Resilience Assessment of Swiss Farming Systems: Piloting the SHARP-Tool in Vaud

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Abstract: Farm systems are exposed to predictable and unpredictable shocks and stresses. Such events may affect the functioning of farm systems and threaten their capacity to provide food in adequate quantities and sufficient quality. The capacity of farm systems to recover, reorganize, and evolve following external shocks and stresses is analysed within the framework of resilience theory. The SHARP (self-evaluation and holistic assessment of climate resilience of farmers and pastoralists) tool was developed to assess the resilience of farm systems to climate change in a participatory way. The SHARP was originally designed for developing countries. This paper outlines the process and changes made to adapt the tool for use in the Swiss farming context, including the challenges and trade-offs of the adaptation. Its first application in the Canton of Vaud provides insights on the levels of resilience to climate change for farmers in Switzerland. The results showed that of twenty-five farmers, “environment” and “market” are two groups of farm-system components where the farm systems are least resilient. The paper provides preliminary comments on agricultural systems in the west of Switzerland that could be explored further.

Keywords: resilience assessment; SHARP; farm systems; Vaud; Switzerland; climate change

1. Introduction

A serious challenge faced by humanity is achieving sustainable farming systems that provide enough food and ecosystem services for present and future generations in the face of two major challenges—climate change and globalization [1–3].

To ensure food security and natural resource conservation, new paths are emerging to manage changes and prepare for further disturbances [4,5]. A useful framework for understanding the dynamic relationship between humans and the environment is the theory of resilience in social-ecological systems. This theory provides models to analyse and develop the capacity of farm systems to manage changes [6].

Holling [7] initially introduced the concept of resilience in the natural sciences in 1973 as “a concept to help understand the capacity of ecosystems with alternative attractors to persist in the original state subject to perturbations”. This concept has then been transferred from the field of ecology to economics and other social sciences [8].

The strict meaning of resilience in ecology concerns the ability of a system to regain the status quo after a major shock or to ”bounce back”. This is a neutral attribute (rather than positive or negative) but is often combined with other aims such as moving towards development (e.g., bouncing forward) [9].
and is often presented as being inherently positive. In social and economic contexts, resilience is understood as the ability to embrace change, with a capability to adapt to largely exogenous events. This difference in definition can be explained by the fact that economic and social systems are constantly changing due to scientific, financial, governance, lifestyles, and resource management changes [10].

The socio-economic resilience was profusely analysed [11–14]. It goes hand in hand with the definition of resilience that has been adopted in the SHARP (self-evaluation and holistic assessment of climate resilience of farmers and pastoralists) approach [15], namely: “Resilience is the ability of a system to recover, reorganize and evolve following external stresses and disturbances”.

In this paper, the focus is on resilience in a socio-ecological system, more specifically, farm system resilience.

Conventional approaches to farm management treat future developments as predictable and underestimate the complexity of the system. They can thus be identified as reductionist approaches [9]. However, in the current rural change context that is uncertain and complex, it is inadequate to follow the conventional “command and control approach” or “equilibrium thinking” centred on linearity, predictability, optimization, homogeneity, and simplification [16]. These generate isolated, inflexible systems by having a one-sided focus on controlling a system to ensure efficiency (e.g., expressed in high and stable yields) [17]. Instead, farmers need to be able to cope with diverse impacts on multiple timescales [18]. Considering the limits of conventional farm management approaches [17,19,20], as well as the lack of models that integrate ecological, social, and economic sustainability over various temporal and spatial scales, the resilience thinking concept, as used in the SHARP approach, is aimed at better understanding the interconnections and challenges involved in moving towards sustainable food production [21]. It takes the complexity and unpredictability as its starting point [22] and so is a perspective for understanding, managing, and governing complex linked systems of people and nature [23,24]. It addresses this new understanding of the world as being unpredictable. It emphasizes the need to encourage the adaptability and transformability of a system rather than looking for optimal solutions. Thus, the SHARP approach is based on this resilience thinking concept which is a radical departure from the usual “command and control” or “equilibrium-based approaches” [2,25] since it recognizes the dynamic issue of how farmer preferences, markets, and institutions change over time [15,26].

Assessing resilience consists in part by identifying the vulnerabilities in social-ecological systems in order to take actions to create a more sustainable future [27]. However, resilience is difficult to operationalize because its nature is abstract and multi-dimensional [28], as well as being very context specific. Thus, instead of measuring resilience itself, Darnhofer et al. [29] suggest finding sets of surrogates or indicators to assess resilience. Cabell and Oelofse [6] have developed thirteen properties named “the 13 behaviour-based indicators” of resilience in agroecosystems based on reviewing the resilience literature (Table 1). The SHARP tool developed over 50 sets of questions to measure the resilience of agricultural systems to climate change. These questions were mapped against the 13 agroecosystems’ indicators to ensure that resilience was being comprehensively assessed [30].

Each of the 13-agroecosystem indicators represent one property of resilience of a system. The more present the thirteen behaviour-based indicators are, the more resilient the farm system is [6].

Accordingly, their absence or low level reflects lower levels of resilience. For instance, one key indicator of resilience is diversity, which provides in the recovery phase (after a shock) the “seeds for new opportunities” and enhances the options for coping with future new shocks and stresses [31]. Concerning farm systems, diversity is needed in the environmental domain, as well as the economic and social domains. Biodiversity as well as diversity of income, sources of funding, insurance, savings and diversity of relationship types and information sources, to name only the main ones, all contribute to the diversity of farm systems [29].

