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ABSTRACT

Many countries are increasingly investing in renewable energy technologies to meet growing energy demands and increase the security of their energy supply. This development is also evident in the Middle East and North Africa (MENA) region, where renewable energy targets and policies have evolved rapidly in recent years. There is a steady increase in both the number of planned and implemented solar photovoltaic (PV) but also of solar thermal projects in form of Concentrating Solar Power (CSP) plants. Many of these installations are designed as large utility-scale systems. Despite the fact that these types of large-scale projects can have significant effects on local communities and their livelihoods, the existing research into the social impacts of such large-scale renewable energy infrastructures at local level is limited. However, assessing and managing these impacts is becoming increasingly important to reduce risks to both the affected communities and to the project and businesses activities. In order to provide more robust evidence on the local effects, this research study reviews the social impacts of large-scale renewable energy infrastructure in the MENA region based on a case study of the $NOOR_O$ I CSP plant in Ouarzazate, Morocco. Data collected during two empirical field studies, in combination with expert interviews and secondary data analysis, provides detailed evidence on the type and significance of livelihood impacts of the $NOOR_0$ I CSP plant. The analysis results in a consolidated list of 30 impacts and their significance levels for different stakeholder groups including farmers, young people, women, community representatives and owners of small and medium enterprises. The results show that, overall, the infrastructure development was received positively. The review also indicates that factors identified as having effects on the sustainability of local livelihoods are mainly related to information management and benefit distribution, rather than physical or material aspects.

KEYWORDS:

Social impact assessment (SIA); concentrating Solar Power (CSP); participatory approach; local stakeholders; renewable energy; Morocco

1. INTRODUCTION

In many Middle Eastern and North African (MENA) countries, rising energy prices, growing energy demand and food insecurity are coupled with high population growth, rapid urbanisation and high unemployment rates. This poses serious challenges for the economic and social development of the region [1]. At the same time, global and regional issues such as climate change, increasing water stress and the depletion of fossil energy resources are putting further constraints on development in these countries [2,3]. Energy aspects play a central role in many of these challenges. Although the region as a whole is known as a major supplier of energy, many countries struggle to meet growing domestic energy demand [4]. Renewable energies are increasingly seen as a key component in addressing these issues. Accordingly, many countries are progressively investing in renewable energy technologies to meet growing domestic demand and increase the security of supply.

As a consequence, in recent years renewable energy targets and policies have also evolved rapidly in the MENA region. The development of solar power in particular has increasingly received attention, resulting in a high number of planned and implemented photovoltaic (PV) and (to a more limited extent) solar thermal projects in the form of Concentrating Solar Power (CSP) plants [5]. CSP systems are typically planned as utility-scale installations. Utility-scale solar can make a significant contribution to meeting ambitious renewable energy targets and to facilitating a rapid increase in energy supply security [6]. Further anticipated advantages are greater economic and technical efficiency and integration.

In addition to these benefits, large-scale infrastructure developments are also known for their potential to significantly impact on the surrounding communities [7]. These social impacts need to be carefully assessed and managed to reduce project risks and ensure that both the local communities and the project and businesses activities benefit from the developments [8]. In the context of the so-called Arab Spring movements in the MENA region, it is essential to ensure that investment in renewable energy infrastructure takes the needs of the local population into account.

Although numerous studies have driven the recent surge in CSP investment by promising multiple social, economic, environmental and even geopolitical benefits at the macro level, discussions about whether these potential effects also translate into benefit at local level have been limited. In comparison to other large-scale infrastructure projects, research on the impacts of large-scale renewable energy infrastructure on local livelihoods is scarce [9]. According to Munday et al. [10], there has been remarkably little empirical investigation into the localised rural development implications of the large-scale deployment of renewable technologies. This is despite the fact that, like any other large-scale infrastructure investment, renewable energy infrastructures such as CSP plants have the potential to impact neighboring communities well beyond the economic dimensions of employment and income generation. Consequently, in order to achieve sustainable development, it is important to take not only technological and regulatory questions into account when planning the scale-up of CSP in MENA countries, but also to consider the local livelihood dimension. Currently, however, many uncertainties remain about the wide array of tangible and non-tangible effects of large-scale deployment of CSP technology at local level.

Addressing this research gap, the SocialCSP project [11] analysed the local impacts of large-scale renewable energy infrastructures in the MENA region, based on the case study of the $NOOR_O$ I CSP plant in Ouarzazate, Morocco. The main objectives of this study were to improve the understanding of the complex relationships between large-scale CSP plants and the livelihoods of people living in the communities in which they are sited. The results of this study, specifically the two assessment steps – impact identification and determination of impact significance – are presented in this paper. Section 2 outlines the state-of-the-art of assessing impacts of large-scale energy infrastructure projects, followed by background information on the analyzed case study (Section 3). Details on the applied social impact assessment approach and the data sources are presented in Section 4. In Section 5, the results – in the form of the identified impacts and the significance of these impacts for different stakeholder groups and from an expert perspective – are described. Finally, Section 6 presents concluding remarks.

2. Assessing the social impacts of renewable energy infrastructure

There is a wide range of literature addressing the question of public and social acceptance of renewable energy infrastructure [e.g. 12,13,14,15], but the actual impact of such infrastructure on local livelihoods has received substantially less attention. Exceptions are the study by Delicado et al. [16], who investigate the impacts of wind and solar plants on local development in communities in Portugal, the analysis by

Munday et al. [10] on the economic development opportunities stemming from wind energy development in Wales and the paper by Del Rio and Burguillo [17], which assesses the impact of renewable energy deployment on local sustainability in Spain. Particularly in terms of social impact assessments, there is less research into the impacts of large-scale renewable energy systems than there is into other large-scale infrastructure projects such as mines [18], pipelines [19] or dams [20,21,22].

Despite the limited empirical research, the expectations of positive outcomes from the implementation of utility-scale renewable energy plants appear to be higher than for conventional energy supply infrastructure projects. This may be because renewables are commonly associated with sustainable development [23] and various environmental and socio-economic benefits can theoretically be linked to the implementation of renewable energies [24,25,26]. However, although the implementation of large-scale renewable energy systems is an important step for the transformation towards a more sustainable energy system on national, regional and global levels, renewable power plants do not automatically foster sustainable development at local level. In this regard, utility-scale renewable power plants show similarities to other large-scale infrastructure projects.

With a focus on solar energy, a number of authors have addressed different types of impacts. Aman et al. [27] for example analysed the safety, health and environmental impacts of solar energy technologies, while Torres-Sibille et al. [28] focused on the aesthetic impacts of solar power plants. Desideri et al. [29] compared the environmental impacts of CSP plants and PV systems and Khan and Arsalan [30] reviewed economic issues and environmental impacts of different solar power technologies. Hosenuzzaman et al. [31], on the other hand, focused only on environmental impacts of power generation using solar photovoltaic. In terms of utility-scale solar power plants, several analyses have been conducted focusing on the land use of such infrastructure developments [32,33], sense of place and place-based conflicts using the example of California [34,35,36] or visual impacts [37]. Beylot et al. [38] assessed the environmental impacts of large-scale solar deployments for the case of grid-connected ground-mounted PV installations and by Guerin [39], who focused on impacts on soil, flora and fauna as well as dust, noise and transport impacts from the construction of a utility-scale solar photovoltaic power plant in eastern Australia. Phillips [40] analysed the environmental impacts of the installation and operation of large-scale solar power plants.

