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Overall Economic Performance of Farms in Burkina Faso: Case of Maize

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Abstract

The objective of this study is to define a conceptual framework for measuring the Global Economic Performance (GEP) of farms in Burkina Faso. After a literature review of GEP measurement methods and indicators, we have specified a composite indicator for this purpose. It is called Global Economic Performance Indicator (GEPI). It consists of one group of positive indicators and another of negative indicators. Each group is the reduced centered average of the indicators that make it up. GEPI was applied to 262 randomly selected maize growers of Burkina Faso grouped into 'production systems', 'farm sizes' and 'provinces'. The results show that the large farms, the motorized producers and those of Tuy are generally the most performantes of their respective group. A comparison of the GEPI of the producer categories shows that the large and medium producers are generally the best performers, with a score of 0.59. The category of motorized producers ranks third with a score of 0.57. In terms of agroecology, the province of Tuy is the last category of globally efficient producers.
Key words: Global Economic Performance Indicator, Farm Management, Maize, Burkina Faso

Tarım İşletmelerinin Toplam Ekonomik Performansının Ölçülmesi: Burkina Faso'dan Örnek Bir Çalışma
Özet

Bu çalışmanın amacı, tarım işletmelerinin Toplam Ekonomik Performansını (TEP) ölçmek için kavramsal bir çerçeve tanımlamak ve uygulamaktır. TEP ölçüm yöntemleri ve göstergelerinin literatür taramasından sonra, bu amaç için bütünleşik bir gösterge belirlenmiştir. Bu gösterge Toplam Ekonomik Performans Göstergesi (TEPG) olarak adlandırılmışır. Bu gösterge bir grup pozitif ölçüt ile bir grup olumsuz ölçütün toplulaştırılmasından oluşmaktadır. Her grup, onu oluşturan göstergelerin ortalamaları ve standart sapmaları dikkate alınarak hesaplamaya dahil edilmiş ve uygulanmıştır. Her bir üretici için TEPG, Burkina Faso'da rastgele seçilmiş 262 mısır üreticisinden anket yoluyla elde edilen veriler kullnılarak tahmin edilmiştir. Sonuçlar, "üretim sistemleri", "büyüklük" ve "il" gruplarına göre karşılaştırmalı olarak sunulmuştur. Araştırma sonucunda büyük çiftliklerin, makinalı üretim yapan üreticilerin ve Tuy ilindeki çiftçilerin genel olarak daha yüksek performans gösterdikleri belirlenmiştir. Buna ek olarak, büyük üreticilerin genel olarak 0,59 puanla tüm mısır üreticileri gruplarında en iyi performansı gösterdikleri bulunmuştur.
Anahtar kelimeler: Toplam Ekonomik Performans Göstergesi, Tarım İşletmeciliği, Mısır, Burkina Faso

1.INTRODUCTION

In the current economic context of agricultural commodity competition and food crises, the policy and agricultural manager are expected to make operational and effective decisions, based on meaningful and accurate data. In order to achieve this, it is essential for the agricultural manager to regularly measure the economic performance of farms and to take action based on the conclusions drawn (Bouljlida, 2002).

Although it is the subject of an abundant literature, the concept of performance remains difficult to define. According to Zahm et al., (2013) consensus is far from being found around its definition and measurement, to the point that Goodman et al. (1983) cited by Zahm et al., (2013) emphasize, the answer to the question "what is performance?" is not nearly as simple as one might think. It is not solved at present from both a theoretical and an empirical point of view. From the theoretical point of view, the problem comes from the lack of unity in theoretical approaches to performance, and therefore from the plurality of answers to this question that Bourguignon (1997) summarized in three types of representation of performance:

- the performance is successful: it depends on the social representations of the success which can vary according to the entities and the actors in the presence;
- performance is the result of the action: there is no value judgment in this case,
- performance is action: this meaning refers to performance as a process (Zahm et al., 2013).

Naro, (2005) emphasizes that this fuzzy character of the concept of performance renders his apprehension subjective because it does not exist as an objective reality but the fruit of a social construct. But the latter is a function of the present and future experiences and aims of each society, which empirically reflects the plurality of actions to apprehend performance.

Indeed, in developing countries where food crises follow one another, the notion of agricultural performance refers mainly to the productivity of farms in order to curb these food crises and also to reduce the incidence of poverty in rural areas. While in productive agricultural economies, performance is primarily about the profitability and competitiveness of agricultural products. This perception of performance most often leads to state intervention in the agricultural market to protect its producers or a sector.

