



MAHIZ

A Serious Board Game by Malena Orduna Alegria

RULEBOOK

Game definitions

- **Maize agriculture:** sustainable production of **Maize** (*Zea mays L.*) that depends on the correct application of production inputs that will sustain the environment as well as agricultural production.
- **Irrigation:** application of controlled amounts of water to plants at needed intervals.
- **Hybrid seed:** seed produced by cross-pollinated plants. Hybrids are chosen to improve the characteristics of the resulting plants, such as better yield, greater uniformity, improved color, and disease resistance.
- **Region's prominence:** the state of the region (all farmers) being important or noticeable based on their **Maize** production and environmental quality.
- **Precipitation:** water that falls from the clouds towards the ground and that can be taken by the plants to grow.
- **Evapotranspiration:** water lost from plants that determine their growth and yield rate.
- **Cooperation:** the act of working together with someone or doing what they ask you.
- **Communication:** to share information with others by speaking, writing, moving your body, or using other signals.
- **Yield:** in agriculture, crop yield (also known as "agricultural output") refers to both the measure of the yield of a crop per unit area of land cultivation, and the seed generation of the plant itself.
- **Flash flood:** a sudden and severe flood lasting for minutes and affecting the growth plant and land for longer period of time.
- **Deficit irrigation:** optimization strategy in which irrigation is applied during drought-sensitive growth stages of a crop. It aims at stabilizing yields and at obtaining maximum crop water productivity rather than maximum yields.

Game idea

Mahiz is a role-playing board game for **2-4 players**, designed to analyze the farmers' behaviors regarding climate change, policy implementations, and technological adaptations in **Maize** agriculture.



Playing time: 45 min + explanation.



Age: from 12 years.

Maize is one of humanity's greatest agronomic achievements. Today it is the most widely produced crop in the world. **Maize** originated in Mexico, which is home to a rich diversity of varieties that has evolved over thousands of years of domestication. The term "**Maize**" is derived from the ancient Taino word *mahiz* which means "**what nurtures life**".

Some of the 59 native Mexican **Maize** landraces



© CIMMYT Maize Germplasm Bank

As Popol Vuh, the Mayan creation story, goes, the creator gods made the first humans from white **Maize** hidden inside a mountain under an immovable rock. To access this **Maize** seed, a rain god split open the rock using a bolt of lightning in the form of an axe. This burned some of the **Maize**, creating the other three grain colors, yellow, black and red. The creator gods took the grain and ground it into dough and used it to produce humankind.

Game description

A small field, an initial farm budget, and basic conditions to grow **Maize**, is all the new farmers have at the start of the game. The implementation of irrigation and hybrid seed technologies offer farmers abundant possibilities to improve their farm production and the overall region's prominence. For the definition of terms used during the game – see *Game definitions* (page 2).

Different events happen during the game – see *Description of Event Cards* (page 11), which can influence the weather conditions, availability of resources as well as the policies of technology implementation.

In each of the 12 rounds, farmers can decide their management strategy by implementing technologies and expanding their land – see *Phases Description*, to adapt to the weather variability and the effects of the events. At the end of the game, the winner is the farmer who has established the best farm practices – see *Scoring* (page 11). Victory points are awarded for the number of full fields produced and **Profit** earned.



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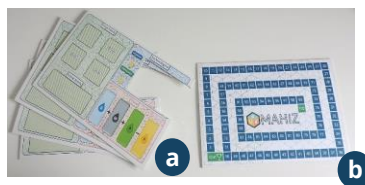
The farmers are encouraged to discuss and plan as a group each growing season to achieve the best regional production, but there can only one be winner.

The game is played competitively as well as cooperatively.

Components

Game boards:

- a. 4 individual boards.
- b. 1 scoring board.



Dice:

- c. Variability of the precipitation (**Rain**).
- d. Variability of the evapotranspiration (**Sun**).
- e. Variability of the market (**Price**) of **Maize**.



