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Original Research Article

Assessment of the sustainability of date palm farms in the Oued-Righ Valley, Southeast Algeria

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Abstract

Our study aims to assess the sustainability of the date palm farms in the Oued-Righ valley using the Farms Sustainability Indicators (Indicateur de durabilité des exploitations agricoles-IDEA) method. Nineteen (19) farmers, who agreed to evaluate their farms, were surveyed using an appropriate questionnaire. In addition, Statistical analysis, using IBM SPSS Statistics version 27, enabled us to explore the results further and understand the relevance of the different variables. The results showed that the three sustainability scales (Agro-ecology, Socio-territorial and Economy) obtained scores higher than 50 points out of 100, in only three farms. The scores obtained by the agro-ecological and economic scales were above average for a large part of our sample, which explains that their agro-ecological and economic practices contributed strongly to the sustainability of these farms. While the score obtained by the socio-territorial scale indicates that practices at this level are limiting factors to their sustainability. The study reveals the need to improve socio-territorial aspects across three components: product and territorial quality, ethics and human development, and employment and services, to improve the overall sustainability of Oued-Righ valley date palm farms.

Keywords: Sustainability; agro-ecology; socio-territorial; economy, IDEA; development; date palm farms.

INTRODUCTION

Date palm cultivation, in Algeria, is widespread in various parts of the South, originally forming the oases. These areas are spread across the Southeast, South-West, Centre-South, and Extreme South (Ababsa, 2007; Benaouda, 2012). They include more than eighteen million palm trees, occupying an area of around 163 985 ha (Amrani, 2021). More than 60% of the national date palm heritage is concentrated in the southeast, in regions such as Biskra, Oued-Souf, and Oued-Righ (Merrouchi and Bouammar, 2015).

The Ouargla region, including the Oued-Righ valley, is one of the most important palm-growing regions, with around 2.6 million date palms, including 2 352 656 productive palms, spread over an area of 22 512 hectares, with an annual production of more than 1.6 million quintals of dates (MADR, 2019). This region has been subjected to numerous shocks since the colonial period, leading to the degradation and disappearance of certain oases and the impoverishment of several farmers (Merrouchi, 2022). Also, climate change, which has shaken the world over the last two decades, with increasing periods of heat and a significant reduction in rainfall, has harmed the development of date palm cultivation and the quality of its product in Algeria and even in neighbouring countries such as

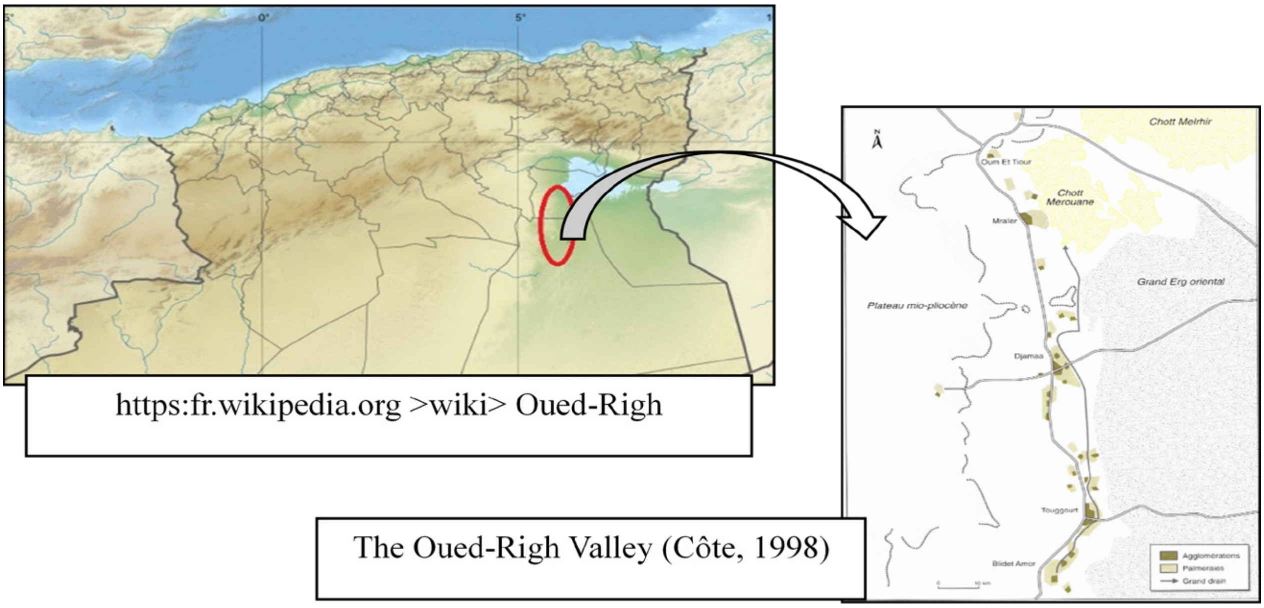

Figure 1. Location of the study area

Morocco and Tunisia (Ait Hamza et al., 2010; Hamdane, 2015; Mokhtari et al., 2016; Roumani, 2020; Faci, 2021). These combined conditions represent constraints to the sustainability of agriculture in the oases, and in these areas in particular, concerning the small size of farms, described as gardens in the Oued-Righ valley by Dubost (1986). According to Toutain et al. (1990), can the sustainability of the gardens be called into question? Given that, the oasis system has lasted for centuries thanks to human ingenuity.

