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RESEARCH ARTICLE

PARTICIPATORY IMPACT ASSESSMENT OF WATER AND SOIL CONSERVATION POLICY IN SOUTH-EAST OF TUNISIA OUM ZESSAR WATERSSHED: MÉDENINE

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Abstract

Sustainable development of land use is determined by changes of the regional supply of Land Use Functions (LUFs) and the demand of future societal land use claims. LUFs are based on the ecosystem services concept, but more adapted to human land use. In this paper, we assessed 3 land-use scenarios towards sustainable development in south est tunisia in order to understand their impacts on LUFs and land use claims. For this, we extended an analytical framework designed to confront LUFs with land use claims identified in multi-level stakeholder strategies in a participatory manner.

Introduction:-

Haracterised by the dilemma of extreme scarcity and instability of the offer and increase of the water resources in the arid regions. These regions know strong pressures which threaten seriously their durability. This situation made of these resources true economic goods requiring new approaches, analysis and management tools. Taking account of the complex character and of multi uses of the water resources, unidimensional and fragmentary approaches of water resources management reached their limits (Auger and al, 2004). This translates the interest to develop integrated approaches of management which consider the watershed as a relevant unit of management. There are many references which adopt this approach by watershed (Gangbazo, 2004; OECD, 2004). Further more, the international conferences on water and environment in particular that of Rio de Janero in 1992 and the 3rd world forum of water held in Kyoto in 2003 called to the adoption of this approach. The OECD recommends to the countries members "to apply the integrated approaches by watershed and by ecosystem ". Which orientation constitutes one of the key elements for an effective water management (OECD, 2004). Otherwise, the interest to consider watershed as a unit of management resides at the fact of being able to take into account of the whole of the activities and their impacts (Auger and al, 2004). This unit also permits to seize interactions between hydrological, climatic, biological and social phenomena (Chaibi and al., 2003; Auger and al., 2004; Graff, 1996; Sghaier and al., 2003; Ouessar and al., 2003; Mahdhi and al., 2004). This paper tries to present the results of FoPIA application in Oum Zessar. This paper reports on a participatory impact assessment of alternative soil and water conservation (SWC) scenarios in the Oum Zessar watershed, Tunisia. The first objective was to assess the impact of three SWC scenarios on key social, economic and environmental land use functions. The second objective was to test and evaluate the applicability of the 'Framework for Participatory Impact Assessment (FoPIA)' for assessing scenario impacts in the context of a developing country, in this case Tunisia. The assessed scenarios included: the originally planned SWC policy implementation at 85 % coverage of potential area of the watershed, the current implementation (70 %), and a hypothetical expansion of SWC measures to the entire potential area (100 %). Our results suggest that implementation of the SWC policy at 100 % coverage of potential area achieves the maximum socioeconomic benefit. However, if stakeholders' preferences regarding land use functions are taken into account, and considering the fact that the implementation of SWC measures also implies some negative changes to traditional

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landscapes and the natural system, SWC implementation at 85 % coverage of potential area might be preferable. FoPIA approved to be a useful tool for conducting a holistic sustainability impact assessment of SWC scenarios and for studying the most intriguing sustainability problems while providing possible recommendations towards sustainable development. We conclude that participatory impact assessment contributes to an enhanced regional understanding of key linkages between policy effects and sustainable development, which provides the foundation for improved policy decision making.

Principal scientific questions related to the watershed of Oum Zessar:

The Oum Zessar Watershed is located in south-east of Tunisia in Medenine governorate with 36000 ha surface area and around 24000 inhabitants (Figure 1). This site is part of Tunisian Jeffara that presents a lower arid Mediterranean climate and a 160 to 220 mm average rainfall per year with an average of 30 days of rain. Analysis of precipitation regime and deficit of water, from rainfall series of 27 years (1976-2003) collected from weather stations installed in the study area, shows that the local climate is characterized by an inter-annual and seasonal irregularity and variability of rainfall. The rainfall frequency analysis shows that 33 per cent of years (within the period of 27 years) are very dry to dry, 25 per cent are normal and 42 per cent are wet to very wet years. This analysis shows also that drought happens generally once, twice or three times every four years (reference???). The alternation of dry and wet years has impacts on local actors and population strategies in these arid zones. The annual average temperature on the period of 27 years at Oum Zessar (1976-2003) is 20°C. June, July and August are the warmest months with an average temperature of 26°C. The coldest months are December, January and February with an average temperature of 12°C. Water resources are a major constraint for pastoral (sheep and goats) and agricultural (cereals and tree cultivation) activities. In the study area, we distinguish between two types of water resources: surface and ground water. The surface water resources are constituted by the runoff. Given the general weakness of rainfall, the volume of runoff water is low. Even during the rainy season, the low rainfall does not allow to generate real river networks at the watershed. In the governorate of Medenine, this volume is estimated at 16 million m^3 per year. Approximately, 11 million m^3 are mobilized (68 per cent) by water harvesting techniques, or recharge wells or with cisterns. Nearly 30,000 cisterns in the Governorate of Medenine can store nearly 1 million m3. The scarcity of superficial water in Tunisian arid zones is relatively compensated by the underground water resources. The south of Tunisia, which is rich in aquifers, stores in fact 25 per cent of water reserves of Tunisia. The deep aquifers constitute the most important resources in the Tunisian dry lands, especially in the Governorate of Medenine. But, these deep aquifers represent a very low renewal rate and a poor chemical quality of the water. The high costs induced by the mobilization and transfer of these waters appear as factors limiting their exploitation. The mobilization of the water of these aquifers is realized more often from deep wells for irrigation, or drinking or used in industries and tourism sector. This site is a typical agro-pastoral interlocked area with the gradual and in some areas accelerated expansion of cropland at the expense of the natural rangelands. In fact it has very significant eco-environment vulnerability, degraded vegetation in rangelands, intensification of agricultural use in plain areas which have led to water resources overuse and to land degradation. This region has been a target area of the main national strategies for natural resource and combating desertification (water and soil conservation, water resources, and rangelands, wind erosion, rural development). Main desertification issues are Human pressure having markedly increased in recent years due to changes in socio-economic policies. The impact of this has been an increasingly irrational use of natural resources: i) Accelerated expansion of rainfed agricultural (especially olive tree and annual crops, cereals, and irrigation system), ii) Significant change of agrarian system and land use, and iii) Development of multi sectors activities for income generation (urbanization, services, migration etc.).

