

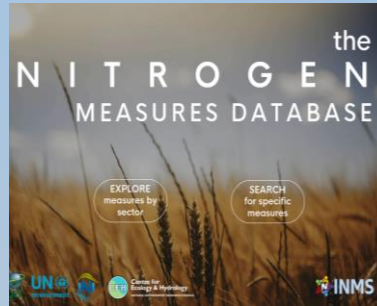
A2.3

The Nitrogen Measures Database

The guidance document on “options
for integrated nitrogen management”

Activity 2.3 /Component 2
Will Brownlie / Albert Bleeker

INMS-5 Meeting



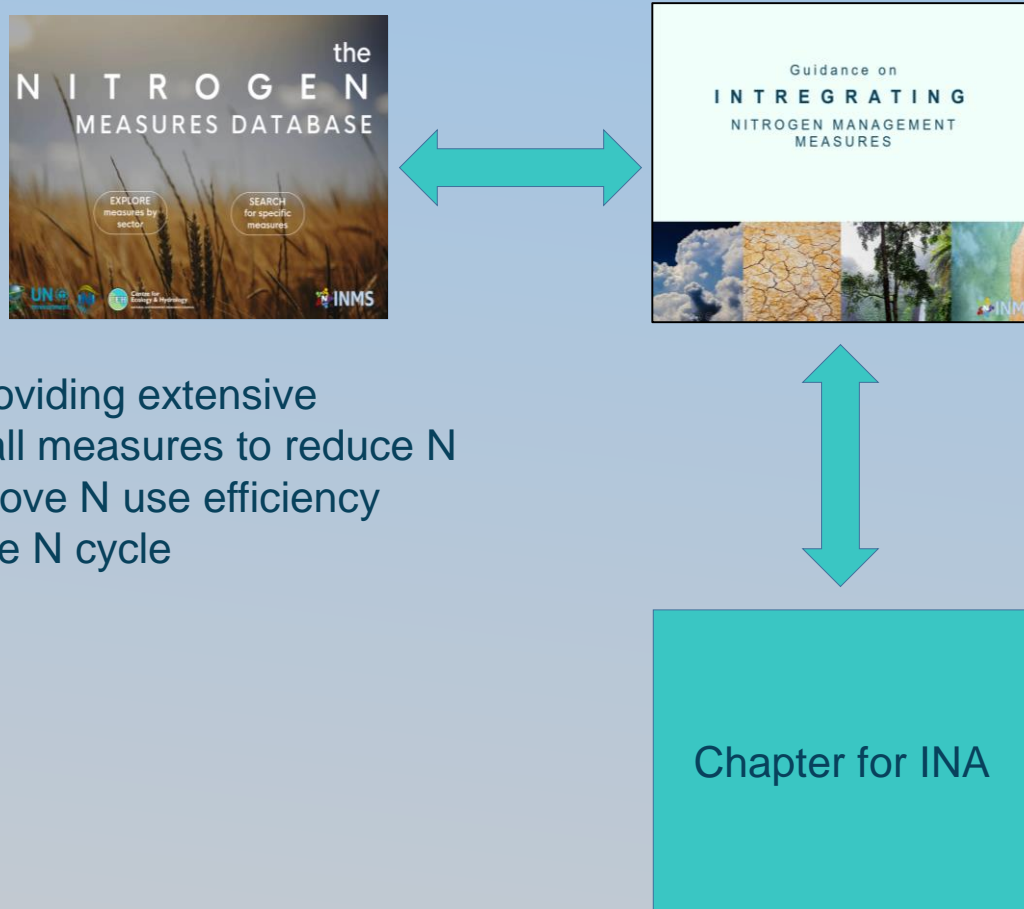
A database: providing extensive information on all measures to reduce N losses and improve N use efficiency across the whole N cycle

Interactive guidance document: on how to integrate measures (i.e. discussing synergies, challenges, regional context) and the importance of delivering a joined up approach across the N cycle



