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The competencies demonstrated by farmers while adapting to climate change

Diane Pruneau*, Jackie Kerry, Marie-Andrée Mallet, Viktor Freiman, Joanne Langis, Anne-Marie Laroche, Evgueni Evichnevetski, Paul Deguire, Jimmy Therrien, Mathieu Lang and Pierre-Yves Barbier

Faculty of Education, Université de Moncton, Canada

World population growth, overconsumption of resources, competition among countries and climate change are putting significant pressure on agriculture. In Canada, changes in precipitation, the appearance of new pests and poor soil quality are threatening the prosperity of small farmers. What human competencies could facilitate citizens’ adaptation to climate change? The competencies displayed by six Canadian farmers were observed as they tried to improve the quality of their soil in order to increase its climate resilience. The farmers in the case study demonstrated a wide array of skills while adapting to climate change. Used to adjusting their farming practices to bad weather, the participants predicted that their already declining soil was very vulnerable to extreme events. They implemented some adaptations: planting forage radish and practicing more crop rotations. During the adaptation process, the farmers showed in-depth local and agricultural knowledge, critical thinking (which they used to assess the solutions), futures thinking and hindsight, identification and control of the variables affecting the crops, openness to novelty, collaboration, optimism and self-efficacy. The research, which results in the identification of competencies conducive to adaptation, leads to the recommendation of a few educational strategies to strengthen adaptive competencies when supporting citizens in a climate change adaptation process.

Keywords: adaptation to climate change; competencies; farmers; environmental education

Introduction

In New Brunswick, a Canadian province, changes in precipitation, variations of snow cover, appearance of new pests and the poor quality of the soil are all threatening the prosperity of small farmers and food security. This precarious situation can lead to climate change adaptation, which means modifying cultivated species, agricultural techniques, products sold, social relationships about food and marketing techniques. Harvesting systems, developed over hundreds of years for given climates, will have to be modified through innovative ideas and approaches (Whitmarsh, O’Neill, & Lorenzoni, 2011). Consequently, New Brunswick farmers must prepare themselves to respond to bad weather and unexpected events, that is to renew their practices and teach one another new techniques. Adaptation requires time and skills. Adaptive capacity is defined as the ability to reduce adverse effects created by change and to take advantage of its beneficial effects (Smith, Klein, & Huq, 2003). This capacity is not limited to climate change. For thousands of years, humans have adapted to

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environmental changes, through physical adjustments, acclimatization, as well as cultural and technological practices (O’Neil, 2008). Adaptation happens in four stages: (1) signal detection, (2) evaluation, (3) decision and response and (4) feedback (Risbey, Kandlikar, Dowlatabadi, & Graetz, 1999). The adaptive capacity depends on the characteristics of individuals and groups, and on the situation to which they must adapt (Belsky, 1984). However, little research exists on specific human competencies that facilitate adaptation to climate change and on educational strategies that could be used to develop these competencies when supporting citizens in an adaptation process.

In this paper, we begin with a theoretical discussion on the human competencies that can increase adaptive capacity to climate change. Then, a case study is presented during which the adaptive competencies of six Canadian farmers were observed while they were looking for adaptations to changes in precipitation patterns. The aim of the study was to identify the competencies that helped the participating farmers to implement adaptive actions. The further objective was to initiate a reflection on educational strategies that can help to develop some adaptive competencies in groups of citizens.

**Adaptive competencies**

The concept of competence, broadly defined, includes the following types of resources and practices: cognitive and metacognitive (e.g. knowledge, know-how, knowing how to act; knowing how to observe, control and improve one’s cognitive strategies); conative (motivation to act); physical, social (calling on an expert); spatial (efficient use of space); temporal (relevant organization of time); material (use of a book or tool); and affective (Joannert, Barrette, Boufrahi, & Masciotra, 2004). Thus, adaptive competencies include a set of resources and practices that enable individuals and groups to adapt to a stressful situation. Capable individuals can optimize their resources (optimism, self-efficacy, innovation and commitment) to face difficulties and reach their goals (Seligman & Csikszentmihalyi, 2000).

