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Adaptation of the "Indicateurs de Durabilité des Exploitations Agricoles (IDEA)" method for assessing sustainability of farms in the lower valley of Ouémé River in the Republic of Benin

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Abstract

The *Indicateurs de Durabilité des Exploitations Agricoles* (IDEA) method was adapted and used to study the sustainability of farms in the Ouémé lower valley in the Republic of Benin. The IDEA survey was tested among a sample of farmers, through discussion groups at village level and via interviews with resource staff. The data collected were then subjected to binomial tests and results from the interviews subject to Student *t*-test. The study showed that some units of sustainability in the initial version of IDEA are applicable in the study area without modification. Other units, such as permanent or temporary grassland, were rejected as they were not considered relevant by village assemblies. Some elementary units, such as the spatial units of the same crop (indicator A6: size of plots), were reformulated to meet the local context. Finally, the scores for some sustainability indicators, such as C1 (economic viability), were adjusted to meet the local context. With further modification, the adapted version of the IDEA method could be used in other agro-ecological zones in Benin and Africa.

Keywords

Agricultural holdings, sustainability, indicators, IDEA, lower valley of Ouémé

Introduction

Since the second half of the 1980s, the international community has started to place special emphasis on sustainable development defined as *one that allows the current generation to meet their needs without compromising the ability of future generations to meet theirs* (WCED, 1987). In this context, agriculture is also a subject of concern with a focus on sustainability because of the negative consequences of conventional farming on water, soil, and air pollution and animal and human diseases (Njomaha, 2002). In Benin, agriculture contributes over 36% to the gross domestic product and provides over 80% of export earnings (BAD, 2013). More than 60% of the male workforce and 36% of the active female workforce work in agriculture. Given the importance of agriculture to this country, it is important to examine and identify the factors that could impede sustainability and indicate the means to correct them. It is in this context that a study on the sustainability of agricultural holdings in the Ouémé lower valley in the Republic of Benin was developed.

The method of "Indicateurs de Durabilité des Exploitations Agricoles" (IDEA) was chosen to conduct the sustainability assessment. Developed in France, the IDEA method addresses three dimensions of sustainability, that is, ecological, social, and economic. The method can be applied to all agricultural production systems and provides the ability to compare several agricultural holdings (Vilain et al., 2008; Zahm et al., 2008). Several researchers have used it to assess the sustainability of farms in different contexts in Algeria (Bekhouche-Guendouz, 2011; Benatallah et al., 2013; Bir and Benidir, 2005; Ghozlane et al., 2010;

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M'hamdi et al., 2009) and Lebanon (Srour, 2006). However, before using the IDEA method, it is necessary to adapt it to local conditions because of differences between the context of French agriculture and that of the study area.

Methodology

Study area

The lower valley of Ouémé (Figure 1) is located between 6°28′ and 6°56′ North latitude and 2°22′ and 2°35′ East longitude (Dossou-Bodjrenou et al., 2006). It covers 1193 km^2 and is a wide topographic depression connected downstream to the area formed by the lagoon of Porto Novo and Lake Nokoué. The area is characterized by two large morphological complexes: the plateau bar land and the floodplain (Pélissier, 1963). The Ouémé lower valley has an equatorial transitional or equatorial Guinean climate with two rainy seasons and two dry seasons. The main rainy season runs from April to July. Floodplains are exploited after flood recession and during the main rainy season, while the plateau land is exploited in two rainfed cropping cycles for both large and small rainy seasons (MAEP, 2013). Flooded land is fertile because of alluvial deposits during the flood, while the plateau land is more or less degraded and the soil fertility is low. The majority of farms are family and traditional type (80%), small (0.25 ha to 1–2 ha), and farm work is almost exclusively manual. The labor force is largely family oriented with a growing tendency to resort to paid labor because of the rural exodus, which is increasing year on year.

