliefs are attached to it. According to community belief, no activity can be realized without the permission of ancestors and gods. It is, moreover, what

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justifies the libation which is made at the beginning of all activities, to ask the authorization of the ancestors and the protecting gods.

4-3-2- Rites and adorations related to the soil

When the rains fail to fall, the women dance Adjanou, which is a sacred dance practiced only by the female, to implore the gods, so that the rains come. Formerly, entering the village with banana diets or palm regimes was, an offense and an offense to the spirits of the earth punishable by fine. But nowadays, following offerings of oxen sacrificed to ancestors and gods, this prohibition has been lifted.

The Baoulé formulate prayers and offer offerings during the main events of the agricultural year, such as during the yam festival, which marks the official beginning of its consumption and therefore of its harvest. Highly regarded and attached to these rites and beliefs, they seemed to be forgotten today. In the traditional local magico-religious system, the ritual provides the individual with help in the face of his anxieties and difficulties. The rite also acts to maintain the confidence of the entire community and the sense of cohesion. The call to GNAMIN-KPLI (deity falling from the sky) and to ASSIES (deity coming from the earth) aimed to bring down the rain. In case of obstruction of social rules, in relation to the soil or the earth, sacrifices or rituals are imposed on the guilty parties. These can be heavy mistakes, which undermine the cohesion of the people and trigger the wrath of gods and spirits (murder or attempted murder, sexual intercourse in the bush). The Baoulé believe that the forest is under the influence of supernatural beings, the spirits of the deceased chiefs who are buried there. They conceive of the forest, the waters, and the earth as a whole, granting or retaining their products according to the good or bad intentions of the supernatural powers. Moreover, this population does not differentiate soil and earth, because these two entities have the same name: Assies.

Some forests are sacred, one enters only under certain conditions, any agricultural activity was prohibited there. But, the land pressure of recent times has made transcend these prohibitions. Rites and adorations of intentions are summarized in Table IV.

Table IV: Rites, worship and their goals.

Event	Stock	objectives
Installing new fields	Started on the appropriateday	Have the blessing of the gods for activity
Realization of work	Libation	The approval of ancestors
Lack / disturbance of the rain cycle	Adjanou, sacrifice in honor of the gods	To implore the gods to restore the normal rain cycle

5- DISCUSSION

5-1-Relevance of typology

The local typology of soils is based on color and texture, which seem to be the most important criteria and, in the alternative, the topographic position of the soil. These properties are most important in most local soil classification systems across developing countries (Norton et al., 1997, Birmingham 2003, Ryder 2003).

The names of soils given in the Baoulés take into account the color, the texture, the morphology and the state of the vegetation. This confirms the results of Kissou et al. (2012). The nomenclature is always preceded by the earth prefix, as mentioned by Bio-Lafia in 2007 in Benin. Other aspects of the soil that can be visibly perceived and used for classification are organic matter and

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clay content. In general, dark-colored soils are considered more fertile than light-colored soils; this is related to their organic matter content (Ryder, 2003). Soils rich in clay are heavy, difficult to work and stick to work tools in rainy weather.

The local soil classification is less detailed than the international classification systems; in addition, it exists in the habits of these farmers in a holistic way and has never been documented on paper. Local taxa are derived from the properties of the superficial soil horizons, not because the population is unaware of the vertical dimension of soils, but it is simply ignored in soil classification. Other populations also perceive the soil through only its superficial layer (Niemeijer and Mazzucato 2003, Bautista and Zinck 2010). From this point of view, this local perception can not be related to an international classification that is based on soil profiles at least 120 cm deep (Habarurema and Steiner, 1997). The vertical dimension of the soils intervenes rather in the assessment of the soil quality for agriculture.

5-2-Relevance of Quality Assessment Criteria

Producers in the study area do not rely solely on the singularity of an indicator to assess the state of soil fertility but take into account the combination of indicators. Bio-Lafia (2007), argued in these studies that several indicators are used to assess the state of fertility or soil degradation in local farmers. Somé et al. (1998), argue that in Burkina Faso, producers observe the appearance of the soil fauna, the yield obtained from the previous crop and the physical appearance of the soil. These authors join Vissoh et al., (2007), who report that some peasant groups use floristic vigor as an indicator of fertile soils. Soil quality is closely related to the water conservation capacity. Concrete soils are more favorable for a cocoa plant. Because of its excellent ability to restore water during drought and because of concretions, which, according to local populations, restore water stored. This observation of farmers is shared by the CNRA (2008) and Kouakou et al. (2013). According to these authors, the significant presence of coarse elements, composed mainly of concretions or ferruginous nodules and quartz can constitute a major obstacle to root development. On the other hand, it can maintain the porosity of the soil and protect it against settlement. This induced porosity helps to considerably reduce water in the soil, but the nature of these coarse elements (concretions and ferruginous nodules) could allow the water to imbibe and be returned to the plants.

