# Monitoring the Adoption of Key Sustainable Climate Technologies in the Agri-food Sector

## A Proposed Methodology

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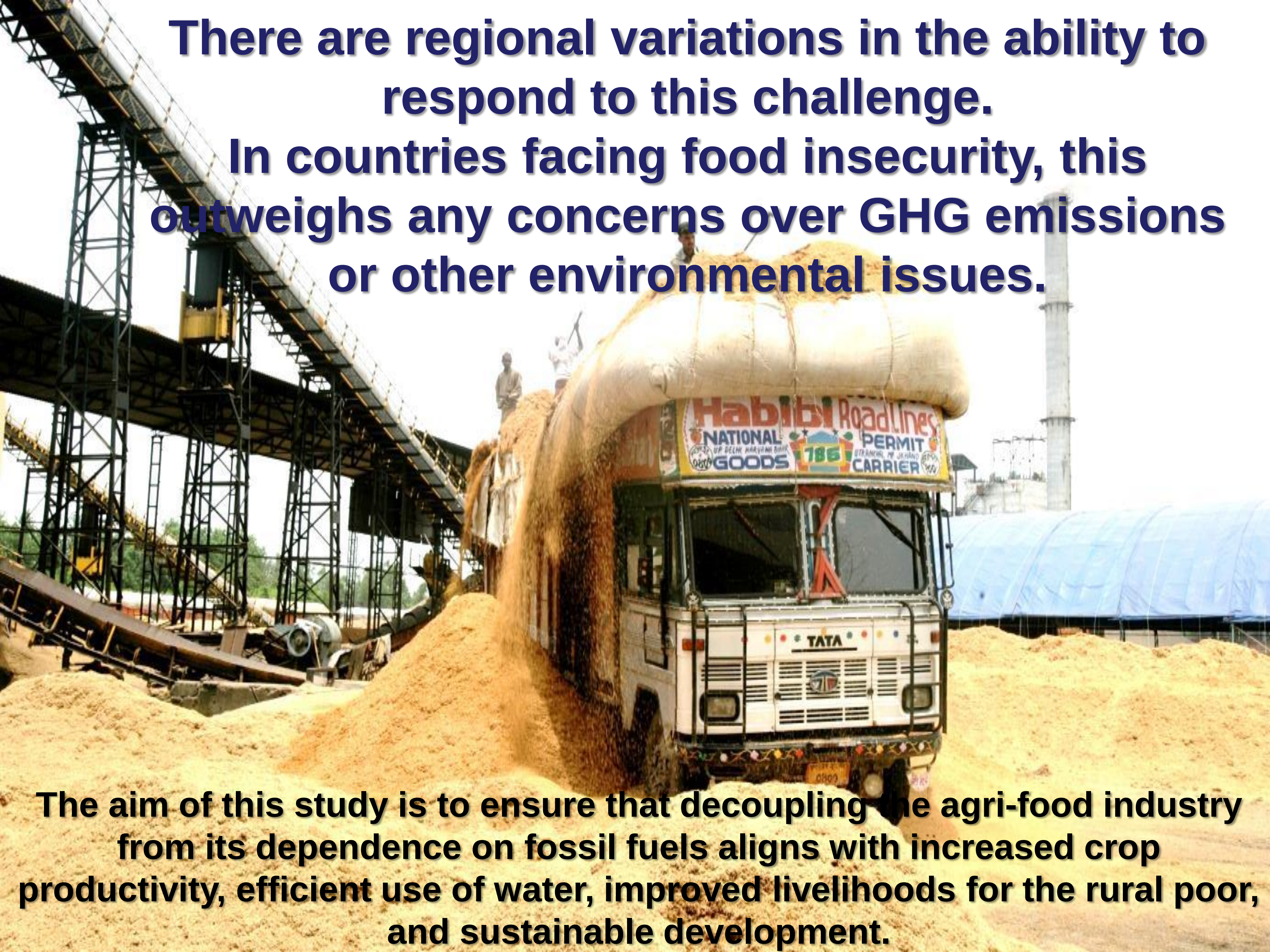
# A key challenge

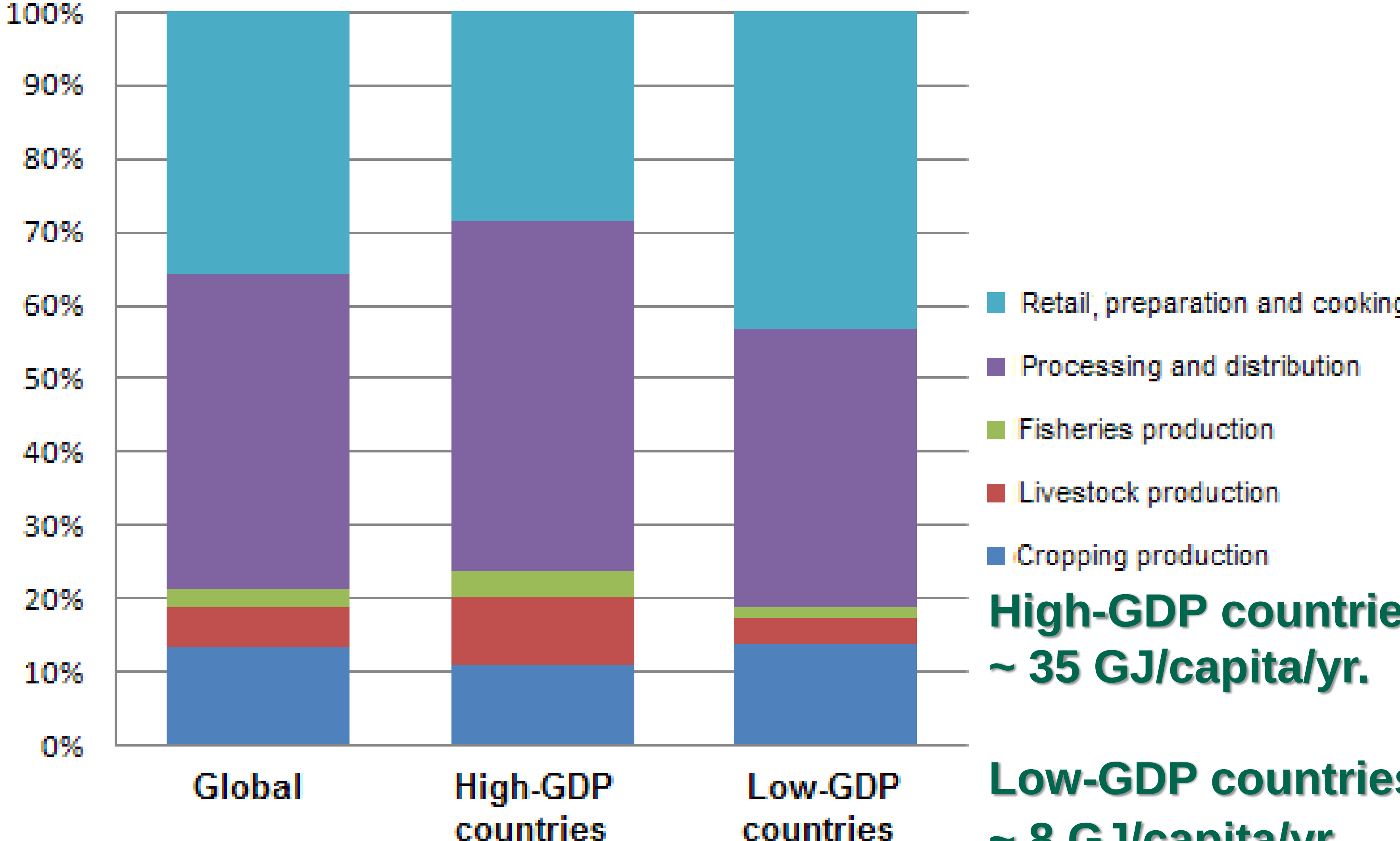
**The problem is that the agri-food sector has been tasked with increasing production to meet the ever growing demand for food and protein, but, together with every other sector, must also reduce its greenhouse gas emissions.**