From the point of view of agri-food chains, the perception of performance varies according to whether the actions are taken at the macro or microeconomic, regional or national, and temporal levels. At the macro and national level, performance is sometimes considered in terms of aggregates such as the Gross Domestic Product (GDPA) and its evolution, the agricultural trade balance, the rate of achievement of food self-sufficiency and in a recent period of its societal impact. At the regional level, performance corresponds to the achievement of objectives or expected results, and more broadly to the creation of value. This is most often the output, productivity, convergence of economic poles shares in the GDPA. In developed countries, there is more talk of agricultural partnerships, research centers and training organizations, whose objectives are to create synergies around innovative projects in one or more sectors of activity with a view to constituting a competitiveness cluster.

From a microeconomic point of view, whether developed or developing countries, it is most often the principles of farm management that preside over the calculations of performance. As a result, the farm is evaluated through economic performance indicators such as, financial returns (return on investment, return on equity and economic value added, productivity, net income, economic (competitiveness, efficiency)) (Bouljlida, 2002).

However, in addition to these financial indicators, modern agriculture in developed countries increasingly takes non-financial indicators in their assessment of agricultural performance. Several dashboards have been drawn up for this purpose. These are, among other things, organizational issues (quality of production, flexibility, deadlines ... (Morin, 2001)); social (employee engagement, work climate, employee performance, employee skills, employee health and safety), societal (agricultural farm engagement in environmental, humanitarian, cultural) (Bouljlida 2002, Bouquin 2004, Crapon and Quairel, 2005)). In southern agriculture, the consideration of non-financial factors in the evaluation of agricultural performance remains limited. This may be due to the fact that agricultural sectors in developing countries are not yet incorporated enterprises. They are still at the stage of family and food farming. As a result, the agricultural objectives differ as a result of the methods of evaluation of agricultural performance also differ. In other words, developed countries have gone beyond the financial and economic framework of performance in order to integrate societal, stakeholder and organizational dimensions into their evaluation.

However, developed countries adopted this new position only after the Brundtland report on sustainable development in 1987. They have shifted from a reductionist representation of performance to a globalizing one that includes social and environmental dimensions (Dohou and Berland, 2008). There is growing talk of Global Performance of Organizations (GPOs) which is the assessment of the implementation by farms of the concept of sustainable development by integrating the financial and non-financial aspects in the evaluation of their performance (Rastoin, 2006, De Rochambeau et al., 2008).

Therefore, there is a change in methodological approach to performance. Indeed, the classic approach of "methodological individualism" that has long dominated the debates is increasingly replaced by the holistic one.

Developing countries, and hence Burkina Faso, are increasingly embracing this holistic approach to measuring agricultural performance. However, their context is characterized by hybrid farming systems that are not totally homogeneous. Social, food security considerations still dominate farming objectives.

How in this context find a global performance indicator taking into account this heterogeneity of agricultural systems?

The main limitation of the performance indicators used by developing countries are modeled on those of developed countries, whereas the contexts are totally different. As a result, the performance indicators in place are not relevant to say whether a family farming, food or essentially commercial is generally efficient or not. Therefore, finding a cross-cutting indicator that takes into account the diversity of the agricultural landscape of these countries is essential.

The performance indicators must take into account economic, financial, social and environmental aspects. In this context the purpose of this study is to propose a synthetic indicator to measure the overall economic performance of maize farmers in Burkina Faso.

2. LITERATURE REVIEW

Economic and financial indicators have long been used to measure corporate performance. Kalogeras et al. (2005) assessed the financial performance of agribusiness firms using a multi-criteria approach to decision support. Their study proposes a new approach to financial decision support, based on data analysis techniques associated with a multicriteria analysis method. By way of illustration, the case of Greek agro-food companies is used. The analysis results in an overall ranking of the performances of the companies examined.

As for Delen, et al. (2013), they measured the company's performance using financial ratios and a decision tree approach. They used a two-step analysis methodology: first, using exploratory factor analysis (EFA) to identify and validate the underlying dimensions of financial ratios, to use predictive modeling methods and financial ratios. Four popular decision tree algorithms (CHAID, C5.0, QUEST, and C & RT) were used to study the impact of financial ratios on business performance.

After developing prediction models, sensitivity analyzes based on information fusion were performed to measure the relative importance of the independent variables. The results showed that CHAID and C5.0 decision tree algorithms produced the best prediction accuracy. The results of the sensitivity analyzes indicate that the ratio of earnings before tax to equity and net profit margin are the two most important variables.