Regarding climate change, research on adaptive competencies remains embryonic. Citizens can theoretically call on a range of competencies to succeed in their adaptation efforts: carrying out a vulnerability analysis of their community, futures thinking, predicting and managing risks, creative problem solving, decision-making, scientific, technical and math skills (Pruneau, Khattabi, & Demers, 2008). Thus, participants capable of analyzing their environment with scientific indicators can efficiently pinpoint problems that might worsen with climate change. With respect to the vulnerability analysis – that is, the degree to which a community is weakened by the harmful effects of climate change (Smit & Wandel, 2006) – some participants can develop a habit of observing the frequency and severity of climate events and identifying the more vulnerable aspects of their community (Pruneau, Khattabi et al., 2008). Other participants can use futures thinking – an ability to foresee the future with a certain degree of certitude – to extrapolate from current trends, to take into consideration environmental disturbances and to maintain a coherent and functional view of the future (Godet, 2001). The capacity to predict risks through futures thinking consists of an evaluative process that measures the probability of harmful environmental effects resulting from exposure to stressors (EPA, 1992). Predicting risks can help with risk prevention and management. Creative problem solving competencies, which include knowing how to pose and represent a problem, to suggest a number of original and effective solutions also appear conducive to successful adaptation (Pruneau, Freiman et al., 2008). Likewise, decision-making in which participants set their goals, consider and assess several alternatives and deliberate in order to choose solutions (Utzschneider & Pruneau, 2010)
may be better for adaptation. In the realm of decision-making, the health of ecosystems and human safety must also be considered, as well as a long-range view of the future. Several math skills can also be used by participants working on proposing adaptations: thinking mathematically; posing and solving math problems in various ways; modeling; reasoning; representing mathematically; manipulating mathematical symbols, formulas and phrases; and communicating mathematically (Kerry, 2010; Niss, 1996).

In previous studies, Pruneau, Vautour, Prévost, and Comeau (2009) and Auzou, Pruneau, Vautour, Liboiron, and Prévost (2010) observed adults with no high school diploma who proposed adaptations to flooding (Montreal citizens living in low income apartments) or to heavy precipitation on crops (Saint-Antoine citizens with little knowledge of farming). These adults managed to suggest many effective adaptation ideas thanks to their endogenous knowledge of their area, their observation skill, their experiential way of solving problems, their capacity to think ahead and their perseverance when working on a complex task.

In another case study, municipal employees were observed while they identified and implemented adaptations to coastal flooding: mapping at-risk zones and restoring biodiversity on the coast. To adapt, the municipal employees used problem solving skills (highlighting components of the problem and identifying constraints), futures thinking, hindsight, risk prediction, vulnerability analysis (of their community), local knowledge, planning and communication (Pruneau et al., in press). These employees were good observers of the local impacts of the climate events. They were able to foresee many impacts related to various heights of sea level. They also made use of their past experiences with coastal storms to predict which people and which neighborhood were more vulnerable. However, some competencies that could potentially be useful in adaptation were used less frequently by participants: decision-making, problem solving, knowledge of adaptation, math skills, hope and self-efficacy. The municipal employees tended to make rapid but not always efficient decisions. Although participants sometimes assessed the proposed solutions, they did not do so explicitly, and the criteria on which they based their assessment could have been more detailed. The participants also did not think about less expensive adaptations, such as preparing action plans. Several math abilities – thinking mathematically, representing and communicating mathematically (Niss, 1996) – could also have been used more often by the participants to improve their understanding of the problem. Lastly, the participants were not very confident in their capacity to prepare their community to react to storms.

**Methodology**

Are the adaptive competencies universal and similar in all adaptation processes? Do adaptive competences change according to the geographic location, the complexity of the problem or the schooling and adaptation experience of participants? Which essential competencies should be developed when supporting a group of citizens in their efforts to adapt? A new case study was conducted to continue the exploration of adaptive competencies. A case study is useful when studying a process among humans and makes it possible to observe adaptation in its natural context (Savoie-Zajc & Karsenti, 2000). Kent County in New Brunswick was chosen for this study because, in this region, the quantity and intensity of precipitation and storm surges may increase, causing more frequent flooding and a greater risk of rivers overflowing (NBDE, 2008). Six farmers, four men and two women, from 35 to 70 years old, some with a college degree, and those who were part of the Really Local Harvest, volunteered to participate in the study.

