How Important Are Cultural and Environmental Objectives for Rice farmers in South Senegal?[1]

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Jel classification: Q12, R31, O18

Abstract

This paper explores farmer-specific cultural, social and economic objectives within the extensive rice system in the Kolda region (South of Senegal). We classify and characterize farmers according to the relative importance of their multifunctional goals. The empirical analysis uses farm-level data collected through a face-to-face questionnaire to a sample of rice farmers. The Analytical Hierarchy Process (AHP) is used to measure farmers' primary and secondary objectives importance in planning their activities, and Cluster Analysis (CA) to classify and characterize farmers according to their priorities. Results suggest that within the "economic" role, the most important goals are "maximization of total farm income" followed by "improving rice quality". They tend to "minimize fertilizers use", both to reduce cost and to preserve the environment. Farmers recognize their potential role in "minimizing illegal immigration". Results can be useful in guiding policy makers by considering farmers' priorities at local level.

***Key-words**: Farmers' objectives; Analytical Hierarchy Process, Rice sector, Senegal.*

Rèsumé

Dans cet article, nous avons analysé les objectifs culturels, sociaux et économiques des producteurs de la région de Kolda (dans le sud du Sénégal) qui cultivent le riz de manière extensive. Nous avons classé et caractérisé les producteurs selon l'importance relative de leurs objectifs multifonctionnels. Cette analyse empirique a été basée sur des données collectées à l'échelle de la ferme en soumettant un questionnaire à un échantillon de riziculteurs. Nous avons employé un Processus de Hiérarchie Analytique pour mesurer l'importance des objectifs primaires et secondaires des producteurs dans la programmation de leurs activités et une Analyse par regroupements pour classer et caractériser les producteurs selon leurs priorités. Les résultats ont indiqué qu'au niveau du rôle "économique", les objectifs les plus importants sont la "maximisation du revenu total de la ferme", suivi par "l'amélioration de la qualité du riz". On constate une tendance à "minimiser le recours aux engrais" pour réduire les coûts et préserver l'environnement. Les producteurs reconnaissent leur rôle potentiel dans la "minimisation de l'immigration illégale". Les résultats obtenus peuvent s'avérer utiles pour orienter les responsables politiques en considérant les priorités des producteurs à l'échelle locale.

Mots-clés: Objectifs des producteurs; Processus de hiérarchie analytique, secteur rizicole, Sénégal.

1. Introduction and objectives

An inherent characteristic of agriculture is the joint production of commodity and non-commodity output which are in general valued by society and known as agricultural multifunctionality (Kallas, *et al*. 2007b). This concept has emerged as a key element in policy debates on the future of agriculture and rural development (Renting, 2009) not only at the European agricultural and rural policy but also at the international trade discussions (Potter and Tilzey, 2007).

There is a debate about what multifunctionality in agriculture signifies and how it might be recognized in practice (Renting, 2009, Marsden and Sonnino, 2008; Wilson, 2007). However, an overall consensus about the definition of the concept is recognized. According to the formal definition (EC, 1998) it is the acknowledgment of three different roles played by agriculture: a) producing food and fiber products, b) preserving the rural ecosystem and landscape, and c) contributing to the viability of rural areas and a balanced territorial development.

This definition suggests that multifunctional agricultural production comprises both market and non-market goods. The former comprise mainly, although not exclusively, food and fiber products (economic function), while the latter include environmental and social functions, which in most cases also have public good characteristics.

Agricultural multifunctionality has been intensely analyzed in EU countries from the supply side of the agricultural systems (provision of commodities and non-commodities outputs) and from the demand side taking into consideration social welfare changes due to variation in the supply of different outputs. As a result of their analysis, an important aspect is that these functions are territorially specific, providing mainly local benefits and depending in a great measure on the agriculture system. Thus, effective policies set are usually formed at local level affecting directly rural society involved (Kallas, *et al*., 2008, Bjørkhauga and Richards, 2008). However, there is a scarce of these studies for developing and underdeveloped countries. A key question that may arise is if farmers in these countries are aware about the muntifucntionality role of their agricultural system and if these functions or objectives are taken into consideration when they plan their activities.

