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EVALUATION OF THE SUSTAINABILITY OF ALGERIAN TREE FARMS BY THE METHOD OF AGRICULTURAL SUSTAINABILITY INDICATORS (IDEA).

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ABSTRACT

We tested the "indicators of farm sustainability (IDEA)" method to assess its adaptability to the Algerian context. We conducted field surveys and interviews with experts.

Our results show that it is necessary to adapt the IDEA method to the Algerian institutional context (IDEA estimated by the European model, different from the Algerian model: legal nature of the land, management and technical and agricultural model, state intervention, market organization, level of training and information of farmers, etc.)

The overall sustainability of fruit farms in the region is determined by economic sustainability. Socio-territorial and agro-ecological sustainability are weak. Producers do not yet have agro-technical reflexes that have a positive impact on the ecology for the protection of the environment, even if the major ecological problems are not visible to them.

Keywords: Evaluation-Sustainability-Farming- Arboriculture- IDEA- Mascara

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1. INTRODUCTION

The worldwide awareness of the inadequacy of "green revolution" agricultural production systems and the adaptive capacity of ecosystems only became apparent after damage to environmental components (land, water, air, soil, living species, etc.) became apparent.

In developing countries, and despite the seriousness of the negative externalities, have continued to copy the productive systems of advanced countries to meet the food needs of present generations without concern for the consequences of these externalities on future generations.

Experiments and evaluation tests of productivist models were being carried out in these developing countries at the same time as remarkable advances were being made in the study of sustainable development, accompanied by international bodies (UNDP, FAO, UNEP, UNESCO, The World Bank, WHO, Global environment Facility, IAASTD, etc.).

Sustainable development, having had the consensus since 1992 at the Rio summit being "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", is being put forward in an attempt to respond to the growing environmental problems, but also to the expectations of society in terms of social and economic development (Del'Homme et al. 2005).

Agriculture is often the most criticized sector, whether in terms of environmental pollution, food security, landscape role or economic performance. Moreover, for some authors "Even with the advent of pesticides, especially insecticides, and integrated pest management practices, global production of major crops is still affected by pre-harvest and post-harvest pests that cause significant losses" (Kogan, Bajwa. 1999). The results of the studies show that the agricultural losses during the different periods of the 20th century caused by insects varied from 7% to 34% with the use of insecticides, compared to 18% without the use of these pesticides. The losses caused by diseases varied from 10% to 12%, a little less than 15% without the use of fungicides. The control of volunteer plants with herbicides was not very effective in the 20th century, as losses, even with the use of these chemicals, still varied from 8% to 12%, compared to losses of 9% without the use of these products. (Kogan, Bajwa. 1999).

Societal pressure has led to a revision of the concept of sustainable agriculture to take into account all dimensions (economic, social and environmental) and define a global framework of analysis.

Applied to the farm scale, sustainability requires the implementation of methods to evaluate it. The first International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) was completed in 2008[1].

[1] This assessment began in August 2002 when the World Bank and the United Nations Food and Agriculture Program (FAO) launched a process to access knowledge, science and technology assessment in agriculture, joined by the Global Environment Facility (GEF) the United Nations Environment Program (UNEP), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Development Program (UNDP) and the World Health Organization (WHO) as sponsors, in addition to NGOs and about four hundred scientists as stakeholders.

In this article we evaluate the sustainability of farms specialized in fruit production in Algeria, a developing country where the concern to meet food needs outweighs all other objectives, while successive governments have signed and ratified all agreements for sustainable development.

We use the Farms Sustainable indicators method (IDEA), which claims to allow the evaluation of the sustainability of farms through indicators (Vilain et all.2008)

Our scientific objective is to test the method and then to see in which measures best support farmers in their evolution towards more autonomous and low-input production systems (fertilizers, pesticides, food, energy, capital...), more respectful of natural resources and people

2. MATERIALS AND METHODS

2.1. Characterization of the study area and sampling of farms to be surveyed

We chose the region of Mascara for this study, located in the northwest of Algeria. This choice was guided by the importance of agriculture in this region, which is known for its diverse potentialities, especially its flagship products such as olives, citrus fruits and vines.