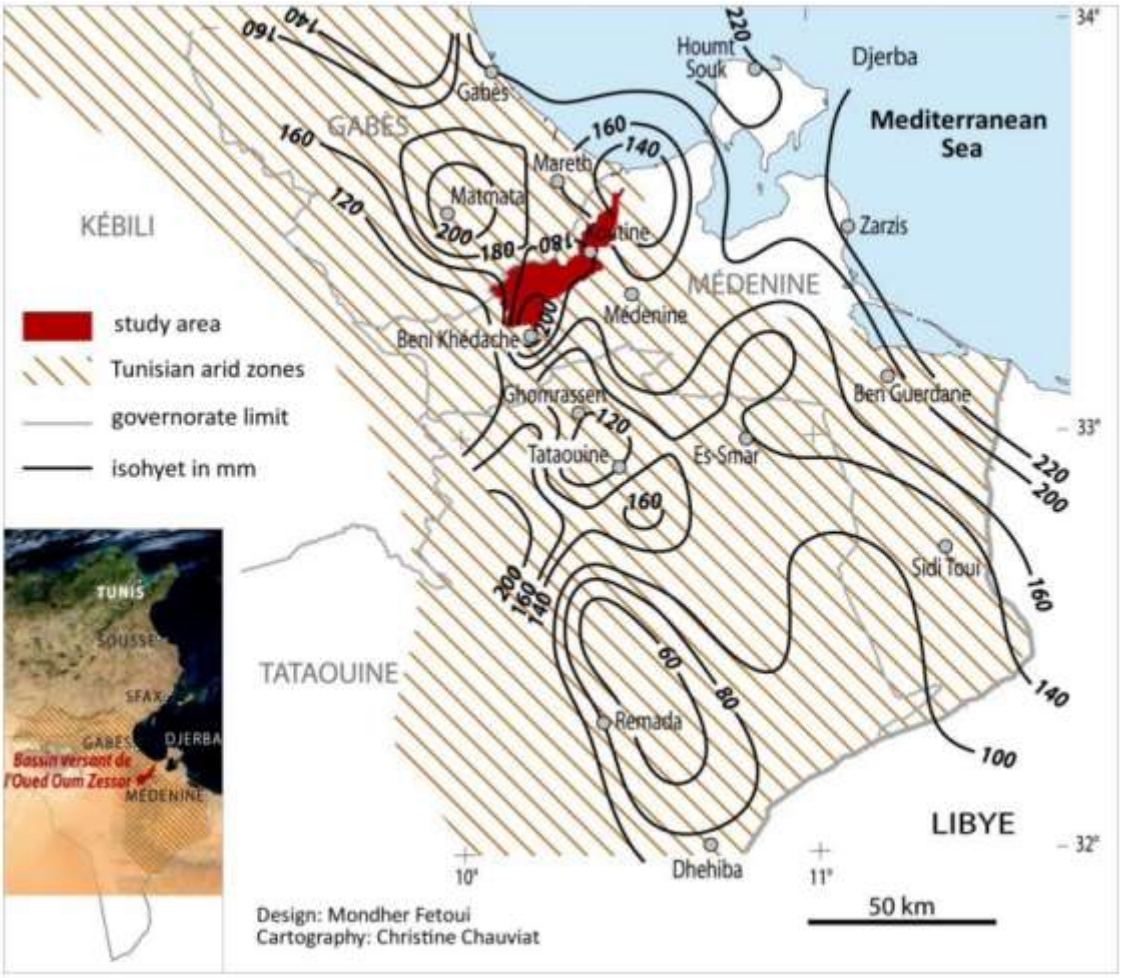


Figure1:- Geographic localization of the watershed of Oum Zessar in the south-east of Tunisia.

Principal scientific questions have been raised by the research developed on the watershed of Oum Zessar. They can be synthesized as follows:

the hydrological, physics and socio-economic impact assessment of water and soil conservation program (decennial strategy 1990-2000) in the watershed of Oum Zessar is still unknown and not assessed. This assessment constitutes a priority of the public services in order to ensure desired durability. The multidimensional, multi space and inter temporal nature of this evaluation encounters several methodological difficulties which it is necessary to surmount.

the need to take into account the externalities between users and actors at the various compartments of the watershed from the upstream to the downstream area.

the problems related to the distribution of the water resources between sectoral users.

the water use and access modes of the local actors in rural zones are not sufficiently known neither in the operation plan nor in the rules plan which govern them. The interactions and the negotiations between economic and social agents within micro watersheds deserve to be apprehended within integrated and interactive management system.