For the economic performance of agri-food chains has been addressed by several authors. Latruffe, L. (2010) reviews the literature on competitiveness, productivity and efficiency in the agriculture and agri-food sectors. It clarifies the concepts and terminology used in this area and provides a critical assessment of the approaches and indicators used in the literature to measure competitiveness, productivity and efficiency at sectoral and farm level. It also discusses recent findings on productivity growth, shifts in relative competitiveness between sub-sectors and countries, and the determinants of competitiveness, as well as identifying key gaps in knowledge. He suggested that more attention should be paid to the agri-food sector, non-price competitiveness factors and the impact of government intervention on competitiveness.

Kroma and Lamien (2017) evaluated the profitability and competitiveness of the gum arabic value chain in improving the living conditions of the Sahel populations in Burkina Faso. Both secondary and primary data were collected. Excel and Value Chain Analysis (VCA) Version 10 software were used for capturing and calculating profitability and competitiveness indicators. The Policy Analysis Matrix (MAP) was used as an analytical tool. From the results obtained, it emerges that the value chain gum arabic is financially and economically profitable. The analysis of competitiveness indicators shows a comparative advantage in producing gum arabic in the Sahel of Burkina Faso. Domestic resource costs show that all economic agents use domestic resources rationally.

Some authors have broadened the analysis of performance by incorporating non-economic aspects. Bremmers et al., (2007) will focus on stakeholders by analyzing the impact of stakeholder groups on the development of the environmental management system in the Dutch agri-food sector. They are based on a survey of 492 Dutch agribusiness firms on the influence of stakeholder groups on the level of implementation of the enterprise environmental management system (EMS). They conclude that key stakeholders (government, clients) are more relevant to the development of EMS than secondary stakeholders (such as environmental organizations).

Kasterine and Vanzetti (2010) analyzed the effectiveness, efficiency and equity of commercial and voluntary measures to mitigate greenhouse gas emissions from the agri-food sector. To do this, market-based mechanisms and voluntary mitigation measures were examined for their effectiveness, efficiency and equity. Measures to reduce agricultural emissions have limited effectiveness and efficiency due to technical difficulties and high costs of measurement, reporting and verification.

Maxime et al. (2006) developed eco-efficiency indicators (EEIs) for the Canadian food and beverage industry to create a framework for a sustainable production system. The proposed IEDs are intensity indicators and recycling rates, and include environmental pressure modulators. Benchmarking and the link to specific treatment operations and management practices will help regulators and industries to promote and implement cleaner and more competitive production initiatives.

Finally some authors have discussed the overall performance of organizations. Zahm et al., (2013) synthesized conceptual frameworks, tools for measurement and application with the Agricultural Livelihood Sustainability Indicators (IDEA) method. In their paper, they presented an inventory of agricultural work on the concept of a broader performance that integrates the social and environmental dimensions. Based on a theoretical analysis of the two main conceptual frameworks (overall performance versus societal performance). They show in detail how the IDEA method accounts for the overall performance concept of a farm, before repositioning the IDEA method among other methods of evaluating this performance. They conclude that the IDEA method fulfills an internal diagnostic function of the overall performance of farms. Thus, it allows for an individual diagnosis to identify the strengths and weaknesses of a farm in terms of sustainability compared to the scores obtained. To do so they assigned scores ranging from 0 to 100. In their application they distinguished three scales of measures: agro-ecological scale (83), territorial scale (74) and the economic scale (60). They deduce the final score of overall performance 60/100. Thus the overall performance is limited by the weak point of the company.

We propose in this study a synthetic indicator that takes into account both the weak points and the strong points of the maize farmers in its evaluation. It is called the Global Economic Performance Indicator (GEPI).

3. MATERIAL and METHODS

3.1. Data

The Hauts-Bassins region is located in western Burkina Faso. It is limited to the North by the Boucle du Mouhoun region, to the South by the Cascades Region, to the East by the South West Region and to the West by the Republic of Mali. It covers a total area of v25,479 km2, or 9.4% of the national territory.

As a research area, Hauts Bassins is the largest maize producing region in Burkina Faso in 2016 with 36.72% of national production (INSD, 2017) and employing 97% of its farmers are maize farmers.

Data collection focused on both primary and secondary data. In fact, primary data were collected through socio-economic surveys of producers in 26 villages in the Hauts-Bassins region. As for the secondary data, they come from the literature review, the work of INSD, MAAH and FAO.

