Public acceptance of hydropower in Switzerland

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Introduction

To mitigate the negative consequences of climate change, societies need to engage in the adoption of cleaner energy technologies. As a consequence of the nuclear disaster in Fukushima in March 2011, new energy strategies have come to life that aim at the gradual nuclear and carbon phaseout. To cover the drop-out electricity production renewable energy sources have to be increased dramatically triggering both technological and social challenges. One of the most utilized renewable energy resource is hydroelectric power that has undergone a long history. This energy resource constitutes the major part of electricity generation (56%, with an average of around 35,830 GWh per annum) in Switzerland and which is planned to be substantially extended over the next decades (SFOE, 2014).

Recently, the social acceptance research has become an emerging field in social scientific discussion due the sensible social tension over renewable energy innovations. To clarify the definition of social acceptance, Wüstenhagen et al. (2007) distinguish three dimensions of social acceptance, namely socio-political acceptance, community acceptance and market acceptance.

Hydropower generation primarily affects the adjacent communities through changing the landscape and deteriorating the aquatic and riparian ecosystem. These ecological and aesthetic impacts bring about local resistance leading to the disapproval of implementation. Studies suggest that well-established trust, social fairness and environmental justice might increase the degree of acceptance (Manaster, 1995; Gross, 2007). When it comes to the adoption of renewable energy sources, the trade-offs that have been studied so far, are usually between environmental gains (e.g. cleaner energy production) and economic loss (Kaenzig et al., 2013). However, several new questions surrounding the trade-offs between global environmental gains (less carbon emission) and local ecological loss (river ecosystem) related to hydropower production remain unanswered. For instance, the current resistance against hydropower production rather shows a dissonance between local concerns and the support of energy policies which might go beyond social acceptance issues.

Methods

To seek answers to this question, we designed a survey to measure public preferences for the extension of hydropower production in Switzerland and related issues aiming

at providing theoretical insight into the economic and ecological trade-offs for alternative hydropower expansion scenarios. A national web-based representative survey has been conducted in Switzerland in 2014 to elicit preferences. The questionnaire was furthermore designed to examine climate change perceptions, worldviews, conservation attitudes and key socio-demographic variables (see Table 1). For the programming of the questionnaire we used the Sawtooth Software. A poll company recruited the respondents between October 30 and November 10 in 2014 using computer-assisted web interview (CAWI) with 1004 respondents. The sample was representative for geographical location, gender, age and income of the Swiss population. The survey was translated into German and French. The Italian and Romansh speaking parts of Switzerland were excluded from the sampling.

To determine public preferences for different hydropower scenarios, we conducted a discrete choice experiment. Choice experiment is a widely used stated preference technique and is characterized by multinomial discrete choice questions in a choice set. Hierarchical Bayes (HB) procedure is applied (Orme, 2000) to estimate the distribution of part-worth utilities across the population and combines with the information on individuals' choices to derive posterior estimates of the individuals' values. The attributes and levels applied in choice experiment are based on expert interviews among others with natural scientists working in the field of ecological impacts of hydropower production.

The first attribute 'ecological impact' describes the change in landscape and natural biodiversity caused by hydropower generation (see Table 1). Hydropower plants typically create longitudinal barriers that have deteriorating impact on sediment regime and prevent aquatic animals from upstream migration. To solve this problem, various types of fish ladders and bypass channels have been designed with varying degree of efficiency. The next two attributes investigate the two main components of environmental justice; distributive and procedural justice. The distributive justice is translated into the 'ownership' attribute that offers alternative options for the operator of the hydropower plant. The procedural justice is captured by the attribute 'public participation' with different options for public involvement. The 'employment' attribute shows different number of jobs created by the construction of the hypothetical hydropower plant in the respondent's canton. The 'income from water rate' constitutes the monetary attribute.

Table 1: Attributes and levels regarding hydropower products for choice experiment

Attributes	*Description and levels*
Ecological impact	The use of hydropower has some negative consequences for aquatic ecosystems and the landscape. Animal and plant species and riparian vegetation are affected by chemical exposure and by structural changes (loss of wetlands, deforestation, water extraction, storage and obstruction of rivers). Respondents are offered to choose between different projects with **large, medium, small** and **almost no** ecological impact.
Ownership	You have the option to choose one of four power companies would you most like to see as the owner of the hydroelectric power plant. The system can be in possession of a **municipal utility, a cantonal utility, a private company or a German company**

Public participation	The public can be involved in different levels in the decision process, such as through **information brochures, public information meetings, participation in the planning process or referendum**
Employment	There are different scenarios, how many jobs could be created by the construction of this hydroelectric power plant in your canton. The number ranges from **10, 20, 30** to **40** jobs
Income from water rate	The operators of hydropower plants have to pay annually to communities and/or the canton the water rate as payment for the use of the water. Suppose that the water rate goes 50% to the canton and 50% to the community. The sum of the revenue your community and your canton of water rate can range from **0.75, 1.0, 1.25 to 1.5 million CHF/year** and is used for public purposes such as the construction of schools, kindergartens or roads in your community or canton

Results

Hydropower generation has led to significant degradation of riverine habitat in Switzerland over the last decades (Burkhardt-Holm, 2002). Based on the survey results, ecological impact of hydropower seems to be the prerequisite of any public acceptance of further expansion (see Table 2 and 3). We find support for the importance of distributional justice, namely people strongly prefer local or regional ownership over hydropower plants owned by private or even foreign companies. As for procedural justice, we find mixed results. People value participation, but not as strongly as one might expect a priori which means that if a certain minimum level of participation is fulfilled, more participation might not lead to stronger acceptance which contradicts to some previous findings suggesting a straight linear relationship between participation and acceptance. Though it can also be an artifact of the different institutional environments (Switzerland with its direct democracy offers sufficient legal provisions for citizens to have a voice). The low importance of water rate suggests that when it comes to hydropower, Swiss people are not very price sensitive, which is in line with findings from other surveys in the electricity sector (Burkhalter et al., 2012).

Table 2: Attribute importances

Attributes	Average Importances
Ecological impacts	41.51 (19.12)
Ownership	30.59 (16.35)
Employment	10.57 (6.72)
Public participation	9.76 (6.26)
Water rate	7.55 (5.22)
Total	100.00

Table 3: Average part-worth utilities

Average Utilities (Zero-Centered Diffs)	Average Utilities
Ecological impacts	
almost none	68.14 (64.94)

small	46.32 (33.23)
medium	-5.29 (23.98)
large	-109.17 (77.44)
Water rate	
0.75 million CHF/year	-13.19 (19.13)
1.0 million CHF/year	1.04 (12.81)
1.25 million CHF/year	3.27 (13.66)
1.5 million CHF/year	8.87 (16.33)
Ownership	
Cantonal utility	47.45 (39.06)
Local utility	38.97 (34.52)
Private company	1.21 (27.28)
German company	-87.63 (61.04)
Employment	
10 jobs	-21.71 (23.06)
20 jobs	-2.86 (15.42)
30 jobs	7.53 (13.20)
40 jobs	17.05 (22.82)
Public participation	
Information brochures	-13.17 (20.39)
Public information meetings	-0.88 (19.68)
Participation in the planning process	11.68 (20.69)
Referendum	2.36 (23.91)

(standard deviation in parentheses)

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