Top-down strategies and tools to promote adaptation and resilient decision-making in agriculture
Brazilian agriculture

Brazilian agriculture is based on more than 300 species of crops and sends 350 types of products to the world, reaching around 200 countries.

- We went from importers to major exporters of agricultural products.
- The world's largest soybean producer and the third largest fruit producer.
- The world's largest exporter of soybeans, coffee, sugar, orange juice, sugarcane ethanol, beef and chicken.
Understanding the challenges
Risk of adverse meteorological events

Drought
Excessive rain
Frost
Heat
Hail

Losses in Proagro

- Excessive rain, 20%
- Frost, 19%
- Hail, 6%
- Drought, 50%
National Program for Agricultural Climate Risk Zoning (Zarc)

- What is Zarc?
- How is it generated?
- Police interface: how is it used on?
- 2020 to 2023 examples
- What’s next?
Agricultural Climate Risk Zoning (Zarc)

It is the delimitation of regions and planting times throughout the year, in classes of probability of adverse weather events (that cause severe yield losses);

Regions

Sowing or planting dates (10-day time step)

<table>
<thead>
<tr>
<th>Municipio</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>D7</th>
<th>D8</th>
<th>D9</th>
<th>D10</th>
<th>D11</th>
<th>D12</th>
<th>D13</th>
<th>D14</th>
<th>D15</th>
<th>D16</th>
<th>D17</th>
<th>D18</th>
<th>D19</th>
<th>D20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batalha</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Belém</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Belo Monte</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Boca da Mata</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Branquinha</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Cacimbinhas</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Cajuereiro</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Campestre</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

- **Risk 20% (01 – 20%)**
- **Risk 30% (21 – 30%)**
- **Risk 40% (31 – 40%)**
- **Risk >40% (risk not accepted by agricultural policy programs)**
Ecuador

Tropic of Capricorn

- 20%
- 30%
- 40%
- >40%
Zarc Results Depends on the crop species

Maize (Zea mays)

Forage Palm (Opuntia ficus-indica)

Macaúba (Acrocomia aculeata)
Zarc results depends on the crop species and production system

* Coffea arabica *(rainfed)*

* Coffea arabica *(irrigated)*
Results are strongly influenced by the soil’s ability to store water (Water deficit risks)
National Program for Agricultural Climate Risk Zoning (Zarc)

- What is Zarc?
- How is it generated?
- How is it used? Why is it important?
- 2020 to 2023 examples
- What’s next?
In Brazil: Two (2) Agricultural Policy Programs use Zarc guidelines as mandatories:

1) **PROAGRO** (since 1970’s)
Agricultural Activities Guarantee Program
It is a type of credit insurance program operated by the State

2) **PSR** (since 2006)
Subvention Program to Agricultural Insurance
It pays to farmers part of the costs to buy agricultural insurance from private companies. Incentive to develop private insurance sector for agriculture in Brazil.

![Loss index 1996-98:](chart)
National Program for Agricultural Climate Risk Zoning (Zarc)

- What is Zarc?

- How is it generated?

- How is it used? Why is it important?

- 2020 to 2023 examples

- What’s next?
1. Multidisciplinary knowledge and data base

Brazilian genotypes and production systems
Agronomic knowledge comes from:
1. Multidisciplinary knowledge and data base

Brazilian genotypes and production systems

2. Crop Modeling

ZARC
1. Multidisciplinary knowledge and data base

2. Crop Modeling

3. Data processing

Brazilian genotypes and production systems
1. Multidisciplinary knowledge and data base

2. Crop Modeling

3. Data processing

Brazilian genotypes and production systems
1. Multidisciplinary knowledge and data base

2. Crop Modeling

3. Data processing

Brazilian genotypes and production systems

4. Validation meetings

ZARC
National Program for Agricultural Climate Risk Zoning (Zarc)

• What is Zarc?
• How is it generated?
• How is it used? Why is it important?
• 2020 to 2023 examples
• What’s next?
New methodology for Zarc considering agronomic management levels

Aims: measure higher or lower risk level in farms in same soil and climatic conditions but with different agronomical practices; Encourage soil preservation and water resources, increase root depth, soil carbon and fertility... **reduce drought risk.**
Thank you!