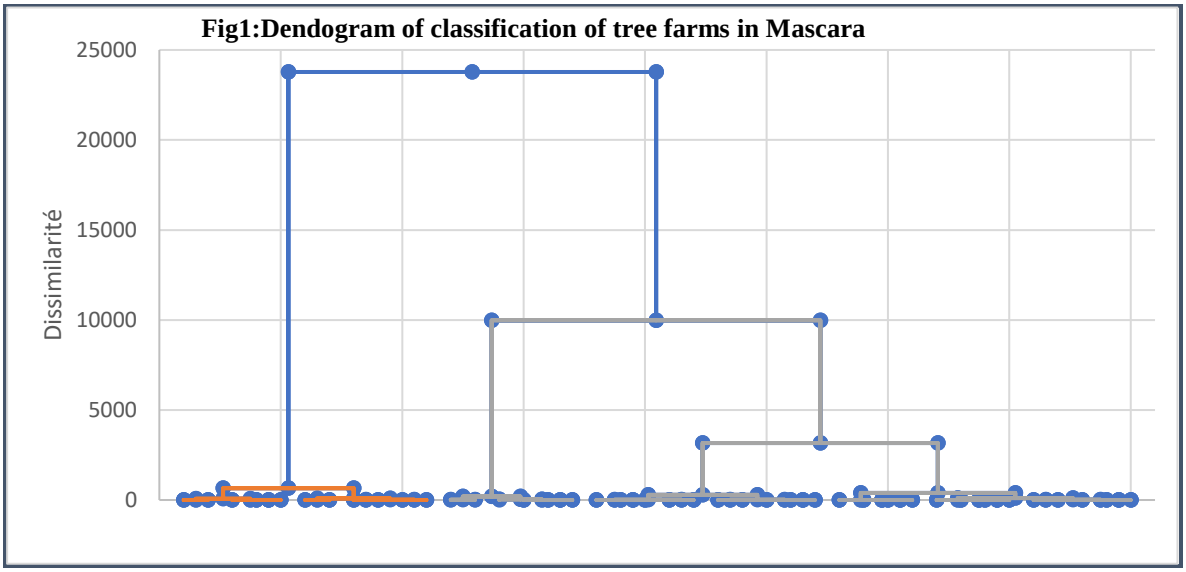
The diagnostic studies that we have done previously (during previous research work) have allowed us to realize the dynamics of investment in the arboriculture sector following the various supports granted by the state under the various development plans (1995-2002-2009-2014).

The 40 farmers surveyed are selected according to the presence of fruit growing, and by agro-ecological zone on the basis of information collected from agricultural services.

On the basis of the data collected from the agricultural services, on all the tree plantations in the communes of the region, we made a double classification: By order of importance of the surface of each tree species, then a classification according to the flagship tree species of the region (olive tree, citrus fruits, vines).