Despite the challenges inherent in measuring resilience, several attempts have been made for different systems [32]. Considerations what happens really after a shock would be very interesting to measure as well with the SHARP tool. Based on an extensive literature review, Scott [33] analyses
for the rural communities that the “bounce-back” view must be seen as well by a “bounce-forward” perspective, as the ability to adapting after a shock is a component of resilience of this system. In fact, the evolutionary point of view of resilience is essential for understanding well the response’s ability of the farmers to any shock, especially when the shocks are severe and repeat in time, as is the case with the climate change. The SHARP tool has been implemented in sixteen countries to help identify areas where resilience could be improved. Through the support of project interventions, using SHARP as a baseline and endline, evidence showed that resilience was significantly improved. This paper outlines the adaptation and piloting of the SHARP resilience measurement tool in Switzerland for farmers in Canton de Vaud. It tests the hypothesis that a resilience tool developed for developing countries can be adapted to the Swiss context and provide meaningful results for farmers. Initial discussions are made on the implications of the pilot study for resilience of farmers and farm systems with an adapted SHARP and to what extent Swiss farmers are resilient to climate change.

Table 1. Thirteen behaviour-based indicators of resilience for agroecosystems [6].

| Indicator | Description |
|-----------|-------------|
| 1. Socially self-organized | The social components of the agroecosystem are able to form their own configuration based on their needs and desires |
| 2. Ecologically self-regulated | Ecological components self-regulate via stabilizing feedback mechanisms that send information back to the controlling elements |
| 3. Appropriately connected | Connectedness describes the quantity and quality of relationships between system elements |
| 4. Functional and response diversity | Functional diversity is the variety of ecosystem services that components provide to the system; response diversity is the range of responses of these components to environmental change |
| 5. Optimally redundant | Critical components and relationships within the system are duplicated in case of failure |
| 6. Spatial and temporal heterogeneity | Patchiness across the landscape and changes through time |
| 7. Exposed to disturbance | The system is exposed to discrete, low-level events that cause disruptions without pushing the system beyond a critical threshold |
| 8. Coupled with local natural capital | The system functions as much as possible within the means of the bio-regionally available natural resource base and ecosystem services |
| 9. Reflective and shared learning | Individuals and institutions learn from past experiences and present experimentation to anticipate change and create desirable futures |
| 10. Globally autonomous and locally interdependent | The system has relative autonomy from exogenous (global) control and influences and exhibits a high level of cooperation between individuals and institutions at the more local level |
| 11. Honours legacy | The current configuration and future trajectories of systems are influenced and informed by past conditions and experiences |
| 12. Builds human capital | The system takes advantage of and builds “resources that can be mobilized through social relationships and membership in social networks” |
| 13. Reasonably profitable | The segments of society involved in agriculture are able to make a livelihood from the work they do without relying too heavily on subsidies or secondary employment |

2. Materials and Methods

2.1. SHARP Concept and the SHARP Tool

The SHARP approach was originally developed by a team at the United Nations Food and Agriculture Organization (UNFAO) [14,30]. The intention was for farmers and pastoralists in
developing countries to self-assess their resilience by means of a tablet-based survey. The SHARP was developed by the FAO of the UN in 2013 and has been continuously updated since.

The SHARP is a freely available, tablet-based survey used to operationalize Cabell and Oelofse’s [6] 13 indicators. It is currently available in five languages. It comprises 56 sets of questions (totalling over 90 individual questions) covering four main dimensions: environmental, social, economics, and governance. The tool focuses on shocks and stresses related to climate change; however, it does include factors not directly linked to climate change (e.g., market prices, conflict, nutrition), recognising the impact that these factors can have on farm systems. Each question should be answered in three parts.

1. A set of “yes” or “no” or numerical questions. This sets the scene, and depending on the response, follow-up questions are asked and provides a place to elaborate if the farmer wants. Each question is scored based on a pre-defined scale developed with experts in each thematic field.
2. The second is focused on a self-assessment of adequacy as a proxy for a farmer stating their perceived level of resilience on the topic.
3. The third gives the farmer a chance to indicate how important the topic is to their livelihood.

Parts 2 and 3 are referred to as self-assessed adequacy and self-assessed importance. They are used to understand better the perspective of the farmer and to prioritize a potential follow-up action. The first part is referred to as ‘academic resilience’. Each part is scored out of ten, which gives 30 possible points, referred to as the relative resilience priority score. Analysis should be done for each of these farm system components as well as collectively to understand holistically the resilience and priorities of the farmer.

The resilience survey assessment is only one of three phases of the SHARP approach, outlined in Figure 1 below. The second and third phases of the SHARP approach highlight the importance of discussing the data and empowering farmers to understand and act to improve their resilience. Phases 2 and 3 were merged into one phase during the workshop due to time constraints and logistics.

**Figure 1.** The three phases of a SHARP (self-evaluation and holistic assessment of climate resilience of farmers and pastoralists) assessment [14].
The tool provides farmers with an analysis of their survey’s answers in an overview of their most and least resilient farm system components illustrated through a resilience scoring and ranking process for future action. As described above, apart from an academic score based on the assessment of the degree of resilience itself, the respondent self-assesses the importance of each farm system component: (“How important is this farm system component for you”?), as well as the adequacy of this particular farm system component (“Is the current state of this farm system component fitting your needs in your own situation”). The objective of this three-level evaluation is to get a result that is sensitive to the perception of the interviewee. A farm system component with very low academic score may have no importance in the precise context of a particular farmer and does not respond to any challenge he really feels. These two points are considered in the final calculation of the final scores, which interpret the three levels together.