Brief presentation of IDEA method

The IDEA method has three sustainability scales each rated with a maximum score (100). The agro-ecological sustainability scale analyzes the ability of an agricultural system to be more or less autonomous for the use of energy and nonrenewable resources. It consists of three components (diversity of production, organization of space, and farming practices) and has 18 indicators (Zahm et al., 2008). The socioterritorial sustainability scale characterizes the integration of the farm within its landscape and society. It consists of three components (quality of products and land, employment and services, ethics and human development) and has 18 indicators. The economic sustainability scale is an economic barometer that helps to understand the economic performance of the farm. It consists of four components (economic viability, independence, transferability, and efficiency) and has six indicators (www.idea.portea.fr). Each component is also limited to a ceiling value (33 or 34 points on the two first scales and 20 or 30 points for the economic scale). These indicators are composed of elementary units of sustainability which can be either quantitatively based on calculations or qualitative. Each indicator has a lowest value equal to zero and a ceiling value, as are the components and scales. The final numerical value of sustainability is the lowest value of the three sustainability scales, thus applying the limiting factors rule in ecosystem dynamics (Zahm et al., 2008).

Checking the validity of the original IDEA method

The original IDEA method was administrated on 50 farmers randomly drawn representing 13% of the 384 farmers selected for the sustainability study, in order to verify the applicability of the elementary units of sustainability. The results were subjected to a binomial test. Using these results, if a basic unit was considered to be applicable by more than 50% of the surveyed farmers (the majority of farmers surveyed), then it was deemed to be applicable in the majority of cases and retained in the adapted version. Otherwise, it was not retained at this stage.

Organization of discussion groups at village level

A discussion group was organized in each of the 25 investigation villages with participation of the village extension agent. In these village assemblies, the units rejected after the validity step above, were presented, and were explained. Participants commented on the relevance of these basic sustainability units to approve or disapprove the adequacy of their use to assess the sustainability of their holdings. A summary of opinions for each unit was made and validated in each of the focus groups. The basic unit of sustainability was rejected if it was not approved by more than 50% of village assemblies. Otherwise, it is reintegrated into the adapted version. The binomial test based on the z-statistic was used. Having participated in all these meetings, it was then necessary to reformulate the units of sustainability in the adapted version.

Interviews with resource staff

Due to the removal of some units and characteristics of the production systems in the study area, it was necessary to adjust some of the scores for selected indicators. This was a complex operation that required some expertise. Staffs with detailed knowledge of agriculture in the study area were consulted. Proposed by their institutions, these included staff responsible for rural development, technical directors of Regional Centers for Rural Development of Ouémé-Plateau and Atlantique-Littoral, researchers from the National Institute of Agricultural Research of Benin, and lecturers from the University of Abomey-Calavi. Discussions were carried out to reallocate the scores to the relevant indicators. The proposed weights were then submitted to conformance testing (Student t-test with a sample) and compared with the initial weights. The average weight for an indicator showing a significant difference from the initial weight was proposed in the adapted method.

Results

Elementary units of sustainability of the initial version applicable without change

In its initial version, the IDEA method contains 129 elementary units of sustainability. The test revealed that 87 (67%) were applicable in the study area without change (Table 1). For the agro-ecological sustainability scale where the proportion of validation was 61%, the

