



Instructor guide to the Fishery with Quotas

Laboratory implementation, theoretical foundations,
experimental evidence, and variants

Behavioral and Experimental Economics Research Lab
Department of Economics



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<https://beer-lab.org/>

How to use this guide

This guide supports the preparation, implementation, and discussion of the **Fishery with Quotas** family developed by the Behavioral and Experimental Economics Research Lab (BEER Lab), Department of Economics, Tecnológico de Monterrey. It is written for instructors in microeconomics, environmental and natural-resource economics, public economics, industrial organization, market design, institutions, and experimental economics. No previous experience with oTree, fishery regulation, or dynamic experiments is assumed.

The document offers three reading paths. The opening chapters provide the operational route for starting a session and supporting participants. The middle chapters explain accounting, predictions, evidence, and institutional variants. The final chapters provide feedback scripts, solved exercises, interpretation rules, exported variables, troubleshooting, and a printable checklist. One guide covers both the basic and extended editions so that shared material is not repeated.

The activity separates four questions. The biological question asks what stock remains and how it regenerates. The regulatory question asks how total allowable catch is chosen. The allocation question asks who receives harvesting rights and whether they may be transferred. The compliance question asks what happens when quota can be exceeded under imperfect monitoring. Keeping these dimensions separate prevents premature claims about whether an institution succeeded.

Author

This guide was prepared by Stanislaw Maldonado, research professor in the Department of Economics at Tecnológico de Monterrey, Monterrey Campus. For questions or suggestions about its content, please contact the author at stanislao.maldonado@tec.mx.

For the instructor

This guide follows the English interface. Spanish configurations reproduce the same parameters. Project only the anonymous aggregate report. Never display participant codes or connect decisions to names, student IDs, computers, or seats.

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Quick guide and learning objectives

1.1 Access through the updated laboratory website

Start at <https://beer-lab.org/en/>. Select **CLASSROOM** in the top navigation menu; it opens <https://teaching.beer-lab.org/en/>. In the **Classroom experiments** catalog, use the search box to locate the activity by name. You can also filter by **Topic** or **JEL code**. Clear any filters left from an earlier search before looking for another game.

Each family's card distinguishes **Español** and **English** access links. The **Show extended version** checkbox selects that edition before following a link. Catalog language and session language are separate choices: verify both. Students use the room specified by the instructor; the instructor prepares and monitors the session through this family's own administrative pages.



Figure 1.1: Current institutional website. Select CLASSROOM in the top navigation menu to open the teaching experiments. Captured on October 7, 2026.

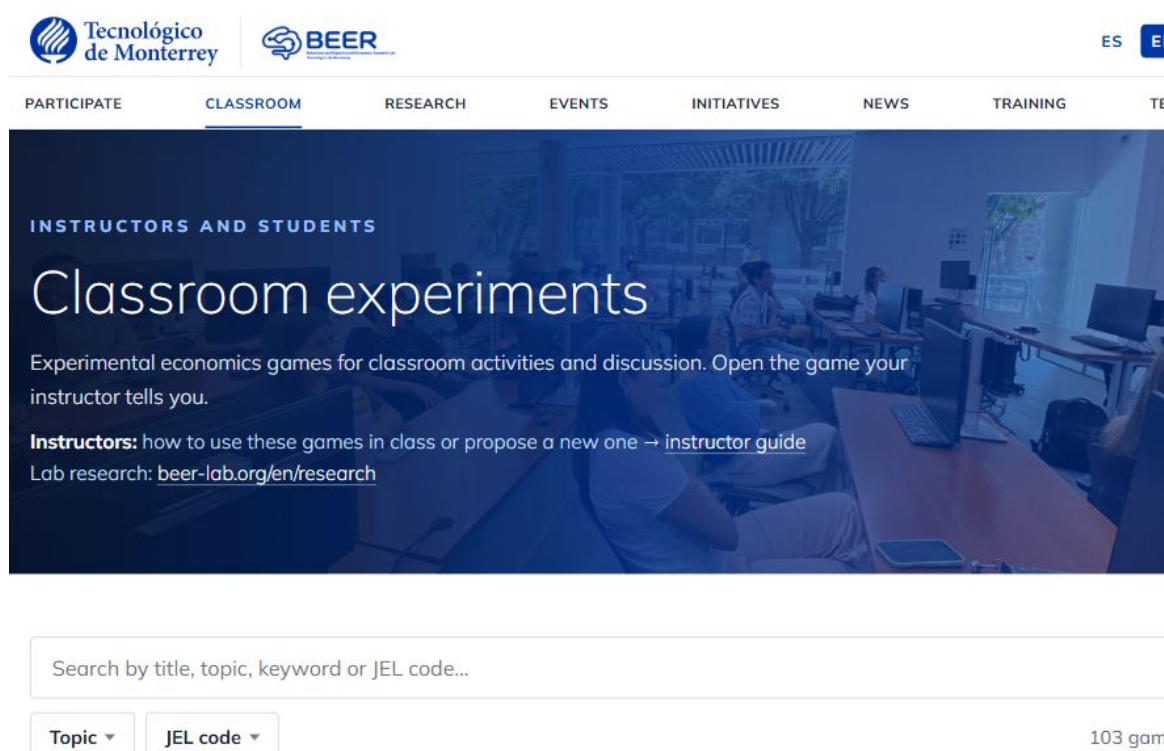


Figure 1.2: Current catalog: search by title, topic, or JEL code. Then locate this family's card and select language and edition. Captured on October 7, 2026.

Checking resources, comprehension, and participant requirements

Before opening the room, check the selected configuration and the number of students present. The session-creation form states the group size and minimum required by that configuration. An individual activity accepts any positive participant count; an interactive activity must satisfy its stated requirement: complete groups when size is fixed, or a minimum participant count when size is flexible. Requirements may change across treatments, for example when adding a third party or changing an institution's size. If you edit a grouping parameter, check the requirement for the edited configuration, rather than relying only on the demo's suggested count.

In the instructions, ensure that students can identify what each role receives, what they can decide, and how the outcome is calculated. An initial account, a distributable budget, and final earnings need not be the same amount. Refer to the resources panel and the example for the selected treatment. Do not carry the basic edition's endowment into a treatment that changes accounts or introduces additional positions.

ECU stands for *Experimental Currency Units*: the activity's unit of account. An outcome of 100 ECU does not automatically equal 100 pesos or 100 dollars. Conversion depends on the session configuration. Before announcing a payment, confirm with the laboratory whether money is paid, the conversion rate, and which decisions count for payment. In hypothetical modules, describe amounts as outcomes in the stated situation.

When a comprehension check is included, an incorrect response receives an explanation beside that question, identifying the submitted answer and the correct answer. Other answers remain in the form. Ask the student to return to the example, locate the relevant rule, and redo the calculation before correcting the response. Avoid revealing answers to the entire class for an individual error, and do not interpret a comprehension mistake as an economic choice in the game.

in cuotas — una temporada	Pesquería con cuotas / Fishery with Quotas — BEER Lab Seleccione una variante de este juego. Select a version of this game.
in cuotas — 10 temporadas, mismos pescadores	
in cuotas — 10 temporadas, pescadores reasignados	
Quotas — one season	
Quotas — 10 seasons, same fishers	
Quotas — 10 seasons, reassigned fishers	
in cuotas extendida — cuotas individuales iguales	
in cuotas extendida — cuota total colectiva	
in cuotas extendida — cuota conservadora	
in cuotas extendida — cuota permisiva	
in cuotas extendida — cuota adaptativa	
in cuotas extendida — cuotas transferibles	
in cuotas extendida — cuotas subastadas	
in cuotas extendida — fiscalización imperfecta	
shery with Quotas — equal individual quotas	
shery with Quotas — collective total quota	
shery with Quotas — conservative quota	
shery with Quotas — permissive quota	
shery with Quotas — adaptive quota	
shery with Quotas — transferable quotas	
shery with Quotas — auctioned quotas	
shery with Quotas — imperfect enforcement	

Figure 1.3: Demo contains only the configurations of this game family, in both languages and editions.