**There are regional variations in the ability to respond to this challenge.**
**In countries facing food insecurity, this outweighs any concerns over GHG emissions or other environmental issues.**




**The aim of this study is to ensure that decoupling the agri-food industry from its dependence on fossil fuels aligns with increased crop productivity, efficient use of water, improved livelihoods for the rural poor, and sustainable development.**

# Shares of energy in the agri-food supply chain



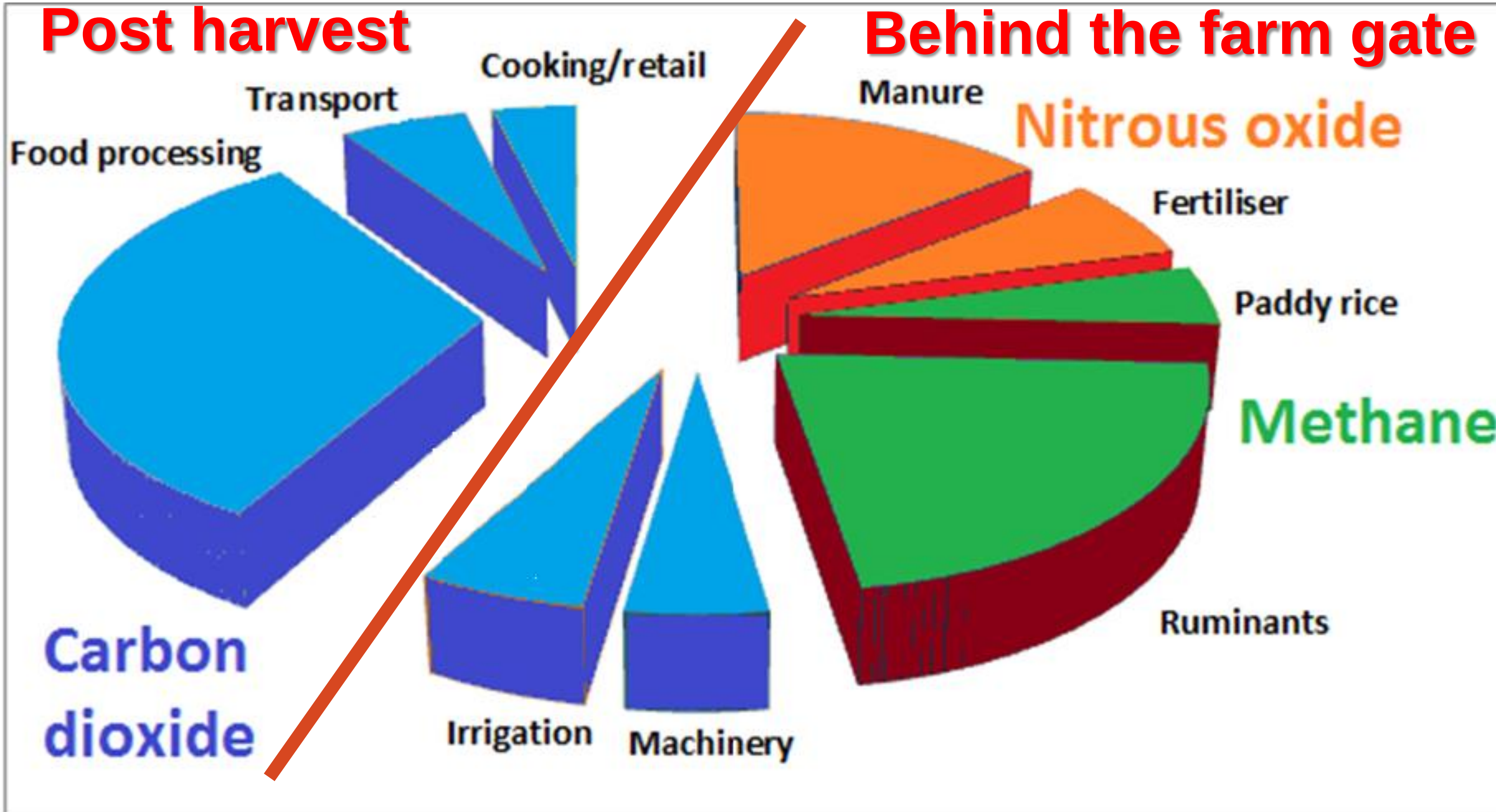

~95 EJ/yr ~50 EJ/yr ~45 EJ/yr

**High-GDP countries ~ 35 GJ/capita/yr.**

**Low-GDP countries ~ 8 GJ/capita/yr.**

**Around 32% of the total global end-use energy demand of ~300 EJ/yr is used for providing food.**

# Annual GHG emissions from the global agri-food sector are around 9.7 Gt $CO_2$-eq.

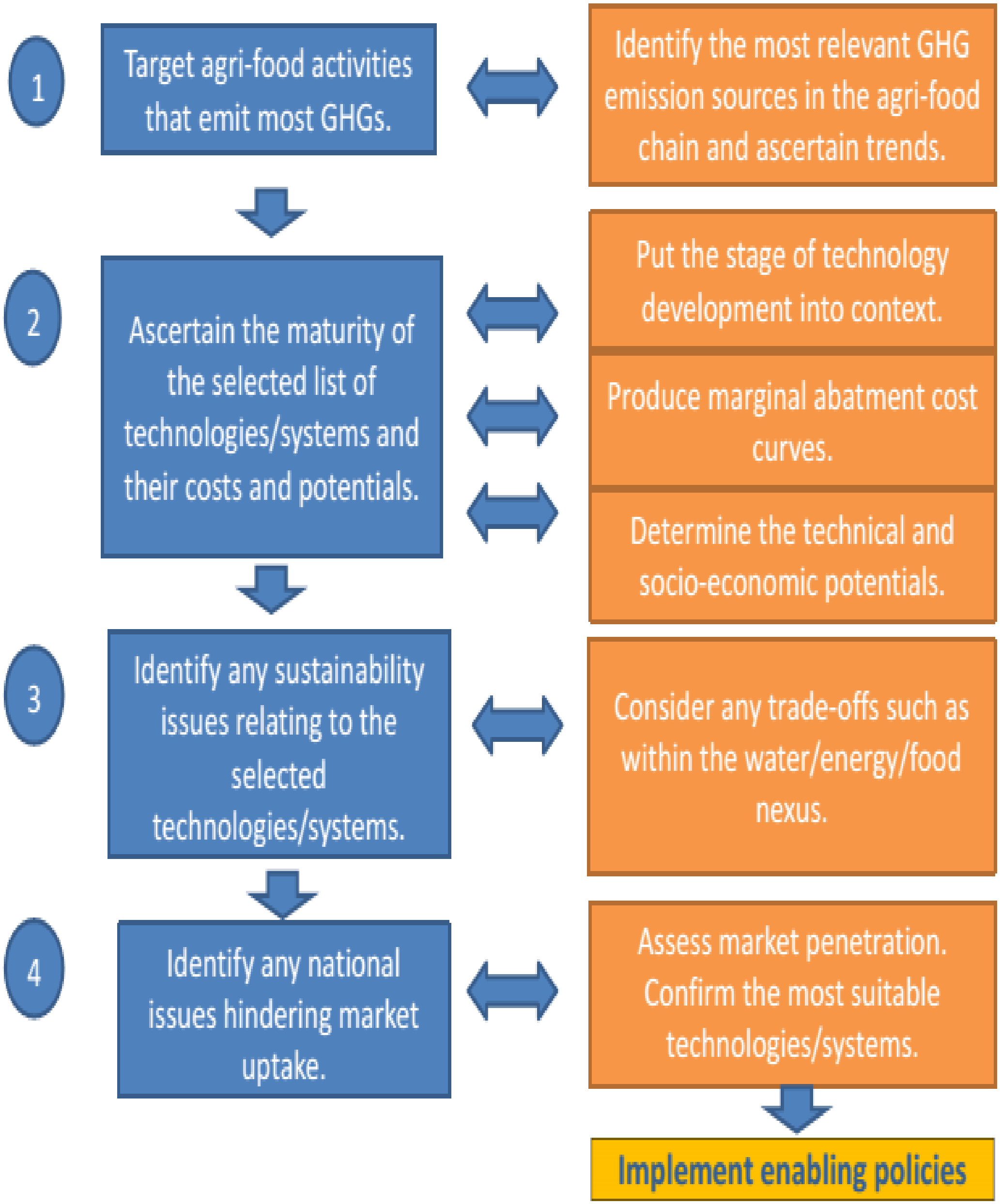



Sources: **IPCC 5th Assessment Report- Mitigation, 2014.**
Chapter 11, Agriculture forestry and other land use;
Chapter 10, Industry; Chapter 8, Transport
**FAO, 2011. Energy-smart food for people and climate**

**This methodology has been developed to enable a country or funding organization to be able to:**

- **identify GHG emissions in the agri-food sector from activities carried out both on-farm and during food processing;**
- **understand the markets for selected agri-food climate technologies and systems;**
- **consider other sustainability issues, not just GHG emission reductions; and**
- **develop appropriate policies and measures to encourage market penetration of the most appropriate climate technologies and systems for that country.**