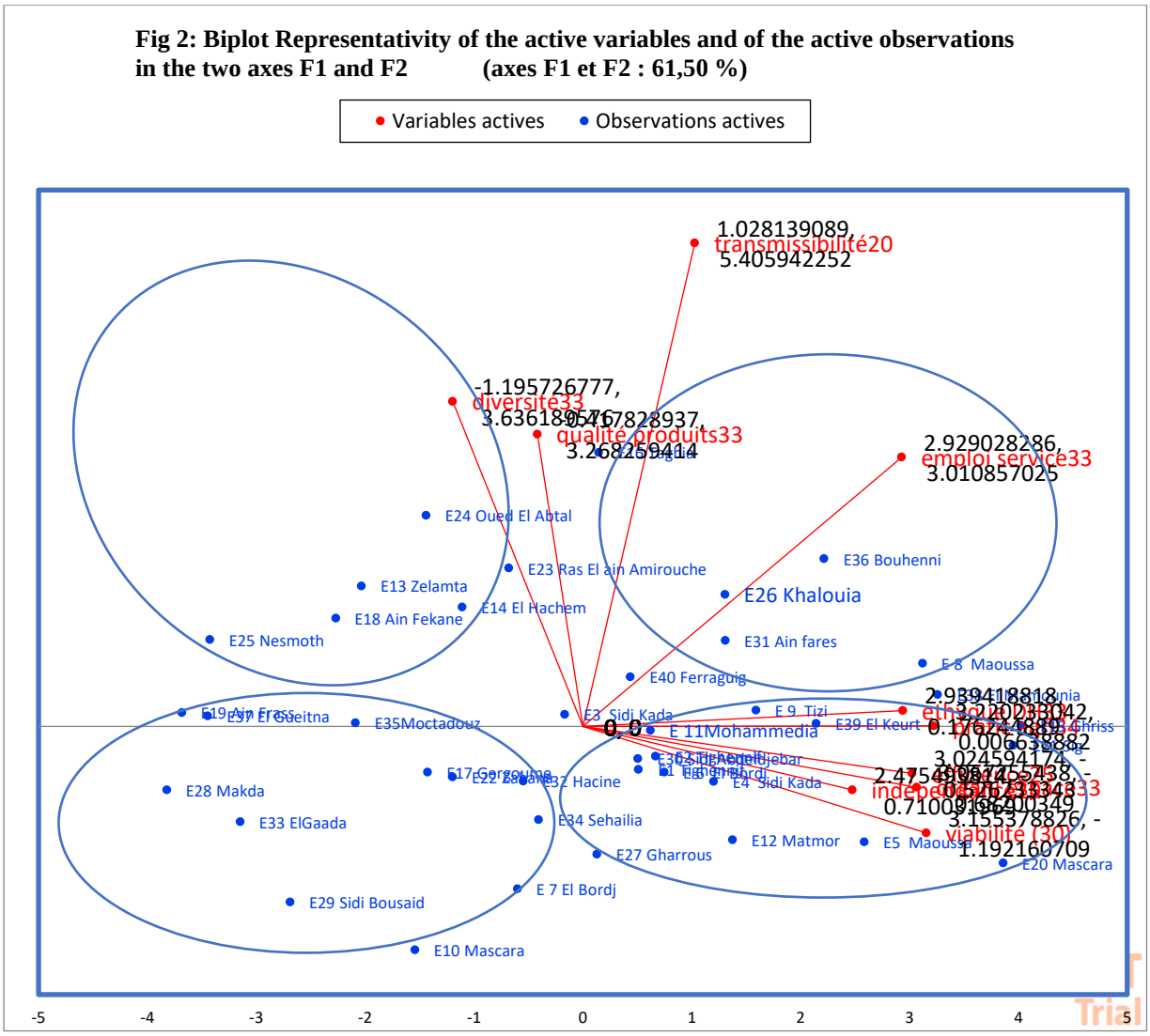
In the second step, we placed each commune in its agro-ecological zone in order to select communes by zone.

Fig1:Dendogram of classification of tree farms in Mascara



Source : Bendjeffal.2021

Fig 2: Biplot Representativity of the active variables and of the active observations in the two axes F1 and F2 (axes F1 et F2 : 61,50 %)



Source : Bendjeffal.2021.

2.2. Questionnaire.

We adapted a questionnaire according to our objectives and our study region. This very detailed questionnaire by agricultural sustainability scale integrates all the aspects proposed by the IDEA method

We also used a semi-structured interview guide for farmers, development agents and some association leaders. This interview guide was in the form of open-ended questions to obtain the opinion of experts on the issues of farm functioning and the sustainability of agricultural activities.

2.3 Working method

Choice of the IDEA method to evaluate the sustainability of farms

a) Description of the method

The IDEA method evaluates the sustainability of a farm based on 42 indicators structured in three independent sustainability scales (the agro-ecological sustainability scale, the socio-territorial sustainability scale and the economic sustainability scale).

- The agroecological scale refers to the agronomic principles of integrated agriculture (Viaux, 1999).

This scale is structured in three components of equal importance (capped at 33 and 34 points), which contribute in an interdependent way to the analysis of the sustainability of the production methods. These 3 components - domestic diversity (4 indicators), spatial organization (7 indicators) and agricultural practices (7 indicators) - are structured in such a way that they leave room for multiple possible technical combinations in the choice of agricultural practices and strategies to achieve the goal of the most autonomous and resource-efficient agricultural systems.

The diversity component is introduced into the analysis to take into account the fact that an economical, autonomous and non-polluting agriculture relies on a significant level of diversity of productions in order to take into account the complementarities and natural regulation processes that function in the different types of cultivated ecosystems.

The spatial organization component: in agro-ecology, the organization of space and the plot of land are important determinants of ecological regulation processes by limiting the proliferation of bio-aggressors and the dependence on pesticides (long rotations, mesh of plots, ecological regulation zones, etc.). The associated indicators concern the organization of the plot of land, the management of non-directly productive environments and the development of spaces.

The agricultural practices component analyzes the intensity of environmental pressure according to the farmer's choices and technical itineraries (level of fertilization, intensity of phytosanitary treatments, fossil fuel consumption, etc.).