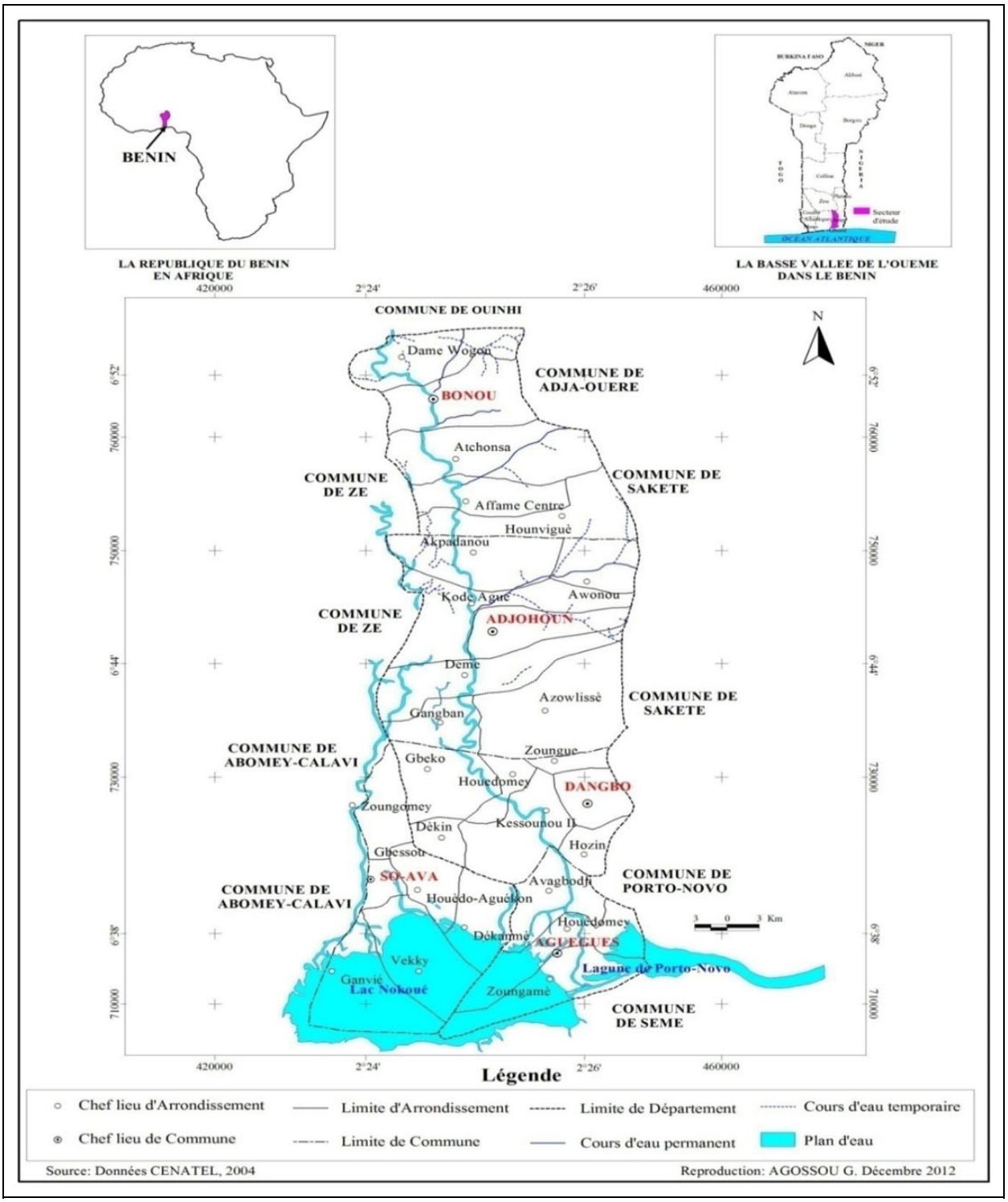

Figure 1. Location of the Ouémé lower valley in Benin.

elementary units were related to the diversity of annual and temporary crops, the diversity of perennial crops, crop rotation, and management of organic matter. Agriculture is rainfed and farmers diversify their production to cope with the vagaries of the climate. For the socioterritorial scale, the proportion of validated units was 69%. A number of units such as biological agriculture, the accessibility of the land, and the farmer's social conditions were relevant in the study area. For the economic scale, a large proportion of elementary units were applicable (88%). They concern the proportion of incomes brought by the most important of activities or by the largest customer, financial dependence, economic transferability, and efficiency of production processes by the farmer.

Elementary units of sustainability reformulated

A summary of views expressed at village meetings revealed that 20 of the basic units (16%), although not retained after testing the initial version of IDEA among a

Table 1. Results from the elementary units of sustainability adaptation process.

