

Save the Water – a Groundwater Management Game

Livio Lunin, Rene Bauer ZHdK

Li Yu, Wolfgang Kinzelbach ETH Zurich

Haijing Wang hydrosolutions

He Pan SWUE

Game Inspired by Situation at Pilot Site in North China Plain: Guantao County

- Guantao population: 346'000
- 2/3 of county area used for agriculture
- Precipitation: 525 mm/year, 70% falls June to September
- Groundwater level decline:
 - ~75 cm/year for shallow aquifer
 - ~100 cm/year for deep aquifer
- Agricultural production not sustainable
 - Decline of groundwater levels caused by double cropping practice
 - Locally high salinity of groundwater
- Increase in supply and/or decrease in demand of water is necessary
- Limitation of pumping plus change of cropping system and their enforcement are required
- Conflict with grain self-sufficiency



The goal

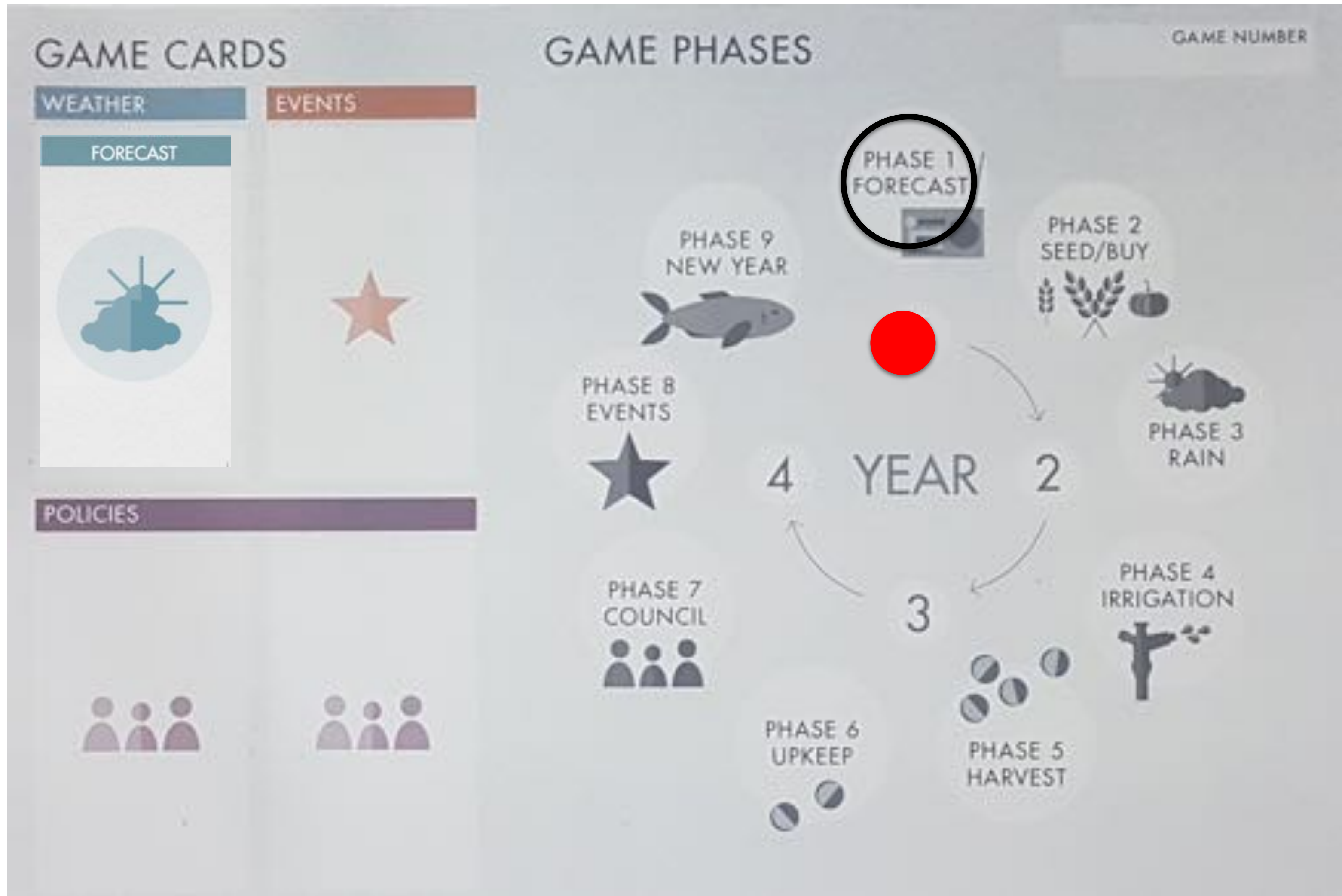
- Each player plays a Chinese farmer, who struggles with the contradiction between groundwater depletion and profitable cropping.
- The game is guided by a game master.
- The collective goal of all the players is to preserve a groundwater reserve
- The individual goal of each player is to have more points than the other players.
- The game ends after 4 rounds (of 1 year each).
- If the last water unit is removed from the groundwater all players lose the game.
- Players can borrow money from each other at terms to be defined by themselves.
- A player leaves the game if he/she cannot pay the demanded costs i.e. he/she does not find a player who lends him/her money.

Character Card



- Each player has a character card.
- It records whether one has bought a big pump (allows to take 3 drops per irrigation time), insurance (good against 4 cases of damage) or a water tank, which fills in normal years (1 drop) and water rich years (2 drops)