In order to identify their adaptive competencies, the participants were observed while working on adaptations to changes in the patterns of precipitation. The participants attended
seven three-hour workshops over a period of eight months. The workshops were led by one researcher, following a general problem solving process to allow participants to demonstrate their competencies. The participants chose a real problem that they had (soil fertility) and which could worsen with climate change. They tried to solve this problem. They expressed their need for information, and the team answered those needs by inviting experts to the workshops. Some interventions were also made to help participants use a number of skills, like decision-making, futures thinking, risk prediction and planning. A Decision Tree (a drawing of a tree on which the branches represent possible courses of action to improve the broad problem of climate change) was used to help participants identify and assess several alternatives as they were selecting the specific problem on which they wanted to work. The Futures Wheel (Hicks, 1994), a visual method of identifying a chain of impacts and risks linked to a problem, was used to help participants consider various consequences related to climate change. Similarly, the following questions helped participants plan their adaptive actions: When do you plan on carrying out these actions? How will you implement them? How will you monitor and assess them?

**Data collection**

In order to identify the participants’ adaptive competencies, we observed and videotaped the workshops. Évéquoz (2004) suggests observing people at work in a context in which competencies can be seen. In order to avoid subjectivity, observation was carried out in accordance with specific indicators. Fact sheets describing the competencies were prepared to identify participants’ competencies (see examples in Tables 1 and 2). These fact sheets were created following a review of the literature on several life skills (Adejumo, Duimering, & Zhong, 2008; EPA, 1992; Évéquoz, 2004; Inayatullah, 2007; Kerry, 2010; Niss, 1996; Peterson & Seligman, 2004; Pruneau, Khattabi et al., 2008). The fact sheets consisted of a list of indicators for each competence likely to be demonstrated by the participants: problem solving, risk prediction, futures thinking, math skills, decision-making, communication, creativity, curiosity, openness, love of learning, etc.

**Table 1. Futures thinking indicators (Kerry, 2010).**

<table>
<thead>
<tr>
<th>Indicators</th>
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<tbody>
<tr>
<td>Futures thinking</td>
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<tr>
<td>Formulate hypotheses and scenarios of what can happen in the future</td>
</tr>
<tr>
<td>Extrapolate current trends to predict the future</td>
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<tr>
<td>Build a desirable future and propose means for achieving it</td>
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**Table 2. Decision-making indicators (Kerry, 2010).**

<table>
<thead>
<tr>
<th>Indicators</th>
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<tbody>
<tr>
<td>Decision-making</td>
</tr>
<tr>
<td>Identify your goals</td>
</tr>
<tr>
<td>Consider the costs in terms of time, money and effort</td>
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<tr>
<td>Consider available information, the long-term future and the well-being of ecosystems</td>
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<tr>
<td>Deliberate</td>
</tr>
<tr>
<td>Name and assess several alternatives</td>
</tr>
<tr>
<td>Use decision strategies to choose doing math calculations, acknowledging and exploring one’s feelings, considering possible regrets and moral aspects, building scenarios, avoiding the worst case scenario</td>
</tr>
</tbody>
</table>
Data analysis

Thematic discourse analysis and the writing of narratives (for each workshop) were used (Paillé & Muchielli, 2005). The verbatim transcript of the workshops was first subjected to a thematic analysis by two researchers, following a semiopen model, by using the fact sheets to make it easier to identify competencies and their indicators. The participants’ words during the workshops were recorded in a table of four columns. In the first column, each participant’s verbal intervention was written. In the second, one or more competencies were identified (by observing if 75% of the competency indicators included on the fact sheets were present in the verbal intervention). In the third column, the indicators demonstrating the competency or the competencies were noted down, and in the fourth, descriptive comments regarding the participants’ practices. The two analysts compared their work and calculated the intercoder reliability score (97%). While some competencies initially described in the fact sheets stood out in the analysis, new competencies also emerged.

