

# **Participatory Analysis of the Sustainability of Livelihoods in the Agro-ecosystem of Abesard, Iran**

**Hadi Veisi<sup>1</sup>, and Sahar Bagheri Toulabi<sup>2</sup>**

<sup>1</sup>*Head of Research Centre of "Education for Sustainable Development",*

<sup>1,2</sup>*Environmental Sciences Research Institute, Shahid Beheshti University, G.C.Iran*

*Email: [hveisi@gmail.com](mailto:hveisi@gmail.com)*

**Abstract:** This paper reports some of the results of a study to explore vulnerability contexts i.e. trends, shocks and local cultural practices that affect livelihood assets i.e. natural capital (land, water, biodiversity), physical capital (infrastructure, machinery), human capital (labour, skills), financial capital (savings, disposable assets), and social capital (rights, support systems) in Abesard, Iran. It also describes structures, including organizations (government, private), and processes, including policies, laws and incentives, that determine the livelihood strategies of households (agricultural intensification or expansion, livelihood diversification, and migration) which, in turn, impact the assets. Participatory vulnerability analysis (PVA) was used within a sustainable rural livelihoods (SRL) framework to assess the differences of the livelihoods of poor, average, and better-off households. Findings revealed that land use change, climate change, market fluctuations and higher mechanization were the main contexts of vulnerability that led to noticeable differences between households, particularly in human resources, landholdings, equipments, linkages, credits and markets, affecting the livelihood strategies pursued. In order to overcome these problems, poor households have tracked agricultural intensification, average households have followed livelihood diversification, and better-off households have practiced agricultural biodiversity and intensification as livelihood strategies. Government has also provided some services such as extension programs, macro- and micro-fertilizers, subsidies for equipment, and energy to compensate for limitations regarding assets and capital. Results showed that rural cooperatives as community based organizations have contributed to finding new markets and also to enhancing farmers' participation in decision making.

**Keywords:** Participatory vulnerability analysis, Households, Strategy, Abesard, Assets

## **1 INTRODUCTION**

Greater recognition of the seriousness of global environmental change has led to a growing interest in the assessment of the vulnerability of households, communities and regions to changing environmental and/or economic conditions [Fazey et al., 2010], and to building more sustainable societies [Fazey et al., 2007; Folke et al., 2005]. In this sense, various frameworks have been developed, which link environmental change to human livelihoods and explain changes or response of human communities to vulnerability induced by agro-ecological changes [FAO, 2006, Feld et al. 2010; Rounsevell et al. 2010; Fazey et al. 2010, Swapan & Gavin, 2010; Senbeta, 2009; Cramb & Purcell, 2001; Sreedevi, 2005]. Rounsevell et al. [2010], for instance, developed the Framework for Ecosystem Service Provision (FESP) to assess the impacts of environmental change drivers on ecosystem service provision, the policy and management responses that would derive from the

value of such impacts. Most significantly, Swapan & Gavin [2010] applied the so-called sustainable rural livelihoods (SLR) framework designed by the Institute of Development Studies (IDS), to explore changes in livelihood patterns and the interaction between human and nature in an agro-ecosystem. It consists of five key components: vulnerability context, livelihood assets, institutions and process, livelihood strategies, and livelihood outcomes [Scoones, 1998]. It explains how, in different contexts (of policy setting, politics, history, agro-ecology and socio-economic conditions), sustainable livelihoods are achieved through access to a range of livelihood resources (natural, economic, human and social capitals) combined in the pursuit of different livelihood strategies (agricultural intensification/extensification, livelihood diversification and migration). Central to the framework is the analysis of the range of formal and informal organisational and institutional factors that influence sustainable livelihood outcomes [Scoones, 1998]. However, employing the SRL framework,- the process of using the SRL framework for planning and implementing an enquiry, and analysing the information this generated - raised a range of questions. On the one hand, there were methodological lessons and practical issues such as what is the best way to represent complexity? How can the multiple views of different actor groups be incorporated into such a representation? How can such a learning process be effectively managed within the boundaries of available resources? On the other hand, there were more abstract considerations: what, and who, is this research for? How could this process of research best be transformed into something which usefully serves the needs of the poor, or supports environmentally sustainable practices?

