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Participatory integrated assessment of adaptation to climate change in Alpine tourism and mountain agriculture

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Winter tourism and mountain agriculture are the most important economic sectors in a major part of the Swiss Alps. Both are highly sensitive to changing climatic conditions. In the framework of the CLEAR project, results from climate impact research in the field of tourism and agricultural production were used to investigate the perception of climatic change by stakeholders and to assess possible adaptations. We used a participatory integrated assessment (PIA) to involve the knowledge, values and experiences of the various social actors in tourism and agriculture (e.g., skiers, tourism managers, farmers) in the research process. Whereas climate change may have various severe direct impacts on the tourism industry, depending on the region, agricultural production may generally benefit from changed climatic conditions. But because of the dependence of farmers on "off-farm" income, the loss due to declining winter tourism in specific areas may cause more important indirect effects. However, the two sectors may adapt actively by choosing from a variety of strategies, and the loss of income from the tourism industry may support the re-evaluation of the various functions agriculture plays in mountain regions, beyond the production of food. The study demonstrates the suitability of the PIA approach to elucidate the interactions between different stakeholders and their perception of the climate change phenomena. A similar participatory approach could be a useful tool to transfer research results and expert knowledge to the political process addressing adaptations to climate change.

Keywords: climate change, mountain agriculture, tourism, participatory integrated assessment, focus groups

1. Introduction

It is indisputable that climate change may have serious physical but also socio-economic impacts, although uncertainty exists with respect to the magnitude of change. Thus description, problem-framing and predictions, as well as developing policies must be undertaken under a high degree of uncertainty, which is associated with both the problem itself and with the processes to deal with it. This situation has contributed to a change in the political culture, where traditional ways of purely expert-oriented problem solving are more and more superseded [27], and even boundaries between experts and lay-people are getting increasingly fuzzy [4].

For the Swiss alpine area, effects on winter tourism and mountain agriculture are of interest because of their economic and social importance and because of their interrelationships [9]. The snow deficient winters at the end of the 1980s revealed the sensitivity of the Swiss tourism industry to the lack of snow. Quantitative snow modeling for skiing conditions in various Swiss ski resorts showed that under changing climatic conditions, the border of snow-reliability will rise from 1200 up to 1500–1800 m [11]. Today, 85% of Swiss ski areas can rely on sufficient snow. However, if there is a rise in snow-reliability to 1500 m, this number would drop to 63% [1] leading to a new pattern of favorable and unfavorable tourism regions in the Swiss Alps. Ski resorts in lower parts of the Alps will be most affected by lack of snow; some of these resorts will probably have to give up ski tourism. Meier [23] estimated that tourism will lose about 1.8–2.3 billion Swiss francs a year due to climate change. However, it is unclear to what extent these figures are reflected in the evaluation of the problem by the stakeholders in the tourism industry. Apparently, tourism managers are able to adapt to this new situation [1], but also the tourists themselves may adapt to the changed conditions.

Agriculture not only plays an important role in producing food, but also in preserving an attractive natural landscape. Although in certain regions agriculture remains the base of economic and social life, in other regions it has become a sector of small importance [12]. As an example, in the Bernese Oberland of Switzerland the number of individuals working in agriculture declined by 30% between 1980 and 1990 [15], but policy measures have been taken to improve the economic situation of mountain farms. Because of the physical conditions, farming in mountain areas is more difficult and less profitable than at lower altitudes. The energy yield of a 15 ha farm declines from 100% at 650–750 m to 68% between 900 and 1000 m, and to 55% at 1100–1300 m above sea level [10]. An economic analysis based on preliminary estimates of changes in productivity showed that differential effects of climate change on lowland and mountain regions could lead to a loss in competitiveness of mountain agriculture [17]. Thus, changes in the physical constraints by climate change may have important implications for farming, and adaptations may be necessary. In spite of that it is unclear how farmers view the importance

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of climate change relative to changes in the socio-economic system, and how this view may depend on the region and on the specific structures of the agricultural system.