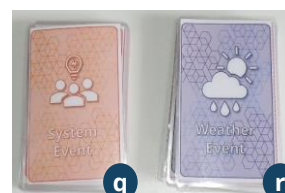
Pieces:

- f. 200 **Maize (Yield)** with bag.
- g. 13 field squares.
- h. 1 Starting player marker.
- i. 12 Farmer markers (3 in each color)
- j. 32 Blue drops (**Rain**)
- k. 32 Yellow drops (**Sun**)
- l. 20 Black drops (**Well**)
- m. 20 Green drops (**Plant**)
- n. Money bills.
- o. 5 squared transparent boxes
- p. 8 Victory Crowns



Cards:

- q. 18 System Event.
- r. 18 Weather Event.
- s. 4 Summary cards



Levels:

- t. 4 Initial levels: Irrigation.
- u. 4 Initial levels: Hybrid Seed.
- v. 4 Improved levels: Technological Advance.
- w. 4 Improved levels: Biological Advance.
- x. 4 Improved levels: Deficit Irrigation



Setup

- 1. The starting player marker is assigned to the person who has eaten corn or bought a product made out of corn most recently – see *Some of the many uses of corn* (page 15) for more inspiration. The starting player marker is automatically passed on to the farmer to the left (clockwise order) at the end of each round.
- 2. Each farmer chooses a color and takes the individual board, the corresponding token markers, a field token and the initial level of technologies. Each farmer gets \$100,000 in money bills.
- 3. The farmer marker is placed on the scoring section. The initial levels are place in each individual board with the levels side turned down, the technological markers are placed under to the initial cost of each technology and a field token is placed on the first field space on the individual board.
- 4. The initial level of resources, meaning the number of drops in each box, is set up the following way:



Example of a 4 players game

Number of Players	Rain Drops
2	12
3	18
4	24

Number of Players	Sun Drops
2	12
3	18
4	24

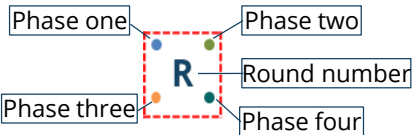
Number of Players	Well Drops
2	5
3	9
4	13

Number of Players	Plant Drops
2	10
3	15
4	20



Distribution of resources. It is advisable to place the compartments as is show in the image.

- 5. 4. Sort the event cards first according to the color (purple for **Weather Events**, orange for **System Events**) and second according to the game variation that is been played. Mahiz can be played in two different variations:
 - I. **Data collection**: The Weather and System Events cards with the round and phase marker are selected and the rest are discarded. Then each deck is ordered by ascending number and place where all player can see them.



- II. **Collective Learning**: Each deck is shuffled and place where all player can see them.

Play of the game

The game consists of 12 rounds. Each round follows the same pattern and consists of **three phases**, which are followed by a **fourth phase** only after rounds 4, 8 and 12.

At the beginning of each round, turn over the top card of the Weather and System Event decks. The effect of the card applies to all farmers and it modifies the starting level of the **Well** for one turn only.

Phases Description

● Phase 1: Investment phase

In order to use the technologies, each player needs to make the decision about investing in the implementation of each technology which can only be done at the beginning of each round. To unlock (turn around) these technologies, each player needs to pay the initial installation costs.

- **Irrigation**: initial costs = \$15,000
- **Hybrid seeds**: initial costs = \$25,000



Technologies' Initial level

Additionally, each player can expand their farm by buying new extra fields with a cost of \$20,000 for each. There is only a limited number of fields available, therefore farmers need to manage their budget carefully.



Investment phase example:

In the first round the red farmer decides to install irrigation technology and pays \$15,000, the blue farmer decides to install hybrid seed technology and pays \$25,000, the green farmer decides to install both technologies and pays \$40,000 and the yellow farmer decides to not install any technologies.

The investment phase occurs only at the beginning of each round.

● Phase 2: Planting phase:

The farmer with the starting player marker rolls the **Rain dice** and every farmer takes the number of **Rain drops** considering the restrictions from the events and sets them on the **Rain delimited area** in their individual board.

Then each farmer in clockwise order decides whether to implement the technologies previously acquired in investment phase:

- When irrigation technology is applied, the irrigation marker is set to the desired level then the farmer pays the cost of operation accordingly and grabs the **Well drops** and sets them on the **Well delimited area** in their individual board. If the **Well** runs out of drops, then irrigation cannot be applied anymore. If there is one cube, then the farmer must still pay the minimum cost of operation.