Rooms

Current rooms:

[ES] Pesquería con cuotas
[EN] Fishery with Quotas
[ES] Pesquería con cuotas: extendida
[EN] Fishery with Quotas: extended

Figure 1.4: Rooms contains the four rooms for this family: basic and extended editions in Spanish and English.

Room: [EN] Fishery with Quotas

Create a new session

Session Config

[EN] Fishery with Quotas — one season

Number of participants

Complete groups of 4 participants. Use a multiple of 4; minimum 4.

Create

[Configure session](#) 

App sequence

fishery_quotas_game (10 rounds)

A classroom experiment on catch limits, quota allocation, trading, and enforcement.

Figure 1.5: Session-creation form for the basic English room. Check the selected configuration and participant requirement before creating the session.

Downloading a session with several rounds

For the instructor

Open **Data** within the relevant session and use that session's CSV or CSV-for-Excel download link. The general export has one row per participant and columns for the different rounds. Ten rounds do not necessarily mean ten rows per person. When the family provides its own long-format export, observations may instead be organized by participant and round or another unit defined by the design.

Save the original file together with the configuration name, session code, and active-round count. Check that columns for the last active round are present and that the data belong to the selected session. Empty cells can represent inactive rounds, a pending decision, or a field that does not apply to a role; do not automatically recode them as zeros. To compare learning, preserve round and group identifiers alongside participant identifiers. Share only anonymous aggregates in class, and record session incidents before constructing derived tables.

1.2 Family profile

oTree application	fishery_quotas_game
Server family	GAME_FAMILY=fisheryquotas
Experimental unit	Fishing ground–season with four fishers
Decision	Requested catch under the announced quota institution
Horizon	One or ten seasons
Season endowment	40 ECU
Initial stock and capacity	100 biomass units

Fish price	6 ECU per unit caught
Unit costs	1, 2, 4, and 7 ECU; one stable type per participant
Extended edition	Collective quota, conservative and permissive limits, adaptive rule, transferability, auction, and imperfect enforcement
Instructor report	Distributions, trajectories, quota use, allocation by cost, excess catch, audits, and fines
Purpose	Compare harvest, conservation, and allocation among fishers with different costs under quota and enforcement institutions.
Basic edition	one season; 10 seasons, same fishers; 10 seasons, reassigned fishers.
Outcome	Harvest, costs, net income, and resource state under the selected quota institution.
Topics	fisheries; catch quotas; regulation; renewable resources; compliance.
JEL	C92; Q22; Q28.

This is an interactive game. Four decisions determine a fishing-ground outcome, and biomass carries from one season to the next. In reassignment configurations, people move across fishing grounds while each group position retains its ecological history. This rule preserves environmental consequences while the class studies user mobility.

1.3 Learning objectives

After the activity, students should be able to distinguish total allowable catch from an individual quota; explain why an aggregate limit can preserve a strategic race; calculate net earnings including harvesting costs, quota payments, and fines; show how cost heterogeneity creates gains from trade; analyze why legal compliance can coexist with a biologically excessive quota; and explain how detection probability and sanctions shape expected incentives to violate a rule.

Students should also learn to evaluate institutions along several dimensions. Final biomass measures an ecological outcome. Total earnings and the location of rights inform productive efficiency. The distribution of earnings and concentration of quota raise distributional questions. Audits and fines identify compliance outcomes and administrative demands. No single indicator settles the institutional comparison.

Theoretical foundation

A quota is a quantitative constraint. Its presence does not guarantee sustainability: the total limit must fit stock dynamics, and the rule requires information and compliance. Transferability may improve allocation among fishers with different costs, but it cannot repair a TAC that is biologically too high.

1.4 Minimum classroom sequence

Allow 45 to 60 minutes for one institution and 80 to 100 minutes for a two-treatment comparison. Use roughly ten minutes for access and instructions, ten to twenty-five for decisions, five to verify completion, and at least twenty for feedback. Before revealing the report, request predictions about quota use, biomass, and which cost types will hold more rights. Recording predictions makes the

report a test of arguments rather than a retrospective description.

For a first class, compare equal individual quotas with a collective total quota. For market design, compare equal rights with transferable or auctioned rights. For compliance, run imperfect enforcement after discussing private benefits and expected sanctions. Avoid opening several sessions simultaneously unless another instructor can help monitor them.

Access, rooms, and family isolation

2.1 From the laboratory website to the game

Begin at beer-lab.org. From the teaching section, open teaching.beer-lab.org and select the *Fishery with Quotas* card. The proposed family domain is fisheryquotas.beer-lab.org. Until DNS and deployment are configured, the verified instance is localhost:8047/demo; it is available only on this computer.

The `/demo` page is for the instructor. It contains the 22 configurations in this family and creates demonstration sessions. The `/rooms` page contains exactly four rooms. Participants should receive a room route, never the Demo panel or an individual link copied from an old session.

2.2 The four rooms

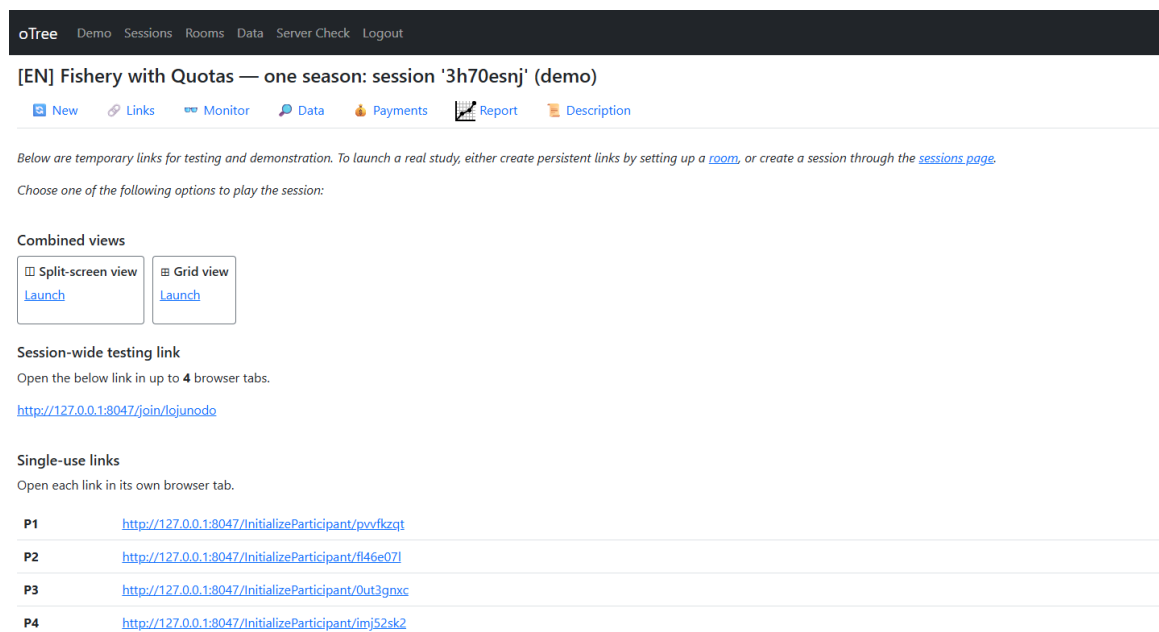
Room	Participant route	Options
Basic ES	<code>/room/pesqueria_cuotas_es</code>	3
Basic EN	<code>/room/fishery_quotas_en</code>	3
Extended ES	<code>/room/pesqueria_cuotas_extendida</code>	8
Extended EN	<code>/room/fishery_quotas_extended</code>	8

A basic room initially selects a basic configuration in the correct language. If another game appears, an extended configuration is selected first, or option counts differ, do not start. That pattern indicates that the instance did not start with `GAME_FAMILY=fisheryquotas` or that the room filter failed.

