**Climate Risk Perceptions and Adaptation Decision-Making at Nordic Farm-Scale – a Typology of Risk Responses**

Janina Käyhkö

Ecosystems and Environment Research Programme, University of Helsinki, Helsinki, Finland

Helsinki Institute of Sustainability Science (HELSUS), University of Helsinki, Helsinki, Finland

P.O. Box 65 (Viikinkaari 1, 4403), 00014 University of Helsinki, Finland

[janina.kayhko@helsinki.fi](mailto:janina.kayhko@helsinki.fi)

**The supplemental online material**

Full list of the discussed climatic challenges and the climate risk perceptions

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| Climatic challenge | Perceived risks |
| All climatic challenges/ combined effect of many challenges | *direct risks:* crop losses, decreased crop and soil quality  *indirect risk:* increased work load, more difficult field working conditions, financial losses, soil packing (from unsuccessful measures, excess driving on the fields, bad timing of field work) |
| Longer growing season | *direct risks:* increased invasions of/ new pests, plant diseases, harmful fungi and weeds, lack of suitable plant varieties  *indirect risk:* increased pesticide usage, giving up on farming |
| Increased heat | *direct risks:* heat waves, droughts, milder winters, decreased snow fall and coverage, decreased frost  *indirect risk:* unsuccessful overwintering of perennial and winter crops, overwintering of harmful organisms |
| Changes in precipitation | *direct risks:* the intensification, prolongation and bad timing of excess or inadequate rain-fall, flooding in the fields (plant suffocation, sowings wash off, crops left unharvest)  *indirect risks:* increased pesticide usage, broken machines, increased drying costs, profit losses and increased labour intensity from water protection practices |
| Increased occurrence of extreme events & Variability and unpredictability | *direct risks:* problems with timing of field work, unusual: reoccurring winters, hailstorms, intensified winds, downpours  *indirect risks:* distortions in the markets, profit losses, falling trees, general insecurity, anxiety |

Categorization of the adaptation measures: the discussing stakeholder group, level of intention (or actual implementation), the driving climatic stressor and the aimed outcome.

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| The adaptation measure | | Subsidies / other economic benefit | Level of intention | | Climatic stressor | Aim |
| *FARMERS* | *EXTENSION OFFICERS* | *FARMERS* | *EXTENSION OFFICERS* |
| *direct sowing (no-tillage)* | *X* | env. comp. (ep) | ACT4 | ACT4 | p, d | 1(4) |
| *light tillage / tillage only when necessary* | *X* | $$ | ACT3 | ACT3 | p, d | 1(4) |
| *green fallows* | *X* | greening | ACT5 | ACT2 | v/p | 3 |
| *nature management fields* | *X* | env. comp. (ep) | ACT3 | ACT4 | v/p | 3 |
| *buffer zones* | *X* | env. comp. (ep) | ACT3 | ACT5 | p | 1(4) |
| *crop rotation* | *X* | greening | ACTall(7) | ACTall(6) | v | 3(4) |
| *adding and changing the variety of crops (e.g. More productive, adaptive to changing conditions)* | *using more productive crop varieties; using crop varieties of a longer growing season (corn, winter grains, fava bean)* | possible: greening (fava beans, etc.) | ACT2, PLAN3 | ACT1, SHOULD1 | g | 1, 3, 4 |
| *wintercrops* | *X* | greening /env. comp. (ep) | ACT6, PLAN1 | ACT2, PLAN2, COULD1 | g | 3, 4 |
| *nitrogen fixating plants/ biological nitrogen fixation/ green manure grass* | *nutrient circulation* | greening/ env. comp. (ep)/ crop reward | ACT2 | ACT2, COULD1 | p, g | 3, 4 |
| *X* | *deep rooted crops* | greening | ACT1, COULD1 | PLAN1 | p | 3 |
| *undersown crop* |  | env. comp. (ep) | ACT3 |  | p | 3 |
| *changing the crop/relation of crops in spring* | *X* |  | ACT3 | ACT1 | v | 1 |
| *resowing* |  |  | ACT1 |  | p, d, v | 2 |
| *leaving the crop unharvested* |  | $$ | ACT4, COULD1 |  | p, v | 2 |
| *subsoiling* | *X* |  | ACT1, PLAN1 | ACT1 | p, d | 1 |
| *structural liming* | *X* |  | ACT1 |  | p, d | 3 |
| *avoiding unnecessary driving/ minimizing autumn field work /good planning of logistics* | *X* |  | ACT5 | ACT2 | p | 1 |
| *co-operation with neighbor farms* | *X* |  | ACT3 | ACT1, SHOULD1 | v | 2 |
| *lighter machines, broader / double tires, precision machinery* | *X* |  | ACT3 | ACT1 | p | 1 |
| *maintenance / adjustment of the subsurface drainage* | *enhancing overall drainage (including wetlands)* | env. comp. (ec) | ACT2, PLAN4 | ACT1, COULD3 | p | 3 |
| *supplementary subsurface drainage on best fields* | $$ | ACT1 | p | 4 |
| *investments on new land* |  | $$ | ACT2, (WISHx) | SHOULD1 | g | 4 |
| *shift to organic production* | *X* | greening/ organic production comp. | ACT2, PLAN2 | ACT5, PLAN1 | v | 1, 4 |
| *taking up animal husbandry* |  |  | COULD1 | SHOULD2, COULD1 | v | 4 |
| *shift to crop husbandry intensity (from animals)* |  |  | ACT1, PLAN1 | ACT4 | v | 1 |
|  | *bioenergy production* | greening |  | PLAN1 | v | 3 |
| *changing the form of enterprise (farm concern)* |  |  | ACT1 |  | g | 4 |
| *digging up the river bed* |  |  | SHOULD1 |  | p | 1, 3 |
| *X* | *enhancing soil structure (by e.g. adding organic matter) explicitly* |  | ACT5 | ACT4, COULD1 | cc | 3 |
| *X* | *protection of waters as the explicit driver (buffer zones, wetlands, wintertime field coverage, catch crops)* | env. comp. | (*ACT3*) | ACT4 (*ACT5*) | cc, p | 3 |
| *X* | *intensifying and optimizing production in general /on certain field segments (best, worst)* | $$ | ACT2, PLAN1 | ACT4 | cc, v | 3 |
| *breaking the crusted surface soil with harrow in spring* |  |  | ACT1 |  | v, (d, p) | 2 |
| *shift to using peat-manure mix (instead of liquid manure)* |  |  | ACT1 |  | p | 3 |
| *grains are left to minimum care if the yield appears to be left small* |  | $$ | ACT1 |  | v | 2 |
| ***Terms & abbreviations:*** | | | | | | |
| *Subsidies / other economic benefit:* | The subsidy options for described measures fall under two subsidy types:   * support for greening, and * environmental compensation   Greening includes ecological focus areas, crop diversification and permanent grass-lands. The environmental compensation is divided to two different types by the new environmental payment scheme from 2015: environmental pledge (ep) and environmental contract (ec).  Other economic benefits described in the interviews included crop reward, organic production compensation and expected profit from the changes ($$) | | | | | |
| *Level of intention* | * The measure is intended by self or by others (PLAN) * The measure has been implemented by self or by others (ACT) * Implementing the measure is assessed necessary by self or by others (SHOULD) | | | | | |
| *Climatic stressors* | * Increased precipitation (p) * Increased temperature& drought (d) * Longer growing season (g) * Climate variability (v) * Climate change in general (cc) | | | | | |
| *Aim of the measure (sic. Juhola et al 2017)* | (1) Reducing risks (2) Increasing coping capacity (more short term)  (3) Increasing adaptive capacity (rather long term capacity) (4) Increasing benefits | | | | | |