In the complex framework of current changes in social, economical and political conditions, impacts of climate changes are only one among other driving forces. Clearly, a full economic assessment of the implications of climate change for differently structured agricultural systems in mountain regions would be necessary, but this was outside the scope of the present work. Instead, a first step was taken towards an interaction between the natural scientists providing information about future productivity levels and the farmers concerned. Model simulations indicate that under climate change conditions, the yield of grazed or cut pastures and meadows in mountain areas increases [29,30]. The increase in productivity is likely to be largest at sites with favorable edaphic conditions, such as the bottom of the mountain valleys [30], whereas changes in marginal areas may be much less. With this scenario and given the trend that the number of livestock units may decrease during the following years, a surplus of land for forage production seems possible. This could lead to the abandonment of the marginal land and the concentration of production to productive and easily accessible fields. In fact, prior to the introduction of subsidies for land maintenance, abandonment of marginal land for economic reasons was an important process in large areas of the European Alps [9].

As mentioned above, the assessment of stakeholders may have the quality of another driving force concerning problem solution as these assessments may foster or prevent policy strategies from implementation. This is important due to mainly three reasons: (i) "Knowledge" can no longer be seen as "objective, factual information", but as a social product, combining facts with norms, values and experiences from a subjective perspective. Thus, distinct perceptions of problems and assessments concerning measures exist [13,16,35]. (ii) The policy process is not a linear, "one-way" process in which scientific experts give their advice to elected politicians. Moreover, scientific policy expertise has its boundaries and ambivalent effects [6]. Political processes are complex processes involving a multitude of actors [32] and do not only build up on factual, "objective" information, but also on power, interests, ideas and institutions [19,26,36]. (iii) As the legitimacy of policy and science in industrialized countries is decreasing, additional ways to extract ideas out of civil society must be sought. Insights from local planning [5] can be used as a preliminary basis for the development of discourse instruments and tools in social empirical research with participatory aims.

The stakeholders' perception of the problem and the inter-relationships between the sectors, as well as their views on possible adaptation strategies can best be assessed by participatory integrated assessments (PIA), an approach which aims at developing methods that allows the combination of evaluations of experts and lay people in the field of integrated assessment [14,18,34]. The aim of this presentation is to link the direct impacts of climate change on tourism and agriculture, to describe PIA methods to investigate the perception of the climate change problem by stakeholders, and to identify possible adaptations to indirect impacts resulting from the inter-linkages between the two sectors, based on selected results from PIA.

2. Methods for involving social actors

The underlying scientific information about impacts of climate change on agricultural productivity and tourism was gained by computer models for the development of snow cover and grassland productivity. Taking this information as the starting point, different methods of empirical social research were used to assess the individual and collective perceptions of stakeholders in the sectors mentioned above.

2.1. Individual perception

In 1998, a standardised written survey was conducted with farmers. 295 questionnaires were distributed in four selected mountain regions of Switzerland (table 1). The response rate was relatively high (45.5%). The regions were selected, firstly, according to the criteria that the majority of the area can be described as mountain area, and, secondly, to represent the French speaking as well as the German speaking parts of Switzerland. Lists of farmers' addresses provided by regional agricultural advisers were used which represented 17–76% of the farms in the four test regions. Table 2 shows that mainly larger farms were included with about 11–20 cows per farm, and that the regions differed in the distribution of the farms according to production conditions (i.e., Mountain Zones). The questionnaire was designed to obtain information regarding (1) the individual perception of the climate change issue among farmers, and (2) the range of possible farmers' responses to projected direct impacts on forage production. In addition to some personal data, each respondent also supplied information about

Table 1
Regions selected to assess farmers' response options and number of questionnaires.

Region	Label	Area	Total number of farms	Number of questionnaires	Reply (%)
Grison	D	Davos/Dischma	97	36	69
Bernese Oberland	S	Higher parts of the Simmental (Zweisimmen, Lenk)	503	88	48
Haute Valais	H	Goms and Simplon	294	78	41
Pays d'Enhaut	P	Château D'Oex, L'Evitaz	122	93	24

Table 2
Characteristics of the responding farmers and their farms (%).

Region	Label	Surface			Number of cows			Age of the farmer				Location (mountain zone)[a]		
		<10 ha	10–20 ha	>20 ha	0	<10	10–20	>20	<35	35–55	>55	2	3	4
Grison	D	4	40	56	0	20	68	12	28	68	4	0	0	100
Bernese Oberland	S	10	52	38	0	26	62	12	22	59	20	43	50	7
Haute Valais	H	7	21	72	3	13	67	17	42	55	3	16	19	65
Pays d'Enhaut	P	10	65	25	0	23	59	18	22	59	20	0	86	14

[a] According to the Federal inventory for the production conditions.