Scale	Component	Number of indicators	Number of elementary units	Elementary units validated after testing on farm		Elementary units reformulated		Elementary units removed	
				Number	%	Number	%	Number	%
Agro-ecological	Domestic diversity	4	11	10	91	–	–	1	9
	Organization of space	7	21	9	43	5	24	7	33
	Farming practices	7	30	19	63	3	10	8	27
	Total	18	62	38	61	8	13	16	26
Socioterritorial	Quality of the products and land	5	17	13	76	1	6	3	18
	Employment and services	6	27	17	63	8	30	2	7
	Ethics and Human Development	7	15	11	73	2	13	2	13
	Total	18	59	41	69	11	19	7	12
Economic	Viability	2	4	3	75	1	25	–	–
	Independence	2	2	2	100	–	–	–	–
	Transferability	1	1	1	100		–	–	–
	Efficiency	1	1	1	100	–	–	–	–
	Total	6	8	7	88	1	13	0	0
Total (all scales)		42	129	86	67	20	16	23	18

sample of agricultural holdings, were nonetheless applicable to farms in the Ouémé lower valley (Table 1). Their use, however, required reformulation. The proportion of such units was 13% for the agro-ecological scale, 19% for the socioterritorial scale, and 13% for the economic scale. Table 2 presents the list of units and proposed reformulations. For agro-ecological scale (indicator A6: plot sizes), instead of 6–16 ha in the initial version, the spatial units of the same crop to be considered were 0.1–0.6 ha to reflect the limited availability of agricultural land and the fact that farmers cultivate a lot of crops on an area of less than 1 ha. The elementary unit of sustainability "if compliance with a territorial specification covering less or more than 50% of the useful agricultural area" (indicator A9: contribution of environmental issues of territory) was reformulated to "compliance with the obligation, in the event of clearing, to leave 25 trees/ha and to practice agroforestry with the food crops." In the villages investigated, they usually do not report where the environmental issues are recorded; therefore, the proposed units were the ones used by the forest administration.

For the socioterritorial scale, because of their imprecise and subjective nature, some elementary units were reformulated (those for which scoring depends solely on the farmer's opinion). Instead of the estimation by farmers concerning the existence or disappearance of holdings in 10 years (indicator B11: probable sustainability), it was proposed that the number of children enrolled in agricultural training schools, the prohibition of sales of agricultural land, and the number of children withdrawn from school by their parents due to rural work. Concerning indicator A16 (quality of life), it was proposed to look at objective aspects such as the quality of the habitat (nature of building materials), hygiene of the habitat (cleanliness), and mode of transport (bicycle, motorbike). In the study area, farmers do not account their activities, so it is difficult to estimate their revenue and production costs. Therefore, the assessment of the gross operating surpluses provided in the initial version of IDEA to calculate C1 indicator was difficult to obtain. This unit was reformulated to the annual farm income compared to the poverty line in the area to determine whether the income provided the farmer with a living wage.

Selecting and removing sustainability units

The village assemblies rejected 23 of the 129 elementary units of sustainability (18%). The proportions removed were 26% from the agro-ecological scale and 12% from the socioterritorial scale. No units were removed from the economic scale (Table 1). Table 3 summarizes the reasons for their removal. The units related to forage crops were removed in indicator A2 (diversity of perennial crops), A6 (size of plots), A8 (ecological regulation zone), and A11 (management of fodder areas), because the livestock production systems in the Ouémé lower valley are extensive. Farmers do not grow forage crops, and the animals are mainly fed on open land and receive some supplements from crop residues. The quantities of food purchased are so low that the "import rate," the unit indicator B12 (contribution to world food balance), is removed. The agricultural production system in the study area is also mainly unmechanized. Tractor use is very marginal. As a result, there is no requirement for farmers to purchase fuel for field operations. At the moment, farmers do not use energy sources such as photovoltaic and wind turbines. Consequently, the units "oil equivalent per hectare," "photovoltaic, wind turbine, and biogas," and "pure vegetable oil" were removed from indicator A18 (energy dependence). The integration between livestock and crop production is limited. Farmers raising animals do not take advantage of the opportunities offered by their animals to improve the fertility of agricultural land, for example, by constructing infrastructure that enables them to recover liquid organic effluents to fertilize their land and the manufacture of biogas as a source of energy on farm. Two basic units in indicator A13 were therefore removed.

Table 2. Reasons for reformulating the elementary units of sustainability.