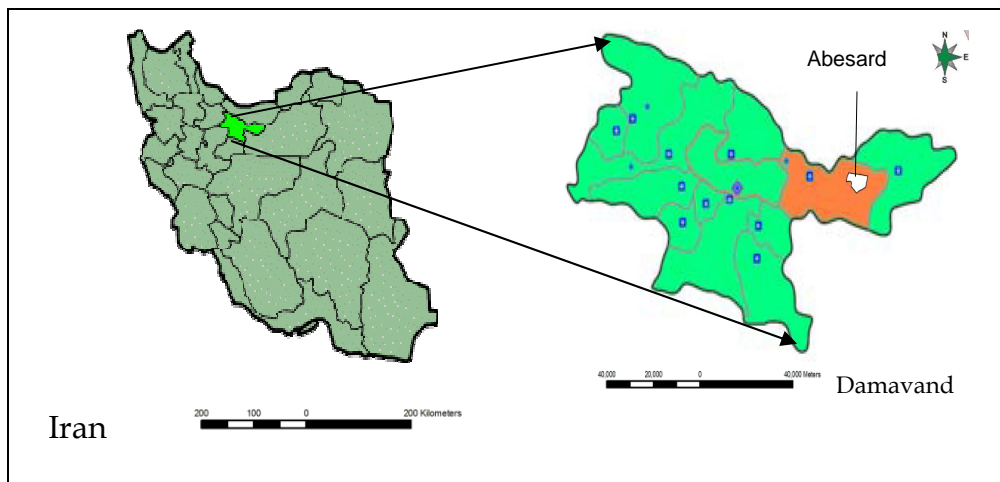
The type of methods which may be used to answer such questions necessarily varies. The conventional survey tools can potentially be combined with appropriate qualitative methodologies and participatory rural appraisal techniques to form a 'hybrid' methodological approach, with sequences of methods designed to explore different questions posed by different elements of the framework. With such basic information on key trade-offs collected in a systematic and rigorous manner, an iterative and more participatory planning process may proceed, where different options can be discussed and intervention choices can be negotiated among different stakeholders [Scoones, 1998]. Accordingly, Fazey et al. [2010] suggested a three-tiered approach to participatory vulnerability assessment that aims to use the learning opportunities provided by the research to enhance local adaptive capacity and learning. They listed a number of ways in which vulnerability assessments can be designed in participatory ways. Some instances include the use of facilitative rather than directive methods; working with, enhancing and building local institutional capacities; focusing on the co-learning of participants as a key outcome of research; seeking to contribute to local skills and capacity building (especially for greater participation); and enhancing linkages across geographical and political scales. As such, Chiwaka and Yates [2005] developed Participatory Vulnerability Analysis (PVA) as a process of social inclusion in vulnerability reduction. It is a "systematic process that involves communities and other stakeholders in an in-depth examination of their vulnerability, and at the same time empowers/motivates them to take appropriate actions". This process involves the community by using simple PVA tools and an easy matrix [Jnavaly, 2007]. PVA uses a step-by-step approach to systematically analyse the causes of vulnerability through 1) tracking vulnerability factors to determine the level of exposure to risk, causes and effects; 2) examining unsafe conditions (factors that make people susceptible to risk at a specific point in time); 3) tracking systems and factors (dynamic pressures) that determine vulnerability, resilience and root causes; and 4) analysing capacities and their impact on reducing vulnerability.

Given this background, the present study focuses on different aspects of altered vulnerability in the Abesard agro-ecosystem which may lead to changes in the livelihood pattern of the community. Trends, shocks and local cultural practices, their impacts on livelihood assets, physical capital, human capital, financial capital and social capital will be studied. According to IDS, it seems that the prevailing social, institutional and organizational environments play crucial roles in the selection of livelihood strategies, and in case the strategies are successful, they lead to sustainable development in the community. This study has been conducted

by application of PVA to assess the sustainability of livelihoods in the Abesard of Iran.

## 2 THE STUDY AREA

The Abesard region is located in the far eastern part of Tehran Province (Figure 1), about 5 kilometres away from Damavand (the county capital) and 35 kilometres away from Tehran (the capital of Iran). Abesard covers an area of about 19000 ha and is one of the most agriculturally productive areas in Iran, with favourable soil and climatic conditions. At present, about 260 households live in the region comprising people of numerous ethnic groups. Agriculture is the major economic sector, and it includes both crop and livestock production. Potato is the major staple crop (25–36%), but a wide variety of other subsistence (wheat, 4%, barley, 2%) and cash products (e.g. apple, 15–20%) are found according to changes in topography and soil type.