With the exception of Corona et al. [9], who conducted a social life cycle assessment of a CSP plant in Spain, most of these impact assessments focus on environmental aspects, while social impacts are often only considered as part of the environment or not considered at all [17,41]. This is true not only for impact evaluations of renewable energy infrastructure but is actually a widespread phenomenon, despite increasing recognition of the importance of assessing and managing social impacts [8]. With the origins of Social Impact Assessments (SIAs) as an integrated element in Environmental Impact Assessments (EIAs) in the 1970s, SIAs often continue to be regarded as a supplement. Consequently, fewer resources are usually allocated to analyzing social issues than biophysical issues [8]. In this context, some authors have remarked that the potential of SIAs has not yet been fully exploited [42,43]. To achieve a more sustainable development, not only in the ecological dimension must be taken into account, but also social aspects need to be considered. Therefore, the social dimension must be integrated more holistically into research concepts, project developments and commercial operations.

In addition to the need to dedicate more resources to the analysis of social impacts, there is also a need for greater participation from local stakeholders and affected communities in impact assessments. Various authors have underlined the necessity to change or complement the more technical-orientated methods with participatory approaches [43,44,45,46,47]. Participatory approaches focus on stakeholder engagement, instead of using only rational-scientific measurements of impacts [48]. Despite the existence

of numerous theoretical reflections on the topic and availability of documentation on applications in small-scale development interventions, case study examples and actual application of participatory impact assessments that provide empirical evidence remain limited. Becker et al. [47], who investigated the effects of the development of dams, are an exception. They assessed the impacts both with a participatory approach, which took into account the views of local residents, and with a technical orientated approach.

In this study we aim to addresses these overall shortcomings by providing a case study example of a participatory approach to assess impacts, thereby following the recommendation of Vanclay [45] that an impact evaluation should be as participative as possible and that the local actors concerned should be directly involved in the process, regardless of the scope of the investigation.

3. Case study: NOOR$_O$ I CSP plant in Ouarzazate, Morocco

The energy system examined in this study is the 160 MW NOOR$_O$ I CSP plant located in Ouarzazate in the southeast of Morocco. The province of Ouarzazate has a semi-arid to arid climate with high temperatures and low precipitation levels, making the local catchment area, the Drâa valley, one of the driest catchment areas on the globe [49]. Droughts and water shortages occur regularly and have severe effects on the domestic agricultural sector, which is the main economic sector in the region. Most of the population lives in rural areas, but migration towards the urban agglomerations within and outside the region is an increasing trend. The development of the NOOR solar power complex in Ouarzazate is, therefore, not only highly relevant as a lighthouse project for renewable energy but also for local and regional socio-economic development.

The construction of the NOOR$_O$ I power plant started in 2013 and it has been in operation since 2016. It was designed as a parabolic trough plant, where rows of parabolic mirrors connected to loops bundle solar radiation onto pipes in which a heat transfer fluid circulates. The heat is used to produce steam, which drives a conventional turbine, thereby generating electricity [50]. The plant is equipped with a full-load molten salt storage unit with a thermal storage capacity of three hours and the mirrors cover an area of about 480 ha [51]. NOOR$_O$ I is one of four power plants planned within the NOOR$_O$ solar complex in Ouarzazate. When complete (scheduled for 2020), the complex will be one of the largest global solar systems with a total capacity of around 580 MW – enough to supply about 600,000 Moroccan households with electricity. The power plant is financed by a combination of debt financing (80%) and private equity (20%) [52]. International financial institutions such as World Bank and African, European, French and German development banks are the key lending agencies. The equity share is borne by different shareholder including the Moroccan Agency for Sustainable Energy (MASEN) and ACWA Power, the project developer and operator.

The development of the Ouarzazate solar complex is part of the Moroccan Solar Plan, which seeks to expand the national solar capacity to 2,000 MW by 2020 [51]. With its ambitious renewable energy targets, Morocco seeks to increase its security of supply and reduce its energy import dependency (currently about 95 %). A growing population, rapid urbanization and economic development are driving up the domestic demand for energy and placing additional pressure on the Moroccan energy sector. However, the Moroccan Solar Plan aims not only to increase security of supply, but also aims to acquire technological know-how in the field of solar energy and contribute to the regional socio-economic development. To achieve these objectives, the implementation of the NOOR$_O$ I CSP plant included both obligatory and voluntary measures to support the social and socio-economic development. Yet, while the mandatory environmental and social impact assessment provided detailed accounts of the potential

environmental and macro-economic impacts resulting from $NOOR_O$ I [53,54,55], only limited attention was given to the potential effects on the livelihoods of the local communities.

4. METHODOLOGY AND MATERIALS

4.1 Methodology: Social Impact Assessment (SIA)

In order to analyse the potential positive and negative impacts of both the construction and operational phases of the $NOOR_O$ I CSP plant, an SIA with a strong focus on the integration of local perspectives was carried out involving affected local stakeholders in different steps of the process.

The assessment was built on a number of systematic steps summarized in Figure 1. The analysis presented in this paper focuses on the results of the two assessment steps – impact identification and determination of impact significance.

