



FUTURE DIRECTION OF IRISH TILLAGE MECHANISATION

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Role of tillage into the future



Global food demand to 2050 requires increasing crop yields by circa 2.4%/an

Global wheat circa 0.9% per annum



Demand for plant proteins alternatives for animal proteins



Demand for alternative animal protein sources rather than Soya



Demand for bio-feedstocks (fuels, biopolymers, green chemicals)

What will influence tillage mechanisation?



Soil biology and soil understanding



Weather patterns



Labour availability



Digital agriculture

Soil biology



Crop yield is a function of light, nutrients and water, and the capture and conversion of these into plant biomass.



In Ireland - we tend to get between 800-1100 kWh/m², which can cause high output crops to be light limited.



Generally over winter most soils have the capability to store significant amounts of water per meter depth



Plant nutrient availability in soil can be limited by nutrient mobility, solubility and root density in the soil layers



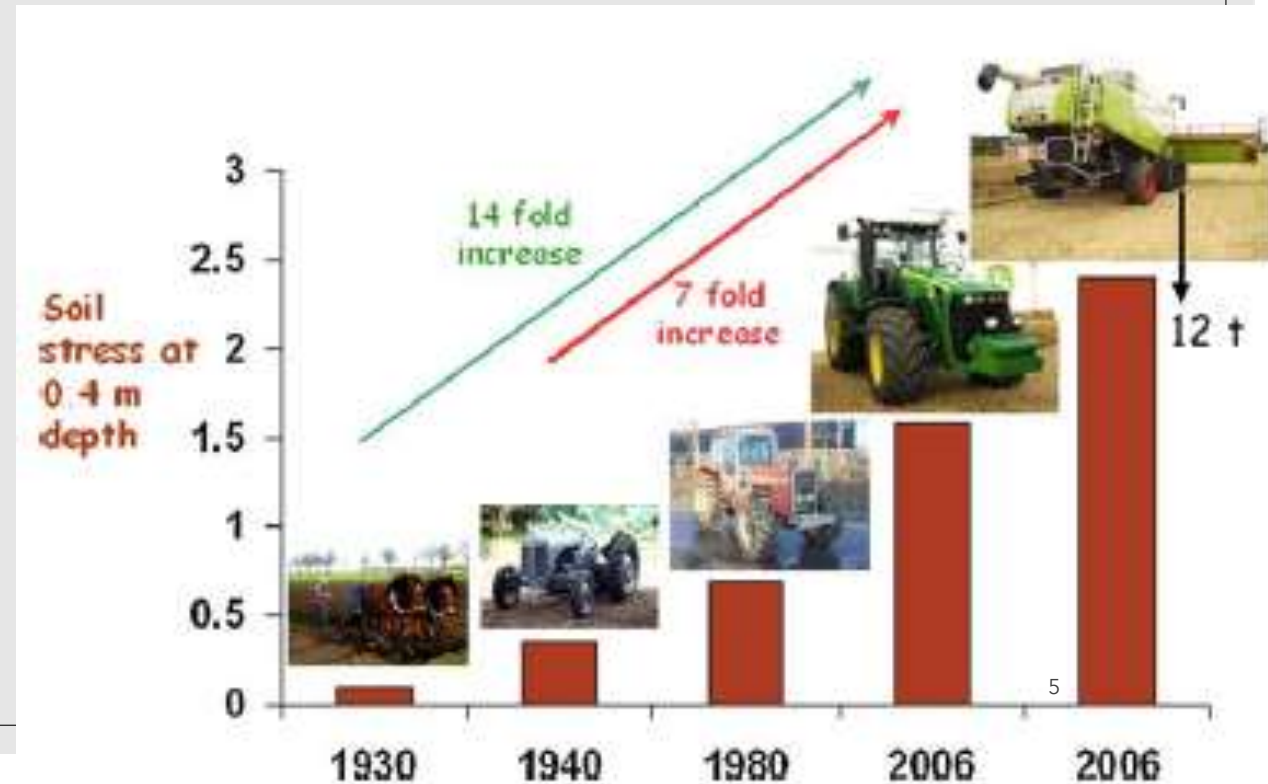
Nitrate - highly soluble can tends to move deeper in the soil throughout the growing season following the drying layer.



Root movement and architecture to access water and nutrients is critical.