It was initially planned to collect the data following stratified sampling. But the reality on the ground has imposed a systematic random sample technique. Indeed, after the tests of the questionnaire in the field, it came back that in addition to the "system of production" there were groupings of producers in three other systems. First, it is the land tenure system where resource allocation varies from one tenure to another. Secondly, the allocation of factors of production and certain indicators of economic performance was related to the size of the farm. Finally, pedoclimatic factors and insect harms affected the three provinces differently. View the plurality of categories of producers it was no longer possible to find a stratum common to them. Hence the systematic random sampling of sampling steps 18.35 to choose the 26 villages surveyed and random selection of 262 maize growers.

The surveyed villages are: Kouakoualé, Diaradougou, Lanfiera-Coura, Mossidougou, Farakoba, Sembleni, Koundimi, Dodougou, Tapokadeni, Badougouya, Diassaga, Sayaga, Banakoro, Dan, Kabala, Zanfagora, Sikorla, Banakoro, Fama, Dimikuy, Tioro, Lollio, Laho, Kongolekan, Samoroguan, Pen. Producers are distributed in Table 1.

Table 1. Distribution of the sample

Groups	Categories	Number	Groups	Categories	Number
Production system	Manual	90	Provinces	Tuy	72
	Draft animal	112		Kenedougou	95
	Engine power	60		Houet	95
Tenure system	Titless landowner	182	Size group	0,1-1 ha	91
	Rent land	30		1,1-2,50 ha	111
	Sharecropping	35		2,51-5,0 ha	45
	Title landowner	15		5,01-50 ha	15
All farm		262	All farm		262

The survey focused on socio-demographic factors, production (quantities and costs of inputs used, quantity and price of output), sales conditions, and production and sales problems of each farmer.

Table 2. Descriptive statistics on the allocation of factors of production

Inputs/da	Security land tenure		Insecurity land tenure system				All farm (262)	
	Landowners (197)		Tenants (30)		Sharecroppers (35)			
	Mean	SD*	Mean	SD	Mean	SD	Mean	SD
Family labor (h)	288.5	170.1	282.6	171.0	297.8	198.0	289.1	174.0
Hiring labor (h)	35.7	39.9	28.9	27.7	40.2	39.9	35.5	38.7
Total labor (h)	324.2	174.6	311.5	181.0	338.0	189.0	324.6	177.0
Dratf animals (h)	21.0	21.5	23.8	19.3	17.7	21.5	20.8	21.2
Tractors (h)	3.4	6.1	2.6	3.7	3.6	5.5	3.4	5.8
Urea (kg)	91.4	66.4	100.6	82.6	91.9	50.5	92.5	66.4
NPK (kg)	111.9	77.1	176.2	213.0	116.2	65.9	119.8	102.0
Manure (kg)	371.0	905.8	561.0	916.0	753.4	1850.0	443.8	1080.0
Fungicide (L)	0.1	0.4	0.0	0.0	0.1	0.5	0.1	0.4
Insecticide (L)	1.1	2.3	1.4	1.8	0.5	1.1	1.0	2.1
Herbicide (L)	5.5	5.6	4.2	3.7	4.0	3.6	5.1	5.2
Seed (kg)	21.7	8.6	22.0	15.9	22.2	7.5	21.8	9.5
Corn (ha)	2576.0	4618.0	2283.0	1.67	1764.0	0.876	2434.0	4.06

** : Standart deviation*

The quantities of the factors are contained in Table 2 Fertilizers and seeds are measured in kilograms, as are medicated products in liters. Four types of fertilizer were used by the producers: urea, phosphate, NPK and organic manures. Improved and traditional seeds are used in the study area. Pesticides are fungicides, herbicides and insecticides.

Fixed assets such as draft animals, machines were valued at their time of use in corn fields. The work was divided into rented workgroups and family workgroups. The contribution of human labor to production is equal to the labor force times worked hours Man unit power.

The efficiency ratios are of profit efficiency and come from the thesis of Sogue Babou's thesis which focused on the economic analysis of the profitability and the efficiency profit of the maize production in the High Basins of Burkina Faso.

Risk of capital invested, influence of traders, environmental costs, market autonomy, production risk and maize quality are determined under a Likert scale ranging from 1 to 5 using a questionnaire administered to producers. The score is the average of scores for each production system.