# The proposed four-step methodology

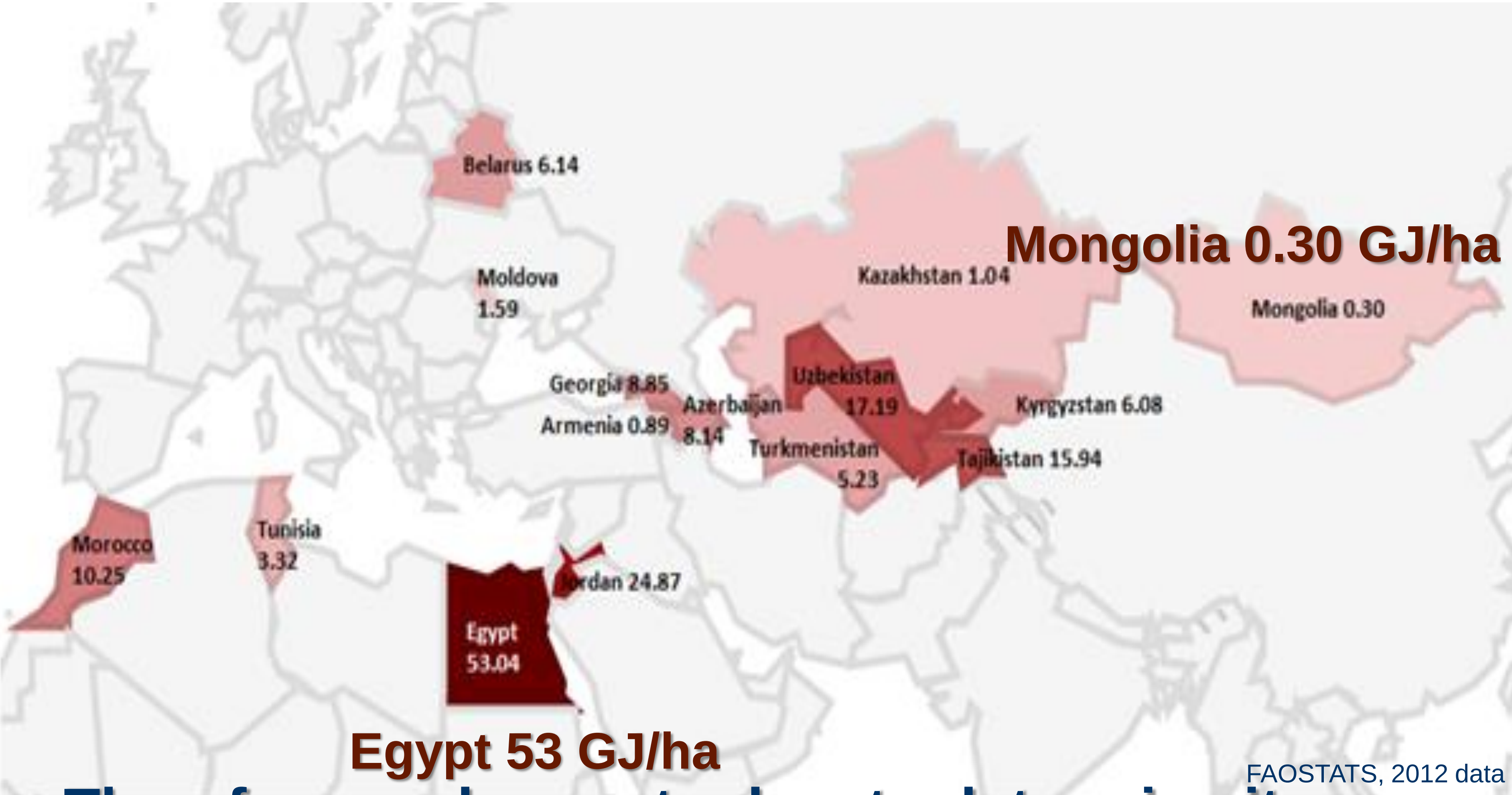



**It was developed to help guide policy-makers and investors to:**

- **assess the market penetration of climate technologies and systems;**
- **consider the costs of reducing GHG emissions by the increased deployment of a climate technology or system;**
- **think through and identify the options available;**
- **then reflect on all the implications of related policy development.**

**The methodological guideline has been kept broad and flexible since every economy has different priorities, agricultural systems, climate, soils, and present status of its agri-food sector.**

# Energy intensity of agriculture (GJ/ha) varies widely, as in the SEMED and ETC countries



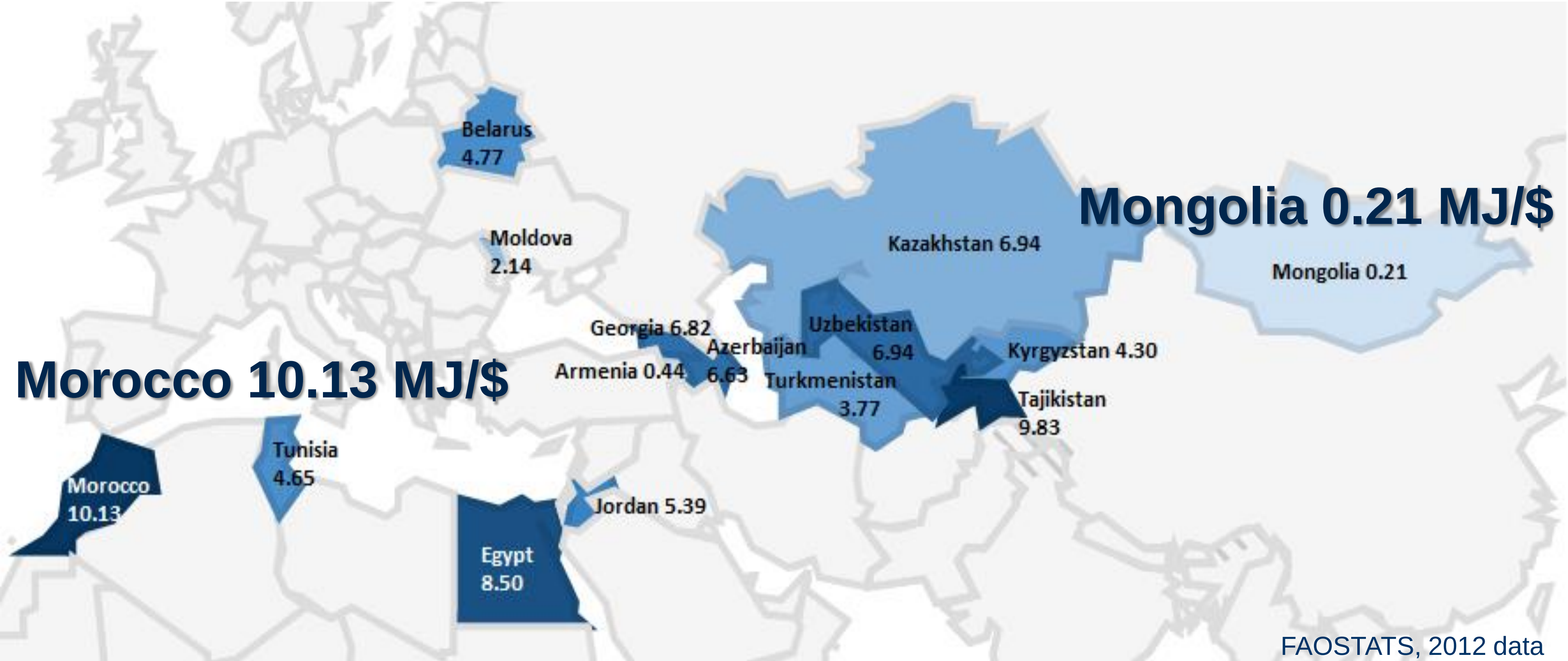

**Mongolia 0.30 GJ/ha**

**Egypt 53 GJ/ha**

FAOSTATS, 2012 data

**Therefore each country has to determine its own mitigation priorities balanced against food security, energy for all, and sustainable development.**