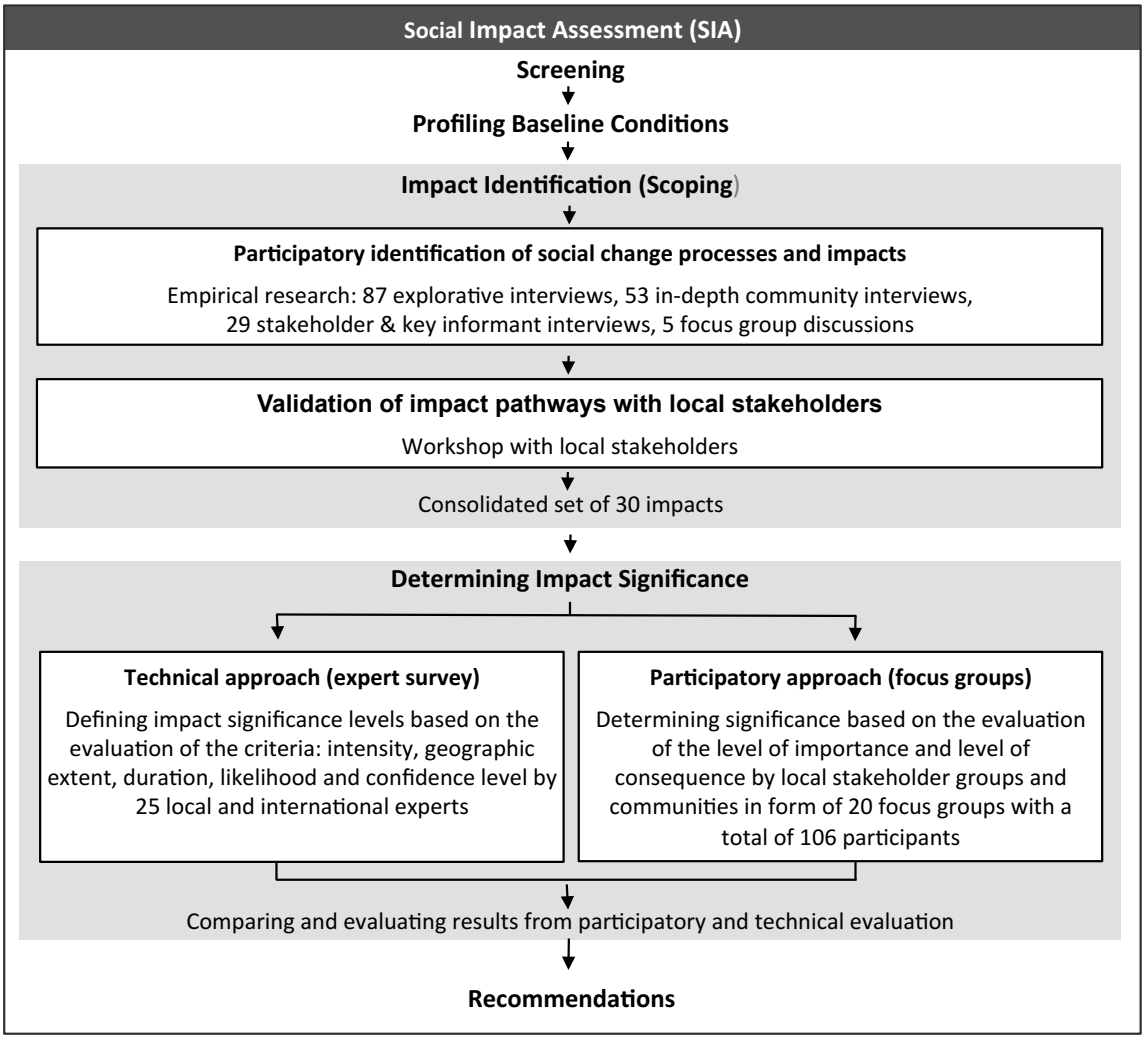

FIGURE 1. Methodology applied for the SIA

1. ***Step 1 - Screening:*** The first step of the SIA was to define the research area, describe the environment in which the project activities occur, analyze which stakeholders are likely to be affected and understand the needs and interests of these stakeholders. This was achieved through a detailed screening process and analysis of background information and data.

2. Step 2 - Baseline profiling: In a second step, the baseline, which reflects existing social conditions and trends at a given point in time, was established. It serves as a benchmark against which potential impacts and changes can be measured [56]. In the present study different data sources were used for profiling the baseline, including statistical census data, research data and other data from secondary literature sources. The data was complemented and verified with input from local stakeholders and the local researchers involved in the project.

3. Step 3 - Impact identification or impact scoping: This step consisted of an extensive empirical study in Ouarzazate to scope the key social issues. In order to understand the possible links between CSP development and its effects on community-level, cause-and-effect relationships of the different development stages of $NOOR_O$ I were analyzed to project social change processes and identify impacts. The result of this process was a consolidated list of 30 positive and negative, observed or anticipated, social impacts.

Step 4 - Determining impact significance: Once the main impact pathways were identified, the significance of these impacts was evaluated following a two-pronged strategy that combined professional expertise with the perspectives of community groups. In the framework of the participatory approach, various local stakeholder groups would be involved (women, young people, farmers, community representatives, workers employed at the CSP plant, unemployed people, students who had moved to Ouarzazate, small and medium business (SMEs)), whereas the technical know-how was obtained by means of an expert survey, which included experts from a number of selected fields (water, energy, health, business and social) and with different roles (local agents, project developers, financiers, investors and academia). Based on these assessments, the identified impacts were classified and prioritized according to their significance.

Step 5 - Recommendations: The outcomes of the SIA and explanations offered by local focus group participants and experts allowed for a better understanding of the local situation in Ouarzazate. The results are also relevant beyond the confines of the case study as they allow for recommendations to be drafted to further improving the planning and implementation process of future utility-scale renewable energy plants.

4.2 Data collection and analysis

The study is based on empirical data from two field studies and a consultation of local, national and international experts. The empirical data was complemented by secondary data from national statistics, scientific literature and regional reports. Both the field studies were conducted over the course of several weeks in Ouarzazate, Morocco, in 2014, while the expert survey was completed in parallel to the second empirical field study – partly through personal interviews in Morocco and partly through an online survey.

The initial empirical field study aimed to scope and identify potential impacts. In total, 87 explorative interviews, 53 in-depth community interviews, 29 stakeholder and key participant interviews and five focus group discussions were conducted. The interviews were designed as semi-structured interviews. The explorative interviews took place in eight communities (Ouarzazate, Ghassate, Agdz, Idelsane, Tiouine, Skoura, Tamezmoute and Taznakht). Based on the results, the research area was narrowed down and grouped into four areas (Ouarzazate, Ghassate, Agdz and Idelsane including Skoura), representing

different types of agglomerations (urban/rural) at different proximities to the power plant (neighboring/distant). The in-depth community interviews were conducted in these four communities. To complement the information from these personal interviews, 13 local interviews with central stakeholders from the four communities and 16 interviews with key participants with particular knowledge and/or influence on pertinent topics were organized. Following the interviews, five focus groups with selected stakeholders (farmers, small and medium enterprises (SMEs), young people, women and people from communities neighboring the CSP plant) were arranged to discuss stakeholder-specific impacts in more detail. The data from the interviews and focus groups was coded, grouped and thematically analyzed. Based on this analysis and following a number of iteration loops, a consolidated list of 30 social impacts was compiled.

The second empirical phase aimed at determining the significance different stakeholder groups attach to these impacts, by using a participatory approach. Eight stakeholder groups were selected, involving vulnerable population groups like women, young people, farmers and the unemployed, as well as stakeholder clusters who either held specific knowledge or were particularly affected by the development of the solar power plant, such as people working at the $NOOR_o$ complex, students who had moved to Ouarzazate, small and medium business (SMEs) and community representatives. Where appropriate, focus groups were held for each of the four communities separately, in order to understand the differences between the groups but also between the communities. A grand total of 106 participants took part in 20 workshops. They were asked to evaluate each impact in terms of the strength of the impact and the value they assigned to the livelihood characteristics/resources affected. The results of the two appraisals were combined into overall significance levels (very high/high/medium/low/very low).

In order to mitigate the risks associated with the participatory approach – for example participants delivering prejudiced judgments or overseeing important impacts – the impact significance was, in parallel, evaluated by 25 experts through a structured questionnaire. The experts were asked to assess the impacts against four significance criteria: intensity, geographical extent, duration and likelihood, taking uncertainty in the form of confidence levels into account. The evaluations given by the experts were then transferred into significance levels comparable to the significance levels derived from the stakeholder evaluations (very high/high/medium/low/very low).[1]

5. ANALYSIS AND RESULTS

5.1 Impact identification

Although the power plant had not yet been commissioned when this study was conducted, beneficial and adverse effects on people's livelihoods had already been observed during the planning and construction phases. These effects varied between communities, stakeholder groups and the different project phases.

In addition to observed impacts resulting from the completed project phases, the evaluation also included anticipated impacts for the operational phase. The anticipated impacts mainly describe the fears, hopes and expectations of the local communities.

A total of 30 social impacts were identified as result of the impact scoping phase. Table 1 describes and categorises these impacts in terms of the type of effects they have (beneficial or adverse) and their status at the time of the study (observed or anticipated). The impacts are grouped based on the areas of the local livelihoods they affect. It is evident that a wide range of impacts affecting the physical infrastructure and

[1] For details on the applied methodology to determine impact significance, please refer to the methodology paper Terrapon-Pfaff et al. 2017 [57]

the natural environment were identified, but an even greater number of impacts touch upon social and societal aspects, participation and information aspects, socio-economic dimensions, human capital development and health and safety issues. The majority of these impacts (18 out of the 30) had already been observed, while eleven were anticipated at the time of the study and one impact had already been observed by some stakeholders and anticipated by others. In terms of positive or negative effects, the results show 19 adverse impacts and only eleven beneficial impacts. This observation does, however, not allow for conclusions to be drawn on the overall social impacts of the power plant. In order to evaluate the overall impact, the significance of the different impacts must be projected and evaluated. This is done in the next step of the SIA process and presented in the following section 5.2.