2.3 Create and distribute a session

Choose the configuration, write a label identifying course, date, and treatment, and use a participant count divisible by four. With 18 attendees, open 16 positions and assign two observers. Do not open 20 on the assumption that two additional participants will appear. Incomplete groups cannot calculate allocation, catch, or growth.

After creation, oTree displays individual links, Monitor, and Report. In an in-person class, distribute the stable room route and let the platform assign positions. During a rehearsal, open each individual link in a different private browser context. Tabs in one profile share cookies and can replace one participant with another.



oTree Demo Sessions Rooms Data Server Check Logout

[EN] Fishery with Quotas — one season: session '3h70esn' (demo)

New Links Monitor Data Payments Report Description

Below are temporary links for testing and demonstration. To launch a real study, either create persistent links by setting up a [room](#), or create a session through the [sessions page](#).

Choose one of the following options to play the session:

Combined views

Split-screen view [Launch](#) Grid view [Launch](#)

Session-wide testing link

Open the below link in up to 4 browser tabs.

<http://127.0.0.1:8047/join/lojunodo>

Single-use links

Open each link in its own browser tab.

P1	http://127.0.0.1:8047/InitializeParticipant/pvofkzqt
P2	http://127.0.0.1:8047/InitializeParticipant/fl46e07l
P3	http://127.0.0.1:8047/InitializeParticipant/0ut3gnxc
P4	http://127.0.0.1:8047/InitializeParticipant/imj52sk2

Figure 2.1: Links for a four-fisher basic session.

Keep three views available: Monitor for page status, Report for the private summary, and the room route to help anyone who closes a browser. Report remains hidden until decisions are complete, preventing partial outcomes from influencing people who are still choosing.

Checkpoint

Before distributing the route, confirm session label, configuration, language, treatment, capacity, and room. Verify that Report is open in a private instructor tab and Monitor displays the expected count. This one-minute check prevents the most frequent operational errors.

The participant experience

3.1 Welcome, rules, and instructions

The first page presents the BEER Lab logo, the educational purpose, and rules for silence, privacy, and navigation. Each person must accept the rules before continuing. The page collects no demographic information. If the activity becomes research, acceptance of laboratory rules does not replace the required consent process.

Instructions define TAC, individual quota, stock, growth, price, unit cost, and ECU. A participant knows their own stable unit cost. This information explains why an additional unit has different private value across fishers. The payoff formula appears before the decision, and the example solves quota 3, catch 3, cost 2, and earnings of 52 ECU.

3.2 Comprehension check

The check asks for the individual quota, example earnings, and growth after total catch of 12. Correct answers are 3, 52, and 5.28. An incorrect response produces an explanation and another attempt. This step prevents an arithmetic error from being interpreted as conservation preference or deliberate noncompliance.

Do not announce answers to the room. Assist privately and direct the person back to the example. If several students fail, pause before the first season and repeat the distinction among stock, TAC, and individual quota.

3.3 Allocation and catch choice

Equal, conservative, permissive, and adaptive treatments display an individual right directly. The collective treatment omits an exclusive right and explains proportional rationing. The transferable treatment inserts a buy-or-sell request and then an allocation result. The auction requests a per-unit bid and maximum quantity, then reveals final quota and the uniform price. Imperfect enforcement permits a choice above the right and displays audit probability and fine.

A quota authorizes a maximum catch; it does not require the holder to use it. This distinction matters for the cost-7 fisher because each caught unit sells for 6 and costs 7 before quota payments. Under collective TAC, requested catch may exceed actual catch. Under imperfect enforcement, actual catch may exceed the assigned right and create an audit risk.



Welcome to the BEER Lab

The **Behavioral and Experimental Economics Research Lab** in the Department of Economics at Tecnológico de Monterrey is a space designed to learn about economic decision-making through controlled activities.

This activity studies how quota allocation, trading, and enforcement affect fishing, earnings, and conservation of a renewable resource.

During the session

- Remain quiet and do not talk or communicate with other participants.
- Make decisions individually and privately.
- Follow the on-screen instructions. Do not refresh, close, or leave this page.
- If you need help, raise your hand or contact laboratory staff privately.

I have read and understood the laboratory rules.

- ☐ Sí
- ☐ No

Start

Powered by [oTree](#)

Figure 3.1: Shared beginning of the participant experience. Institutional welcome and acceptance.



Basic version • One season



How the regulated fishery works

Four fishers share a fishing ground. The authority sets a total allowable catch and applies the institution announced for this session.

Resources and unit of account

Monetary endowment per participant and round: 40 ECU. The fish stock is a separate resource measured in fish units.

ECU stands for Experimental Currency Units. It is the unit of account for this activity.

This session does not convert ECU into real money.

Equal individual quotas

The total allowable catch is divided equally, and each fisher decides how much of their quota to use.

Sequence in each season

1. The stock and total allowable catch are displayed.
2. The authority allocates quota; when applicable, rights are traded or auctioned.
3. Each fisher requests a catch.
4. Catch, costs, payments, enforcement, and natural growth are calculated.
5. The resulting stock carries into the next season.

Quota and harvesting right

A quota authorizes a maximum catch; it does not require that amount to be caught. A total quota limits the group, while an individual quota assigns a portion to one person.

Biological dynamics

After fishing, remaining biomass grows logistically. Growth is low when little resource remains and also when the fishing ground is near capacity.

$$\text{Growth} = 0.50 \times \text{remaining stock} \times (1 - \text{remaining stock}/100)$$

Earnings

Each caught unit yields 6 ECU. Unit cost differs across fishers and remains constant during the session. Quota purchases, auction payments, and fines are subtracted; quota sale proceeds are added.

$$\text{ECU} = 40 + 6 \times \text{catch} - \text{unit cost} \times \text{catch} - \text{quota payment} - \text{fine}$$

Worked example

With quota 3, unit cost 2, and catch 3, earnings are $40 + 18 - 6 = 52$ ECU. If the group catches 12 from a stock of 100, 88 remain and natural growth equals 5.28.

The numbers are a classroom adaptation. Quota and regeneration are expressed in resource units rather than real tonnes.

Continue

Powered by oTree

Figure 3.2: Current basic-edition instructions, with initial resources and experimental units.



Review the marked questions. Each shows your answer and an explanation; your other answers are retained.



Fishery with Quotas

Comprehension check

Answer all three questions. You may correct an answer if you make a mistake.

Resources and unit of account

ECU stands for Experimental Currency Units. It is the unit of account for this activity.

This session does not convert ECU into real money.

How many ECU does the fisher in the example earn?

