

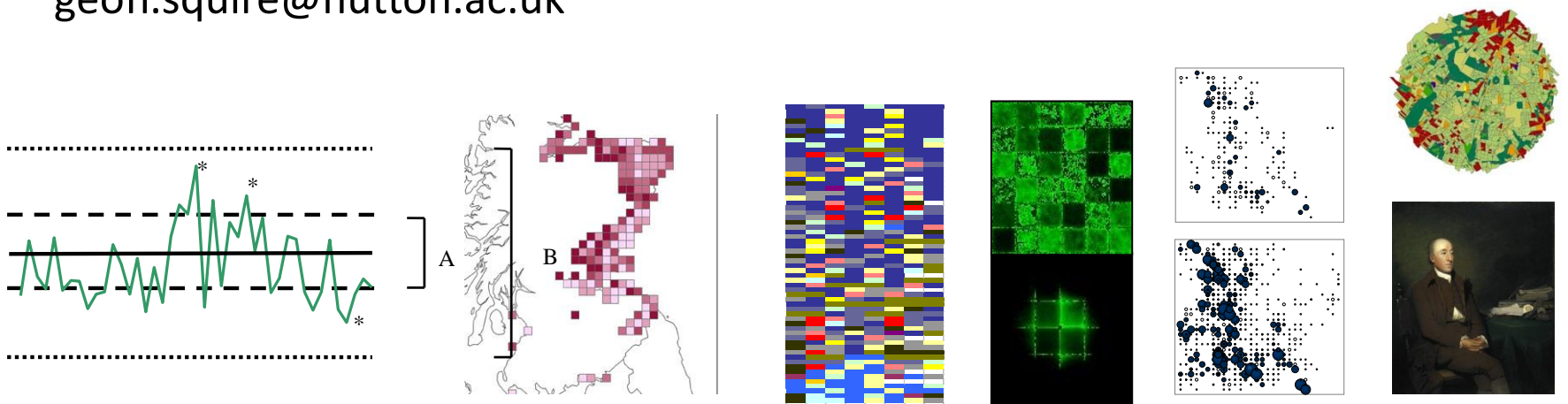
Transitions to sustainable legume based cropping systems



In the context of sustainable agriculture and environment

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CAP
and
Greening

EN

2017

NO

21

Special Report

**Greening: a more
complex income
support scheme, not
yet environmentally
effective**

(pursuant to Article 287(4), second subparagraph, TFEU)



“Greening lacks a fully developed intervention logic with clearly defined, ambitious targets and its budget is not directly linked to the policy’s delivery of environmental and climate related objectives”

European Court of Auditors
2017

'After CAP' working Group (Scotland)

- Great uncertainty over what will happen in a few years
- Consensus that the system does not work properly
- Need to recognise much broader outcomes that deserve support – why payment just for being there
- And responsibility by all sectors (including eaters)
- Balance between food and feed/industrial/alcohol (beyond booze security)
- Farming to get more from 'food and drink' success
- More local production and consumption
- Massive task in education within production and among the public.
- **Major problem in defining current state**

Future of CAP: relevance to TRUE

- Making the case for legumes as a major components of future agriculture and food systems
- Define and quantify the baseline (e.g. N and C cycles/fluxes, food webs, soil function)
- Who pays /who is responsible?
- Global citizen instead of buccaneering opportunist?

Each country or region will have its background information -

- Hutton Institute report on CAP (see next slide)
- Recent 'after CAP greening' study (in Scotland)

Quantifying the baseline

Case study: North East
Atlantic croplands

Case study – north Atlantic maritime (Scotland)