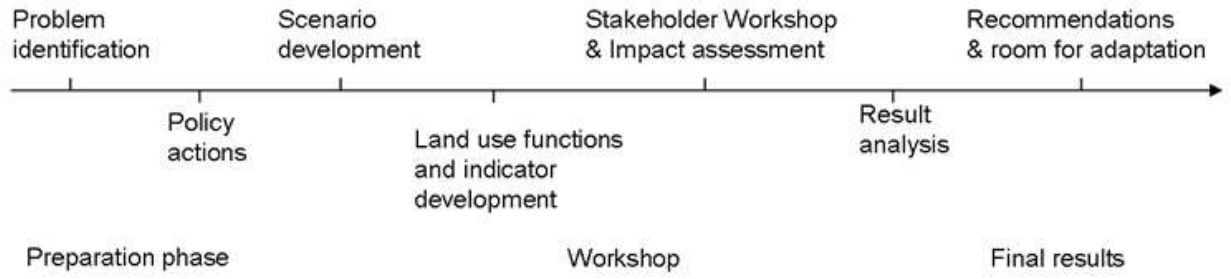
the economic efficiency of the agricultural production units in relation to the water resources also deserves to be evaluated.

Research approach and developed methodological tools:
Oum Zessar watershed is characterized by the aridity of the climate, and the fragility of the plant communities. The agrarian system itself is characterised by the coexistence of irrigated and dry agriculture (cereal, fruit, etc.) with rangeland. Conversely, land uses have changed with the privatization of the traditional collective lands and the evolution towards a more intensive agro-pastoral system. Due to the increased human needs and the development of agriculture, the pressure on natural resources, and particularly on land resources, is becoming higher and higher. This pressure induces land degradation and a significant decrease of crop yield. The sedentarisation of pastoralism and an accelerated land privatization, as well as governmental subsidies for some new agricultural activities like irrigated agriculture, have caused land fragmentation and increasing pressure on the land. Environmental threats and the progressive degradation of natural resources pose critical impacts to sustainable development, particularly in the arid regions of Tunisia. Oum Zessar watershed aces severe land degradation problems due to limited water resources, growing population, increasing land competition and agricultural intensification (Ouessar et al. 2009; Schiettecatte et al. 2005). In response to ongoing degradation problems, the Tunisian government has invested 562 million Dinars (= US $389 mil) since 1990 on soil and water conservation (SWC) measures at the national level (Sghaier et al., 2009). The major goals of the SWC policy are to tackle land degradation in a vulnerable environment and to enhance the capacity of the land for agricultural production through the promotion of both traditional and modern water-harvesting techniques (Ouessar et al. 2009). Policy initiatives have mainly been realised through subsidies provided by the government. Large parts of the Oum Zessar watershed were enrolled in the SWC policy program and have since experienced dynamic changes in land management due to the reorientation of agricultural production from small-scale and subsistence farming towards market-oriented agriculture. Regional decision makers are currently assessing the `success of the SWC policy´ and considering a possible expansion of the SWC policy in Oum Zessar watershed. To ensure policy efficiency, decision makers request a comprehensive and reliable assessment of the possible impacts of policy changes on the economic, environmental and social components of development (O'Farrell and Anderson 2010; Pope and Grace 2006; Scrieciu 2007). An impact assessment of the SWC policy towards sustainable development could support the decision-making process. In this study, we demonstrate the use of the Framework for Participatory Impact Assessment (FoPIA) by conducting a case study-based sustainability impact assessment of SWC scenarios in Oum Zessar watershed. For this purpose, FoPIA, which was originally developed for the European context (Morris et al. 2011), was adapted to the regional conditions in Oum Zessar watershed. Sustainability impact assessment (SIA) is an increasingly accepted way of incorporating this holistic perspective into policy assessments (Boulanger and Brechet 2005; De Ridder et al. 2007; George and Kirkpatrick 2006). Several policies and land use policies have been implemented to alleviate the pressure exerted on natural resources and to enhance the socio-economic situation of the local population. These policies can be divided into two groups, namely a group formed by ‘Resource oriented policies’, and another formed by ‘integrated policies’. Thus, an ex-ante land use policies impact assessment procedure was needed in this area to predict their impact on the regional sustainable development. Due to the complexity of the regional sustainability which cannot be assessed by one tool only and requires a mix of quantitative and qualitative methods, a participatory approach as necessary. The Framework for Participatory Impact Assessment (FoPIA) provided an overall structure and guideline for the impact assessment based on DPSIR approach (Drivers, Pressure, State, Impact, Responses). The FoPIA approach requires some available information (scenarios, land use changes, sustainability issues, case study informations) and condensed complex and cross-disciplinary information into “handable” workshop (stakeholder friendly) information; allowed for direct interactions and transparent discussions of potential impacts.

Main characteristics of "FoPIA" approach and unfolding of the workshop:
FoPIA has been developed to facilitate a stakeholder inclusive sustainability impact assessment (Morris et al., 2008). It facilitates the exchange on individual perceptions (knowledge) about regional sustainability issues and structures and stimulate discussions among. The FoPIA is a participation-based, stand alone framework of sequenced methods for involving national, regional and local stakeholders in assessments of land use policy impacts. The main purpose of the FoPIA is to estimate impacts and changes on sustainable development (SD) (social, economic, environmental) that take place when a certain land use policy is implemented.

