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Methodology development and application in a case study of the concentrated solar power plant NOOR$_{O}$ I in Morocco

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Determining significance in social impact assessments (SIA) by applying both technical and participatory approaches: methodology development and application in a case study of the concentrated solar power plant $NOOR_O$ I in Morocco

Abstract

One of the main objectives of impact assessments is to identify potentially significant impacts. However, determining this significance has received very limited attention as a procedural step in social impact assessments. Consequently, only limited research and documentation exists on approaches, survey tools and evaluation methods, especially with regard to participatory approaches and combined participatory-technical approaches. This study aims to address this research gap by developing and applying a joined participatory and technical impact significance evaluation. The approach is applied in a case study which analysed the livelihood impacts of the large-scale concentrated solar power plant $NOOR_O$ I in Ouarzazate, Morocco.

The analysis shows that although different approaches and significance criteria must be applied when involving both local stakeholders and experts, the linked analysis offers more robust results and an improved basis for decision-making. Furthermore, it was observed in the case study that impacts affecting the social, cultural and political spheres were more often considered significant than impacts affecting the physical and material livelihood dimensions. Regarding sustainability assessments of large-scale renewable energy plants, these findings underline the importance (as for other large-scale infrastructure developments) of placing greater emphasis on the inclusion of social aspects in impact assessments.

Keywords: Social impact assessment, impact significance, participatory approach, local stakeholders, renewable energy, Morocco

1. Introduction

Social impact assessment (SIA) is an overarching term for concepts, processes, methods and tools to analyse, evaluate and manage the intended and unintended positive and negative social consequences of planned interventions (Vanclay, 2003 and 2006). Focusing on the social aspects of sustainable development, the main application of SIA is within the regulatory approval process for infrastructure and resource extraction projects (Esteves et al., 2012). Accordingly, SIA is also appropriate as an analytical framework for assessing and understanding the social sustainability aspects of renewable energy projects. However, while some sustainability assessments of renewable energy installations and solar energy systems do exist (Philips, 2013), the assessment of the social impacts of such infrastructure developments remains a complex and challenging task (Kirchherr and Charles, 2016). Consequently, the existing literature produced by academics and practitioners has tended to focus on the standard socio-economic indicators, such as number of jobs created, economic effects on specific sectors or contribution to economic growth, but to date few publications have addressed the social implications of the deployment of large-scale renewable installations at local level.

Among the key reasons cited for the limited application of SIA in practice, not only for renewable energy projects but also in general is the lack of a normative framework (UNEP, 2007: II) and the limited availability of guidance on suitable methods, tools, models or data sources to evaluate social impacts (Arce-Gomez et al., 2015; TEP and CEPS, 2010). Accordingly, different authors have emphasised the need for procedural, theoretical, methodological and practical improvements (Suopajärvi, 2013; Mahmoudi et al., 2013), particularly regarding stakeholder engagement and the application of participatory processes within SIAs (Esteves et al., 2012).

One particular aspect that has received limited attention in SIA frameworks is the assessment of the significance of the predicted impacts (Ijäs et al., 2010). The term significance is not used consistently in impact assessments, but the understanding of significance differs depending on the assessment step. In the first step of an impact assessment, the screening and scoping phase, significance frequently describes a selection mechanism (Kjellerup, 1999). While in the prediction

and evaluation stage the concept of significance typically refers to an evaluation of what is vital, appropriate or acceptable/unacceptable, interpreting the levels of importance (Lawrence, 2007a). In this paper, the term significance is applied in the latter sense.

In SIAs, the step of determining impact significance is often not discussed and in case it is mentioned, regularly no further information is provided on how significance levels were or could be determined. In contrast, several authors emphasized the importance of determining impact significance levels in environmental impact assessments (EIA) (e.g. Briggs, 2013; Rowan, 2009; Lawrence, 2007a-c; Duinker and Beanlands, 1986; Sadler, 1996). However, the actual application of the concept of significance in EIAs is also limited and remains one of the most complex, difficult and least understood aspects of EIA (Ijäs et al., 2010; Wood, 2008). Little documentation on practical applications exists (Schindler et al., 2016), especially concerning the participatory approaches which are called for by various authors (Arce-Gomez et al., 2015; Esteves and Vanclay, 2009; Vanclay, 2003; Becker et al., 2003 and 2004).

Based on these observations, the following research needs have been identified: (a) to advance the integration of significance evaluation in SIA; (b) to provide guidance on tools and methods for participatory assessments of impact significance (also in combination with technical approaches); and (c) to document practical applications of these approaches and tools. Addressing these research needs, the overall objective of this paper which is based on the findings from the project SocialCSP (Wuppertal Institute and Germanwatch 2015) is to advance the understanding and practice of determining impact significance within SIAs. Particular attention is given to the combination of participatory and technical impact significance assessment methods, drawing on the findings from an applied research study on the impacts on the livelihoods of adjacent local communities of the large-scale concentrated solar power (CSP) plant $NOOR_0$ I in Ouarzazate, Morocco.

Starting with a brief overview of the role and state of the art of determining impact significance in SIAs and EIAs in section 2, followed by a short introduction to the empirical case study $NOOR_0$ I in section 3, the paper continues by describing the methods and survey tools applied in the case study to determine impact significance in section 4. In section 5 the application of these tools and the case study results are presented. Finally, following a discussion of the methodological aspects and the practical application in section 6, conclusions are drawn in section 7.

2. Significance determination in impact assessments - state of the art and method derived for a combined participatory and technical approach

Predicting and evaluating the significance of impacts is one of the major challenges in impact assessments. However, to the best of the authors' knowledge, to date only Rowan (2009) has addressed the topic explicitly within the setting of SIA. Therefore, the subsequent passage is largely based on findings and discussions from EIA literature.

Although various definitions of significance exist, most of comprise one of the following two characteristics: (a) significance is a value judgement, this means that significance essentially depends on the value society attributes to certain elements (level of importance); and (b) the resulting degree and type of the change in terms of measurable effects (level of consequences). While some authors, such as Thompson (1990) or Cloquell-Ballester et al. (2007), differentiate among these two components by defining the first aspect as impact significance in regards to the costs caused to society by an impact and the second element as a prediction of the impact's magnitude, many recent publications include the predicted magnitude of impacts as an element in determining the overall impact significance (Lawrence, 2007a).

Apart from the different definitions, there are also many different approaches to operationalising the concept of significance. These can be divided into two main groups: technical approaches and participatory approaches (Lawrence, 2007b). On the one hand, technical approaches focus on technical properties - relying mainly on expert judgements, technical data and data analysis. Participatory approaches, instead, focus on the relative importance assigned by an individual or a group to an impact. Because social values are characterised by plurality (Wood, 2008; Vanclay 2002), these types of judgements are based on the particular context and can be "subjective, normative and value-dependent" (Lawrence, 2007a).

To date, most impact assessment studies have applied technical approaches. However, technical approaches cannot account for the fact that stakeholder groups may have diverting sets of social values, relationships, histories and other elements distinctive to their own contexts (Becker et al., 2004). Consequently, determining significance without involving stakeholders cannot adequately reflect the range of realities of the affected individuals and groups. On the other hand, relying solely on stakeholder perceptions runs the risk of producing biased results and neglecting important impacts because local stakeholders cannot always anticipate the scope and effects of certain developments (Becker et al., 2003). Therefore, determining impact significance should combine technical knowledge with local stakeholder perspectives – but there are very few case studies that combine participatory and technical approaches to determine impact significance (Schindler et al., 2016; Arce-Gomez et al., 2015).