ECU

Your answer: 53. The correct answer is 52. Review the example: quota is 3, earnings are 52 ECU, and growth after total catch of 12 is 5.28.

How much does the resource grow in the example?

biomass units

What is the individual quota in the example?

biomass units

Check and continue

Powered by [oTree](#)

Figure 3.3: Current comprehension check with an incorrect answer, its specific explanation, and retained responses.



Season 1 of 1 · Equal individual quotas

Catch decision

Choose how many units you want to catch this season.

Available stock

100.0

biomass units

The stock remains above the fragile-stock threshold.

Total allowable catch	12
Your individual quota	3
Your unit cost	1.0 ECU
Fish price	6.0 ECU

Requested catch

You may request any amount from zero through your final quota.

Confirm catch

Powered by [oTree](#)

Figure 3.4: Basic decision with stock, TAC, quota, cost, and fish price visible.

What participants will see

Participants never see identities or individual choices made by others. Markets and auctions disclose only their own allocation, applied price, and aggregate volume. The season result separates private accounting from the aggregate fishing-ground outcome.

3.4 Results and explicit completion

The results page uses two columns. The first reports request, actual catch, sales, cost, quota payment, fine, and ECU. The second reports initial stock, TAC, total requested catch, total actual catch, remaining biomass, growth, and next stock. Enforcement adds audit status and sanctioned excess.

After the active horizon, *Activity completed* summarizes cumulative ECU, personal catch, fines, and final biomass and asks the participant to wait. It has no button leading to “No more pages left.”

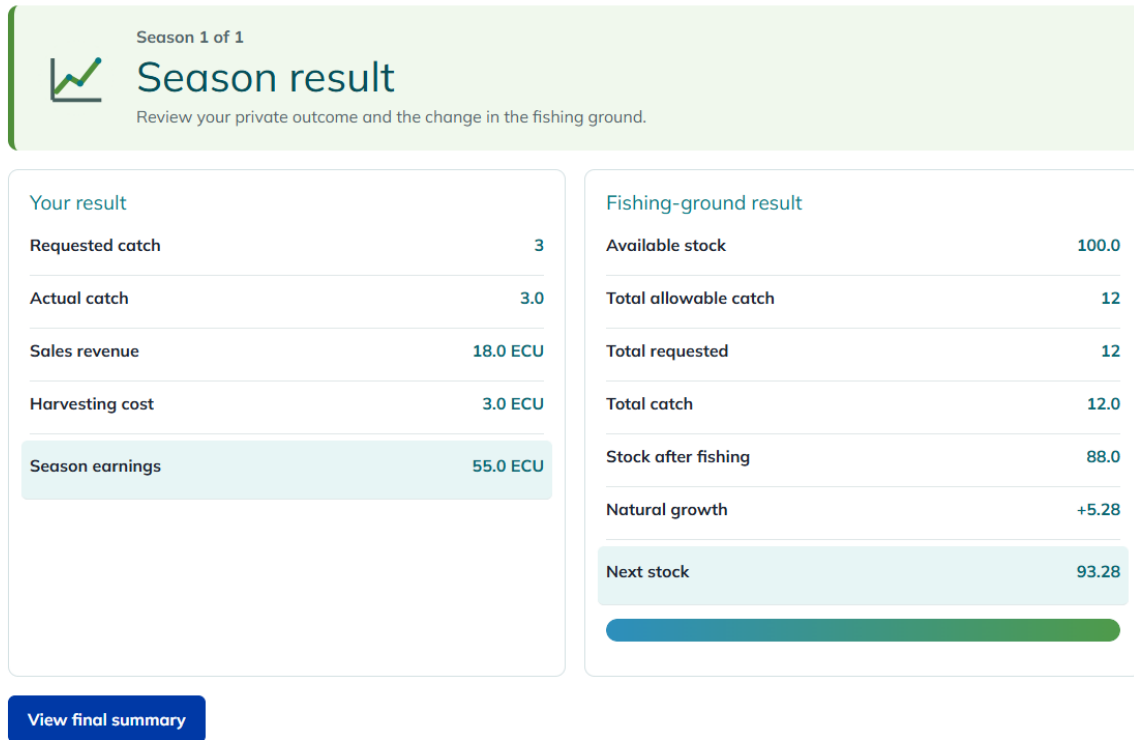
Powered by [oTree](#)

Figure 3.5: Season outcome and final screen. Private and fishing-ground results.



Activity completed

Your decisions have been recorded. Please wait for the instructor's directions.

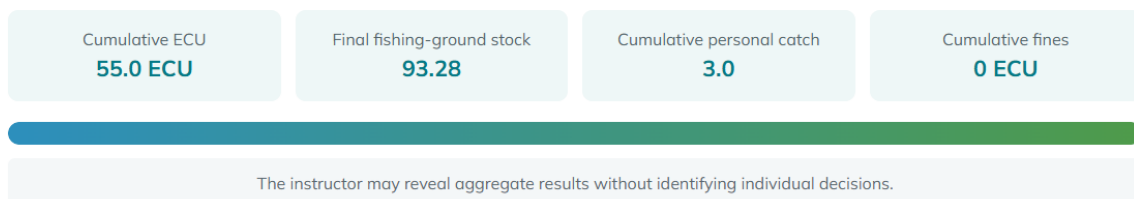
Powered by [oTree](#)

Figure 3.6: Explicit completion page.

Bioeconomic model and accounting

4.1 Stock, harvest, and regeneration

Let S_t denote stock at the beginning of season t and H_t total actual catch. Remaining biomass is $R_t = S_t - H_t$. The activity uses logistic growth,

$$G(R_t) = 0.50R_t \left(1 - \frac{R_t}{100}\right), \quad S_{t+1} = R_t + G(R_t).$$

Carrying capacity is 100. Growth is zero without biomass, low when very little remains, and low again near capacity. Its maximum is 12.5 at a remaining stock of 50. This shape distinguishes stock from flow: retaining more fish does not always maximize one-period growth, although it can preserve a larger productive base.

Starting from 100 with catch 12 leaves 88. Growth is $0.50 \times 88 \times 0.12 = 5.28$, so next stock is 93.28. Repeated catch of 12 approaches a positive range. Repeated catch of 20 can cross into a region where growth cannot replace removals and lead to collapse, even when every fisher obeys an assigned right. Compliance and sustainability are therefore separate questions.

4.2 TAC and individual rights

Let Q_t be total allowable catch. Equal allocation gives each person $q_{it} = Q_t/4$. The benchmark sets $Q_t = 12$ and $q_{it} = 3$. The conservative rule uses 8 and allocates 2; the permissive rule uses 20 and allocates 5. The adaptive rule computes an integer per-person quota from $0.03S_t$, bounded between zero and five, and multiplies it by four. This discretization supports a clear interface but creates thresholds that a real manager might smooth.

Collective TAC keeps $Q_t = 12$ without assigning q_{it} . Each person requests d_{it} . When $\sum_i d_{it} \leq Q_t$, actual catch equals requests. When requests exceed the limit, proportional rationing gives

$$h_{it} = Q_t \frac{d_{it}}{\sum_j d_{jt}}.$$

A larger request can therefore increase one's share without increasing group catch. The mechanism is a simplified representation of competition for a global quota.

