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

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**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 measuresExplicit 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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