**Figure 1.** Geographical location of Abesard in Tehran province, Iran

## 3 METHODOLOGY

In this study, the adopted research approach was PVA. It was conducted in three main phases namely: 1) preparation, 2) analytical framework, and 3) local level analysis [Chiwaka and Yates, 2005].

The preparatory phase comprised awareness-raising at the agro-ecosystem level, defining the purpose, stakeholder analysis and team preparation. It started with exploratory interviews with a range of government and local leaders and followed by collecting secondary data and defining the purpose. Stakeholder analysis and building a research team were the next steps. Firstly, assessment of the sustainability of livelihoods in the Abesard agro-ecosystem was defined as the study goal. After that, we contacted the agricultural centre, local leaders and the local government at the agro-ecosystem level to raise awareness and discuss about the goals of the research, the PVA process, the experiences of other programs as well as to ask for their support for our PVA exercise. Then, to get some background information (population, geographic information and livelihood sources), secondary data related to the site of study were collected through the website of the Agricultural Centre of Abesard and published materials such as projects reports. A research team consisting of a socio-economist, an agronomist and an animal scientist was then formed which was accompanied by local partners (development experts and reference persons). Following this, they were trained in the PVA process to learn how to use participatory tools, and at the end a working agreement was established for achieving the aims of the study. At the end of this phase and to identify the range of stakeholders that should be involved in the PVA process, a focus group discussion involving local leaders and reference people (councils, local coordinators etc.) was organized. This group was intended to

identify general characteristics relating to livelihoods. In this regard, matrix scoring was applied [Mikkelsen, 1995; Chambers, 1997; Cramb and Purcell, 2001] to establish a wealth ranking system. Consistent with Cramb et al. [2004], it was agreed that three categories captured the important differences within the community, translated as “better-off”, “average”, and “poor”. Without defining the attributes associated with these three categories, the group then allocated all households to a category, using the community map as the basis for classification. The distribution was based on the open agreement of those who were present. As a result, 15% of households were assigned to the better-off category, 38% to the average category, and 47% to the poor category. Once this was done, the group listed the attributes that members felt had implicitly been used to distribute households between the wealth classes. A list of households was obtained from the community mapping exercises. The households were stratified according to their wealth-ranking. Following the identification of wealth strata, five households from each group were randomly selected according to their wealth status, resulting in 15 households in total.

The second phase consisted of four analytical steps: 1) situation analysis; 2) analysis of the causes of vulnerability; 3) analysis of community action and capacity; and 4) drawing action from analysis. In this phase, and in order to conduct situation analysis, 5 interviews were done in each category. For each household, semi-structured interviews were conducted at the farmhouse, according to a basic protocol. The interviews were carried out over a period of two weeks, with each interview lasting about two hours. Accordingly, households were asked to identify and clarify assets (or livelihood resources) and activities (which together constitute its livelihood strategy), key events and changes that affected them most, indicating the nature and source of vulnerability contexts, and associated impacts, consequences and responses. Respondents explained changes in livelihoods, natural resources status, livelihood strategies, overall quality of life, and influential sources of change (e.g. stresses and shocks). At the end of each interview, we asked respondents to summarise and clarify their responses again, so that we could accumulate into guideline sequences what factors of vulnerability lay behind perceived impacts and consequences. For the purposes of our research, the causal loop diagram and vulnerability matrix were chosen to show factors of vulnerability, impacts, consequences, and the causal relationships between them.

At the end of the period of residency in the community, and in order to conduct local level analysis, the research team invited the reference people to an exposition of the maps, diagrams, matrices, and calendars that had been prepared by the households themselves, in order to hold a generated discussion about the research themes (phase III). Accordingly, the results were discussed and further developed based on the framework for ecosystem service provision that consisted of different standpoints from the participants in steps 1 and 2, but agreed upon by all participants.

## **4 FINDINGS**

### **4.1 The capital assets of livelihoods**

Similar to Sreedevi [2005], five types of resource were identified in this study (Table 1). The three wealth groups were assessed in terms of five capital assets (human capital, natural capital, financial capital, and physical capital). As indicated in Table 1, family size was bigger for the poor group (> 5) and smaller for the average (3-5) and better-off (< 4) groups. In general, 15% of households were assigned to the better-off category, 25% to the average category and 60% to the poor category. The analysis of assets involved comparisons of interviewed households between the three wealth groups, utilising the qualitative data in Table 1.