3.2. Model specification

For the decision of the overall economic performance of the sector will be made based on an integrating indicator. Indeed, we admit that each criterion or dimension of the performance affects or is affected by the other criteria. As a result, the Global Economic Performance Indicator (GEPI) is the difference between the means of the reduced central indicators of two categories of indicators:

$$GEPI = \sum_{i=1}^{m} \frac{1}{m} \frac{(I_i - u)}{S_i} - \sum_{j=1}^{k} \frac{1}{k} \frac{(I_j - v)}{S_j}$$

(1) = (2) - (3)

(1) = the GEPI composite indicator;

(2) = the composite sub-indicator consists of a set of supposedly positive indicators: productivity, profit, profitability, efficiency, competitiveness, flexibility, responsiveness, etc. ;

(3) = the composite sub-indicator consists of a set of supposedly negative indicators: costs (average and total), pressure in the work,

m is the number of supposedly positive indicators, Animal force productivity (kg/h), Tractor productivity (kg/h), Land productivity (kg/ha), Profit, Total Factor Productivity, Gross Margin.

k = the number of negative indicators;

Ii = is the indicator of the ith farm;

Ij = is the indicator of the jth farm

U = the average of the indicator Ii;

V = the average of the indicator Ij

Si = standard deviation of variable Ii

Sj = standard deviation of variable Ij

Decision criteria:

If GEPI> 0, the system is globally efficient;

If GEPI = 0 the overall performance of the system is average;

If GEPI <0 the system is not globally efficient;

Finally, the most successful system is that with the largest GEPI.

The advantage of this model is to allow performance comparison at all levels: cross-sectoral, intra-sectoral, make comparisons based on a set of different or similar indicators because the GEPI has no unit. Therefore, the assessment can be generalized to the Global performance of organizations taking into account all the dimensions of the organization, namely the economic, social, systemic, ecological and political dimensions. Moreover, GEPI being an average, it is easy to identify in which field the sector is relatively less efficient in order to remedy it. Finally, the GEPI makes it possible to say whether or not the organization is globally efficient or not.

3.3. Application of the model

The model will be applied to a set of agricultural performance indicators of 262 maize producers in Burkina Faso. The data is primary and collected from a simple random sample. These data break down into three main groups of producers. The production system group (manual producers, hitched producers, motorized producers), the size group of farms and that of the provinces. The variables used are divided into negative indicators and positive indicators:

1. Positive indicators: economic efficiency, physical productivity (kg/ha), productivity in value (TL/ha), gross margin (TL/ha), profit (TL/ha), total factor productivity , profitability, partial productivity in kg per hour of labor, draft animals (kg/h) and tractor (kg/h), partial productivity of land (kg/ha), partial productivity in value per hour of labor , draft animals and tractor. In addition, we added variables such as the producer's level of production security, the level of marketing autonomy and the corn quality level. Levels are rated on a Likert scale of 1 to 5 (from least to most important);
2. Negative indicators: variable costs (TL/ha), fixed costs (TL/ha), total costs (TL/ha), level of production risk (locust and/or locust infestation, drought, flood), environmental costs, influence of traders on corn prices.

4. RESULTS

The results in Table 3 show that motorized producers have the greatest number of performance indicators. While manual producers are the worst in the group. In fact, motorized producers perform better on 14 indicators (60.87%) and less efficient on 6 indicators (26.09%).

The manual producers have 5 indicators where they are the best performers against 9 indicators where they are the worst performers. This gives respectively 21.74% and 39.13%. However, the results show that manual producers are more efficient for costs and especially for non-economic indicators. Indeed, they have the lowest level of risk with an average score of 2.84/5 against 3.23/5 for motorized producers. In addition, traders have less influence on manual producers than motorized ones. The level of influence on manual producers is 2.78/5 against 2.97/5 for motorized producers. This allows manual producers to be more autonomous than motorized ones. This paradox is explained by the fact that maize is mainly produced for self-consumption among manual producers while it is intended for the market for motorized producers. This is why motorized producers rely more on product quality and environmental quality to meet the demands of consumers.