Soil Compaction - A threat to food security

- Soil compaction affects 68 million hectares of crop land globally
- Farm sizes have increased along with machinery size
- Wet soil has reduced strength to externally applied load
- Heavy axle load impacts subsoils >0.4 m - Irreversible damage. Impeding roots at depth.



Research Trials



Impacts of Soil management



Soil structure impacts on crop yield, - complicated by texture and crop type



Soil moisture is critical, timing of soil activities (cultivation., sowing etc) is important

- even small reductions in soil water content will significantly reduce the negative impact of machine trafficking on the top soil and on the subsequent layers.



Root length density crucial for water and nutrient uptake

Rapidly growing crops with poor root systems will have limited nutrient uptake

Franklin D Roosevelt said; **"A society that destroys its soils - destroys itself"**

Weather patterns



Climate change is increasing the seasonality and intensity of rainfall in Europe

More frequent winter flooding
More frequent summer water stresses



Many climate models predict further reductions in summer rainfall

Some typically wheat regions are becoming marginal with respect to yield potential as limited by water availability



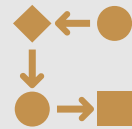
Reduction in operating windows - estimated to be 5 days in spring time and 5 days in autumn now lost due to unfavourable weather/soil conditions over the last 20 years.

Labour availability



Tillage equipment significantly more sophisticated

Touch screen controls, data input requirements