In addition to the choice of approach, it is important to define the criteria to measure impact significance. Common criteria applied in technical assessments comprise duration, spatial scale, intensity, reversibility, probability, frequency, residuals effects and mitigation potential. Furthermore, several authors advocate to integrated the degree of certainty in assessing the criteria into the evaluation (Soares et al., 2006; Noh and Lee, 2003; Rossouw, 2003). However, this type of criteria can usually not be evaluated without technical knowledge before the impact occurs. Hence, these criteria are normally not suitable to be applied in a participatory process, especially when working with local stakeholders in developing countries.

The literature contains very little guidance on criteria that can be applied to specify the values associated by local communities with features of their living environment (Stolp et al., 2002). The only exception in the SIA literature is the paper from Rowan (2009) which focuses on impact significance within the SIA process. Rowan (2009) suggests to determine the significance of an impact using the two criteria effect on wellbeing (magnitude) and vulnerability of the affected groups (sensitivity). Similar recommendation can also be found with regards to ecosystem service impact assessments, where it is suggested to use the magnitude of an impact on the ecosystem service and the vulnerability of the affected beneficiaries as criteria to determine significance (Landsberg et al. 2011). Whereas the effect on wellbeing appears to be a suitable criterion to apply in a participatory assessment to measure the *level of consequences*, vulnerability is a complex concept, which cannot be easily evaluated by local stakeholders. Following the citizens' value approach as described by (Stolp et al., 2002) instead, the *importance* ascribed to a particular livelihood asset could be applied as an alternative criterion to determine the level of significance. This can be justified because just when local stakeholders place value on a livelihood asset can an impact with an effect on the wellbeing be deemed significant. In this context the term value can be defined as the importance individuals or groups place on particular elements of their living environment (Stolp et al., 2002).

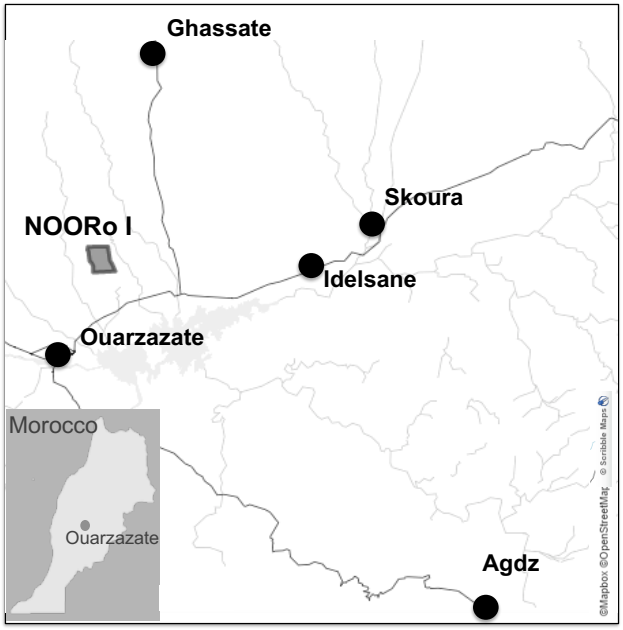
Accordingly, the two criteria considered suitable in this study to determine significance in a participatory setting are (a) the importance of the livelihood asset affected (*level of importance*) and (b) the level of effect on the wellbeing of different local stakeholders (*level of consequences*). Having selected the criteria, the assessment design for evaluating significance needed to be established. A number of different survey and aggregation methods could be used, such as expert consultations, analysis of cause-effect relations and multi-criteria assessments (UNEP, 2007). However, there is no commonly applied assessment design instead it is recommended to adapt the assessment method to the study needs (Arce-Gomez et al., 2015). The assessment design and methods applied for the empirical study in Morocco are presented in section 4.

3. Case study description

The study in which the combined participatory and technical approach to determine impact significance was applied aimed to analyse the livelihood impacts of Concentrated Solar Power (CSP) plants at local level. The research is based on the project SocialCSP which conducted an impact assessment study on the 160 MW pilot CSP plant $NOOR_0$ I in Ouarzazate, Morocco.

The province Ouarzazate is located in the southeast of Morocco, in the lower catchment of the Drâa Valley at the edge of the Saharan desert. The city Ouarzazate and the surrounding communities of Agdz, Idelsane and Ghassate form the research area of the presented case study (Figure 1). The area is characterized by its semi-arid to arid climate with low perception levels and high temperatures

in the summer and cool temperatures in the winter. The area regularly experiences long lasting droughts and water shortages making the Drâa Valley one of the driest catchment areas worldwide (De Jong et al., 2006). Despite the dry conditions the region is highly dependent on the agricultural sector, which is the main source of household income. While the majority of the population is still living in the rural areas, there is a strong trend of accelerated migration towards the urban centres in and outside the region. The main reasons being high poverty and unemployment rates as well as declining agricultural yields in the drought-affected areas. The objectives perused with the establishment of the solar power plant NOOR in Ouarzazate are therefore not only focused on energy aspects but also on fostering local and regional socio-economic development.



(Source: Own figure)

Figure 1: Overview map research area

$NOOR_O$ I was the first of four solar energy plants in Ouarzazate which, when completed in 2020, will be one of the largest solar installations worldwide with a capacity of about 580 MW. The whole NOOR programme is part of the Moroccan Solar Plan, which aims to expand the use of solar energy in Morocco to decrease the country's dependence on energy imports. The high import dependency (about 95%) places an enormous burden on both the national budget and the country's energy security. Moreover, due to population growth, rapid urbanisation and economic development, energy demand is expected to continue to rise, putting even greater pressure on the Moroccan energy sector.

In addition to the energy security objectives, the aim of the Moroccan Solar Plan in general, and the NOOR programme in specific, is to develop technological expertise in the solar energy sector and to contribute to socio-economic development in the region. Accordingly, the implementation of the CSP plant $NOOR_O$ I was accompanied by both mandatory and voluntary social and socio-economic development measures. However, although environmental and macro-economic impacts have been documented in detail (5 Capitals 2012 a-c), the potential positive and negative impacts on the livelihoods of the local communities, resulting from $NOOR_O$ I and its associated programmes, have received less attention. Therefore, the overall study focused on understanding the complex relationships between a CSP plant and the social and socio-economic environment in which it is placed.

In order to understand to which extent local communities benefit from or are negatively affected by the construction and operation of these power plants a social impact assessment approach was applied which included two extensive empirical field studies in Ouarzazate. The main objective of the first field study was to identify potential impacts in a participatory process. In this process thirty impacts were identified (Table 1) for which the respective significance levels were than

determined during the second field study. This paper focuses on the analysis step of determining impact significance within the SIA process, presenting the developed methodology and the lessons learned from its application[1]. The identified impacts comprise beneficial and adverse impacts that have already been observed for the completed project phases or are anticipated to materialise in the operational phase. After developing the method, this case study will serve as a practical example of a combined technical and participatory significance evaluation in an SIA.