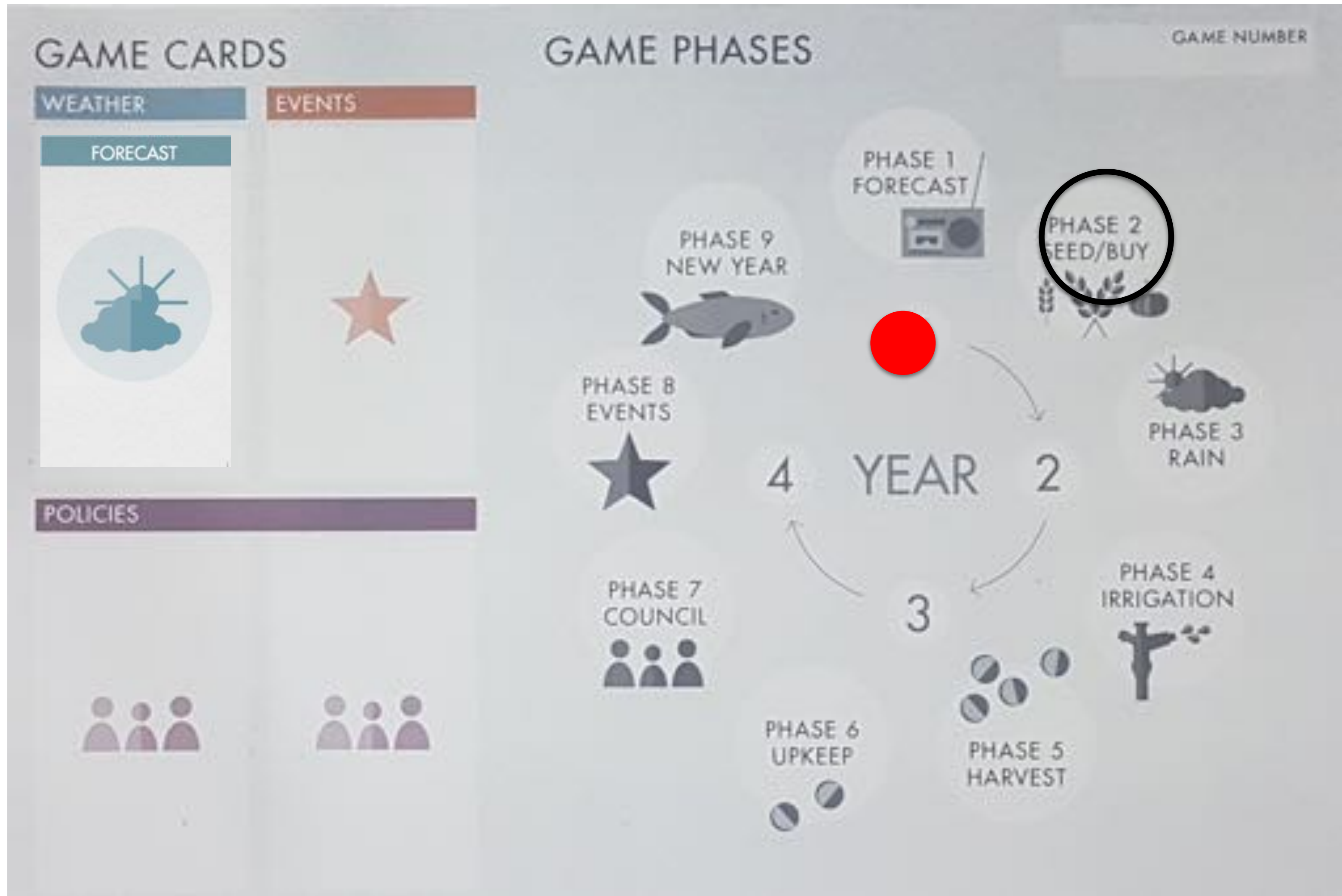
Gameboard 1



The game simulates 4 years

Each year is represented by 8 phases

Gameboard 1

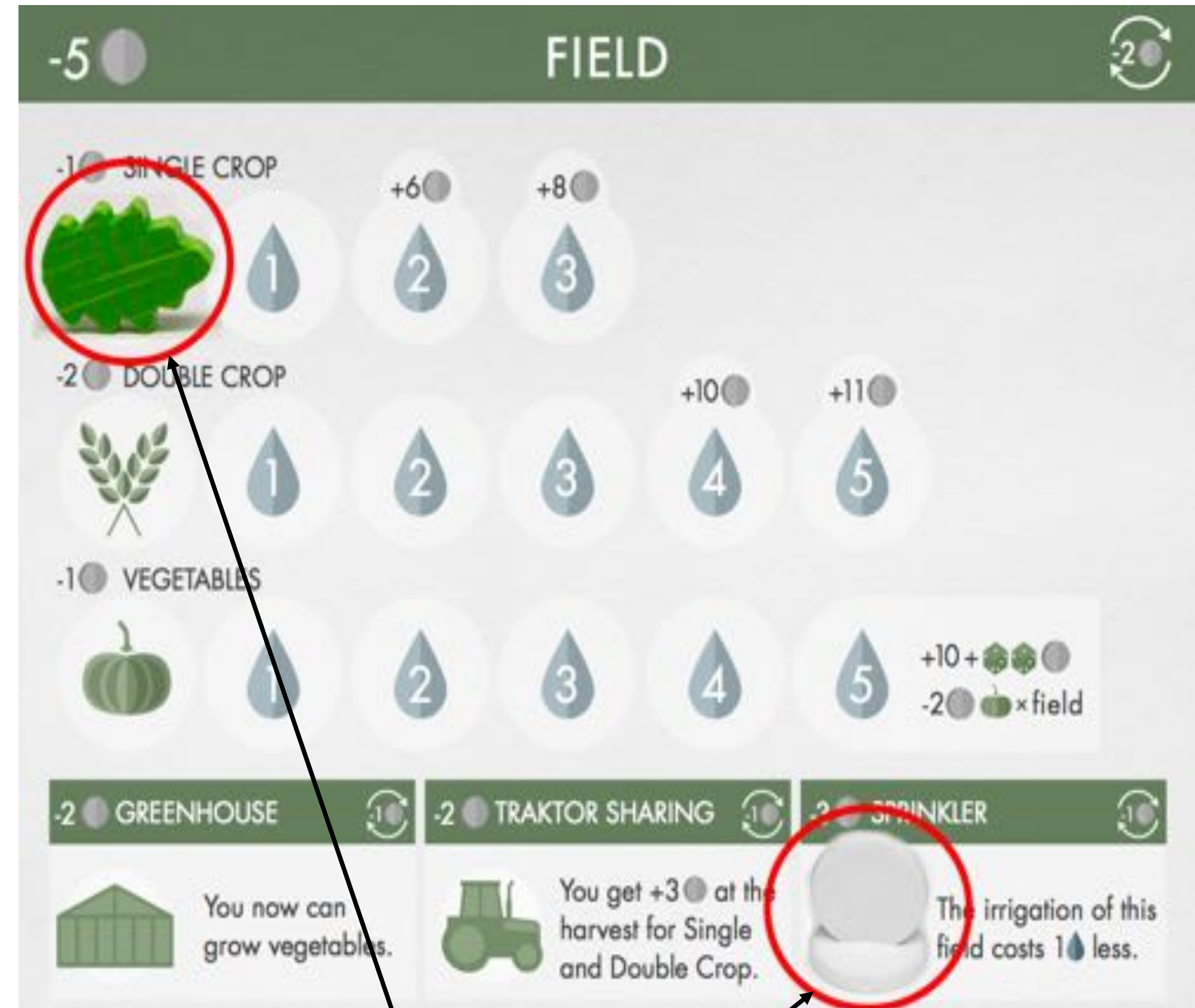


The game simulates 4 years

Each year is represented by 8 phases

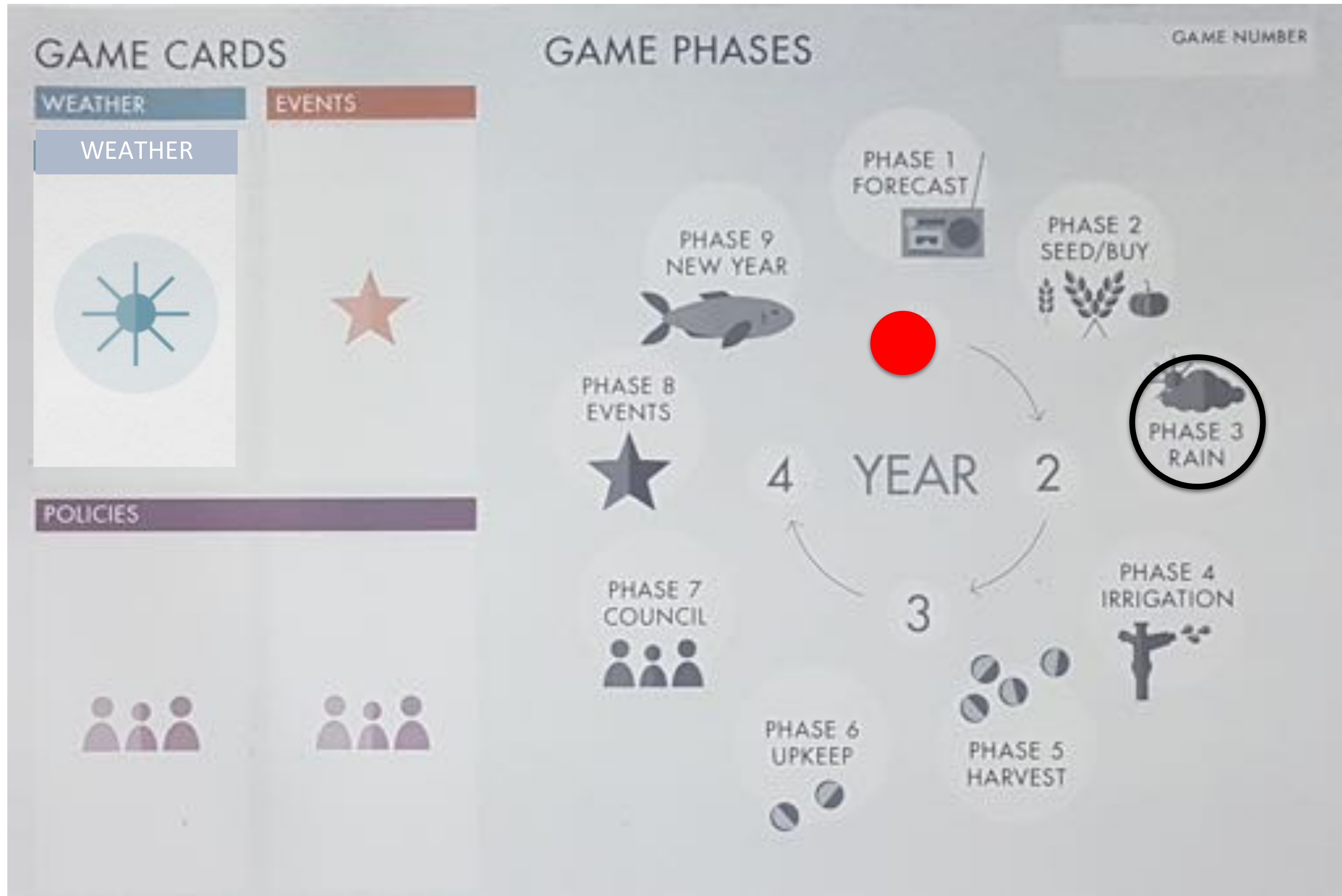
Field Card

- Each player initially has 1 field and 8 coins
- Options for planting are single crop, double cropping and vegetables grown in green houses
- The water requirements and cost of seeds are shown on the field card
- A field costs 5 units
- Vegetables can only be grown if a greenhouse is bought beforehand.
- Other devices which can be bought are a share in a tractor and water saving equipment.