4.3 Payoffs and heterogeneous costs

Each fisher starts a season with 40 ECU. Fish price is $p = 6$, and unit costs are $c_i \in \{1, 2, 4, 7\}$. With catch h_{it} , net quota payment m_{it} , and fine f_{it} , earnings are

$$\pi_{it} = 40 + (p - c_i)h_{it} - m_{it} - f_{it}.$$

A negative net payment is revenue from selling rights. Before rights are priced, per-unit margins are 5, 4, 2, and -1 . A money-maximizing cost-7 fisher does not harvest, while cost-1 and cost-2 fishers value additional units most.

For example, a cost-1 fisher buys two units for 3 ECU each, ends with quota 5, and catches 5. Earnings are $40 + 30 - 5 - 6 = 59$. A cost-7 fisher sells two units, retains one, and catches zero. Net quota payment is -6 , producing 46 ECU. Trade creates gains relative to forcing the high-cost fisher to use three units, but distribution depends on initial ownership and price.

4.4 Auction and expected enforcement

In the auction, each participant submits per-unit bid b_i and demand up to k_i . The system expands demands into unit bids, ranks them from highest to lowest, and awards up to TAC. Every winning unit pays the lowest winning bid. This uniform-price rule is a teaching adaptation: one marginal bid per participant does not capture every strategy available in a multiunit auction.

Under imperfect enforcement, quota is 3 but requested catch may reach 6. Each excess unit yields private margin $p - c_i$. With audit probability $a = 0.5$ and fine 12, expected sanction is $aF = 6$. A risk-neutral ECU maximizer, including the cost-1 type, compares a benefit of 5 with expected cost 6 and should comply. Choices may differ because of risk perception, mistakes, loss aversion, or reactions to previous audits.

Theoretical foundation

The condition $aF > p - c_i$ is an expected deterrence condition, not an individual guarantee. Audits are random, and a small session may contain violations without fines or a concentration of fines. Display excess decisions, audits, and sanction amounts together.

Theory, predictions, and evidence

5.1 From common access to harvesting rights

The classic fishery problem arises because a user receives the benefit from extraction while part of the depleted-stock cost falls on other users and future periods. A TAC separates a biological decision from private competition by setting a group limit. An individual quota adds exclusivity over part of that limit and removes the incentive to be first in a race for a global quota.

With perfectly enforced individual rights, the benchmark prediction is straightforward. A fisher with positive margin uses the right; a fisher with negative margin leaves it unused when sale is impossible. TAC is not exceeded. Rights can remain idle, and equal allocation can be productively inefficient when costs differ.

5.2 Transferability and productive efficiency

With transferable rights, a unit should move from someone who values it less to someone who values it more whenever a price lies between valuations. At price 3, cost-7 and cost-4 types should sell because harvesting margins are -1 and 2 . Cost-1 and cost-2 types can buy because margins are 5 and 4 . If orders match, catch shifts toward lower-cost production and total private earnings increase without changing TAC.

This prediction assumes price comprehension, trust in execution, and no attachment to the initial allocation. Field and laboratory evidence finds that quota prices can be volatile, fleet capacity can adjust slowly, and concentration generates distributional debate. The report therefore shows allocation by cost, traded volume, and price rather than only mean earnings.

5.3 Biological limits and feedback

A rights institution does not automatically choose a sustainable limit. The permissive treatment allows full legal compliance while stock declines. The conservative treatment protects biomass but reduces current catch. The adaptive treatment represents feedback control: when biomass falls, future rights fall. Its advantage is responsiveness; its costs include measurement needs, volatility, and discrete thresholds.

Dynamic theory compares the marginal value of harvesting now with the future value of biomass. That value depends on horizon, discounting, later rules, and expected compliance by others. This classroom session does not estimate an intertemporal utility function. It uses observed trajectories to ask what incentives would make users internalize future stock value.

5.4 Enforcement, risk, and legitimacy

The deterrence model compares private violation gains with detection probability and sanctions. Real compliance also depends on legitimacy, social norms, information, and perceived fairness. Groups with identical parameters may differ because early audit realizations change beliefs or because participants interpret a fine as a warning.

Do not call a low violation rate definitive proof that fines work. The session combines deterrence, comprehension, and risk. Do not call a high rate proof of dishonesty. First check whether participants understood request, quota, and actual catch, and remember that the activity is anonymous and pedagogical.

5.5 Evidence and limits of the adaptation

Gordon formalizes rent dissipation under common property. Moloney and Pearce develop quantitative rights as a regulatory instrument. Dewees documents the end of the race to fish and business adjustment after individual quotas. Costello, Gaines, and Lynham relate catch-share programs to a lower probability of collapse without implying that every program guarantees conservation. Moxnes finds that quota markets and auctions need not attain ideal predictions and that prices can differ from fundamental benchmarks.

The application reduces that complexity to one resource, four cost types, and transparent rules. It excludes bycatch, multiple species, vessel investment, long-run ownership consolidation, finance, scientific uncertainty, and fishery-dependent communities. These omissions isolate mechanisms but must be acknowledged in feedback.

Instructor report and interpretation

6.1 Controlled disclosure

Report first displays participants, grounds, completed ground-seasons, and pending observations. While any expected decision is missing, the reveal button remains disabled and the page refreshes. Once the session is complete, the instructor selects *Reveal results*. Results can be hidden again while preparing the discussion.

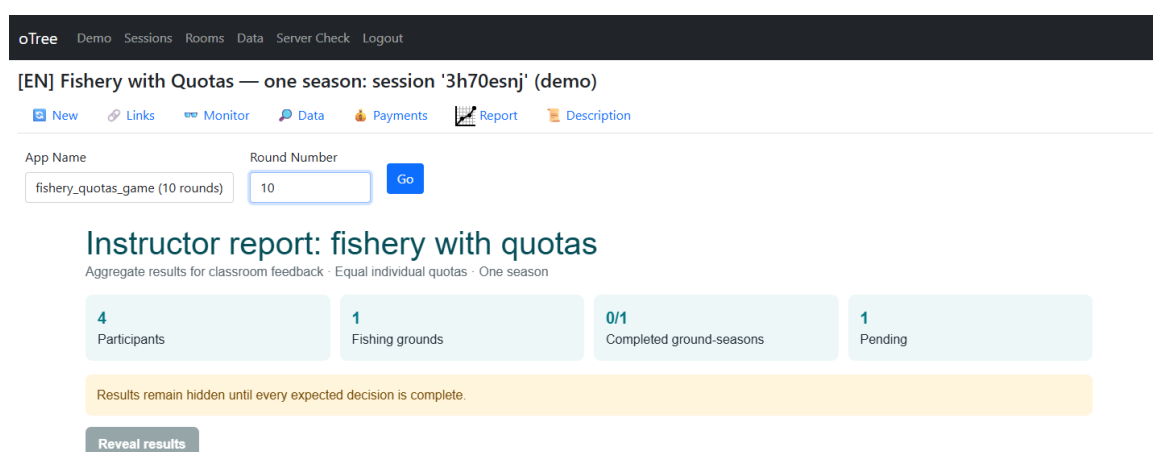


Figure 6.1: Controlled disclosure in the instructor report. Report blocked during decisions.

6.2 Metrics and denominators

Mean requested catch uses completed decisions. Actual catch may be lower because of collective rationing or physical scarcity. Quota use divides catch within rights by assigned units. Under collective TAC, the application retains an equivalent reference allocation for comparison, but the instructor should state that no exclusive rights existed. The excess rate is relevant only under imperfect enforcement and counts decisions with catch above three.