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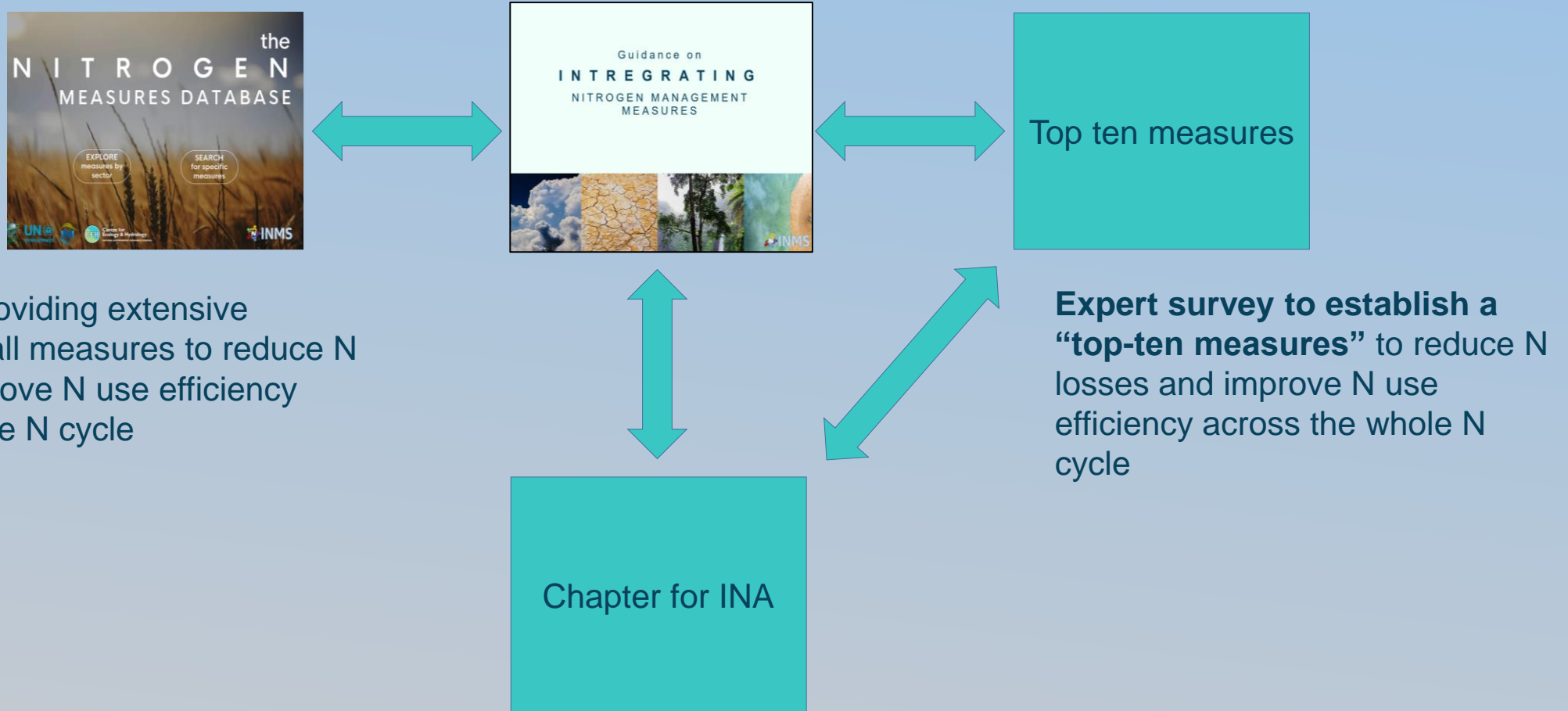
Interactive guidance document: on how to integrate measures (i.e. discussing synergies, challenges, regional context) and the importance of delivering a joined up approach across the N cycle



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Conclusions of this work will feed into a single **chapter in the International Nitrogen Assessment.**

Interactive guidance document: on how to integrate measures (i.e. discussing synergies, challenges, regional context) and the importance of delivering a joined up approach across the N cycle



A database: providing extensive information on all measures to reduce N losses and improve N use efficiency across the whole N cycle

Expert survey to establish a “top-ten measures” to reduce N losses and improve N use efficiency across the whole N cycle

Conclusions of this work will feed into a single **chapter in the International Nitrogen Assessment.**

the N I T R O G E N MEASURES DATABASE

EXPLORE
measures
by sector

SEARCH
for
specific
measures



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Search a record...