Scale	Indicator	Sustainability elementary unit	Reformulation
Agro-ecological	A6: Size of plots	No spatial unit of the same crop (plot) with a dimension greater than 6, 8, 10, 12, and 16 ha	No spatial unit of the same crop (plot) with a dimension greater than 0.1, 0.2, 0.3, 0.4, 0.5, and 0.6 ha
		If average size is less than or equal to 8 ha	If average size is less than or equal to 0.3 ha
	A8: Ecological regulation zone	% of useful agricultural area in ecological regulatory area	Presence of fallow plots on farm
	A9: Contribution to environmental issues of territory	If compliance with a territorialized specification covering less or more than 50% of the useful agricultural area	Compliance with the obligation to practice agroforestry with the food crops in the event of clearing
			Compliance with obligation to leave 25 trees/ha in case of clearing
	A10: Valorization of space	Loading herbivore and granivore	Feeding poultry mainly from (1) crop products and by-products of the holding, (2) free ranges, and (3) food purchases
			Feeding pigs and small ruminants mainly from (1) crop products and by-products of the holding, (2) free ranges, and (3) food purchases
	A12: Fertilization	Apparent nitrogen balance	Urea supply
	A13: Liquid organic effluents	Wastewater treatment, composting	Composting
	A17: Water resource management	Irrigation and/or antifreeze device	Irrigation device
Socioterritorial	B4: Space accessibility	Fencing devices and free access to hikers, mountain bikes, horses	Accessibility of agricultural space by trails or tracks, by water or by roads
	B6: Short trade	For each 5% of the ratio: value of direct sales (excluding aid)/turnover (excluding aid)	Sales to local consumers, intermediaries (local market traders), traders in the territory, traders coming from outside the territory, to different customers coming from the territory alone, to different customers in the territory and outside the territory
		Proximity sales	
	B8: Services, multi-activities	Practices of integration or social experiments (pre-employment, professional pre-employment)	Number of family assets that subsequently created their own farms
	B9: Employment contribution	Ratio: useful agricultural area/human work unit (more than 125 ha/UTH, between 50 ha/UTH and 125 ha/UTH, between 20 ha/UTH and 50 ha/UTH, and less than 20 ha/UTH	Ratio: Useful Agricultural Area/familial asset (more than 1 ha/familial asset, between 0,75 and 1ha/familial asset, between 0,5 and 0,75 ha/familial asset, between 0,25 and 0,5 ha/familial asset and less than 0,25 ha/familial asset)
	B11: Probable sustainability	Existence of almost 10 years of operation	(1) Number of children enrolled in agricultural training schools, (2) prohibition of sales of agricultural land, (3) none of the two modalities (probable disappearance in 10 years), and (4) number of children withdrawn from school by their parents due to rural work (negative note)
		Probable existence	
		Existence if possible	
		Probable disappearance of exploitation in 10 years	
	B12: Contribution to the world food balance	Production of protein plants on >30% of useful agricultural area	Production of protein plants for livestock feeding on (1) 0–10% of the total area, (2) more than 10–20% of the surface, (3) more than 20–30% of the total area, and (4) more than 30% of the total area
	B16: Quality of life	Self-estimation by farmer	(1) The quality of the habitat (nature of building materials), (2) the hygiene of the habitat (cleanliness), and (3) the state of the transport means (bicycle, motorbike)
Economic	C1: Economic viability	VE = (Gross operating surplus-financial needs)/unpaid human work unit	Gross annual income of the farmer compared to poverty line in area

Table 3. Reasons for the removal of elementary units of sustainability.