Furthermore, the tool follows six principles. The first is the holistic approach to understand farm system resilience to climate change. It means that the assessment embraces the environmental, economic, social, as well as the institutional dimension. The second is a farm system centred approach, integrated in a way that allows understanding past and present contexts. This is important especially when shocks have been recent. The third principle is to take general resilience as an overall characteristic, and besides, climate resilience as a specific characteristic. It avoids having the climate resilience as the only component measured by the tool. The fourth, was put as a goal to have a participatory, flexible, knowledge exchange and learning approach to project planning, implementation, monitoring, and evaluation. This has consequences in the necessary adaptation of the tool to each particular context of use. The fifth is to have systematic practices to foster stakeholders’ engagement. The sixth and final principle is to consider that climate resilience does not equal sustainable development. Resilience is taken as a neutral attribute. It is not inherently positive or negative, but rather describes the ability of something to bounce back (crudely) to a given state, or to bounce forward to a better state. One could be resilient in a negative situation and resistant to change. When looking to improve the livelihood of someone, the context should be to improve his or her circumstances and support him or her to be more resilient in the improved context—more than just resilient in general.

To explain the logic of the assessment using the SHARP tool, the interpretation of results must be done very carefully. On the one hand, the ranking chart with the adequacy and academic scores should be compared to the ranking chart with only the academic score (cf. Table 2). Importantly, phase 1 should always be followed by phase 2. This means that the results/ranking must always be discussed and validated by farmers within a workshop. The results should be used as a “springboard” for discussion rather than being a final outcome of the assessment [30]. Thus, the SHARP tool is not prescriptive but is a “guide” that provides information and aims to generate discussion to identify areas that need to be addressed to improve resilience levels [30]. Results coming out of the SHARP tool should first be discussed with the farmers and if results are then aggregated at a higher level, they should be used carefully. A detailed description of the initial SHARP tool can be found in [14,30].

2.2. Constructing the SHARP-Swiss Tool

To remain consistent with the initial version, we kept the thirteen behaviour-based indicators of Reference [6] above, which form the core of the SHARP tool. Additionally, we kept the ten-point per part scoring scale. We adapted and tested the tool along the seven steps, illustrated in Figure 2.
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2.2.1. Adaptation

Rephrasing and adding/deleting questions: A group of 14 Swiss experts (eight agronomists, five members of the SHARP team at FAO, and one agroeconomic policy maker) worked to rephrase 90 questions. Questions continued to be matched against the 13 agroecosystem indicators mirroring the linkage of the original SHARP tool. At least one of the 14 experts validated each change to the original version. During the pre-test five farmers with specialized knowledge in livestock or crop farming were involved in adaptation.

2.2.2. Score Adjusting

As the conditions in Switzerland are, for some farm system components, considerably different from those in developing countries, we adjusted the specific scoring of 65 questions.

2.2.3. Translation

The authors translated questions from English to French, with back translation.

2.2.4. Computerization

The FAO IT team and a computer scientist from the École Polytechnique Fédérale de Lausanne (EPFL) adapted the tablet-based application.

2.2.5. Pre-Test

We pre-tested the first version of the SHARP-Swiss on five farmers from the Canton de Vaud to see if further changes were required before a larger test on 25 farmers. The pre-test led to some minor adjustments in rephrasing questions to make them more understandable in the Swiss context. Once we integrated adjustments, the proper SHARP-Swiss was pilot-tested with 25 farmers from the Canton of Vaud in November 2016 using the tablet-based application.
2.2.6. Pilot Test of the SHARP-Swiss Tool

A two-phase pilot-test was implemented with objectives to verify: (1) whether the SHARP-Swiss computer application works well; (2) if we could generate coherent results; and, (3) if the novel tool suits Swiss farmers.

2.3. Phase 1: Self-Assessment of Resilience Using Computer Tablets

Three morning sessions with seven to nine farmers were organized with the support of the local agricultural service (Direction de l’Agriculture et de la Viticulture du Canton de Vaud). Each session lasted three hours and consisted of: (1) a thirty-minute introduction to the tool; (2) two hours to test SHARP-Swiss with each farmer working on a tablet and completing a self-evaluation of resilience for his/her farm system; and (3) thirty minutes to discuss the immediate results generated and opportunity for the participants to give their feedback. (The majority of the farmers were familiar with tablets so after presenting the SHARP-Swiss application, farmers answered the survey independently).

2.4. Phase 2: Discussion of The Results in a Workshop to Identify Causes of Low Resilience and Discuss Potential Innovations to Increase Resilience

The second phase consisted of a three-hour workshop with small groups (of those farmers who participated in phase 1) to discuss results that came out of the resilience assessment using SHARP-Swiss. During the discussion, results of the self-evaluation (the mean values of each question per group) were presented and discussed with the objective of identifying causes of low resilience as well as innovations and activities that some farmers had already implemented or could implement to enhance the resilience regarding these farm system components. The farmers were also asked to suggest ways to bring about innovations that appeared appropriate to them.

Farmers received a small incentive to join the survey, in form of a gift to the value of 50 CHF.

2.5. Data Analysis

To analyse the farmers’ self-evaluation survey data, we exported data from the tablet application into Excel. It generated results in a code format not directly interpretable for statistical analysis. A computer scientist developed an Excel macro adapted to SHARP-Swiss to read data. Figure 3 shows the scoring system and example resilience calculations.

The data was reviewed in two forms—the first: resilience scores (grouping the three parts: “academic (B)”, “adequacy” (D), and “importance” (F), for a combined score of 30); and the importance scores alone (one third of the potential score therefore maximum 10, column F in Table 2 below).
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From all the farmers, 44% (28% very important and 16% a lot) of them seem to acknowledge the importance using distribution channels without intermediaries. However, more than half of them do not consider this distribution channel considerably important.

