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4R NUTRIENT STEWARDSHIP

The 4Rs and Greenhouse Gas Reduction – Beneficial Management Practices for Your Farm

RIGHT SOURCE

RIGHT RATE

RIGHT TIME

RIGHT PLACE

AGENDA

- **The Challenge** – Greenhouse Gas Emissions and Agriculture
- **The 4Rs** – An Introduction/The Essentials
- **Getting Started** – A Practical Plan
- **Nitrogen Management (NERP)**
- **Environmental & Economic Benefits**
- **Sources for More Information**

THE SUSTAINABILITY CHALLENGE

- GLOBAL POPULATION **7 BILLION PEOPLE**
- **9 BILLION** BY 2050
- MORE FOOD FROM **EXISTING LAND**

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THE **4R NUTRIENT STEWARDSHIP** PROGRAM WILL PLAY A **KEY ROLE** IN MEETING THE SUSTAINABILITY CHALLENGE.

JEREMY RICHARDS, SHUTTERSTOCK.COM

FAO SAYS

- Agricultural production will need to increase by at least 70 percent to meet demands by 2050
- Food security requires agricultural production systems to change in the direction of higher productivity.
- Higher productivity tends to increase GHG emissions
- The sustainable intensification of production, especially in developing countries, can ensure food security and contribute to mitigating climate change by reducing deforestation and the encroachment of agriculture into natural ecosystems

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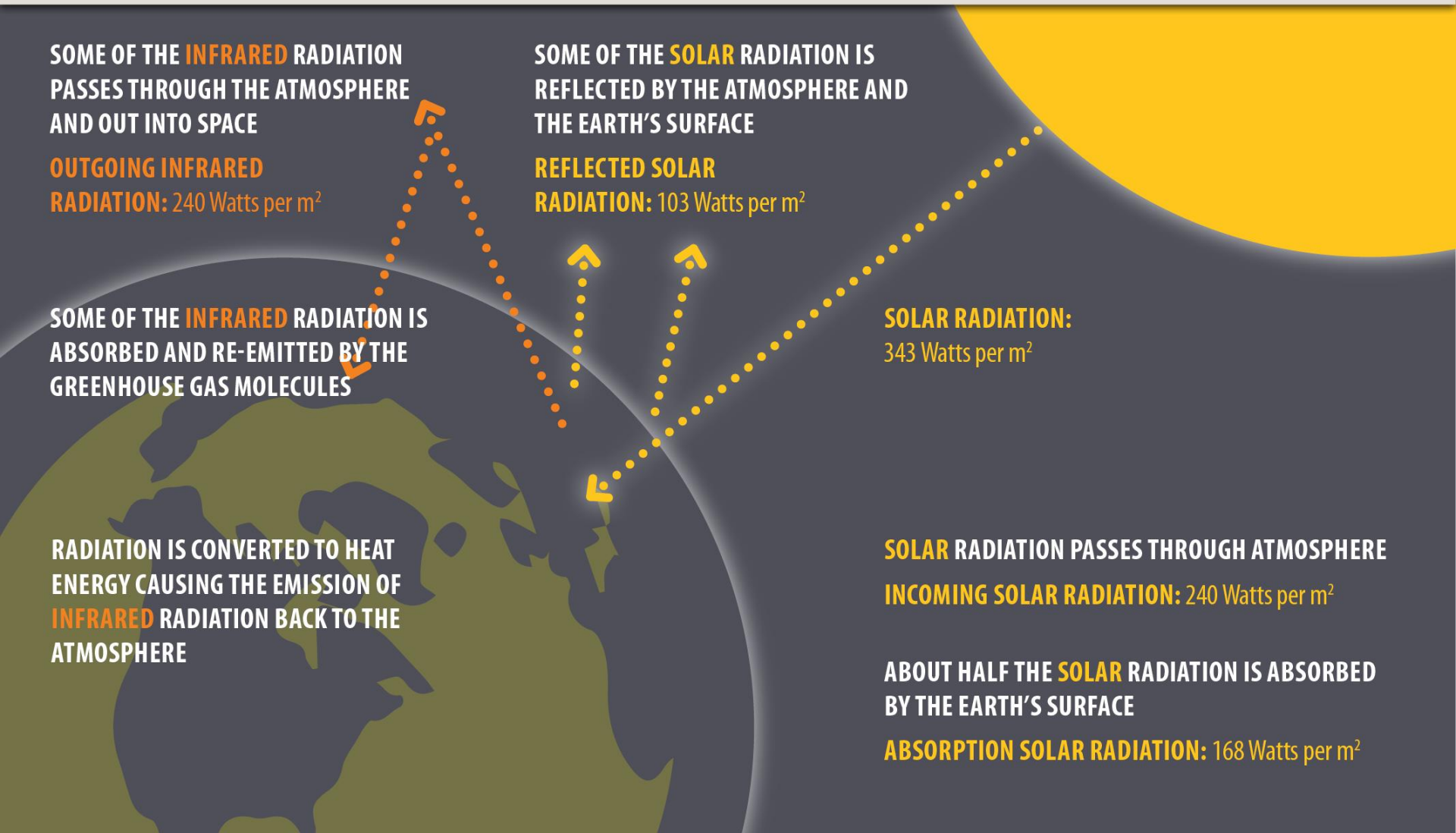
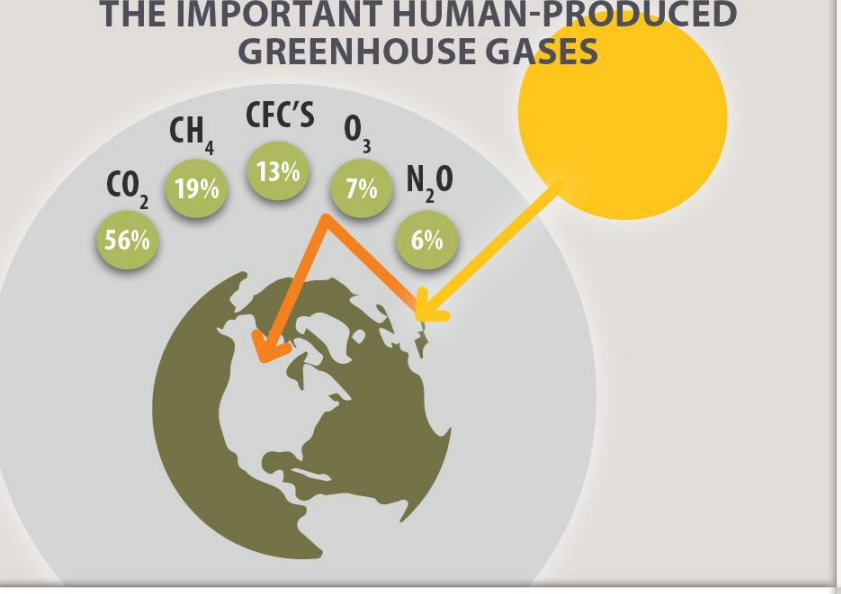
THE GREENHOUSE EFFECT