# Another simple indicator is the direct energy input needed per unit of food production value (MJ/$).



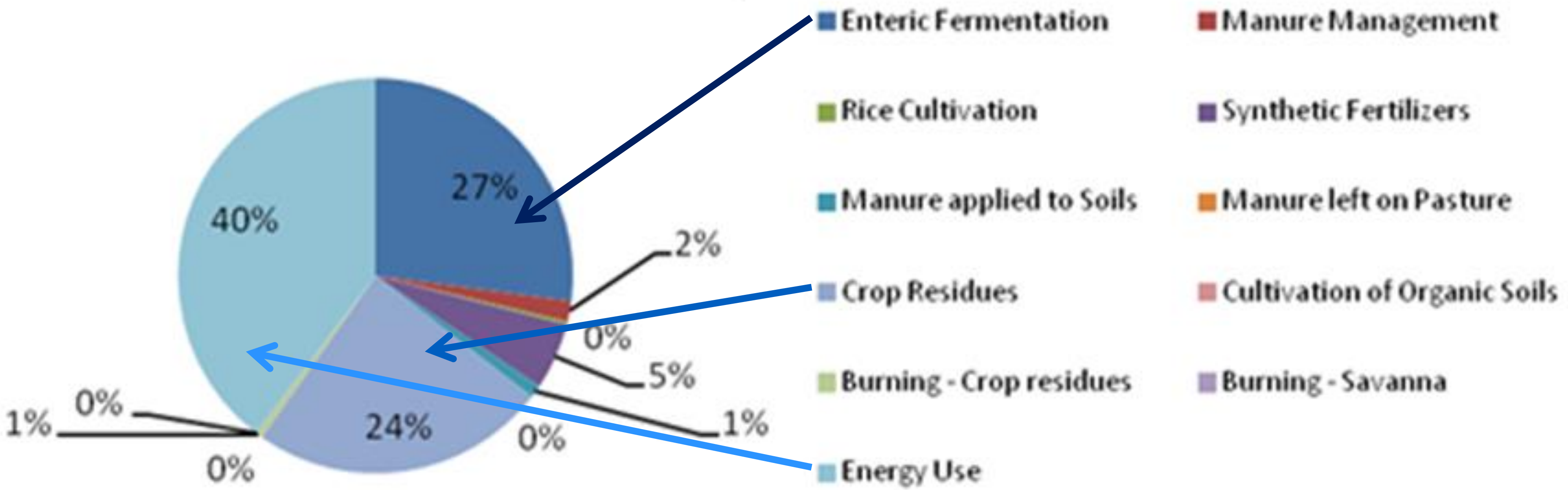

**For the leading countries, reducing energy inputs should be the goal without reducing either productivity or product quality, whilst also reducing food losses.**

# The following key questions can be answered by applying the 4-step approach:

- Is there sufficient market deployment of a climate technology/system with perceived benefits?
- Would a policy to encourage market deployment be economic and also gain the co-benefits?
- Are there environmental and social issues involved that might constrain deployment?
- Could education, training, capacity building, and technology transfer, help overcome the barriers?
- What are the most appropriate policies to encourage market penetration of a specific climate technology/system?

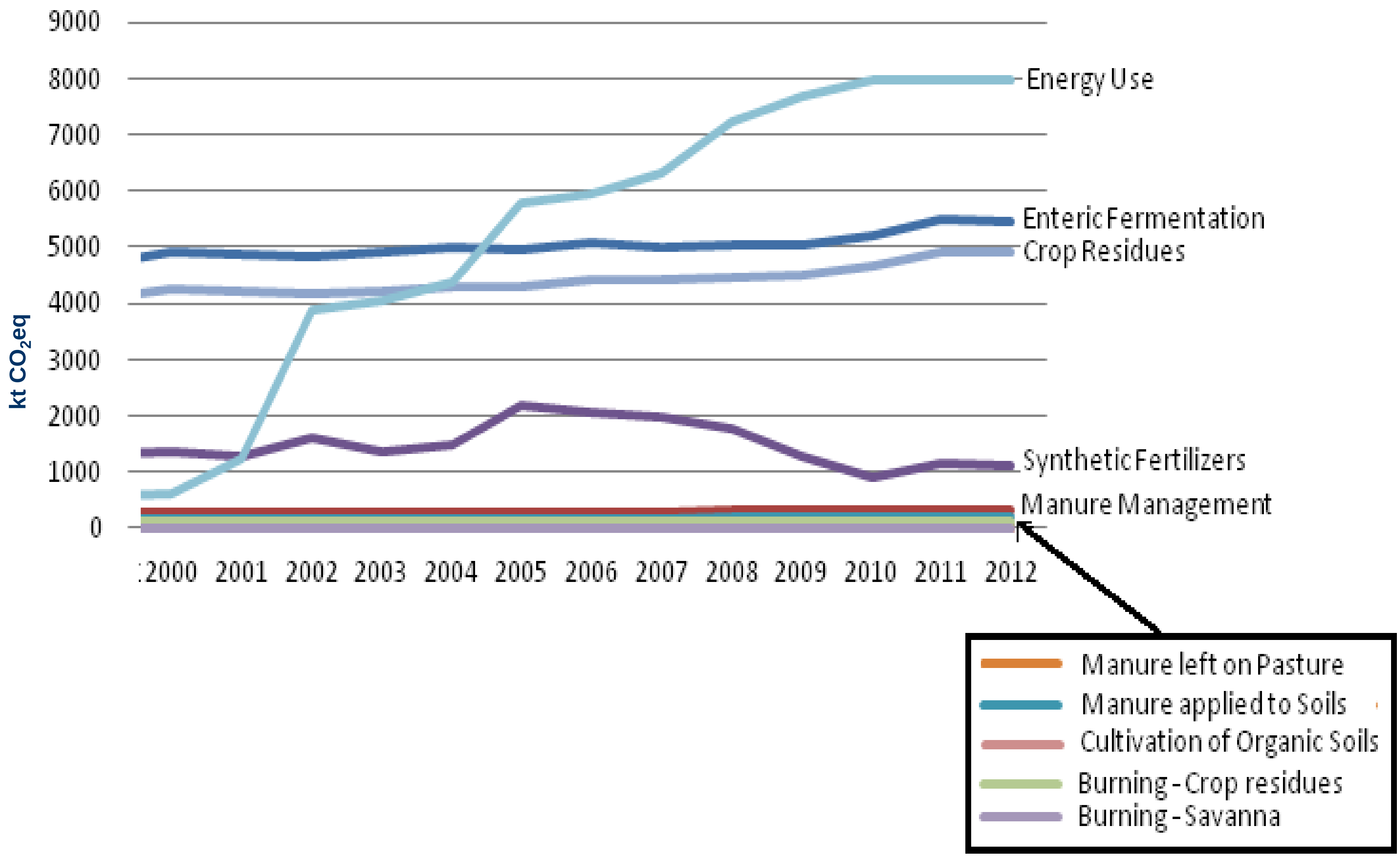
# STEP 1: Identify the agri-food activities that emit most GHGs