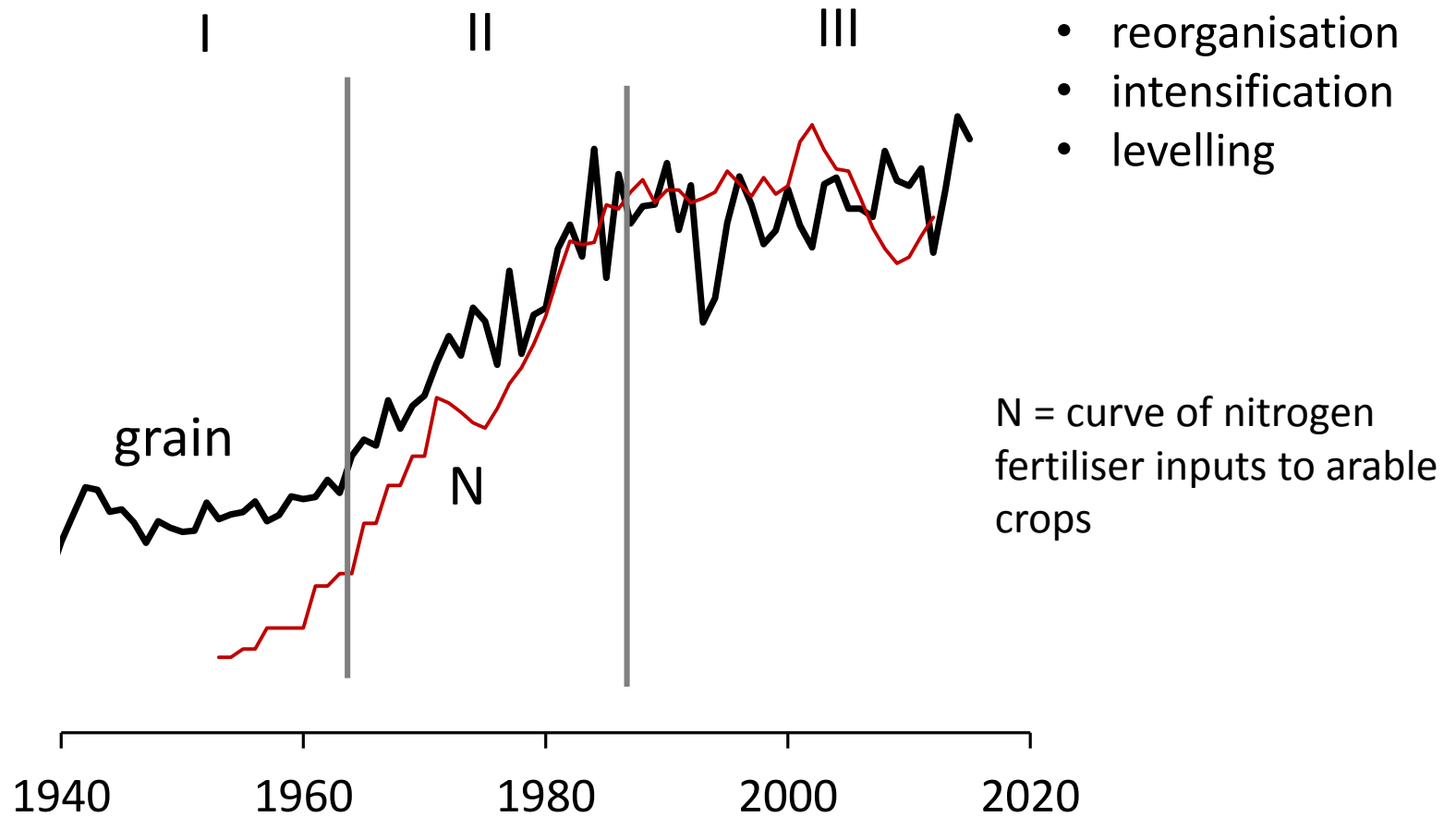
Current states

- C and N cycles – inputs, losses
- Production constraints – weather, soil, agronomy, crop varieties
- Impacts and environmental feedbacks – soil, food webs, functional biodiversity