TABLE 1. Overview of identified impacts

Impact fields	No.	Impact	Description	Status: observed (O) anticipated (A)	Type: beneficial (+) adverse (-)
Social and societal aspects	1	Strengthened family ties and social support	Due to increased migration, particularly from young people who returned to their families, people reported stronger family ties and social support among family members - both in quantity and quality.	(O) / (A)	+
	2	Reduced social standing and political influence	Concerns that increased migration and inequitable benefit sharing could lead to adverse changes in the social structure and power dynamics within communities.	(A)	-
	3	Intensified local pride and increased regional reputation	Due to public and media interest, the King's visit to inaugurate the plant and the project's national value, the development of $NOOR_O$ I is associated with increased local pride and reputation for the Ouarzazate region.	(O)	+
	4	Accelerated changes to community atmosphere and cultural identity	Increased migration of external and foreign workers and students could affect the region's cultural traditions, values, behaviours and lifestyles.	(A)	-
	5	Preferential treatment of affected communities and inclusion of women	Preferential treatment in sourcing labour, goods and services from the local communities of Ghassate and the city of Ouarzazate.	(O)	+
	6	Social conflict, rivalry and feelings of envy	Social tension among community factions and villages, driven by unmet expectations and envy towards communities benefitting from projects under the Social Development Plan.	(O)	-
Information and participation	7	Uncertainty, unrealistic expectations and frustration	Lack of understanding and uncertainty regarding the activities and outcomes of the $NOOR_O$ I among local stakeholder groups leading to unrealistic expectations and frustration.	(O)	-
	8	Social exclusion and powerlessness in decision-making	Local stakeholders felt that their possibilities to participate meaningfully in the consultation and decision-making process were limited.	(O)	-
	9	Suspicion towards the project and its developers, as well as community protest	Despite job creation and community development projects, some local stakeholders felt that they were not sufficiently informed and engaged, leading to discontent and opposition to the project and suspicion towards the developers and implementing organisations.	(O)	-
Physical infrastructure	10	Improved living conditions in adjacent communities	Investment into basic community infrastructure and services within the social development plan improved living conditions by providing access to important livelihood services and facilities.	(O)	+
	11	Stimulated regional socio-economic and infrastructure development	Investment and potential multiplier effects of $NOOR_O$ I raised hopes for socio-economic and regional infrastructure development.	(A)	+
	12	Strain on regional infrastructure and services	Fears of local stakeholders that the population increase due to construction jobs, new university programmes and the renewable energy training institute will put a strain on public infrastructure and services like sanitation, healthcare and education.	(A)	-
Natural environment	13	Decreased psychological well-being and reduced cultural attachment in adjacent communities	Local community members associated the transformation of rural landscapes into an industrial zone with negative effects on psychological well-being and feelings of alienation, because of their emotional ties and cultural attachment to their ancestral land.	(O)	-
	14	Decreased water security in the community of Tasselmant	According to villagers from Tasselmant, the availability of local water resources was reduced due to the use of groundwater for construction purposes.	(O)	-
	15	Deprivation of farming livelihoods in Ouarzazate and cascading effects in the downstream oases of the Drâa Valley	Concerns that water withdrawals from the Mansour Eddahbi reservoir could have direct impacts on water availability in the Drâa Valley and cascading negative effects on the downstream oases of the Drâa Valley, reducing the capacity to sustain agricultural activities.	(A)	-
	16	Deprivation of subsistence activities in adjacent communities	Adjacent villagers expressed concerns that the clearance of the site for $NOOR_O$ I and the associated activities of soil sealing and fencing may result in future decreases in biodiversity and ecosystem services.	(A)	-

Table 1 continued

Socio-economic aspects	17	Economic participation and benefits for local SMEs	The local content requirement for $NOOR_O$ I, preferencing local labour, materials and services and integrating local SMEs into the project's value chain, was associated with regional economic development and increased local entrepreneurship.	(O)	+
	18	Economic exclusion of micro-scale SMEs	Although the local content requirement was generally perceived as beneficial, many micro-scale SMEs complained that their chances for business opportunities were low due to their lack of capacities compared to foreign or more highly-skilled external firms and workers.	(O)	-
	19	Improved socio-economic situation and standards of living	Hopes for new income and employment opportunities from $NOOR_O$ I to alleviate poverty and bring socio-economic development to the Ouarzazate province.	(O)	+
	20	Deterioration in socio-economic situation and standards of living in adjacent communities	Despite positive socio-economic effects, people living near the power plant, especially women, reported decreased abilities to practice livelihood activities such as grazing goats and collecting firewood, leaving families who did not profit from employment opportunities at $NOOR_O$ I more vulnerable to economic shocks.	(O)	-
	21	Increased regional prosperity and added value	The implementation of $NOOR_O$ I is perceived to be an important catalyst for development and increased regional prosperity.	(O)	+
	22	Erosion of local purchasing power and decreased standards of living among low-income groups	Fears of local stakeholders that regional economic growth and demand for products from migrant and local workers, students and tourists could inflate prices for local consumers, including those not benefitting from the project.	(A)	-
Human capital	23	Increased public interest in renewable energy systems and civil society engagement	Increased public awareness of renewable energy and the need to address environmental problems, including climate change, as well as increased engagement and interest in civil society empowerment.	(O)	+
	24	Benefits from skill development and knowledge transfer (particularly among young people)	Efforts in the field of local capacity building, skill development and R&D provide the means to increase the competitiveness and productivity of the local industry, generating employment opportunities for local suppliers and workers.	(A)	+
	25	Mismatch between educational qualifications and labour market requirements	Despite efforts to promote capacity building and skill development, many young people noted the mismatch between the training currently offered by local educational institutions and the requirements to work at $NOOR_O$ I.	(O)	-
	26	Strengthened technological capacity of local firms	Hopes that increased collaboration, knowledge and technology in association with foreign companies would increase the capacities of the local industry.	(A)	+
	27	Poor and unequal labour conditions	Complaints about unequal employment benefits and contract periods, working conditions and lack of commuting infrastructure.	(O)	-
Health and safety	28	Influence of noise, dust and vibration on psychological well-being	Local stakeholders reported psychological distress due to increased dust, noise and vibrations due to earth removal and exhaust emissions from construction vehicles or mechanical equipment.	(O)	-
	29	Environmental pollution	Concerns related to possible health impacts resulting from pollution or contamination of local air, water and land resources and mirror reflections during the construction and operation of the power plant.	(A)	-
	30	Increased crime and fatal road accidents	Concerns related to the potential for increased crime rates related to drug and alcohol abuse due to the influx of external and/or foreign workers and students, as well as concerns that increased traffic to the project site could cause an increase in fatal road accidents.	(A)	-

(Source: Compiled based on [11]).

5.2 Evaluation of the significance of the impacts

Once the main impact pathways were identified, the significance of the 30 resulting impacts was evaluated. Based on these assessments the identified impacts were classified and prioritised according to their significance.