THE IMPORTANT HUMAN-PRODUCED GREENHOUSE GASES



GHG EMISSIONS BY COUNTRY

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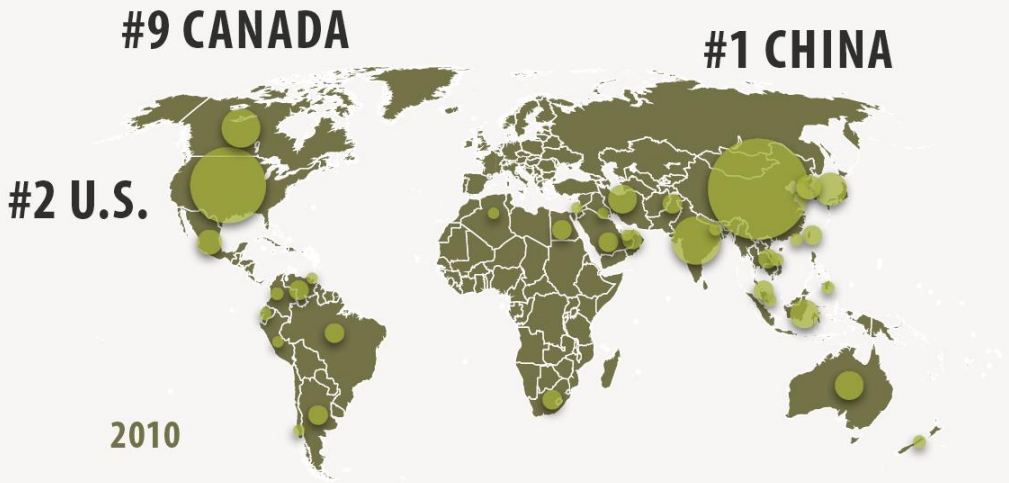
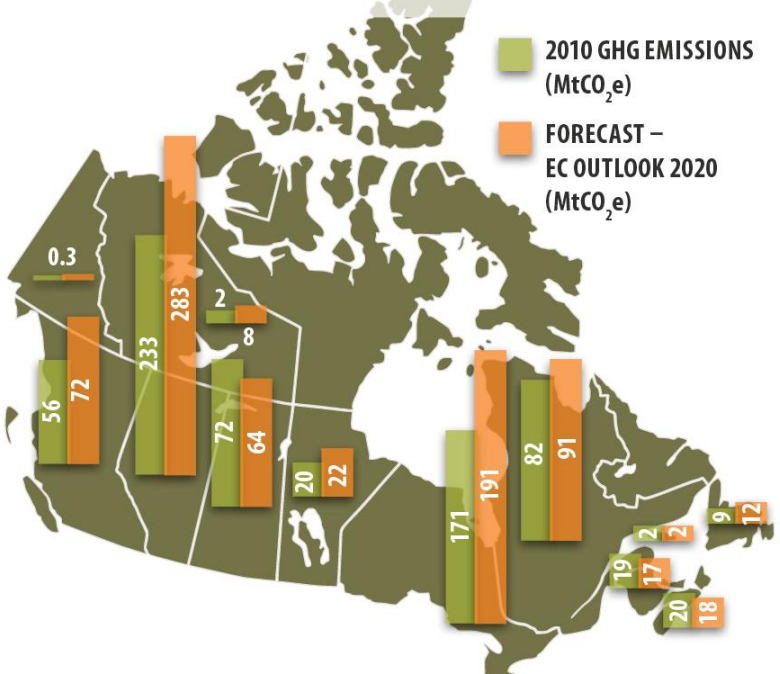
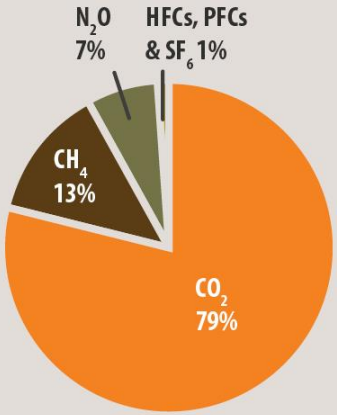