Figure 3. Analysis of direct selling of produce to consumers.
Table 2. Examples of the calculations used to assess the resilience of a farm system component and its relative ranking of importance to address [14].

| Question          | Response | Academic Score (/10) | Self-Assessment Of Adequacy Response | Self-Assessment Of Adequacy Response (/10) | Self-Assessment Importance Response | Self-Assessment Importance Response (/10) | Relative Score (/30) (B+D+F) | Priority Ranking |
|-------------------|----------|----------------------|--------------------------------------|--------------------------------------------|-------------------------------------|------------------------------------------|-------------------------------|-----------------|
| Sources of water  | 3        | B                    | average                              | 5                                          | a little                            | 7.5                                      | 19.5                          | 3               |
|                   | n        | 0                    | a little                             | 2.5                                        | very                                | 0                                       | 2.5                           | 1               |
| Locally adapted seeds | y   | 10                   | completely                           | 10                                         | a lot                               | 2.5                                      | 22.5                          | 5               |
|                   | 3        | 6                    | not at all                           | 0                                          | average                             | 5                                       | 11                            | 2               |
| Group membership  | 2        | 6                    | a lot                                | 7.5                                        | a little                            | 7.5                                      | 21                            | 4               |

NB: This process incorporates the farmers/pastoralists' self-assessment of importance, adequacy of the component and the “academic” score as developed during an expert e-discussion and feedback from experts. A lower overall score indicates a higher priority. The scoring of self-assessed importance is on an inverse scale to “academic” score and self-assessment as more importance indicates a higher priority, whereas higher “academic” and self-assessed resilience is “better”, and thus less important to address. Relative score = “academic score” + “self-assessment of adequacy” + “self-assessed importance”. A question with a lower “relative score” will have more of a priority for discussion and improvement than other questions that have lower academic, self-assessed resilience or importance to the farmer. See the SHARP background document for a more detailed description of the scoring system.
The scores measuring resilience in the SHARP approach are not meant to be prescriptive in that they do not dictate a specific course of action to improve resilience. Rather, the value of the approach is to produce self-evaluation scores that go on to generate structured discussions with farmers to begin understanding and building their resilience. The 3-h workshop in phase 2 is crucial to delve deeper into the analysis. The workshop is monitored by a facilitator and has two phases. The first focuses on the three least-resilient farm system components found in the phase 1 analysis. To guide the farmers in their reflection, the facilitator presents the graphs that came out of phase 1 (one for each farmer and a graph combining the results of all farmers) (scores from the Excel macro) to the whole group. In the discussion, the causes of low resilience of the three components are teased out. In the second part of the workshop, the joint discussion between farmers and the facilitator continues to find possible solutions, innovations that might improve the identified causes of low resilience. Discussions used “Post-it” notes to farmers and flipchart sheets for participatory activities.

3. Results

3.1. Adaptation of SHARP to a Swiss Context

3.1.1. Strategy for Adapting SHARP to SHARP-Swiss

As described in the Methods (Figure 2), we adapted SHARP to SHARP-Swiss in a seven-step process. The main changes were expanding the economic questions, adjusting the phrasing, and scoring to a Swiss context. We made the changes in the Microsoft Word version of the survey and scoring tables. A pre-pilot test (five farmers) was followed by larger scale pilot test (25 farmers).

3.1.2. Adapting the Survey

• Rephrasing questions

The rephrasing of questions consisted of adjusting wording to better suit the Swiss context and to propose adapted choices of answers for the multiple-choice questions. The essence of the questions did not change to remain consistent with the initial version of the SHARP tool. For example, we rephrased the question “Do you have access to local farmer markets?” to “Do you sell your products at a local farmers market?” The original tool has over 50 “sets” of questions in order to be comprehensive and adequately assess the 13 agroecosystem indicators. This is in part to ensure that there are responses to each of the agroecosystem indicators in case some are not applicable in a certain context. The challenge in part comes from the phrasing of questions. For instance, different contexts use different words or phrases to mean the same thing, such as “shop” versus “store” when purchasing items, or “wells” versus “boreholes”. The scoring also needed updating, as 2 hectares of land in Africa may be reasonable for a farm, but in Switzerland would be too small to be financially viable.

• Removal and addition of new questions

We deleted questions not relevant to a Swiss context and added others to integrate elements specific to Switzerland and its agricultural policy. Again, removal or addition of questions was conducted after discussion with the 14 experts and a thorough literature review. We used the same approach as initially used to add questions to SHARP, meaning that each question contributes to one or more of the thirteen behaviour-based indicators outlined by Cabell and Oelofse [6]. For example, we added the question “Do you share machinery with other farmers?” to the Swiss survey to the first “Socially self-organized” third “Appropriately connected”, and tenth “Globally autonomous and locally interdependent” behaviour-based indicators. Therefore, we kept the same proportion of questions in the survey (we removed around 45 questions and added 50 new ones) contributing to each of the 13 behaviour-based indicators as the original SHARP tool.
3.1.3. Adapting the Scoring

In order to generate comparable results to the initial SHARP, the scoring system was maintained (scores out of 10 for the three parts described in the Methods). Some farm system components in Switzerland are considerably different from those in developing countries; however, we had to adjust the scoring of some questions. For example, the scoring of infrastructure questions as infrastructure in Switzerland is in most cases, more developed than in developing countries. Similarly, the scale of activity typically needed adapting as education and group membership are usually much higher in Switzerland and size of farms greater than in many developing countries. A concrete example is the question regarding the access/use of information sources on cropping/livestock practices (corresponding to agroecosystem indicator 3 “ Appropriately connected”). In the original SHARP, having access to one source resulted in a score of 4 out of 10, whereas in the SHARP-Swiss, using one source of information has a score of 2 out of 10. This affects direct comparisons of individual scores between the two versions of SHARP; however, at the agroecosystem indicator level, results are comparable.