## 1a) Shares of total agri-production GHG emissions in 2012 by activity in Morocco

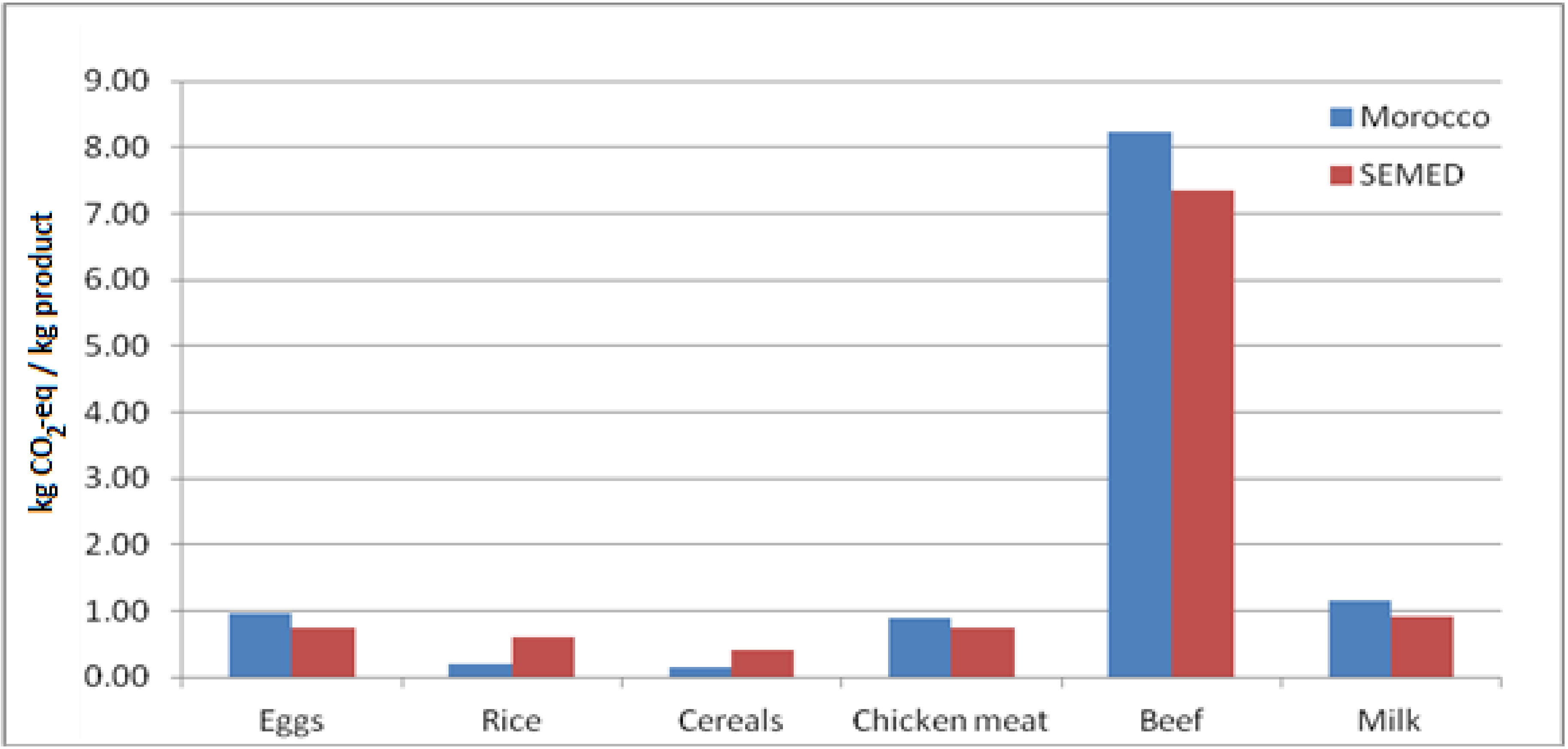


## STEP 1: Identify the agri-food activities that emit most GHGs

# 1b) Trends for agricultural GHG emissions in Morocco from 2000 to 2012



## 1c) Where feasible the variations in emission intensities by commodities can be assessed and benchmarked against other countries.




**This approach provides an overview of the most relevant agri-food GHG emission sources in a country.**

**These can then be reduced by stimulating the adoption of alternative climate agri-food technologies or systems, and encouraging their rapid market penetration.**

# Selected agri-food production and processing technologies and systems with good mitigation potential are reported in detail as Technology Notes.

| |
|---|
| Conservation agriculture |
| Livestock breeding and production |
| Drip irrigation systems |
| Solar/ wind water pumping |
| Greenhouse designs and operation |
| Tractor testing and operator performance |
| Decentralized waste-water and water recycling |
| Crop, vegetable and fruit drying |
| Cold storage and cool chain |
| Biogas from animals, crops or food processing residues |
| Renewable heat and power systems (incl. bioenergy) |
| [Plus any other technologies specific to the country] |

## *STEP 2. Prioritize climate technologies/systems based on costs and markets*

**Aims to match the appropriate climate technology/system with the relevant GHG emission source based mainly on costs and market potential.**
**The climate technologies/systems identified for possible deployment are prioritized on the basis of:**

- **stage of maturity and current status in the country context;**
- **costs of abatement; and**
- **estimated market potential.**

**Since STEP 2 is a challenging part of the methodology with data gaps evident, only the technologies of direct relevance to the activity need to be considered.**

# 2a) Example of a technology/system prioritisation matrix using 3-star ratings where "*manure management*" is the specific activity under consideration based on STEP 1 (so not for Morocco this time)

| Climate technologies and systems | Gap between current uptake and potential saturation level | Energy performance | Scale of market) | Potential to reduce national GHGs | Mitigation costs $/t CO2-eq avoided | Data availability | Stage of commercial availability | Total score |
|---|---|---|---|---|---|---|---|---|
| | 10% | 15% | 10% | 10% | 35% | 10% | 5% | |
| Conservation agriculture | ** | ** | * | ** | ** | * | *** | 2.00 |
| Tractor performance | | | | | | | | |
| Drip irrigation systems | | | | | | | | |
| Solar/ wind water pumping | | | | | | | | |
| Greenhouse technologies | | | | | | | | |
| Livestock GHG emissions | *** | *** | * | * | * | ** | * | 1.55 |
| Decentralised waste-water and water recycling | * | ** | ** | * | * | * | ** | 1.4 |
| Crop and fruit drying | | | | | | | | |
| Cold storage and cool chain (including renewables) | | | | | | | | |
| Biogas from agri-food residues | ** | *** | * | ** | ** | * | *** | 2.15 |