Activities more specialised - registered pesticide user



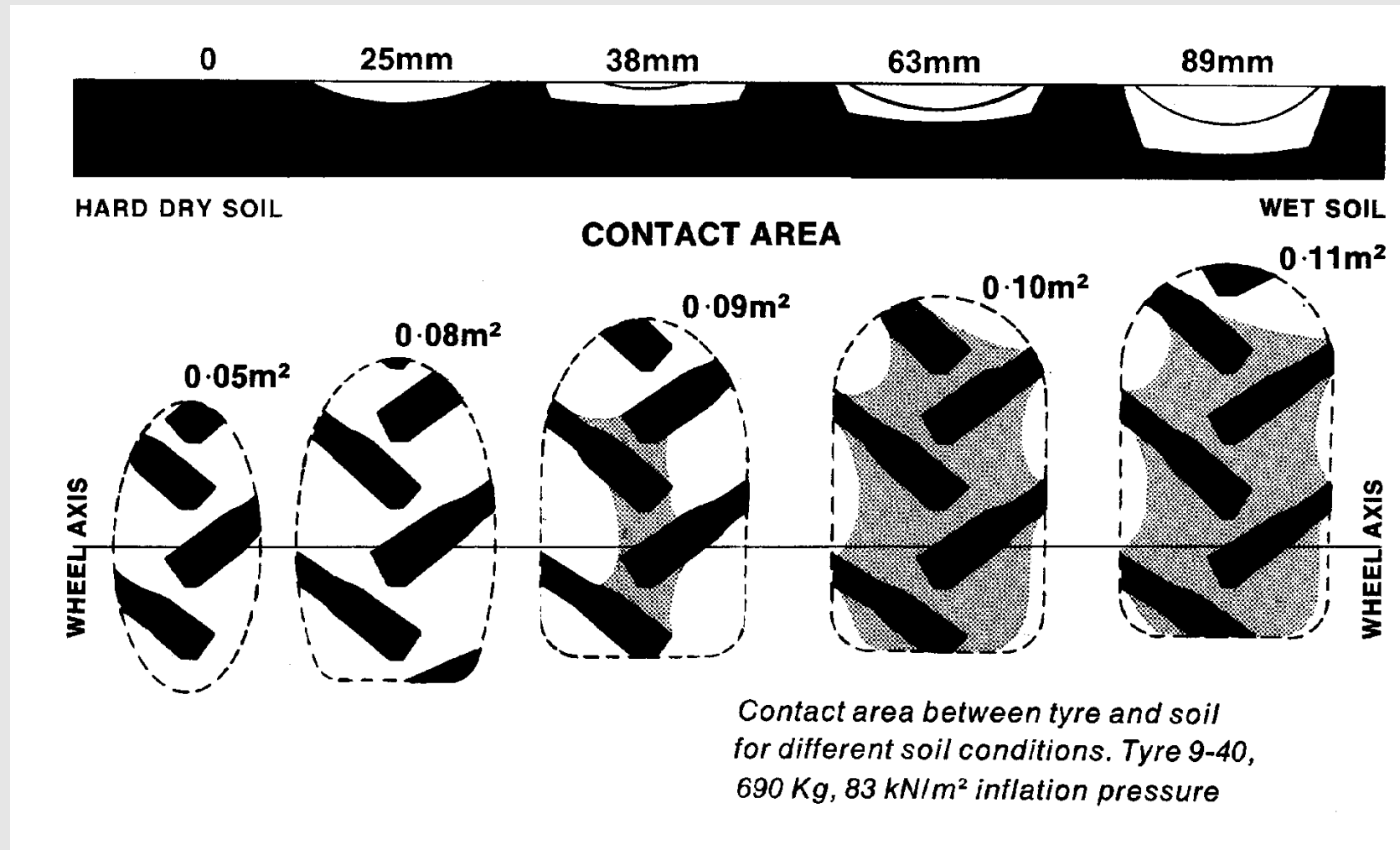
Compressed intense working periods

Sowing, harvesting
Significant lone working aspects

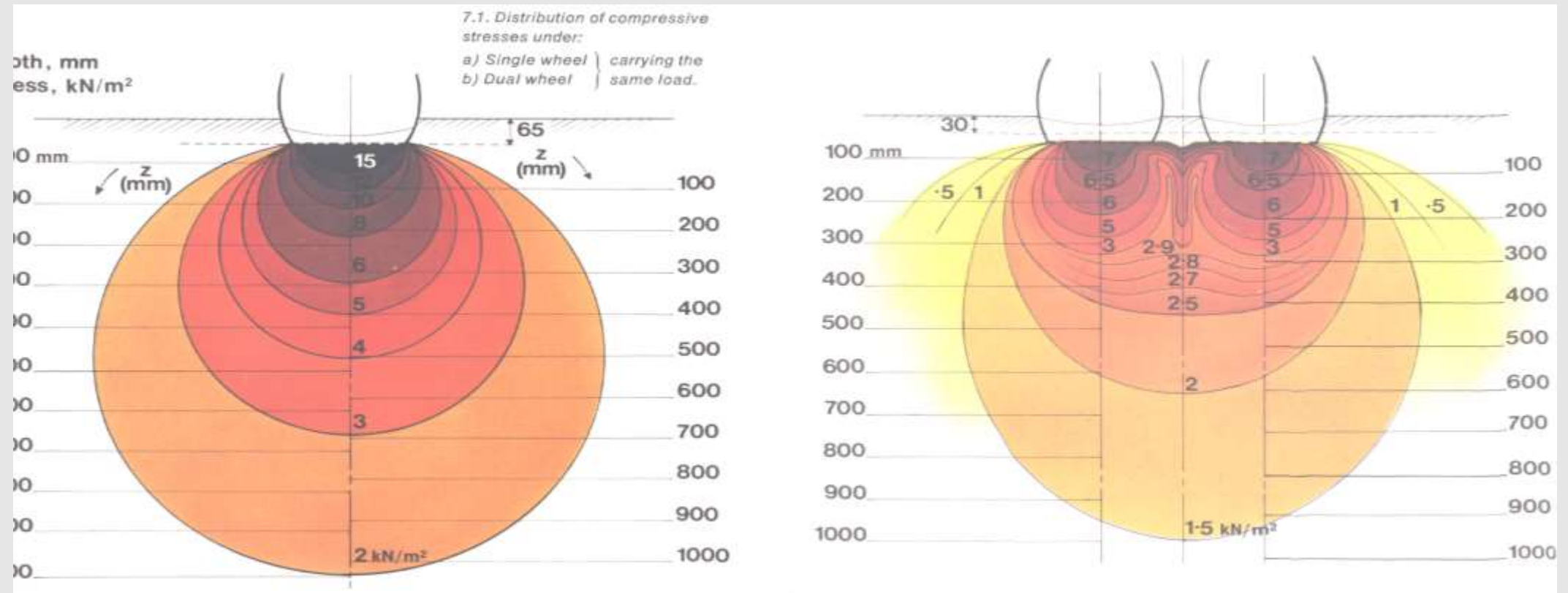


Alternative well paid and well structured employment in off farm opportunities

Dealing with the compaction issue: Tyre contact areas



Dual wheels

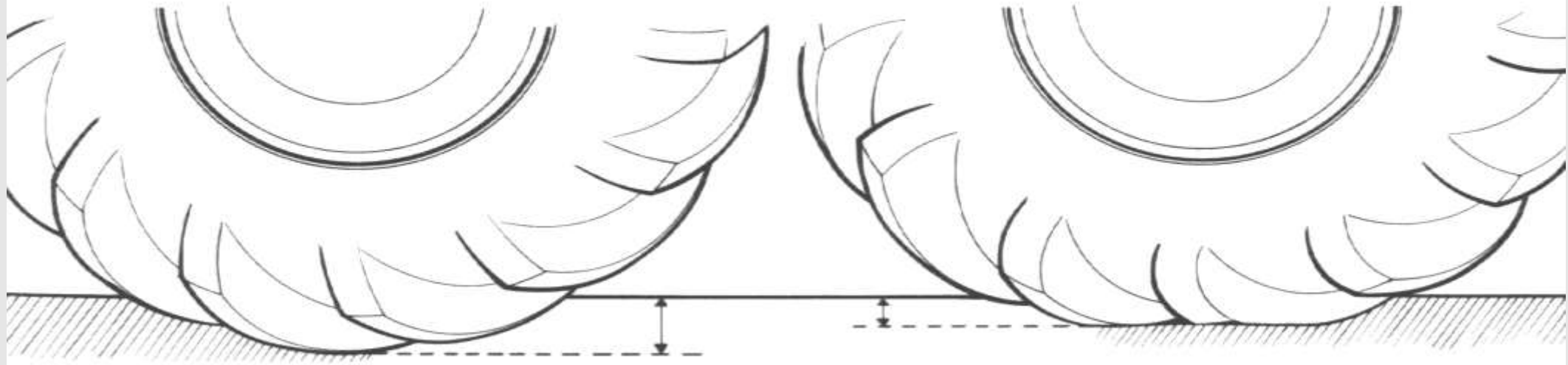


Tyre sinkage

Sinkage pattern of rigid and deformable wheels.

RIGID WHEEL OR TYRE WITH HIGH INFLATION PRESSURE

WHEEL WITH TYRE AT LOW INFLATION PRESSURE



MAXIMUM SINKAGE WITH RIGID WHEEL

MAXIMUM SINKAGE WITH SOFT WHEEL

Tracks as an option

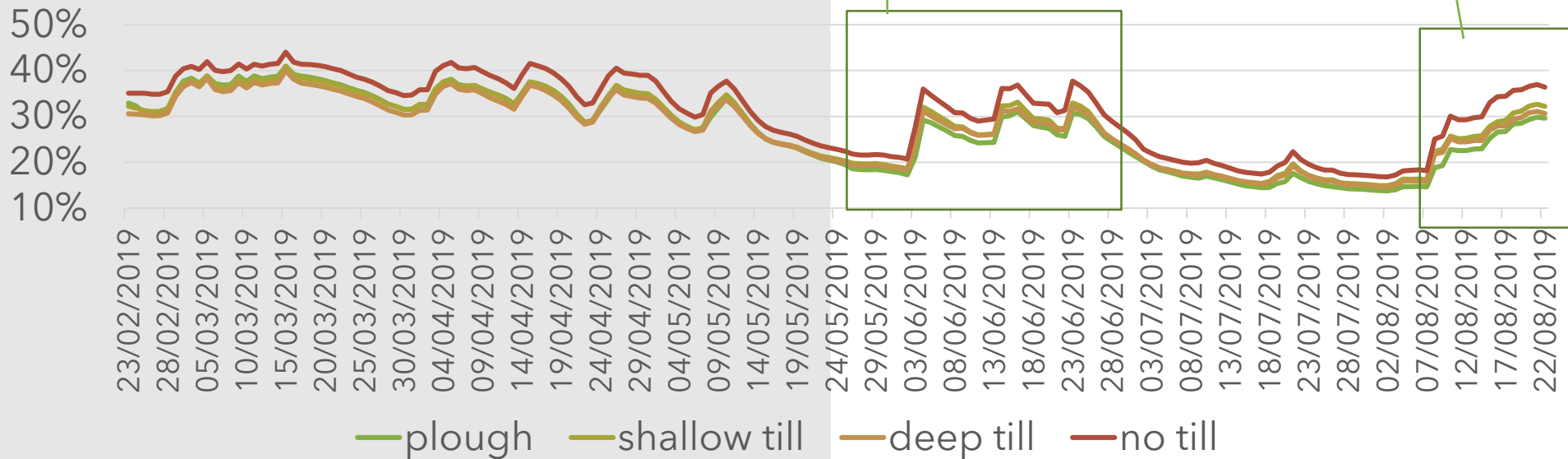
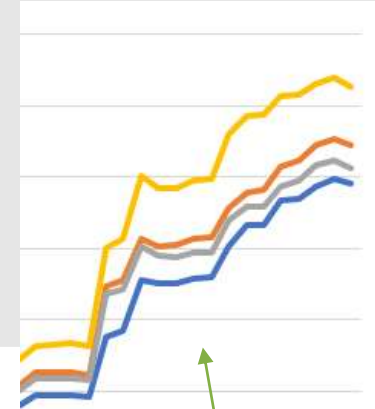
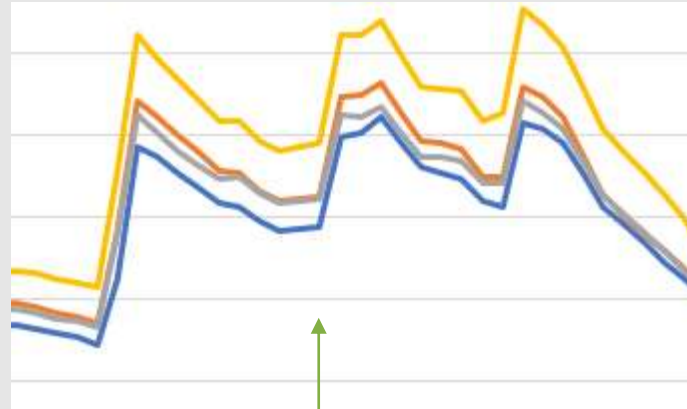