Search

Climatic Zone

- Any -

Geographic Region

- Any -

Sector

- Any -

Sector Category

- Any -

Nitrogen Species

- Any -

Apply filters

Spreading liquid
manure with trailing
hose



Lowering protein
consumption of
cattle



Lowering protein
consumption of
pigs



Lowering protein
consumption of
poultry



Optimising grazing
time of cattle



Agri-
Waste Composting



Alternative
Tile Intakes: Perforated
Risers



Manure injection



Barnyard runoff
control



Bedding area
management



Acidification of slurry
during application

Genetic variations in
crops

Manure belt or manure
scraper

Covering slurry with
floating membranes

Gypsum Application

Progress

Database:

- Reviewed over 60 documents & >500 papers
- Created a nitrogen measures working group
- Held three workshops (2 x Edinburgh, 1 x Nairobi)
- Presented the database both nationally and internationally
- Built a web based searchable database – modified three times
- Defined datasheet measures template – modified three times (four?)
- Selected the measures to cover N cascade
- ~50(of 120) draft measures have been submitted for editing

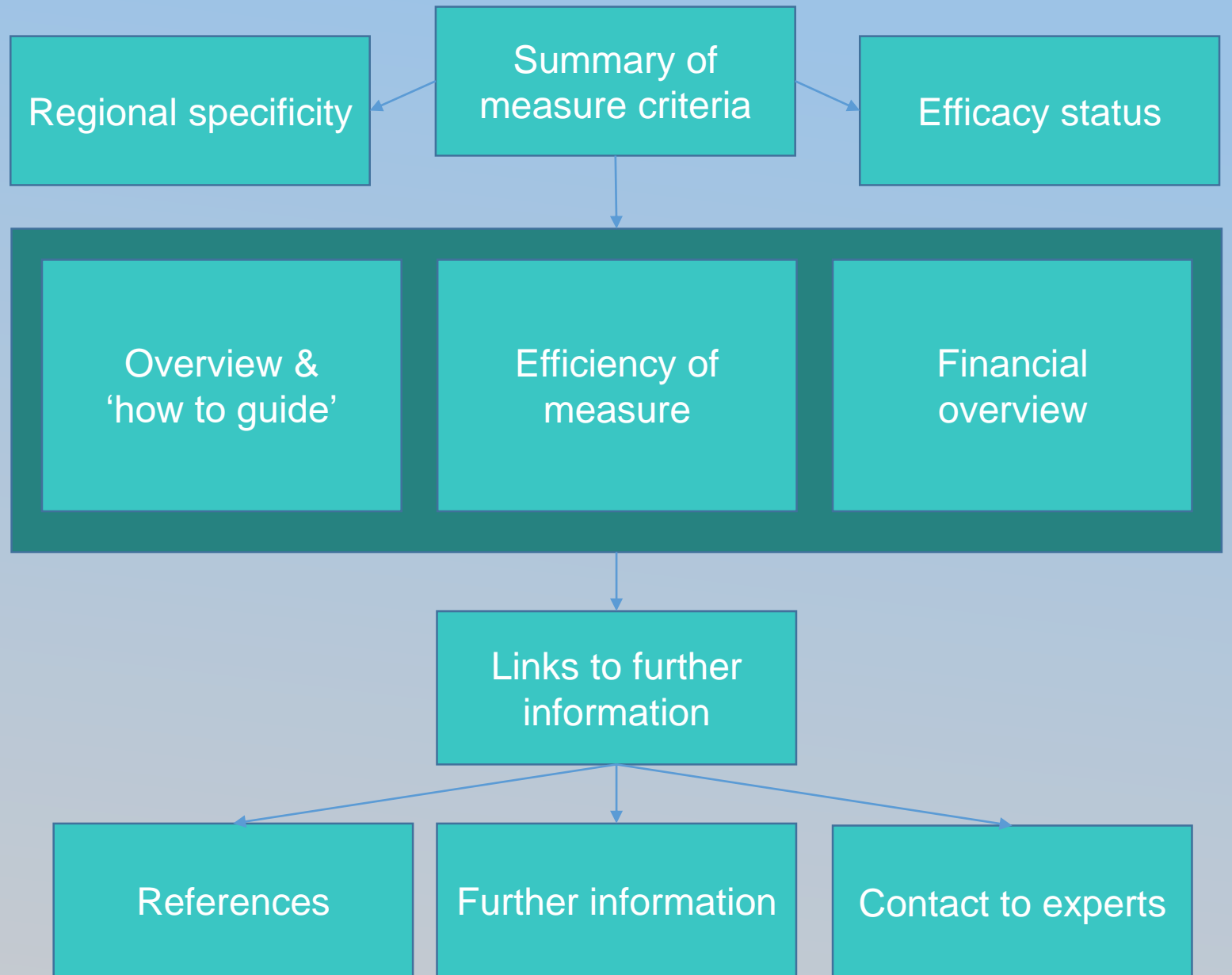
Guidance document & INA chapter

- Draft plan for both

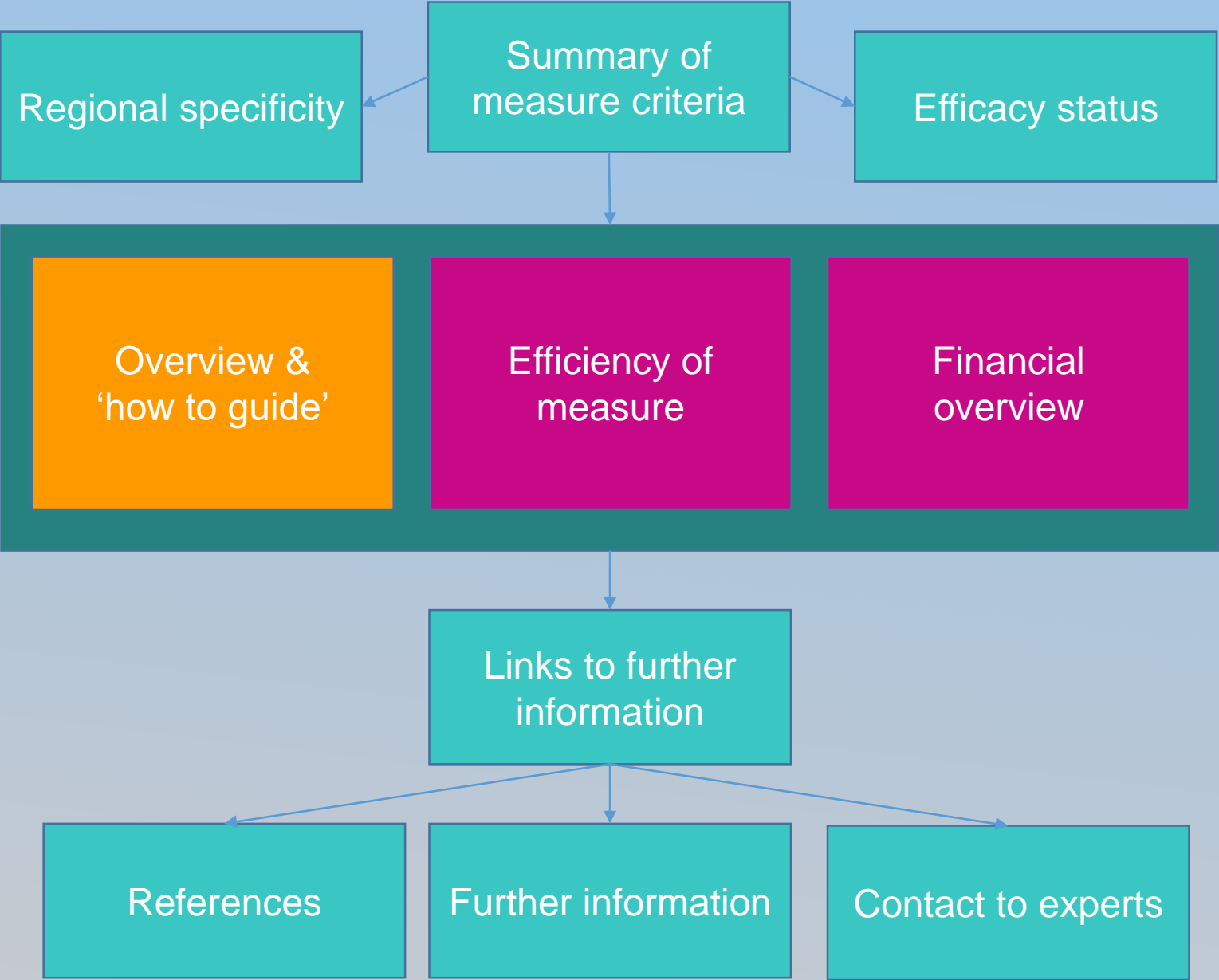
Top ten measures

- Developing selection criteria, and methodology to select top ten measures, which may extend to regional top tens for each UN global region.