Preparation phase:
During the preparation phase, scenarios and land use functions (LUFs) are drafted, stakeholders selected, and workshop facilities (posters, maps) prepared. The preparation phase starts prior to the FoPIA workshop and includes gathering relevant and quantitative information and it should address most relevant view points to the problem (decision context and policy actions, land use changes and driving factors, sustainability issues). This information can for example be obtained from literature surveys or consultation with regional experts. The purpose of this phase

is to become familiar with the decision-context and to develop plausible scenarios and a key set of sustainability indictors.



FoPIA flow chart

Stakeholders selection:
The FoPIA uses expert knowledge to perform the impact assessment. A group size of 10-15 participants is recommended that should allow for active discussions and knowledge exchange among workshop participants. The final stakeholder group should consist of experts from social, economic, and ecological disciplines (balanced) in order to address all three sustainability dimensions within the impact assessment. - In this context stakeholders (experts) are individuals, groups and organisations that are 'more or less' directly affected by decisions and actions or that have the power to influence the outcomes of these decisions (Freeman, 1984). For the FoPIA, however, it is recommended to consider only experts in the same workshop since this method requires some academic exercises.

Policy and Scenario development:
Scenarios are the basis of the ex ante impact assessment in the FoPIA and should be designed to facilitation the impact assessment procedure on alternative land use management options. Principle scenario elements include a description of step-wise changes in land use patterns over time, the consideration of driving forces, a base year, the time horizon and target year, and a formulated storyline that describes the causal links between scenario assumptions and likely consequences. The projection year should meet decision maker's requirements with regard to policy implementation and the duration of the policy program. Driving forces need to be identified that affect the land use activities in the study area for the considered time horizon and that can be estimated with simple statistics or expert knowledge. For the assessment of the impacts of policies, it is required to construct a baseline or so-called counterfactual scenario in order to show what would happen in the absence of a policy change.

Following the two national forums organized with the local actors of rural development, two LUP were retained for the analysis of impact by the FoPIA method:
1. The Water and Soil Conservation policy (WSC),
2. The Water management policy, with their two components. Intersectoriel Policy and Pricing Water Policy.

The analysis of the two policies suggested and the discussions that it generated, led participants to evaluate in priority the impacts of the WSC policy by the FoPIA method during this workshop. Being constrained by time (workshop for only one day) and to avoid dispersion, the participants agreed to limit themselves to the WSC policy watershed of Oum Zessar. The scenario of reference is the continuation of these policy actions at the current rhythm of installations (autonomous development) to reach 85 % of potentially suitable surfaces until 2015. Two other scenarios are proposed to the participants (Figure 2).

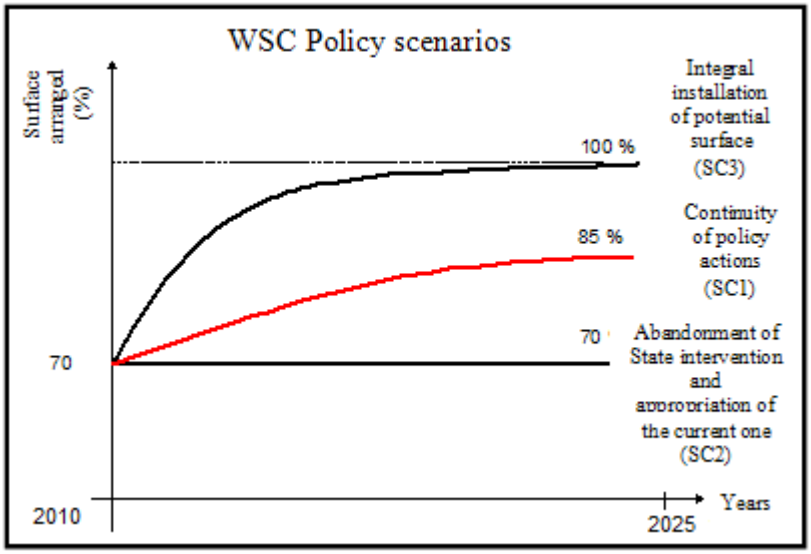


Figure 2:- Scenarios retained for Water and Soil Conservation Policy.

The last two scenarios are described as follows:

1. Reduction of the State intervention (on the level of 70 % of arranged surfaces), but with an appropriation by the local populations of 100 % of these surfaces,
2. "Integral" installation of the watershed area, i.e. 100 % of potentially arranged surfaces.