No.	Values	Impacts
1	Family and social support	Strengthened family ties and social support
2	Preservation of social standing and political influence	Reduced social standing and political influence
3	Local and regional reputation	Intensified local pride and increased regional reputation
4	Preservation of community atmosphere and cultural identity	Accelerated changes to community atmosphere and cultural identity
5	Inclusion of marginalised communities and social groups	Discrimination against marginalised communities and social groups
6	Social peace and community cohesion	Social conflict, rivalry and feelings of envy
7	Provision of transparent and comprehensive information	Uncertainty, unrealistic expectations and frustration
8	Community engagement and participation in decision-making processes	Social exclusion and powerlessness in decision-making
9	Trust in project developers and dealing with community concerns	Suspicion towards the project and its developers, as well as community protest
10	Improvement in living conditions in adjacent communities	Improved living conditions in adjacent communities
11	Regional socio-economic and infrastructure development	Stimulated regional socio-economic and infrastructure development
12	Availability and affordability of regional infrastructure and services	Strain on regional infrastructure and services
13	Preservation of land as a culturally important resource	Decreased psychological well-being and reduced cultural attachment in adjacent communities
14	Maintaining sufficient water supply in Tasselmant	Decreased water security in the community of Tasselmant
15	Water security in the Drâa Valley	Deprivation of farming livelihoods in Ouarzazate and cascading effects in the downstream oases of the Drâa Valley
16	Preservation of biodiversity in adjacent communities	Deprivation of subsistence activities in adjacent communities
17	Economic participation of SMEs	Economic participation and benefits for local SMEs
18	Economic participation of micro-scale SMEs	Economic exclusion of micro-scale SMEs
19	Poverty alleviation, income generation, healthcare and improved standards of living	Improved socio-economic situation and standards of living
20	Preservation of subsistence farming activities in adjacent villages	Deterioration in socio-economic situation and standards of living in adjacent communities
21	Regional prosperity and added value	Increased regional prosperity and added value
22	Price stability of local commodities	Erosion of local purchasing power and decreased standards of living among low-income groups
23	Public interest in renewable energy	Increased public interest in renewable energy systems and civil society engagement
24	Skill development and knowledge transfer (particularly among the youth)	Benefits from skill development and knowledge transfer (particularly among the youth)

[1] For more information on the overall SIA applied in the study, please refer to Wuppertal Institute and Germanwatch 2015.

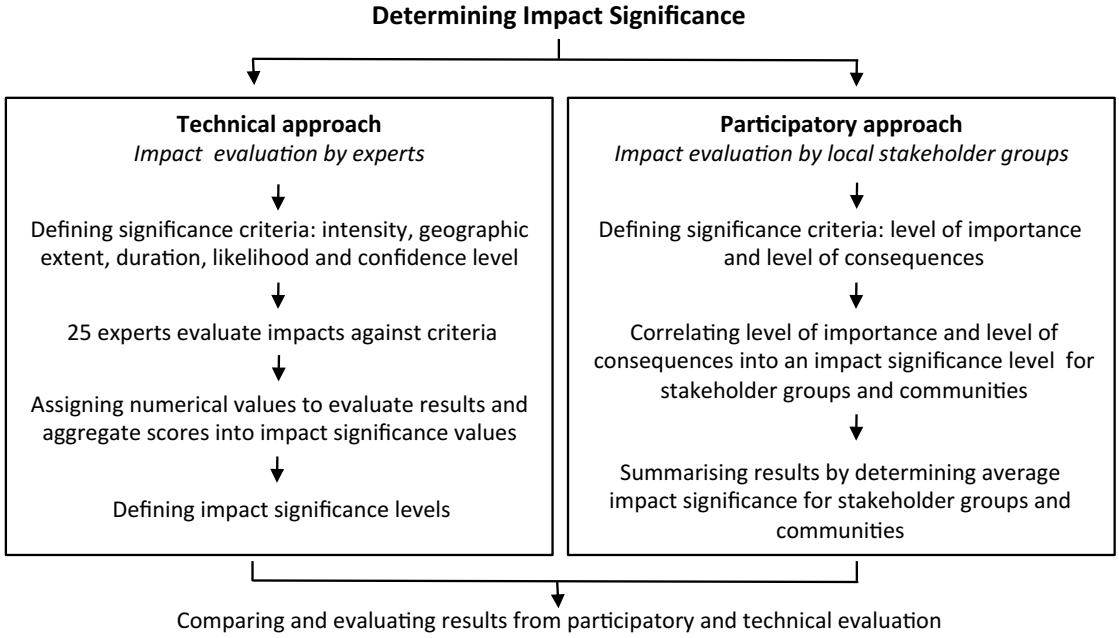
25	Educational qualifications	Mismatch between educational qualifications and labour market requirements
26	Technology transfer to local firms	Strengthened technological capacity of local firms
27	Fair and equal labour conditions	Poor and unequal labour conditions
28	Tranquil environment and quiet surroundings	Influence of noise, dust and vibration on psychological well-being
29	Clean and unpolluted environment (land and water resources)	Environmental pollution
30	Roads and public safety	Increased crime and fatal road accidents

(Source: Based on Wuppertal Institute and Germanwatch 2015)

Table 1: Social and environmental values and associated impacts evaluated

4. Assessment design and methods

Figure 2 illustrates the linked technical and participatory assessment framework, together with the applied assessment tools. The *technical assessment* was designed as an expert survey of local and international experts, while the *participatory appraisal* applied a set of rating and preference ranking tools to evaluate the significance of impacts from the perspectives of local stakeholder groups.



(Source: Own figure)

Figure 2: Overview of the applied combined technical and participatory approach for determining impact significance

4.1 Participatory approach: focus groups

The main objective of the participatory assessment was to determine the significance attributed to impacts by different stakeholder groups. Important steps in the assessment design process were to (a) identify relevant stakeholder groups; (b) define criteria to evaluate the significance; (c) select suitable survey and evaluation methods; and (d) evaluate the significance level based on the assessments.

4.1.1 Stakeholder groups

In this study a total of 106 local stakeholders participated in 20 focus groups. Based on a stakeholder analysis, eight priority groups were identified: women, youth, farmers, community

representatives, the unemployed, small and medium enterprises, workers employed at the CSP plant and students who had recently moved to the community (Table 2). For the four stakeholder clusters of women, youth, farmers and community representatives, separate focus groups were organised in each of the four communities: Ghassate, Ouarzazate, Idelsane/Skoura and Agdz. These communities are representative of the different types of communities potentially affected by the infrastructure development of the CSP plant $NOOR_O$ I. Conducting separate focus groups for these communities allowed for the comparison not only between stakeholder groups but also between communities.

Stakeholder groups	Number of cases (n)	Communities	Number of cases (n)
Women	23	Ouarzazate	36
Youth	23	Ghassate	25
Farmers	20	Agdz	23
Community representatives	19	Idelsane / Skoura	21
Workers CSP	6	Outside the community	1
The unemployed	5		
SMEs	4		
Students new to the community	6		
Total	106		106

(Source: Based on Wuppertal Institute and Germanwatch 2015)

Table 2: Sample size distribution of local stakeholder groups and communities

4.1.2 Significance criteria

In section 3, two general criteria were derived to evaluate significance in participatory assessment. Adapting these general criteria to the study context, the following criteria were applied in the study: (a) the level of importance associated with the social, cultural, economic or environmental attributes of the living environment potentially impacted by the different development stages of $NOOR_O$ I (Importance); and (b) the level of consequences, reflecting the degree to which the impact effects personal wellbeing (Impact magnitude).