The definition of sustainable development as it is widely used today is expressed in a classic diagram made of three circles of equal size, the three pillars of sustainable development: the environment, the economy, and society. Sustainable development represents the core of the intersection of these three circles.

Broadly speaking, the aim is to ensure that sufficient wealth is produced to satisfy the needs of the population (economic pillar), while reducing social inequalities (social pillar) and avoiding environmental degradation (environmental pillar) (Allemand, 2006 in Hertig, 2011).

The literature proposes many methods for assessing sustainability in agriculture at the farm, plot, and regional levels. With this in mind, the proposed research involves analysing the sustainability of a sample of date palm farms using the IDEA method. This method has been used in various parts of the world, particularly in Algeria, with some preliminary modifications, in an attempt to adapt it to the situation under study by the authors De Castro et al., 2009; Ligan Topanou et al., 2015; Idder et al., 2021; Djouhri et al., 2022.

The aim of using the IDEA method in this study is to assess the sustainability of a sample of farms to get to know of their degree of sustainability and propose improvements where sustainability indicators are limiting factors.

Let us assume that these date palm farms have existed for millennia, and the assessment of their sustainability will confirm this. As for the method used (IDEA), the latter being created in a different context than the Algerian one, will require adjustments and re-adaptation.

MATERIALS AND METHODS

The study area

The Oued-Righ valley is located in the south-east of the Algerian Sahara, around 700 km from the capital Algiers, between latitudes 32°54′, 39°9′ North and longitudes 05°50′, 05°75′ East. It appears as a gutter 150 km long and 15 to 30 km wide. On a South-North axis, the altitude rises from 145 m at El-Goug upstream to less than 35 m at Chott Merouane downstream, with a surface area of 3,000 km^2 (Boumaraf, 2013). It is the oldest cultivated region in the Sahara, with date palms as its main crop, as evidenced by a text by Ibn Khaldoun (Pérennes, 1979) (Figure 1). The climate of the Oued-Righ valley is a desert climate, characterised by low and irregular rainfall, temperatures that fluctuate significantly from day to day and from year to year, low air humidity, and winds that are sometimes very violent (Bouaichi and Ben Abdallah, 2019).

Table 1. Sustainability indicators by component and scale

Scale	Component	Indicator	Indicator	Maximum values	
Agro-ecological sustainability scale	Diversity	Diversity of annual crops	A1	14	Total limited to 33 units
		Diversity of perennial crops	A2	14	
		Animal diversity	A3	14	
		Enhancing and preserving genetic heritage	A4	6	
	Space organisation	Crop rotation	A5	8	Total limited to 33 units
		Plot size	A6	6	
		Organic materials management	A7	5	
		Ecological regulation zones	A8	12	
		Contributing to the region's environmental challenges	A9	4	
		Enhancing space	A10	5	
		Fodder area management	A11	3	
	Farming practices	Fertilisation	A12	8	Total limited to 34 units
		Liquid organic waste	A13	3	
		Pesticides	A14	13	
		Veterinary treatment	A15	3	
		Protecting soil resources	A16	5	
		Water resource management	A17	4	
		Energy dependence	A18	10	
Total:					100
Socio-territorial sustainability scale	Product and territorial quality	Quality approach	B1	10	Total limited to 33 units
		Enhancing built heritage and landscape	B2	8	
		Non-organic waste management	B3	5	
		Space accessibility	B4	5	
		Social involvement	B5	6	
	Employment and services	Valuation through short sectors	B6	7	Total limited to 33 units
		Autonomy and enhancement of local resources	B7	10	
		Services, multi-activity	B8	5	
		Employment contribution	B9	6	
		Collective work	B10	5	
		Probable perenniality	B11	3	
	Ethics and human development	Contributing to the world food balance	B12	10	Total limited to 34 units
		Animal welfare	B13	3	
		Training	B14	6	
		Work intensity	B15	7	
		Quality of life	B16	6	
		Isolation	B17	3	
		Welcome, hygiene and safety	B18	4	
Total:					100
Economic sustainability scale	Viability	Economic viability	C1	20	
		Specialization rate	C2	10	
	Independence	Financial autonomy	C3	15	
		Aids sensitivity	C4	10	
	Transmissibility	Capital transferability	C5	20	
	Efficiency	Efficiency of the production process	C6	25	
Total:					100

Source: Vilain et al. (2008)

Assessment tools

Farm sustainability indicators (IDEA)

The tool used to assess sustainability is the third edition of the IDEA method. Version 3 of IDEA assesses the sustainability of a farm based on 42 indicators, integrating the three dimensions of sustainability (agro-ecological, socio-territorial, and economic).

The agro-ecological scale refers to the agronomic principles of integrated agriculture (Viaux, 1999). This scale is structured into three equally important components (capped at 33 and 34 points), which make an interdependent contribution to the analysis of the sustainability of production methods.

The socio-territorial scale, with its three components, refers to ethics and human development, essential characteristics of sustainable agricultural systems. It characterises the integration of the farm into its territory and society. It assesses the farmer's quality of life and the importance of the market and non-market services he provides to the region and society. The three components of this scale have the same weight and are capped at 33 and 34 on a maximum scale of 100.