From an agronomic point of view, the choice of indicators for these three components depends on their capacity to highlight agricultural systems that are likely to maintain their fertility and productive potential in the long term, a capacity that is correlated with the agroecological management of natural resources.

- The socio-territorial scale refers to ethics and human development, essential characteristics of sustainable agricultural systems. It characterizes the integration of the farm in its territory and in society. It allows us to evaluate the quality of life of the farmer and the weight of the market or non-market services that he provides to the territory and to society. In this sense, it allows a reflection on issues that go beyond the farm.

The three components of socio-territorial sustainability (product quality, employment and services, ethics and human development) have the same weight and are capped at 33 on a maximum scale of 100. In practice, this scale associates and weights quantifiable practices and behaviors with more qualitative elements (such as the architectural quality of the buildings, the landscape quality of the surroundings).

Some indicator values, such as probable sustainability, work intensity, quality of life and sense of isolation, are self-reported and estimated by the farmer. Some indicators are related to the family and not to the farm strictly speaking, in order to take into account, the importance of the family-farm link in the analysis of the sustainability of agricultural systems. Indeed, beyond the sole economic goals, the life project and countless relational links also interfere with the life of the farm.

- The economic sustainability scale analyzes the economic results beyond the short term and cyclical hazards. Structured in 4 components and 6 indicators, the analysis goes beyond the mere consideration of economic performance seen from the point of view of short-term economic or financial profitability, but also analyzes the

degree of economic independence, the transferability of the farm and the efficiency of its production process. On a maximum scale of 100, each of these four components is capped at between 20 and 25 units.

Ultimately, three main principles are apparent in the construction of the method:

(i) The principle of autonomy (not autarky) according to which the more autonomous a system is, the less dependent it is on variations in factors over which it has little control (market, supplies, inputs, etc.),

(ii) The principle of diversity: the more diversified a system is, the more resistant it will be to external hazards and shocks (weather, market prices, sensitivity to pest attacks, etc.) and

(iii) The principle of responsibility towards the stakeholders of the territory.

b) Construction approach

The general scientific approach adopted for the construction of the method is based on the five steps proposed by Mitchell et al. (1995) and Girardin et al. (1999) for the construction of indicators:

a. definition of objectives

b. selection of hypotheses and driving variables

c. creation of associated indicators,

d. the determination of reference thresholds or the choice of standards, and finally

e. validation through testing.

Seventeen (17) objectives/issues were selected to formalize the assumptions of the sustainability model and to expose the choices made in the analysis model of the determinants of sustainability.

IDEA is known as a scoring method that measures the overall performance of the farm (or sustainability level of a farm), based on 42 indicators (qualitative and quantitative).

This method postulates from the start that it is possible to quantify the sustainability of the different components of a farming system by assigning a numerical score, based on information collected at the farm level, and then to weight and aggregate this information to obtain a final score for each of the three sustainability scales (agro-ecological, socio-territorial and economic). The calculation method is based on an equal score for each scale varying between 0 and 100 points.

All this information is transformed into elementary units of sustainability that determine the score attributed to each indicator. The score of a farm for each of the three sustainability scales is the sum of all the elementary sustainability units obtained (or points) for the various indicators of the scale considered. The farm is considered sustainable for the scale considered when it has a high score. For each scale, the calculated values of the indicators are aggregated into "components" of the same theme.

3. RESULTS AND DISCUSSION

3.1 Results for the overall sustainability of tree farms

The overall sustainability of the tree farms in the region of Mascara is fragile since it is more carried by the economic sustainability (58.29) in particular the independence component (17.8/25) which can mean the financial autonomy

of the farmers and their low sensitivity to public aid. On the other hand, a weakness of viability is noted (score 14.97/30) and with an efficiency higher than the average (score 14.27/25). Even if the transmissibility score is just above average (11.25/20), the survey reveals a crisis on the horizon linked to the low attractiveness of the agricultural activity for young farmers' sons

Globally, the sustainability of tree farms in the Mascara region is pulled down (figure n°1) by the agroecological (35.05/100) and socio-territorial (36.66/100) scales. The organization of the space marks the lowest score with 7.53/33. This can be explained by the fact that farmers do not use crop rotations on parcels that are subject to continuous fragmentation, given the mode of transmission of inheritance, which favors the passage to small parcels. Also, one rarely encounters plots left in the landscape (wetlands, alpine pastures, etc.) to allow for ecological regulation, preferring grazed fallow land with a high animal load during long days and all-out plowing on arable land.