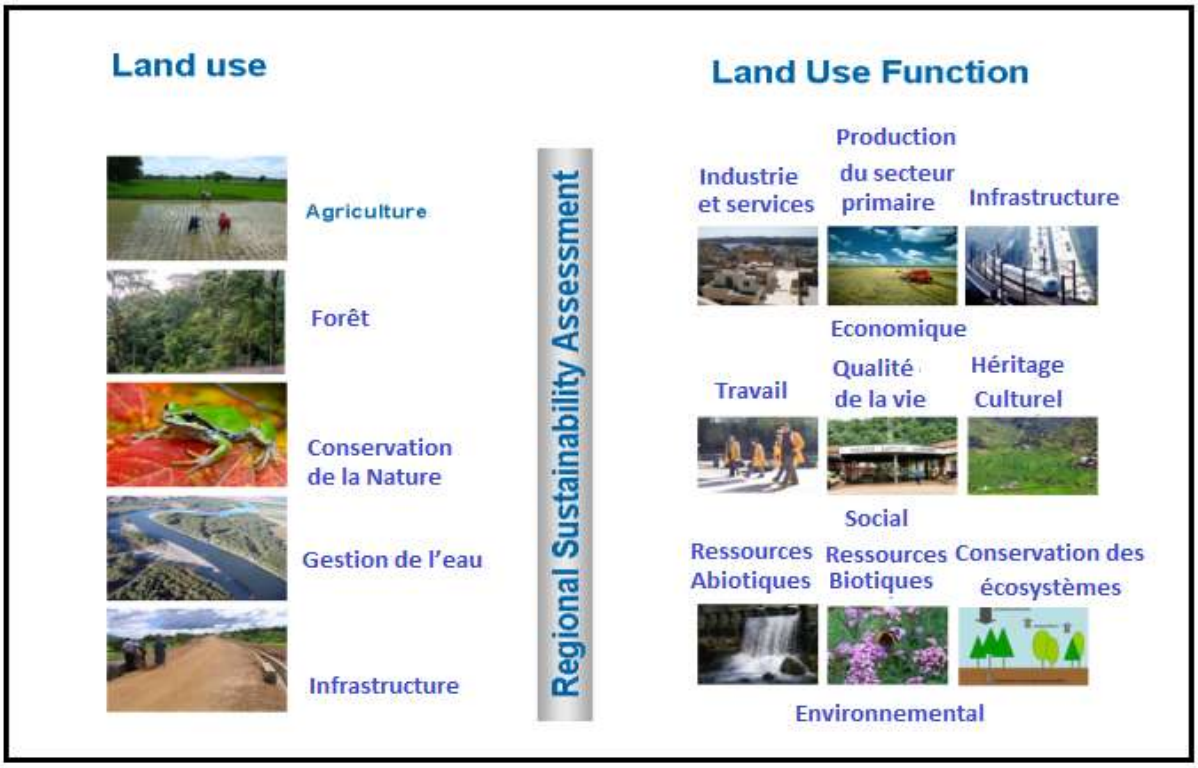
Compared to the scenario of reference, these two scenarios are extreme scenarios which should make it possible .3 to obtain contrasted results and as much as possible to avoid confusions in the evaluation process.

Land Use Functions and indicators of development:

Synthetic indicators representative of each LUF were proposed to the participants for evaluation and adjustment (Table 1).

Table 1:- Indicators selected for each Land Use Function (LUF).

Dimensions	Land Use Functions (LUF)	Indicators
SOC 1	Provision of Work	Employment rate
SOC 2	Human health	Life expectancy
SOC 3	Cultural heritage	Traditional techniques
ECO 1	Industries & services	Regional investments
ECO 2	Primary sector Production	Farmers income
ECO 3	Infrastructure	Road network
ENV 1	abiotic Resources	Water availability
ENV 2	biotic Resources	Biodiversity
ENV 3	Ecosystem Conservation	Natural land



For the FoPIA approach, a set of nine regional land use functions (LUFs) needed to be developed that should reflect key sustainability issues at regional level. As a starting point a brainstorming session can be used to identify most relevant sustainability issues related to land use in the study area. The LUFs framework should then be applied to classify and group those sustainability issues into social, economic, environmental categories, three per dimension, and complement if necessary. For the impact assessment each LUF will be represented through one corresponding indicator in order to have a more precise criterion for handling the LUFs. These indicators should be defined during the preparation phase to be presented to the stakeholder group during the workshop.

First scoring:
a first step, it is to find out stakeholders' perceptions on regional sustainability. Doing so, individual perceptions were reported by the participants by giving scores of importance on each LUF for the region of the watershed. The scores ranged from 0 (no importance) to 10 (very important). An analysis and discussion of results of the first scoring functions of land use has been conducted was used to exchange ideas and preferences among participants – providing the basis for a second round.

Second scoring:
Following an interpretation of the first scoring results, adapting elements of this discussion such that land use functions have been made. A second scoring with the same group of participants was conducted and showed that, through discussions, average scoring results become more homogenous while stakeholders manifested the preferences and importance on regional LUFs

Identification and assignment of LUF indicators:
for each land use function, award a development index deemed most relevant. For each LUF one corresponding indicator was selected to make the LUF more precise for the IA

Workshop proceedings: steps in applying FoPIA method (IA)
During the impact assessment, stakeholders were asked to give scenario impact-scores on each LUF indicator. This step consists on a scoring of land use functions indicators. In this step, the scores range from (-3 to +3) (-3: highly significant negative impact and +3: highly significant positive impact).

Weighting of land use functions:
This step expresses the trade-off between several land use functions. The assignment of weights for each land use function reflects the degree of importance of each function in the development in the watershed. These weights range from 1 to 9.

Results of the application of the FoPIA approach:
Scores given by participants:
The results analysis of the LUFs evaluation by participants showed the priority given to employment in the social dimension, or more precisely to employment maintains, and life quality. The importance given to cultural heritage, considered here by the participants in terms of transmission assets. Participants showed little interest in industries and services in the watershed because this area is relatively remote from urban centers and commercial channels. Similarly, industry has not a great importance because of the improvement of roads network. The majority of participants preferred improving agricultural productivity and the availability of abiotic resources, relative to the preservation of biotic resources and ecosystem. The stakeholder's preference was explained by the priority accorded to the socio-economic situation enhancement of local population related in fact to the Abiotic resources availability and by consequence agricultural productivity. But this result has given rise to debates in which they give importance to preserving and enhancing natural resources for economic activities.