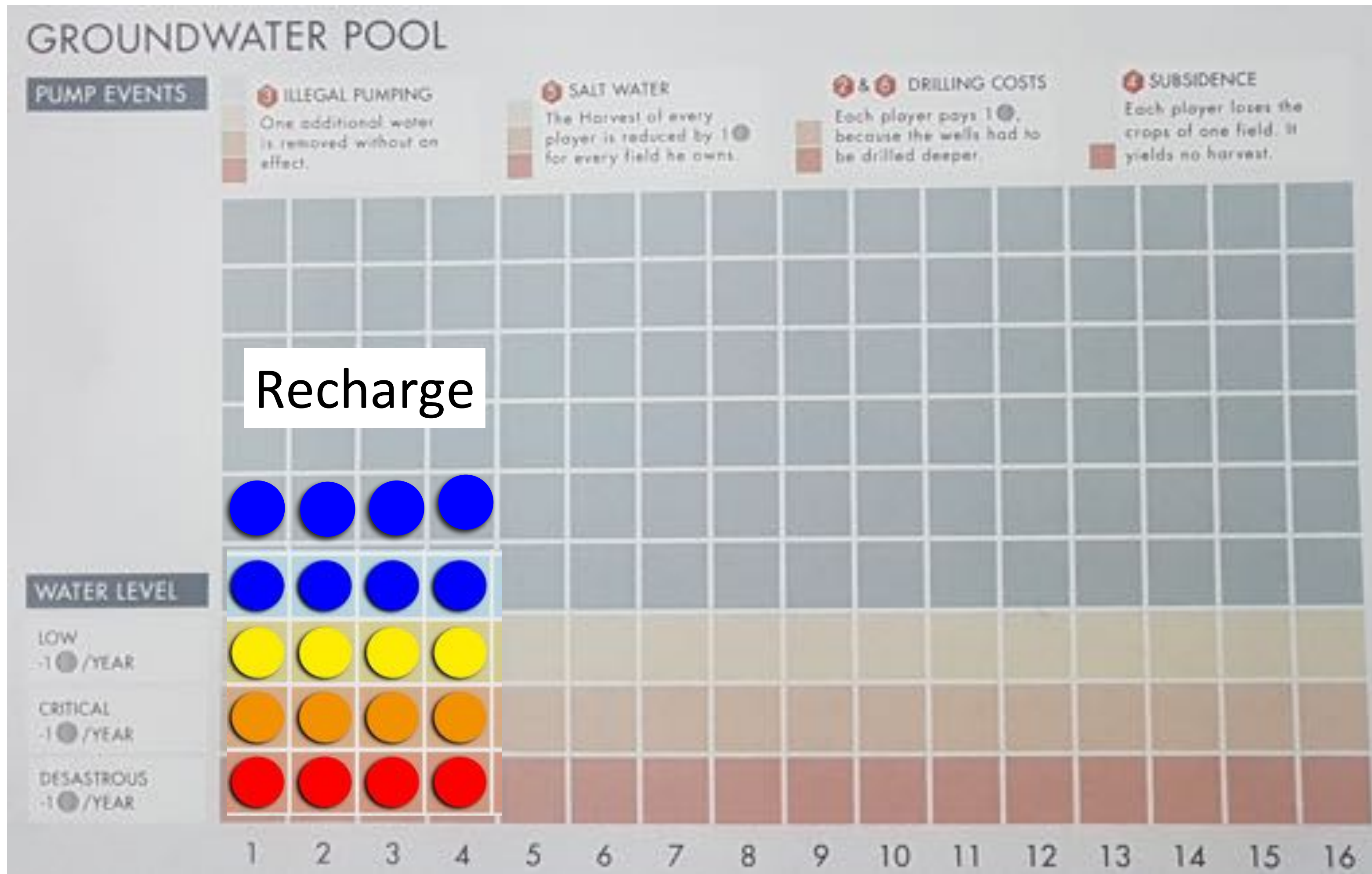
Tokens put on card

Gameboard 1

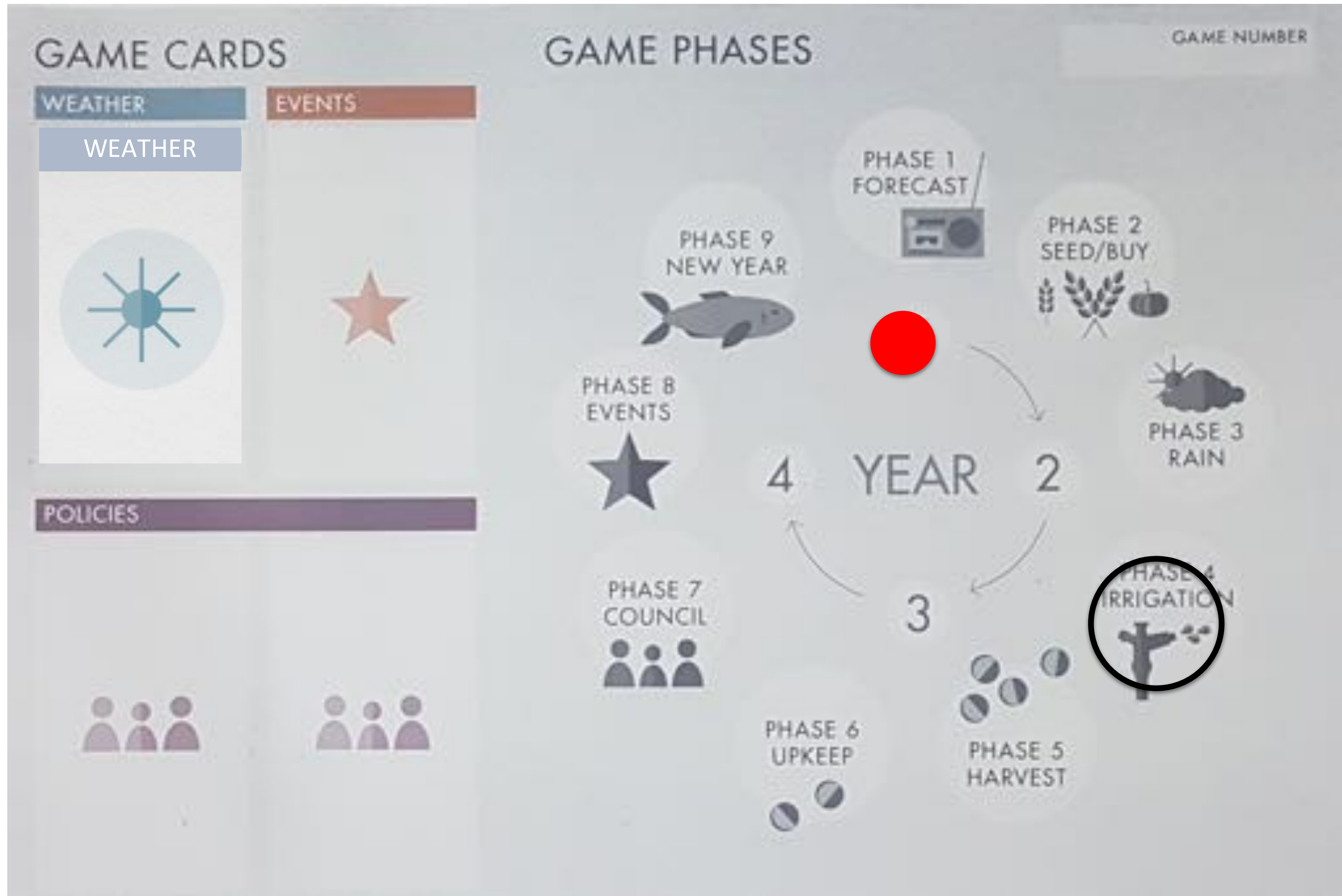


Gameboard 2

Initial status: 4 players with 1 field each