Scale	Indicator	Sustainability unit removed	Main reasons
Agro-ecological	A2: Diversity of perennial crops	Permanent grassland and/or temporary grassland over 5 years:	Extensive livestock production system. The absence of forage crops and the animals are mainly fed on the open course
	A6: Plot sizes	If only natural meadows, paths and/or mountain pastures	Extensive livestock production system. The absence of forage crops and the animals are mainly fed on the open course
	A8: Ecological regulation zone	Permanent grasslands on floodplains (undrained or amended), ripisylve	Extensive livestock production system. The absence of forage crops and the animals is mainly fed on the open course
		Terraces, stone walls maintained	Unknown in the agricultural holdings surveyed
		Nonmechanizable routes, mountain pastures (if actual grazing)	Extensive livestock production system. The absence of forage crops and the animals are mainly fed on the open course
		Existence of a map locating the main environmental issues	A map locating the main environmental issues does not exist in the study area
	A11: Management of fodder areas	Permanent grassland greater than 30% of useful agricultural area	Extensive livestock production system. The absence of forage crops and the animals are mainly fed on the open course
		Area occupied by corn silage	Extensive livestock production system. The absence of forage crops and the animals are mainly fed on the open course
	A12: Fertilization	Nitrate trap crops on at least 10% of the useful agricultural area	The agricultural holdings of the survey area are traditional and have no information about the nitrate trap crops
	A13: Liquid organic effluents	Individual aerobic biological treatment of effluents with approved spreading only on the farm's surface	Insufficient integration between livestock and crop production (no infrastructures that enable to recover liquid organic effluents or to produce biogas)
		Collective treatment of effluents with approved spreading plan	Insufficient integration between livestock and crop production (no infrastructures that enable to recover liquid organic effluents or to produce biogas)
	A16: Soil resources protection	Permanent grassland or vegetation cover at least 11 months out of 12 months	Extensive livestock production system. The absence of forage crops and the animals are mainly fed on the open course
	A17: Water resource management	Irrigation by pivot or frontal ramp	Predominant rainfed agriculture. Poor control of water for the benefit of agriculture despite the availability of water in the area. Very few farmers have irrigation schemes on their farms
	A18: Energy dependence	Oil equivalent per hectare	Very little mechanization of agricultural production. Tractor use is very marginal or nonexistent in the study area (no requirement to purchase gasoline or gas oil for field operations
		Photovoltaic, wind turbine, biogas	Very little mechanization of agricultural production. Tractor use is very marginal or nonexistent in the study area (no requirement to purchase gasoline or gas oil for field operations
		Pure vegetable oil	Very little mechanization of agricultural production. Tractor use is very marginal or nonexistent in the study area (no requirement to purchase gasoline or gas oil for field operations
Socioterritorial	B1: Quality approach	Linked to the process (red label, ISO 14000, ...)	In the agricultural holdings investigated, the quality approach applicable are Geographical Indication (GI) and Appellation of Controlled Origin (ACO)
	B3: Inorganic waste management	Selective sorting and elimination by collective collection	Insufficient integration between livestock and crop production (no infrastructures that enable to recover liquid organic effluents or to produce biogas)
		Plasticulture, enrubannage	Plasticulture and enrubannage are practices unknown by the farmers in study area
	B10: Collective work	Employers' group	The agricultural holdings of Ouémé Valley are generally poorly equipped family farms. The main objective is self-sufficiency in the household. They offer no real job opportunities except for family assets

(continued)

Table 3. (continued)

Scale	Indicator	Sustainability unit removed	Main reasons
		Networking	The agricultural holdings of Ouémé Valley are generally poorly equipped family farms. The main objective is self-sufficiency in the household. They offer no real job opportunities except for family assets
	B12: Contribution to the world food balance	TI = import rate = (area imported × 100)/useful agricultural area	Extensive livestock production system. The absence of forage crops and the animals are mainly fed on the open course
	B14: Training	Reception of paid trainees (more than 10 days per year)	The agricultural holdings of Ouémé Valley are generally poorly equipped family farms. The main objective is self-sufficiency in the household. They offer no real job opportunities except for family assets

Table 4. Score adjustment for selected indicators.

Scale	Components	Indicator	Number of respondents	Average new weighting	Standard deviation	Value and *t* Sig.	Initial weight
Agro-ecological	Farming practices	A16: Soil resource protection	31	10 (9.34; 10.65)	1.862	14.952***	5
		A18: Energy dependence	31	5 (4.34; 5.65)	1.862	−14.952***	10
Socioterritorial	Ethics and human development	B12: Contribution to world food balance	31	5 (4.21; 5.78)	2.236	−12.450***	10
		B13: Animal welfare	31	8 (7.21; 8.79)	2.236	12,450***	3
Economic	Economic viability	C1: Economic viability	31	50.32 (47.96; 52.68)	6.7	25.198***	20
	Independence	C3: Financial autonomy	31	10 (8.49; 11.51)	4.282	−6.502***	15
		C4: Sensibility on subsidies	31	5 (3.89; 6.11)	3.162	−8.803***	10
	Transferability	C5: Economic transferability	31	10 (8.98; 11.02)	2.887	−19.287***	20
	Efficiency	C6: Efficiency of the productive process	31	14.68 (13.32; 16.04)	3.859	−14.893***	25

Note: *** denotes significance at the 1% level.