5.2.1 Stakeholder evaluation

To assess the significance levels of the identified impacts, the impacts were evaluated by twenty different focus groups. Not all effects apply to all groups. In order to ensure that a group would be able to make a meaningful evaluation only those impacts were assigned to a group by which it was/is or will be affected or for which the group members were best suited to assess them based on their special knowledge.

Women

Women formed a separate stakeholder group as they are often disadvantaged and particularly vulnerable in traditional societies. It was important to offer them the possibility to take part in the study on an equal footing and to voice their views and opinions. For this reason, four women-only focus groups were organized, one group dedicated to each of the concerned areas. The results show that, generally, women seemed to be particularly worried by impacts on social assets and policy aspects. They were highly to moderately affected by uncertainty, unrealistic expectations and frustration (Impact 7) and social exclusion and powerlessness in decision-making (Impact 8), while the most significant impact proved to be the positive impact of intensified local pride and gains for regional reputation (Impact 3). This points to women being especially sensitive to factors as for instance participation or information disclosure, which became also evident in the focus group conversations. Several women stated that they do not have a stake in decision-making and, therefore, also felt excluded from the processes associated with the power plant development. In the group for the city of Ouarzazate it also became clear that the women had further expected that more employment opportunities for women would be created by the power plant development. In addition, all focus groups emphasized the need to integrate marginalized people such as themselves, but also the unemployed and disabled.

With regards to the differences between the four communities, the results indicate that women from the urban areas of Ouarzazate were somewhat less exposed to the effects stemming from the development of power plant $NOOR_O$ I than women in the three rural research areas. For Ghassate, the community neighboring the power plant, women indicated that they were or would be moderately affected by most impacts, but attached on average less importance to the associated values, resulting in lower impact significance levels. Women from all communities classified impact 23 (Increased public interest in renewable energy systems and civil society engagement) as moderate. It was stated that due to the project people had started to consider regenerative forms of energy for their household needs and to power farming operations. Overall, it is apparent that positive effects were attributed higher levels of significance than negative effects by the women involved.

TABLE 2. Impact significance evaluation: women

Impacts			Communities				Average
No.	Observed (O) Anticipated (A)	Beneficial (+) Adverse (-)	Ouarzazate (n=5)	Ghassate (n=6)	Agdz (n=6)	Idelsane/ Skoura (n=6)	(n=23)
1	(O)/ (A)	+	Low	low	n/a	n/a	low
2	(A)	-	very low	moderate	n/a	n/a	very low
3	(O)	+	moderate	moderate	moderate	very high	moderate
4	(A)	-	very low	low	moderate	low	very low
5	(O)	+	Low	low	low	very high	high
6	(O)	-	moderate	low	very high	low	low
7	(O)	-	Low	moderate	high	low	low
8	(O)	-	very low	moderate	very high	high	moderate
9	(O)	-	very low	low	high	low	very low
10	(O)	+	n/a	moderate	n/a	n/a	low
13	(O)	-	n/a	very low	n/a	n/a	very low
14	(O)	-	n/a	moderate	n/a	n/a	low
15	(A)	-	n/a	n/a	very high	n/a	high
16	(A)	-	n/a	low	n/a	n/a	low
19	(O)	+	very high	high	moderate	very high	low
20	(O)	-	n/a	low	n/a	n/a	very low
22	(A)	-	very low	n/a	n/a	very low	very low
23	(O)	+	moderate	n/a	moderate	low	low
28	(O)	-	n/a	low	n/a	n/a	low
29	(A)	-	n/a	low	n/a	n/a	very low
30	(A)	-	very low	low	n/a	very low	very low

Farmers

Four farmer focus groups, one for each of the affected communities within the research area, were conducted. When assessing the impacts on farmers across the communities, it is clear that none of the impacts has been considered to be of high importance. Rather, a high number of impacts was considered to be of moderate significance. Intensified local pride and gains in regional reputation (Impact 3) was found to have the highest effect across farmer groups. The farmers further stated that they benefitted moderately from increased regional prosperity and added value (Impact 21). Furthermore, Ghassate farmers confirmed that the people who work at $NOOR_O$ I could better their livelihoods. They also felt that the development of the power plant had enhanced the reputation of the province, which they hoped would lead to further investment in the area.

Apart from these overall observations, the results vary considerably between the four communities. It is apparent that farmers from the community of Ghassate, in direct proximity of the power plant, are more strongly impacted compared to farmers in Ouarzazate, Agdz and Idelsane/Skoura. Compared to the other three communities, farmers from Ghassate indicated that they were or would be moderately to severely impacted from a range of adverse effects. These primarily concerned the social and political dimensions (Impact 4, 6 and 8), but also included impacts affecting human health, such as the influence of noise, dust and vibration on psychological wellbeing (Impact 28) and environmental pollution (Impact 29). Especially high was the impact rating for uncertainty, unrealistic expectations and frustration (Impact 7), which demonstrates that the level of information made available to farmers locate in proximity of the power plant appears to have been insufficient for avoiding these types of consequences.

TABLE 3. Impact significance evaluation: farmers

Impacts			Communities				Average
No.	Observed (O) Anticipated (A)	Beneficial (+) Adverse (-)	Ouarzazate (n=5)	Ghassate (n=5)	Agdz (n=5)	Idelsane/ Skoura (n=5)	(n=20)
2	(A)	-	low	low	n/a	n/a	low
3	(O)	+	high	low	low	high	low
4	(A)	-	very low	moderate	low	low	low
5	(O)	+	low	low	low	low	low
6	(O)	-	low	moderate	low	low	low
7	(O)	-	very low	moderate	very low	very low	very low
8	(O)	-	very low	moderate	low	very low	low
9	(O)	-	low	low	very low	very low	very low
10	(O)	+	n/a	low	n/a	n/a	low
12	(A)	-	very low	very low	very low	n/a	very low
13	(O)	-	n/a	low	n/a	n/a	low
14	(O)	-	n/a	low	n/a	n/a	low
15	(A)	-	low	n/a	low	n/a	low
16	(A)	-	n/a	low	n/a	n/a	low
19	(O)	+	high	low	low	low	low
20	(O)	-	n/a	very low	n/a	n/a	very low
21	(O)	+	low	low	low	very low	low
22	(A)	-	very low	very low	n/a	low	very low
23	(O)	+	very low	very low	low	very low	very low
28	(O)	-	n/a	low	n/a	n/a	low
29	(A)	-	very low	low	low	n/a	low
30	(A)	-	n/a	n/a	n/a	very low	very low

Community Representatives

Consultations with stakeholders also comprised four focus groups with representatives of the communities in the four defined research areas. The delegates from the affected communities considered both positive and negative impacts to be significant. It was found that, as for other stakeholder groups, the community representatives saw intensified local pride and gains for regional reputation (Impact 3) as one significant impact. Aggregated significance levels across communities also show that high significance was assigned to the potential impact of deprivation of farming livelihoods and sequential impacts on the downriver oases of the Draâ Valley (Impact 15), which received high ratings in the affected communities of Ouarzazate and Agdez. While social conflict, rivalry and feelings of envy (Impact 6) and improved living conditions in neighboring communities (Impact 10) were evaluated to be of medium significance.