Tyres at low inflation pressure can have an equivalent ground pressure to some track options, however these are wider than tracks and can have a higher draft requirement compared with tracks. Higher purchase and operational cost.

Emerging tyre technology. Mittas - Trelleborg



Timing with respect to soil moisture (top 30cm) Lyons Farm



Reduce machine size

- Instead of 6m sower with 300 hp, 3 x 3 m sowers with 120hp, requires the development with autonomous equipment.

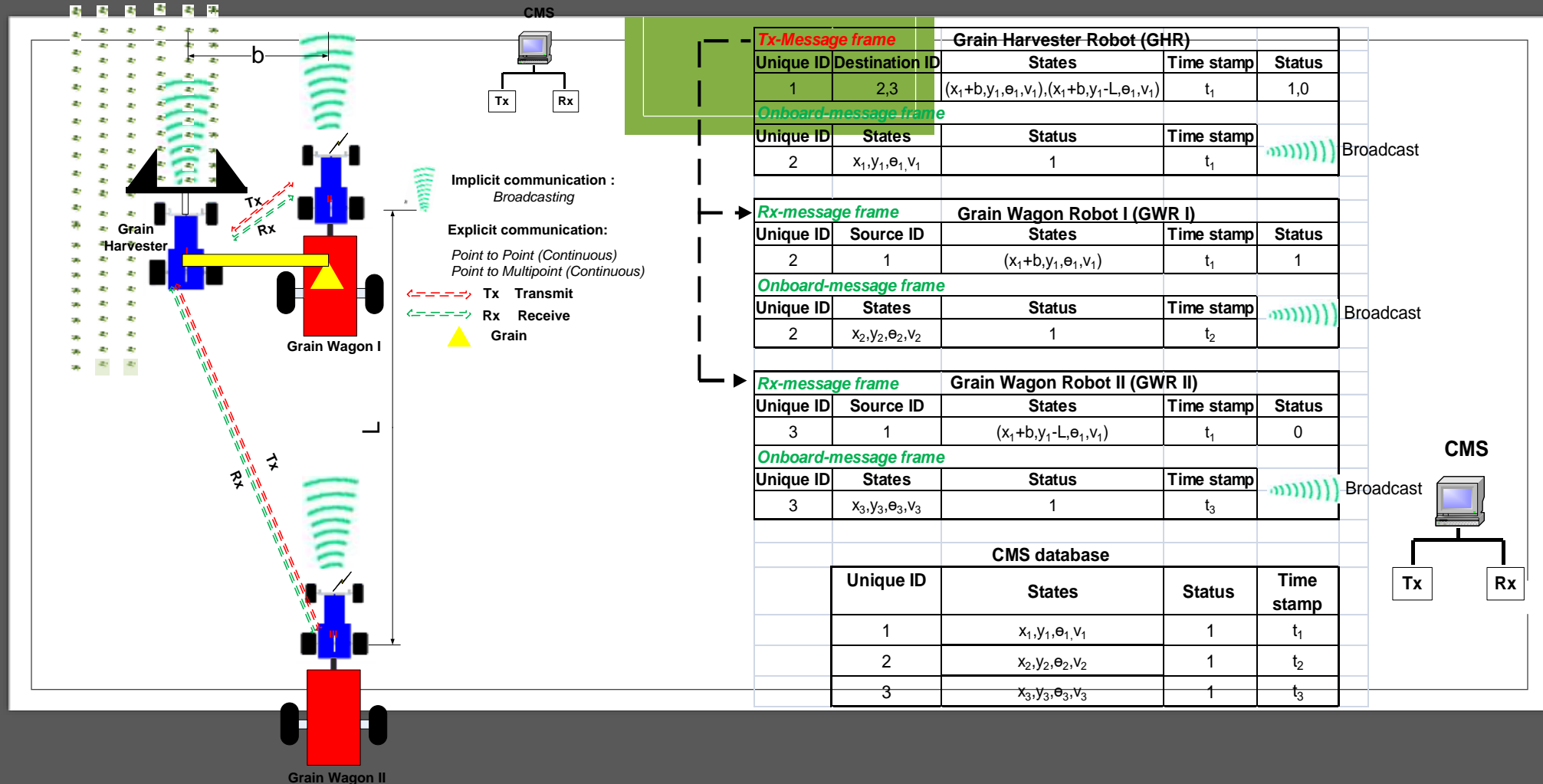


A few concerns...

- How much will **they cost?**
- What are the **benefits?**
- Are they **more profitable** than conventional machines?
- How many machines will I need?
- **Insurance?**
- Labour impacts?
- **Risk?**
- Environmental impacts?
- Energy consumption?
- More questions than answers!!!



MRSCA FOR AGRICULTURAL OPERATIONS



Heterogeneous MRS (absolute cooperation)

Digital Agricultural

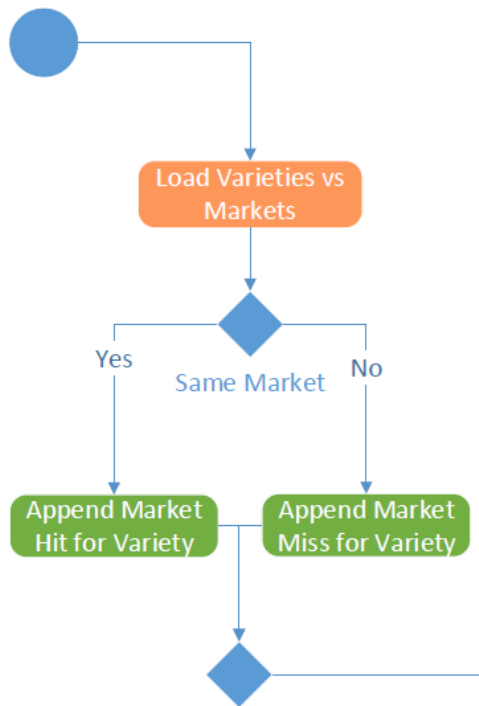
- **ICT tools for agriculture**

“The deployment of information and communication technology (ICT) towards agricultural practices has been considered one of the main ways of optimizing processes and improve outcomes” (Nakasone et al., 2014).