In the narratives, built for each workshop by two researchers, first individually and then as a team, we tried to answer the following questions: What happened during this workshop? How did the participants choose a problem, analyze it, and propose adaptations? Which competencies were observed? The grid for building narratives progressively emerged while the first narratives were being written. Each narrative shows at which stage the participants’ practices are situated, the competencies they demonstrate, their ways of working and their limitations.

Validity and reliability criterions

During the collection and analysis of data, the validity and reliability of the research were provided by methodological triangulation: having two researchers analyzing the data and taking advantage of two different analysis methods: identification of the competencies with the fact sheets and writing narratives. The research results were also presented to the participating farmers who approved their accuracy.

Results

During the workshops, the farmers went through the main stages of environmental problem solving: the problem space, the solution space and the action space (Pruneau et al., 2007). They began the process by analyzing the impacts of climate change on agriculture (the larger problem) and finished by implementing some initial adaptations to counter the poor quality of their soil (the specific problem). One of the implemented adaptations was to plant low-tillage radish in their fields to reduce compaction and improve soil aeration. The farmers also prepared a grant application to obtain mechanized equipment for this purpose and committed themselves to rotating their crops more often.

During the first workshops, participants predicted several climate change impacts on agriculture. To achieve this, they used their in-depth local and agricultural knowledge, futures thinking, hindsight, risk prediction, identification and control of variables that influence harvest and inference. Figure 1 shows the Futures Wheel drawn up by the farmers to predict how a shortfall of rain, too much rain, and heat waves can affect their harvest and their work. In addition, the wheel holds the participants’ first adaptation ideas.

In Figure 1, we notice the subtlety of the participants’ analysis of the climate change problem. To build this Futures Wheel, farmers shared their observations of the effects of climatic variations on their crops. The participants brought out the key elements of
the problems they already faced and of those they considered possible in the future. The participants listed several elements such as unpredictability, the presence of new insect pests, an increase in temperature, frequency and intensity of precipitation and subsequent plant diseases and weeds. In Figure 1, we also note the participants’ ability to predict the results of the mutual influence of several climatic variables on one another. For example, the participants started by saying that too much rain could lead to harvest losses, excessive weed growth and soil erosion, thus causing a loss of topsoil. Then, the participants added a second variable: a thin snow cover in winter. They linked this variable to an overabundance of rain, from which they inferred a reduction in water reserves, a poor root protection of perennials and an increase in the ease of pruning orchards. This way, the participants played around with several variables in order to predict a number of impacts caused by weather.
changes and to make their predictions contingent on the presence of one variable or another: pests, pollinators, snow cover, thaw, etc. Practicing making predictions enabled participants to prioritize problems and choose the one they would try to adapt to: the quality of their soil. This element is placed at the center of the Futures Wheel. For the participants, the issue of improving the quality of their soil to increase its climate resilience was the first that needed to be addressed.

During the workshops, listening to the farmers’ discussion, we were able to understand where their great ability to analyze climate change came from. The participants’ extensive experience observing their fields, ecosystems, harvests and practices – in the context of climate change – dates back a long time. The participants learned to keep a careful eye on climatic variations and other changes (e.g. pests, snow cover, pollinators) that influence their harvests. Farmers have had to adapt to changes in the climate many times. They are also aware of the meteorological observations made by predecessors in their region. Farmers even know the weather conditions in various countries around the world and are familiar with some adaptations that are implemented in these countries. Indeed, according to Leith (2009), farmers rarely think about the climate the way climatologists do, i.e. with reference to meteorological data and statistical models. Farmers are able to imagine weather conditions through observation (the behaviors of animals) and conversations (the neighbors’ theories), thereby gathering information that will be available for several generations in various locations (McIntosh, Tainter, & McIntosh, 2000). In this way, the participants’ deep roots in time (analyzing the past to predict the future), in climatic variations (remembering impacts and the means of countering them) and in their farmlands (knowledge of soils, ecosystems, effective practices for specific plant species) make it easier for them to compare current problems with those previously experienced and with those in other regions. The comparison of problems coupled with the participants’ long experience in observation enable farmers to make informed inferences about problems they may have to face and enable them to choose where their adaptation efforts will be placed: their soil.