The economic sustainability scale is structured into four (4) components and six (6) indicators. This scale analyses not only economic results but also 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 (Vilain et al., 2008) (Table 1).

For the apparent balance sheet, we have seen that most nitrogen input comes from organic and mineral fertilisation. The nitrogen generated by the animals and associated crops is insignificant as these two activities are negligible.

The amount of nitrogen used was calculated based on the two products most commonly used by our sample: organic fertiliser (sheep or cattle manure) and chemical fertiliser (Urea 46). The standard units used in this calculation for these two materials are those used by (Vilain et al., 2008; Siboukeur, 2013; Gomgnimbou et al., 2016) with the following average contents: Organic fertiliser: N (6 kg/t), P (4 kg/t), K (10 kg/t); Urea 46: N (460 kg/t), P (0 kg/t), K (0 kg/t).

Survey

A questionnaire was first drawn up to enable us collect the information needed to fill in the 42 indicators that make up the IDEA method. It was validated by a field test to check that the questions were coherent and consistent, and that the farmers understood them.

The surveys took place in April 2019 and July-August 2021, with 19 farmers who agreed to collaborate and showed an interest in evaluating their farms.

Data treatment

Based on the information obtained, the indicators supported by the IDEA method were constituted and filled in on Excel, enabling us to obtain the first results. Statistical analysis, using IBM SPSS Statistics version 27, enabled us to further explore the results obtained and understand the relevance of the different variables. The data were analysed using appropriate statistical methods to identify relationships between the variables studied. Pearson's correlation coefficient was used to assess the strength and direction of linear relationships between quantitative variables. The coefficients obtained

Table 2. Descriptive statistics for selected low-variability indicators

Sustainability indicators	Average	Mode	Standard deviation	Variance	Minimum	Maximum
A7	3.00	3	0.000	0.000	3	3
A8	7.42	7	0.838	0.702	7	9
A9	0.00	0	0.000	0.000	0	0
A10	0.00	0	0.000	0.000	0	0
A11	0.16	0	0.688	0.474	0	3
B9	5.79	6	0.631	0.398	4	6
B11	2.63	3	0.895	0.801	0	3
B13	1.21	1	0.855	0.731	0	3
B16	3.74	4	0.991	0.982	2	6
B17	2.32	2	0.671	0.450	1	3
B18	1.68	2	0.749	0.561	0	2
C4	10.00	10	0.000	0.000	10	10

Source: Survey results

were interpreted according to their absolute value, following the recommendations of Mukaka (2012): weak correlation (0 to 0.3), moderate correlation (0.3 to 0.7), or strong correlation (0.7 to 1).

A principal component analysis (PCA) was also carried out to reduce the dimensionality of the data and identify the main components explaining the total variance. These analyses enabled us to identify significant trends and gain a better understanding of interactions among the variables studied.

RESULTS AND DISCUSSION

Revision of indicators

Based on the results obtained, the descriptive analysis revealed that some of the method's indicators, essentially relating to the agro-ecological and socio-territorial scales, as shown in Table 2, obtained values that varied very little, resulting in a standard deviation and variance tending towards or equal to zero (0).

In order to adapt the criteria covered by the IDEA method to the reality of the study area, changes were made to certain indicators as well as the allocation of certain points.

Belmessaoud (2011) points out that applying the IDEA method to the Saharan context shows an acceptable level of adaptation, given the relevance expressed by several of its indicators. Limits to the application of the IDEA method have been noted. Some indicators appear to be entirely irrelevant to the Saharan context, while others overestimate the rating scales.

When we designed the survey questionnaire, we immediately found certain indicators unsuited to the Algerian context, which led us to adapt them even before we began our field surveys. The indicators thus revisited are: A6, A15, A16 from the agro-ecological sustainability scale; B7, B8, B10, B14 from the socio-territorial sustainability scale, and C1, C4, C5 from the economic sustainability scale (Table 3).

Furthermore, after processing the survey data, certain indicators (listed in Table 2) showing very low variability need to be reviewed and adapted to the Algerian context and the study area.

The method has already been readjusted by several authors, such as Gasmi et al. (2019), who encountered

Table 3. Presentation of indicators adapted to the situation of the area

Sustainability scales	Indicators	Initial status	Situation after modification
Agro ecology	A6	plot size	Consider the plots as the surface area of the farm (Mix of crops on the same plot)
	A15	veterinary treatments (TV = 1 not planned) Depending on the method: TV between 0.5 and 1:2 TV between 1 and 2: 1	If TV=1, the score we gave is 2 (TV between 0.5 and 1)
	A16	soil resource protection (soil turning)	All manual work is considered as soil work without turning.
Territorial-Socio	B7	Autonomy and enhancement of local resources, energy of agricultural origin	Points are awarded (2 points) for items (Product/organic matter exchange). Because agricultural energy is not used
	B8	services, multi-activity (social integration)	Another item is added, which is the practice of *Aachour* (1/10 of agricultural production to be offered to people). Consider this social policy and award it the necessary points instead of social integration.
	B10	Collective work (grouping of employers, networking) (practice absent in the Algerian context)	Allocation of ratings to items: pooling of equipment (2p) and mutual aid (3p).
	B14	Training (reception of paid trainees)	Replaced by: Agreement by the farmer to organize the demonstration days and visits at his farm.
Economical	C1	Economic viability (net farm income RNE)	The RNE is compared to the Algerian SMIG.
	C4	Aid sensitivity (grants and subsidies)	Assigning a full score (10p) to the indicator
	C5	Economic transferability	The farms capital range. - old palm grove: between 600000 DA and 2400000 DA/ha - new palm grove: between 2400000 DA and 4800000 DA/ha

Source: Made by the authors.