With regards to social conflict, rivalry and feelings of envy (Impact 6), Ghassate community representatives reported that sentiments about the CSP facility had altered as a result of conflicts over land. Conversely, Agdz representatives have not experienced these effects in their community, implying that Ghassate's population who live in close proximity to the CSP plant, were the only ones to experience this impact and that the impact was not experienced in the region in general. In terms of Impact 15, community representatives stated that they expected it to affect their community as, in their eyes, the solar power plant puts more constraints on local water resources. This does however not reflect the current reality, as $NOOR_O$ I requires less than 1 % of the water from the El Mansour Ad Dahbi reservoir (the main water source for the region).

TABLE 4. Impact significance evaluation: community representatives

Impacts			Communities				Average
No.	Observed (O) Anticipated (A)	Beneficial (+) Adverse (-)	Ouarzazate (n=5)	Ghassate (n=6)	Agdz (n=4)	Idelsane/ Skoura (n=4)	(n=19)
3	(O)	+	moderate	high	moderate	moderate	moderate
4	(A)	-	low	high	low	low	low
6	(O)	-	high	low	moderate	moderate	moderate
7	(O)	-	low	low	very low	very low	low
8	(O)	-	low	low	high	low	moderate
9	(O)	-	very low	very low	very low	low	very low
10	(O)	+	n/a	moderate	n/a	n/a	moderate
11	(A)	+	low	very low	n/a	high	low
12	(A)	-	very low	very low	n/a	n/a	very low
13	(O)	-	n/a	low	n/a	n/a	low
14	(O)	-	n/a	very low	n/a	n/a	very low
15	(A)	-	high	n/a	high	n/a	high
16	(A)	-	n/a	very low	n/a	n/a	very low
19	(O)	+	low	moderate	low	moderate	moderate
20	(O)	-	n/a	very low	n/a	n/a	very low
21	(O)	+	low	moderate	moderate	moderate	low
22	(A)	-	very low	very low	n/a	very low	very low
23	(O)	+	low	low	low	high	low
28	(O)	-	n/a	very low	n/a	n/a	very low
29	(A)	-	low	very low	low	n/a	very low
30	(A)	-	very low	very low	n/a	high	very low

Young people

Another key interest group that could gain in particular from investments in large infrastructure developments such as $NOOR_O$, in terms of job opportunities or improved access to education, are young people. Meanwhile, young people are not always in the position to participate in decision-making processes, especially in traditional societies. It was, therefore, important for the participatory process to address young adolescents as a stakeholder group and take their perceptions into account by enabling them to voice their thoughts

The findings across the communities show that no impact was rated as having high significance. Impacts rated as having high effects were not rated as having high importance and vice versa. Nevertheless, the results also show that a high number of impacts are considered to be of moderate significance. The participants across communities agreed, like other groups that intensified local pride and gains for regional reputation (Impact 3) was an impact they experienced strongly. In terms of this impact, the young people from Agdz asserted that the region benefits from the project in terms of reputation, which, in their view, might encourage additional investments and raise health services and education levels. They also emphasized that the solar plant raised renewable energy awareness, but that this should not be the end of the story - sustainable energy ought to be advertised more strongly as in their opinion renewable energy sources have the potential to bring about local economic and social development.

With regards to differences between the communities, the group from Ghassate rated certain impacts as having higher significance than the other groups. The results further suggest that the young people from the community closest to the CSP plant benefitted or expect to benefit more from $NOOR_O$ I. This has resulted or could result in a sense of both social rivalry and envy, given that not all people enjoy equal benefits from the power plant.

TABLE 5. Impact significance evaluation: young people

Impacts			Communities				Average
No.	Observed (O) Anticipated (A)	Beneficial (+) Adverse (-)	Ouarzazate (n=6)	Ghassate (n=6)	Agdz (n=6)	Idelsane/ Skoura (n=5)	(n=23)
1	(O)/ (A)	+	low	high	n/a	n/a	high
2	(A)	-	very low	very low	n/a	n/a	very low
3	(O)	+	moderate	moderate	moderate	moderate	moderate
4	(A)	-	moderate	very low	moderate	low	low
5	(O)	+	low	moderate	low	moderate	moderate
6	(O)	-	low	moderate	low	moderate	moderate
7	(O)	-	low	low	low	low	very low
8	(O)	-	very low	very low	moderate	low	very low
9	(O)	-	very low	very low	low	very low	very low
10	(O)	+	n/a	high	n/a	n/a	high
12	(A)	-	moderate	n/a	n/a	n/a	moderate
13	(O)	-	n/a	low	n/a	n/a	low
19	(O)	+	high	high	low	high	high
22	(A)	-	low	n/a	n/a	low	low
23	(O)	+	low	low	high	low	low
24	(A)	+	high	low	n/a	low	moderate
25	(O)	-	very low	low	n/a	moderate	moderate
30	(A)	-	very low	very low	n/a	very low	very low

Stakeholder groups across communities: workers, unemployed, SMEs and external students

In addition to the four stakeholder groups of women, youth, farmers and community representatives, which were conducted separately for each of the four communities, four cross-community stakeholder groups were organized. Those participating in these stakeholder groups were grouped by occupation status, type of business activities or, for the student group, by their status as newcomers.

Workers employed at the CSP plant considered themselves to be severely afflicted by poor and unequal labour conditions (Impact 27). However, according to the participants, having a stable job at the $NOOR_O$ complex was still preferable to being unemployed, despite the fact that they were dissatisfied with the working conditions. Further significant impacts for this stakeholder group included Impact 3, Impact 6, Impact 8 and Impact 25.

The stakeholder group consisting of the unemployed put forward the view that even marginalised people of their kind should have a chance at integration in order to narrow the gap across social strata. While this is a legitimate request, it should be recognised that even large infrastructure developments can only employ a limited number of people and cannot solve all social problems. Factors independent of infrastructure investments, for example low levels of educational attainment, tend to add to marginalisation. Correspondingly, stakeholders stated that they are highly affected by the mismatch existing between qualification levels and the demands of the labour market (Impact 25). It hardly comes as a surprise that this group also felt impacted by uncertainty, unrealistic expectations and frustration (Impact 7) and social exclusion and powerlessness in decision-making (Impact 8). With regard to Impact 22, they did not perceive a decline in their spending capacity due to the power plant development, rather they commented on the fact that their spending capacity had actually been low before due to a vulnerable local economy. Similarly, the representatives of small and medium enterprises (SMEs) stated that they strongly experience economic exclusion of micro-scale SMEs (Impact 18), as well as the discrepancy between the level of qualification and the demand of the labor market (Impact 25).

Given that for SIAs it is considered to be vital to include the views of those individuals that were attracted to the region as a result of factors related to power plant development, students relocating to Ouarzazate to enrol in the newly established education programme focusing on renewable energies were selected for an additional focus group discussion. Another group in that category would have been foreign workers. But as this group is not particularly exposed in the case of $NOOR_O$I because the workers come mainly from Europe, they do not form a primary focus group of a sustainability assessment at community level. The selected focus group of newcomers, the students, could not compare the current situation to the conditions prior to their arrival and the project implementation. Consequently, they were only able to assess a certain set of impacts. One of the impacts with the highest significance for this group was Impact 23 (stronger interest of the public in regenerative energy systems). For one thing, participants stated that awareness of renewables is increasing, which they hope will help them to build their own businesses, and in general they hope that renewable energies will boost the national economy and reduce the cost of energy generation. On the other hand, the students felt under pressure to answer questions from the public on sustainable energies in general and $NOOR_O$ I in particular. Moreover, although this did not materialise in the impact significance rating, the students stated that they felt that a degree in renewable energy from the study programme in Ouarzazate would not allow them to find a job at $NOOR_O$ I later on, as some of them had hoped.