If the well levels reaches zero due to the use of irrigation, the well loses 1 drop for the rest of the game.

- When hybrid seed technology is applied, the hybrid seed marker is set to the level desired then farmer pays accordingly the cost of operation and grabs the **Plant drops** and sets them on the **Plant delimited area** in their individual board.

Planting phase example:

The results of the rolling of the **Rain dice** is 2, therefore all farmers grab two **Rain drops** and sets them in the first compartment in their individual boards. The red farmer decides to implement level 1 of the irrigation technology and pays \$10,000, then the red farmer grabs 3 **Well drops** and sets them in the second compartment. The blue farmer decides to implement level 1 of the hybrid seed technology and pays \$15,000, then the blue farmer grabs 2 **Plant drops** and sets them in the third compartment. The green farmer decides to implement level 1 of both of the technologies and pays \$25,000, then the green farmer grabs 3 **Well drops** and sets them in the second compartment and 2 **Plant drops** and sets them in the third compartment. The yellow farmer cannot implement any technologies because they weren't bought in the previous phase.



● Phase 3: Harvest Phase:

The farmer with the starting player marker rolls the **Sun dice** and every player takes the number of **Sun drops** considering the restrictions from the events and sets them on the **Sun delimited area** in their individual board. If hybrid seed technology was applied, then the effect of the level applied in the **Sun** is activated, the farmer grabs the reduced number of **Sun drops**.



Harvest phase example:

The results of the rolling of the **Sun dice** is 4, therefore the red and yellow farmer grab 4 **Sun drops** and the blue and green farmers, because they implemented hybrid seed technology, only grab 2 **Sun drops**.

Yield calculation

Each farmer calculates the amount of **Yield** obtained in the round based on the number of drops that each farmer has in their individual board:

$$[\text{Rain drops} + \text{Well drops} + \text{Plant drops}] - \text{Sun drops} = \text{Maize Produced (Yield)}$$

Each player grabs the amount produced of **Maize** and sets them in the field(s) in the individual board. Each field can hold only 9 **Maize**, if there is not enough space in the available field then the remaining **Maize** is set in the extra seed compartment in the individual board.

Yield calculation example:

Based on the drops in the farmers compartment. This growing season the red farmer produced 1 **Maize**, the blue farmer produced 2 **Maize**, the green farmer produced 5 **Maize** and the yellow farmer produced 0 **Maize**. When a farmer produced negative **Yield** then this farmer has to reduce the existing **Maize** from previous rounds.

Extra Seeds

When there is **Maize** in the extra seed compartment in the individual board, the farmer must wait for the next investment phase and buy a new field, then the player can pay \$1,000 for 3 **Maize** to grow these extra seeds in the fields.



Extra seed example:

In the next round the yellow farmer got 2 more **Maize**, achieving a total **Yield** of 2 **Maize**, the red farmer got 4 more **Maize**, achieving a total **Yield** of 5 **Maize**, the blue farmer got 4 more **Maize**, achieving a total **Yield** of 6 **Maize**, the green farmer got 6 more **Maize**, achieving a total **Yield** of 11 **Maize** because the green farmer doesn't have an extra field then the 2 extra **Maize** must go to the extra seed compartment.

● **Phase 4: Selling phase:**

Only at the end of round 4, 8, 12.

The farmers decide who rolls the **Price dice** and the farmers calculate their **Profit** based on the total region production.

1. The total **Yield** from the region is calculated by adding the **Yield** from all farmers. The regional production is classified by the following criteria:

Number of players	Classification of Production		
	Poor	Optimal	Excessive
2	4 or less	5-21	22 or more
3	7 or less	8-32	33 or more
4	11 or less	11-43	44 or more

2. Based on the **Price dice** result, the **Profit** is calculated by multiplying the number of **Maize** in the field(s). Each farmer can choose how many **Maize** to sell. **Maize** in the extra seed compartment cannot be sold.

Dice Result	Maize Price based on the Production		
	Poor	Optimal	Excessive
0	\$3,000	\$6,000	\$2,000
1	\$5,000	\$8,000	\$4,000
2	\$7,000	\$10,000	\$6,000
3	\$9,000	\$12,000	\$8,000

After all farmers obtained their **Profit**, the victory points are calculated.