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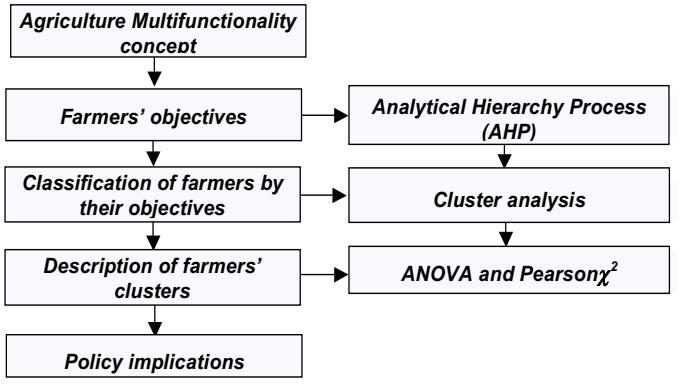
The present study aims to expand the relatively sparse literature on agriculture multifunctionality in these countries. Concretely we explore from the supply side of agriculture multifunctionality, farmers' objectives within the extensive rice culture in south Senegal. Furthermore, we seek to classify and characterize farmers according to the relative importance of their multifunctional objectives. Data used in this analysis were obtained from face-to-face questionnaires with 110 rice farmers carried out during March-June 2010 in the Kolda region in the south region of Senegal.

The remainder of this paper consists of five main parts. Section 2 explains the methodology employed in this research. The next two sections introduce the case of study and the empirical application. In Section 5 results are discussed. Finally, some concluding remarks are outlined.

2. Methodology

To achieve our goal, we have proposed a methodological framework which is divided in different steps as can be seen in Figure 1.

Figure 1 - *Methodological framework.*



2.1. The Analytical hierarchy Process: AHP

The AHP is a multi-criteria decision-supporting method in discrete environments developed by Saaty in the late 70s (Saaty, 1977; 1980). It aims to decompose a complex decision problem in a hierarchy of smaller constituent sub-problems. Determining the most considered objective from a set of goals is a decision problem where the top level of the hierarchy represents the concept valuation. It is decomposed into a predefined number of characteristics (attributes/primary objective) on the second level and their corresponding levels/secondary objectives on the third level. AHP estimates eliciting weights (w) for each attribute and attribute level in order to explain farmer behavior in relation to the agricultural multifunctionality concept. The relative importance or weight (w) for the primary function (objectives or attributes) and level (secondary functions or attributes) are obtained from pairwise comparisons.

In order to implement the AHP, one needs to carry out a survey where individuals are asked to make two types of pairwise comparisons: a) a pairwise comparison of the levels within each attribute; and b) a pairwise comparison of the attributes. First, the respondent has to indicate which of the two elements the respondent prefers. Then a nine-point scale is used to measure the strength of this preference by means of verbal judgments. From the answers provided, a Saaty matrix with the following structure is generated:

$$S_k = \begin{bmatrix} a_{11k} & a_{12k} & \dots & a_{1jk} \\ a_{21k} & a_{22k} & \dots & a_{2jk} \\ \dots & \dots & a_{ijk} & \dots \\ a_{i1k} & a_{i2k} & \dots & a_{NNk} \end{bmatrix} \quad (1)$$

where a_{ijk} represents the value obtained from the pairwise comparison between attribute/level i ($i \in$ N / $i \in$ P) and attribute/level j; ($j \in$ N / $j \in$ P) for each individual k.

Under perfect consistency in preferences, K weights (w_{Nk}) for each attribute and K weights (w_{Pk}) for each level can be easily determined from the N(N-1)/2 values and P(P-1)/2 values for a_{ijk} respectively. However, perfect consistency is seldom present in reality, where personal subjectivity plays an important role in the pairwise comparison.

In order to estimate the weight vector that is better able to represent the decision-maker's real weight vector, Saaty (1980; 2003) suggested two options as the accurate estimate of real weights: the geometric mean and the main eigenvector. As all criteria meet the requirements to estimate the above-mentioned weights, we choose the geometric mean (Aguarón and Moreno, 2000; Kallas, *et al*., 2007a). Using this approach, weights assigned by subject to each attribute and level are obtained using the following expression:

$$w_i = \sqrt[K]{\prod_{k=1}^{k=K} w_{ik}} \qquad \forall\ i,\ k \quad (2)$$

The AHP was originally conceived for individual decision-making, but it was rapidly extended as a valid technique for the analysis of group decisions (Easley, Valacich and Venkataramanan, 2000). Thus, we need to aggregate the corresponding individual weights (w_{ik}) across farmers to obtain a synthesis of weights for each objective and level (w_i). For the aggregation process, we consider the geometric mean as the most suitable method for aggregating individual weights (w_{ik}) in a social collective decision-making context (Forman and Peniwati, 1998):

$$w_i = \sqrt[K]{\prod_{k=1}^{k=K} w_{ik}} \qquad \forall\ i \quad (3)$$

With the aim to obtain and ordering weights for levels of each attribute, we need to calculate a global weight for each level ($w_{G\_}$ *L*n.p). These global level weights are obtained by multiplying aggregated levels' weights (w_i for each level $L_{n.p}$) by its corresponding weight (w_i) of attribute (A_n) as mentioned by Malvinas *et al*. (2005).