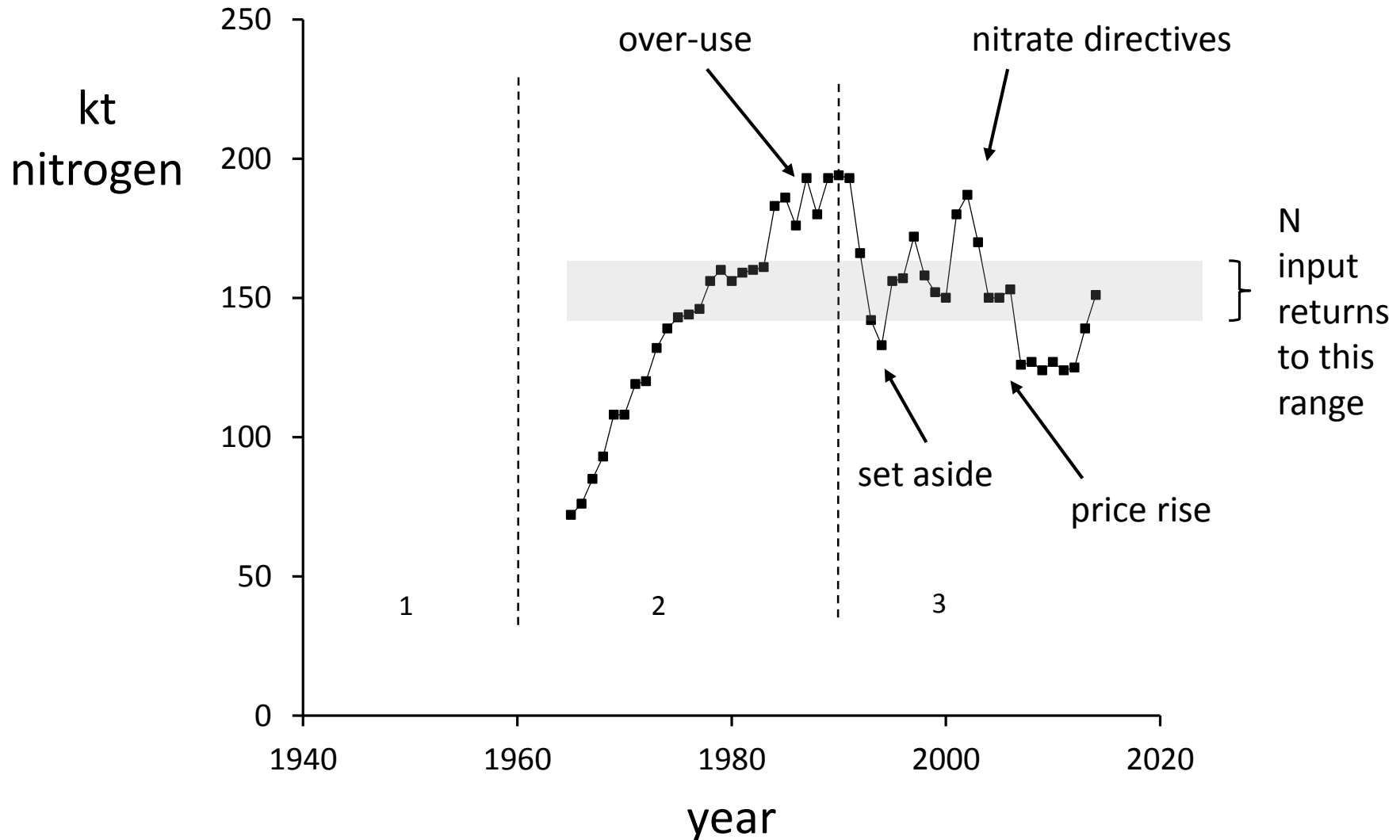
Where are legumes

- What limits them
- What are the opportunities

three phases of intensification



nitrogen input Scotland



estimate of total nitrogen
fertiliser , Scotland

Squire 2017; Original data: Fertiliser Practice

..... the N balance

What's the N baseline

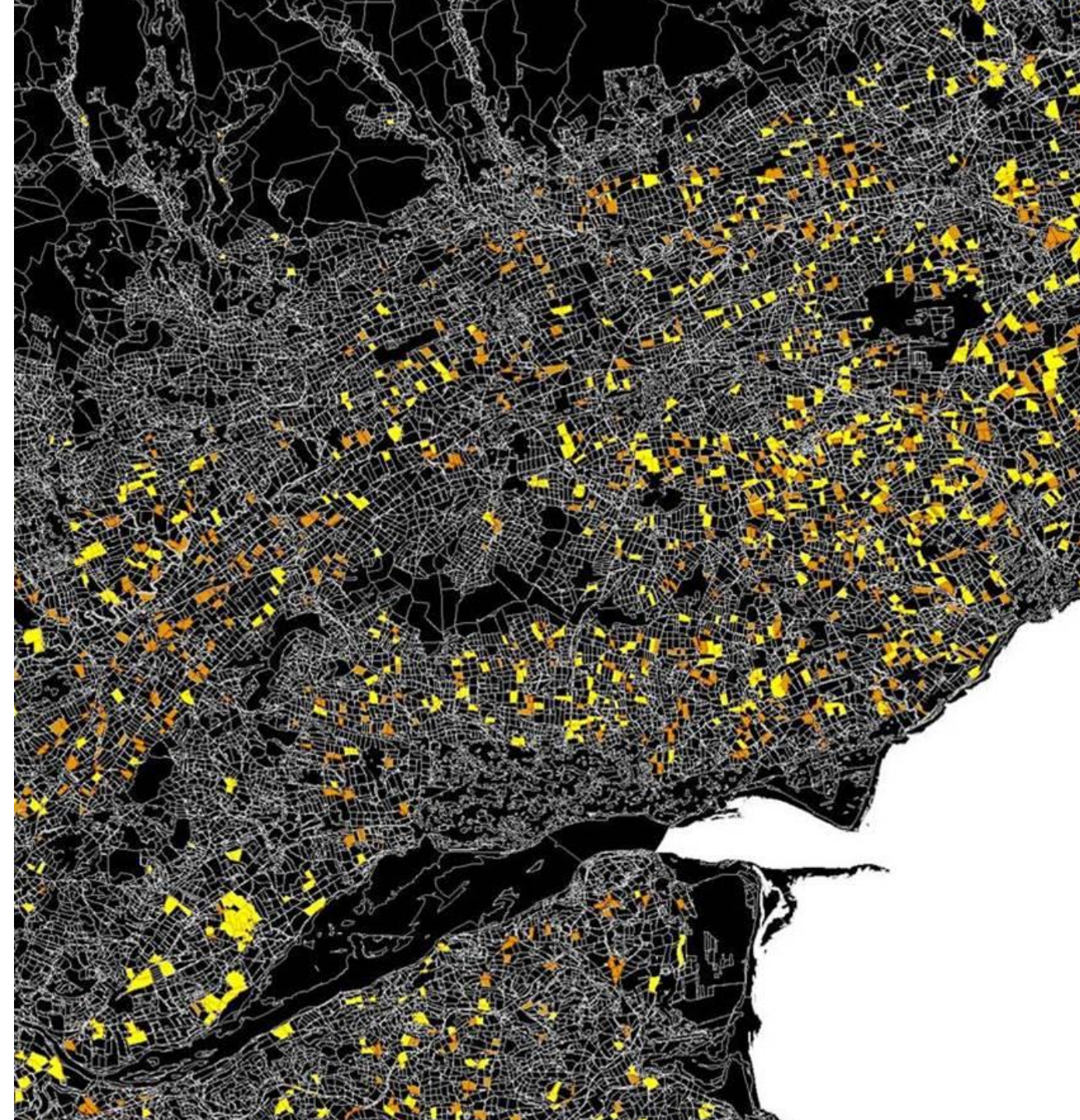
- How to estimate current N inputs
- Ok from national survey (FP) for mineral N
- Uncertainties in national / regional account
 - organic manures – much uncertainty, dilution, %N
 - feed imports (GM soya)
 - N movement and losses in cereal production for animal feed
 - N fixation in forages (almost ZERO information)
- Data in fertiliser survey available for small sub-set of fields