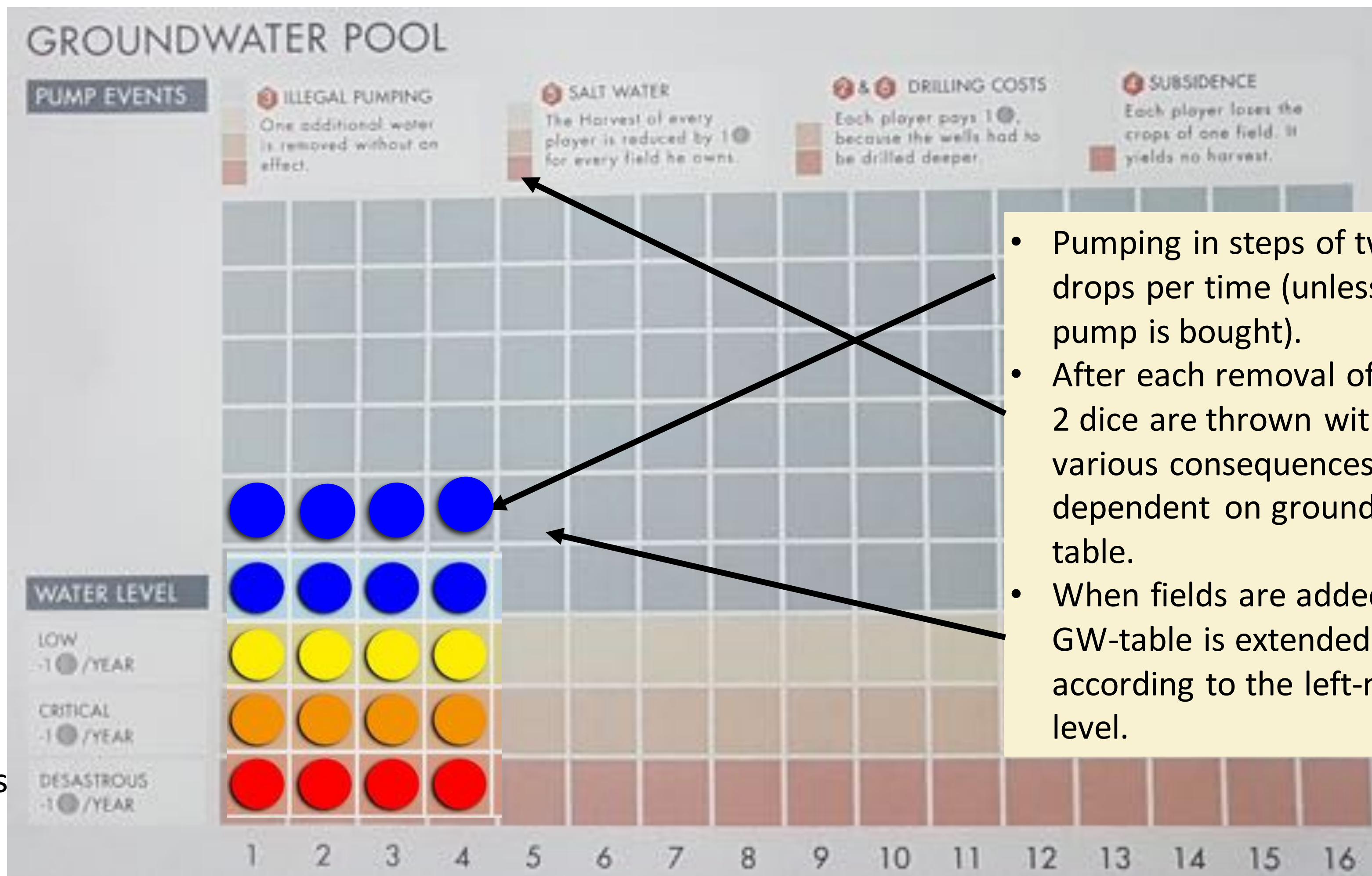


Gameboard 1



Gameboard 2

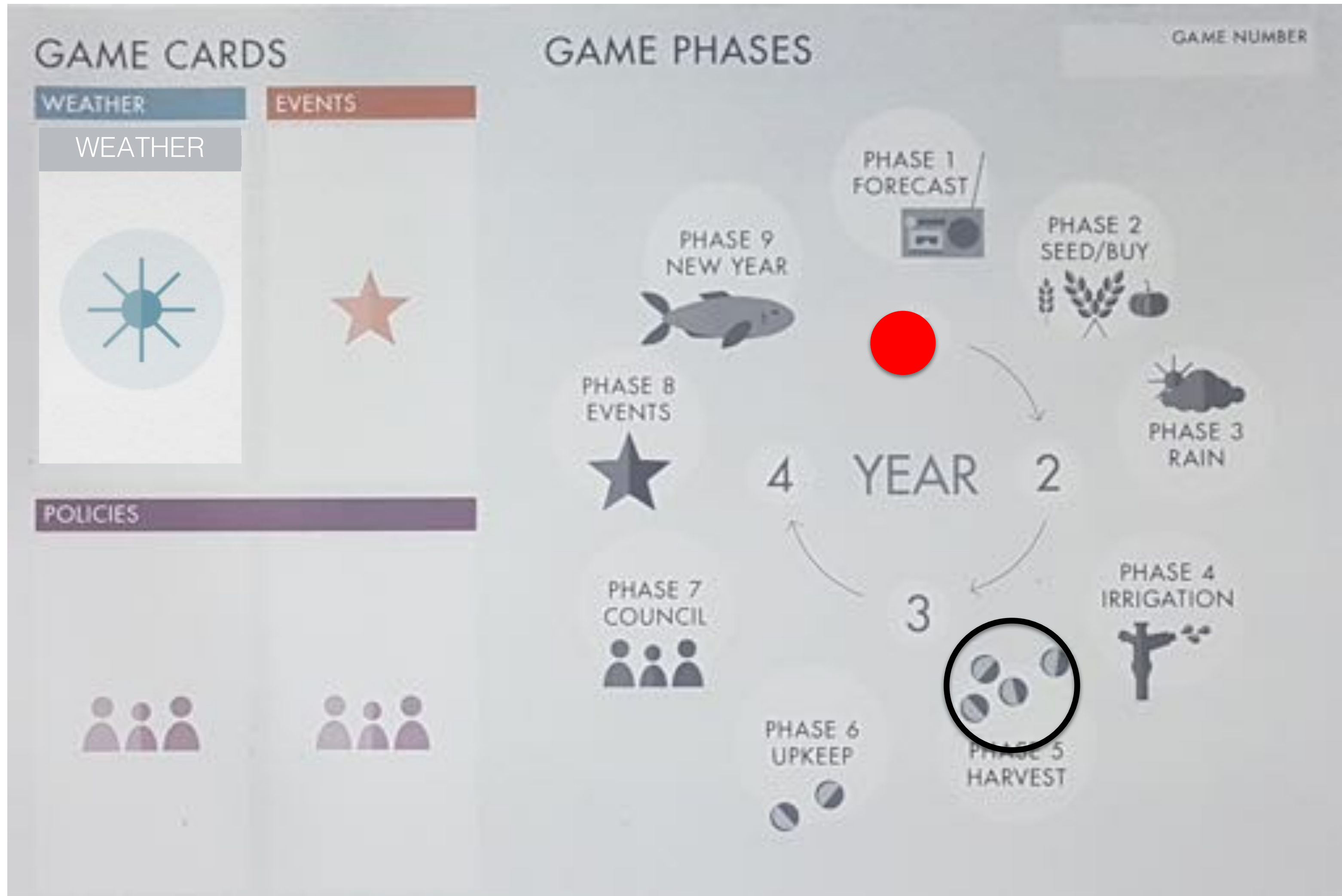
Initial status: 4 players with 1 field each