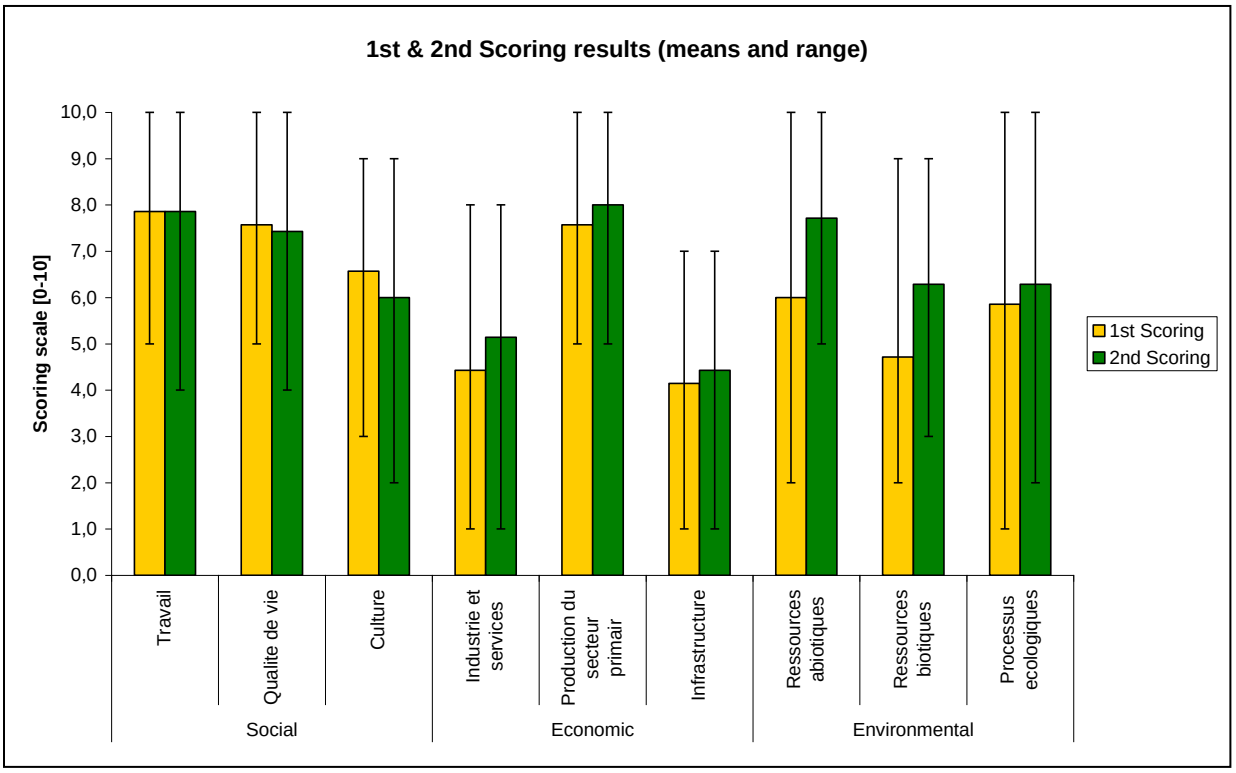


Figure 3:- Results of the two operations of land Use Functions scoring.

A reassessment of the scores of those LUFs led participants to report the lack of logic in the importance given to work while agriculture in this area contributes only 9% of employment.

Analysis of the impact of different scenarios:
Indicators level:
Life expectancy: This indicator was considered irrelevant and not relate to the water and soil conservation (WSC) policy that to be assessed. The stakeholders suggest using the Human Development Index (HDI) indicator widely used internationally. However, Participants felt that it was possible for the workshop to keep the proposed indicator.

The road network in km: this indicator considered irrelevant to evaluate the WSC policy. It has been proposed to consider the length in km of roads covered by the WSC techniques or the number of road protected from erosion.

Employment. The continuity of current policy (SC2) scenario and the integral management of the area scenario (SC3) have a positive impact on employment while the abandonment of state intervention scenario (SC1) has very little effect. It was mentioned here that the WSC works are employments creator to local people and they are indirectly generating new agricultural activities (planting olive trees in particular). But the contradiction was brought by one participant who noted that agriculture currently represents only 9% of the workforce so this indicator has a little weight.

Quality of life:
This indicator was the most criticized and has given the strongest opinion divergence. Some participants advanced the no relevance of this indicator at watershed level and it was independent from these policies. The discussion that followed showed the difference between socio-economic condition between the farmers in the upstream and downstream watershed. This difference can be explained by the water availability in the two watershed components caused by the WSC works. For example, the WSC techniques in the upstream are reducing the water flow to downstream and can negatively affect the Sebkha in the downstream.

Cultural heritage:
The chosen indicator is the use of traditional techniques (local knowledge). The stakeholders agreed that can be correlated to the WSC policies. But the participants were asked about "how to quantify this indicator"? It was reported that less government intervention could lead to involve a private intervention and makes a return to traditional techniques.

Industry and services:
The WSC sites create more services and more chances to develop small agro-industries. But, some stakeholders have argued that WSC actions have no apparent impact on services and industries, and that sometimes extension of agricultural land by the WSC work can negatively affect the industry and service sector by reducing the area availability.

Primary production sector: we can consider that more WSC techniques lead to more production and income, but with less natural rangelands, which affect the traditional livestock. Finally, indirectly, the WSC techniques contribute to groundwater recharge, allowing more than irrigated crops and more productive agriculture.

Infrastructure: By creating of new agricultural spaces WSC techniques facilitate access to rural roads. However, the indicator selected that's length of roads in km seemed irrelevant. The participants advanced that this indicator should be replaced by the length of roads (in km) or the number of road works protected from erosion, because in the mountainous regions the degradation of roads can disrupt the agricultural activities.