Additionally, throughout the adaptation process, the farmers showed a marked interest in learning as well as openness to novelty. These attitudes seemed to have facilitated their adaptation process. Their curiosity and their desire to learn encouraged them to read texts on agriculture and to attend presentations on this subject, which enabled them to acquire new knowledge. In fact, the participants mentioned a few times that they had already visited, or would like to visit, other regions to look at fields, techniques and equipment. Furthermore, the participants’ curiosity and desire to learn were discernible through the numerous questions they asked the invited experts. The new knowledge acquired also seemed to help participants analyze the adaptations proposed by themselves or the experts. The participants’ openness to novelty (e.g. new techniques, new equipment) motivated them to act. For these farmers, trying out new techniques was an interesting challenge. They claimed to be convinced that they would benefit, in the short or long term, from learning new things.

The farmers proposed a number of appropriate solutions because they know many agricultural techniques used in other regions and countries. Critical thinking and their extensive experience helped the participants identify the effects, the advantages and the disadvantages of each solution. This was conducive to a speedy assessment of the proposed solutions and helped them select the adaptation measures to be implemented.

The participants demonstrated optimism and displayed collective self-efficacy relative to their adaptive capacity. They believed that if they carefully chose the changes to apply, and if they helped one another, then the adaptation measures were sure to work. The advantages of the proposed adaptation ideas seemed to be more important to them than
the constraints that were explored. The participants were not discouraged by the potential difficulties, which can be explained by the fact that they often had to find ways of adapting to seasonal changes in the temperature. The participants told themselves that since they successfully overcame obstacles in the past, they would be able to do so again in the future. They were, therefore, very motivated by the adaptation project, which can be explained in a number of ways. First, farmers depend on crop yields to meet their needs, and these yields are closely linked to the climate. Thanks to their particular observational skills, they were conscious of the necessity to expect changes and to be ready for them. In agriculture, it is assumed that climate change will have some positive impacts on farming, such as a longer growing season and a greater variety of cultivated species. For that reason, adapting to climate change can be motivating for farmers because, by being fully cognizant of the issue, they may have the opportunity to increase their prosperity. Finally, the participants were aware of the difficulties in other regions, such as Florida. Thus, they were able to assess the potential presence of risks in their own area.

Discussion

The purpose of our research was to identify some human competencies that facilitate citizens’ adaptation to climate change. The use of the case study methodology made it possible to observe a group of adaptation champions: motivated citizens whose income depends on the availability and quality of natural resources; citizens who are conscious of the potential threat posed by global changes; and, above all, citizens used to constantly adapting to weather changes. Table 3 shows the competencies that emerged from this study and that may have facilitated the participants’ adaptation process. Table 3 also offers an interpretation of the usefulness of these competencies in the participants’ adaptation process.

As shown in Table 3, the competencies identified among the farmers all seem to play a role in facilitating adaptation. Multidimensional and multidisciplinary climate change is a complex environmental problem. Climate change impacts ecosystems, infrastructures, health, human work, watercourses, the economy, food security, social justice, etc. In turn, the direct impacts of climate change have an effect on, among others, urban, geographic, social and ecological components. The long chain reaction can sometimes be unpredictable. There are several causes of climate change: e.g. human, agricultural, industrial and political actions; atmospheric, oceanic, physical and biological reactions. Because of its numerous causes and impacts, the climate change problem is similar to a complex system: a vast web of causal and sequential links between interdependent components that mutually influence one another in a number of ways (Homer-Dixon, 2000). The climate change problem must, therefore, be defined as completely as possible in the specific targeted field, so that citizens can adapt efficiently. This is how experts in a given field, like farmers, are able to predict several climate change impacts. To do this, they make the most of their observational skills; they infer impacts by taking into account meteorological and agricultural variables they are familiar with; and they compare what is happening in their area with events in countries where the situation is already serious.

What is more, climate change arouses disbelief, refusal and uncertainty in some people as to their existence and the moment such impacts become critical. The anxiety caused by this phenomenon, or by a lack of knowledge thereof, leads some citizens to deny its presence, and others to view it as a remote possibility or situate it in a geographically faraway place (Pruneau, Khattabi, & Demers, 2010). Awareness of tangible and current signs of climate change is thus a prerequisite to stimulating the desire to adapt, as it was
Table 3. The competencies demonstrated by farmers and an interpretation of the usefulness of these competencies in an adaptation process.