Table 3
Selected ski resorts and number of questionnaires.

	Altitude of ski resort (m)	Number of lifts	Number of questionnaires	% reply
Engelberg-Titlis	1000–3033	19	550	95
Melchsee-Frutt	1076–2248	7	150	99
Lungern-Schoenbuehl	709–2144	6	75	93
Beckenried-Klewenalp	458–1950	8	150	94
Dallenwil-Wirzweli	577–1579	4	75	98

the farm structure and the importance of off-farm income. In addition, five face-to-face semi-structured interviews were conducted with agricultural experts.

For winter tourism, 1000 skiers and snowboarders were questioned in a standardized written survey in five ski resorts in Central Switzerland (table 3). The questionnaire comprised of questions about their perception of climate change and possible adaptive behaviour [11]. The questionnaires were personally distributed and collected which explains the high response rate of 96%. The sample of the survey is representative for tourists visiting the Cantons Ob- and Nidwalden during the winter season 1996/1997. Moreover, the survey covers a basic diversity of structures of ski resorts [11].

Standardized surveys are a widespread and convenient method of gathering quantitative data: a representative sample of participants can be taken into account and participants are free when filling the questionnaire in as far as time is concerned and there is no danger to feel under pressure by the researcher. Additionally, analyzing standardized questionnaires by statistical methods can be done with fewer uncertainties than analyzing qualitative data. However, the disadvantage lies in the fact that the completion of the questionnaire by individuals cannot be controlled by the researcher and that in the case of uncertainties, these cannot be clarified instantly.

In contrast, qualitative face-to-face interviews with experts allow to take the needs and interests of the interviewee into account. The interviewer follows a guide which can range from a list of topics to exactly formulated questions, but is open to topics raised by the interviewee. Thus, this kind of questioning covers more aspects than a standardized interview format, and it results in more detailed information. Representative results are not possible, as the number of interviewees is usually too low. This is because the research questions aim at revealing new aspects of a topic which require mainly qualitative instead of quantitative data. Qualitative interviews allow a more controlled situation concerning the collection of data, but they are more difficult to analyze, depending on their structure [7,8].

2.2. Collective perception

Three focus groups comprising 17 persons were conducted with decision makers from the tourism industry in different locations in the test region Obwalden and Nidwalden. The sample for the three homogenous groups was composed according to the criteria "responsibility in decision-making in the tourism sector". These were defined as persons working on a full, part-time or voluntary basis in the tourism sector as well as cantonal and local politicians.

Focus groups are a qualitative instrument of social research with which the perception of complex topics such as climate change can be explored more deeply. Depending on the composition of the group, dominant as well as latent opinions on a phenomenon can be investigated. The interaction of individuals within focus groups is explicitly desired (opposite to group interviews), as forming and defending of arguments is seen as important for opinion building. Moreover, interaction allows for creativity among participants, and it can also support the development of new ideas, e.g., when policy recommendations are envisaged. In the case of PIA, the advantages of focus groups are seen in the small setting which supports the creation of a natural atmosphere and encourages the exchange of attitudes and opinions. Thus, focus groups are especially suitable for the development of new ideas.

Typically, focus groups are moderated discussions focusing on a kind of collective action [20,24]. So far, this instrument has been used mainly in health research and to investigate environmental risks or latent attitudes [14]. Usually, discussions involve six to nine people and last approximately for 2–3 h [24]. A short film, a letter, or, as in our case, an piece of information is used as a stimulus. This method allows the simulation of opinion forming. The interaction among group members is encouraged by the moderating person who is responsible for the social process in the group, such as guaranteeing a fair discussion. The resulting database is broad, rich and contains dense discourse

data [25], but it is heterogeneous. It may consist of material from the group (e.g., notes, reports) itself or more commonly it may be material about the group such as video tapes (in rare cases also audio-tapes), minutes and notes taken after the discussion(s). Video tapes are transcribed, often in a selective manner due to limited resources.

The transcripts of the focus groups with decision-makers in the tourism sector were analyzed according to content analysis; they were condensed step-by-step and the statements summarized by paraphrasing in order to filter out main messages. The aim was mainly to gather knowledge about the character of the climate change phenomena, such as problem framing, perceptions and recommended strategies.