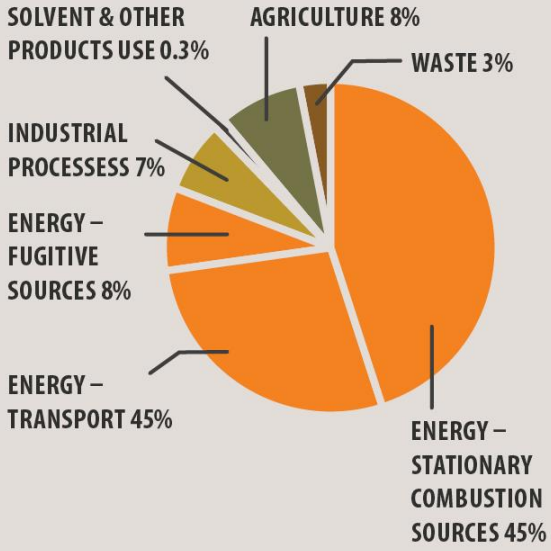
GREENHOUSE GAS EMISSIONS IN THE CANADIAN CONTEXT



CANADA'S TOTAL EMISSIONS BREAKDOWN 2010 BY GREENHOUSE GAS



CANADA'S EMISSIONS BREAKDOWN 2010 BY IPCC SECTOR



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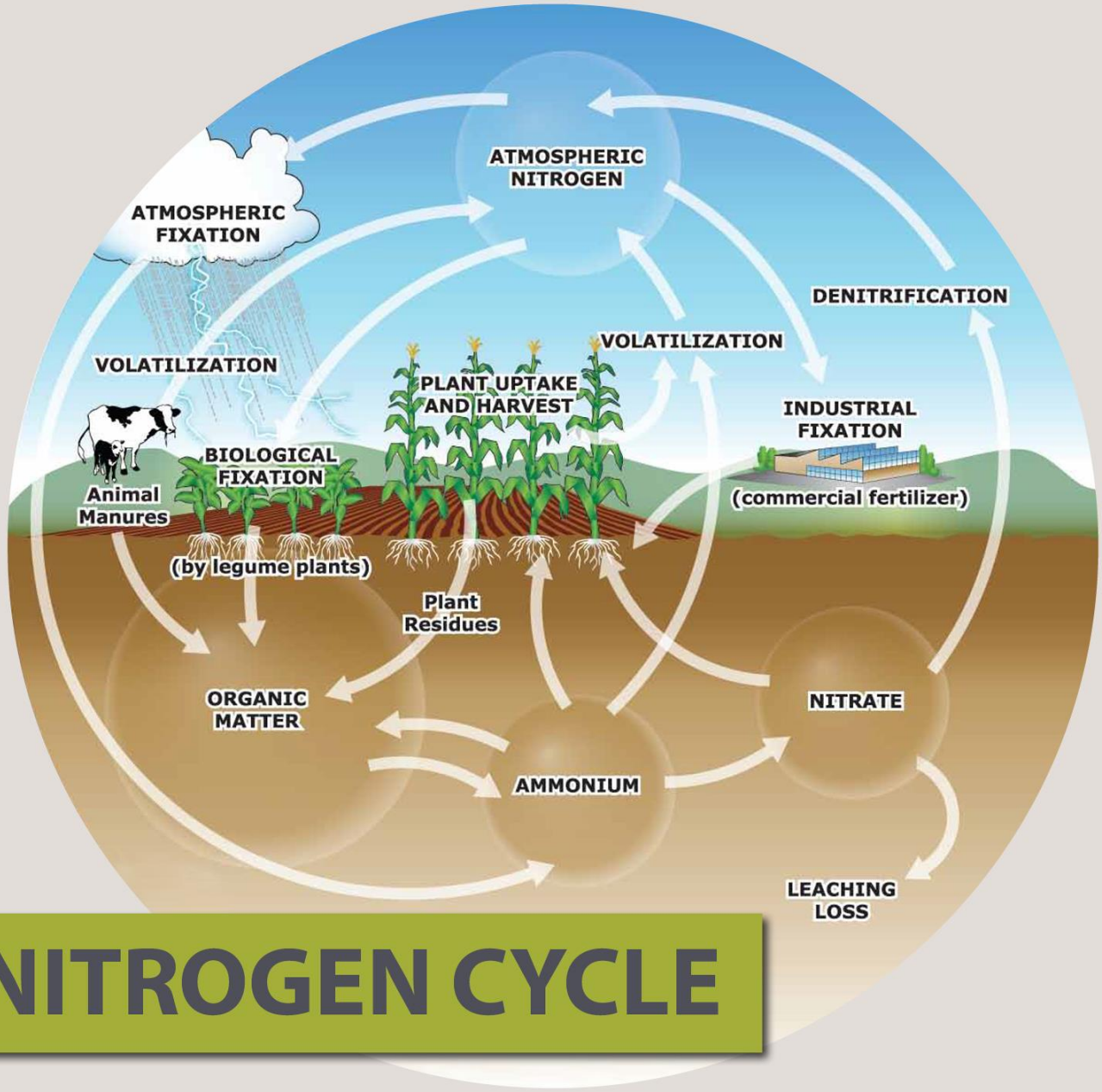

THE NITROGEN CYCLE

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SUSTAINABILITY GOALS

ECONOMIC

- **IMPROVE** FARM **PROFITABILITY** BY IMPROVING RETURN ON FERTILIZER DOLLARS
- **SUPPLEMENT** FARM INCOME THROUGH PARTICIPATION IN THE ECOLOGICAL GOODS AND SERVICES MARKET
- MAKE THE MOST OF DOLLARS SPENT ON FERTILIZER

SOCIAL

- CREATE **CARBON OFFSETS** THAT **ASSIST SOCIETY** IN ADAPTING TO CLIMATE CHANGE
- HELP **INCREASE GLOBAL FOOD SUPPLY** BY INCREASING PRODUCTIVITY PER ACRE ON THE FARM

ENVIRONMENTAL

- **REDUCE INTENSITY** OF GHG EMISSIONS FROM FERTILIZER USE ON THE FARM
- **PREVENT** NUTRIENT LOSS FROM CROPPING SYSTEM

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THE 4RS

RIGHT SOURCE

RIGHT RATE

RIGHT TIME

RIGHT PLACE

KEY SCIENTIFIC PRINCIPLES

- ENSURE BALANCED SUPPLY
- SUIT SOIL PROPERTIES

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- ASSESS ALL SOURCES
- ASSESS PLANT DEMAND

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SOURCE | RATE | TIME | PLACE