Yet TRUE should try to estimate

- the savings of N due to current legumes
- effects of replacing (e.g.) cereals with legumes

THANKS TO IACS

identifying fields and crops



potato (brown)
oilseed rape (yellow)

mapping intensity

nominal pesticide or N per field based on crops grown



every field in Sc
year by year

Authors: Quesada, Begg, Squire

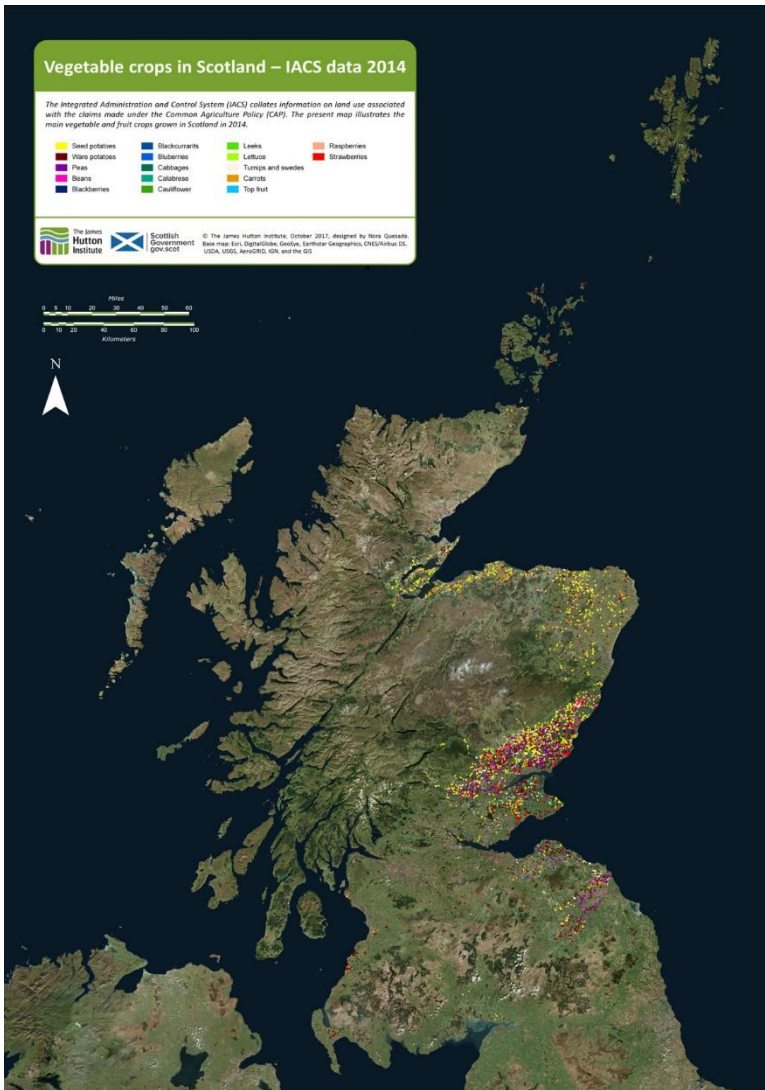
Current and potential role of legumes

Case study: North East Atlantic
croplands

..... possible therefore

- To define number, area and location of grain legume crops
- The crops that they are grown with and the N and pesticide inputs to those crops
- Estimate the savings of N due to current legumes
- Estimate effects of replacing (e.g.) cereals with legumes
- Estimate the % legume needed to reduce applied mineral N by stated amounts e.g. 10%, 20% or to stated max or mean levels
- A methodology is being developed in TRUE

Map of vegetable crops



- Use EU IACS data to locate fields and assign a crop by year
- Example of Scotland – important but small area of vegetable growing
- Legumes (peas and beans) <1% of arable-grass surface (east)
- N provided by mineral fertiliser, feed imports