Table 4. Correlation between variable components

	D.AGR	D.SOC	D.ECO	D.GLO	C.DIV	C.ORG	C.PRA	C.QUA	C.EMP	C.ETH	C.VIAB	C.IND	C.TRAN	C.EFF
D.AGR	1.00	0.23	−.570*	−0.10	**.705****	0. 32	0. 20	−0.06	.675**	0. 01	−0.43	−0.11	−0.39	−.603**
D.SOC	0. 23	1. 00	−0.08	0. 42	−0.09	0. 05	0. 38	.565*	0. 29	669**	0. 14	−0.11	−0.42	0. 02
D.ECO	−.570*	−0.08	1. 00	**.709****	−.476*	−0.30	0. 00	0. 25	−0.35	0. 13	**.788****	.719**	0. 45	**.806****
D.GLO	−0.10	0. 42	**.709****	1. 00	−0.28	−0.16	0. 28	.492*	0. 01	0. 30	.682**	**.764****	0. 09	.485*
C.DIV	**.705****	−0.09	−.476*	−0.28	1. 00	0. 23	−.459*	−0.12	.610**	−.495*	−0.37	−0.16	−0.16	−.640**
C.ORG	0. 32	0.05	−0.30	−0.16	0. 23	1. 00	−0.22	−0.13	0. 06	0. 10	−.545*	−0.03	0. 06	−0.20
C.PRA	0. 20	0. 38	0. 00	0. 28	−.459*	−0.22	1. 00	0. 27	0. 12	.563*	0. 11	0. 06	−0.26	0. 12
C.QUA	−0.06	.565*	0. 25	.492*	−0.12	−0.13	0. 27	1. 00	0. 09	0. 24	.532*	0. 23	−0.26	0. 15
C.EMP	.675**	0. 29	−0.35	0. 01	.610**	0. 06	0. 12	0. 09	1. 00	−0.12	−0.19	−0.18	−0.37	−0.38
C.ETH	0. 01	.669**	0. 13	0. 30	−,495*	0. 10	.563*	0. 24	−0.12	1. 00	0. 09	−0.09	−0.11	0. 39
C.VIAB	−0.43	0. 14	**.788****	.682**	−0.37	−.545*	0. 11	.532*	−0.19	0. 09	1. 00	.520*	−0.09	.654**
C.IND	−0.11	−0.11	.719**	**.764****	−0.16	−0.03	0. 06	0. 23	−0.18	−0.09	520*	1. 00	0. 35	0. 35
C.TRAN	−0.39	−0.42	0. 45	0. 09	−0.16	0. 06	−0.26	−0.26	−037	−0.11	−009	0. 35	1. 00	0. 15
C.EFF	−.603**	0. 02	806**	.485*	−.640**	−0.20	0. 12	0. 15	−0.38	0. 39	.654**	0. 35	0. 15	100

*. The correlation is significant at the 0.05 level (two-tailed). **. The correlation is significant at the 0.01 level (two-tailed).

Source: SPSS results
Legend: D.AGR (agro-ecological sustainability), D.SOC (socio-territorial sustainability), D.ECO (economic sustainability) D.GLO (global sustainability), C.DIV (diversity component), C.ORG (spatial organization component), C.PRA (farming practices component), C. QUA (Product and Territory Quality component), C.EMP (Employment and Services component), C.ETH (Ethics and Human Development component), C.VIAB (Viability component), C.IND (Independence component), C.TRAN (Transmissibility component), C.EFF (Efficiency component).

difficulties in calculating scores for the pesticides, transmissibility, and economic viability indicators. Calculating the pesticide indicator is complicated on small family farms because these farmers do not record the products they use or the doses they apply.

Sustainability assessment results

Typology

In presenting the results of the sustainability survey, Gibon (1994) explains that a typology is a way of organising the diversity of farms into a few major types considered as homogenous. Any typology aims to classify farms objectively, in such a way that the units in a given class are very homogeneous among themselves and very heterogenous concerning farms in other classes (Cerf et al., 1987).

Statistical analysis

An exploratory approach using PCA (Principal component analysis) was followed in advance, in order to explore the underlying structure of the data and reduce the number of variables to a few factors. To ensure that there were minimal correlations between variables, a correlation matrix was created for the ten components, grouping all the variables in the analysis (Table 4).

The sustainability scores obtained for the three scales vary from one scale to another and from one farm to another. The sustainability score, represented by the sustainability limiting factor (Vilain et al., 2008), obtained for our sample, varied between 10 and 64 points out of 100, with only five farms exceeding the 50-point threshold (Table 3). Examination of the magnitude of the coefficients indicated the existence of some correlations between certain components, in particular: Agro-ecological sustainability (D.AGR) is correlated with diversity component (C.DIV) statistically significant at $p < 0.01$; and economic sustainability (D.ECO) is correlated with viability component (C.VIAB), Independent component (C.IND)and efficiency component (C.EFF)and are all statistically significant at $p < 0.01$ (Table 4).