3. Results

3.1. Adaptation in agriculture

3.1.1. The perception of climate change by Swiss mountain farmers

Climate change is considered an important issue by the majority of the farmers in all but one region, but the relative importance of the current economic situation is ranked much higher (figure 1(A)). In all selected regions, signs of climate change have been observed; among those less severe winters and a reduction in the snow cover are by far the most important ones (not shown). In contrast, a change in summer precipitation has only been noticed by a minor fraction. The perception of the climate change problem seems not to

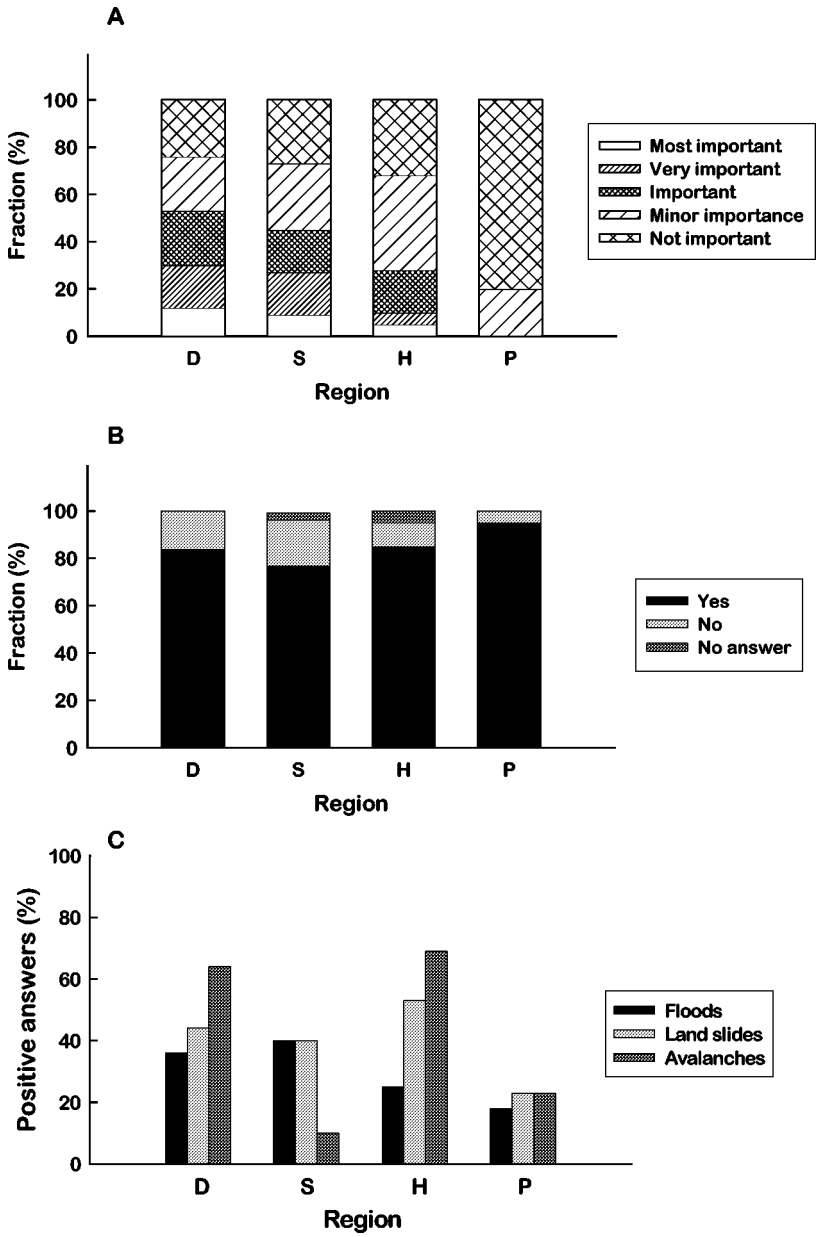

Figure 1. Farmers' response to the question (A) "How important is the climate change issue?", (B) "Have signs of climate change already been observed?" and (C) "Is your land threatened by floods, land slides or avalanches?" Labels for regions are given in table 1.

be related to the observation of recent visible changes in the environment (figure 1(B)), but more directly to the sensitivity of the land to natural disasters (figure 1(C)). Especially in the region of Grison (Davos, D) and Haut Valais (H), the majority of the farm land is exposed to high risk for avalanches and land slides, and in the lower area in the Bernese Oberland (S) to a risk of floods. Apparently, least sensitive to these events is the region of the Pays D'Enhaut located in the western part of the Swiss Alps, where climate change is not considered an important issue.