The thematic map: coding of the interview transcripts and operationalization of the theoretical framework with examples from the results.

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|  | *Thematic map* | | | | |
| *Operationalization:* | | *Predetermined themes:* | *Iteratively detected keywords /themes:* | *Examples/ type of quotations:* | *Coding* |
| Questions regarding perceptions of climatic challenges (weather variations and extreme weather events), vulnerability (personal, regional agriculture, crop yields and crops), severity and probability | | climatic challenges, vulnerability, severity, probability, experiences, climate awareness and beliefs | surviving, securing, harm, weakening, challenges, bad thing, worry, risk, problem, disturbing, wasting, loosing, stress, learning and depressing. | mainly implicit notations  *‘climate change makes progress slowly but with certainty’* | *Climate risk perceptions* |
| Explicit questions on observations and expectations on the effectiveness and costs of measures and the perceptions of farmers’ capabilities to manage/handle the measures  Explicit question on other factors (than climatic) affecting farmers’ adaptation behavior | | effectiveness and cost of adaptation measures; norms, subjective norms, limitations and dis/incentives | costs, benefit, success, profitability, value, decision, invention, timing, enhancement, effectiveness, planning, long-term vision, diversification, misinvestment, focus, target, subsidy, compensation, prize, lure, development, savings, risk | explicit and implicit notations related to both, expected and implemented measures  ‘*All measures are primarily done in order to decrease labour and expenses*.’  *‘it is difficult to make changes’*  ‘*I’m so slow to adapt new things*’  *‘neighbors thought I’m crazy’* | *Adaptation assessment* |
| direct questions on intentions to adapt | | Intentions to use measures to avoid harms and risks of climatic/weather related events | deliberate, ponder, consider, prepare, learn, plan, study, interest, possibility, update, improve, modernize, project, synergy benefit, uncertainty, cooperation | mainly explicit notations on certain measures or strategies | *Adaptation intention* |
| ’Have you countered maladaptation?’ + explanation of the concept, when necessary | | unintended harmful outcomes of adaptation measures |  | mainly implicit notations on unintended harmful outcomes | *Maladaptation* |
| Explicit questions on implementation of adaptation measures | | Implemented measures to avoid harms and risks of climatic/weather related events |  | explicit notations on certain measures or strategies | *Adaptation measures* |

Uusimaa is a typical Nordic region that is relatively urban and densely populated centre by the sea, and nevertheless mostly covered by forests and agricultural lands.

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| *Uusimaa region* | | *Climatic vulnerability & agriculture factors* | |
| *Inhabitants* | 1 644 107 | *Erosion risk degree* | high |
| *Habitats/ km2* | 180 | *Coastline (with Baltic Sea)* | 1 200 km |
| *Dominating soil types* | clayey & clayey silt soils |
| *Farmer population* | 2 828 |
| *Total land area (km2)* | 9 097 | *Average farm size* | 50 Ha |
| *Agricultural land of the total land area (km2)* | 1 860 | *The main crops (excluding fodder)* | spring wheat, barley and oats |
| *Sea water area (km2)* | 6 490 | *Climate change scenarios relevant for agriculture* | temperatures and precipitation rise, snow cover and frost decrease, winters become darker, changes become greater in the winter than in the summer |
| *Municipalities* | 26 |
| *Villages* | 260 |
| *Climate (Köppen -classification)* | warm humid continental |

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