$$w_{G\_Ln.p} = w_{An} \times w_{Ln.p} \quad (4)$$

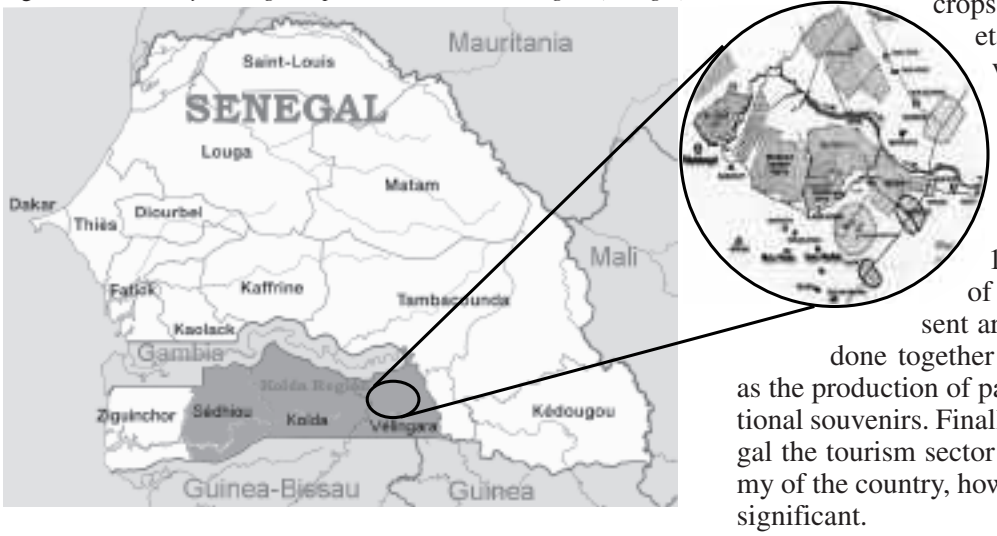
where, $\sum w_{G\_Ln.p} = 1$, for all levels.

3. Case study: the empirical application

3.1. Geographical location

Senegal is divided administratively into 14 regions which are divided into 45 departments integrated in various rural communities (ANSD, 2008). The region of Kolda (southern Senegal) occupies an area of 21,011 km^2 and has a population of 847,243 inhabitants (ONG7a, 2008). It has three departments: Kolda, Sedhiou and Vélingara (Figure 1). The latter is the department used in our studied area.

Figure 1 - *Case study: Vélingra department in the Kolda region (Senegal).*



The population is predominantly young. Only 3.6% of the population is over 65 years and almost 50% are under 15 years, resulting in a high dependency ratio. The percentage of women is slightly higher, especially in the age range from 20 to 40 years which is when male population begins to migrate to other cities or countries.

Poverty in rural environments and high unemployment rate make the immigration an important social problem. The schooling and compulsory education is very low and it mainly affects the female population. (PERD, 2008). Senegal has a high ethnic diversity such as wólofs (43,3%), peuls (33,8%), séréres (14,7%), diolas (3,7%), malinkés (3,0%), soninkés (1,1%) among others. In the studied area, the majority of population is of ethnic Peul (49.3%), followed by the Mandingo ethnic group (23.6%). Peul population comes from an essentially nomadic group who has been gradually settled during years. They are used to have animal farming in addition to some crops during the rainy season. Almost 60% of the Kolda population lives in rural areas, where agriculture is the main source of income.

In the rural population, men are traditionally devoted to field work in subsistence farming or in other commercial crops. Women are responsible of the vegetables cultivation. This is realized on a very small scale in the rainy season. Most production is for household consumption and a small portion is sold at local markets. There is usually a large plot in most rural communities; each plot is cultivated by 150 women, each of which takes care of her little part, which usually represent around 50 m^2. This farming activity is done together with other economic activities such as the production of palm oil soap and small shops of traditional souvenirs. Finally, it's worth mentioning that in Senegal the tourism sector play an important role in the economy of the country, however, in the studied area is almost insignificant.

The analyzed area is the least industrialized region of Senegal with a high potential of agricultural activities. It account for about 1,100,000 ha of arable land with only 23% devoted to agriculture. Water is abundant mainly from rainfall (1,200 mm) and the presence of the Casamance River makes the rice culture as the most appropriate crop.