Concerning physical capital, findings revealed that households in the poor group had no tools or implements, and had access to only 4 hours of water usage per week, while those in the average group had electricity, a motorbike or a tractor, and had access to water for about 10-12 hours per week. Households in the better-off group owned all their tools, and had access to more than 20 hours of water usage per week.

Human capital was assessed by the number of people and workers in the household and consumption status, health status, and education status [Flora, 2001]. The poor group only used household labour, while the average group employed seasonal labour for some activities (e.g. weeding) and the better-off group hired full-time workers for all agricultural activities. The farmers of the average group had a better status in terms of health (as a social indicator) since they attend health check-up 2-3 times a year. In contrast, the farmers of the better-off group did not go to the health centre for check-ups and the farmers of the poor group did not go to the health centre and took care of their health issues themselves. The average and better-off households had a higher level of education than the poor households. Women had very low levels of education, while all the household heads valued it for children of either sex.

**Table 1, The Capital Assets of livelihoods**

Key indicators of capital assets	Poor group	Average group	Better-off group
Physical capital <ul style="list-style-type: none"> <li>• Agricultural machinery</li> <li>• Water supply</li> </ul>	<ul style="list-style-type: none"> <li>- Have no tools, machinery and implements,</li> <li>- Only have a right to 4 hours of water usage per week</li> </ul>	<ul style="list-style-type: none"> <li>- Own a few suitable farm tools and machinery e.g. tractor,</li> <li>- Have a right to 10-12 hours of water usage per week</li> </ul>	<ul style="list-style-type: none"> <li>- Own basic tools and machinery e.g. tractor, a few hoes and an axe.</li> <li>- Have more than 20 hours of water usage per week</li> </ul>
Human capital <ul style="list-style-type: none"> <li>• Consumption status</li> <li>• Health status</li> <li>• Education status</li> <li>• Training and other extension services</li> </ul>	<ul style="list-style-type: none"> <li>- Not enough to eat</li> <li>- Farmers pay attention to health issues; do not go to healthy centre for check-up</li> <li>- 20% young people, 45% middle aged, 35% elder. 60% head of family (Secondary school), 65% women (illiterate) and 80% (child) other members of the family (primary school).</li> <li>- Farmers do not have access to extension services and advice.</li> <li>- Household labour</li> </ul>	<ul style="list-style-type: none"> <li>- Enough to eat</li> <li>- Farmers pay attention to health issues, and go to health centre 2-3 times for check-up</li> <li>- 40% Young people, 30% middle aged, 30% elder. 85% head of family (Diploma and bachelor degree), 60% women (higher education) and 60% (child) other members of the family (higher education)</li> <li>- Farmers receive some credit, often from within the village, not outside institutions. To some extent, they also access to extension services and advice.</li> <li>- Household labour, and few workers</li> </ul>	<ul style="list-style-type: none"> <li>- Cash surplus and investment</li> <li>- Farmers do not pay attention to health issues; They do not go to health centre for check-up</li> <li>- 50% Young people, 30% middle aged, 20% elder. 55% head of family (Diploma), 40% women (higher education) and 90% (child) other members of the family (higher education and bachelor)</li> <li>- Farmers have access to a range of credit sources for the purchase of inputs. They always access to extension services and even agricultural specialists from outside of Abesard.</li> <li>- Many workers</li> </ul>
Financial capital <ul style="list-style-type: none"> <li>• Sources of Income</li> <li>• Credits</li> </ul>	<ul style="list-style-type: none"> <li>- Farmers work as bricklayers and labour for others.</li> <li>- Farmers access to local market.</li> <li>- No cattle or sheep</li> <li>- Credit from private lenders on a short-term basis with a high interest rate.</li> </ul>	<ul style="list-style-type: none"> <li>- Farmers work as members of staff, shopkeepers, labour force for others</li> <li>- Farmers access to local, regional and rarely international market.</li> <li>- Not many cattle and sheep (&lt;15)</li> <li>- Credit from private provider and the government sector if necessary.</li> </ul>	<ul style="list-style-type: none"> <li>- Farmers work as shopkeepers, and renting agricultural tools.</li> <li>- Farmers access to local, regional and, rarely, international markets.</li> <li>- Many cattle (&gt;15)</li> <li>- Credit from the government sector on a longer-term basis with a low interest rate</li> </ul>
Social capital <ul style="list-style-type: none"> <li>• Farmers society or organization</li> </ul>	<ul style="list-style-type: none"> <li>- Farmers are members of local cooperative and participate only in decisions regarding water management.</li> </ul>	<ul style="list-style-type: none"> <li>- Farmers are members of local cooperative and receive some extension advice.</li> <li>- They participate in decisions regarding water management and marketing.</li> </ul>	<ul style="list-style-type: none"> <li>- Farmers are members of local and regional cooperative for both cash and food crops. They make decisions regarding marketing and control it.</li> </ul>
Natural capital <ul style="list-style-type: none"> <li>• Land quality and fertility of soil</li> </ul>	<ul style="list-style-type: none"> <li>- Small plot : &lt;1 ha of potato-land Water retention is low because soil is compact.</li> </ul>	<ul style="list-style-type: none"> <li>- 1 ha&lt;land &gt;3ha of potato – land and garden (&gt;3)</li> <li>- Water retention is good, but nutrient holding capacity is low.</li> </ul>	<ul style="list-style-type: none"> <li>- Plenty of land &gt; 3 ha of potato –land and garden (&gt;3) Very fine clay with appropriate water retention and nutrient holding capacity.</li> </ul>
Number in category	60% of the total households in Abesard	25 % of the total households in Abesard	15 % of the total households in Abesard