5-3-Soil management and cropping system

The valorization of the lands, by the residents of Kpouébo, is done by the system of mixed production, whose yam constitutes the pioneering culture. The cultural association adopted in this system is explained by two reasons:

- practical reasons (a parcel of cleared land must carry most of the crops covering the family's food needs), provided the association is possible;
- technical reasons (reduction of the workload, association with good performance).

In the knowledge system (corpus) of soils of the study area, the populations, although aware of the place of water in the success of their farms, have at no time made the case of local techniques water management, or special techniques to combat erosion. This is contrary to the knowledge of the populations of the landlocked countries of the Sahelo-Sudanese area, where according to Roose et al. (1995), the traditional technique of zaï, allows the rehabilitation of degraded lands. The absence of this aspect in the corpus of Kpouébo populations is explained by the fact that the dry periods have never been so long and so severe to undermine agricultural activities as is the case today. The crop diversification observed aims to adapt to the climatic conditions and the revaluation of the selling prices of certain food crops such as plantain. The rainfall cycle has also imposed changes in the crop calendar nowadays.

5-4-Cosmos

In terms of beliefs, the soil is much more than a medium of production, but it is linked to a set of rituals without which any company in relation with the soil would be doomed to failure. Moreover, the earth and the soil are named by a single word in the local language Assiè. Inseparable, these two entities are represented by the same divinities, which influence the success of cultures

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and the prevention of catastrophes. This irrational conception of soil perception was noted by Kasongo (2009) in Cameroon among the Bemba people of the rural world. The populations of Kpouébo, represented the corpus, the praxis and the cosmos a few years ago, as an inseparable whole, as a system that can not exist, without the taking into account of all these dimensions. To understand the practices of men on the ground is to understand, above all, the way they perceive it. Like the things of creation, the soil is part of a living whole that imposes certain constraints. Because we do not touch the ground, just as we do not install a building, without the consent of the tutelary powers who have custody. However, beliefs, because of the mixing of populations and the advance of Christianity, tend to disappear. However, taking these beliefs into account is essential. Because according to Osbahr and Allan (2003) the understanding of the knowledge and the management of the soil by the local farmers are very important for the development of the technologies and approaches of extension which are useful to them. In fact, the soils, the rivers, the forest and the deities that populate it, are to be considered carefully, as a coherent whole having a meaning.

6- CONCLUSION

The ethnopedological study has led to the discovery of knowledge about soil resources, particularly with regard to the local classification system and the criteria for assessing soil quality for agricultural uses. It also allowed the review of the different rituals of the magico-religious system of the indigenous populations of Kpouébo sub-prefecture in relation to the biophysical resources.

In terms of the Corpus, the results of this study showed that in the study area indigenous people have a well-structured knowledge of their soil resources. Soils are classified according to an approach that integrates their position in the landscape, the color as it is appreciated on the surface of the ground and the naked eye, the texture and type of coarse elements that are found there. Cultural practices are undergoing changes because of the disruption of rainfall and land pressure. Slash-and-burn agriculture is gradually giving way to a system where cut-out Adventists are used to enrich the soil after decomposition. Fallowing is one of the main techniques for restoring the fertility of degraded soils. But, it is compromised by land pressure, characterized by the reduction of arable land.

At the cosmic level, the results showed that the rural population of the sub-prefecture of Kpouébo is convinced that the lands are under the influence of supernatural beings. The spirits of the ancestors are there and the dead chiefs are buried there. Even if nowadays because of the religions, this conviction tends to disappear, it does not remain about it less, that this population considers the "bush" and the waters as a whole which grants or retains the products according to the will of the spirits (supernatural powers). This belief that the causality of obtaining material goods depends less on man, but especially on supernatural minds and means, constitutes the irrational aspect of rural economic life (economy based on agriculture) in the zone of 'study. Thus, rites were invented for the goods whose obtaining entailed risks and whose success exceeded the rational understanding and the practice of the Men.

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