TABLE 6. Impact significance evaluation: focus groups across communities - workers, unemployed, SMEs and external students

Impacts			Stakeholder groups across communities			
No.	Observed (O) Anticipated (A)	Beneficial (+) Adverse (-)	Workers at the CSP plant (n=6)	Unemployed (n=5)	SMEs (n=4)	Students new to the area (n=6)
2	(A)	-	n/a	very low	n/a	n/a
3	(O)	+	high	low	high	n/a
5	(A)	-	n/a	low	n/a	n/a
6	(O)	-	high	low	n/a	high
7	(O)	-	low	moderate	moderate	high
8	(O)	-	moderate	high	low	n/a
9	(O)	-	low	very low	very low	n/a
10	(O)	+	n/a	low	n/a	n/a
12	(A)	-	n/a	very low	n/a	n/a
17	(O)	+	n/a	n/a	very low	n/a
18	(O)	-	n/a	n/a	moderate	n/a
19	(O)	+	low	n/a	low	n/a
20	(O)	-	n/a	very low	n/a	n/a
21	(O)	+	low	n/a	very low	n/a
22	(A)	-	low	very low	very low	n/a
23	(O)	+	very low	low	low	high
24	(A)	+	low	n/a	low	low
25	(O)	-	moderate	moderate	moderate	low
26	(A)	+	n/a	n/a	very low	n/a
27	(O)	-	moderate	n/a	low	low
2	(A)	-	n/a	very low	n/a	n/a

5.2.2 Expert evaluation

In the expert evaluation, the impacts have been evaluated against four significance criteria (intensity, geographical extent, duration and likelihood), taking into account the level of confidence of the experts in passing their judgments. Not all experts evaluated all impacts; instead they were requested to assess only those impacts that fell within their area of expertise and knowledge.

The intensity criterion describes the degree to which an impact affects the livelihood of local communities. The experts' survey did not rate any of the identified impacts as having a high or very high intensity. Instead, nearly all impacts were rated as having low to moderate intensity. The impact 30 (elevated crime rate and fatal road accidents) in fact was considered to have practically no effects for the analyzed communities. Out of seven effects that are evaluated to be of medium or higher intensity, there are five positive impacts (3, 11, 19, 21 and 24) and two negative impacts (18 and 25). Both negative effects are linked in that the competences available in the local economy do not meet the demands of a new and complex technology such as CSP in terms of required skill levels. Despite the project's investment in improving the technical skills of local workers (Impact 24), the need to further strengthen the general education and skill levels of both the local workforce and the private sector has become evident. To address these matters goes however well beyond what can be achieved with the implementation of a renewable energy project, but requires effort and commitment on the political level.

Geographical extent was the second significance criterion used by the experts to assess the impacts. Determining the extent of geographical coverage refers to the question if an impact is limited to a small area or concerns a larger region or group. While many studies assess the scale of an impact up to national or even international level, the focus of this study was only on local effects and, therefore, the evaluation of the geographical extent was limited to the regional context. A number of impacts were rated by the experts to have an impact right through to the provincial level. Most of these impacts were positive (3, 11, 17, 21, 23 and 24). The only negative impact was Impact 15, which concerns the farming livelihoods in Ouarzazate and the downstream oasis. As such, this is an expected impact that has not yet occurred, but if it would occur, it would be significant as far as geographical extent is concerned. Impacts that were, as per their description, limited to the communities neighboring the power plant (Impacts 13, 14, 16, 20 and 28) were confirmed by the experts to have only a limited geographical extent.

To evaluate the significance of the impacts, the third criterion was the duration of the expected and observed effects. It refers to the duration of the impact, which can range from momentary, short-term, medium-term, long-term to irreversible. The experts did not classify any of the effects as irreversible and only one impact was assessed as being medium to long term. Indeed, this impact was the positive effect of competence development and knowledge transfer, especially among young people (Impact 24). The anticipated lasting advantage is expected to come from training and skills development, which should contribute to expanding the human capital available within the local economy. For a skilled workforce engaged at the building stage it is more likely to find new employment in regional or national labor markets later on. Given that the impacts were overall assessed as being mainly medium to short term, it can be assumed that most of the impacts, including the positive impacts, will be shorter than the project duration.

In addition to intensity, geographical extent and duration, the likelihood of impacts materializing was evaluated. It is a measure of the probability that an effect actually occurs. The results of the expert survey suggest that most impacts are likely to occur/to have occurred, outlining a probability of up to 50 %. Only two positive impacts were attributed to a higher probability (Impacts 3 and 11), while six negative impacts were categorized as being unlikely to occur (Impacts 4, 12, 14, 22, 27 and 29). From these findings it can be seen that many of the impacts on people's physical lives were evaluated to be less likely, while impacts on the socio-political dimension were found to be more likely.

TABLE 7. Impact significance evaluation: expert survey

Impacts			Expert survey				
No.	Observed (O) Anticipated (A)	Beneficial (+) Adverse (-)	Intensity	Geographical Extent	Duration	Likelihood	Average significance level expert survey
1	(O)/ (A)	+	medium	urban	medium term	likely	low
2	(A)	-	low	urban	medium term	likely	low
3	(O)	+	medium	provincial	medium term	most likely	moderate
4	(A)	-	low	communal	medium term	unlikely	very low
5	(O)	+	low	urban	medium term	likely	low
6	(O)	-	low	communal	short term	likely	low
7	(O)	-	medium	urban	medium term	likely	moderate
8	(O)	-	medium	communal	short term	likely	low
9	(O)	-	low	communal	medium term	likely	low
10	(O)	+	medium	communal	medium term	likely	low
11	(A)	+	medium	provincial	medium term	most likely	moderate
12	(A)	-	low	urban	short term	unlikely	very low
13	(O)	-	low	communal	medium term	likely	low
14	(O)	-	low	communal	short term	unlikely	low
15	(A)	-	medium	provincial	medium term	likely	low
16	(A)	-	low	communal	medium term	likely	low
17	(O)	+	medium	provincial	medium term	likely	low
18	(O)	-	medium	urban	short term	likely	low
19	(O)	+	medium	urban	medium term	likely	moderate
20	(O)	-	medium	communal	short term	likely	low
21	(O)	+	medium	provincial	medium term	likely	moderate
22	(A)	-	low	communal	short term	unlikely	low
23	(O)	+	medium	provincial	medium term	likely	moderate
24	(A)	+	medium	provincial	long term	likely	moderate
25	(O)	-	medium	urban	medium term	likely	moderate
26	(A)	+	medium	urban	medium term	likely	low
27	(O)	-	medium	communal	short term	unlikely	low
28	(O)	-	low	punctual	short term	likely	very low
29	(A)	-	low	communal	medium term	unlikely	very low
30	(A)	-	none	urban	medium term	none	very low

5.3 Summary of results: Social Impact Assessment of $NOOR_O$ I CSP plant, Morocco

The results show that the $NOOR_O$ I CSP plant was, overall, received positively in the region of Ouarzazate. Aspects such as information management and the distribution of benefits have had, or will have, the greatest impact on the sustainability of livelihoods at the community level. Specifically, citizens in adjacent communities have mentioned that they perceived the information management as not sufficient to fully understand all the relevant project details or to participate meaningfully in the decision-making processes. This is despite the fact that - in compliance with national law and internationally accepted standard procedures - various attempts have been made throughout the siting and implementation phases of the project to disseminate information and involve and interact with local stakeholders.