Matrix of agronomic inputs

Mineral nitrogen
kg/ha

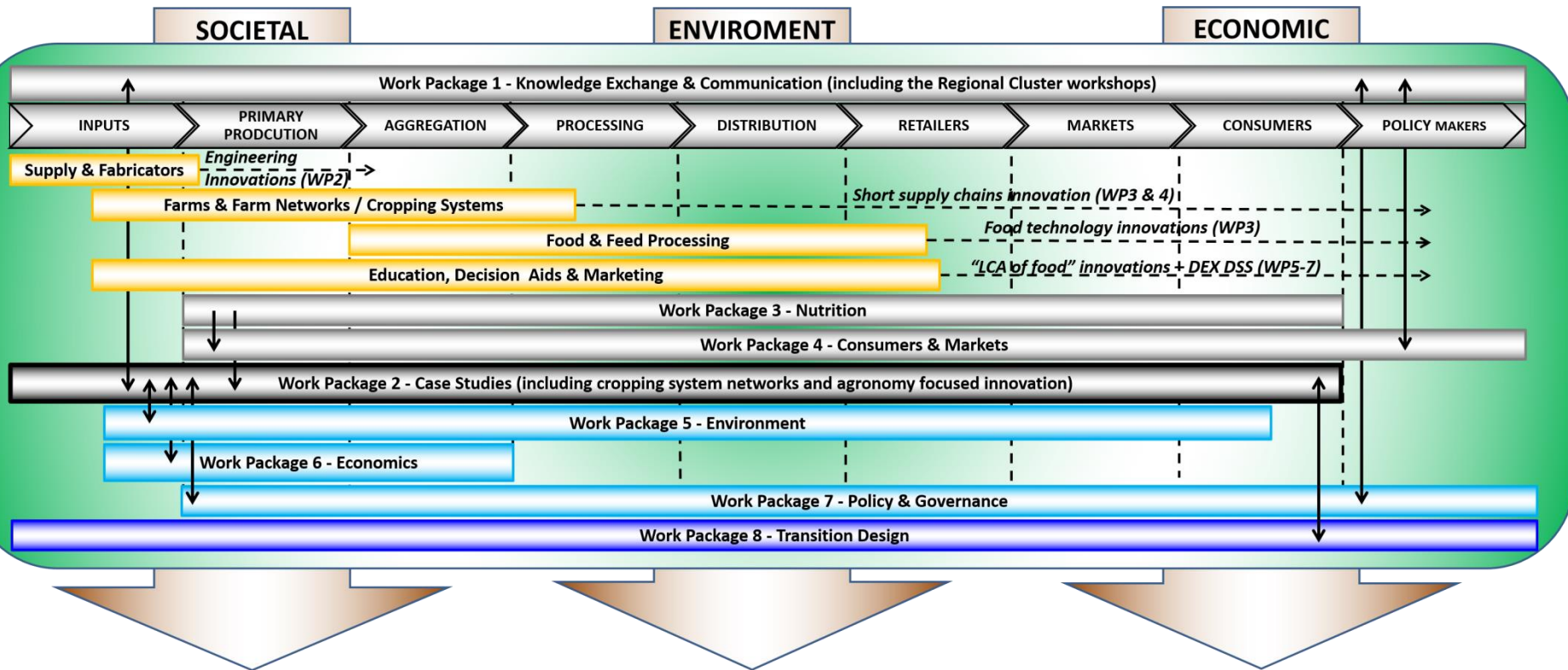
200							
180			0.17	2.34	1.66		
160		0.01	1.53	4.96	2.23	0.26	
140	0.10	0.98	5.35	5.09	1.50	0.13	
120	0.34	2.21	2.60	4.67	3.57	0.25	0.01
100	10.14	11.30	17.65	6.65	0.83	0.05	<0.01
80	1.63	2.61	4.85	0.90	0.07		
60	0.34	1.20	0.48	0.03	<0.01		
40	0.30	0.77	0.04	<0.01			
20	0.08	0.02					
0	0.08						
	0	2	4	6	8	10	12

Pesticide formulations applied per year

- About 0.5M fields
- Arable
- IACS defined crops grown in sequence
- Assign pesticide and N from national survey
- Numbers show %arable in each box
- Legume minor (ca 1%) but mostly at low input end