4.1.3 Criteria assessment

Both criteria were judged by local stakeholders in 20 focus groups of 4-6 people, moderated and documented by local researchers. The assessment was designed as a combination of ranking and rating techniques based on participatory rural appraisal (PRA) survey methods (Chambers 1994; FAO, 1999). These tools are especially suitable for evaluating and understanding perceptions, preferences and priorities in local settings in developing and emerging countries (Cramb and Purcell, 2001). To allow for the collection of data on frequency and variability and to prevent dominant group members from influencing the results, the evaluation was first done individually by each participant, before results were discussed in the group. During these discussions, the aim was not to establish a common result. The evaluation itself consisted of two major steps, which were implemented in each of the 20 focus groups.

In a *first step* the stakeholders were asked to evaluate the *importance* of a list of environmental and societal attributes. The listed aspects were associated with the list of impacts (Table 1), so that each environmental and societal property equalled one of the identified impacts. Judging the importance of these aspects of the living environment before evaluating the impacts had the advantage that the judgement was not directly connected to the project and the related worries, hopes and expectations of the stakeholders, which produced more systematic and "neutral" information (Stolp et al., 2002). In tangible terms, local stakeholders in each group were asked individually to rank (from 1 to 10) the selected environmental and societal attributes according to their importance to themselves, their business, their families or their community (see Appendix, Table 10). The rankings were then discussed within the group to gain an insight into the reasons for divergence.

Following the ranking exercise, in a *second step* the magnitude of impacts, defined as the degree of effects on the personal wellbeing, was evaluated. A scoring approach was applied, allowing for perceptions of change and the severity of each impact to be measured (Abeyasekera, 2001). In this

study, the decision was taken to determine in a first step if the stakeholders were, are or will be affected. Where positive replies were received, a three-point scale (low/medium/high) was applied to measure the impact magnitude. Following the individual assessment, the results were discussed in the focus groups to attempt to understand possible divergence between the scores.

4.1.4 Significance evaluation

In order to evaluate the final significance level, a correlation between the importance ranking and the impact magnitude rating had to be established. To this end, a matrix approach was used, combining the data from both assessment steps into significance levels (Table 3). To achieve this, the importance rankings had to be assigned numerical scores.[2] After these scores were assigned, the mean importance scores were calculated for each of the 20 stakeholder groups, across the different groups for the communities Ghassate, Ouarzazate, Idelsane/Skoura and Agdz and for the entire sample. These mean scores were categorized into high importance (scores over 6), medium importance (scores between 4 and 6) and low importance (scores under 4). The rating data from the evaluation of the impact magnitude was analysed using a similar approach, translating qualitative information into scores (low=1; medium=2 and high=3) and calculating the average ratings for the different groups (see Appendix, Table 10). Based on the resulting matrix, the significance level was specified for every combination of importance and impact magnitude. With the help of descriptive data summaries and graphical representations, impacts with high importance and a high degree of effect could be identified. Furthermore, agreement and disagreement within and between stakeholder groups concerning significance could be analysed. To examine the results from the impact magnitude rating, it is important to differentiate between positive and negative impacts, as a high degree of effect from a positive impact is wanted while the contrary applies for negative impacts. The results of the participatory assessment are presented in section 5.1.

		Importance		
		low (< 4)	**medium** (4 - 5.9)	**high** (≥ 6)
Impact magnitude	**low** (< 1.5)	very low	low	low
	medium (1.5-2.4)	low	moderate	high
	high (≥ 2.5)	moderate	high	very high

Table 3: Matrix to determine significance level based on criteria importance and impact magnitude

4.2 Technical approach: expert survey

Like the participatory approach, the main objective of the technical assessment was to determine the significance attributed to impacts by different experts. Important steps in the assessment design process were: (a) to identify suitable experts; (b) to define criteria to evaluate the significance; (c) to select suitable evaluation methods; and (d) to evaluate the significance level based on the assessments.

4.2.1 Expert survey design

The technical assessment consisted of an expert evaluation by local and international experts. The survey was designed as a structured questionnaire, intended to acquire empirical knowledge from 25 local and international experts who are either from or are active in the region, or have other relevant expertise in the fields in question. The term expert, as used in this study, does not refer exclusively to professionals but also includes selected community members, who are an important

[2] The value ranked as most important on rank "1" was assigned a score of "10", the item ranked second was assigned a score of "9" and so on 3=8; 4=7; 5=6; 6=5; 7=4; 8=3; 9=2 and 10=1.

local knowledge source for evaluating local level impacts (UNEP, 2007). The wide range of impacts required to engage experts from different sectors (e.g. water, health, social, business, project development, science and the finance sector) who were in the position to evaluate the identified impacts based on their specific knowledge. It was requested that the experts to only evaluate those impacts associated to their fields of expertise, but it was ensured that every impact was evaluated by a minimum of two experts.

4.2.2 Significance criteria

The experts evaluated all impacts against four criteria: intensity, geographic extent, duration and likelihood. *Intensity* refers to the level to which an impact has effects on the livelihood of the local population, *geographic extent* describes the scale of the area affected, *duration* defines the time span the impact continues to affect the livelihoods from the time it emergences and onwards and *likelihood* relates to the probability of the occurrence of the impact.

4.2.3 Criteria assessment

The criteria were evaluated on a five-point scale. The scale definitions were adapted to the local level addressed in this study (Table 4). Moreover, the experts were asked to specify their confidence level in making each judgement on each criterion on a three-point scale (low/medium/high, see Table 5). This allowed to account for uncertainties in the expert judgements.

Criteria	Scale	Definition
Intensity	None	No impact / livelihoods not affected
	Low	Low impact / no substantial effects on livelihoods
	Medium	Moderate impact / moderate effects on livelihoods
	High	High impact / substantial effects on livelihoods
	Very High	Very high impact / very extensive effects on livelihoods
Geographic extent	Punctual	Communities of Tasselmant and Tidgehste
	Communal	Rural commune of Ghassate
	Urban	Ouarzazate city
	Provincial	Province of Ouarzazate (incl. Skoura)
	Regional	South Drâa Valley (incl. Agdz, Tamezmoute, Zakora)
Duration	Momentary	less than one year
	Short term	1 – 5 years
	Medium term	5 – 10 years, less than the project lifespan
	Long term	10 – 20 years, lifespan of the project
	Irreversible	permanent
Likelihood	None	Impact will not occur / has not yet occurred
	Unlikely	Impact is unlikely to occur / has not yet occurred
	Likely	Impact is likely to occur / has not yet occurred
	Most likely	Impact is most likely to occur / has already occurred
	Definite	Impact will definitely occur / impact has occurred
Confidence Level	High	Very confident
	Medium	Confident
	Low	Not confident

Table 4: Definition of significance criteria in the expert survey

4.2.4 Significance evaluation

Based on the outcomes of the expert survey the impact significance was determined. To this end, the results for each criterion were translated into scores, which were than aggregated into a final significance score.