In terms of financial capital, households in the better-off group with the most resources had greater access proportional to financial capital. The average land

area owned by each household in the better-off group was almost more than 5 ha, while households of the average and poor groups owned  $1 < > 3$  ha and  $1 \leq$  ha, respectively. The difference in the number of cattle kept by the groups was the most striking finding. While households in the poor group had no cattle or sheep, those in the average and better-off groups had  $\leq 15$  and  $> 15$  cattle and sheep, respectively. There was also a difference in sources of credit between the groups. Whereas the poor and average groups obtained credit from private lenders on a short-term basis at a high rate of interest, the better-off group obtained credit from the government sector on a longer-term basis at a low interest rate. Hence, the poor households suffered an overall disadvantage in financial terms. Findings also showed that the farmers of the better-off group have more control over marketing activities outside the area, the sale of production, cattle, and the buying and selling of land compared to other groups of the farmers. The households in the average group were active in the local marketing activities. The poor households often ran local retail establishments.

The presence of community self help groups is an indicator of social capital within the community [Putnam, 1993]. In this sense, our findings showed that although all the households were members of a production cooperative, the poor households participated only in decisions regarding water management, while the better-off and average groups were involved in making decisions regarding water management as well as marketing.

An analysis of the findings indicted that there was a clear difference in natural capital between the groups, as measured by the land quality and fertility of the soil in Abesard. Whereas in the better-off group, the soil of their farmlands is characterized by very fine clay soil with appropriate water retention and nutrient holding capacities, the area of land owned by the poor group was small and the water retention capacity of their farms was also low, because the soil was compacted. The average group owned  $1 \text{ ha} < \text{land} > 3 \text{ ha}$ . Water retention of their soil is good, but nutrient holding capacity is low.

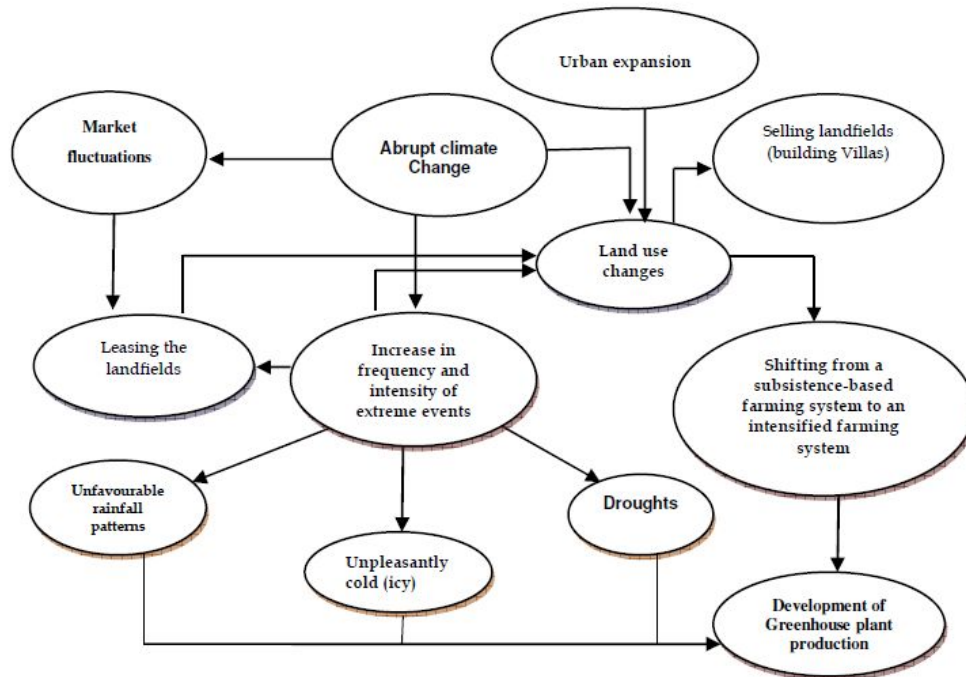
## **4.2 Identifying and ranking the factors of vulnerability**