Deeper layers cause higher pumping costs

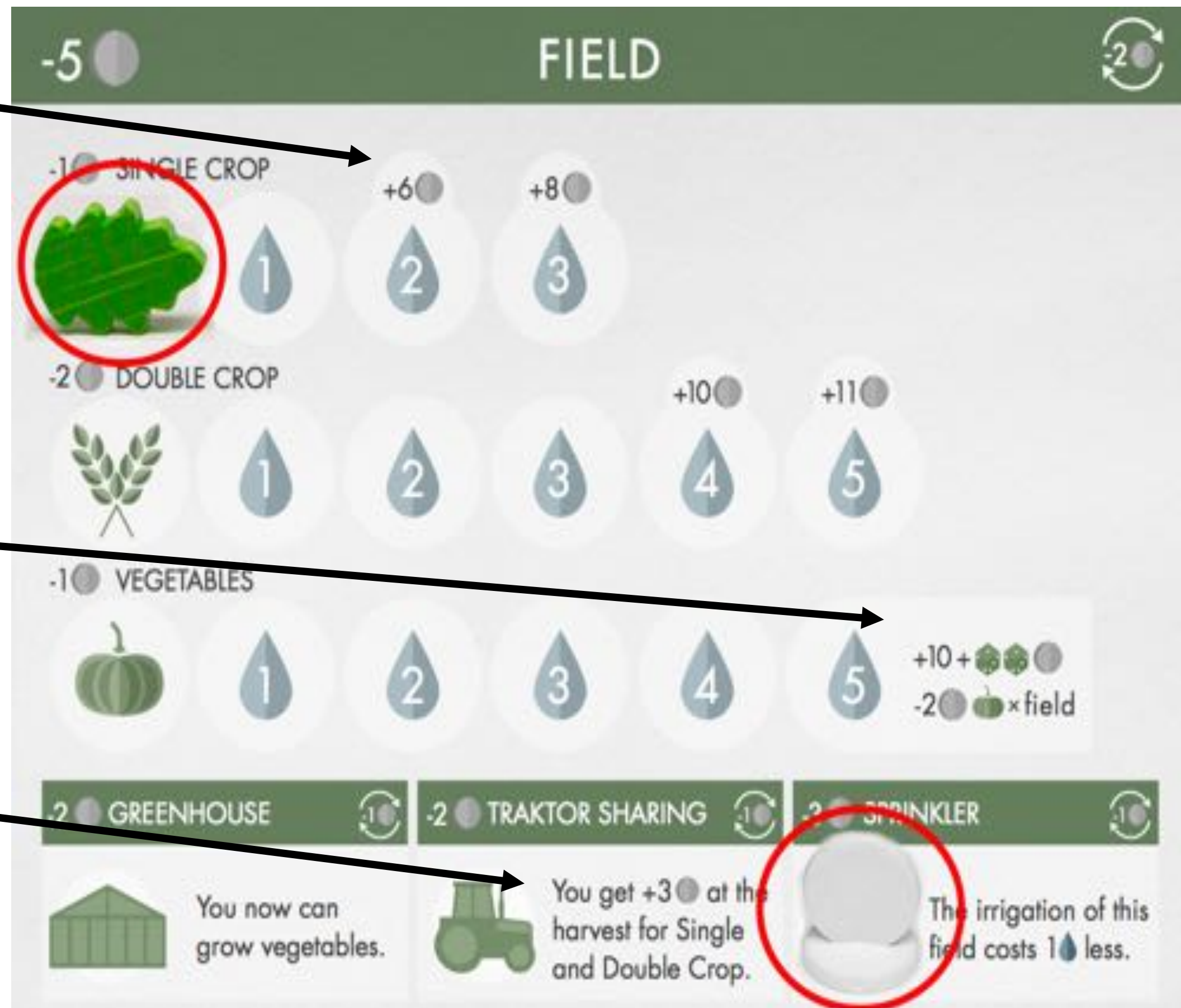
- Pumping in steps of two drops per time (unless big pump is bought).
- After each removal of drops 2 dice are thrown with various consequences dependent on groundwater table.
- When fields are added, the GW-table is extended according to the left-most level.