Table 1: *Evolution of population and labor force size in Senegal.*

	1995	**2000**	**2005**	**2010**
Total Population (millions)	8.37	9.51	10.87	12.43
Agricultural population (millions)	6.27	6.99	7.82	8.73
Total Labour force (millions)	3.47	3.98	4.63	5.44
Labour force in agriculture (millions / %)	2.60 74.99%	293 73.50%	3.3 71.89%	3.83 70.24%
Females (% of labour force in agriculture)	45.58%	46.09%	46.57%	47.40%
Rural population (% of total Population)	60.38%	59.66%	58.87%	68.62%

Source: FAOSTAT, 2010

3.2. Agricultural activities

As commented, agriculture is the main source of income for local people. The Labour force in agriculture represents a great part of the total work force (70.24%) which has slightly decreased since 1995 (4.75%). However, the role of female is increasing in the agriculture work force (47.40% in 2010), leading to a rise of the rural population, highlighting female role in maintaining families' economy in Senegal (Table 1). Finally, it is relevant mentioning that the share of the agriculture value added in total GDP account for only 20% (FAOSTAT 2010).

The agriculture production system in Senegal is based on rain-fed crops. Only 2% of land is devoted to irrigated crops. Senegal has an irrigation potential of 275,000 ha of which about 100,000 ha are well prepared and less than 50,000 are cultivated annually. The main cereal crops are millet, sorghum, rice and corn (Table 2) and the industrial crops are mostly peanuts and cotton (FAOSTAT, 2010)

Table 2 - *Most important commodity production.*

Commodity	Quantity (t)
Groundnuts, with shell	1,036,250
Sugar cane	836,000
Millet	810,121
Rice, Paddy	502,104
Maize	328,644

Regarding the rice crop, the total production shows a clear trend (Figure 2), with small variations. However, since 2004 an increasing rate can be observed. Excluding the years 2006-2007 in which there were severe droughts, in 2008 the production of rice has increased rapidly, being close to meet the goal of rice self-dependence production.

Rice production systems in Senegal can be divided in two different types of rice cultivation: irrigated and rain-fed culture. The latter is the most important in the studied area. In this context, aspects that make rice agriculture difficult are divided according to the cultivation types. In irrigated area agriculture problems are usually; non-efficient irrigation systems, low agricultural equipment, few subsidies, obsolete or inadequate equipment, difficulties in obtaining agricultural loans and the lack of an organized market system. The rain rice system shares some of the above mentioned problems beside the fact that all crops are managed manually (lack of mechanization), low use of inputs, low yields, difficulties to finance activities, erratic rainfall and the absence of quality seeds and adapted varieties. In general, this system is characterized with its extensive activity being a good example for agriculture multifunctionality as a case study. Rice cultivation in Vélingra area (Kolda region) is mainly developed in floodplains during the rainy season in the Anambé Basin.

3.3. Sample selection

Data used in this analysis were obtained from face-to-face questionnaires with rice farmers carried out during March-June 2010 in the Vélingra department in Kolda region in south Senegal. Our study was structured in two phases (Table 3). The first one consists of 4 interviews with local agents that represent public authorities in the area to have the first contact. Later, an open-ended questionnaire was carried out with 25 farmers located in 8 different villages that represent the most important sector of rice farming area. These qualitative questionnaires were realized in order to identify farmers' opinions, attitudes and objectives they usually consider in their rice farming management. The obtained information is used to design a structured questionnaire carried out in the second quantitative phase. In this part, 110 questionnaires were done using a quota sampling approach. The criteria used to establish the sampling quotas were the village (where the farms are located) and age of farmers.

The survey collects extensive information on farmer's characteristics, attitudes and opinions, farm physical and economic characteristics. Information collected on farmer and household characteristics includes age, gender, education, number of family members, or nearness of family and friends to farmer residence. Information gathered on farm characteristics