<table>
<thead>
<tr>
<th>Competencies demonstrated</th>
<th>Possible usefulness in the farmers’ adaptation process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism and self-efficacy</td>
<td>To have the courage to try new practices and to keep from becoming discouraged by obstacles</td>
</tr>
<tr>
<td>Openness to novelty and change</td>
<td>To want to learn and try new agricultural practices</td>
</tr>
<tr>
<td>Interest in learning</td>
<td>To seek ideas about adaptation, to be interested in what invited experts have to say and to be informed among themselves</td>
</tr>
<tr>
<td>Awareness of the presence of climate change and of its impacts</td>
<td>To want to act and change one’s practices</td>
</tr>
<tr>
<td>Knowledge of what is happening around the world</td>
<td>To compare local problems with problems elsewhere and to gain adaptation ideas from this comparison</td>
</tr>
<tr>
<td>Adaptation experience</td>
<td>To know how to adapt and to feel capable of doing so</td>
</tr>
<tr>
<td>Observation</td>
<td>To accurately determine what has previously happened as a result of climatic changes</td>
</tr>
<tr>
<td>Local knowledge</td>
<td>To determine what happens with climatic variations, how, and which are the vulnerable components (observing geography)</td>
</tr>
<tr>
<td>Hindsight</td>
<td>To recall the details of past climate events and to learn from them for the future (observing history)</td>
</tr>
<tr>
<td>Futures thinking</td>
<td>To predict several likely or potential impacts of climate change</td>
</tr>
<tr>
<td>Risk prediction</td>
<td>To determine the zones and components that are at risk, target the main risks and assess their probability</td>
</tr>
<tr>
<td>Knowledge of adaptation practices</td>
<td>To find several ideas about adaptation and to assess these ideas</td>
</tr>
<tr>
<td>Identification and control of variables</td>
<td>To predict risks by considering various variables: agricultural components and adaptation efforts</td>
</tr>
<tr>
<td>Inference</td>
<td>To reach conclusions regarding risks and the priorities in adaptation</td>
</tr>
<tr>
<td>Peer-learning and collaboration</td>
<td>To improve the analysis of situations, to increase competence in global changes and adaptation and to motivate those trying new practices</td>
</tr>
<tr>
<td>Critical thinking</td>
<td>To assess solutions with peers and experts</td>
</tr>
</tbody>
</table>

The case with the farmers who participated in our research. In fact, having already observed signs of this phenomenon, the participants demonstrated high adaptive motivation. The uncertainty present in climate change requires resorting to futures thinking and hindsight by those wishing to adapt. To make informed predictions of climate change impacts, it is important to imagine various scenarios (like the experts on the Intergovernmental Panel on Climate Change) and events that may take place by drawing on previous experiences or by extrapolating from current trends.

By the same token, adapting to climate change entails making changes to practices, the environment, objects and lifestyles. Where there is change, there is resistance to change. The openness to novelty and interest in learning expressed by the farmers in this research are competencies that encouraged the acceptance of change in practices and perseverance when faced with obstacles and peers’ opposing arguments. Optimism is particularly important because climate change causes sudden, unexpected and sometimes frightening events. Perseverance, a competency necessary when dealing with complex problems, is also beneficial because climate change events will occur over an extended period of time. Critical
thinking is also an essential competence to be used when working in uncertainty, whether regarding the scientific information that is available or the prediction of potential climate change impacts. Equally important, critical thinking seems to help assess various ideas about adaptation. Finally, collaboration is an essential competence in any environmental action and more so in a context of adaptation: collaboration can reassure indecisive people and awaken a sense of self-efficacy, promote the dissemination of information and increase a group’s collective talents.