Although agricultural practices score (16.64/34), this is explained more by the low use of fertilizers and pesticides, not as an ecological practice but as a form of economy to reduce costs. There is a low knowledge of effective products for the types of diseases that can infest their productions (besides, multiple phytosanitary products circulate in the market without any control or knowledge of its traceability).

Table n°1: Global IDEA of the fruit farms in the region of MASCARA

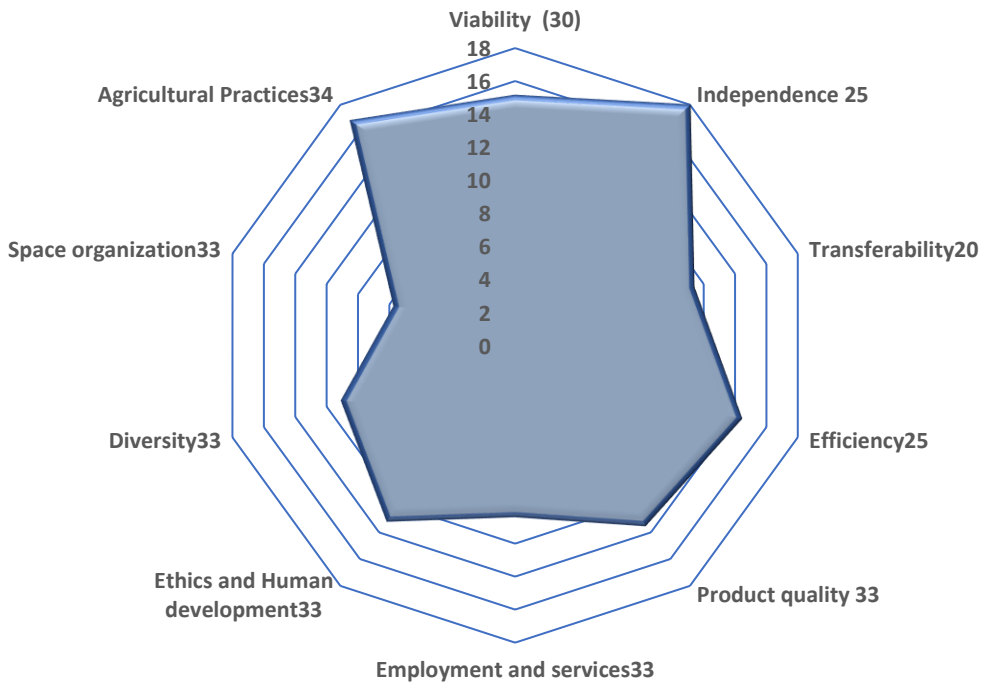
mic sustainability (100)		**territorial sustainability (100)**		**ecological sustainability. 100**	
Viability	14,97/ (30)	Product quality	13,32/(33)	Diversity	10,88/(33)
Independence	17,8/ (25)	Employment and services	10,25/(33)	Space organization	7,53/(33)
Transferability	11,25/ (20)	Ethics HD	13/(33)	Agricultural practices	16,64/(34)
Efficiency	14,27/ (25)				
S/total	58,29/ (100)	S/total	36,6/(100)	S/total	35,05/(100)

Source: Bendjeffal.2021.

The agroecological scale has a low score of 35.05 (Table No.). In our opinion, these results are the logical consequences of the poor organization of space, in particular ecological regulation, which scores only 0.74/12, and the smallness of agricultural plots following the permanent fragmentation of farms, whether for public land or, worse, for private sector land subject to the system of transferability by inheritance without demanding conditions for cultivation (score of 11.25/25), which is a warning of the risk of abandonment or detour of agricultural land away from the agricultural sector (urbanism, industry, tourism).

Overall sustainability of fruit farms in Mascara 2019

Fig 3: General sustainability of fruit farms in Mascara.



Source: Bendjeffal.2021

The use of fertilizers (score 5.5) without predefined objectives and the use of certain phytosanitary products (score 3.75) all over the place mean that the agricultural practices will not allow the required agroecological sustainability.

The treatment of effluents (score 0), whether industrial, domestic or natural, is left to the State alone even if they pollute the farm. The State is in such a situation that it never commits a budget for this operation and even requires nothing from the farmers in this area.

Animal welfare (score 0) is a concept that has not yet found a societal debate to require producers to take greater responsibility.