Figure 2 - *Production and surface of rice paddy in Senegal (1962-2009).*

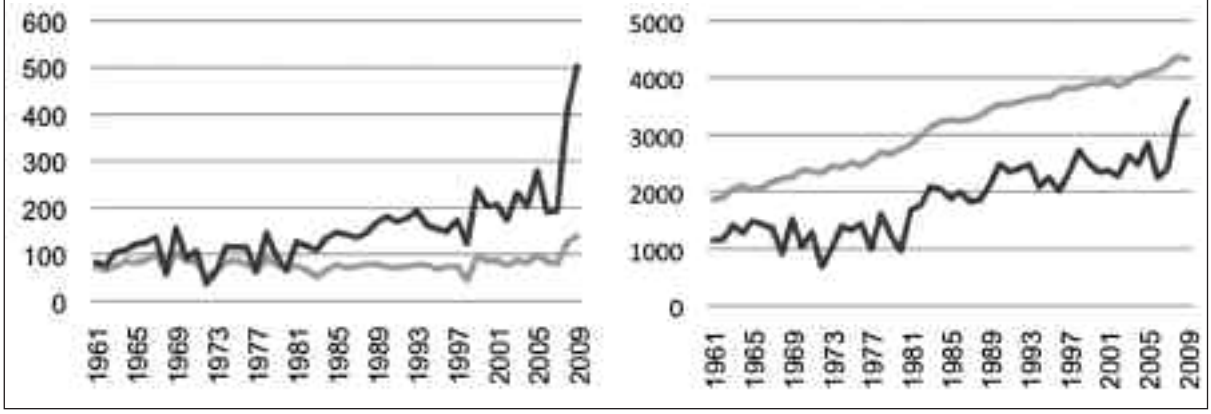


Table 3 - *Methodological phase and sample size.*

Phase	Activity	Observations
Phase 1	Interviews with local agriculture agents	4
	A qualitative open-ended questionnaire	25
Phase 2	A quantitative structured questionnaire in 8 villages: (Anambé, Sare kareba, Souture, Sare samba buty, Yale keny, Sare bouti, Temanto maya and Sare faspare kande)	110

consists of farm size, ownership of the farm, distance between farm and farmer residence, number of plots in the farm, water availability, soil quality, Variables reflecting farm management and results are: preferred sources of information on agricultural practices, proportion of rented land, number of cultivated crops, proportion of irrigated land, percentage of total family income coming from agriculture, number of generations working in the farm, total cost per hectare. Exogenous factors include, among others, difficulties in obtaining information, problems in getting loans, output prices or public subsidies.

3.4. AHP model building

As previously commented in our methodological framework (Figure 1), the AHP modeling is the first step to be carried out after carrying out the structures questionnaire. Agricultural Multifunctionality by definition is a complex good involving various goods and services. Therefore, we need to clearly define what we are aiming to value and then to present to farmers (the interviewees) as clearly and precisely as possible to make the pair-wise comparisons. The strategy employed to describe multifunctionality was to identify and specify the most relevant attributes of the agricultural sector in the study area. With this in mind, we first relied on our qualitative prior research in phase 1 (see Table 3) regarding the identification of the objectives that agriculture should aim for, as expected by farmers. The exploratory results of this qualitative part of our research allowed us to determine three primary objectives being related to the three most important attributes of agriculture in this case study and considered to be included in the comparison: the economic, environmental and socio-cultural objectives.

In addition, within each primary objective, other secondary objectives were also identified. Secondary economic objectives were: "maximize rice sales", "maximize total farm income from agricultural and non-agricultural activities" and "maximize rice quality". For the environmental secondary objectives we included: "promote environmental friendly farming practices", "minimize use of fertilizers and conserve soil fertility" and "rational use of water". Finally, for the secondary socio-cultural objectives we identified: "help eliminating illegal migration (job creation)", "keep the existing socio-cultural values linked to rice culture" and "increase the participation of women in agricultural decision" (Table 4). The relevance of the corresponding functions (both primary and secondary objectives) were subsequently discussed in different focus groups; one comprising university lecturers in the field of agricultural economics and another one comprised by the local agriculture agents of the case study (from the qualitative phase mentioned in Table 3) in order to test their validity before starting interviewing farmers.

Table 4 - *Primary and secondary objectives.*

Primary objectives	Secondary objectives
Economic Objective	Maximize rice sales. Maximize total farm income from agricultural and non-agricultural activities. Maximize rice quality.
Socio-cultural objective	Help eliminating illegal migration (job creation). Increase the participation of women in agricultural decision. To preserve existing cultural values linked to rice culture.
Environmentale Objectiv	Promote environmental friendly farming practices Minimize use of fertilizers and conserve soil fertility Rational use of water

4. Results

4.1. AHP Results

As noted before, the AHP allows weights to be obtained for each farmer of their considered primary (attributes) and secondary objectives (levels), using the geometric mean criteria. The results of the aggregation of weights for the three primary objectives (w_{A1}, w_{A2} *and* w_{A3}) across farmers are shown in Figure 3.

These results suggest that the "economic" primary objective is the most important with an aggregate weight of 47.1%. The "Environmental" objective occupies the second position with an aggregate weight of 23.3%. In last position we found the "socio-cultural" objective with an aggregate weight of 18.1%.