Abiotic resources (mainly water and soil): The indicator of water availability is very relevant in this case: more WSC techniques led to less runoff water loss and increase water availability.

Biotic resources (vegetation): The evaluation showed significant differences of perception. Some participants said that WSC techniques have a negative effect on the natural area availability and natural biodiversity. Conversely, other participants say that these techniques increase the cultivated biodiversity which is important issue.

Ecosystem Conservation: The above discussion has continued for this indicator. Technique reduce rangeland surface in the upstream watershed, but also modify downstream coastal marine ecosystems (Gulf of Bou Ghrara) by reducing freshwater inflows (such as reduced production of clams). Others argue that amenaged areas led to the land vegetation and by consequence the natural species recolonize these amenaged areas.

Land Use Functions level:
Overall, all LUFs together, the scenario of maintaining the current policy of WSC (SC1) and full development of the watershed (SC3) seem to be most favourable in terms of impact on sustainable development. But, the scenario of abandonment of State intervention (SC2) has positive effects on some indicators: cultural heritage, biotic resources and ecosystems (Figure 4).
Measuring the impact of three scenarios depends on many components of sustainable development taken into account and therefore political priorities. For example, the full development scenario has a positive impact on

employment in contrast to the scenario of abandonment of State intervention and conversely, the negative impact on ecosystems and the abandonment scenario is preferable in this case.

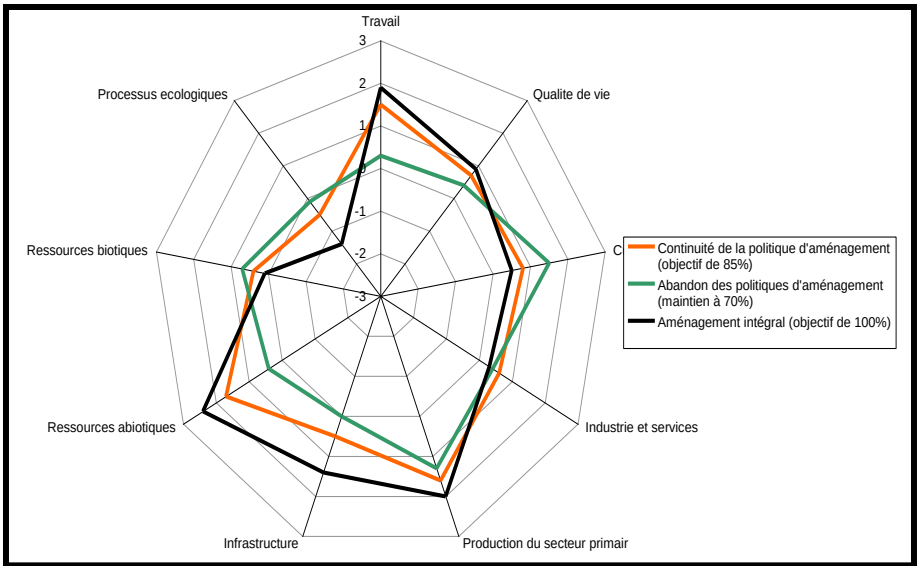


Figure 4:- Impact of three scenarios on the various components of sustainable development.

Diversity of perceptions:

The diversity of individual sensibilities that each participant has his own perception of reality and even the probably impacts of scenarios. The results show that diversity on each chart and standard deviations of scores on indicators (Figure 5) illustrate the great diversity of viewpoints. The lowest diversity of perceptions characterised the biotic resources: this is probably the indicator that posed the least problems of misunderstanding, but also and especially the primary purpose of WSC political. Conversely, perceptions of biotic resources and ecosystems and to a lesser extent on the cultural heritage and services and industries are widely dispersed. They reflect certain vagueness in the understanding of these indicators, but also differences of opinion between the participants.