Score adjustment for selected indicators

Two main reasons determined the adjustment of weights for 9 of 42 (21%) indicators in the initial IDEA version: firstly, the need to remove some important units and secondly, to accommodate the characteristics of the agricultural holdings in the study area (Table 4). Decreasing the score for indicator A18 (energy dependence) from 10 to 5 was motivated by the need to remove the main unit of sustainability "oil equivalent per hectare" similarly for indicator B12 (contribution to the global food balance). For the economic scale, the scores for three indicators were decreased in favor of indicator C1 (economic viability) which had its score increased from 20 to 50. This was due to four characteristics of the farms in the study area. The lack of accessibility of farmers to credit due to conditions they could not fulfill (guarantees and interest rates) leads to low debt ratios. The lack of aid to farms means that they have very low levels of aid. Characterized by a small amount of capital, they have a relatively low ratio of operating capital per family asset. Finally, given the low levels of inputs used, farms have relatively high efficiencies. All these characteristics give them very high scores for C3, C4, C5, and C6 which artificially inflated their score on the economic scale to the detriment of indicator C1, which was the most important indicator for the economic sustainability of the farm.

Adapted version of the IDEA method to the Ouémé lower valley

This research helped to develop a version of the IDEA method adapted to the specific conditions in the lower valley of Ouémé river (Table 5). It was based on units of sustainability validated or reformulated and weight adjustments of indicators. The context and the specific characteristics of the area's agricultural holdings were the main reasons why changes were implemented. This adapted version maintains the three sustainability scales (all rated at 100), the 10 components with their initial distribution between scales, and the number of indicators (42). Scoring adjustments of 9

Table 5. IDEA version adapted to the Ouémé lower valley.

Agro-ecological scale			Socioterritorial scale			Economic scale		
Component	Indicator	Range	Component	Indicator	Range	Component	Indicator	Range
Domestic diversity	A1: Diversity of annual and temporary crops	0–14	Quality of the products and land	B1: Quality Policy	0–10	Viability	C1: Economic Viability	0–50
	A2: Diversity of perennial crops	0–14		B2: Enhancement of buildings and landscape heritage	0–8		C2: Economic specialization rate	0–10
	A3: Animal Diversity	0–14		B3: Inorganic waste management	0–5	Independence	C3: Financial autonomy	0–10
	A4: Valorization and conservation of genetic resources	0–6		B4: Space Accessibility	0–5		C4: Sensibility on subsidies	0–5
Organization of space	A5: Crop rotation	0–8		B5: Social involvement	0–6	Transferability	C5: Economic transferability	0–10
	A6 Size plots	0–6	Employment and services	B6: Short trade	0–7	Efficiency	C6: Efficiency of the productive process	0–15
	A7: Organic matter management	0–5		B7: Autonomy and development of local resources	0–10			
	A8: Ecological regulation zone	0–12		B8: Services, multi-activities	0–5			
	A9: Contribution to environmental issues of territory	0–4		B9: Employment contribution	0–6			
	A10: Valorization of space	0–5		B10: Collective work	0–5			
	A11: Management of fodder areas	0–3		B11: Probable sustainability	0–3			
Farming practices	A12: Fertilization	0–8	Ethics and human Development	B12: Contribution to the world food balance	0–5			
	A13: Liquid organic effluents	0–3		B13: Animal welfare	0–8			
	A14: Pesticides	0–13		B14: Training	0–6			
	A15: Veterinary treatments	0–3		B15: Work intensity	0–7			
	A16: Soil resources protection	0–8		B16: Quality of life	0–6			
	A17: Water resource management	0–4		B17 Isolation	0–3			
	A18: Energy dependence	0–5		B18: Reception, hygiene and safety	0–4			

IDEA: Indicateurs de Durabilité des Exploitations Agricoles.

sustainability indicators do not affect the balance of component scores from 33 to 34 points for the first 2 scales. For the four components on the economic scale, the adjustment of scores gives the viability's component a weighting that accounts for 60 out of 100.