Table 3. Descriptive statistics of production system performances indicators

Indicators	Manual		Draft animal		Engine power		Total	
	Mean	SD*	Mean	SD	Mean	SD	Mean	SD
Economics indicators								
Efficience score	0.84	0.12	0.86	0.09	0.87	0.13	0.86	0.11
Production (TL/ha)	1343.55	871.91	1471.07	731.76	2857.29	663.72	1744.72	979.15
Variable cost (TL/ha)	1034.75	630.12	1028.69	457.06	1168.51	446.80	1062.79	522.21
Fixed cost(TL/ha)	647.12	403.83	805.96	388.27	969.47	464.49	788.84	427.84
Total Cost (TL/ha)	1681.88	805.87	1834.65	604.02	2137.98	705.83	1851.64	719.82
Gross margin (TL/ha)	308.79	824.73	442.38	794.79	1688.78	710.70	681.93	959.40
Profit (TL/ha)	-338.33	891.46	-363.58	793.88	719.30	907.10	-106.92	963.69
Total factor productivity	0.85	0.54	0.85	0.42	1.49	0.67	1.00	0.59
Profitability	-0.15	0.54	-0.15	0.42	0.49	0.67	0.00	0.59
Labour productivity (kg/h)	4.33	3.40	5.03	2.90	11.96	7.68	6.38	5.50
Animal productivity (kg/h)	105.96	150.29	78.77	153.62	226.88	690.82	122.03	359.22
Tractor productivity (kg/h)	419.52	585.27	753.04	1850.07	501.42	744.84	580.45	1310.47
Land productivity (kg/ha)	1225.24	801.64	1345.22	655.02	2611.62	577.07	1594.02	887.91
Labour productivity (TL/h)	2.47	3.17	1.98	2.73	8.51	6.43	3.64	4.80
Animal productivity (TL/h)	51.62	139.31	39.81	92.72	177.70	594.11	75.44	305.30
Tractor productivity (TL/h)	217.75	427.80	219.26	880.89	359.68	602.13	250.90	691.31
Land productivity (TL/ha)	672.83	813.62	591.96	782.92	1865.91	747.81	911.49	941.11
Non-economics indicators								
Assiet security	1.51	0.97	1.61	0.91	1.52	0.89	1.55	0.93
Production risk	2.84	1.55	3.18	1.57	3.23	1.67	3.08	1.59
Environment cost	3.16	1.57	3.11	1.52	3.02	1.56	3.10	1.54
Traders influence	2.78	0.47	2.90	0.66	2.97	0.97	2.87	0.69
Commercial autonomy	3.02	0.52	2.97	0.45	2.90	0.78	2.97	0.56
Corn quality	3.12	0.45	3.13	0.51	3.28	0.61	3.16	0.52

* *: Standart deviation*

As before, the results in Table 4 highlight two poles of performance: producers of very large areas and very small farms. Indeed, the producers of 5.01-50.00 ha are the best performers out of 16 out of the 23 indicators, ie a percentage of 69.57%. In contrast, the producers of 0.1-1.00 ha are only the best performers in terms of production risk level with the score of 2.75/5 against 3.47/5 for farms of 5.01-50.00 ha. Moreover, the producers of 5.01-50.00 ha are most efficient in terms of environmental management with a score of 2.80/5 and quality of product quality with a score of 3.60/5.