Network Zarc - Embrapa:

Falbemi De Souza Costa
Idesio Luis Franke
Jackson Rondinelli Da S Negreiros
Carlos Ricardo Fietz
Danilton Luiz Flumignan
Éder Comunellos
Harley Nonato De Oliveira
Cornelio Alberto Zolin
Laurimar Gonçalves Vendrusculo
Jorge Lulu
Roberta Aparecida C Monteiro
Jose Renato Cortez Bezerra
Jose Rodrigues Pereira
Tais De Moraes Falleiro Suassuna
José Francisco Pereira
Luis Wagner Rodrigues Alves
Wardsson Lustrino Borges
Alailson Venceslau Santiago
Adriano Venturieri
Roní De Azevedo
Sandra Maria Neiva Sampaio
Alcindo Eleonor Wander
Alexandre Bryan Heinemann
Marcelo Goncalves Narciso
Silviano Carlos Da Silva
Roseline De Queiroz Chaves
Marlos Alves Bezerra
Fernando A. Macena Da Silva

Joao Luis Dalla Corte
Marco Antonio Da Cruz Borba
Marcelo Ayres Carvalho
Ana Claudia Barneche De Oliveira
Ivan Rodrigues De Almeida
Sergio Delmar Dos A. E Silva
Silvio Steinmetz
Jair Costa Nachtigal
Jose Mario Ferro Frazao
Antonio Carlos Reis De Freitas
Rosana Clara Victoria Higa
Sergio Gaiad
Adriano Franzoni Otavian
Alan massaru Nakai
Aryeverton Fortes De Oliveira
Daniel De Castro Victoria
Deise Rocha Martins Dos S Oliveira
Eduardo Monteiro
Giampaolo Queiroz Pellegrino
Gustavo Rodrigues
Jose Ruy Porto De Carvalho
Luis Gustavo Barioni
José Eduardo B. A. Monteiro
Renato José Santos Maciel
Santiago Vianna Cuadra
André Minitti
Cicero Lucena
Francisco Ferraz Laranjeira Barbosa

Mauricio Antonio Coelho Filho
Tiberio Antonio Coelho Filho
Aderson Santos Martins Da Silva
Aderson Soares Andrade Junior
Edson Bastos
Paulo Fernando de M. J. Vieira
Edvaldo Sagrilo
Francisco De Brito Melo
Celso Vainer Manzatto
Nilza Patricia Ramos
Rodrigo Mendes
Dartanha Jose Soares
Alexandre M. Abdão Dos Passos
Alexandre Ferreira Da Silva
Camilo De Lelis T. De Andrade
Daniel Pereira Guimaraes
Derli Prudente Santana
Ivenio Rubens De Oliveira
Miguel Marques Gontijo Neto
Rodrigo Veras Da Costa
Sidney Netto Parentoni
Balbino Antonio Evangelista
Eric Arthur Bastos Routledge
Francelino Peteno De Camargo
Jones Simon
José Ricardo Macedo Pezzopane
Alexandre Bermdt
Balbina Maria Araujo Soriano
Fernando Antonio Femandes

Admar Bezerra Alves
Lourenco De Souza Cruz
Aloisio Alcantara Vilarinho
Magna Soelmia Beserra De Moura
Elder Manoel De Moura Rocha
Flavio De Franca Souza
Thieres Silva
Jose Renato Boucas Farias
Sergio Luiz Goncalves
Ricardo Vilela Abdelnoor
Rubson Natal R. Sibaldelli
Divania de Lima
Alexandre Hugo Cezar Barros
Evaldo De Paiva Lima
Jose Carlos Polidoro
Antonio Dias Santiago
Elio Cesar Guzzo
Marcelo Ferreira Fernandes
Jose Carlos Santos
Ana A. Gama da Silva
Ana Christina Sagebin Albuquerque
Gilberto Rocca Da Cunha
Marcelo André Klein
Aldemir Pasinato
Marco Antônio F. Conceição
Maria Emilia Borges Alves