Farming in the mountains is sensitive to the timing of the first grass cut, which in turn depends on the development of the vegetation and the weather conditions during late June and early July. 63–100% of the respondents see the time as being earlier today, as compared to 10 years ago, which is attributed to a shift in plant development, but also to the increased availability of facilities to aerate and dry hay stacks. The latter allows for an earlier cut to improve forage quality regardless of climatic conditions. With respect to the timing and duration of the grazing period at high altitude sites, only a minor fraction of the farmers have noted a change, in agreement with official statistical information [33].

3.1.2. Consequences of increased grassland productivity

Theoretically, a surplus of land could increase the abandonment of marginal land, but from the replies to the questionnaire, it is clear that this option is not envisaged by Swiss farmers, mainly because of current subsidies. Land abandonment was only identified as an option by 7% in the Bernese Oberland, 20% in the Pays D'Enhaut, 16% in the Haute Valais, and 0% in the Grison (Davos) area. Instead, more active response options where favored. If possible, farmers would like to increase the number of grazing cattle, they would consider harvesting and selling the surplus of hay, or they would apply alternative forms of land use (figure 2(A)). The latter option would involve, for instance, a change from cattle to sheep or other animals, or the conversion of grassland to forest (figure 2(B)).

More subtle responses to increased forage availability would be to shift the timing of the hay cut to an earlier date, to increase grazing, or to lower the intensity of production by reducing the use of fertilisers and/or cutting frequency (i.e., extensification). Although extensification is not seen as a very important option (figure 2(A)), it would favorably agree with the general trend set by Swiss and European Union agricultural policy.

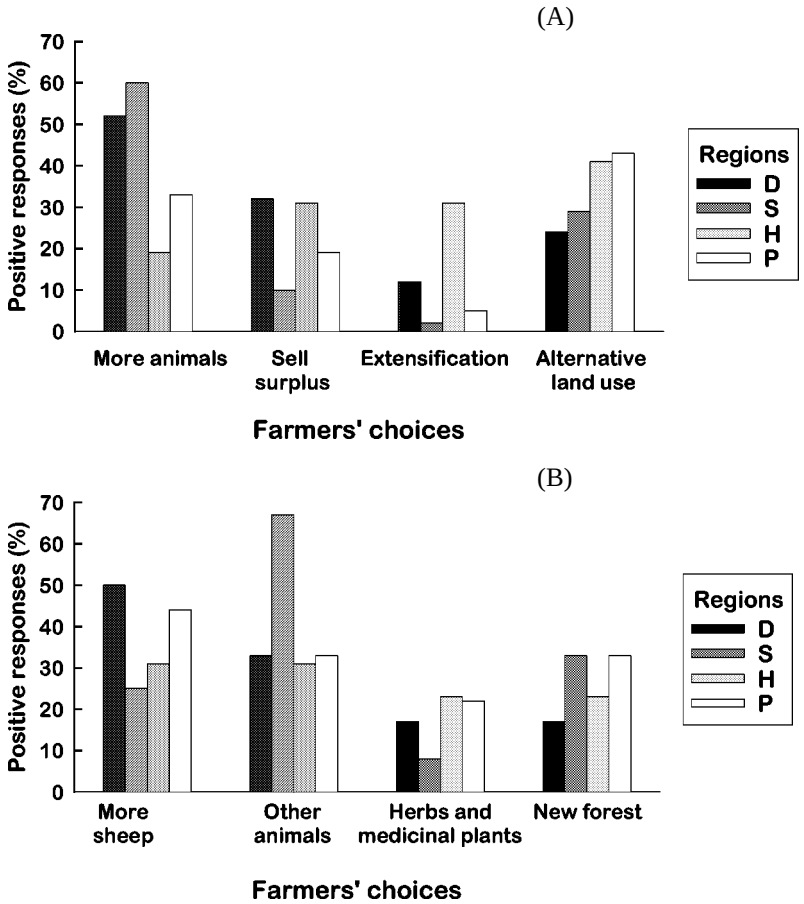

Figure 2. (A) Possible responses to increased forage production under climate change conditions. (B) Different options for alternative land use if forage production exceeds the demand. Labels for regions are given in table 1.