As stated previously, and in the original version of SHARP, the SHARP-Swiss includes a “subjective” part at the end of each of the farm system components. Users are asked to give their opinions of adequacy and importance (see above), which are mapped to a scoring system from zero to 10.

The FAO SHARP team approved the Swiss version of the tool. We found that adapting the full 90 questions from a developing country to the Swiss context was time consuming; however, the process was feasible and should allow SHARP to be adapted for use in further contexts. The key hypothesis of this paper is that a resilience tool developed for developing countries can be adapted to a Swiss context to provide meaningful results for farmers. Once the SHARP tool version was successfully adapted to the Swiss context, we went on to test it in a pilot study with Swiss farmers of the Canton of Vaud region.

A pre-test (five farmers) lead to some adjustments in rephrasing questions to make them more understandable in the Swiss context. We then carried out a larger pilot-test of SHARP-Swiss with twenty-five farmers from the Canton of Vaud in November 2016 using the tablet-based application.

3.2. Pilot-Test of the SHARP-Swiss with 25 Farmers in Canton of Vaud

Sample and Objective of the Pilot-Test

We selected 25 farmers from the Canton of Vaud for the pilot-test. The sample does not statistically represent farmers of the Canton of Vaud due to the limited timeframe of the study. The sampling was not done randomly for logistical reasons; selected participants all live near to the office where evaluations and workshops took place.

The pilot test was carried out in a two-phase procedure as described in the Methods. Importantly, we looked for feedback to finalize SHARP-Swiss.

Of the 25 farmers who participated in phase 1 in November 2016, only about half of them (13) participated in phase 2, organized for April 2017 due to spring work on the farm. Nevertheless, the workshop provided valuable output.

3.3. Resilience Assessment: Phase 1

Results of phase 1 are shown in Table 3.
Table 3. Phase 1 results for all questions showing the four scores showing the mean results for the 25 participants.

| Farm System Component | Academic | Adequacy | Importance | Combined Priority Ranking Score |
|-----------------------|----------|----------|------------|---------------------------------|
| 1 Veterinary access   | 9.1      | 9        | 2.9        | 21                              |
| 2 Information and communication technologies | 10 | 8.4 | 2.5 | 20.9 |
| 3 Soil quality and land degradation | 7.4 | 8.2 | 5.3 | 20.9 |
| 4 Infrastructure      | 10       | 8.9      | 1.9        | 20.8                            |
| 5 Meals               | 10       | 10       | 0.6        | 20.6                            |
| 6 Major productive assets | 9.7   | 8        | 2.5        | 20.2                            |
| 7 Water quality       | 9        | 9.1      | 2          | 20.1                            |
| 8 Utilisation of new varieties and breeds | 8.9 | 7.4 | 2.7 | 19 |
| 9 Leguminous plants   | 9        | 6.6      | 3.3        | 18.9                            |
| 10 Livestock practices| 4.4      | 7.8      | 6.5        | 18.7                            |
| 11 Fertilizers        | 7.9      | 8.3      | 2.4        | 18.6                            |
| 12 Information on climate change | 8.3 | 7.8 | 2.1 | 18.2 |
| 13 Land management practices | 8.6 | 7.9 | 1.6 | 18.1 |
| 14 Weed species and management | 5.7 | 7.3 | 5 | 18 |
| 15 Income generating activities external to the farm | 6 | 7.3 | 4.6 | 17.9 |
| 16 Previous collective action | 7.8 | 6.9 | 3.1 | 17.8 |
| 17 Crop and livestock losses | 6.6 | 5.4 | 5.7 | 17.7 |
| 18 Savings            | 7.6      | 6.4      | 3.6        | 17.6                            |
| 19 Disturbances       | 6.4      | 6.1      | 5.1        | 17.6                            |
| 20 Market information | 7.8      | 6.2      | 3.5        | 17.5                            |
| 21 Household          | 6        | 7.5      | 4          | 17.5                            |
| 22 Trust and cooperation | 7.8   | 6.6      | 2.9        | 17.3                            |
| 23 Land holding       | 8.2      | 5.8      | 3.2        | 17.2                            |
| 24 Market access—buying | 6.6   | 7.9 | 2.4 | 16.9 |
| 25 Local farm inputs  | 6.4      | 8.1      | 2.2        | 16.7                            |
| 26 Animal nutrition   | 5        | 8.7      | 2.5        | 16.2                            |
| 27 Trees and agroforestry | 4.7   | 4 | 7.5 | 16.2 |
| 28 Animal disease control practices | 7.5 | 6.8 | 1.8 | 16.1 |
| 29 Synthetic pesticide use | 5.6 | 7.1 | 3.2 | 15.9 |
| 30 Seed/breed sources | 5.4      | 7.9      | 2.56       | 15.86                           |
| 31 Group membership   | 6        | 7.1      | 2.32       | 15.42                           |
| 32 Energy sources     | 5        | 9.2      | 1.2        | 15.4                            |
| 33 Insurance          | 6        | 7.4      | 1.77       | 15.17                           |
| 34 Gov. policies/programs on climate change | 5 | 9 | 1.1 | 15.1 |
| 35 Crops              | 4.8      | 8.6      | 1.7        | 15.1                            |
| 36 Main expenditures  | 5.9      | 7        | 1.6        | 14.5                            |
| 37 Income sources     | 5.2      | 7.7      | 1.6        | 14.5                            |
| 38 Water sources      | 4.7      | 5.4      | 4.2        | 14.3                            |
| 39 Record keeping     | 4.9      | 6.5      | 2.7        | 14.1                            |
| 40 Production types   | 4.4      | 6.9      | 2.4        | 13.7                            |
| 41 Investment to adapt or transform the farm | 6.2 | 5 | 2.4 | 13.6 |
| 42 Buffer zones       | 4.2      | 2.2      | 7.2        | 13.6                            |
| 43 Sources of funding | 4.2      | 6.2      | 3          | 13.4                            |
| 44 Market access—selling | 4.4   | 6.1 | 2.6 | 13.1 |
| 45 Pest management practices | 3.4 | 7 | 2.4 | 12.8 |
| 46 Water conservation techniques and practices | 3.9 | 4.2 | 4.4 | 12.3 |
| 47 Intercropping      | 1.7      | 6.4      | 3.9        | 12.3                            |
| 48 Interaction between stakeholders of the chain | 3.6 | 4.1 | 4.1 | 11.8 |
| 49 Energy conservation | 3.3      | 3.1      | 4.2        | 10.6                            |
| 50 Use of distribution channels without intermediaries | 1.1 | 4.1 | 4.4 | 9.6 |
| 51 Market prices      | 2.3      | 3.4      | 2.8        | 8.5                             |
| 52 Aquaculture        | 0        | 0        | 0          | 0                                |
| **Average score**     | **6.1**  | **6.9**  | **3.2**    | **16.2**                        |
In the 25 investigated farm systems, the mean most resilient farm system components were veterinary access (21), information and communication technologies (20.9), infrastructure (20.8) and meals (20.6). The average least resilient farm system components were: use of distribution channels without intermediaries (9.6) (direct selling), intercropping (12), energy conservation (8.5), and market prices (8.5) and aquaculture, but this last was taken out, as the 0-scoring indicates that it is not relevant nor important.