In the *first step*, the evaluation results were translated into numerical values taking the confidence levels into account. As no commonly accepted method exists for this process (Lawrence, 2007c), the approach presented by Soares et al. (2006) was followed in this study. Soares et al. (2006) recommends to divide each level of the 5-point scale into three intervals based on the certainty

level (Table 5). In this way, the final value for each of the criterion also depends on the certainty of the expert judgments.

Intensity (I)	Confidence Level		
	High	Medium	Low
None	0	1	1
Low	2	1.5	1
Medium	3	2.5	2
High	4	3.5	3
Very High	5	4.5	4

Geographic extent (G)	Confidence Level		
	High	Medium	Low
Punctual	1	0.5	0.5
Communal	2	1.5	1
Urban	3	2.5	2
Provincial	4	3.5	3
Regional	5	4.5	4

Duration (D)	Confidence Level		
	High	Medium	Low
Momentary	1	0.5	0.5
Short term	2	1.5	1
Medium term	3	2.5	2
Long term	4	3.5	3
Irreversible	5	4.5	4

Likelihood (L)	Confidence Level		
	High	Medium	Low
None	0	1	1
Unlikely	2	1.5	1
Likely	3	2.5	2
Most likely	4	3.5	3
Definite	5	4.5	4

Table 5: Rating scales for the criteria assessment in the expert survey

In the *second step,* the scores of each criterion and for each impact were aggregated into a final score, which could then be translated into a significance level. Various arguments exist for or against different methods of aggregation, but no commonly accepted aggregation rule exists (Ekener-Petersen, 2014, Tomlinson et al., 2006). In this study, to aggregate the criteria scores, it was decided to draw on social risk assessment research which stresses the importance of the probability of an event followed by the extent of its consequences (Mahmoudi et al., 2013), applying the following aggregation rule:

$$Significance = L_i \times (I_i + G_i + D_i)$$

L_i Likelihood of impact *i*
I_i Intensity of impact *i*
G_i Geographic extent of impact *i*
D_i Duration of impact *i*

The values for intensity (I), duration (D) and geographic extent (G) are added together and then multiplied by the value assigned to the likelihood (I) criteria, resulting in a range of scores between 0 and 75. The main weakness of the aggregation function is the risk that an impact rated unlikely to occur, but which could have irreversible consequences, could be overlooked. To avoid this risk, the results must be carefully assessed by the researcher after the aggregation to avoid relying solely on the numerical outputs.
Once the final scores for each impact are calculated, they must be translated into impact significance levels. The present study differentiates between five significance levels (very high/high/moderate/low/very low), which are based on the score ranges listed in Table 6.

Significance	Scores	Description
Very high	61- 75	High probability and very high level of effects in a widespread area and with long-term effects on the livelihoods of communities
High	46- 60	Probable impact with high effects on the livelihoods of communities, affecting many people or having a long-term effect
Moderate	31- 45	Medium level impact affecting a limited number of people in a small area for a limited time span
Low	16 -30	Only very limited effects; social, cultural and economic activities of communities continue unchanged

Very Low	0-15	No impact or impact of very low order

Table 6: Significance levels and scores for the expert survey

5. Application and results: case study CSP plant NOOR$_O$ I, Morocco

5.1 Results of the participatory assessment (focus groups)

Impact significance in the participatory assessment is defined as the correlation of importance rankings and the impact magnitude ratings, as described in section 3.1. The results of combining these two criteria into significance levels by applying the approach outlined in Table 3 are presented in Table 7. It can be observed that only a few impacts have a very high or high significance level on average and for the different stakeholder groups. This shows that although individuals may be highly affected in positive or negative ways, overall neither a specific stakeholder group nor the overall population was disproportionately affected. Furthermore, a higher number of (potentially) beneficial impacts were rated as having a higher significance compared to the (potentially) adverse impacts (Table 7). In addition, *observed* impacts were generally rated as being more significant than *anticipated* impacts, with exception of impact no. 15 which describes the concerns regarding the water situation in Ouarzazate and the water catchment area of the Drâa Valley. The reason why this potential future impact was assigned a high significance could be related to the fact that water has a high significance for the local livelihoods while being a scarce resource in the region at the same time.

Analysing the results for the four communities, no substantial differences can be observed, although stakeholders from the community of Ghassate were slightly more affected by the impacts due to their geographical proximity to the project site. However, looking at the different stakeholder groups, the results show that youth and students rated a higher number of impacts as significant compared to the other stakeholder groups. This could be explained by the fact that young people had higher expectations associated with the implementation of the CSP plant NOOR$_O$ I with regards to employment, income and education prospects.

The results of the participatory assessment also show that impacts affecting the human, social and political dimensions were among the impacts rated as the most significant compared to impacts on the physical, financial and natural environment, which were appointed lower significance levels overall. These findings underline the importance of including 'soft' factors, such as cultural identity and social cohesion, in impact assessments in addition to impacts on material and environmental livelihood assets.

No.	**Im-pacts**	**Stakeholder groups**								**Communities**				**Overall**
	Beneficial (+) or adverse (-)	Women **(n= 23)**	Youth **(n= 23)**	Farmers **(n= 20)**	Community Representatives **(n= 19)**	Workers CSP plant **(n= 6)**	The unemployed **(n=5)**	SMEs **(n= 4)**	Students new to the community **(n=**	Ouarzazate **(n= 36)**	Ghassate **(n= 25)**	Agdz **(n= 23)**	Idelsane/ Skoura **(n= 21)**	Average (n=106)
1	+	low	**high**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	low	n/a	n/a	low
2	-	very low	very low	low	n/a	n/a	very low	n/a	n/a	very low	low	n/a	n/a	very low
3	+	mod.	mod.	low	mod.	**high**	low	**high**	n/a	mod.	low	low	**high**	low
4	-	very low	low	low	low	n/a	low	n/a	n/a	very low	low	low	low	low
5	+	**high**	mod.	low	mod.	**high**	low	n/a	**high**	low	mod.	low	**high**	low