3.2. Adaptation in tourism

3.2.1. Adaptations of skiers – results of the survey

The aim of the skier survey was to investigate how skiers and snowboarders perceive climate change and how they think they would adapt to possible climate change. 83% of the respondents believe that climate change would threaten ski tourism and almost half of them believe that this would happen between 2000 and 2030. Thus, it can be concluded that skiers and snowboarders perceive climate change as a serious problem for the tourism industry.

Skiers and snowboarders were asked where and how often they would ski, if they knew that the next five winters would be snow deficient. 49% of the respondents would ski in a resort which is more snow reliable, and 32% would ski less often (figure 3). Although only 4% of the respondents would give up skiing, it can be concluded that climate change would have serious impacts on the number of skier days. The most vulnerable ski resorts in the lower regions of the Alps have to deal with a significant decrease of younger guests, day tourists and novice skiers, which is exactly the target group of these resorts.

3.2.2. Adaptations of the tourism managers – results of focus groups

Tourism managers are not determined to play an inactive role with regard to the projected climate change and to the possible change in demand. There is a set of possible adaptation strategies to maintain tourism [21]. The focus groups with tourism managers allowed to charaterize their perception of climate change and their preferred strategy for adaptations. The main results show that,

- tourism managers have a wide range of opinions to deal with the probability of climate change and change in snow conditions; nobody questions climate change in principle;
- they perceive climate change as a problem for the ski industry, but they give low priority to this problem. There are, however, no discussions about future winter tourism, which are not influenced by the issue of climate change;
- they believe that media reports and comments, and to some extent reports in politics and science are too dramatic, leading to a bad image of ski tourism; this has severe impacts not only on the demand side, but also on the support of the ski industry by the financial sector (lower credit rating) and policy makers (less subsidies);
- snow reliability is getting more and more important in the destination choice of skiers and for ski resorts; although tourism managers downplay possible impacts of climate change on snow reliability and ski tourism, they use climate change as an argument to extend artificial snowmaking;
- adaptation strategies of tourism managers differ widely, and to link the perception of climate change to the preferred adaptation strategies is not easily possible. However, there are discrepancies between the main strategies of the tourism managers and strategies that seemed to be more successful in the context of the whole tourism industry. Tourism managers perceive forward strategies (e.g., extend into higher regions) to maintain ski tourism as important.

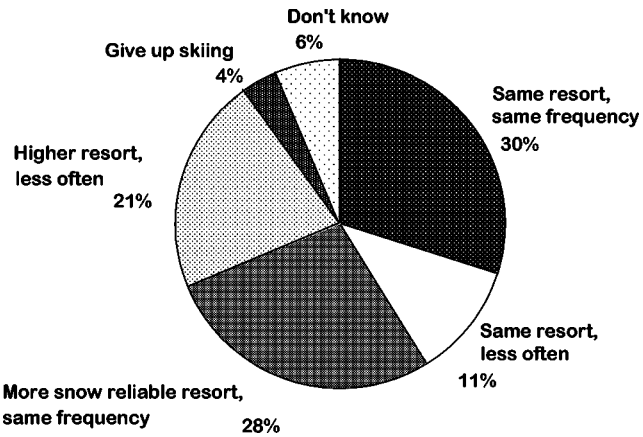

Figure 3. Tourists' responses to the question "Where and how often would you ski, if you knew that the next five winters would have very little natural snow?"

3.3. Indirect impacts on tourism and agriculture

It seems likely that in the absence of a change in the frequency of natural disasters and extreme climatic events, farmers would be sufficiently flexible to adjust to direct effects of changed conditions without large investments. However, because of the strong links between the two sectors, direct impacts of climate change on tourism or agriculture are likely to have additional indirect impacts on the other sector. Depending on the region, farmers depend to a variable degree on off-farm income (table 4). In two regions, more than 50% of the farmers depend on winter tourism, and only a small fraction on summer tourism. This is important because government subsidies and the total gross margin could change in the future independent of climate change, whereas additional income from activities in other sectors, such as winter tourism, may change because of climate change. It becomes clear, that more farmers in a region view the climate change problem as important, when the fraction of them with income from tourism is high (figure 1(A), table 4).

Whereas direct impacts of climate change on the tourism industry may have serious indirect effects on agriculture, in-

Table 4
Fraction (in % of respondents) of farmers with off-farm income from different sources.