However, the quality of inter-item correlations was checked using the KMO index, which complements the examination of the correlation matrix. This index took a value of less than 0.50 (0.405), which is, according to its interpretation, unacceptable and can be justified by the small sample size. What's more, the data in the study do not show sufficient variability, hence the irrelevance of the PCA.

Durability scores

The sustainability scores obtained for the three scales vary from one scale to another and from one farm

Table 5. Scores obtained by sustainability scale for the farms surveyed

Farm	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*
Sustainability Agroecology	74	64	66	47	46	56	66	42	63	50	85	67	70	50	59	62	54	75	62
Socio-territorial sustainability	44	48	32	54	34	39	58	49	43	40	49	54	58	51	39	37	34	49	41
Economic sustainability	69	47	44	66	68	68	71	90	61	72	37	19	52	79	73	69	65	31	10
Overall sustainability (sustainability score)	44	47	32	47	34	39	58	42	43	40	37	19	52	50	39	37	34	31	10

Source: Made by the authors

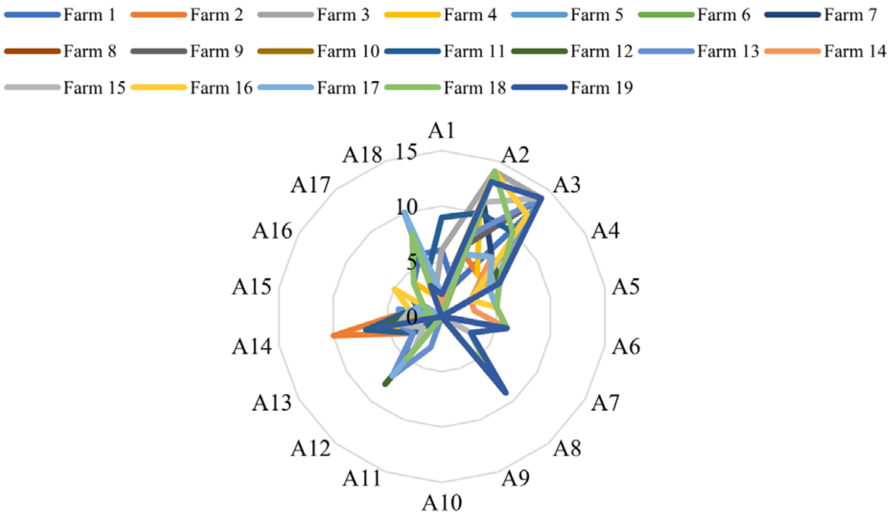

Figure 2. Results of agro-ecological sustainability indicators across 19 farms

to another. As for the sustainability score, which is represented by the limiting factor of sustainability (Vilain et al., 2008), obtained for our sample, it varies between 10 and 58 points out of 100, with an average of 38.68 ± 11.15, of which only three farms exceeded the 50-point threshold (Table 5).

Agro-ecological sustainability

It is on the agro-ecological and economic sustainability scales, where farms are more sustainable, and concerned, respectively, sixteen out of nineteen and thirteen out of nineteen farms, whose scores exceeded 50 points. The socio-territorial sustainability scale was considered a limiting factor for 74% of the sample. The averages obtained, respectively, for the three scales (agro-ecological, socio-territorial, and economic) are: 60.95 ± 11.11, 44.89 ± 8.11, and 56.89 ± 20.76. The three farms that scored below average in agro-ecology were penalised by the crop diversity, in particular, perennial crops and forage crops, which in turn penalised livestock practices (Figure 2).

Socio-territorial sustainability

For the socio-territorial sustainability scale, only five farms out of nineteen, or 26.31%, scored above average, varying between 51 and 58 points. The remaining farms were below average, with sustainability scores ranging from 32 to 49 points.

Farms with above-average socio-territorial results were favoured by the indicators (non-organic waste management, social involvement, short value chain, contribution to employment, training, work intensity, contribution to balanced diet). On the other hand, farms with below-average scores, representing 73.68%, were penalised by the indicators: non-organic waste management, social involvement, and collective work (Figure 3).

Economic sustainability

As for the economic result, thirteen farms out of nineteen, or 68.42%, scored above average, ranging from 52 to 79 points, with one farm being the exception with a score of 90 points. These farms have good economic viability, made possible by high value-added and low input use, financial autonomy, thanks to low financial dependence on partners, and an efficient production