Designing transitions

transition paths



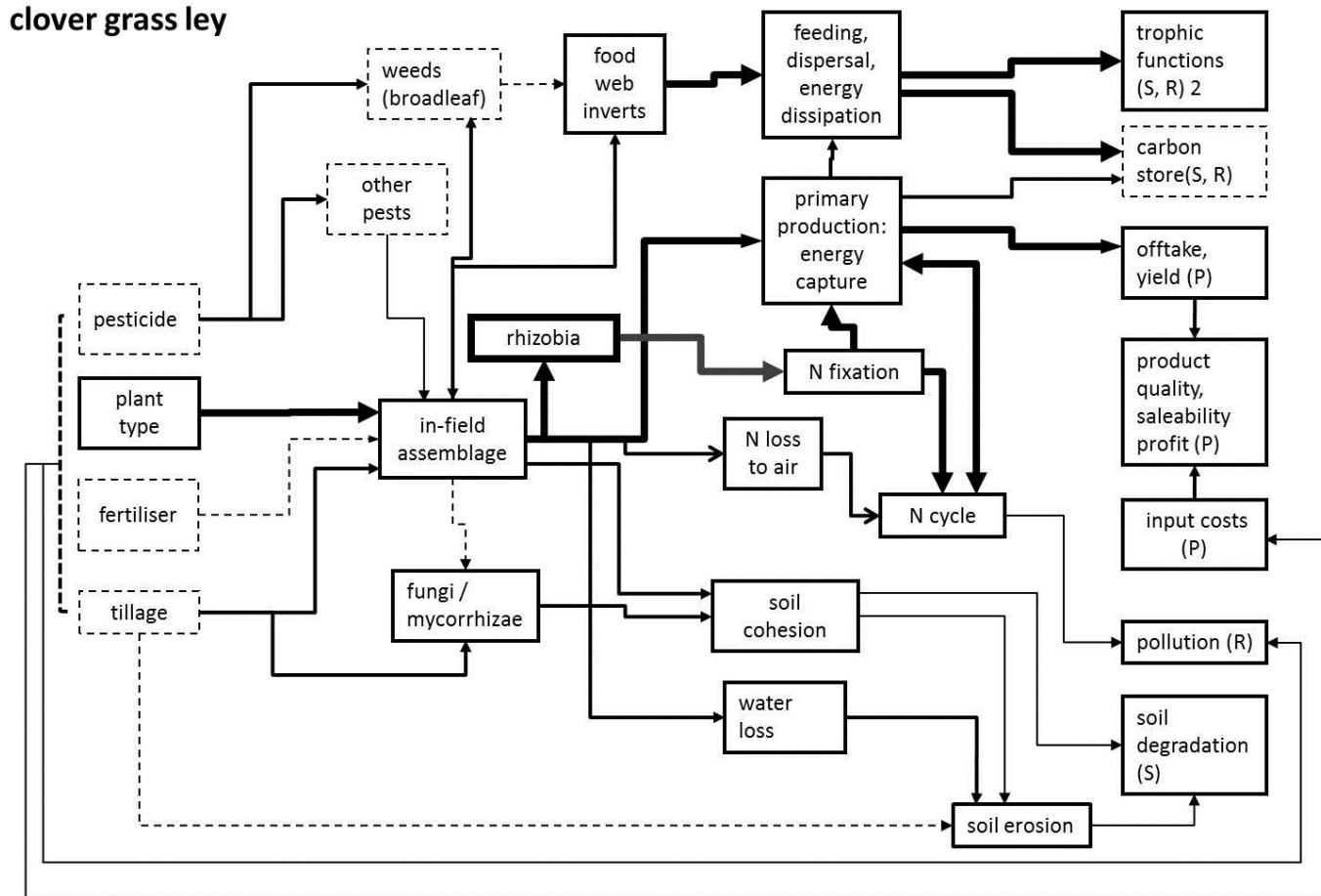
..... and sustainability indicators

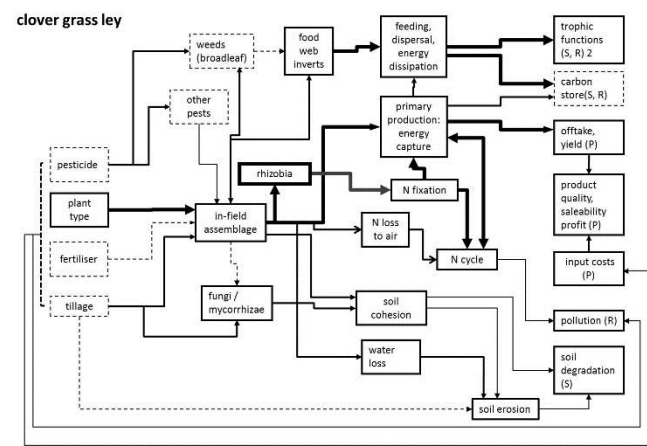
Opening and closing 'channels'

- Crops and management open channels for the flows of energy, matter (C, N, P), life forms and money
- Need to understand what regulates the channels
- Then define a suitable balance
- Compare and test practical designs

solutions – design

Example – crops open or close channels among the ecological processes. Here is a simplified example with three main channels: product output, above ground food web and soil processes.