Weightings can be adjusted to suit the country conditions

# 2b) Energy end-use data for the agri-food processing sector for SEMED and ETC countries (TJ/yr) - where available.

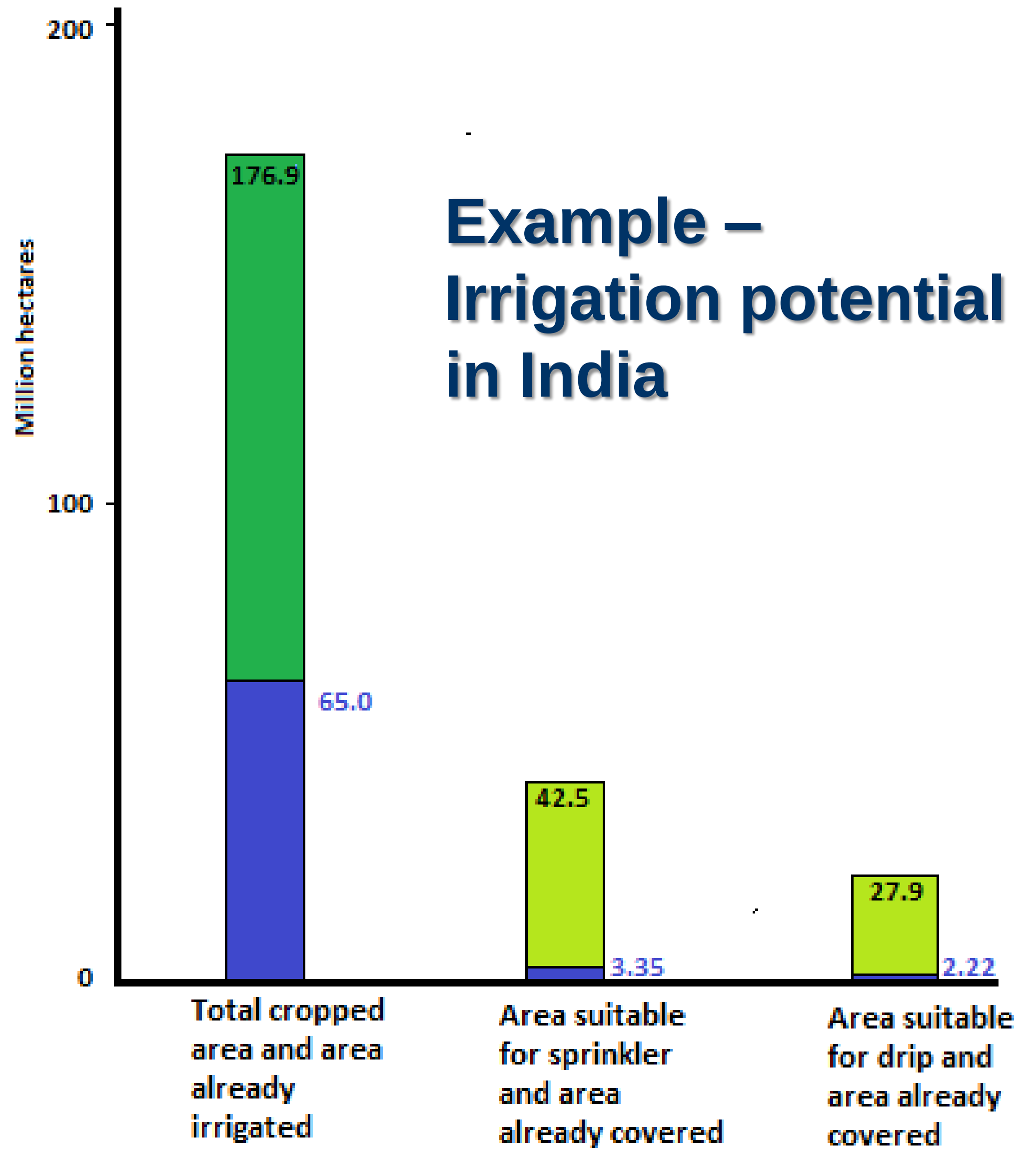
| SEMED | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| Morocco | N/A | | | | | | |
| Tunisia | | | | 3991 | 4349 | 4833 | 5323 |
| Egypt | N/A | | | | | | |
| Jordan | N/A | | | | | | |
| ETC | | | | | | | |
| Armenia | N/A | | | | | | |
| Azerbijan | | | 4971 | 9839 | 10265 | 8950 | 9632 |
| Belarus | 45 | 26326 | 26568 | 27420 | 28672 | 30473 | 31834 |
| Georgia | | | 353 | 360 | 389 | 561 | 1106 |
| Kazakhstan | | | | 13658 | 26596 | 30149 | 8455 |
| Kyrgyzstan | | | 569 | 511 | 490 | 486 | 529 |
| Moldova | | | 3991 | 4476 | 2911 | 3864 | 3786 |
| Mongolia | N/A | | | | | | |
| Tajikistan | | | | | | | 302 |
| Turkmenistan | N/A | | | | | | |
| Uzbekistan | N/A | | | | | | |

**This data from UNSD appears variable and uncertain with many gaps.**
**Some countries may already collect their own data or, if not, may need to do so.**