Each datasheet for each measures provides the current information that is available in the literature under the following categories



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Example pages you will find on the database for each measure

1: measure overview (incl: challenges & co-benefits)

2: NUE of measure (if available)

3: Financial information

4: references – links to further info

Genetic variations in crops to increase their nitrogen use efficiency

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Summary Measure Description Financial Implications Refs and Further Info Authors

Measure overview:

Nitrogen levels often applied to the soil are not efficiently used by the crops and leads towards the inefficient N use efficiency and increased environmental concerns. The management of this resource (N) is a significant challenge to most agricultural systems as it can have a significant impact on yield and environment. The actual use of applied nitrogen fertilizer to cereals is poor, where only 30–40% is actually used by cereals. Crop cultivars differ in uptake and utilization of nitrogen, thus differ in their N use efficiency. Exploitation of such differences through screening, conventional breeding and/or molecular biology, can sustain not only crop productivity but also improve N use efficiency. Identification of low nitrogen requiring crop varieties for countries with low income is highly desirable. Genetic variability to use nitrogen efficiently is one of the most cost-effective and strategic ways of reducing NH_3 and N_2O emissions.

How to implement the measure:

Identification of low nitrogen requiring crop varieties for countries, one of the most cost-effective and strategic ways of reducing NH_3 emissions. Local gene pool of crops needs to be screened. Genotypes effect differences through screening, conventional breeding and/or molecular biology. Awareness of N efficient cultivars should be given to the rural community. Eventually, it may lead us to cope with the food security.

Co-benefits and trade offs:

By growing N efficient crops, farmer may attain increased crop yield and income. Eventually, it may lead us to cope with the food security. Awareness of N efficient cultivars should be given to the rural community. Eventually, it may lead us to cope with the food security.

Challenges:

Screening is a long duration process. Availability of the seeds of different crop varieties in different climates and regions also offers hurdles. Lack of extension services in rural areas.

Genetic variations in crops to increase their nitrogen use efficiency

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Summary Measure Description Financial Implications Refs and Further Info Authors

Indicator for the efficiency of the measure:

Nitrogen Species	DIRECT CHANGE
Ammonia emissions (NH_3)	↓ = small decrease (estimated range 1-29% change from reference system)
Dinitrogen emissions (N_2)	
Nitrous oxide emissions (N_2O)	
Nitric oxide emissions (NO)	
Nitrate leaching & runoff (NO_3)	
Dissolved organic N leaching & runoff	

Reference system:

Nitrogen use efficiency of conventional or cultivated cultivars be considered as reference system, as development and adoption of N efficient medium-term strategy.

Genetic variations in crops to increase their nitrogen use efficiency

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Summary Measure Description Financial Implications Refs and Further Info Authors

Financial Implications table definitions:

Types of Cost	Indicator of cost	If available please provide quantified measurements from published studies and a brief description of the assessment scenario
Cost saving of preserving ecosystem function	↓ = low saving	\$5 to 8 cost saving may be anticipated by adopting crop genotypes requiring 10-15% less fertilizer N
Cost saving of preserving ecosystem function		
Cost saving of preserving ecosystem function		
Cost saving of preserving ecosystem function		

References:

Maqsood, M., Shehzad, M. A., Ramzan, Y., & Sattar, A. (2014). Effect of nitrogen nutrition on growth, yield and radiation use efficiency of wheat (*Triticum aestivum* L.) cultivars. *Pakistan Journal of Agricultural Sciences*, 51(2).

Rodgers, C. O. and Barnett, A. J. (1988). Cultivar differences in the rate of nitrate uptake by intact wheat plants as related to growth rate. *Plantarum*, 72: 121-126.

Banziger, M., B. Feil, J. E. Schmid, P. Stamp 1992. Genotypic variation in grain nitrogen content of wheat as mineral nitrogen supply in the soil. *European Journal of Agronomy*, 1(3):155-162.