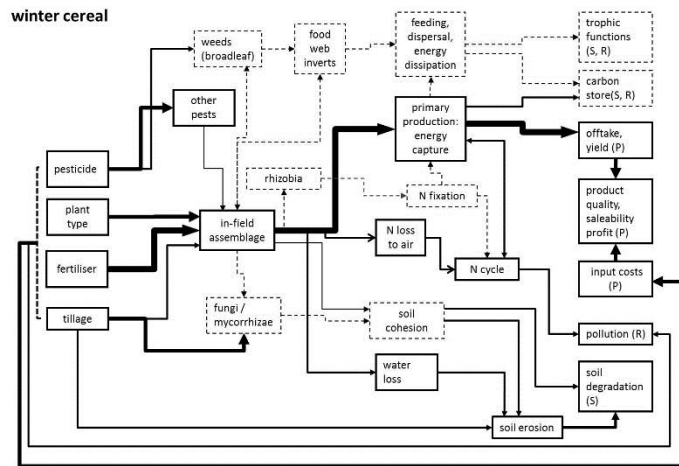




legume-
grass ley

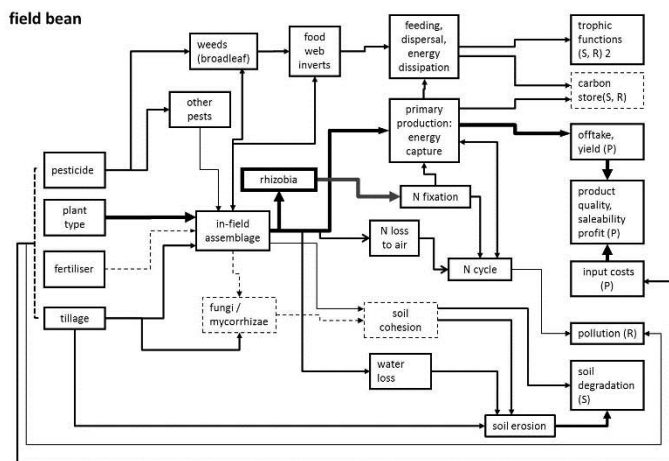
design

each crop type open
or closes channels
to ecosystem states
and services



winter
cereal

first set the
desired,
sustainable
ecosystem states



field
bean

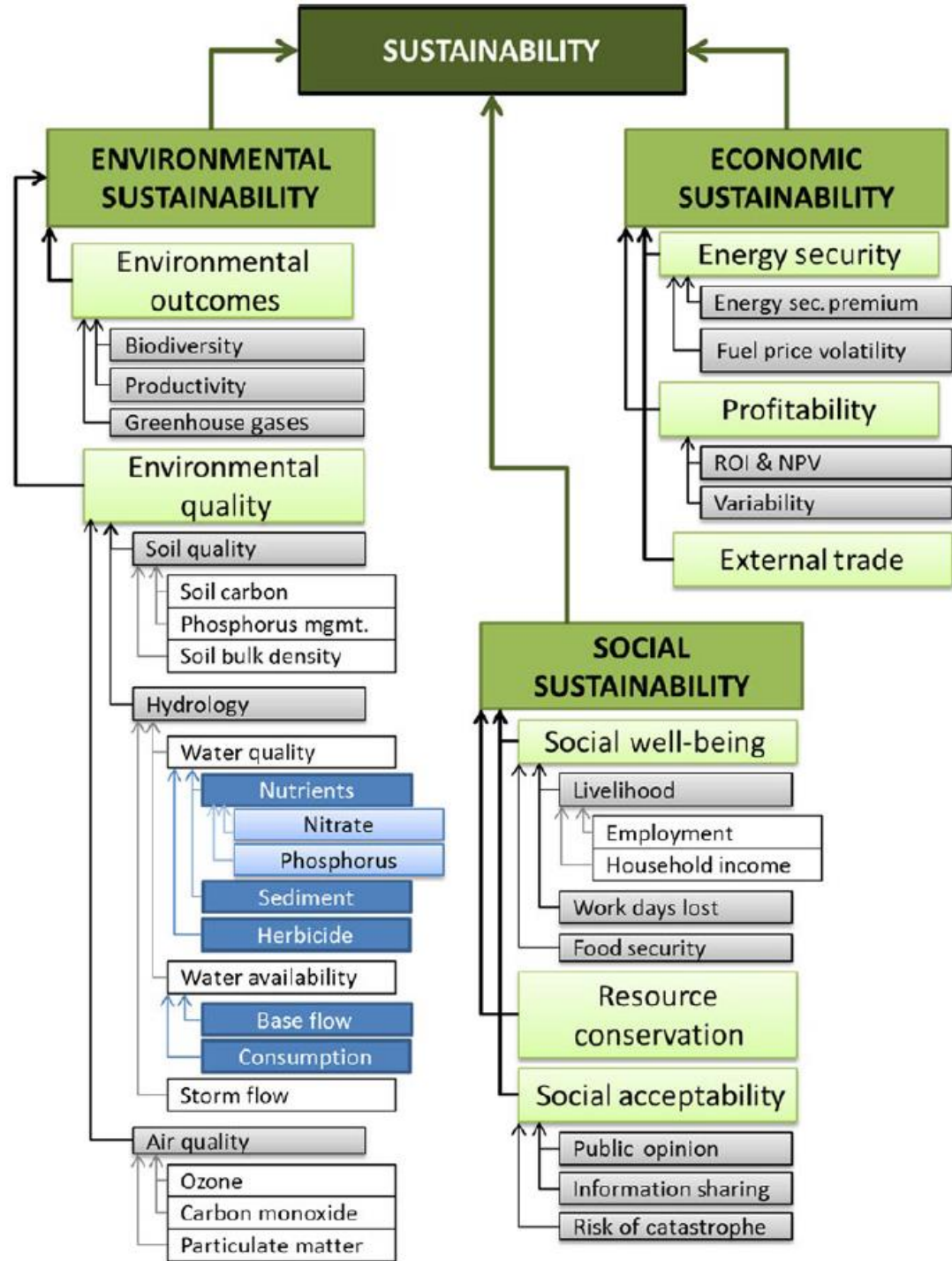
the pathways should
be combined over
time and space to
achieve the desired
system