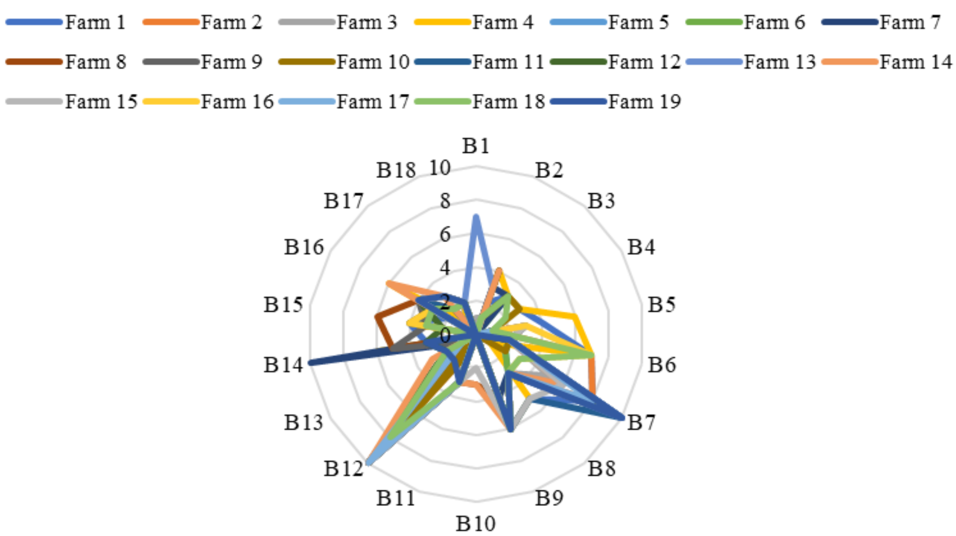

Figure 3. Results of socio-territorial sustainability indicators across 19 farms

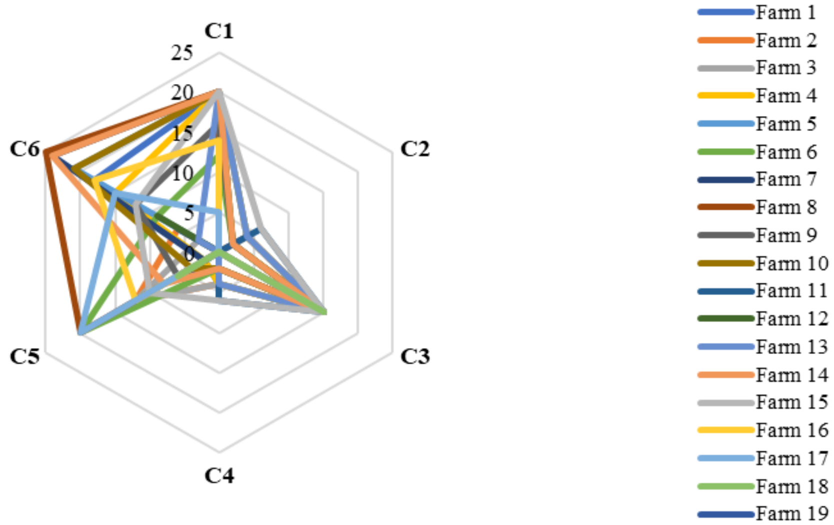

Figure 4. Results of economic sustainability indicators across 19 farms

process explained by good resource valorization. Nevertheless, the other economic indicators, the rate of specialization and transferability, did not score well, as there is little diversity of activities and low use of non-wage labor (Figure 4).

The results obtained in this study concur with certain studies carried out on the same production system (Idder et al., 2021; Djouhri et al., 2022) for the sustainability of agroecological practices, but for economic sustainability, the two studies do not agree. According to Gharbi et al. (2022), the conflict between these two scales exists because farmers are concerned with maximising their production and neglecting the environmental aspect.

Extreme scores

Maximum score

The highest score is obtained by farm seven (N°7) with a score of sustainability of 58 points and scores of 66, 58, and 71 points, respectively, for the scales (Agro ecological, socio-territorial and Economic). Nevertheless, this farm is penalized by indicators (A1 and A3) of the "Diversity" component; by indicators (A5, A9, A10 and A11) of the "Spatial organization" component; by indicators (A13, A16, A17) of the "Agricultural practices" component; by indicators (B1, B4, B5, B10) of the "Product Quality and Employment and Services" components; by indicator B15 of the

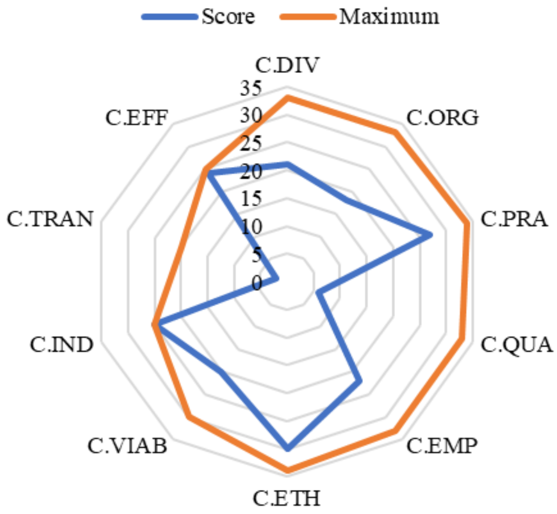

Figure 5. Factors limiting sustainability indicators in the farm No.7

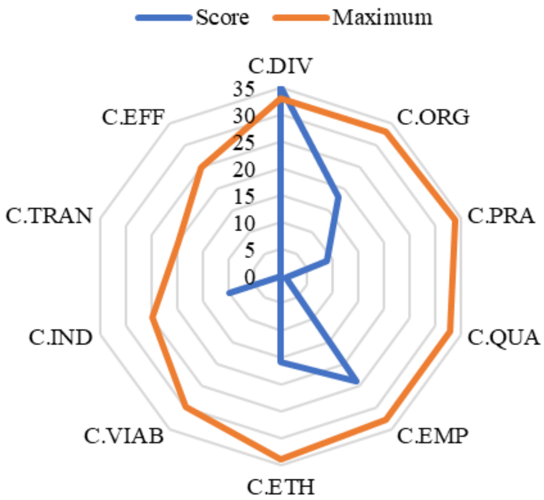

Figure 6. Factors limiting sustainability indicators on the farm N°. 19

"Ethics and Human Development" component and by indicators (C2 and C5) of the "Viability and Transmissibility" components (Figure 5, Table 5).