Gameboard 1

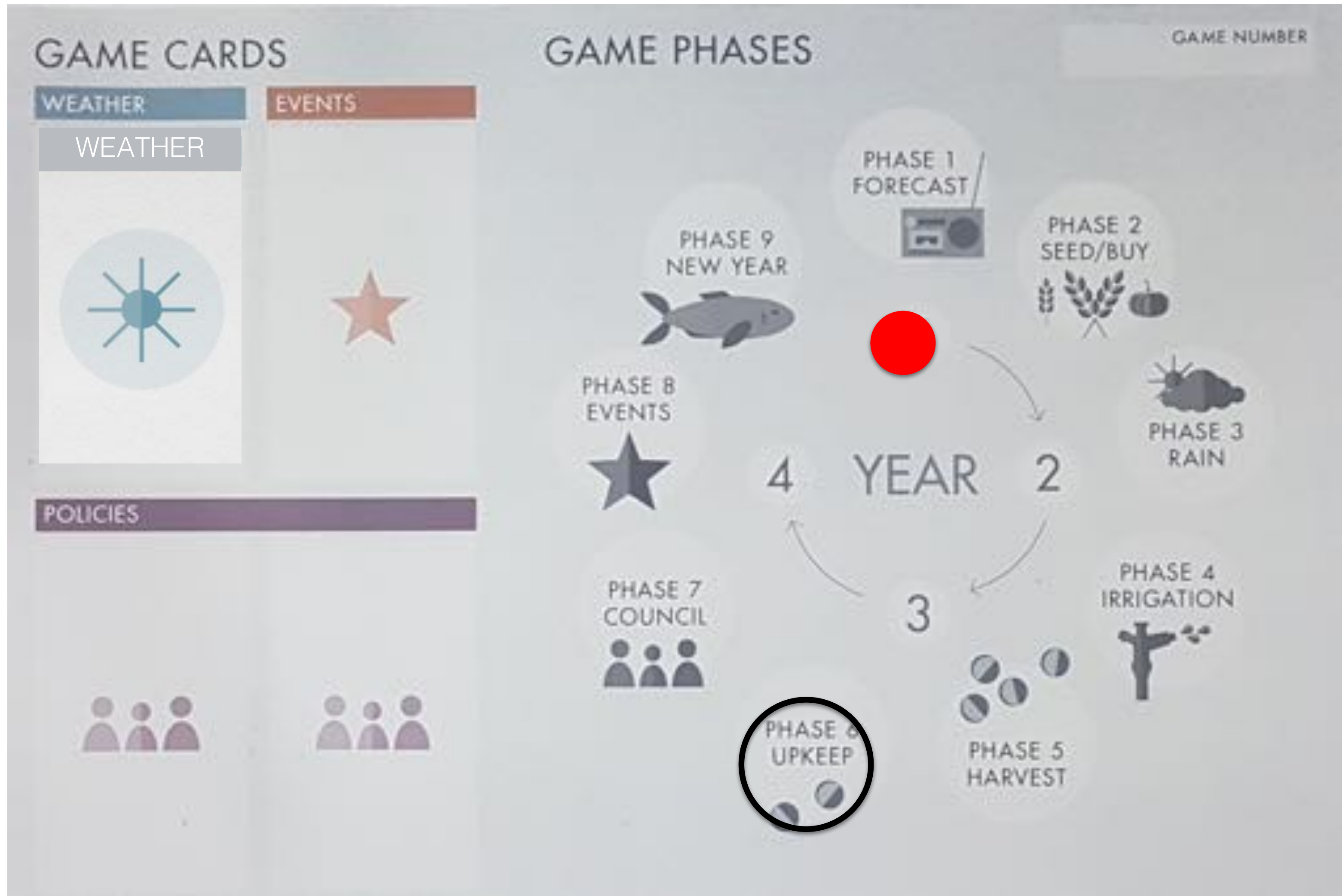


Field Card

- At harvest farmers are payed according to figures given on the field card
- The price for vegetables is exposed to market fluctuations and income is strongly reduced if more than 1 player plants vegetables
- A tractor increases income from a field in single and double cropping



Gameboard 1



Field Card

Up-keep is paid according to figures in the field card

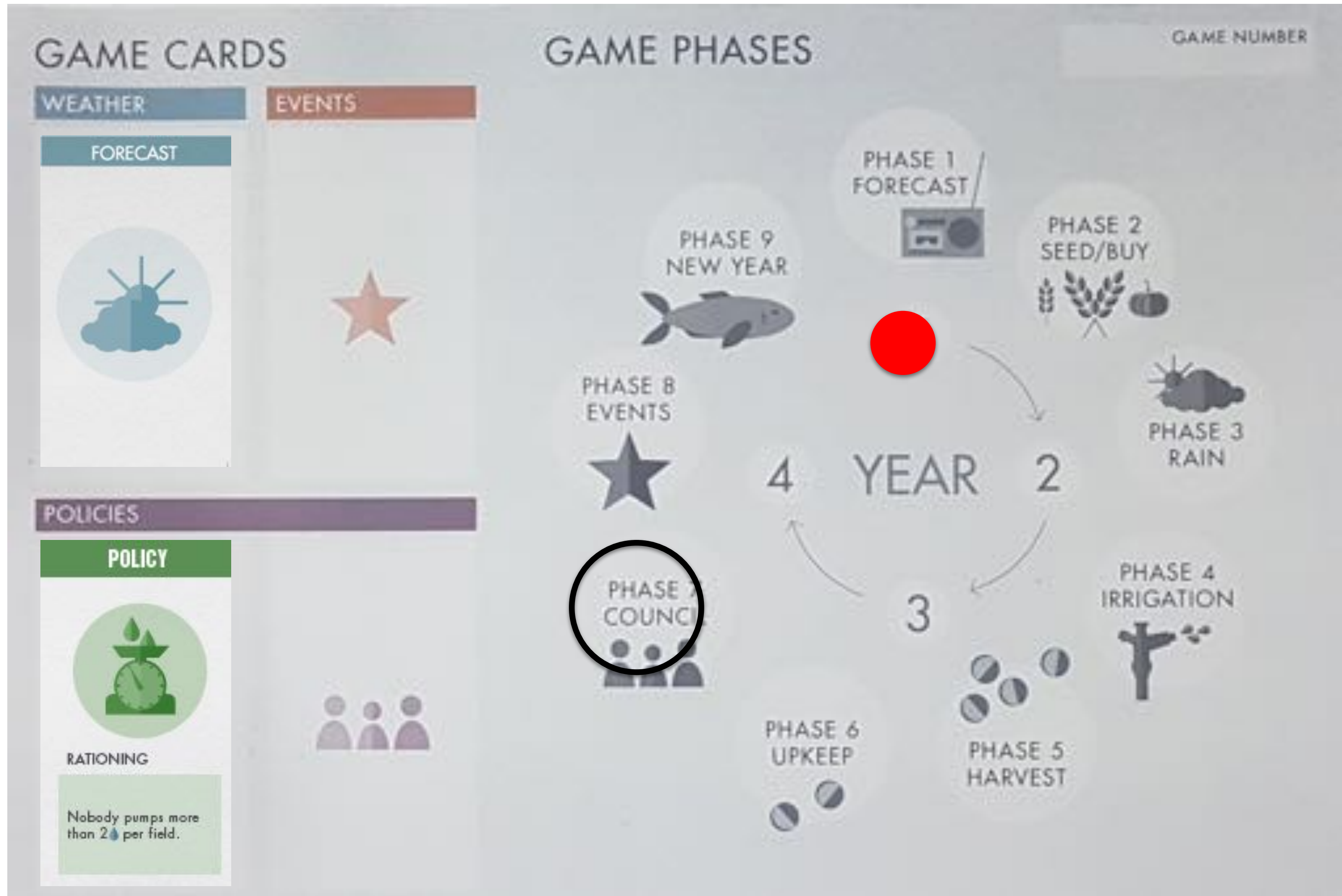
The image shows a 'FIELD' card with a cost of -5 coins. It features several options:

- SINGLE CROP:** -1 coin, 1 water drop, +6 coins, +8 coins.
- DOUBLE CROP:** -2 coins, 1 water drop, 2 water drops, 3 water drops, +10 coins, +11 coins.
- VEGETABLES:** -1 coin, 1 water drop, 2 water drops, 3 water drops, 4 water drops, 5 water drops, +10 coins, -2 coins x field.
- GREENHOUSE:** -2 coins, 1 coin.
- TRAKTOR SHARING:** -2 coins, 1 coin.
- SPRINKLER:** -2 coins, 1 coin.

Below the card, three utility cards are shown:

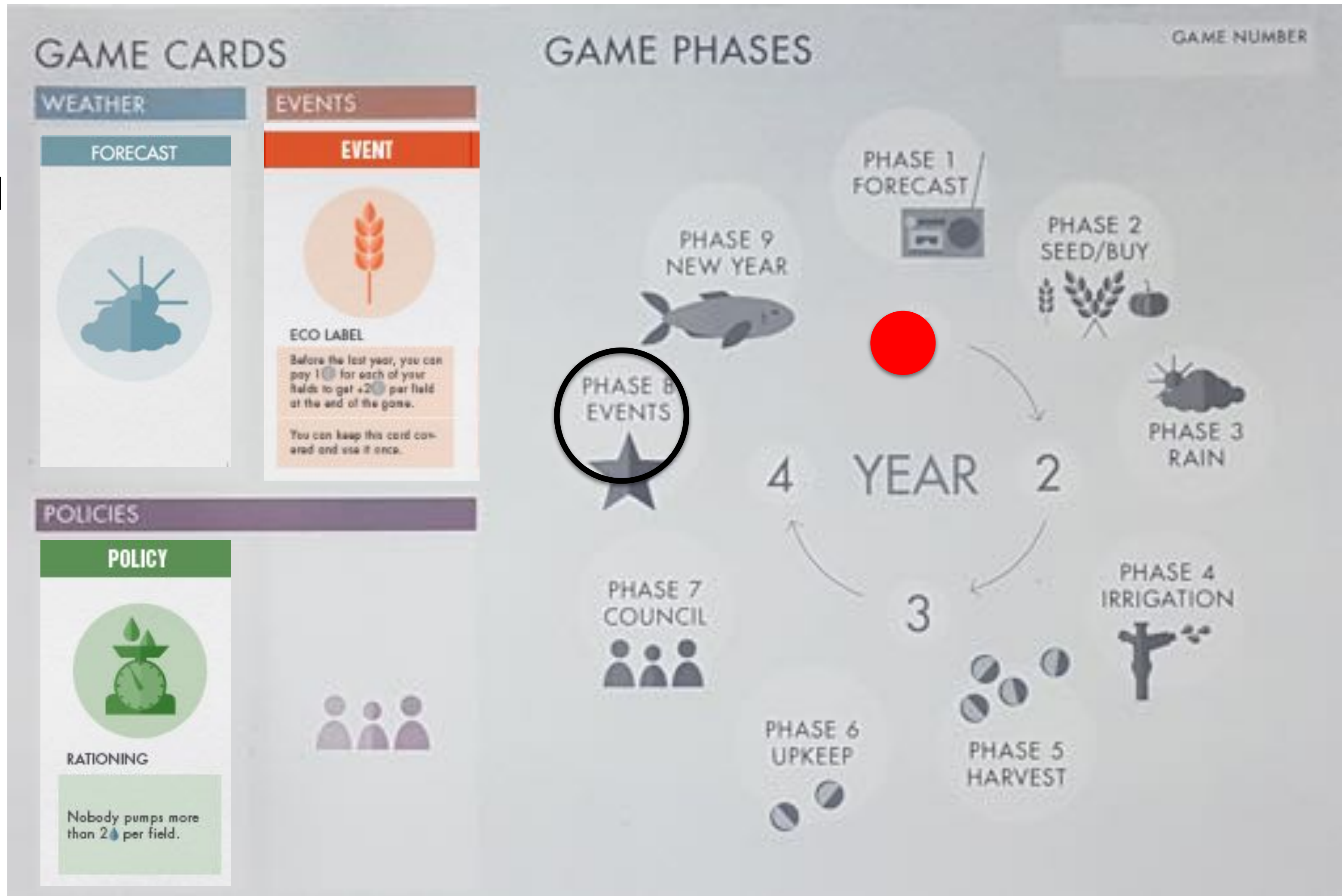
- GREENHOUSE:** You now can grow vegetables.
- TRAKTOR SHARING:** You get +3 coins at the harvest for Single and Double Crop.
- SPRINKLER:** The irrigation of this field costs 1 water drop less.

Gameboard 1



You can choose from 4 policies

Gameboard 1



- Good and bad events can happen
- Then a new year starts

Some conclusions for Guantao

- For modernization and profitability, farms have to become bigger. The tendency is there due to urbanisation
- Change in cropping system is key to sustainability
- To a certain extent water saving will help
- A higher groundwater table makes life easier
- Already if a small fraction of users overpumps, the «Tragedy of the Commons» can be felt by all

And Central Asia?

- Traditionally groundwater use was in most regions allowed for drinking water purposes only
- Groundwater was used at the end of irrigation canals where transferred water was insufficient.
- Groundwater will play a bigger role with increased climatic variability
- Once groundwater is also used for irrigation a cautious approach is needed as can be learned from the game

Let's Play!