Results from weighting attributes' levels (i.e. secondary objectives) are summarized also in Figure 4. As can be seen, there are differences in the weights for levels. For the "economic" primary objective, the most important secondary objective is "maximize total farm income from agricultural

and non-agricultural activities" (33.3%) followed by "maximize rice quality" (28.1%) and "maximize rice sales" (19.7%).

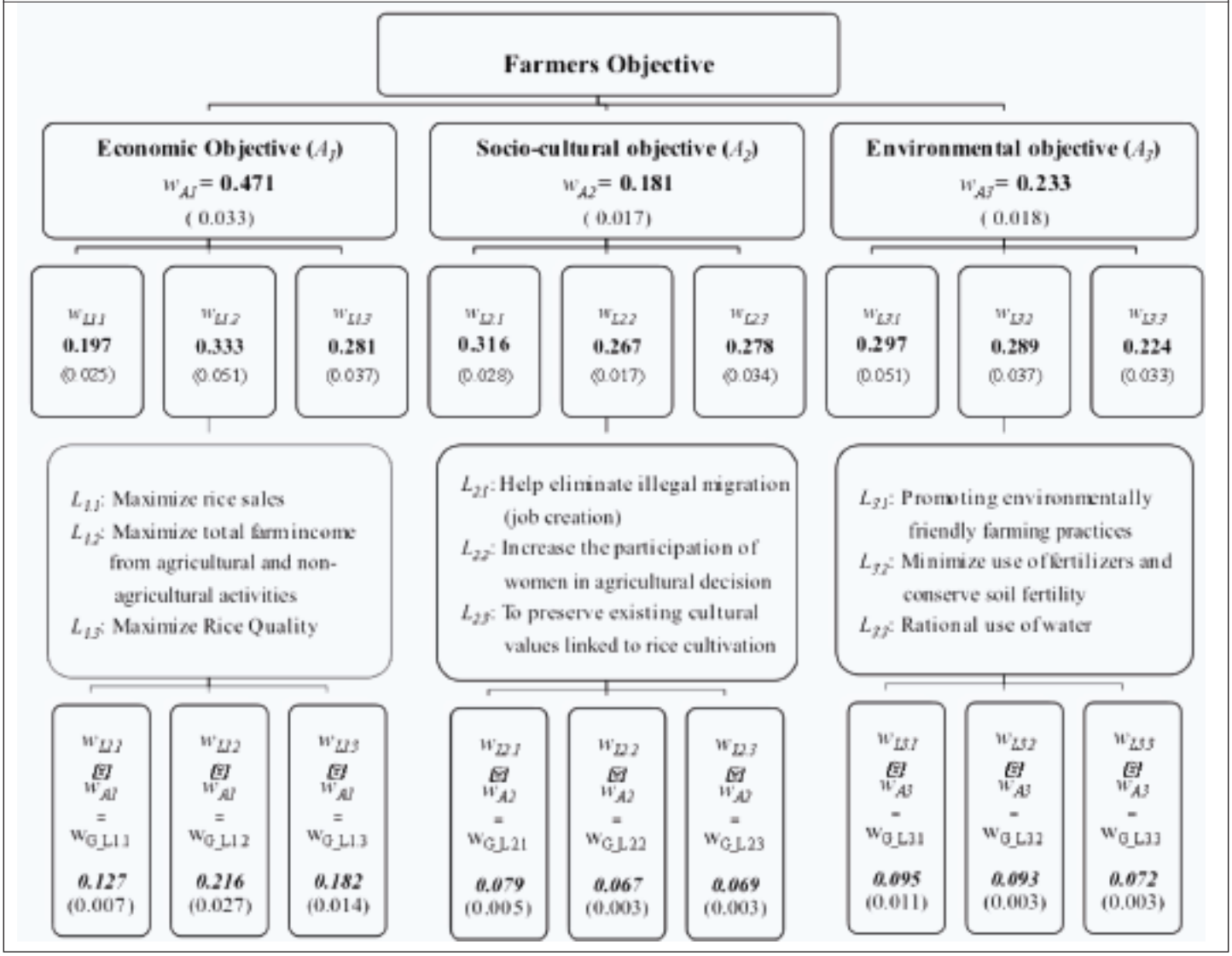
The highest weight for the "environmental" attribute is assigned to "promote environmental friendly farming practices" (29.7%) followed by "minimize use of fertilizers and conserve soil fertility" (28.9%) and "rational use of water" (22.4%). Finally, in relation to the "socio-cultural" primary objective, the most important weights are associated with "help eliminate illegal migration by job creation (31.6%), followed by "to preserve existing cultural values linked to rice cultivation" (27.8%) and "Increase the participation of women in agricultural decision" (26.7%).