Mean final stock uses one observation per ground at the end of the active horizon. The sustainable-ground rate uses 20 as a classroom fragility threshold, not a universal biological benchmark. Mean ECU includes endowments, production costs, rights payments, and fines. Traded volume means matched units in the posted-price market and awarded units in the auction; these are related but different concepts.

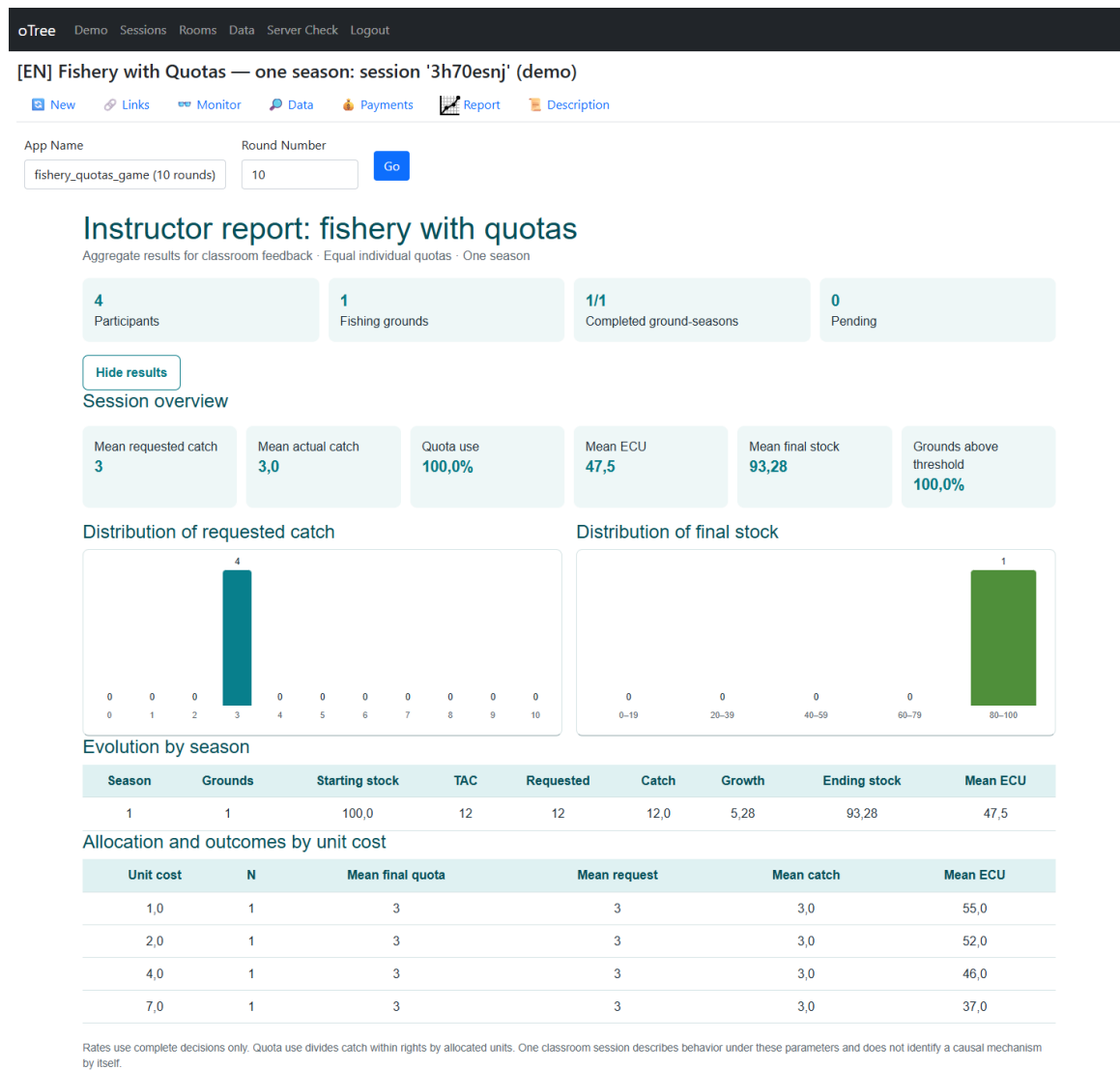


Figure 6.2: Basic report after disclosure.

6.3 Projection-ready displays

The requested-catch histogram reports discrete values from zero through ten. The biomass histogram places final grounds into five stock intervals. The season table reports starting stock, TAC, requests, catch, growth, ending stock, and ECU. The cost-type table tests whether rights and catch moved toward lower-cost fishers.

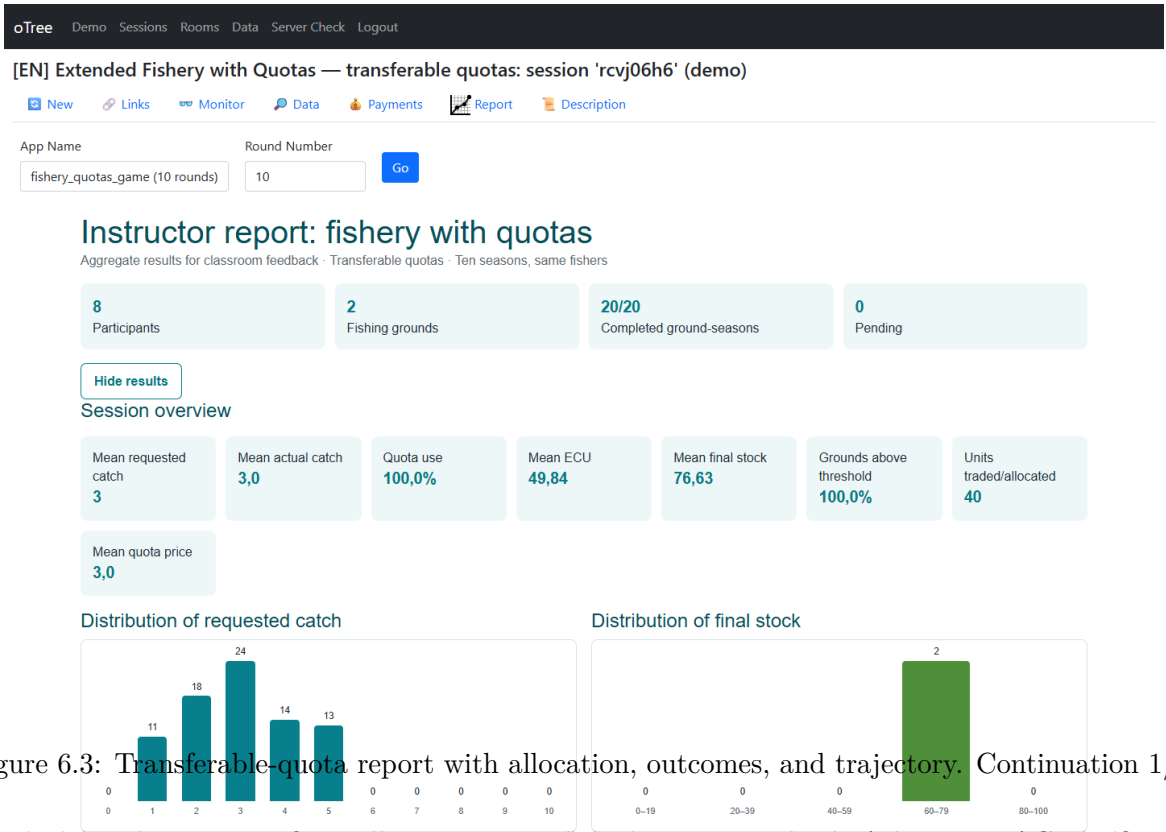


Figure 6.3: Transferable-quota report with allocation, outcomes, and trajectory. Continuation 1/2.

