Sami Paavola[1], Hanna Mäkinen[2], Reijo Miettinen[1] and Helena Kahiluoto[2]
[1] **Center for Research on Activity, Development, and Learning**, P.O. Box 9, 00014 University of Helsinki, Finland
E-mail: **etunimi.sukunimi@helsinki.fi**
[2] **MTT Agrifood Research Finland, Agrifood Resilience Group.** Jokiniemenkuja 1, 01370 Vantaa, Finland
E-mail: **etunimi.sukunimi@mtt.fi**

Enhancing Resilience with Response Diversity

Uncertainty posed by climatic and socio-economic variation and change raises a need to enhance resilience and adaptive capacity of agrifood systems. The focus on social aspects requires reconsideration on the concept of resilience.

We propose a new approach and practical tools for actors to build more resilient cultivars, and food systems. We present an approach to empirically reveal response diversity, that is, the factors of change that are critical to a system in question.

A case of developing response diversity in collaboration with barley breeders is presented. The aim is to make a tool for practitioners to be better prepared for uncertainty in climatic conditions. A key operationalization of response diversity was a clustering of several Finnish barley cultivars according to their response to critical weather conditions.

The response diversity approach requires a long-term perspective. To serve as a tool for practitioners collaboration among national stakeholders is needed.

Fig 1.

Resilience: *"the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker et al 2004)*

Response diversity: *"the diversity of responses to environmental change within functional groups, i.e., among species or cultivars contributing to the same function" (Nyström 2006).*

Resilience

Resilience is nowadays a widely used concept concerning the status and dynamics of social-ecological systems. The concept originates from the discourse of ecological systems. Resilience points out unpredictable and non-linear nature of change both in natural and social-ecological systems. Inclusion of human agency seems to have effects on the uses of the concept by introducing issues like the capacity for renewal, learning, and coping with changes. Human interventions can change existing cycles of change.

Resilience has been characterized with general indicators like diversity, modularity, social capital, or innovation. Resilience has been difficult to operationalize in more concrete means. Therefore, we need to characterize resilience also in smaller, more manageable social-ecological systems, and with concrete means.

In this study, we used the idea of *retooling*, that is, the idea that change in practices requires the development of novel kinds of tools and artefacts which are used as practical means of activity.

Response diversity

Climate change is characterized with uncertainty, variability, and extremes. How climate will change in a certain locality and time period, is uncertain, as well as its indirect consequences to e.g., market. Diversity appears to play a key to provide resilience to variability and seeds to build capacity to adapt to change. The larger diversity in itself does not necessarily secure the specific functions.

Response diversity refers, not just to diversity in general, but to the diversity of responses within one group providing an important function such as fodder (barley or forage crops) to critical change and variability. Despite an increasing diversity of barley cultivars grown in Finland, the diversity in responses to weather factors critical to barley yield is decreasing in regions where barley is most important.

Since cultivars differ in their reactions to critical weather (Fig 1), targeted combinations of species and cultivars could enhance the performance of fodder production in weather variability.

Case: Response diversity in barley breeding

A generic procedure of response diversity suggested by Kahiluoto et al., (2014) is developed towards a more concrete tool, barley cultivars as the case. Empirical data for 1980-2009 from locations with different climate was collected, 12 critical weather factors for barley yield were identified in the data, and the 112 barley cultivars were clustered according to yield responses to those weather factors.

The aim was to study whether these results might be transformed into a tool of decision making in enhancing resilience in barley production. The data comprised recordings of meetings between agrifood researchers and barley breeders in a commercial company.

Conclusions

- The barley breeders find the approach useful
- On the other hand the long-term perspective, demanded by it, is a challenge for a commercial barley breeding
- The discussion will be extended to other relevant partners, like industry, seed retailers, and national emergency supply agency

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