As mentioned, the global weights represent the total preference score or the total relative importance of each secondary objective taking into consideration all objective. Thus, we find that the most considered secondary objective are all of them with economic nature. First, farmers consider the "maximization of total farm income" (21.6%) followed by "maximize rice quality" (18.2%) and "rice sales" (12.7%). Later it comes "promote friendly practices toward environment" (9.55%), "minimizing the use of fertilizers" (9.35%) and "helping to eliminate illegal migration" (7.92%). Finally, the last considered secondary objective for rice farmers is "increase the participation of women in the agricultural decision" (6.72%). In this line, it is relevant mentioning that these results scores of farmers' objectives will be used in a following step as covariates to classify farmers following a cluster analysis.

4.2. Farmers' cluster according to their objectives

The specific aim of this analysis is to classify farmers into different homogeneous groups according to their identified objectives, using cluster analysis. This analysis is a set of techniques used to classify objects into homogeneous groups different from each other, called clusters with respect to some predetermined selection criteria. Objects

Figure 3 - *Relative importance of the multifunctional objectives.*



within each cluster are "close" to each other and considered similar, and different cluster are "distant" and considered different. Therefore, it is also known as classification analysis or numerical taxonomy approach.

We used the weights obtained from the AHP of the three primary objectives (economic, environmental and socio-cultural). As these variables are considered quantitative, we used the "Euclidean distance" as a measure method between individuals and partitioning methods to identify clusters[2]. Finally on the basis of the economic and environmental objectives we identified two clusters[3] (Table 5)

Table 5 - *Centers of the clusters with respect to economic and environmental objectives.*

Relative importance of primary objectives	Centers of the final clusters		ANOVA	
	Cluster 1	***Cluster 2***	***F***	***P-value***
Weight of the ***economic*** objective (w_{A1})	0.62	0.31	*195.264*	*0.000*
Weight of the ***environmental*** objective (w_{A2})	0.17	0.38	*63.231*	*0.000*
Frequency	***73***	***37***		

As can be seen in Table 5, clusters are clearly identified on the basis of the relative importance of the economic and environmental objectives. The first cluster is composed of 73 farmers that are economically driven with high preference toward the economic objective (62%) compared to cluster 2 formed by 37 farmers whose individuals give only 31% of importance of this objective. This cluster as can be observed is environmentally driven one giving more relative importance of the environmental objective (38%) compared to (17%) of the first cluster. In the following step we try to identify clusters' in order to describe their profile.

4.3. Description of farmers' clusters

To identify farmers' characteristics in each cluster we used the ANOVA analysis for the quantitative variables and Pearson Chi-squared (c^2) test for the categorical variables. For the former group of variables, results (Table 6) show that farmers that are economically motivated in opposite to the environmental group are older, live near their farms, have higher crop area and more rice surface. They grow different crops in the rainy seasons and need new machinery in their field. They are not very committed to promote environmentally friendly farming practices. However, they are more interested in minimizing the use of fertilizers and conserving soil fertility. These results seem controversy, but could be understand from a cost point of view. Farmers by diminishing the use of fertilizers are trying to reduce production cost rather than their commitment to environment.

For the categorical variables, results show (Table 7) that 63.0% of the farmers in cluster 1 have the agriculture activity as their only source of income and 80.0% use machinery in rice growing, while only 73.0% of farmers in cluster 2 have other economic activities beside the agriculture and 64.9% use manual method in rice cultivation.

A summary of the cluster analysis description can be observed in Table 8.

Table 6 - *Farmers' characteristic in each cluster.*

Characteristics	Mean by clusters		ANOVA	
	Cluster 1 Economically driven	**Cluster 2** Environmentally driven	***F***	***P value***
▪ Age	43.25	39.37	4.062	*0.046*
▪ Distance to the farm from the home	5.14	8.17	6.364	*0.013*
▪ ha of orchard	3.06	1.86	3.944	*0.050*
▪ ha of rice	9.03	2.76	2.780	*0.098*
▪ Total hectares of crops in the rainy season	11.65	4.43	3.288	*0.073*
▪ Need of new machinery (in a scale from 0 to 10)	8.27	4.68	18.104	*0.000*
▪ $w_{L3.1}$: Promoting environmentally friendly farming practices	0.34	0.42	3.881	*0.051*
▪ $w_{L3.2}$: Minimize use of fertilizers and conserve soil fertility	0.37	0.29	4.430	*0.038*
Frequency	***73***	***37***		

5. Concluding remarks

Our paper focuses on assessing the relative importance of farmers' objective in relation to agricultural multifunctionality in the extensive rice culture in Vélingra region south Senegal. We carry out an empirical study using the Analytical Hierarchy Process to measure farmers' primary and secondary objectives in planning their activities and cluster analysis to classify and characterize farmers according to their considered objectives. The model is estimated using farm-level data from a sample of 110 rice farmers. Data were collected through a face to face questionnaire carried out in 2010.