6	-	low	mod.	low	low	low	mod.	mod.	**high**	low	mod.	low	low	low
7	-	low	very low	very low	mod.	mod.	**high**	low	n/a	mod.	low	low	very low	low
8	-	mod.	very low	low	very low	low	very low	very low	n/a	very low	mod.	mod.	mod.	mod.
9	-	very low	very low	very low	mod.	n/a	low	n/a	n/a	very low	very low	low	very low	very low
10	+	low	**high**	low	n/a	n/a	n/a	n/a	n/a	low	mod.	n/a	n/a	mod.
11	+	n/a	n/a	n/a	low	n/a	n/a	n/a	n/a	low	very low	n/a	**high**	low
12	-	n/a	mod.	very low	very low	n/a	very low	n/a	n/a	low	very low	n/a	n/a	low
13	-	very low	mod.	low	low	n/a	n/a	n/a	n/a	n/a	low	n/a	n/a	low
14	-	low	n/a	low	very low	n/a	n/a	n/a	n/a	n/a	very low	n/a	n/a	very low
15	-	**high**	n/a	low	**high**	n/a	n/a	n/a	n/a	**high**	n/a	**high**	n/a	**high**
16	-	low	n/a	low	very low	n/a	n/a	n/a	n/a	n/a	very low	n/a	n/a	very low
17	+	n/a	n/a	n/a	n/a	n/a	n/a	very low	n/a	low	n/a	very low	n/a	very low
18	-	n/a	n/a	n/a	n/a	n/a	n/a	mod.	n/a	**high**	n/a	low	n/a	mod.
19	+	low	**high**	low	mod.	low	n/a	n/a	n/a	low	**high**	low	**high**	low
20	-	very low	n/a	very low	very low	n/a	very low	n/a	n/a	very low	very low	n/a	n/a	very low
21	+	n/a	n/a	low	low	low	n/a	very low	n/a	low	low	n/a	low	low
22	-	very low	low	very low	very low	low	very low	very low	n/a	very low	very low	very low	low	very low
23	+	low	low	very low	low	very low	low	low	**high**	low	low	low	low	low
24	+	n/a	mod.	n/a	n/a	low	n/a	low	n/a	low	low	low	low	low
25	-	n/a	mod.	n/a	n/a	mod.	mod.	mod.	low	mod.	mod.	**very hi.**	mod.	mod.
26	+	n/a	n/a	n/a	n/a	n/a	n/a	very low	n/a	very low	n/a	very low	n/a	very low
27	-	n/a	n/a	n/a	n/a	mod.	n/a	low	low	mod.	mod.	low	low	mod.
28	-	low	n/a	low	very low	n/a	n/a	n/a	n/a	n/a	low	n/a	n/a	low
29	-	very low	n/a	low	very low	n/a	n/a	n/a	n/a	low	very low	low	n/a	very low
30	-	very low	very low	very low	very low	n/a	n/a	n/a	n/a	very low	very low	n/a	very low	very low

(Source: Based on Wuppertal Institute and Germanwatch 2015)

Table 7: Results from the participatory assessment of impact significance[3]

5.2 Results of the technical assessment (expert survey)

The findings from the expert survey of the impact significance levels indicate that none of the impacts is of very high or high significance (Table 8). Eight impacts were evaluated to be of moderate significance, whereas the other impacts were evaluated to be of low to very low significance. The group of moderate impacts comprised six positive impacts and two negative impacts.

Of particular interest is the higher significance rating of impacts that describe the way people feel or experience effects, such as impact no. 7 which accounts for the unrealistic expectations that exist within the local communities regarding the benefits of the CSP plant. These types of impact cannot easily be quantified but can have real effects that can affect the timely implementation of the project and increase the risks for project developers and funding agencies. The fact that experts

[3] The focus groups each only evaluated a selected number of impacts because not all stakeholder groups are effect by all impacts or have the knowledge to make a meaningful evaluations of all impacts. Accordingly, each stakeholder group was assigned a limited number of impacts by which they were/are/would be affected or which they were best qualified to evaluate.

evaluated this impact to be in the group of the most significant effects highlights that for large-scale infrastructure projects such as $NOOR_O$ I material and physical factors are not the only relevant issues. 'Soft' factors and non-material aspects of wellbeing can play an equally important role for the successful and sustainable implementation of an infrastructure project.

In terms of the four evaluation criteria – likelihood, intensity, geographic extent and duration – the expert evaluation rated a number of impacts addressing the social and political dimensions as having a higher *likelihood*. Furthermore, most impacts were as being likely to occur or likely to have occurred, indicating a probability of up to 50%.

Regarding the *intensity,* almost none of the adverse impacts were rated by the experts as being of high or very high intensity with a sufficient confidence level (scores between 3.5 and 5). Instead, nearly all impacts were evaluated to be of low to moderate intensity. The two adverse impacts that were evaluated as being above moderate intensity both addressed the fact that local qualifications often do not match the contractual or employment requirements at the CSP plant. These findings underline the fact that for a complex and novel technology such as CSP particular skills are needed. The human capital available within a local economy can however often only partially provide these skills. Though, technical skills training for the local workforce was part of the accompanying programme for the $NOOR_O$ I project, these types of renewable energy projects cannot single-handedly close existing education and skills gaps. This appears to be a challenge which requires effort and commitment well beyond the scope of an energy infrastructure project.

Regarding the *geographic extent,* only a few impacts were evaluated as having effects up to the provincial level. With one exception, these were identified as mainly positive impacts. The adverse impact (no. 15) that was rated as having effects up to provincial level describes risks to the farming livelihoods from reduced water availability in Ouarzazate and the water catchment area of the Drâa Valley. This is an impact that has not yet materialised, but if it were to happen it would be substantial - also in regards to the geographic extent.

With regards to the *duration,* none of the impacts were classified by the experts as being irreversible; in contrast, most of the impacts were rated as having only medium-term to short-term effects. This means that most impacts are anticipated to last shorter than the project lifespan – this is the case for both negative and positive impacts. The positive impacts that were rated as having long-term effects were skill development and knowledge transfer, increased interest in renewable energy and improvement in living conditions in adjacent communities. The perception that skill development and knowledge transfer will be a longer-term benefit can be attributed to the fact that it is expected that trained personnel employed in the construction phase have enhanced opportunities to move on to new jobs in the regional or national labour markets in the future.

	Impacts		**Technical Approach (Expert survey)**					
	Status: observed (O) anticipated (A)	**Beneficial (+) or adverse (-)**	**Intensity (0-5)**	**Geographic Extent (0-5)**	**Duration (0-5)**	**Likelihood (0-5)**	**Average Significance score (0-75)**	**Average Significance Level**
1	(O) / (A)	+	2.7	2.8	2.8	3.0	26.8	low
2	(A)	-	1.9	2.5	2.6	2.9	22.2	low
3	(O)	+	3.4	4.3	3.0	4.0	43.1	moderate
4	(A)	-	1.8	2.4	2.5	2.3	15.3	very low
5	(O)	+	2.3	2.7	2.8	2.6	22.6	low
6	(O)	-	2.2	1.8	2.2	3.3	21.8	low
7	(O)	-	2.7	2.8	2.8	3.3	31.6	moderate
8	(O)	-	2.8	1.9	2.4	3.2	25.0	low
9	(O)	-	2.0	2.4	2.6	2.6	18.4	low
10	(O)	+	2.9	2.3	3.1	3.1	28.1	low
11	(A)	+	3.2	4.1	2.5	3.5	35.3	moderate
12	(A)	-	1.5	2.5	2.0	1.8	11.8	very low
13	(O)	-	2.0	1.3	2.6	2.6	16.0	low

14	(O)	-	2.0	1.5	2.4	2.3	16.9	low
15	(A)	-	2.5	3.8	3.4	2.9	29.3	low
16	(A)	-	1.7	1.4	2.7	2.8	17.5	low
17	(O)	+	2.7	3.6	2.5	3.0	29.7	low
18	(O)	-	3.0	3.4	2.0	3.1	30.0	low
19	(O)	+	3.1	3.1	3.0	3.2	32.2	moderate
20	(O)	-	2.6	1.5	2.4	2.7	18.2	low
21	(O)	+	3.0	4.1	3.0	3.2	36.4	moderate
22	(A)	-	2.1	2.2	2.2	2.2	19.5	low
23	(O)	+	2.6	3.6	3.3	3.4	36.4	moderate
24	(A)	+	3.3	3.8	3.5	3.4	38.3	moderate
25	(O)	-	3.3	3.1	2.6	3.3	31.2	moderate
26	(A)	+	2.5	3.4	2.8	2.8	27.8	low
27	(O)	-	2.6	1.7	1.9	2.4	19.5	low
28	(O)	-	1.6	0.4	1.9	3.1	12.2	very low
29	(A)	-	1.8	1.7	2.8	1.8	12.2	very low
30	(A)	-	0.9	3.0	2.8	1.4	6.7	very low