In terms of improving and delivering positive impacts on livelihoods, the results show that, alongside indirect positive effects (such as strengthening family ties and social support through reverse migration flows and increased public interest in renewable energy), direct effects (such as creating local employment opportunities, strengthening capacity and improving infrastructure in neighbouring communities) have been identified as the most significant. Furthermore, as infrastructure and services in the region had been among the poorest in the country, investments made under the social development plan to improve access and availability of social services proved to be also a key component in the distribution of net benefits among the local population. In addition, the socio-economic situation and the standard of living in a number of households have already improved as a result of the employment, income and multiplier opportunities arising from local content obligations. These requirements ensured that also local SMEs were engaged throughout the building phase. However, it is expected that only a limited number of jobs for local workers and commercial prospects for both locally based suppliers and contractors remain throughout the operational phase. Despite the potential of local content requirements to promote industrial growth, the local economy in the Ouarzazate region has only limited capacities to absorb these opportunities. It is, therefore, uncertain to what extent local economic participation will be sustained and long-term benefits will be achieved. However, indirect income effects in the service and tourism sector could generate, albeit to a limited extent, additional local economic opportunities which were previously non-existent. In line with the findings of Delicado et al. [16] and del Río and Burguillo [17] the creation of economic opportunities in rural areas is valued by local stakeholders, even if those opportunities are limited.

In terms of negative livelihood impacts, the research results provided evidence that most of the negative impacts resulting from $NOOR_O$ I were found to be of lower significance and that several of the negative livelihood effects associated by the local stakeholders with $NOOR_O$ I can only be attributed to a limited extent to the project implementation. Most of the identified impact pathways and negative effects can either be interpreted as an increase in already existing sustainability challenges in the project region, or as impacts that are not explicitly attributed to the CSP technology or related to the local setting. Negative impacts include the potential impact of the project's operational water use was one of the major concerns for the local stakeholders. Although studies have shown that the water demand of the $NOOR_O$ I CSP plant will not negatively affect the local water availability, this type of local concern would need to be addressed more intensively in order to avoid potential future conflicts. This contrasts with the impacts in form of loss of collective land and limited access to ecosystem services, which are not being considered to be critical. Apart from the environmental impacts and despite efforts to foster the development of capacities and skills, it was found that the discrepancy between training provided by local educational institutions and working requirements in $NOOR_O$ I were among the negative impacts with the highest ratings. Furthermore, the distribution of employment opportunities and social development plan projects among communities and social groups resulted, in some cases, in competition, which negatively affected social satisfaction within and between communities.

Negative impacts rated to have only limited effects include the potential influence of outsiders, foreign workers and students on cultural identity and local traditions. The same applies to the concerns of the local population that new immigrants could further burden the already limited social services and infrastructure. Likewise the expressed fear that in migration could result in rising local prices and reduced safety and security was finally evaluated as having only a low relevance. Moreover, increased dust, noise and vibrations during the construction phase, as well as worries about potential health effects of air, water and soil resource pollution were found to be of low significance to the local stakeholders. Similarly,

increased light emissions due to the mirror reflections from the power plant were ranked as having low significance.
The results show that, overall, the infrastructure development was received positively. The factors identified to have consequences for the livelihood sustainability at local level (either already or in the future) are mainly issues related to information management and benefit distribution, rather than physical or material aspects. This can be seen as important feedback for project developers and decision-makers in ministries.

6. DISCUSSION

The analysis provides empiric evidence on the social impacts of a large-scale CSP power plant based on the case study of NOORo I in Morocco. Despite the empiric results of this analysis, the applied research approach still has certain limitations and uncertainties. These arise from factors such as the variability and quality of the input data collected during the empirical research phases, choices made within the stakeholder selection process and assumptions made in summarizing information during the impact identification process. However, the key strength and likewise the main constraint of the presented study lies in the fact that it relies extensively on stakeholder participation. Extensive stakeholder participation risks giving rise to biased judgments that represent personal opinions instead of informed assessments. Moreover, the opinions of the focus group participants might not reflect the entire spectrum and diversity of the local perspectives, as studies have shown that people who are more educated and well informed demonstrate a stronger degree of interest and take part more often in such processes compared to the average citizen [18,43,47]. In order to reduce these risks, efforts were made to identify local community and institutional structures and to include vulnerable groups. In spite of these risks associated with stakeholder involvement, the approach adopted shows ways in which local communities can be involved at different stages of impact assessments.
The results show little substantial deviation between the average ratings for the significance levels of the different impacts from the participatory evaluation and the expert survey. It is, however, crucial to acknowledge the fact that the notion of significance and the interpretation of the significance levels will always be subjective to a certain degree. Accordingly, the significance of social impacts may change over time and between local stakeholder groups and experts. Therefore, it is important not only to focus on the average rating but also to look at the differences between stakeholder groups to make sure concerns of vulnerable groups are taken into consideration.
The stakeholder consultations further indicate that not all groups benefitted equally and that the expectations of local stakeholders and experts sometimes exceeded the social and economic development potential that could be achieved through the implementation of a large-scale renewable power plant. These findings are in line with Delicado et al. [16], who found feelings of unfulfilled expectations existed among local stakeholders in communities in the vicinity of solar and wind plants in Portugal. Consequently, the importance of other project components, such as stakeholder participation and expectation management, should not be underestimated when planning and implementing renewable power plants. Despite the importance of stakeholder participation, it also has its limitations. Cuppen [58], for example, argues that social conflicts surrounding the implementation of energy projects are often not only related to the energy project itself but evolve based on existing local and regional issues and, consequently, cannot be completely avoided. Social conflicts around renewable energy projects should, therefore, be regarded as a form of self-organized participation [58].

While the focus of this study was the implementation of CSP technology in Morocco, the methodology and the findings are not necessarily only CSP-specific and could potentially be applied to other regions and other large-scale renewable energy or infrastructure projects with certain site and technology-specific amendments. However, in order to be able to make more thorough sustainability recommendations for large-scale CSP or other renewable energy developments worldwide, it would be essential to conduct a systematic integrated analysis of impacts for a number of different large-scale power plants, including a comparison with fossil or nuclear fired power plants for which such assessments are also lacking.

7. CONCLUSIONS

The importance of assessing the socio-economic benefits of large infrastructure projects is widely recognized, but to date few publications exist in the academic and practitioner literature on the potential impacts of these developments at local level. Even less information is available on the local impacts of large-scale implementation in the MENA region. To fill this research gap, this social impact assessment of $NOOR_O$ I in Ouarzazate, Morocco, provides detailed empiric insights, which allow an enhanced understanding of the effects CSP infrastructure developments can have on the social and socio-economic environment in which they are sited.

Although CSP technology in general can help to meet the rising energy demand and replace the use of fossil fuels, the analysis shows that the implementation of the technology is unlikely to automatically foster sustainable development at local level. Yet, the results point to an overall positive response to the infrastructure development. Moreover, the review shows key factors affecting the sustainability of regional livelihoods to be related to information management and benefit sharing rather than physical or material aspects. However, the participatory approach applied also provides empirical evidence on how different interest groups are affected differently by the infrastructure development. Combined with the expert assessment of the impacts, the analysis provides a broader understanding of the complex relationships between large CSP facilities and the livelihood of people in the communities where they are located.

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