After Squire & Iannetta (in prep)

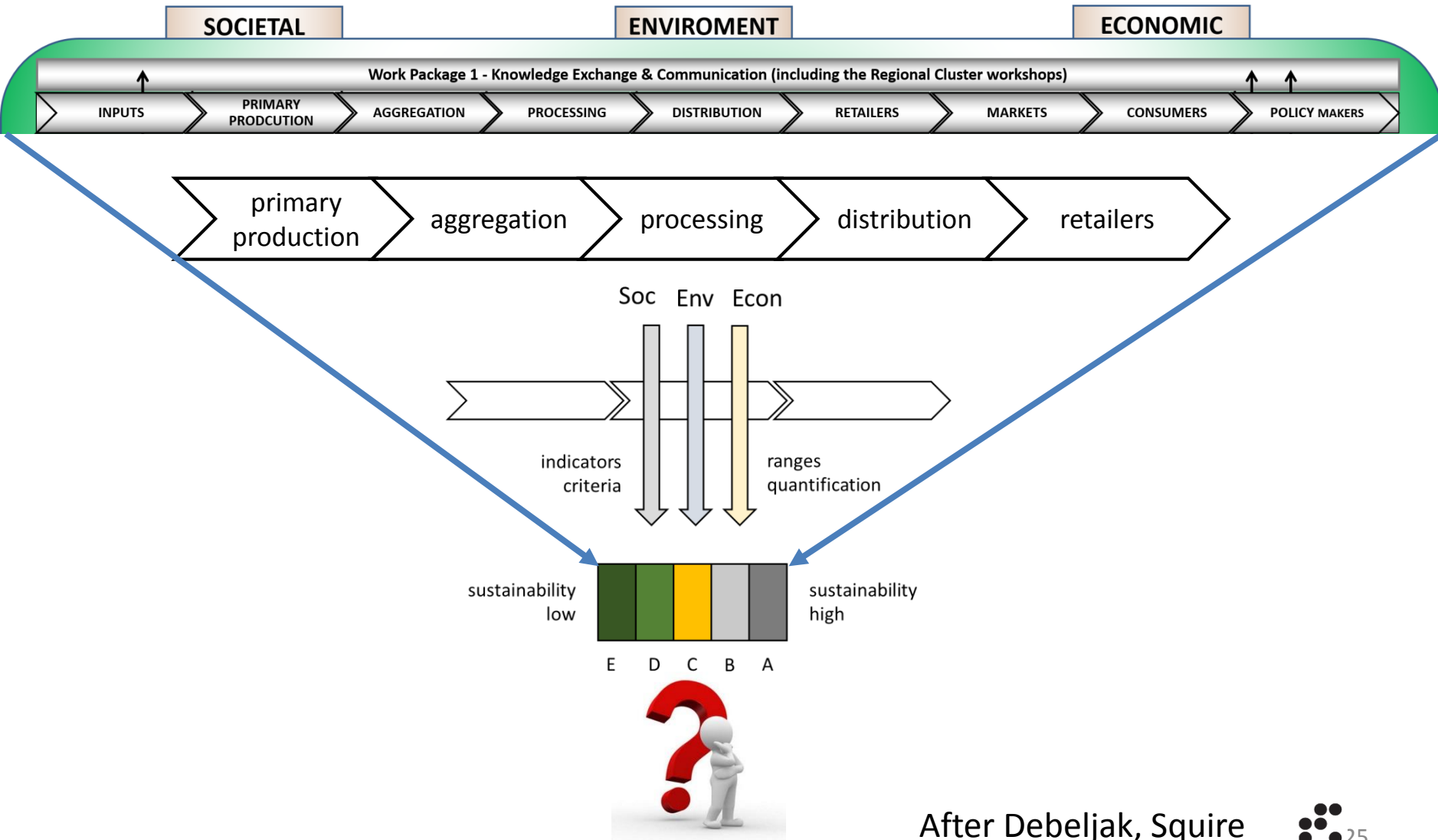
Multi-attribute decision models (MADM)

(decision trees in DEXi)

Examples of sustainability indicators



Sustainability assessment of TRUE quality chain



After Debeljak, Squire

next steps



The James
Hutton
Institute

- agree common approach – JSI Slovenia, JHI
- liaise with partners working on sustainability indicators – define and set limits and categories
- assemble into a working DEXi structure / model
- test on one or two case studies 2017/2018
- roll out to whole of TRUE through ELINs during 2018

replenish soil organic matter

5-6 years, multiple interventions,
reverse soil C decline

split-field design

red = higher soil
carbon