(Source: Based on Wuppertal Institute and Germanwatch 2015)

Table 8: Results from the expert assessment of impact significance

5.3 Comparing the participatory and expert survey results

In comparing the results (Table 9), it is clear that all but one of the impacts were rated by both the local stakeholders and experts as having, on average, only very low to moderate significance. Furthermore, the ratings from the expert survey and the participatory assessment show only few differences and where these variations do occur, the ratings differ by only one level of significance – except in on case for impact no. 15. Thus it can be argued that the overall results of the significance evaluation do not deviate substantially, although different perceptions exist regarding individual impacts.

However, it can also be observed that the ratings given by the local stakeholders are often higher than the expert ratings. The causes for these higher ratings could simply be owed to the circumstance that an information deficit exists on the part of the local stakeholders. However, this may also reflect the fact that the local stakeholders experience impacts differently and more intensely, or they place a higher value on certain livelihood aspects than the experts assume. This could indicate that certain impacts might be negligible from an external perspective, but are in fact significant for the local stakeholders.

	Impacts			**Average impact significance**	
	Impact	**Status:** observed (O) anticipated (A)	**Beneficial (+) or adverse (-)**	**Technical approach: expert survey**	**Participatory approach: focus groups**
1	Strengthened family ties and social support	(O) / (A)	+	low	low
2	Reduced social standing and political influence	(A)	-	low	very low
3	Intensified local pride and increased regional reputation	(O)	+	moderate	low
4	Accelerated changes to community atmosphere and cultural identity	(A)	-	very low	low
5	Discrimination against marginalised communities and social groups	(O)	+	low	low
6	Social conflict, rivalry and feelings of envy	(O)	-	low	low
7	Uncertainty, unrealistic expectations and frustration	(O)	-	moderate	low

8	Social exclusion and powerlessness in decision-making	(O)	-	low	mod.
9	Suspicion towards the project and its developers, as well as community protest	(O)	-	low	very low
10	Improved living conditions in adjacent communities	(O)	+	low	mod.
11	Stimulated regional socio-economic and infrastructure development	(A)	+	moderate	low
12	Strain on regional infrastructure and services	(A)	-	very low	low
13	Decreased psychological well-being and reduced cultural attachment in adjacent communities	(O)	-	low	low
14	Decreased water security in the community of Tasselmant	(O)	-	low	very low
15	Deprivation of farming livelihoods in Ouarzazate and cascading effects in the downstream oases of the Drâa Valley	(A)	-	low	**high**
16	Deprivation of subsistence activities in adjacent communities	(A)	-	low	very low
17	Economic participation and benefits for local SMEs	(O)	+	low	very low
18	Economic exclusion of micro-scale SMEs	(O)	-	low	mod.
19	Improved socio-economic situation and standards of living	(O)	+	moderate	low
20	Deterioration in socio-economic situation and standards of living in adjacent communities	(O)	-	low	very low
21	Increased regional prosperity and added value	(O)	+	moderate	low
22	Erosion of local purchasing power and decreased standards of living among low-income groups	(A)	-	low	very low
23	Increased public interest in renewable energy systems and civil society engagement	(O)	+	moderate	low
24	Benefits from skill development and knowledge transfer (particularly among the youth)	(A)	+	moderate	low
25	Mismatch between educational qualifications and labour market requirements	(O)	-	moderate	mod.
26	Strengthened technological capacity of local firms	(A)	+	low	very low
27	Poor and unequal labour conditions	(O)	-	low	mod.
28	Influence of noise, dust and vibration on psychological well-being	(O)	-	very low	low
29	Environmental pollution	(A)	-	very low	very low
30	Increased crime and fatal road accidents	(A)	-	very low	very low

Table 9: Comparison of results from the expert and the participatory assessment of impact significance

In the opposite case, i.e. where the experts' significance rating is higher than that of the local stakeholders, several explanations are thinkable. It could be the case that local stakeholders are unable to evaluate the magnitude of the impact on their lives – but from an objective point of view the impact is or will be significant. Another explanation could be that they are simply not aware of an impact because it has not yet materialised. In such instances, the results from the expert survey contribute to avoiding the risk of overlooking or ignoring important impacts. However, it could also be the case that that the experts value different aspects higher compared to local stakeholders or because the experts are not personally affected they can give a more objective perspective.

In this study, experts generally evaluated the positive impacts as being of higher significance. This result could be interpreted in various ways: (a) the positive impacts have not yet completely materialised, but the experts anticipate that they will; (b) the experts are over-optimistic regarding the positive impacts, but in reality particularly vulnerable groups have only restricted opportunities to take advantage of the benefits the CSP development offers; or (c) the positive impacts of infrastructure projects are over-estimated for strategic reasons, portraying developments in a more positive light than the reality.
Whatever the reasons behind the experts' ratings, it is essential to comprehend that the concept of significance and the analysis of distinctive significance levels remains to some degree subjective. Accordingly, the significance of social impacts can differ over time and between groups (Lawrence, 2007c). Therefore, it cannot be expected to reach a complete agreement between different local stakeholder groups and experts on impact significance. Despite this, integrating the different perspectives can contribute to a better understanding of the impacts of renewable energy infrastructure projects, as for other large-scale infrastructure developments, which can subsequently help to support the development of sustainable implementation models.

6. Discussion

The analysis presented exemplifies the development of a methodological approach and practical application of a combined participatory and technical impact significance assessment within an SIA. For the participatory assessment, the process of evaluating the importance stakeholders place on aspects of their living environment was extended from environmental values to societal and social values, comprising cultural, family and community aspects. On the other hand, for the technical assessment, an expert survey was conducted which is a widely-applied approach in EIAs and SIAs to determine impact significance. Although the applied approaches provided valid results, certain limitations were also evident.
The main strength, and equally the major weakness, of the presented study resides in the participatory elements. One risk of the participatory assessment approach is that selected individuals may not systematically represent the communities and stakeholder groups because better educated and better informed individuals often show a higher level of interest and participate more to participatory processes than the average citizen (Suopajärvi 2013; Esteves and Vanclay 2009; Stolp et al., 2002; Becker, 2003). Furthermore, like with every other participatory approach, the risk exists that the judgments from the participants are biased, which can result disproportionate consideration being given to personal opinions rather than to actual impacts. Efforts were made in this study to overcome these shortcomings by identifying the span of social and organisational structures in the affected communities and by focusing on the inclusion of vulnerable groups. Despite these risks relating to stakeholder engagement, the applied approach provides an example of how local communities can participate in the significance evaluation stage in impact assessments. Such participation has been quite limited to date; most approaches have generally simply aimed to ensure the legitimacy of projects by, for example, the simple disclosure of information for public comment (Dendena and Corsi, 2015) However, these type of public consultations are often inadequate for engaging local communities in decision-making processes, especially in the context of rural areas in emerging and developing countries (Esteves et al., 2012).
With regards to the technical assessment, the risks lie mainly in the way in which the survey data is translated into significance levels. By translating expert judgements into scores and aggregating these into a final score the complexity and difficulties for decision-makers to understand and interpret the outcomes can be reduced. Yet, information is inevitably lost at each aggregation stage and trade-offs among the criteria are possible. In this study, though, it is useful to be cumulate the data to be able to express significance levels on a unified scale make the results comparable and better understand potential differences between the expert and the participatory assessment.