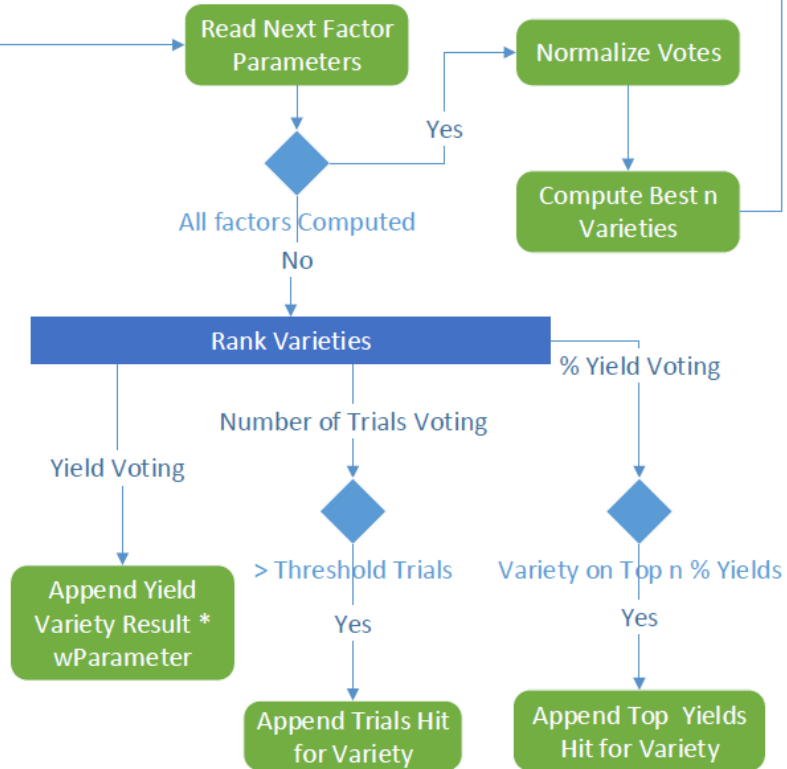
- **Technology accessibility**

“The technological revolution that has brought the widespread availability of mobile devices and internet services permits the provision and access of expert ICT tools, once accessible only for few, to store and analyse agricultural and scientific data, for even smallholder farmers” (George et al., 2017).