Discussion

The adapted version of the IDEA method for evaluation of the sustainability of farms in the Ouémé lower valley was obtained following a process involving four successive stages including validation, reformulation, removal of elementary units, and reviewing the weighting indicators. The reasons for these changes are linked to the specific attributes of the agricultural holdings of the study area. These include (i) extensive livestock production system, (ii) little integration of agriculture and livestock in the study area, (iii) rainfed agriculture characteristics of the study area, (iv) low mechanization levels, (v) food security of members as the main production objective of farms that are poorly equipped and remain essentially poor, (vi) societal issues and low levels of farmer knowledge, and (vi) the lack of obtaining reliable statistics on production, processing, and trade. One of the important factors concerned C1 (economic viability) which seemed very low compared to other indicators on the economic scale. Indeed, the economic

viability of a farm is one of the pillars of sustainable agriculture (Bir, 2008; Landais, 1998).

To assess the sustainability of dairy cattle farms in Mitidja and Annaba, Bekhouche-Guendouz (2011) also adapted some indicators in the IDEA method by modifying or removing some units that did not fit the local context. Among the reasons for their changes were the characteristics of the Mediterranean climate with irregular rainfall forcing farmers to adopt specific practices for irrigation and soil protection. They reviewed the weighting of indicators A12 (fertilization), A13 (liquid organic effluents), A14 (pesticides), A16 (protection of soil resources), A17 (management of water resources), and B13 (animal welfare). Casto et al., (2009) evaluated the sustainability of farms in the Municipality of Sao Pedro (Brazil) using 17 of 42 indicators without any modification, amending 21 and removing 4 because of difficulties in accessing raw data for calculating indicators and consideration of the tropical agricultural practices in Brazil (sugarcane silage).

Due to the different situations of agriculture in France and Lebanon such as farm transmission mode based on the sale in France and inheritance in Lebanon, Srour (2006) implemented a number of changes in the structure of indicators and their scoring. To apply the IDEA method in evaluating the sustainability of breeding dairy cattle in the semiarid area of Algeria Setif, BIR (2008) modified the structure of certain indicators because of difficulties in accessing economic data and the lack of references for calculation of indicators A12 (Fertilization), A17 (water resource management), and C5 (economic transferability). Due to the similarity of the agroclimatic and economic conditions, the adapted IDEA version developed in this research would also be applicable for fisheries in the lower valley of Ouémé river (PNUD and MEPN, 2008) and other agro-ecological zones of Benin, with slight modification. In the cotton zone of northern Benin, for example, which is characterized by larger and more mechanized farms, reformulation of indicators A6 and C5 would be required. In the Côte d'Ivoire, Ghana, Guinea, Guinea-Bissau, Liberia, Sierra Leone, and Togo, characterized by shifting cultivation with low inputs as observed in Benin (FAO, 1996), this version could be used with slight modifications. The reasons that governed the changing of weighting for some indicators should be similar for equivalent agro-ecological zones in Benin and West Africa.

Conclusion

This study made three types of amendments to the IDEA method with a view to develop a version adapted to the context of the Ouémé lower valley: firstly, the removal of units that were shown to be inapplicable during the test of the initial version and rejected by the village assemblies of farmers. These units were primarily related to permanent grassland, energy dependence, inorganic waste management, and import rate of aliments purchased from other parts of the world to feed animals; secondly, reformulation of basic units due to their imprecise and somewhat subjective nature and units for which scoring solely depended on farmer's self-estimation (dimensions of plots, proximity sales, probable existence, or disappearance of holdings); and finally, changing the scoring of indicators such as A16, A18, B13, B12, C1, C3, C4, and C5 to better reflect the specific conditions of the study area. The modified version is considered appropriate for use in other agro-ecological zones in Benin and in Africa where similar conditions exist, although some modifications may be necessary.

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