- ASSESS DYNAMICS OF CROP UPTAKE AND SOIL SUPPLY
- DETERMINE TIMING OF LOSS RISK

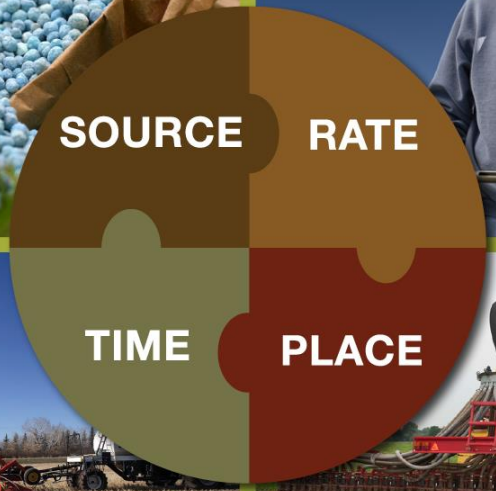
KEY SCIENTIFIC PRINCIPLES

- ENSURE BALANCED SUPPLY
- SUIT SOIL PROPERTIES

- ASSESS ALL SOURCES
- ASSESS PLANT DEMAND

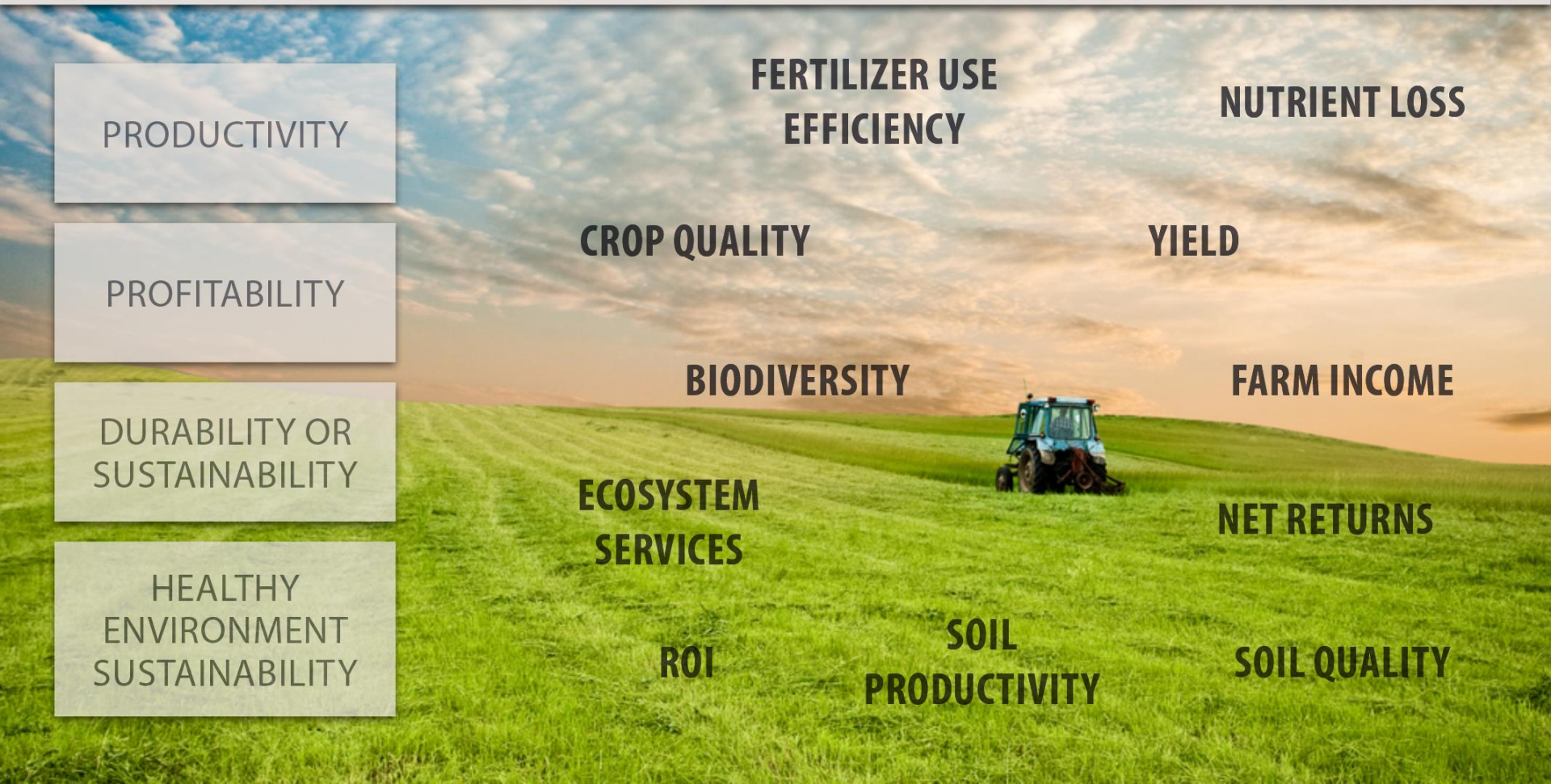
- ASSESS DYNAMICS OF CROP UPTAKE AND SOIL SUPPLY
- DETERMINE TIMING OF LOSS RISK