Selling phase example:

*Based on the last example, the total regional production is 24 **Maize** which is in the Optimal classification. The **Price dice** result is 2, therefore the red farmer made a **Profit** of \$50,000, the blue farmer made a **Profit** of \$60,000, the green farmer made a **Profit** of \$90,000 and the yellow farmer made a **Profit** of \$20,000. The **Maize** located in the extra seed compartment cannot be sold. For the next four rounds the farmers now have what they have the money not spent from the budget saved and the **Profit** they made to keep or change their farm strategies.*

Scoring

Each farmer will move their farmers' marker in the scoring board accordingly to the victory points obtained. Victory points are awarded depending on the **Yield** and the **Profit**:

- Each **fully produced field** (e.g. 9 **Maize**) gives 10 victory points.
- The **Profit** made in the selling phase divided by \$10,000

The victory crowns are earned when a farmer achieves more than 100 victory points so that the counting can be continued in the scoring board.

Scoring example:

*Based on the **Profit** and production in the previous examples the red farmer gets 5 victory points, the blue farmer gets 6 victory points and the yellow farmer gets 2 victory points, while the green farmer earned a total of 19 victory points, 10 for the full field and 9 for the **Profit**.*

End of the game

The game ends after 12 rounds. There is a selling phase at the end of the 12th round, which is followed by the last scoring. The farmer with the most victory points is the winner. In case of a tie, the farmer with most money wins. In case of a further tie, the farmers share the win. In case of bankruptcy, the farmer can negotiate a loan with the other farmers or end the game.

Description of Event Cards

All events are up for discussion and cooperation. Mutual advice and collective planning is encouraged.

Weather Events

- **Drought!:** the **Rain dice** results of this round is educed by 3 drops.
Well level variation: remove 2 drops at the beginning of the round.
- **Flash Flood!:** if the **Rain dice** result of this round is 4 or more then the **Yield** is reduced by:

Rain	Yield
4	-1
5	-2
6	-3

- Well level variation:** add 2 drops at the beginning of the round.
- **Hot and Early Spring!:** the **Sun dice** result will be incremented by 2 drops.
Well level variation: remove 2 drops at the beginning of the round.
 - **Cold and Late Winter!:** the **Yield** of each farmer is reduced by 2.
Well level variation: add 2 drops at the beginning of the round.
 - **No change:** no weather effects, only basic conditions based on the dice.

System Events

- **Technological Advance!:** there is an improvement available for the irrigation technologies, the farmers can buy this advance for \$15,000 and get new levels of irrigation technologies that will stay for the rest of the game:



Well level variation: add 2 drops at the beginning of the round.

- **Biological Advance!** : there is an improvement available for the hybrid seed technologies, the farmers can buy this advance for \$20,000 and get new levels of hybrid seed technologies that will stay for the rest of the game:



Well level variation: add 2 drops at the beginning of the round.

- **Environmental Policy!:** for this round only the technologies have an increased costs by +\$1,000.

Well level variation: remove 2 drops at the beginning of the round.

- **Groundwater Policy!:** if the **Rain dice** result is less than 4, the farmers who have irrigation technologies installed decide to not use them in this round and earn \$3,000 instantaneously. If the level of the **Well** is less than 2 then the farmers who used irrigation technologies have to pay a fine of \$7,000.

Well level variation: remove 2 drops at the beginning of the round.

- **Organic products demand!:** the demand for regional non-genetically modified has increased , the farmers who have hybrid seed technologies installed decide to not use them in this round and earn \$7,000 instantaneously.

Well level variation: add 2 drops at the beginning of the round.

- **Market equalizer!:** In the next selling phase, the farmers are ordered by production. The farmer with the most **Yield** can give 3 **Maize** to the farmer with the least **Yield** and money to secure a **Price dice** result of 2. For the rest of the farmers, the **Price** is set by rolling the **Price dice**.

Well level variation: no change.