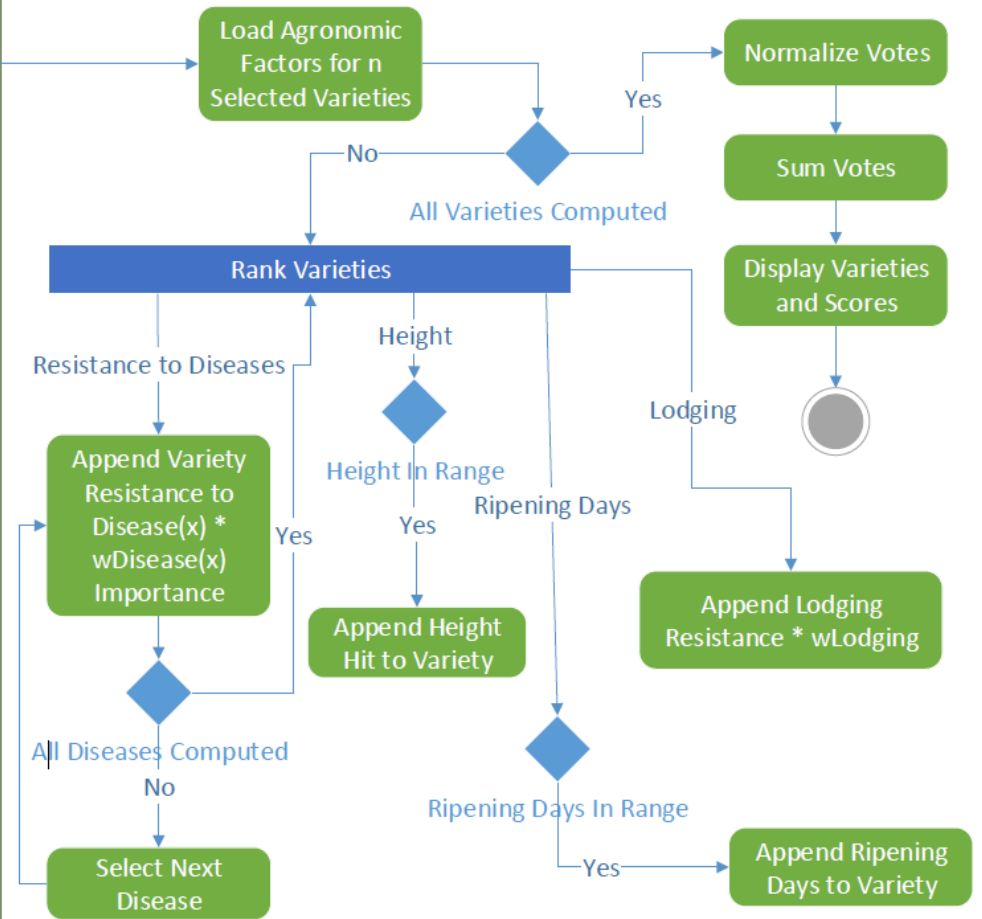
Ranking Market



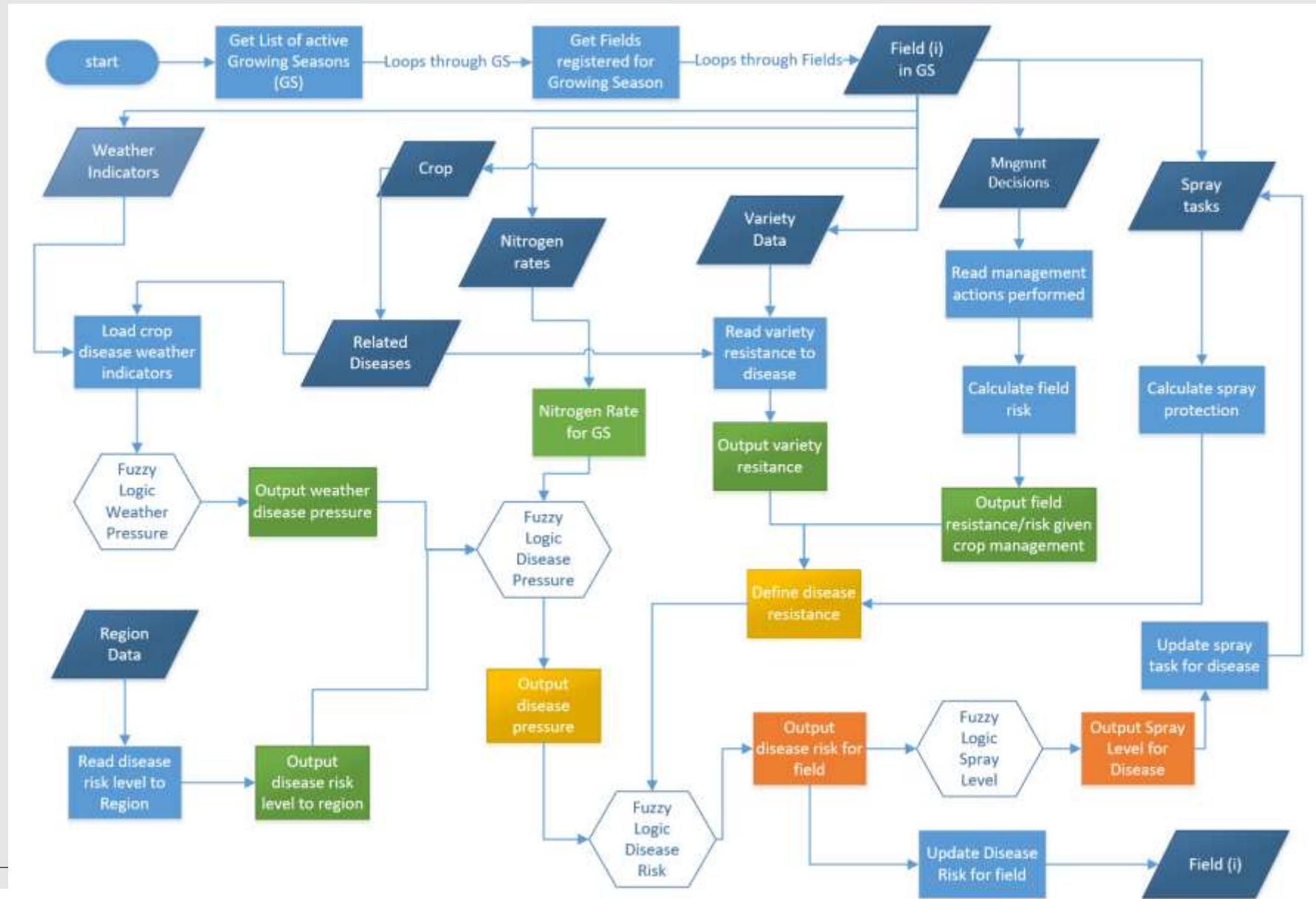
Ranking Other Site-Specific Factors



Ranking Agronomical Factors



Crop Health - Disease Risk Assessment



The adoption of Digital Agriculture



THE CLIMATE CORPORATION



FarmersEdge™

MONSANTO



JOHN DEERE



Trimble®



Decision support system

- Soils and machinery data and interactions
 - Machinery choices
 - Options to co-own machinery - 1-2 growers
 - Machinery ring
 - Specialised contractors - tillage focus - part ownership
-
- Data collection and interpretation is critical



Q&A