With regard to socio-territorial sustainability, which is concerned with many qualitative but important aspects insofar as they impact overall sustainability. The score on this scale is 36.6 out of 100. The quality of the products, the nature of the food influences the human and animal welfare. This quality is problematic in an open market with no public health requirements. On the other hand, the accessibility of the space seems to be well rated in view of the access infrastructure to the space (score 4/4) available. Operators still seem reluctant, after more than 57 years, to get involved in organizations (score 1.12/9) that allow them to defend their interests. Those that do exist are the result of public authorities created in the past to regulate protest movements.

Table 2: Sustainability value of the agroecological scale

Component	Indicator	Score	Boundary
Diversity =10.88	Animal diversity by species or breed	2.85	0 à 13
	Annual or temporary crop diversity	4.65	0 à 13
	Diversity of perennial crops	3.38	0 à 13
	Valuation of regional breeds or cultivation of rare species	0	0 à 5
Space organization =7.53	Crop rotation	2.53	0 à 10
	Ecological regulation	0.74	0 à 12
	Loading	1. 50	0 à 5
	Forage area	1.63	0 à 3
	Plot size	1.13	0 à 6
Agricultural Practices =16.64	Fertilization	5.5	0 à 10
	Pesticides	3.75	0 à 10
	Effluent Treatment	0	0 à 10
	Animal Welfare	0	0 à 3
	Soil Protection	1.25	0 à 5
	Irrigation	2.64	0 à 4
	Energy	3.5	0 à 8
Total agro-ecological sustainability		35,05	0 à 100

Source; Bendjeffal.2021

The socio-territorial dimension aims at human development, citizenship, ethics, coherence and local development as well as taking responsibility in a structure and living on or near the farm. Our interviews with resource persons reveal that more than 80% of the farmers have a preference for agglomerations and cities, even if they have a house (acquired within the framework of the State subsidy for rural housing).

The know-how of the farmers is recognized even though their educational level does not exceed, in all cases, the secondary level (Training action score = 3.3). The meetings and days organized by the agricultural services have had a positive impact on their technical knowledge required by the practice of arboriculture in addition to the technical and commercial information to gain the production and sales side.

Table3: Value of the sustainability of the socio-territorial scale

Component	Indicators	Score	Boundary
Product quality 13.32/33	Quality of food produced	6	0 à 12
	Valuation of the built heritage and landscape	2.2	0 à 7
	Accessibility of the space to users	4	0 à 4
	Involvement in associative structures	1.12	0 à 9
Employment and services 10.25/33	Commercial services and pluriactivity	2.5	0 à 5
	Valuation of products through short channels	1.5	0 à 5
	Level of employment on the farm	3	0 à 11
	Forms of collective work	1,5	0 à 9
	Probable perpetuity of the farm	1.75	0 à 3
Ethics and Human development 13/33	Contribution to the food balance	4.2	0 à 10
	Training action	3.3	0 à 7
	Intensity of work	3.6	0 à 7
	Quality of life	2.5	0 à 6
	Isolation	1.5	0 à 3
Total socio-territorial sustainability		38.67	0 à 100

Source: Bendjeffal.2021

Finally, the last area concerns the efficiency of the production process and the capacity of the farm to generate added value: the better the score, the lower the share of operating expenses in the product.

The elements necessary to calculate the various indicators are found in the management documents and balance sheets of the farms. These economic evaluation indicators, which are necessarily synthetic, refer to other indicators on the agro-ecological or socio-territorial scales, which address the notions of efficiency or reproducibility in other ways.

Table 4: Value of the sustainability of the Economic sustainability

Component	Indicators	Score	Boundary
Viability 14.97/30	Economic viability	09.17	0 à 20
	Economic specialization rate	5.80	0 à 10
Independence 17.8/25	Financial autonomy	11.3	0 à 15
	Sensitivity to direct aid	6.5	0 à 10
Transmissibility 11.25/20	Transmissibility	11.25	0 à 20
Efficiency 14.27 /25	Efficiency of the production process	14.7	0 à 25
Total Economic sustainability			0 à 100