Read physical quantities first, allocation second, and payments third. Ask: Was TAC used? Was enough biomass retained? Who held the rights? Did the average cost of active harvesting fall? How much income came from harvest and how much from selling rights? This sequence separates productive efficiency² from distribution.

Feedback script

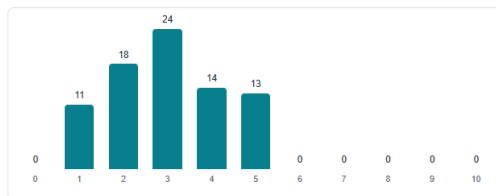
“The quota limited aggregate catch, but that is only the first evaluation. We will now examine who received rights, what they paid, whether rights were used, and what happened to stock. Then we can separate efficiency, sustainability, distribution, and compliance.”

6.4 Diagnosing unexpected patterns

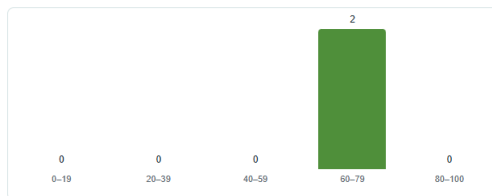
Allocation and outcomes by unit cost						
Unit cost	Mean final quota	Mean request	Mean catch	Mean ECU		
1,0	20	4,3	4,3	4,3	57,6	

If TAC is unused, inspect high costs, auction bids, unmatched trades, or voluntary conservation. If trading does not reallocate, compare buy and sell orders; volume is constrained by the short side. If the auction price is zero, demand may be insufficient or zero bids may win. If violations occur without fines, remember audits are random. If permissive quotas do not collapse the stock, high-cost types may have left rights unused.

Distribution of requested catch



Distribution of final stock



Evolution by season

Season	Grounds	Starting stock	TAC	Requested	Catch	Growth	Ending stock	Mean ECU
1	2	100,0	12	12	12,0	5,28	93,28	50,0
2	2	93,28	12	12	12,0	7,61	88,89	49,62
3	2	88,89	12	12	12,0	8,88	85,77	49,5
4	2	85,77	12	12	12,0	9,67	83,44	49,62
5	2	83,44	12	12	12,0	10,2	81,64	49,88
6	2	81,64	12	12	12,0	10,57	80,21	50,25
7	2	80,21	12	12	12,0	10,84	79,05	50,0
8	2	79,05	12	12	12,0	11,05	78,1	49,62
9	2	78,1	12	12	12,0	11,2	77,3	50,0
10	2	77,3	12	12	12,0	11,33	76,63	49,88

Allocation and outcomes by unit cost

Unit cost	N	Mean final quota	Mean request	Mean catch	Mean ECU
1,0	20	4,3	4,3	4,3	57,6
2,0	20	3,7	3,7	3,7	52,7
4,0	20	2,35	2,35	2,35	46,65
7,0	20	1,65	1,65	1,65	42,4

Rates use complete decisions only. Quota use divides catch within rights by allocated units. One classroom session describes behavior under these parameters and does not identify a causal mechanism by itself.

Figure 6.4: Transferable-quota report with allocation, outcomes, and trajectory. Continuation 2/2.

6.5 Basic versions

6.6 One season

The one-shot interaction presents stock, TAC, right, and costs without reputation or ecological learning. It supports accounting practice and asks whether a right is fully used. The monetary prediction varies by cost: the three nonnegative-margin types catch through quota, while the cost-7 type prefers zero. The resulting stock introduces regeneration, but one period cannot demonstrate stability.

6.7 Ten seasons with the same fishers

The same four people share one ground. They can learn how catch changes biomass despite having no communication channel. The fixed TAC limits the group, while utilization depends on costs. Compare early and late seasons for learning, depletion, or persistent nonuse. Do not label convergence as cooperation without an explicit collective choice.

6.8 Ten seasons with reassignment

People change grounds while each ground retains its stock. The design reduces social continuity and makes inherited ecological consequences visible. Cost type follows the participant. Compare ground trajectories and dispersion, not only round means, because reassignment combines different users with different ecological histories.

Extended variants

7.1 Equal individual quotas

The institutional benchmark uses TAC 12, three units per person, and perfect enforcement. Ask whether equal rights imply efficiency. They do not when costs differ and exchange is unavailable. Observe unused quota by the cost-7 type and resulting biomass. This treatment anchors every comparison without changing biology.

7.2 Collective total quota

TAC remains 12 but no one owns an exclusive portion. Requests above the limit are rationed proportionally. A participant can increase their share by requesting more, producing a strategic race inside a hard aggregate limit. Total catch remains capped, while requested catch measures competitive pressure and allocation may favor costly producers.

Compare total requested catch with TAC and actual catch. A request of 34 followed by catch 12 does not mean that 34 were removed; it measures strategic demand. Ask what would change if competition consumed real effort or if a season closed when TAC was reached. Those dimensions are abstracted to isolate individual rights.

7.3 Conservative quota

TAC is 8, with two units per person. Biomass tends to remain high, but present catch is forgone. Evaluate season earnings alongside final stock. The conclusion is not that the lowest quota is always best: management weighs current benefits, growth, uncertainty, information, and distribution.

7.4 Permissive quota

TAC is 20, with five units per person. Repeated legal use can deteriorate stock even under perfect compliance. This treatment corrects a frequent intuition: a policy is not sustainable merely because observed catch is legal. Project the trajectory and locate the point at which growth no longer replaces removal.

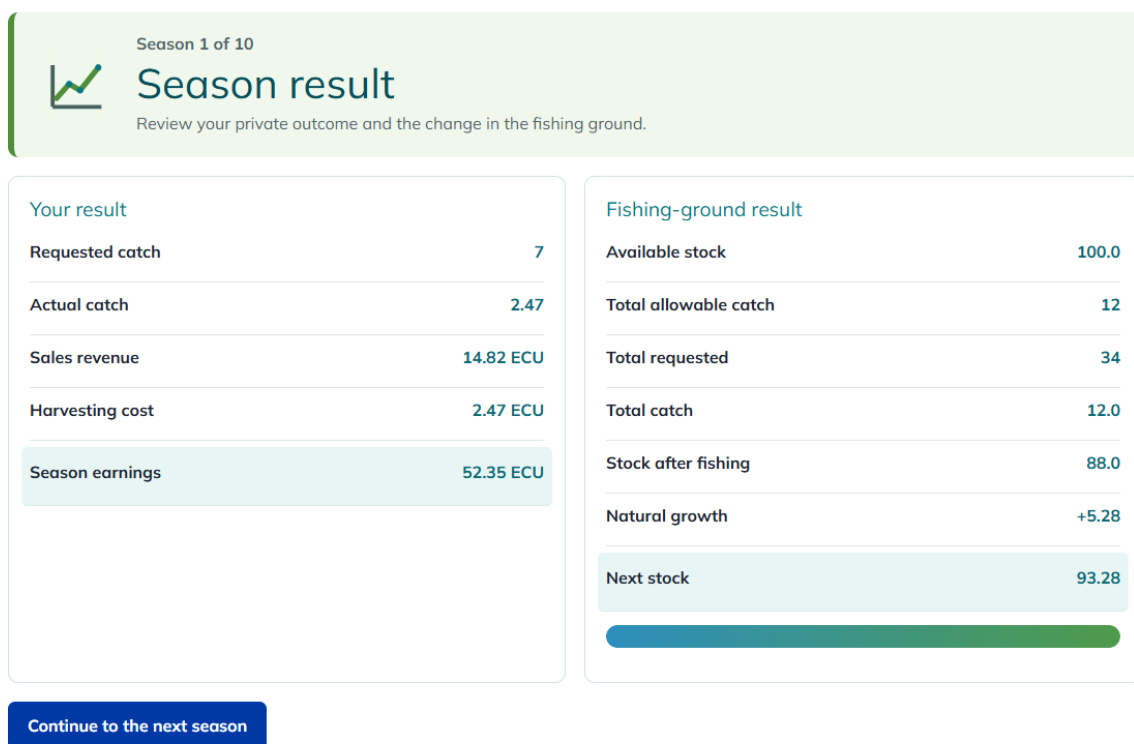
Powered by [oTree](#)

Figure 7.1: Proportional rationing under a collective total quota.