- **Deficit irrigation!:** New type of irrigation technology is available. The farmers can buy this advance for \$15,000 and get new levels of irrigation technologies that will stay for the rest of the game:



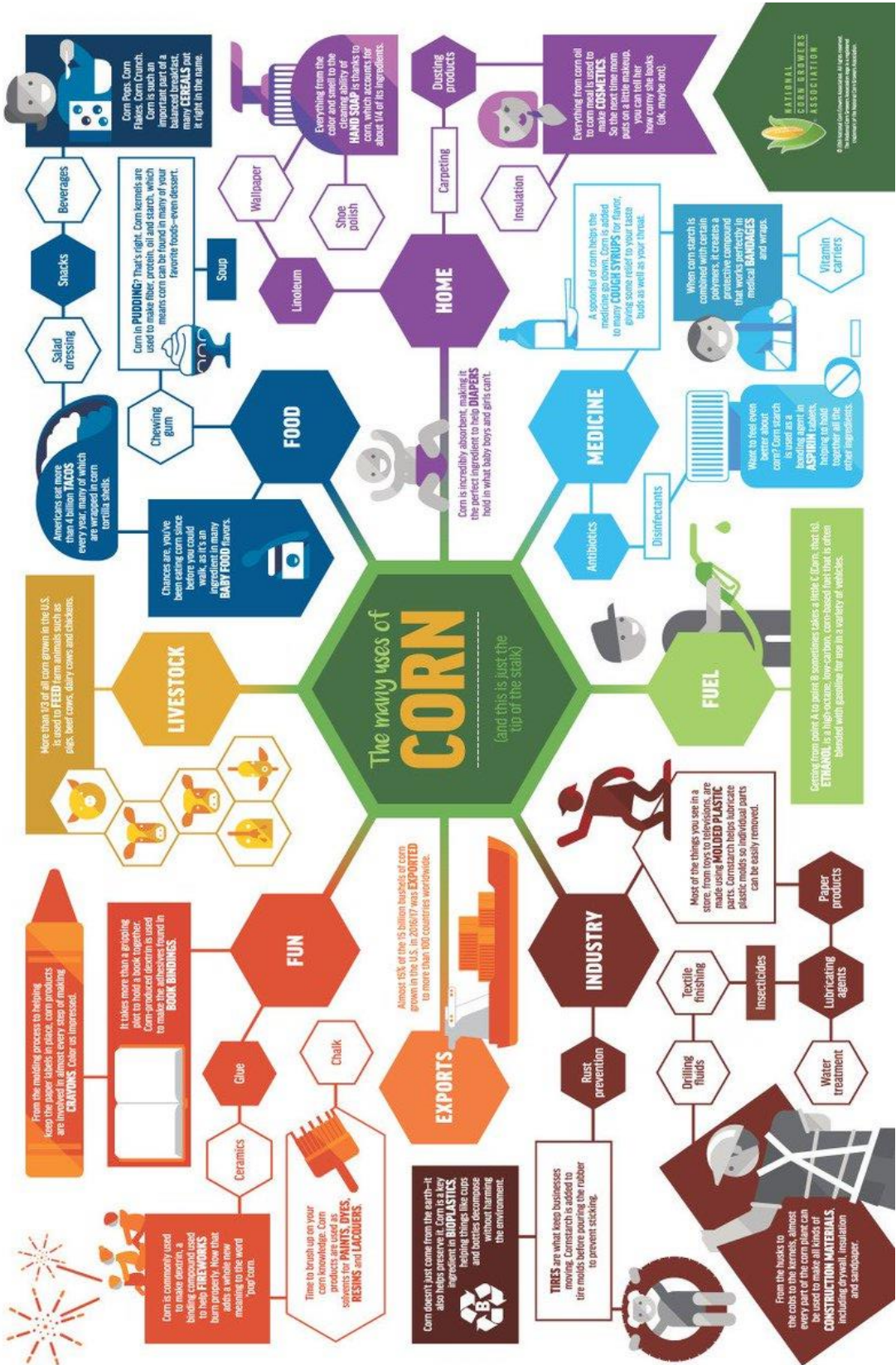
Well level variation: add 2 drops at the beginning of the round.

- **No change:** no system effects, only basic conditions based on the dice.