Table 4. Descriptive statistics of land size groups performances indicators

Indicators	0.1-1.00 ha		1.1-2.50 ha		2.51-5.0 ha		5.01-50.00 ha		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Economics indicators										
Efficience score	0.84	0.12	0.86	0.10	0.88	0.07	0.88	0.15	0.86	0.11
Production (TL/ha)	1412.45	748.71	1492.98	887.93	2633.25	842.79	2957.74	713.12	1744.72	979.15
Variable cost (TL/ha)	1242.43	630.87	873.56	382.80	1169.63	451.23	1052.75	451.37	1062.79	522.21
Fixed cost(TL/ha)	812.40	403.04	703.50	410.01	1036.06	462.67	535.83	219.58	788.84	427.84
Total Cost (TL/ha)	2054.83	796.27	1577.06	565.73	2205.68	692.90	1588.58	465.72	1851.64	719.82
Gross margin (TL/ha)	170.02	718.43	619.42	868.14	1463.62	823.16	1904.99	699.57	681.93	959.40
Profit (TL/ha)	-642.38	804.14	-84.09	796.67	427.56	873.17	1369.16	808.11	-106.92	963.69
Total factor productivity	0.71	0.34	0.97	0.51	1.28	0.54	2.04	0.91	1.00	0.59
Profitability	-0.29	0.34	-0.03	0.51	0.28	0.54	1.04	0.91	0.00	0.59
Labour productivity (kg/h)	3.98	2.44	5.52	3.82	9.23	4.98	18.75	9.98	6.38	5.50
Animal productivity (kg/h)	87.02	191.64	89.78	104.97	147.59	148.74	496.39	1358.30	122.03	359.22
Tractor productivity (kg/h)	369.09	847.15	718.91	1573.97	663.16	1424.07	599.78	1079.16	580.45	1310.47
Land productivity (kg/ha)	1295.64	693.34	1361.31	803.52	2385.68	715.54	2751.33	683.95	1594.02	887.91
Labour productivity (TL/h)	1.39	2.06	3.00	3.49	6.34	4.18	13.99	8.78	3.64	4.80
Animal productivity (TL/h)	22.85	130.77	59.87	92.72	111.50	130.81	401.57	1169.77	75.44	305.30
Tractor productivity (TL/h)	80.13	278.73	327.34	908.64	332.49	487.75	476.46	929.28	250.90	691.31
Land productivity (TL/ha)	471.49	727.76	809.61	851.91	1666.66	816.98	2069.10	835.15	911.49	941.11
Non-economics indicators										
Assiet security	1.51	0.92	1.59	0.93	1.58	0.92	1.47	1.06	1.55	0.93
Production risk	2.75	1.55	3.31	1.57	3.04	1.61	3.47	1.73	3.08	1.59
Environment cost	2.99	1.52	3.20	1.55	3.20	1.63	2.80	1.37	3.10	1.54
Traders influence	2.91	0.57	2.85	0.65	2.76	0.77	3.20	1.21	2.87	0.69
Commercial autonomy	2.99	0.38	3.05	0.60	2.84	0.61	2.67	0.90	2.97	0.56
Corn quality	3.11	0.50	3.17	0.42	3.11	0.68	3.60	0.51	3.16	0.52

The results in Table 5 give equivocal results for the provinces of Tuy and Houet. In fact, the producers of Tuy and Houet respectively have 10 and 11 indicators for which they are the best performers. On the other hand, those of Tuy have 7 indicators where they are the least efficient. In addition, Tuy producers have the best scores for production risk, the influence of traders on producers and the quality of the product. However, Tuy producers have the least secure production assets, the least performing in terms of environmental costs and commercial autonomy. The producers of Houet are the most efficient in terms of environmental management with a cost score of 2.54/5. They are also the best performers in the commercial autonomy with a score of 3.22/5.

Table 5. Descriptives statistics of provinces performances indicators

Indicators	Tuy		Kenedougou		Houet		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Economics indicators								
Efficience score	0.89	0.06	0.84	0.13	0.84	0.11	0.86	0.11
Production (TL/ha)	1932.10	785.09	1624.75	893.17	1722.67	1164.80	1744.72	979.15
Variable cost (TL/ha)	1116.95	381.50	1071.65	624.31	1012.88	502.65	1062.79	522.21
Fixed cost(TL/ha)	826.32	392.90	844.16	471.04	705.13	398.13	788.84	427.84
Total Cost (TL/ha)	1943.27	462.10	1915.81	843.32	1718.01	733.18	1851.64	719.82
Gross margin (TL/ha)	815.15	832.85	553.09	933.83	709.79	1062.36	681.93	959.40
Profit (TL/ha)	-11.17	789.02	-291.06	927.14	4.66	1093.12	-106.92	963.69
Total factor productivity	1.02	0.46	0.91	0.53	1.06	0.72	1.00	0.59
Profitability	0.02	0.46	-0.09	0.53	0.06	0.72	0.00	0.59
Labour productivity (kg/h)	5.78	3.14	5.32	4.07	7.89	7.50	6.38	5.50
Animal productivity (kg/h)	93.93	90.11	121.87	205.27	143.48	555.83	122.03	359.22
Tractor productivity (kg/h)	1185.57	2241.75	244.14	516.97	483.61	676.29	580.45	1310.47
Land productivity (kg/ha)	1735.42	678.10	1507.10	842.68	1573.78	1052.73	1594.02	887.91
Labour productivity (TL/h)	3.52	3.20	3.03	3.53	4.35	6.54	3.64	4.80
Animal productivity (TL/h)	58.80	79.66	62.81	155.22	100.69	478.43	75.44	305.30
Tractor productivity (TL/h)	452.44	1067.54	112.78	437.26	236.27	473.66	250.90	691.31
Land productivity (TL/ha)	1062.39	832.46	839.23	873.89	869.37	1071.26	911.49	941.11
Non-economics indicators								
Assiet security	1.44	0.93	1.69	0.98	1.49	0.86	1.55	0.93
Production risk	2.53	1.19	3.47	1.54	3.09	1.79	3.08	1.59
Environment cost	4.38	1.16	2.71	1.45	2.54	1.33	3.10	1.54
Traders influence	2.81	0.70	2.95	0.22	2.85	0.94	2.87	0.69
Commercial autonomy	2.68	0.55	2.95	0.22	3.22	0.69	2.97	0.56
Corn quality	3.28	0.61	3.06	0.41	3.18	0.53	3.16	0.52

Table 6 contains the results of the Global Economic Performance Indicator (GEPI). According to the results, the overall performance of maize growers is average with a score of 0. However, the categories do not have the same overall performance.