Respondents expressed similar views and discussed a broad range of social, economic and natural factors of vulnerability and impacts. Abrupt climate change, urban expansion, and market fluctuations were determined as the most important in terms of social–ecological change affecting their lives and livelihoods. As Figure 2 shows, abrupt climate change and urban expansion have altered land use patterns. Therefore, some farmers have shifted from a subsistence-based farming system to an intensified farming system, or have sold or leased their landfields, to cope with an increase in the frequency and intensity of extreme events. They also have formed a production cooperative to decrease market fluctuations.

On the basis of the findings of household interviews and the key informants, rising farmland values due to urban expansion had changed the land use patterns. New owners have built villas and orchards and, in some cases, enterprises such as greenhouses and factories. Accordingly, they employed labour for agricultural activities and guarding the villas, and dug many wells. As a result, in social terms, the layout of the traditional homesteads in Abesard has changed due to entering new ownership and the migration of affected villagers to other places in search of new jobs. Also, ecologically, increased demands on groundwater resources and pumping water out of the ground faster than it is replenished over the long-term have caused problems such as decreasing the volume of groundwater in storage, groundwater depletion and the subsequent drying up of wells, reduction of water in streams and deterioration of water quality, increased pumping costs.

The key informants also addressed that, loss of biodiversity, shrinkage of usable farm area, changes in land, soil and water resources, declining soil fertility, and increased erosion are all consequences of climate changes. In this sense, respondents in the focus group identified climate-related vulnerability factors such as drought, flood, unfavourable rainfall and unpleasant cold as the most important ecological changes affecting their lives and livelihoods. They noted that the unpredictability of rainfall has had an impact on agricultural production so that it has made agricultural production, the main source of income, difficult and undependable. This has led overall to market fluctuations as well as increased

vulnerability in food and water security, with direct impact on changes in land, soil and water resources. Respondents also describe how, due to unpleasant cold, their orchards have been dying and the fruits produced have deteriorated in quality.



**Figure 2.** The causal loop model of vulnerability factors in Abesard

#### 4.3 Livelihood strategies for adaptation to vulnerability factors

In response to the impacts of climate change and land use pattern changes, the poor group performed a combined set of livelihood strategies to conserve the natural resource base and to restore stable equilibrium to their farms after facing shocks or disturbances (e.g. drought, flood, market turbulence). They achieved the above goal through using household labour (women and children) for agricultural practices, doing off-farm jobs (labour force), and planting trees such as apple, peach and walnut around their farmlands to serve as a support to family food production and food security. In contrast, better-off farmers used natural resource-based strategies including intensification and livelihood diversification, so that they mix crops, practice correct crop rotation and fallow, and grow different crops to overcome the factors of vulnerability. Also, to support farmland reliability, they accept new technologies and act on good extension advice. These measures contribute to how the farmers employ the potential internal and external capacities of farms to achieve sustainability of livelihood. For the average group, the factors of vulnerability affected physical capital i.e. soil quality, and small land size. Regarding their land, it is fragmented and the soil fertility has declined. To overcome these challenges, farmers in this group responded through a complex of livelihood strategies such as agricultural intensification/extensification and livelihood diversification. These farmers practice fallow, apply organic fertilizer (manure), retain weeds and crop residues on the soil and use mixed cropping to conserve natural resources. They also vary the factors entering to the system, such as changing seeds every two years and following recommended planting methods for higher productivity. To extend farmlands, the farmers of this group hire land. As mentioned earlier, the farmlands of the average group are characterized to some extent by reliability and resilience, because they have access to resources and inputs, to some basic tools and to local, regional, and occasionally international markets. These characteristics make the framers ready when facing with shocks or disturbances (e.g. drought, flood, market turbulence) and yield variability. However, they sometimes have low adaptive capacity because they have to sell off farmlands due to the lack of supportive institutions and changes in climate and market mechanisms. Instead, they start working as shopkeepers.