Source: Bendjeffal.2021

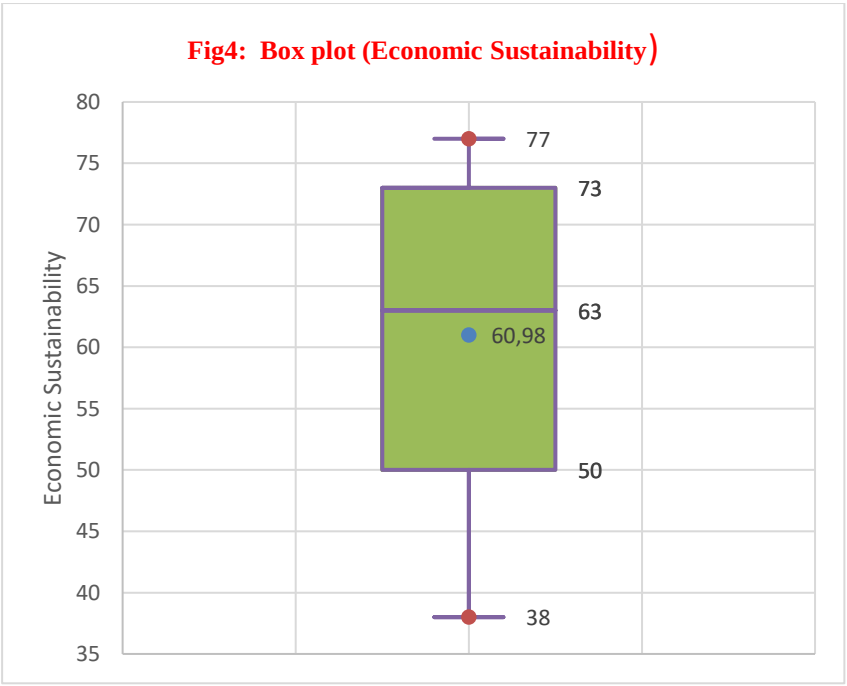
The results of the analysis of the information collected show that the individualistic spirit of the farmers allows them to gain, in terms of financial rationality, since the score of financial autonomy is relatively interesting (score 11.3/15) to which it is necessary to add the good score for the sensitivity to aid which is 6.5/10.

The specialization (score 5.8/10) of the region's farms is not yet apparent as long as investments in the agricultural sector are still subject to financing measures not yet adapted to the social and ideological system.

One of the points that should alert agricultural policies, following the analysis of the data, is that of transmissibility, which is not yet well measured and requires real scientific support. However, the figures collected corroborate with the interviews with young people, which show that young rural people are only marginally interested in agricultural activities, which are considered difficult, and in view of the failure of rural development programs that were supposed to create all the conditions to encourage people to work the land and stay in the countryside.

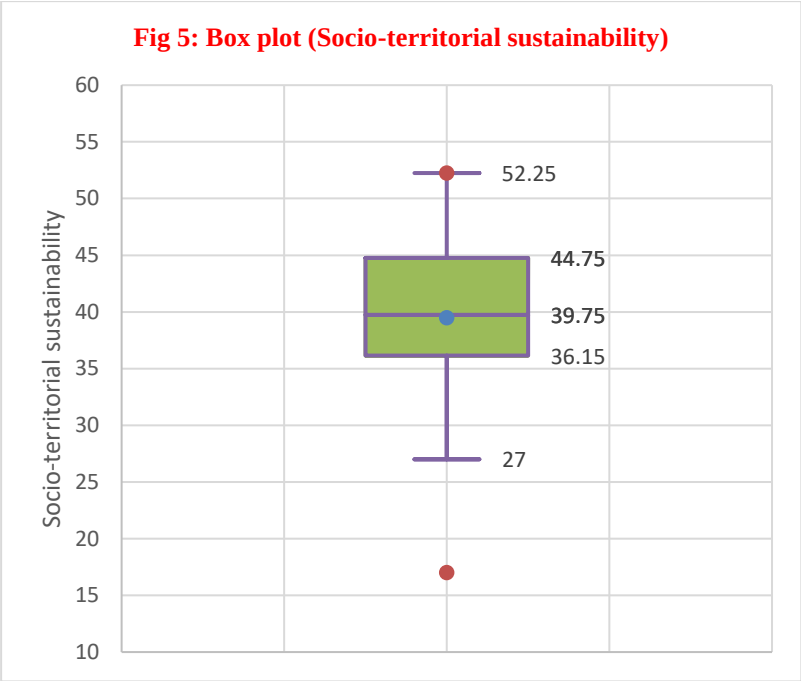
3.2. Individual results

Fig4: Box plot (Economic Sustainability)