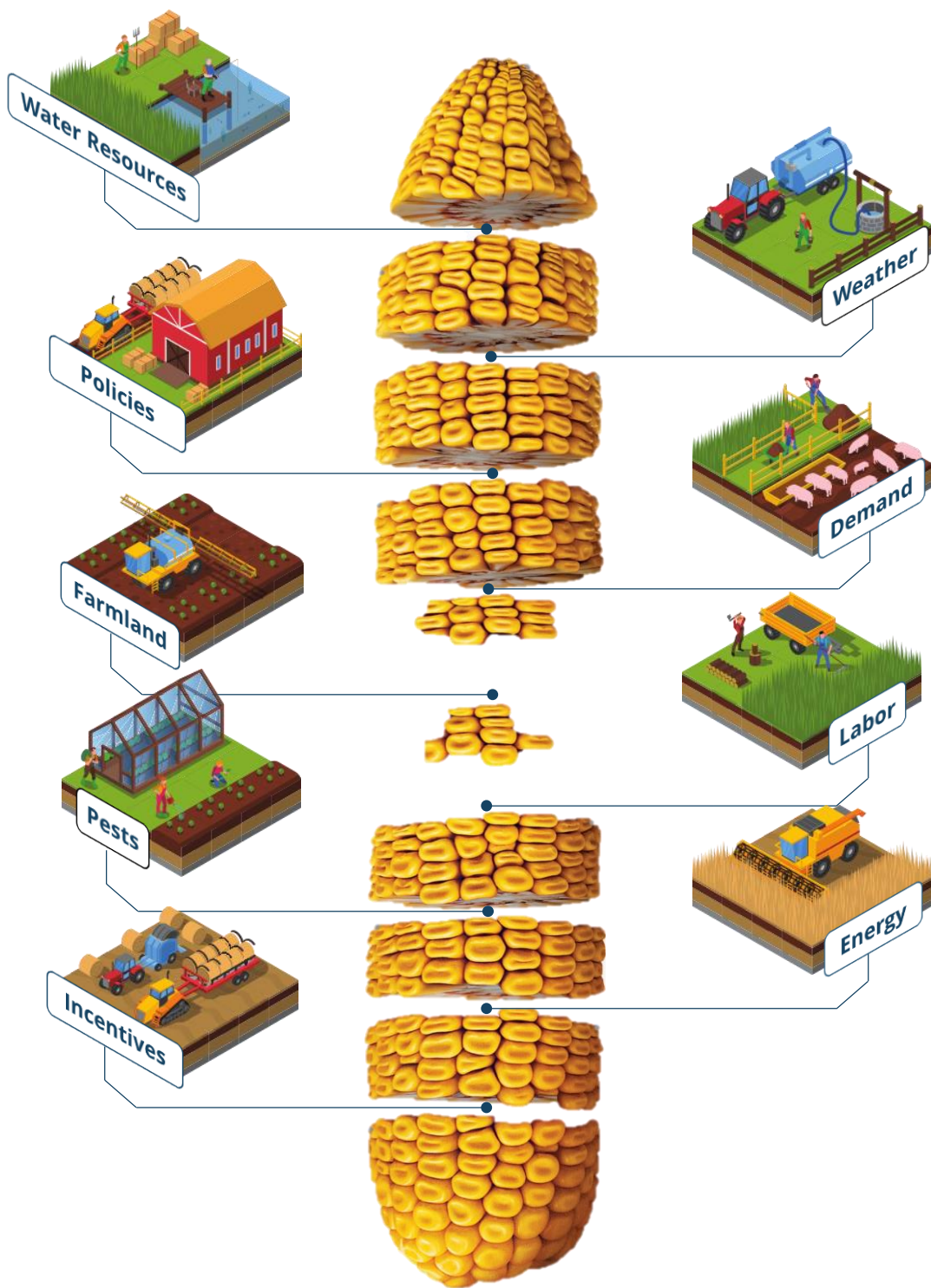
Penalties and Loans

- **No production penalty:** In case a farmer doesn't produces any corn in the round, the farmer must play \$2,000.
- **Bank Loan:** Farmers at any time can ask for money from the bank. The interest rate is a fixed one of 7% for each round.

Some of the many uses of Corn



Factors behind agricultural decision making.



Rulebook authors: Malena Orduña Alegría and Franziska Finster.