Table 6. Descriptive statistics of GEPI

	Categories	GEPI	N	Std. Deviation
System of production	Manual	-0.30	90.00	1.32
	Draft animal	-0.06	112.00	0.96
	Engine power	0.57	60.00	0.86
Land size	0,1-1 ha	-0.23	91.00	1.26
	1,1-2,50 ha	-0.13	111.00	1.05
	2,51-5,0 ha	0.59	45.00	0.85
	5,01-50,00 ha	0.59	15.00	0.65
Provinces	Tuy	0.40	72.00	0.71
	Kenedougou	-0.16	95.00	1.27
	Houet	-0.15	95.00	1.15
	Total	0.00	262.00	1.12

5. DISCUSSION

The results show that each production system performs well for a given indicator, but none of them perform well for all the united indicators. Considering only the traditional performance indicators, namely profit efficiency, profit, costs, gross margin, total factor productivity, motorized producers, large producers and those of Tuy are the best performers. While taking into account non-economic indicators such as environmental costs and the security of capital, the manual producers, the small and medium producers, and those of the province of Kénédougou, are the best performers. However, this last category of producers practices family farming oriented towards the consumption while the motorized production, the big producers practice a market-oriented agriculture where the search for profit is the main objective. In other words, the production systems are performants according to the angle of analysis. The challenge of this study is to measure the final performance and to classify these producer categories by taking into account all the indicators mentioned using the GEPI indicator which takes into account the interest of each system to draw up objective measure.

The GEPI shows that, in the production system, motorized producers are the best performers with a score of 0.57. Next are producers with draft animals with a score of -0.06 and finally manual producers with a score of -0.30. As a result, manual and hitched producers are not generally efficient despite their good non-economic performance. In the "farm size" group, the overall performance is positively correlated with the size of the farm. Indeed, it varies from -0.23 for farms from 0.1-1 ha to 0.59 for those from 5.01 to 50.00 ha.

According to the territorial scale, the province of Tuy is overall the best performing with a score of 0.40 followed by that of Houet with a score of -0.15 and finally that of Kénédougou with a score of -0.16.

Finally, a comparison of the GEPI of the producer categories shows that the producers of 5.01 to 50.00 ha are overall the best performers, with a score of 0.59, followed by farms of 2.51 to 5.0 ha, with the same score as the previous ones with a large dispersion of observations. The category of motorized producers ranks third with a score of 0.57. Finally, the province of Tuy is the last category of globally efficient producers.

In sum, the economic indicators also influence the economic performance of the non-economic maize-growers, as shown by the positive correlation between the GEPI results and those of profit-efficiency.

6. CONCLUSION

The global economic performance indicator defined above makes it possible to measure the overall performance of the entities to be studied. There are no limiting factors, the level of overall performance each of which is equal to the value of the GEPI.

The application of GEPI to maize production has shown that overall performance is a function of increasing the level of agricultural mechanization and the size of farms. In fact, producers with a low endowment of agricultural capital are overall the least performing. The same is true for small farms.

In addition, large area producers are the best performers of all producer categories. The motorized producers occupy the second place of overall performance and finally the province of Tuy closes the list of categories of successful producers. However, the literature teaches that mechanization induces an increase in areas planted to generate economies of size. As a result, a policy of improving the overall performance of producers can aim at improving the level of agricultural capital and improving access to agricultural inputs and equipment. Mechanicization will directly lead to an increase in overall performance of 57%. The latter will in turn cause the expansion of the sown areas, which will lead to a 59% increase in overall performance.

Finally, its application emphasizes that manual producers, small farms are more sensitive to non-economic factors than motorized producers and large areas. This is due to the food production of these categories of producers so they are less exposed to market risks compared to large producers.

Given the cross-cutting nature and simplicity of the global performance indicator, we recommend it in analyzing the performance of agricultural systems in Africa.

We invite other researchers to verify its robustness in all areas.

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