The average of the resilience score of the 25 investigated farmers and their farm systems had a medium level of resilience (shown in Table 3 where the average academic score is 6 points out of 10). For the farmers, the three most important components of their farm system were identified to be meals they eat, governmental policies/programs on climate change, and energy sources.

It is worth noting that in this test, the “low resilient aspects” do not match the “important aspects” for the farmers. Indeed, aspects that are assessed as not resilient by the SHARPT tool may have in the particular context of Swiss agriculture no current relevance for the well-being of the farmers. In fact, none of the three most important aspects belonged to the ten least resilient farm systems’ components. As a matter of fact, the results highlight the importance of considering both the resilience score and the importance score for prioritizing individual, group or government actions rather than simply aggregating results and deciding based on composite scores. As mentioned above, these scores are indicators and not true representations of preferences or resilience levels and should accordingly be used as a starting point for discussions to build resilience.

3.4. Farmers’ Perception of Resilience Levels: Phase 2

In this section, we present the output of the farmers’ discussion during the workshop (phase 2). Their reaction to the lowest levels of resilient farm-system components, as well as their feedback regarding the tool are analysed and discussed. The statements reported in this section are only those of the farmers themselves, without judgement or recommendations made by the researchers.

The three least-resilient farm system components were debated, with the objective of identifying causes of low resilience as well as investigating innovations and activities that some farmers already implemented or could implement to enhance resilience regarding these farm system components. The farmers were also consulted on ways to disseminate innovations that appeared appropriate to them.

3.4.1. Use of Distribution Channels without Intermediaries-Least Resilient Component 1

From the self-assessment done with the SHARP-Swiss tool, products not sold directly to consumers (see Figure 3) reduced the overall resilience of the farm system. Farmers believed the reasons for not selling directly to consumers come from three hindering factors: (1) needing too much time and investment; (2) difficulty in accessing direct contact with consumers, location of farms too far from where consumers live; and (3) difficulty in differentiating products to find attractive niches.

During the second part of the workshop, the farmers discussed how the hindering factors causing low resilience could be improved. For the first (“need too much time and investment”), money investment could be reduced by organizing crowdfunding via existing social networks or consumer–investors involved directly at the farm. Another idea would be to move from conventional to organic farming, as often there are more volunteers willing to work for free to get the experience of organic farming, such as workers affiliated to World-Wide Opportunities on Organic Farms (WWOOFers). Time investment could be lowered by cooperation between groups of farmers to sell through structures such as “La Ruche qui dit oui/The Food Assembly” or “le système de paniers/Association pour le Maintien d’une Agriculture Paysanne (AMAP)/ The food basket”. The second hindering factor could be improved by setting up road signs, improving marketing strategies through customized websites, social media, flyers, local newspaper, organizing on-farm events (e.g., brunch, Christmas markets, schools on farms), participating in small structures (e.g., small mills), and by cooperating/collaborating between farmers to sell in cooperatives as above. The third
factor could be improved through large-scale differentiation (farm uniqueness/region); cultivating crop species/varieties that do not exist in the agroindustry, but which consumers would be attracted by, such as ancient varieties of cereals for bread with better nutritional value. In addition, imported products demanded by consumers, but that are not currently in sufficient quantities (e.g., cream cheese) or do not exist in Switzerland are ways to make a distinction. Furthermore, by being attentive to the ecological or health demand trends (e.g., gluten intolerance to conventional cereals) and offering a smart alternative to industrial products, is a way to enter an unsaturated market. Another way to help the farmers with the commercialization of their products would be to diversify or emphasise unique qualities of their produce, including lectures on processing and management/marketing in agricultural school.

3.4.2. Intercropping

Low resilience was also related to a low-level of intercropping practice. On discussing this point, farmers identified causes primarily linked to poor market opportunities: in mixing the crops (e.g., pea–barley mixtures); the farmers do not find enough buyers who agree to buy and sort the harvested crops. According to the farmers, the value chain of such mixtures and the sorting infrastructure need be adapted.