Ehdaie, B., Merhaut, D. J., Ahmadian, S., Hoops, A. C., Khuong, T., Layne, A. P. and Waines, J. G. (2010). Root System Size In Nutrient Uptake and Nitrate Leaching Potential in Wheat. *Journal of Agronomy and Crop Science*, 196: 455-466. doi:10.1111/j.1479-2630.2010.00433.x

Said, A., Ahmad, I. & Hussain, T. (2007). Performance of different wheat genotypes under environmental stress in the valley. *SARHAD JOURNAL OF AGRICULTURE*, 23(3), 545.

Ortiz-Monasterio, R., Sayre, K. D., Rajaram, S., & McMahon, M. (1997). Genetic progress in wheat for nitrogen use efficiency and nitrogen rates. *Crop Science*, 37(3), 898-904.

Wu, P., & Tao, Q. N. (1995). Genotypic response and selection pressure on rice under different nitrogen regimes. *Journal of Plant nutrition*, 18(3), 487-500.

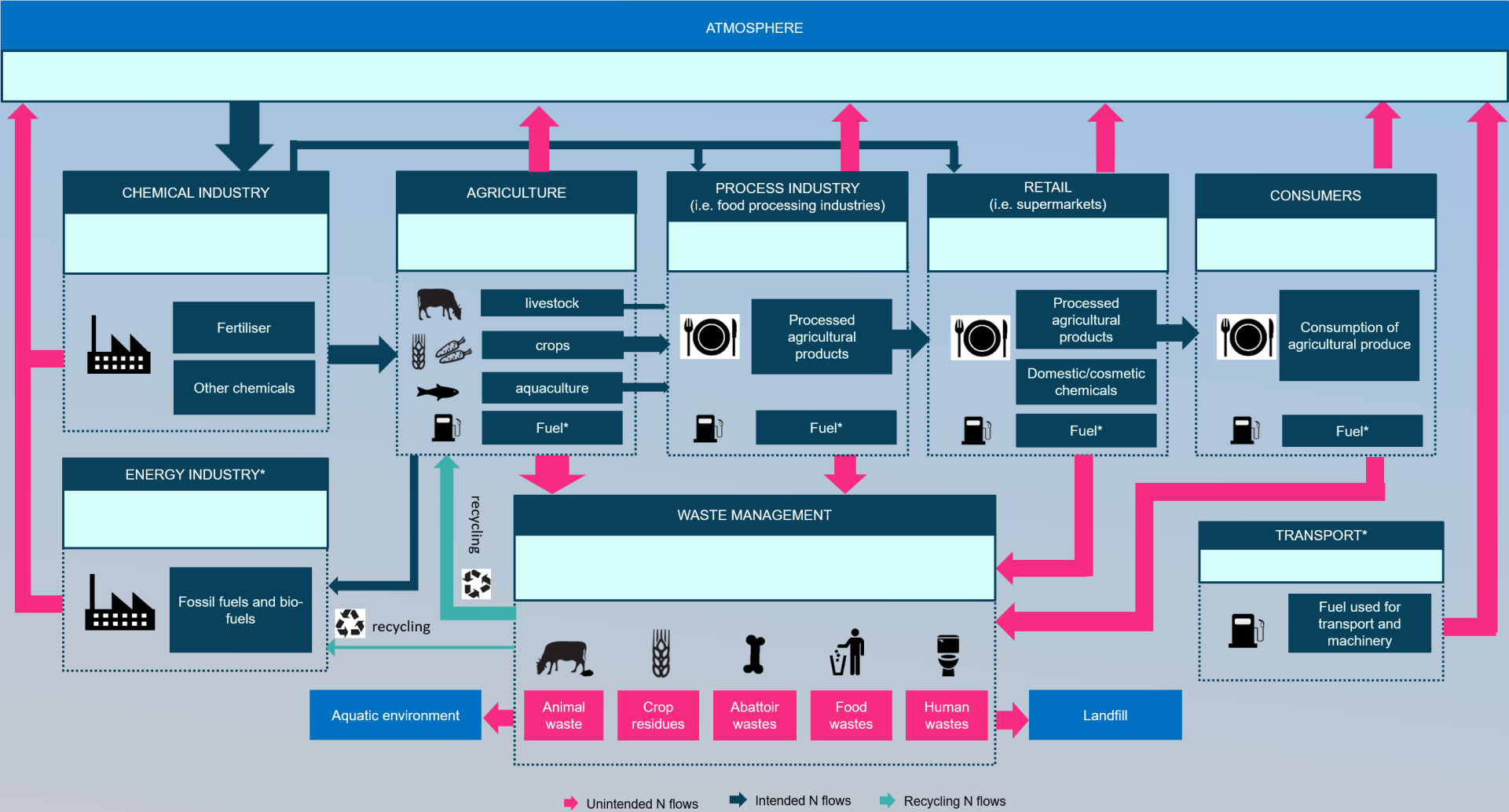
Fageria, N. K., & Baligar, V. C. (2003). Methodology for evaluation of lowland rice genotypes for nitrogen use efficiency. *Field Crops Research*, 58(1), 35-52.