Region	Label	Tourism		Forestry	Other sources
		Winter	Summer		
Grison	D	64	0	38	46
Bernese Oberland	S	51	15	37	63
Haute Valais	H	19	6	7	40
Pays D'Enhaut	P	10	5	37	42

direct impacts of agriculture on tourism are more subtle and did not appear very clearly in this assessment. Nevertheless, the increase in surplus land may offer the opportunity for alternative land use, such as the production of speciality crops, as identified as a possibility by 8–23% of the farmers, or afforestation (figure 2(B)). The increased supply of regional agricultural specialities could have a favorable indirect effect on tourism.

4. Discussion and conclusions

The work presented here represents a first attempt to actively expose selected stakeholders to results from natural science studies carried out in the framework of the CLEAR project, and to assess their views and perceptions by PIA. The assessments confirms that stakeholders are aware that both the tourism industry and agriculture is affected by climate change, and that tourists, the tourism industry and farmers are prepared to adapt to climate change in various ways. However, in spite of the significant direct effects projected by climate change impact simulations, changing social, political and economical conditions could affect the two sectors much more than climate change. This conclusion is based on the results from PIA and needs to be substantiated by an economic assessment.

Direct impacts of climate change on tourism are mostly negative and appear to be more serious than effects on agricultural productivity which appear to be on the positive side. Because of decreased snow availability, the tourism industry will concentrate on the best suitable regions in the higher parts of the Alps. Climate change will affect lower ski resorts first where it may lead to significant losses to the local economy, which would affect the farmers via the loss of additional income. Moreover, the demand for local agricultural products may decrease because of the lack of tourists. These results from the survey confirm that direct impacts of climate change on agricultural production may be less important relative to these indirect effects, as earlier suggested based on economic modeling [17]. Despite the severe threats, the tourism managers perceive climate change as a problem with low priority. They believe that forward strategies are the most successful way to adapt to climate change. Considering the financial problems in the ski industry and the possible impacts of climate change, it would be more advisable to find alternatives to snow related tourism (e.g., all-year tourism). Furthermore, some ski resorts in lower regions should actively plan to cancel ski tourism.

With respect to agriculture, the results from the survey indicate that farmers consider themselves sufficiently flexible to adjust to changed conditions and that they would be most successful in coping with the changes in productivity and plant development by a combination of extensification and adjustments in the cutting regime. As an alternative, farmers would consider increasing grain production, or starting small production of specialities, such as medicinal plants. Clearly, the feasibility of these options would need to be assessed in more detail. Since animal feed is complemented with concentrate which is often transported over long distances, the production of grain within the respective region could be an environmentally friendly strategy. However, the farmers aim to keep the addition of concentrate low which can be achieved by maintaining a high forage quality. 84–95% of the farmers in all regions would try to maintain a high nutritional value of the forage by adjusting the cutting date, and by producing more silage. Potentially, increased grassland productivity could lead to intensification in areas near the farms, resulting in ecological problems in both utilized and abandoned meadows, but in Switzerland, measures have been taken to support the maintenance of proper land management, and the farmers are prepared to consider changes in land utilization in order to increase the value of the landscape for purposes other than food production. Hence, with climate change the need to subsidize land maintenance may increase in the future.

Decreasing tourism caused by the lack of snow could have indirect negative effects because farmers would suffer from the loss of off-farm income. Especially regions with a developed tourism in lower parts of the Alps are endangered by climate change effects, as represented in the survey by the Bernese Oberland region (S) with large fraction of farms in mountain zone 2. Such a loss of income may accelerate the ongoing re-evaluation of the various functions agriculture plays in mountain regions. The assessment clearly shows that various possibilities are considered by the farmers, and when combined with other efforts, such as direct marketing of regional products [37], they may present a real opportunity under changed climatic conditions.

On the one hand, the results of the PIA approach used here underline the potential of involving social actors which are directly or indirectly affected by the phenomenon of climate change to formulate policies. Alternatively, the methods and systematic analysis of PIA need further improvement: the combination of methods of political planning and empirical social research needs further study and the question of how policy makers could best be supported by the results needs to be studied further. A possible next step could involve joint focus groups with experts and stakeholders from both the tourism and agricultural sectors as well as politicians, which could be a fruitful tool to transfer perceptions of society and expert knowledge “back” into the political process and thus increases the chance that results of an Integrated Assessment could support politics more effectively.

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