Social impact assessments are also often criticised for addressing only the negative impacts, as these are relevant for potential mitigation measures (Esteves and Vanclay, 2009). However, impact assessments should, by definition, address both negative and positive impacts. Accordingly, this

study evaluated both the negative and positive impacts. The analysis showed that positive impacts can be perceived differently by stakeholder groups and experts. The over-estimation of positive impacts by experts can result in positive decisions being made about the implementation projects; decisions that could otherwise have been rejected. Therefore, it is important for positive impacts to be evaluated by both experts and local stakeholder groups.
Furthermore, the question remains how the approach and the results can be used beyond the case study context. While the impact significance levels are somewhat site-specific and cannot simply be generalized, many insights from the study, for example on the type of impacts that showed to be significant, can be helpful when analysing impacts of energy infrastructure developments in the MENA region. Moreover, the methodological design, especially the integration of participatory elements in SIAs could be applied to other case studies also outside the MENA region.
Based on the experience from the development and practical application of a combined approach to determine impact significance, additional research needs have been identified. To provide further insights into methods for evaluating the significance levels of social impacts, questions relating to the combination of different significance criteria into significance levels, and the evaluation and correlation of the different results from participatory and expert assessments, need to be addressed. Furthermore, it would be beneficial if more examples of practical applications were available and if authors would describe in greater detail the steps and methods they use and the challenges they face in determining impact significance, both in SIAs and EIAs. This would allow for the comparison of the results and lessons learned, extending the benefits of the SIA beyond the individual case study and thereby fostering a better understanding of social impacts.

7. Conclusion

This research study provides an example of a structured way of evaluating impact significance in a combined participatory-technical approach. In the participatory assessment, impact significance was evaluated based on the importance of the livelihood asset potentially affected and the magnitude of the impact on their wellbeing. Combining the results of this participatory assessment with the results of an expert assessment allowed for a more differentiated understanding of the significance of impacts resulting from the implementation of the CSP plant $NOOR_0$ I on the local livelihoods in Ouarzazate, Morocco. Moreover, it provided valuable information relating to where and for whom mitigation measures would be particularly necessary.
The results demonstrated that, to some extent, different stakeholder groups and experts evaluated the significance of positive and negative social impacts differently, but that the results did not deviate greatly for most impacts. It was also evident that in addition to physical and material livelihood impacts, the way people feel about and interpret certain developments are also important factors. Although these impacts are not quantifiable, they can be significant and need to be addressed accordingly.
Addressing the overall question of the sustainability of large-scale renewable energy facilities, the results of the significance evaluation can contribute to a better understanding of the livelihood impacts and possible reactions of affected communities. This could be an initial step in helping to make large-scale renewable energy implementations more sustainable in terms of the impacts at local level and on the social dimension.

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their cooperation and support in this study.

Appendix

	Average (106)		Women (n= 23)		Youth (n= 23)		Farmers (n= 20)		Community Represen-tatives (n= 19)		Workers at the CSP plant (n=6)		The unemployed (n=5)		SMEs (n=4)		Students new to the community (n=6)	
	I	M	I	M	I	M	I	M	I	M	I	M	I	M	I	M	I	M
1	7.3	1.0	7.5	0.2	7.1	1.7												
2	2.2	2.4	2.0	0.6	0.8	0.7	4.2	1.1					2.0	1.2				
3	3.7	1.4	5.6	2.2	2.7	2.7	3.5	2.4	2.2	2.6	6.0	1.8	1.0	2.0	6.3	2.0		
4	4.8	1.5	3.8	0.5	4.6	1.3	4.7	1.0	6.4	1.1								
5	5.4	1.1	6.1	1.5	4.9	1.6	4.3	1.2					8.6	1.2				
6	5.7	0.3	4.7	1.0	5.9	1.5	6.5	1.1	4.7	2.1	6.2	2.0	6.0	0.4			8.8	1.5
7	3.2	1.4	3.0	1.9	3.0	1.4	3.3	1.4	1.8	1.5	1.8	2.3	4.8	2.0	5.8	2.0	7.2	2.3
8	4.7	1.8	5.3	2.2	3.7	1.4	4.1	0.9	5.5	1.6	5.5	2.3	7.2	2.0	2.5	1.5		
9	2.7	1.7	2.5	1.1	2.6	1.0	1.9	0.6	3.1	0.7	5.5	0.8	2.4	0.6	3.5	0.5		
10	5.6	1.4	5.2	1.3	6.0	2.2	4.0	0.6	5.5	2.0			7.2	1.2				
11	4.3	0.5							4.3	1.1								
12	1.8				2.2	2.5	1.1	1.1	1.8	1.4			2.6	1.4				
13	5.1	0.8	3.8	0.8	4.3	1.0	8.6	1.4	4.2	1.0								
14	3.5	1.0	4.7	0.7			3.0	1.8	2.7	0.0								
15	7.7	1.4	8.5	2.3			6.0	1.0	9.0	2.2								
16	0.1	1.7	0.0	2.3					0.3	0.2								
17	3.8	1.6					0.0	1.8							3.8	0.3		
18	5.0	0.8													5.0	2.3		
19	6.6	1.5	7.0	1.4	7.8	1.5	6.2	1.4	4.7	1.6	7.8	1.2			6.0	0.8		
20	2.8	1.0	2.3	1.3			3.0	0.6	2.5	0.5			3.4	0.2				
21	3.2	0.8					2.4	1.9	3.7	2.1	4.2	1.2			3.3	1.3		
22	3.0	1.8	3.1	0.5	3.3	1.6	2.8	0.5	1.9	0.9	5.7	0.7	2.4	0.6	3.8	0.5		
23	2.8	1.4	2.9	1.9	2.6	2.0	2.3	1.2	3.2	2.0	1.0	1.0	2.6	1.6	0.3	2.0	8.0	1.5
24	5.1	2.3			5.1	1.6					2.8	2.0			4.5	0.3	7.8	0.7
25	5.1	0.7			4.2	1.5					5.7	1.7	4.8	2.4	5.3	2.0	7.0	0.8
26	2.5	0.8													2.5	0.5		
27	4.1	1.6									2.8	2.5			2.8	1.5	6.2	1.0
28	0.0	1.7	0.0	1.5			0.0	2.4	0.0	1.0								
29	3.5	1.6	0.8	1.3			4.2	0.7	3.9	0.8								
30	1.9	0.8	1.8	0.4	1.6	0.6	2.8	1.4	2.1	1.1								

(Source: Based on Wuppertal Institute and Germanwatch 2015)

Table 10: Mean importance (I) and impact magnitude (M) ratings by stakeholder groups across communities

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