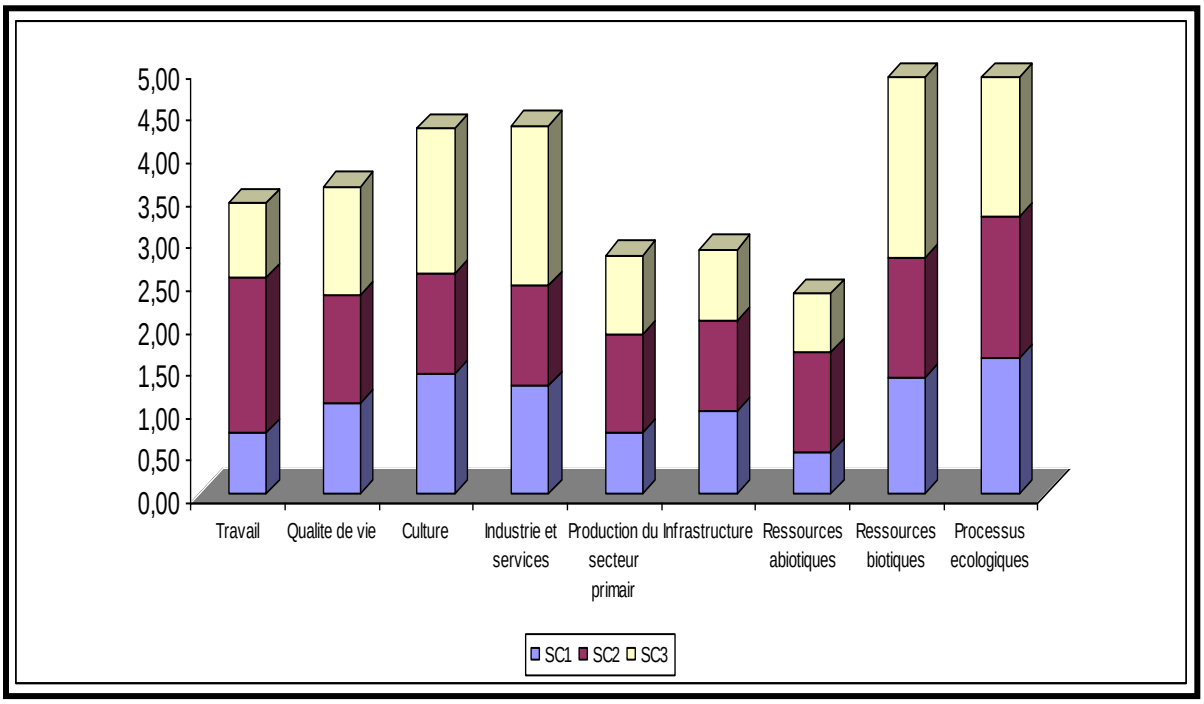


Figure 5:- Standard Deviations of scenarios notations for each LUF.

Lessons:
The FoPIA method allows a process of participatory impact assessment approach based on "expert". To be effective the process requires careful preparation that goes into first place by a very good description of the situation studied. The selection of participants is essential. They must be real experts, that is to say, mastering both the question and the situation. The discussion is at the heart of the method requires time so that interactions are productive. This will require very professional implementation: commitment and availability of "experts" working conditions. The values of standard deviations are significant and show a large diversity of perceptions. The analysis of this diversity appears to be essential. The diversity arises from differences in perceptions of experts who give importance to various differentiated components of sustainable development (production, social, environmental) and therefore according to Land Use Function.

FoPIA should be thinking in terms of decision making for successful debate. The tools used (graphs) are primarily intermediate tools. The decision is often a collective process which "involves most often to identify and assess the individual's opinions that lack the same level or the same field of expertise" (Cicourel, 2002: 145). The intermediate tools used to stabilize representations, knowledge and relationships in the process is doing. The individual opinion is a support and facilitator of coordination between actors involved in a complex process whose purpose and outcome are often uncertain. It creates cooperation between actors.

This cooperation is the result of the discussion. It should deepen the identification of cause and effect relations between actions (by policies) and the different Land Use Functions. In the framework of this exercise the debate has highlighted the need to rethink the scenarios. The scenarios related to the WSC were not the most appropriate. Instead of taking into account the extension of the surface, it might have been more interesting to study the quality of participation and the appropriation of these arrangements by local actors.

The debate was actually a fact explaining perceptions of different actors. He showed interest to clarify the relationship between cause and effect to better explicit the interrelationships between action and impact. This explanation, prior to or during the discussion, is essential. It tends to some consensus as expressed in notations after the debate. Consensus building is not the goal even if the decision in terms of public policies is also the result of consensus. The above explanation helps to clarify the indicators of land use functions or even identify several criteria to measure an indicator. For example, to measure the employment rate, we can refer to the employment rate induced by WSC works or employment rates induced by increased agricultural activity linked to facilities.

Especially it must be accompanied by training sessions and applying the method to better manage the problems of subjectivity. The success of this approach depends on the degree of understanding of the indicators and their contribution to sustainable development, by the actors of development and farmers.

Conclusion:-

This paper allowed an impact assessment of alternative SWC policy scenarios in the Oum Zessar watershed, using the participatory FoPIA assessment tool. A main outcomes of applying FoPIA are the learning process during the assessment procedure. This study showed a differential impacts of SWC scenarios on selected social, economic and environmental land use functions. The results of the impact assessment showed that the selected social and economic land use functions mainly benefit under the promotion of SWC measures as a result of enhanced water resource availability for land-based production. The land use functions assessed to be of the highest important by the stakeholders were also targeted by SWC policies, i.e., the provision of abiotic resources (water availability, ENV 1), primary production (ECO 2), and the provision of work (SOC 1). The LUF `Cultural identity´ was assessed as having a negative impact if SWC measures are expanded due to changes in 'traditional (SCO 3)' landscapes (e.g., introduction of dams, gabions, etc.). The expansion of SWC measures in the Oum Zessar watershed was assessed to have negative impacts on the natural vegetation (ENV 2) and key ecosystem processes as a result of changes in land management accompanied by increasing land use pressure. Based on the assessment results, an implementation of the SWC policy at 100% coverage of potential land could be suggested if achieving the maximum socio-economic benefit is the goal. However, if stakeholders' preferences are taken into account, and considering the fact that the implementation of SWC measures also implies some negative changes to the natural system, SWC implementation at 85% might be preferable. From a methodological perspective, the role of stakeholder participation appeared to be crucial during all assessment steps for the consideration of the region specificities:

1. to translate policy measures into a plausible set of regional land management scenarios,
2. to analyse the sustainability context and key land use functions,

3. to develop operational and regionally relevant assessment indicators,
4. to assess and explore SWC scenario impacts and trade-offs, and
5. to derive possible suggestions for implications in land management.

Participatory impact assessment contributes to an enhanced regional understanding of key linkages between policy effects and sustainable development. On the one hand, stakeholder knowledge was used to provide a region-specific and holistic picture of the potential impacts of policy on sustainable development. On the other hand, in addition to providing their knowledge; the stakeholders also benefited from the impact assessment process. Land administrators and authorities have an interest in successful and efficient policy implementation. Active participation during the impact assessment provides a platform for social learning, exchange and better understanding of the complexity of human-nature interactions.

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