Source: Bendjeffal.2021

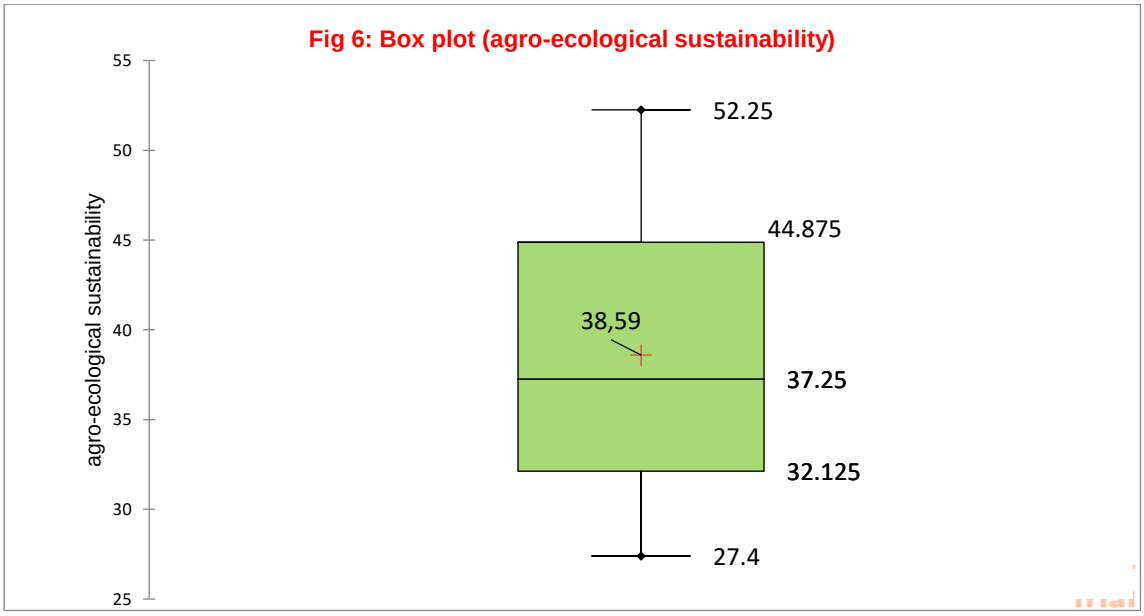
The difference between the lowest and highest score is 39 points while the median is 63 points. This dispersion is explained by the low viability of some farms, particularly those in the agro-ecological zones (Mountains of Saïda) characterized by a harsher climate and the limited performance of some tree species such as citrus, quince, olive, etc.



Source: Bendjeffal.2021.

In the sustainability plot, the difference between the highest and lowest values is 25.25, which can be considered low in relation to that of economic sustainability.

On the other hand, the median is superimposed on the average and the difference between the average and the highest value of this indicator is 5 and between the median and the lowest value which is 3.6 for the socio-territorial sustainability. All this may mean that the level of socio-territorial sustainability is similar in the majority of fruit farms in the region and that the mode of exploitation is similar, since the central state is omnipresent in most of the decisions taken by the farmers, in addition to an economy of scarcity of almost all food products.



Source: Bendjeffal.2021

CONCLUSION

The dispersion of economic results differs from that of the other scales. This can be explained by the difference in names found in our sample, and marketing strategies that do not all allow the various fruit species to be valued at the same level. At the economic level, producers are subject to high risks due to plant diseases and, above all, the lack of water in the Habra-Sig region, which in some cases may compromise the agricultural year due to the low water mobilization by dams and reservoirs.

Downstream pressure on production costs and selling prices, in a context of strong competition and low consumer purchasing power. Technical innovations to stabilize yields must be adapted to the low financial capacities of producers. In this group, economic viability is strongest. The rate of specialization is generally good, which highlights the unused potential of the farms, especially in terms of citrus exports.

The FSI evaluation method that we have tested remains incomplete, especially at the socio-territorial level, where the indicators are just assessments of individuals and cannot be evaluated numerically. Also, the method must be adapted by type of production system and by socio-economic system that governs the mode of operation of farms.

In addition, the FSI method can be used to guide decision-makers and technicians in the choice of support methods for farmers to achieve sustainable agricultural development.

The future of agriculture in the region is more related to the revision of the marketing mode and the marketing through a well-studied marketing plan. The rehabilitation of collection, preparation and packaging platforms for fruit products, a complete review of the missions of the Chamber of Agriculture and professional associations could allow for greater involvement and an incentive to invest in farmers if they are accompanied by extension programs for new production and marketing techniques.

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