# 2c) Assessing the scale of the market and growth trends for specific climate technologies/systems.

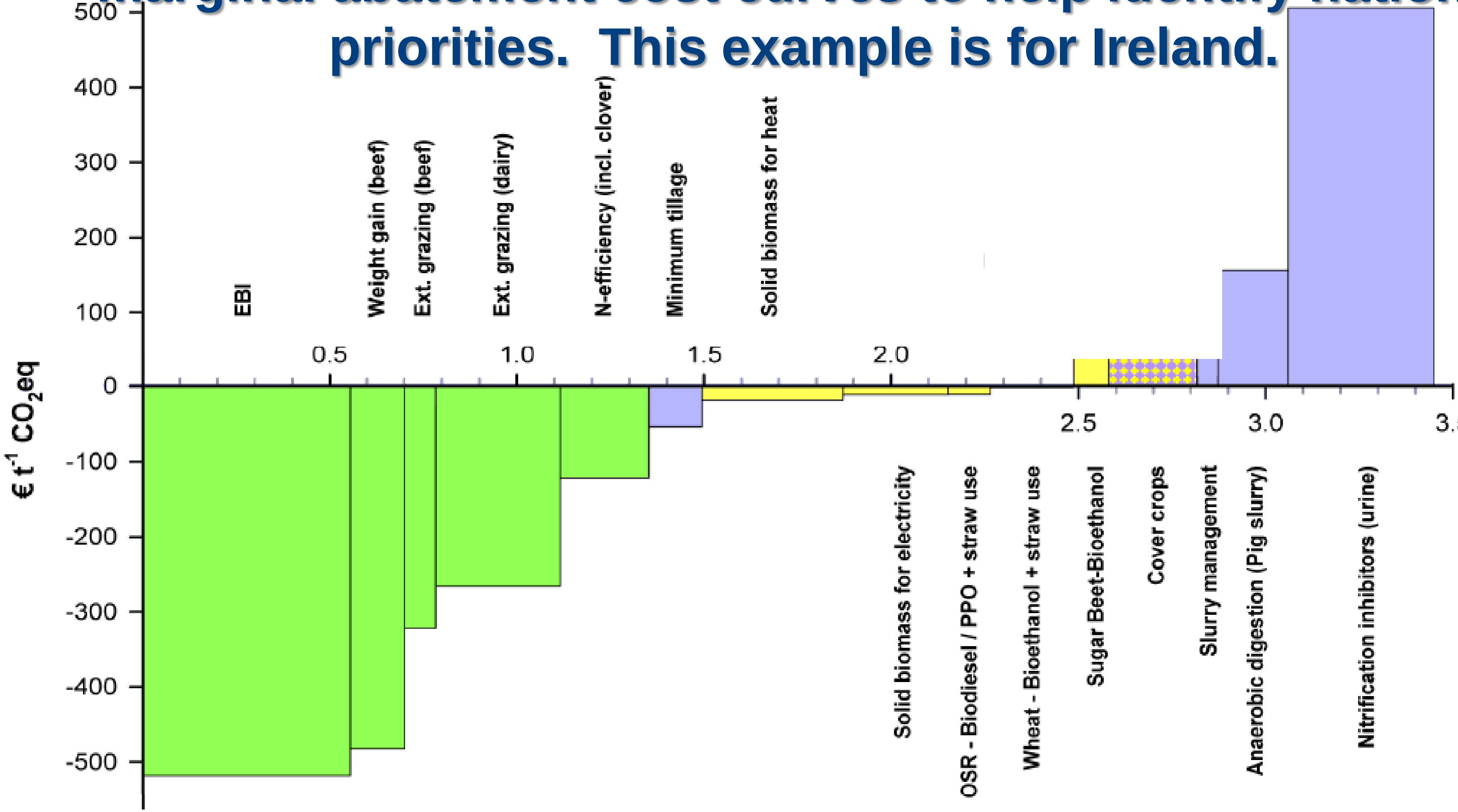
**Where the technology is mature, then historical market trends can be used to help project future market potential.**

**Example – Irrigation potential in India**




*Based on Chakrawal, 2010*

# 2d) Costs and potentials could be assessed using a marginal abatement cost curves to help identify national priorities. This example is for Ireland.




For agriculture, other issues are also critical, such as avoiding loss of productivity, more efficient water use, greater resilience to extreme events, support for rural communities, and sustainable development. So climate change mitigation may be seen as a “co-benefit”.

# *STEP 3: Identify other relevant issues of sustainability*

**The climate technology/system mitigation options which seemed economically promising from STEP 2 are now confronted within the specific local context relating to local natural and human resource constraints.**

## 3a) Sustainability issues and co-benefits based on the example from STEP 2 of *manure management*.

| Climate technologies and systems | Improved resilience to possible climate change impacts | Water implications | Energy implications | Land use implications | Achieving additional co-benefits |
|---|---|---|---|---|---|
| Conservation agriculture | Soil moisture retained from less cultivation. Possibility of double cropping. | Less irrigation needed since land cover provided by mulch. | Reduced tractor fuel for tillage operations. | Soil erosion constrained by continual land cover. | Time spent on tillage operations reduced. Less drudgery where manual cultivation techniques used. |
| Biogas from animals, crops, or food processing residues | | Some water needed for digester feedstock depending on manure type and moisture content. | Reduced dependence on imported fossil fuels. | | Nutrients recycled to the land through the sludge. Odours reduced. If biogas used for cooking, can reduce smoke from fuelwood giving improved health. |

## 3b) A full water/energy/food nexus analysis could be conducted if preferred but it would require considerable time inputs.

## *STEP 4: Address barriers hindering uptake.*

**This step is mainly about policy development. It is non-prescriptive and simply identifies broad policy areas.**

*[More details were given in the earlier presentation]*

**A pilot study to test the methodology is planned as the next phase of the study.**

**The aims will be to help:**

- **evaluate the method on a practical basis;**
- **assess the prioritization criteria for selection and deployment; and**
- **further identify gaps in available data.**

**Morocco will be the national case study for this pilot so, where possible, this country has been used to provide examples throughout the FAO report.**

# It is realised the proposed method could be a challenge to undertake in full by a country or funding agency.

- **A team of staff and/or consultants would need several months to engage with stakeholders, collect data, produce a cost abatement curve, etc.**
- **So where such a detailed approach is not acceptable for any reason, a less formal, more rapid “desk-top study” may be feasible.**
- **It would need to rely on a mix of existing indicators and available GHG emissions data; employ national data that already exists; and use existing literature to ascertain typical impacts of specific technologies where available.**
- **However, there could be a greater risk of poor policy development as a result of inadequate analysis.**
- **It may be that funding agencies may be less inclined to invest in a country that has not conducted a full analysis.**

# Mitigation is a challenge for the agri-fo sector but many opportunities exist:

- It is possible to decouple the agri-food supply cha from its current dependency on fossil fuels.
- Low-carbon technologies are available to reduce energy intensity at all steps along the value chain
- Renewable energy technologies can help improve energy access, food security, employment and resilience as well as reduce GHG emissions.
- Policy selection to increase market penetration of low-carbon technologies needs to account for all these co-benefits.
- Possible impacts of climate policies on water, lan use and productivity should be evaluated.
- Overall there is good potential to reduce agri-food GHG emissions - but we are running out of time…