Farmers suggested better planning of the commercialization of mixed crops from input providers (e.g., seed providers, machine providers) to the consumer or end-buyers. In addition, the farmers were of the opinion that “strip intercropping” (a strip of one-crop alternates with multiple rows of another crop) would allow them to continue to use the same equipment and sell through the same distribution channels. For farmers, it would be easier if plots could be combined and reorganized to have, for example, one big plot of strips of barley and peas instead of having one small plot only of barley or peas.

3.4.3. Market Prices

Low resilience was connected with low market prices. When discussing this point with the farmers, they felt the causes of dissatisfactory (too low) prices for their products came primarily from: (1) costs in Switzerland being generally high; (2) high costs covering investments that were abandoned due to agricultural policy changes; (3) strict environmental policy requirements for cropping in general; (4) a power imbalance to obtain a fair share of the market (launches on the market of cheaper imported agricultural products that are not under the same environmental/production requirements); and (5) a power imbalance to negotiate prices with the two major Swiss retailers.

In the second part of the workshop, the farmers debated possible solutions for these particular problems.

Regarding high costs in Switzerland, one way to reduce some of the structural costs could be to cooperate with groups of farmers to acquire agricultural equipment/input through structures such as “Communauté d’Usage des Machines Agricoles” (CUMA), or plot-sharing and selling-cooperatives (such as “La Ruche qui dit oui/The Food Assembly” as well as “le système de paniers/AMAP/The food basket” or “L’association Marché Paysan”). In addition, another way to reduce costs could be to look for multipurpose inputs/crops/animals, such as choosing a cow breed that can produce milk and good meat. Concerning administrative costs, these could be reduced by promoting further data automation.

Concerning the other causes, farmer intervention to make improvements is limited as change is mainly in the hands of policy makers, although collective action could be taken to lobby policy makers. Point 2 could be mitigated by improving transition support from one policy change to the next; by improving structural flexibility such as giving support to multifunctional structures; by adjusting agricultural education to give the farmers the tools to make better management decisions, to help them move from specialization to diversification; and to educate them as soil engineers/technicians to improve input autonomy.
Concerning the power imbalance, policy makers could help the situation by measures such as following the principle of food sovereignty and fostering local production to change the market share ratio influencing what is currently imported but could be cultivated in Switzerland (like organic products). Introducing a kilometre-based charge; promoting more biodiversity on harvested crop plots than on fallow plots; upgrading quality (environmental and nutritional) in products by enforcing better labelling requirements or by demanding the same agricultural production regulations for imported and Swiss products (including processed products like flour and dough). A good example of the latter is the import system that the Swiss brand “Bio Bud” applies. Nevertheless, there are other solutions that are within other stakeholders’ reach, such as promoting structures like “BioConsommActeurs” to raise consumer awareness about differences in social, nutritional/health, and environmental aspects of Swiss agricultural products compared to similar imported agricultural products, to change consumers’ purchasing behaviour. Furthermore, for consumers, the link to health could be clearer if there is more collaboration between the Health and Agricultural Departments. Farmers could also distinguish themselves from agro-industrial products by diversifying the range of cultivated crops with crops/varieties that are different (e.g., shelled buckwheat, small spelt, millet, and quinoa) and in high demand in a market not yet saturated. This means that economic, environmental and consumer-preference aspects should be combined when choosing a crop/variety. Farmers said that support is needed to improve collaboration along the value chain by integrating mills/bakers or groups of farmers selling directly to consumers.

For the fifth point, the power imbalance to negotiate prices with the two major Swiss retailers could be improved by diversifying farm distribution channels by integrating direct selling structures mentioned above. Furthermore, creating new semi-direct selling partnerships by grouping together farmers to either process their product directly (e.g., collaboration with a mill or bakery) or sell their product to a grocery store such as the “La Ferme” shop in Yverdon are other solutions. In addition, collaborating with producers’ groups or negotiating structures such as those that exist for organic farmers (e.g., Progana or Table ronde du lait bio) or structures for protected designation of origins are ways to defend fairer prices. However, in cases where supply and demand within an association (or similar structure) cannot find a common agreement, a price/supply arbitration tool or a legal basis should be introduced to maintain indigenous food production and reward the work of the farmers with at least the cost price. Also, adjusting agricultural education with more marketing/management/processing modules could give farmers the tools to be less “shackled” by the system and offer them alternative options (e.g., process and sell their products directly to consumers). Related to the latter, from the policy side, providing support to small local structures such as milk-houses/mills or fostering value chains managed by farmers would help to enlarge the options for farmers. Another solution from the policy side is to introduce sanctions for marketing lies about the image promoted by certain stakeholders versus the reality (2–3 chickens running in a meadow vs. intensive animal husbandry). This would enable more transparency/traceability for consumers’ purchasing choices. At the international level, some reforms and coordination improvements of international agendas could bring to light the importance of farmers and the importance of giving them more weight since they are the main stakeholders to move our food systems in a sustainable direction.

4. Discussion

4.1. Farmers’ Feedback on SHARP-Swiss

Positive feedback came out of the pilot-test of SHARP-Swiss. The majority of farmers who participated appreciated having a computerized tool that generates immediate results of the survey. Furthermore, they enjoyed being in small groups to discuss results and having their voices heard. The results, presented as graphs, enabled the farmers to kick-start joint discussions. In the workshop environment, they could compare themselves to the others, identify what makes one system more or less resilient than another does and see where the common issues/priorities lay. The process of
evaluating their resilience and discussing it in groups increased their awareness of innovations, actions, and methods that the farmers may use to increase their resilience.