#### **4.4 Activities for transforming structures and processes**

In-depth interviews with two governmental officials showed that government agencies such as agricultural organizations have performed multi-sectoral adaptation options to decrease the impacts of factors of vulnerability. These included: improvements to systematic observation and communication systems; development and technological innovations such as the development of drought-resistant crop varieties; education and training to help build capacity among stakeholders; public awareness campaigns to improve stakeholder and public understanding of climate change and adaptation; strengthening or making changes in the fiscal sector such as new insurance options; and risk/ disaster management measures such as emergency plans, agricultural fairs to provide an opportunity to exhibit the production potentials of Abesard in agriculture and finding new customers to guard against market fluctuations. Also, farmers in Abesard have established a production cooperative to provide inputs for their members and develop the farmers' ability in marketing.

### **5 DISCUSSION**

PVA is typically a Participatory Sustainability Impact Assessment (PSIA) [Fussler and Klein, 2006]. Modelling methods are crucial for PSIA since they are used to formalise the perspectives of participants and the addressed problem. They are explicitly chosen to accomplish a new and unfamiliar perception of the problem situation [Gottschick, 2008]. In this sense, the results of the present research revealed that modelling methods such as causal loop diagrams in PVA enable to reveal the scenarios of different community groups for promote and sustain their livelihoods. Within scenarios, the individual problem perception is not only enriched by communication about the other participants' perspectives but also by the meaning of the chosen modelling approaches and their underlying principles and assumptions. In this regard, Videira et al. [2010] asserted that modelling methods allow stakeholders to build alternative policies, to reflect on their long-term dynamics, and to gain insights on the interrelationships underlying persistent sustainability problems.

### **6 CONCLUSIONS AND RECOMMENDATIONS**

In this research, results revealed that abrupt climate changes, market fluctuations and land use pattern changes have been positioned as driving forces on community livelihoods in the agro-ecosystem of Abesard. These forces affected the state of livelihood assets. As farmland values raised, the layout of the traditional homestead in Abesard changed, groundwater depleted, pumping costs increased and lands fragmented. As such they caused impacts such as loss of biodiversity, shrinkage of the usable farm area, changes in land, soil and water resources, declining soil fertility, and increased erosion. In response to and coping with these changes, the poor group households pursued strategies of livelihood diversification (using household labour for agricultural practices, doing off-farm jobs) and agricultural intensification (planting trees such as apple, peach and walnut around their farmlands); better-off households used natural resource-based strategies including intensification (mixing crops, practicing correct crop rotation and fallow) and livelihood diversification (growing different crops); and households in the average group applied a complex of livelihood strategies such as agricultural intensification/extensification and livelihood diversification (changing seeds every two years and following recommended planting methods). Government also has provided multi-sectoral adaptation options such as extension programs, macro and micro fertilizers, subsidies for equipment, and energy to compensate for limitations regarding assets and capital. Another option for adaptation to stressors was a rural production cooperative that has contributed to finding new markets and also to enhancing farmers' participation in the decision making process.

Given the nature of the information analysed about livelihoods in the agro-ecosystem of Abesard using a participatory approach, it can be concluded that the



livelihoods of households are not entirely locally determined but rather the result of complex linkages across space and multi-scalar relations [Adger et al., 2006, Eakin, 2006; Nepstad et al., 2006], while the options for adaptation in distinct geographic locations are also linked through cross-scalar processes in space and time. Therefore, in accordance with Eakin et al. [2009], we recommend that vulnerability and adaptation should be viewed as 'teleconnected' phenomena in future studies about assessment of livelihoods in agro-ecosystems, to move forward to reduce vulnerability to the anticipated impacts of vulnerability factors, while recognizing that social processes are as complex and dynamic as the agro-ecosystem.

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