- RECOGNIZE CROP ROOTING PATTERNS
- MANAGE SPATIAL VARIABILITY



CROPPING SYSTEM OUTCOMES

(PERFORMANCE INDICATORS)



MY EXPERIENCE

PRACTICAL APPLICATION


nutrient
stewardship
A PRACTICAL APPROACH
GETTING STARTED

PLANNING STEPS

1 SUSTAINABILITY GOALS

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1 SUSTAINABILITY GOALS

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PERFORMANCE INDICATORS

YIELD	AMOUNT OF CROP HARVESTED PER UNIT OF CROPLAND PER UNIT OF TIME
QUALITY	SUGAR, PROTEIN, MINERALS, VITAMINS OR OTHER VALUE ADDING ATTRIBUTES
NUTRIENT USE EFFICIENCY	YIELD PRODUCED OR NUTRIENT REMOVED PER UNIT OF NUTRIENT APPLIED
CARBON CREDITS	NITROUS OXIDE EMISSION ESTIMATES, CARBON SEQUESTRATION ESTIMATES
SOIL EROSION	DEGREE OF SOIL COVERAGE BY ACTIVELY GROWING CROPS AND CROP RESIDUES
OFF-FIELD NUTRIENT LOSSES	LOSSES FROM EDGE OF FIELD, BOTTOM OF ROOT ZONE, AND TOP OF CROP CANOPY
NUTRIENT BUDGET	A TOTAL ACCOUNT OF NUTRIENT INPUTS AND OUTPUTS PER FIELD
FACTOR COST	DOLLARS OF CROP PRODUCED PER DOLLAR OF NUTRIENT INPUT
SOIL PRODUCTIVITY	SOIL ORGANIC MATTER, AND OTHER SOIL QUALITY INDICATORS
BIODIVERSITY	DIFFICULT TO QUANTIFY – CAN BE DESCRIPTIVE
WATER USE EFFICIENCY	YIELD PRODUCED PER UNIT OF AVAILABLE WATER

2 GATHER PRODUCTION INFORMATION

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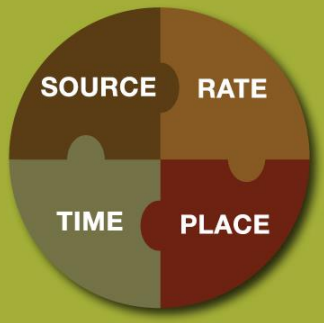
FOR EACH FIELD:

3 FORMULATE 4R PLAN

3 FORMULATE 4R PLAN

DEVELOPING BMPS FOR NITROGEN



RIGHT	CURRENT PRACTICE SUB-OPTIMAL CROPPING SYSTEM PERFORMANCE	EVIDENCE FOR IMPROVED PRACTICE	BPM IMPROVES CROPPING SYSTEM PERFORMANCE
SOURCE	UREA IN ALL FIELDS	→	CONTROLLED RELEASE IN HIGHER RISK FIELDS
RATE	SAME RATE ALL WHEAT FIELDS	→	FIELD SPECIFIC RATE FOR EACH WHEAT FIELD
TIME	EARLY FALL	→	LATE FALL AFTER SOIL COOLED BELOW 10°C
PLACE	BROADCAST	→	NARROW BAND

4 IMPLEMENT PRACTICE CHANGE

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CURRENT PRACTICE

- SIGNIFICANT IMPROVEMENTS MAY TAKE SEVERAL YEARS TO FULLY IMPLEMENT.

INTERIM IMPROVEMENT

- SOME PRACTICES WILL BE FIELD SPECIFIC AND SOME WILL BE WHOLE FARM.