Minimum score

This is the farm (N°19) that obtained the lowest sustainability score (10 points), (Figure 6, Table 3). Its limiting sustainability factor is to be found, with seriousness, at the level of its economic practices and to a lesser degree at the level of its socio-territorial practices.

The sustainability scores obtained in socio-territorial and economic terms are well below average (41 points, 10 points). However, its agro-ecological practices are highly significant, with an above-average sustainability score (62 points), thanks to the diversity of crops and animals grown on the farm. The limiting factor for this farm's economic sustainability is poor production efficiency, high financial dependency and low economic viability, due to high intermediate consumption. While socio-territorial sustainability is penalized by poor product quality (from B1 to B5), a low contribution to employment and services through low collective work (B10), a lack of contribution to the global food balance (B12) and low labor intensity (B15) (Figure 6).

CONCLUSION

Evaluating the sustainability of the Oued-Righ valley's date palm farms using the IDEA method has enabled us to identify the indicators that contribute to sustainability or are at the root of threats to sustainability through the scores obtained. The indicators that make up the agro-ecological and economic scales contribute strongly to the sustainability of the farms studied. On the other hand, indicators for the socio-territorial scale are limiting factors for the sustainability of these farms.

To enhance the overall sustainability of the farms studied, efforts should focus on improving the indicators that constitute the socio-territorial scale. The indicators requiring particular attention include the management of non-organic waste, social involvement, collective work, and the contribution to territorial development. Non-organic waste should be recycled or repurposed within the farm's various activities. Regarding social engagement, farmers are encouraged to join or establish collective-interest associations where these are absent, to foster mutual support, promote integrated farm management, and contribute to the improvement of their territories.

The IDEA method is easy to use and is suitable for the study region, with some readjustment. However, it still needs to be tested on a larger number of farms and readjusted over time to make it easily applicable and thus help strengthen sustainability on farms in the region that are vulnerable, particularly in terms of natural resources.

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CONFLICT OF INTEREST

The authors declared no conflicts of interest concerning the research, authorship, and publication of this article.

ETHICAL COMPLIANCE

The authors have followed ethical standards in conducting the research and preparing the manuscript.

REFERENCES

Ababsa F.S. (2007): Introduction au cours de socio-économie du développement des régions sahariennes en Algérie. Revue Agroscopie, V1, INRAA. 2eme édition 2007, 207 p.

Ait Hamza M., El Faskaoui B., Fermin A. (2010): Les oasis du Draâ au Maroc. Rupture des équilibres environnementaux et stratégies migratoires. Revue Française de référence sur lesdynamiques migratoires. Pp. 56–69.

Amrani K. (2021): Durabilité des agrosystèmes oasiens: évaluation et perspectives de développement. Cas de la palmeraie d'Ouargla (Algérie). Thèse de doctorat, LaboratoirePacte Territoires, Ecole Doctorale sciences de l'homme, du politique et du territoire. Université Grenoble Alpes. 328 p.

Belmessaoud R. (2011): Durabilité des élevages des petits ruminants dans le contexte saharien,cas de la wilaya d'El Oued, thèse de magister, ENSA, 113 p.

Benaouda M.E.H. (2012): Agriculture oasienne: Situation, tendances et développement in Proceding de l'atelier sur "la sécurité alimentaire et l'agriculture Saharienne. Université Kasdi Merbah Ouargla, les 15 et 16 Février 2012. Pp. 30–41.

Boumaraf B. (2013): Caractéristiques et fonctionnement des sols dans la vallée d'Oued Righ, Sahara Nord Oriental, Algérie. Thèse de Doctorat, Université de Reims Champagne-Ardenne, France, 97 p.

Bouaichi N., Ben Abdellah Y. (2019): Contribution à l'étude morphologique et dégradation du Canal Oued-Righ, partie Sud. Mémoire de Master en Hydraulique. Université Echahid Hamma Lakhdar El-Oued, 86 p.

Cerf M., Damay J., Silier J.P. (1987): La typologie des exploitations. Chambre d'Agriculture 1987, supplément N°743.

Côte M. (1998): Des Oasis malades de trop d'eau? In Cahiers Sécheresse, vol 9, N° 2, pp. 123–130.

Dubost D.(1986): Nouvelles perspectives agricoles du Sahara algérien. In: Revue de l'Occident musulman et de la Méditerranée, N°41–42. Désert et montagne au Maghreb. pp. 339–356.

De Castro J., Sanchez D., Moruzzi P., De Lucas A., Bonnaudo T. (2009): Adaptation de la méthode Française IDEA pour l'évaluation de la durabilité des exploitations agricoles dela commune de Sao Pedro (Etat de Sao Paulo, Brésil). Rencontres autour des Recherches sur les Ruminants 16: 101–104.