Conclusion

The participants in this research employed several competencies to implement adaptations deemed to be appropriate according to the list of criteria proposed by Bizikova, Neale, and Burton (2008). That list of competencies includes: futures thinking, local knowledge, adaptation experience, knowledge of adaptation practices, observation, risk prediction, hindsight, variable identification and control, inference, peer-learning and collaboration, optimism and self-efficacy, openness to novelty and change, interest in learning, awareness of the presence of climate change, knowledge of what is happening around the world and critical thinking. These competencies, many of which are seen as scientific reasoning (inference; identification and control of variables) (Dunbar, 2000; Zimmerman, 2000), as geographic competencies (organizing and analyzing geographic information; orienting on problems; evaluating alternatives; calculating risks; perceiving complex cause-effect relations and dynamics; anticipatory thinking; Haubrich, 2000) or simply as life skills, all appear favorable to adaptation. Among these competencies, endogenous knowledge, observation, problem-solving skills and futures thinking emerged from the previous works of Pruneau et al. (2009), Auzou et al. (2010), Kerry (2010) and Pruneau et al. (in press).

Certainly, following the case study presented here and results from other studies previously reviewed above, the competencies listed in Table 3 emerge as important competencies to adaptation. It would be relevant to test educational strategies that can develop these competencies among citizens who are taken through an adaptation process. Given the latent nature of climate change impacts, and because citizens must be aware of the necessity of adapting in order to want to act, futures thinking and risk prediction seem to be essential competencies that should be developed in citizens during an adaptation experience.

How then should futures thinking be developed in citizens during an adaptation process? According to Inayatullah (2007), futures thinking fosters the development of individual and collective potential in learners by increasing their ability to consider and organize qualitative transformations for the future. In addition, people often feel overwhelmed when they think about the future and the immensity of the challenges they will have to face. In this regard, futures thinking makes it possible to inspire a sense of hope and a desire to act (Slaughter & Bussey, 2006). According to what the farmers revealed during the case study, the visual method known as the Futures Wheel helped them predict several climate change impacts and visualize the problem as a whole. The effectiveness of this method reminds us of Godet (2001) and Inayatullah (2007), who said that to emphasize futures thinking, learners can be asked to systematically consider several futures – probable, possible and preferable futures. While allowing the identification of different possible scenarios for the future, the Futures Wheel encouraged participants to infer several tangents from each climate change impact. This made it easier for the participants to divide the vast, complex problem of climate change into smaller problems from which they could select a priority problem, thus focusing their efforts and their creativity on one small problem at a time. The technique of dividing a complex problem into small objectives has proven itself in creative problem
A second technique that can be useful when fostering futures thinking is developing future scenarios. Written or drawn, these scenarios (discussed and worked through in groups or in the community) represent events that could happen at different moments in the future, shed light on the possible and probable futures that emerge from the Futures Wheel and motivate participants to want to act in order to fulfill their scenario of a desired future.

How then should risk prediction be developed in citizens? There is little research in the scientific literature that describes specific community risk assessment methods in the context of climate change (Prato, 2008). The concept of risk includes two implicit components: a source of danger and an element of inherent uncertainty (Bedford & Cooke, 2006). That is, a potential danger, threat or inconvenience that is more or less predictable and that has yet to happen, but that will have negative repercussions. The works of Lundgren and McMakin (2009) in risk communication bring to light that risk analysis can best be accomplished with citizens by using a participative approach. We also believe that participants should be encouraged to think about different aspects of risk: severity and magnitude, dangerous amount of exposure, probability, vulnerable areas and citizens, time and duration, community’s ability to defend itself, economic values and conditions of the threatened population. Educational strategies are proposed (Pearce, 2005; Van Aalst, Cannon, & Burton, 2008) in order to perform a time, spatial and social risk analysis: field observation, risk mapping, numbering risks on a scale, personalizing risks (looking at each risk from the point of view of a given occupation, age, etc.) and expressing risk-related emotions. To help citizens think about different dimensions of risk, the following questions are suggested: Who and what ecosystems will be affected? How many people will be injured? How will they be weakened and to what extent? How long will the problems last? What are your perceptions and concerns with respect to this risk?

Other case studies on community adaptation to climate change will have to be carried out in order to confirm the positive contribution of the human competencies identified in this study to the adaptation process. Little by little, case studies could also take the shape of experimentation research (Paillé, 2007) during which educational strategies likely to develop competencies conducive to adaptation are tested and assessed.

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References