BEST MANAGEMENT

- 4R IS BASED ON INCREMENTAL IMPROVEMENTS

5 MONITOR EFFECTIVENESS

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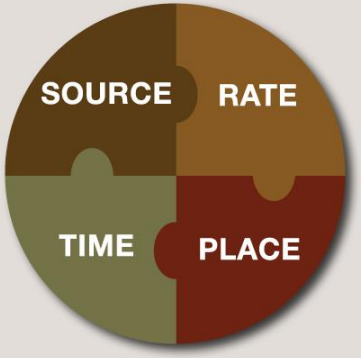
MEASURE

EVALUATE

ADAPT



5 MONITOR EFFECTIVENESS

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MONITORING PRIORITIES

- ACCURATE YIELD AND NUTRIENT INPUT DATA ON A FIELD SPECIFIC BASIS SHOULD BE THE FIRST PRIORITIES OF YOUR MONITORING PROGRAM.

THE 4R PLAN

- 4R LINKS GOALS TO SITE SPECIFIC CROPPING SYSTEM PERFORMANCE.
- 4R CAN MEET THE DIVERSE NEEDS OF NUTRIENT MANAGEMENT PLANNING.
- 4R PLANNING IS A CONTINUOUS CYCLE.
- 4R USES PERFORMANCE INDICATORS TO MEASURE ACHIEVEMENT.


nutrient
stewardship
NERP
Nitrous Oxide Emission Reduction

BENEFITS OF NERP

› FARMERS

› INDUSTRY

› GOVERNMENT

› RESEARCHERS

› ENVIRONMENTAL GROUPS

FAO CLIMATE-SMART AGRICULTURE

- HIGH PRODUCTION
- INTENSIFIED
- RESILIENT
- SUSTAINABLE
- LOW EMISSION

FAO	NERP
HIGH PRODUCTION	**NERP** SUPPORTS INCREASED PRODUCTION OF CROPS THROUGH BETTER MANAGEMENT
INTENSIFIED	**NERP** REWARDS HIGHER INTENSITY ON EXISTING FARMLAND
RESILIENT	**NERP** PROMOTES CONSERVATION AGRICULTURE
SUSTAINABLE	**NERP** SUPPORTS ECONOMIC VIABILITY, REDUCED ENVIRONMENTAL IMPACT AND SOCIETIES NEED FOR FOOD SECURITY
LOW EMISSION	**NERP** REDUCES EMISSIONS PER KILO OF GRAIN OR OILSEEDS