Furthermore, the farmers appreciated the holistic approach of SHARP-Swiss as it integrates environmental as well as economic, political, and social dimensions, the assessment of their farm system seemed more realistic and comprehensive. Additionally, the majority found it interesting to have an assessment about resilience since it relates directly to them and their reality. As the impacts of climate change are felt more fully, resilience as a concept and attribute is becoming more important.

4.2. Use of SHARP and SHARP-Swiss

The farming systems’ resilience assessment from SHARP is easy and attractive, mainly because it does not require administrative documents: the so-called “academic part” of the survey does not require specified measured numbers, so the farmers can answer it based on immediate and general knowledge of the daily functioning of the farm.

Furthermore, as presented in the Methods section, each farm system component is made up of an academic part with a maximum of ten points and a self-assessed part with a maximum of twenty points (ten points each for adequacy and importance). The self-assessed adequacy part is completely subjective but counts for half of the resilience score (ten out of twenty points when importance is removed) so it can considerably influence the results. Thus, the ranking of some farm system components can be difficult to understand. In fact, some farmers were surprised to see that some of the farm system components with very low academic scores had low self-assessed importance score (e.g., the farm system component “intercropping”).

The second workshop is essential to the approach since it is the phase where precious information to support building farming system resilience is gathered. The input is crucial for any stakeholder projects for the food system of a country, as well as for policy makers to get an overview of the farmers’ reality. Rather than simply using the survey’s overall relative resilience ranking, discussions lead to a better understanding of farmers’ resilience, which in turn enables priorities to be set for projects aiming to build resilience as well as individual action. Thus, discussion is part of the process of increasing resilience [30]. As written in the SHARP User Manual, the rationale for SHARP is mainly to find the least resilient farmers, learn from them, and empower them to increase their resilience [30]. The practitioners who facilitate the survey must first understand the concept of resilience in the way the SHARP approach defines resilience and take responsibility for what they do. Then, they must take enough time to listen to the participants (farmers) and learn from them. Otherwise, rushing and lack of commitment will skew the analysis [30].

While the small sample size limits our ability to generalise about farmers in Canton de Vaud, some interesting findings warrant further investigation. Despite the tool being adapted to the Swiss context, the farmers were still shown to have higher resilience scores in areas typically associated with developed countries such as Information and Communication Technologies (ICT), infrastructure, climate change information, water quality, and veterinary services. However, many profitability or market-related questions (e.g., sources of funding, interactions between stakeholder of the chain, market prices, and use of distribution channels without intermediates) scored at the bottom of the academic resilience ranking. These results indicate that farmers in Canton de Vaud (potentially any other developed country contexts) are resilient to the direct shocks and stresses from climate change but may feel the effects indirectly through less profitability due to their vulnerabilities in markets and price fluctuations. This also highlights the importance of being resilient to all aspects of ones’ livelihood as any area of low resilience can be exploited by shocks and stresses that the other areas may not be able to compensate for. It will be important to explore this further to understand the implications of different climate change scenarios on agriculture systems and to discuss resilience improving strategies among farmers and policy makers.
4.3. Perspectives and Recommendations

The SHARP tool was adapted to the Swiss context and received positive feedback from the pilot farmers; the following steps will be undertaken.

The SHARP application has been adapted but the Excel macro used to process the large amount of data must still be finalized to get accurate statistics on large data sets. The macro is necessary to translate the raw data from the android tablet to an Excel file and to build graphs for the analysis. This will be done in order to process with a representative sample of farmers in a next step of the research in Canton de Vaud.

Second, a proper and systematic sampling approach should be developed in order to understand better the resilience of categories of similar farms (i.e., up-scaling the approach to a farming systems comparison) (FAO, 2015). This will allow targeting development projects to similar groups of farms.

Third, an online platform should be developed. This online platform would allow the gathered information of future workshops to be shared among all relevant stakeholders of the Swiss food system. Thus, once the macro and the platform are finalized, the SHARP approach will be carried out on a larger scale in the Canton of Vaud of Switzerland to make sure that the adapted application works well with big quantities of data and to have a more representative sample. Then, if the outcome gets positive feedback, the SHARP approach will be carried out in other Swiss Cantons with a Swiss-wide online platform.

5. Conclusions

In the present context of climate change, our world food production system needs resilient farm systems to face the unpredictable and uncontrollable disturbances that come along with these societal trends. To enable farm systems to become more resilient, a closer look at their current situation is needed to know where to start with projects that aim to support the building of their resilience. For that, the SHARP approach, first implemented in vulnerable developing countries, is useful since it allows farmers to have a good overview of the actual situation and to bring valuable farmers’ insights for setting priorities of projects aiming to build farming system resilience. Thus, given that this approach has considerable potential, it was relevant to widen its scope from developing to Western countries and now it is important to expand from a pilot assessment to representative assessments across Switzerland and other countries. This takes on even more significance in view of the fact that most of the world’s arable land is under Western farming systems and becoming increasingly vulnerable to climate change.

We present here the first step, a pilot test undertaken with 25 farmers allowing us to check, for the first time, acceptance of the SHARP approach by Swiss farmers, to verify whether coherent results were produced and to provide precious feedback for the finalization of the new version of the tool.

This approach does not limit the interventions to improve the current practices of the food system of a country. On the contrary, it opens opportunities to all kinds of innovative interventions, even a rethinking of the current system such as a shift towards diversified agroecological systems, as long as those innovations improve the resilience of farm systems in the way the SHARP approach defines resilience. This may be of particular relevance given the drawbacks of industrial, non-diversified agriculture.

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