[2] For more details about cluster analysis consult among others, Everitt, *et al.* (2011).

[3] Weight of the socio-cultural objective for cluster 1 (21%) and for cluster 2 (31%) was not significantly different between both clusters.

Table 7 - *Farmers' characteristic in each cluster.*

Cluster based on economic and environmental weights					
		Cluster 1 Economically driven	**Cluster 2** Environmentally driven	(χ^2 of Pearson)	*P value*
Have agriculture as their only source of income?	Yes	63.0%	37.0%	12.724	0.000
	No	27.0%	73.0%		
Total		100.0%	100.0%		
Growing method	Manual	19.2%	64.9%	22.66	0.000
	Mechanical	80.8%	35.1%		
Total		100.0%	100.0%		

Table 8 - *Main characteristics of each identified cluster.*

Cluster 1 **Economically focused farmers** **"professional farmers"**	**Cluster 2** **Environmentally driven** **"part-time farmers"**
▪ Relatively old farmers	▪ Relatively young farmers
▪ The majority is devoted only to agriculture, (unique income source).	▪ The majority have the agriculture as a part time activity
▪ Large farm size	▪ Small farm size
▪ Farm is near their home	▪ Farm is relatively far from their home
▪ More diversified crops	▪ Less diversified product
▪ Needs and high use of machinery	▪ Low use of machinery
▪ Less committed with environmentally friendly farming practices.	▪ More committed with environmentally friendly farming practices.
▪ Looking for minimizing production cost (less use of fertilizer).	▪ Insignificance of minimizing fertilizers cost (already they use small quantities)
▪ Seek out for conserving soil fertility as their activity is relatively less extensive	▪ Not concerned with the soil fertility since their activity is extensive.

Results from weighting farmers' objectives suggest that the "economic" objective is the most important one followed by the "environmental" and "socio-cultural" objectives. Furthermore, as expected, maximizing the total farm income from agricultural and non-agricultural activities farmers is the most important secondary objective followed by maximizing rice quality. Farmers are aware of the importance of rice quality and recognize that it should be enhanced to better face their marketing problems. A main problem is the low perceived price due to irregular quality of their output. Using certified rice seeds seem to be a constraint for farmers due to their high cost. Public policy should focus on allowing farmers to easily access to certified seeds rather than other direct or indirect subsidies.

Regarding the environmental objective, farmers try to use environmental friendly farming practices as the agriculture represent almost their unique source of income. Thus, they are aware of the importance of sustaining it. Farmers in their farming plan stated that they tend to minimize fertilizer use. However, as commented, this is followed in order to reduce production cost rather than their commitment with environmental aspects of their activities. In relation to the socio-cultural objective, the illegal immigration has been shown to be the most important aspect. Contrary to what we would expect that the local society would be in favor to immigration (especially to European countries and big cities within Senegal) results show that farmers in maintaining their activity are recognizing their role in minimizing rural abandonment. This could be explained in part by the worldwide economic crisis that is affecting the flow of immigrant from underdeveloped countries mainly to Europe.

Despite the homogeneity of the relative weights obtained from AHP, the result of cluster analysis shows two distinct groups of farmers. The former are professional one with large farm size with more diversified crops and they prioritize their economic objective. The other group is formed by few part-time farmers, with small farm size and few cultivated crops. In this context, results can be useful as a guide for the policy makers of agricultural policy at local level. They suggest that agricultural policy should be developed at local level to ensure maximum social welfare assessing farmers' priorities. This perspective, opposed to the view of the agricultural sector as primarily a commodities supplier, ought to imply changes making local governments' key actors in the development of rural areas. There-

fore, the resulting weights given for the different objectives should be considered as insights of farmer's importance regarding the performance of their agricultural system in this specific region. In any case, it should be noticed that in order to optimize policy decision-making, other related issues need to be attempted, such as the real joint production of commodities and non-commodities form agricultural systems and to analyze to any extent non-commercial functions from agricultural are demanded. In this context, introducing farmers' priorities in the design of agricultural policies is not new. This tendency has been confirmed by the Common Agricultural Policy (CAP) through its different reforms, increasing the national/regional, even local power of decision makers. The results of this study could be regarded supporting the agricultural policy orientation based on tools and instruments subject to compliance with a range of environmental, food safety and other social functions.

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