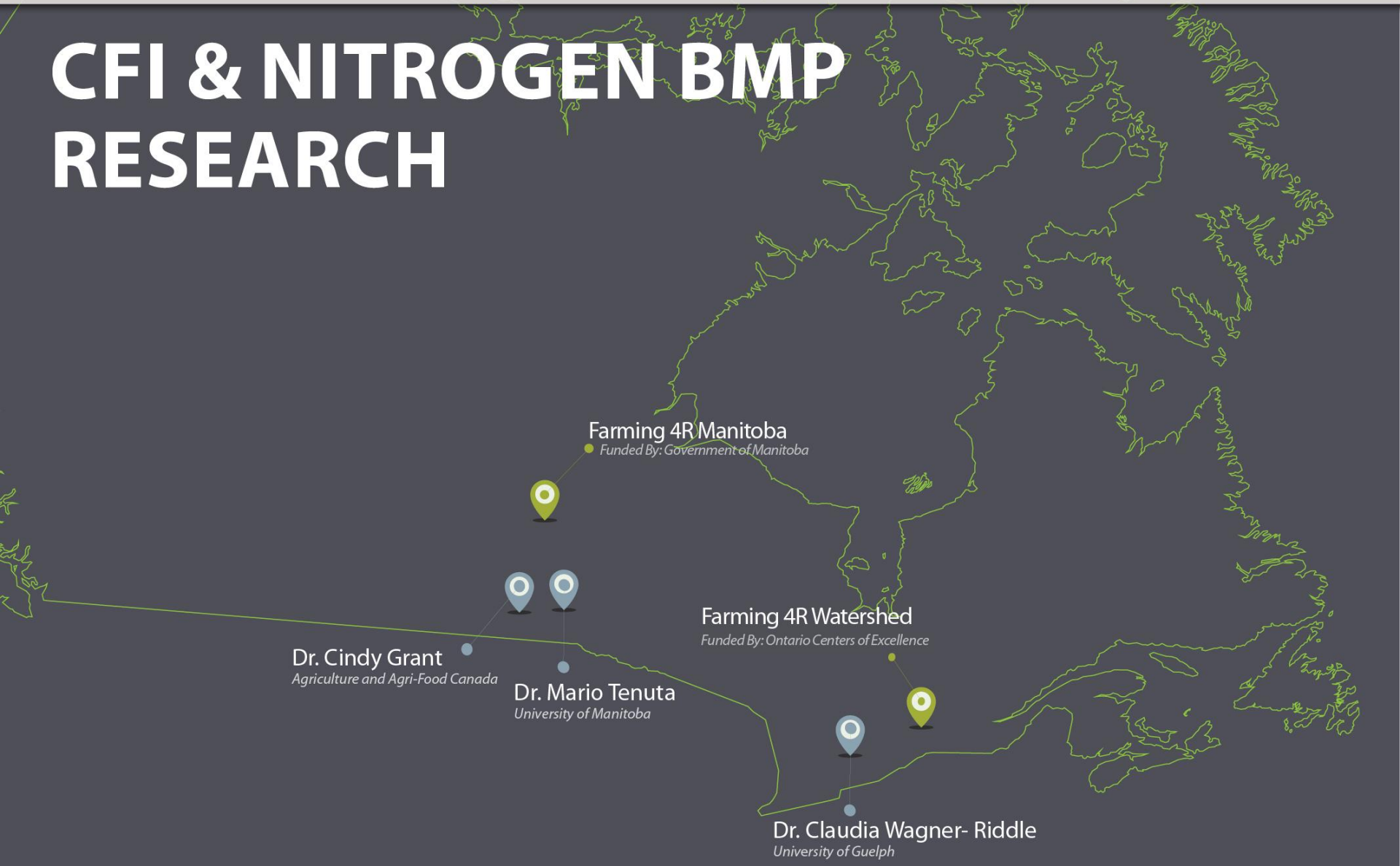
NERP PROTOCOLS

THE BOTTOM LINE:

- **15% TO 25% REDUCTION** IN NITROUS OXIDE EMISSIONS FROM FERTILIZER APPLICATION
- NEW SCIENCE COULD ALMOST **DOUBLE THESE ESTIMATES**
- **MANAGES** THE RISK OF NITRATE ACCUMULATION IN SOILS

Performance Level	Right Source	Right Rate	Right Time	Right Place
Basic	• Ammonium-based formulation	• Apply N according to recommendation of 4R Plan using annual soil testing and/or N balance to determine application rate	• Apply fertilizer in spring; or • Split apply; or • Apply after soil cools in fall	Apply in bands / Injection
Intermediate	• Ammonium-based formulation; and • Use slow / controlled release fertilizers; or • Inhibitors; or • Stabilized N	• Apply N according to qualitative estimates of field variability (landscape position, soil variability)	• Apply fertilizer in spring; or • Split apply; or • Apply after soil cools in fall if using slow / controlled release fertilizer or inhibitors / stabilized N	Apply in bands / Injection
Advanced	• Ammonium-based formulation; and • Use slow / controlled release fertilizers; or • Inhibitors; or • Stabilized N	• Apply N according to quantified field variability (e.g. digitized soil maps, grid sampling, satellite imagery, real time crop sensors) and complemented by in season crop monitoring	• Apply fertilizer in spring; or • Split apply; or • Apply after soil cools in fall if using slow / controlled release fertilizer or inhibitors / stabilized N	Apply in bands / Injection

CFI & NITROGEN BMP RESEARCH



IN CLOSING

THROUGH SUSTAINABLE ACTIONS,
WE CAN **PROTECT** OUR SOIL,
WATER AND AIR FOR SOCIETY.

FARMING 4R FUTURE WORKS TO EMPOWER FARMERS WITH THE KNOWLEDGE AND RESOURCES THEY NEED TO UTILIZE **4R NUTRIENT STEWARDSHIP** FRAMEWORK.

4R NUTRIENT STEWARDSHIP CAN
HELP GROW CROPS SUSTAINABLY

RESOURCES

- Speak to your local agri-retailer about 4R Nutrient Stewardship
- Go to **farming4Rfuture.ca** to find online resources, connect to social networks and participate in the conversation
- Visit a 4R demonstration farm in your area
- **Become a 4R Farmer Advocate:** this program recognizes growers who are leading the way when it comes to implementing 4R nutrient stewardship on the farm

RESOURCES

http://www.youtube.com/watch?v=g3l1Lu-jNUU