V. K. Dwivedi, B. S., Balasubramanian, V., Gupta, R. K., ... & Padre, A. T. (2004). Calibrating the leaf color chart for nitrogen content of rice and wheat in a systems perspective. *Agronomy Journal*, 96(6), 1606-1621.

Other Information:

G. (2017). Nitrogen use efficiency in crops: lessons from Arabidopsis and rice. *Journal of Agricultural Science*, 159(1), 1-10.

That database covers measures for all N flows throughout the N cycle, and promotes circular economy approach



Guidance on
I N T E G R A T I N G
NITROGEN MANAGEMENT
MEASURES



GUIDANCE DOCUMENT “Opportunities for nitrogen mitigation”

To include a top 10 measures (globally, by region?)

AUDIENCE: **Policy makers**, environment agencies and extension services

- **PURPOSE:** Outline why we should, and how we can integrate nitrogen measures.
- **WHAT IT WILL LOOK LIKE:**
 - Concise, highly visual, easily accessible/readable.
 - 50-100 pages
 - Printed
 - Web-based (interactive PDF) versions.

To include top 10 measures (globally, by region?)

1. Bayesian decision tree: high resources / high accuracy
2. Multi-criteria analysis: medium resources / medium accuracy
3. Expert opinion: Low resources / medium accuracy?

Combination of 2 & 3?



Multi Criteria Analysis

Selection criteria for top ten measures to reduce nitrogen emissions would be based on

1. environmental,
2. technical,
3. economic,
4. political, and
5. social aspects



measures_scored - view-only

Brownlie, William J.

FileHomeInsertFormulasDataReviewViewHelpTell me what you want to do

ClipboardFontAlignmentNumberTablesCellsEditing

Comments

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
		Environmental			Technical					Economic		Political		Social												
		Crit 1	Crit 2	Crit 3	Crit 1	Crit 2	Crit 3	Crit 4	Crit 5	Crit 1	Crit 2	Crit 1	Crit 2	Crit 1	Crit 2	Crit 3	Crit 4									
	Measure 1																		E	T	E	P	S		Index	
	Measure 2																									
	...																									



Expert Opinion

Expert Survey with weighting preference for selected 10 measures

40+ experts given list of measures
100 chips, distributed between 10 measures selected
Agree a statement on what we want the measures to achieve – environmental improvement?
Provide instructions to avoid participant bias



Key (current) challenges:

- Developing a network of contributors to provide content and review each measure (perhaps >150 measures).
- Addressing regional differences in the suitability of measures, (review by demo regions, or major UN regions? i.e.

[Africa](#) (UN-ECA)

[Asia and the Pacific](#) (UN-ESCAP)

[Europe](#) (UN-ECE)

[Latin America and the Caribbean](#) (ECLAC)

[Western Asia](#) (EN-ESCWA)

- Ensuring database and content are useful for the audience

We need

- Measures content providers
- Reviewers
- Regional leaders to help select top ten measures





WORLD
RESOURCES
INSTITUTE



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ACTIVITY 2.5

Collation & synthesis of knowledge, experience & measures adopted by GEF and others on excess & insufficient reactive nitrogen

INMS4

SARA WALKER + CLARE HOWARD



objectives

- Collate and share case studies of successful interventions in the N cycle through GEF and other programs
- Identify and communicate knowledge gaps and key factors which increase the chance of success of an intervention

Key questions that we will answer

- Is nitrogen management changing as a result of GEF (or other) interventions?
- Based on learnings from past projects, how can stronger nitrogen approaches be developed in the future?

- Database and summary document on:
 - GEF nitrogen measures
 - nitrogen measures adopted by others
- Synthesis compendium supported by database on:
 - common themes
 - barriers to change
 - factors for success
 - etc.