Djouhri N., Bouammar B., Dadamoussa M.L. (2022): Evaluation of Sustainability of Phoenicicultural and Market Gardening Production Systems of the Development in the Ouargla Region (Southern Algeria). Al-Qadisiyah Journal for Agriculture Sciences (QJAS) 12: 143–155.

Faci M. (2021): Impacts du changement climatique sur le cycle phénologique du palmier dattier (Cas de Deglet Nour aux Ziban). Thèse de doctorat en sciences agronomiques, université Mohamed Khider, Biskra, 208 p.

Gasmi H., Morardet S., Younsi S., Burte J. (2019): Évaluation de la durabilité des exploitations agricoles familiales par la méthode IDEA à l'amont du bassin versant Merguellil Kairouan, Tunisie. Actes de congrès, 13. JRSS, Journées de Recherche en Sciences Sociales, 2019/12/12–13, Bordeaux (France) Cote: En ligne URL / DOI: https://www.sfer.asso.fr/source/jrss2019/articles/F22_Gasmi.pdf

Gharbi I., Elloumi M., Jamin J.Y. (2022): Influence of land practices on the sustainability of irrigated farms in Tunisia: An analysis using the IDEA method. Journal of New Sciences 88: 4972–4983.

Gibon A. (1994): Dispositifs pour l'étude des systèmes d'élevage en ferme. In Gibon, A. (éd.), Flamant, J.C. (éd.). The study of livestock farming systems in a research and development framework. Proc. of the 2nd International Symposium on Livestock farming Systems. EAAP publications, 1994, n°63, p. 410–422.

Gomgnimbou A.P.K., Coulibaly K., Sanon A., Bacye B., Nacro B.H., Sedogo P.M. (2016): Study of the Nutrient Composition of Organic Fertilizers in the Zone of Bobo Dioulasso Burkina Faso. International Journal of Scientific Research in Science, Engineering and Technology 2: 617–622.

Hamdane A. (2015): Changement climatique et sécurité alimentaire: cas des oasis de la Tunisie. ResearchGate. 22 p.

Hertig P. (2011): Le développement durable: un projet multidimensionnel, un concept discuté. Formation et pratiques d'enseignement en questions, 13: 19–38.

Idder M.A., Idder-Ighili H., Dadamoussa M.L., Belaroussi M.E.H., Boumadda A. (2021): Durabilité des systèmes phoenicicoles (Cas de la région d'Ouargla). Revue des Bio Ressources 11: 55–62.

Ligan Topanou O., Okou C., Boko M. (2015): Durabilité agro-écologique des exploitations agricoles dans la commune de Gogounou au Bénin. Afrique Science 11: 129–137.

Merrouchi L., Bouammar B. (2015): Le fonctionnement de la filière dattes dans la région de Touggourt Sud-est Algérien. Revue El-Bahith N°15, pp. 201–211.

Merrouchi L. (2022): Analyse de fonctionnement des exploitations agricoles oasiennes dans la Vallée de l'Oued-Righ (Sud-est Algérien). Thèse de doctorat ès-science en sciences agronomiques. Université Kasdi Merbah d'Ouargla, 157 p.

Mokhtari S., Helimi S., Mihoub A., Lakhdari K.(2016): L'Oued Righ au défi du changement climatique : quel effet sur les besoins en eau du palmier dattier. Revue Agriculture. Numéro spécial 1: 198 –204.

MADR (2019): Série statistiques B. Direction de Statistiques Agricoles et des Systèmes d'Informations, Ministère de l'Agriculture et du Développement Rural, Algérie.

Mukaka M.M. (2012): A guide to appropriate use of correlation coefficient in medical research. Malawi Medical Journal 24: 69–71.

Pérennes J.J. (1979): Structures agraires et décolonisation. Les oasis de l'Oued-Righ (Algérie). Edition O.P.U, 372 p.

Roumani M.(2020): Impacts du changement climatique sur le niveau de recrudescence des dégâts dus à la pyrale des dattes Apomyelois ceratoniae Zeller, 1839, sur trois cultivars de dattes: Deglet nour, Mech degla et Ghars dans la région de Biskra. Thèse de doctorat en sciences biologiques, université Mustapha Ben Boulaid, Batna 2, 99 p.

Siboukeur A. (2013): Appréciation de la valeur fertilisante de différents types de fumier. Mémoire de fin d'études pour l'obtention du diplôme d'Ingénieur d'Etat en agronomie saharienne. Université Kasdi Merbah-Ouargla, 78 p.

Toutain G., Dollé V., Ferry M. (1990): Situation des systèmes oasiens en régions chaudes. Options Méditerranéennes, Série A: Séminaires Méditerranéens N°11: Les systèmes agricoles oasiens, pp. 7–18.

Viaux P. (1999): Une troisième voie en grande culture – Environnement, Qualité, Rentabilité, Editions Agridécisions. 211p.

Vilain L., Boisset K., Girardin P., Guillaumin A., Mouchet C., Viaux P., Zahm F. (2008): La méthode IDEA: indicateurs de durabilité des exploitations agricoles: Guide d'utilisation. Troisième édition actualisée. Educagri, Dijon, 184 p.

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