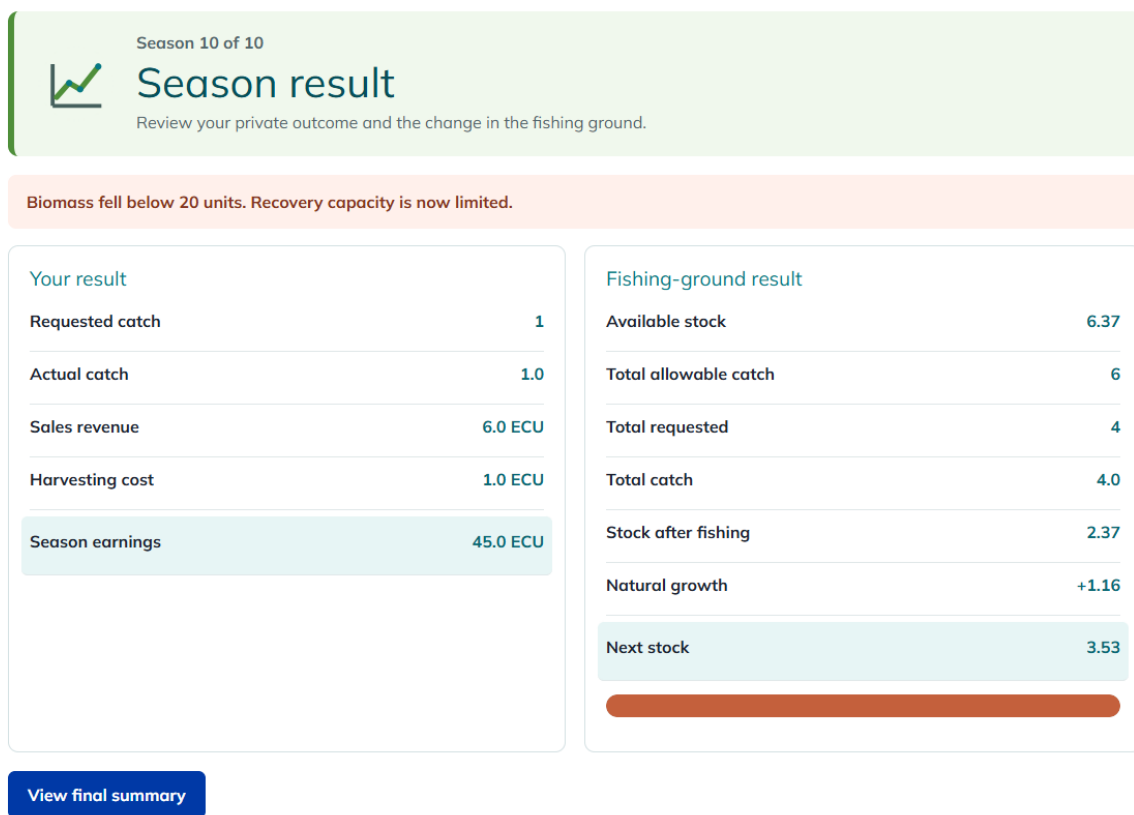
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Figure 7.2: Weakened stock after repeated permissive quotas.

7.5 Adaptive quota

The rule uses current stock to set an integer quota per person. When biomass declines, TAC falls. It teaches feedback control and the role of scientific information. It also exposes a design issue: discrete rules create jumps and can reduce opportunity abruptly when stock crosses a threshold.

Compare biomass under fixed and adaptive rules. If both preserve stock, inspect variability and cumulative catch. If the adaptive TAC falls, ask whether that is failure or the preventive response the rule was built to deliver.

7.6 Transferable quotas

Each person starts with three units and may buy or sell up to two at 3 ECU. Orders are matched, and an order may be partially executed. A seller's net quota payment is negative and therefore increases ECU. The aggregate number of rights remains unchanged.



Season 1 of 10

Quota market

Choose whether to buy, sell, or keep your allocation. A request may be partially filled when there is no matching counterparty.

Your initial quota
3

Your unit cost
1.0 ECU

Price per unit
3.0 ECU

Your request

—

Submit request

Powered by oTree

Figure 7.3: Posted-price classroom quota market. Request to buy or sell.

The benchmark predicts that cost-1 and cost-2 types buy while cost-4 and cost-7 types sell. Compare final quota and catch by cost. Then discuss initial entitlement: post-trade production may be efficient while the distribution of resource rents remains controversial.

7.7 Auctioned quotas

The authority offers 12 units. Each participant submits a per-unit bid and quantity. Unit bids are ranked and all winners pay the lowest winning bid. In the simple benchmark, willingness to pay is no greater than $6 - c_i$. A bid above that value may secure rights while reducing earnings.

Use auction revenue to introduce resource rent. The application does not redistribute that revenue to participants. Compare auction and free allocation: productive allocation may be similar while the recipient of rents changes.

Season 1 of 10

 **Allocation result**

Review your final quota and any payment or revenue before choosing catch.

Your initial quota	3	Units traded or allocated	2
Quota change	1	Applied price	3.0 ECU
Final quota	4	Your unit cost	1.0 ECU
Net quota payment	3.0 ECU		

A negative payment represents sale revenue.

Continue

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Figure 7.4: Executed allocation and payment.

Season 1 of 10

 **Seasonal quota auction**

Submit a per-unit bid and the maximum quantity you want. You may receive fewer units than requested.

Total allowable catch	Your unit cost	Fish price
12	1.0 ECU	6.0 ECU

Your benefit before paying for quota is 6 minus your unit cost for each unit caught.

Bid per unit	Units requested
0 ECU	0

Submit bid

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Figure 7.5: Simplified seasonal quota auction. Sealed price and quantity bid.

Season 1 of 10

Allocation result

Review your final quota and any payment or revenue before choosing catch.

Your initial quota	0
Final quota	4
Net quota payment	16.0 ECU

A negative payment represents sale revenue.

Units traded or allocated	12
Applied price	4.0 ECU
Your unit cost	1.0 ECU

Continue

Powered by [oTree](#)

Figure 7.6: Awarded quota and uniform price.

7.8 Imperfect enforcement

Individual quota is 3, but the menu permits up to 6. Every excess unit faces a 50% audit probability and a 12 ECU fine. Expected sanction is 6, greater than the largest private margin of 5. The risk-neutral benchmark predicts compliance, although choices and random audit realizations may differ.

Project excess rate, audit count, and fines. Do not divide audits by all decisions if the system draws an audit only after an excess. State the denominator before comparing groups.

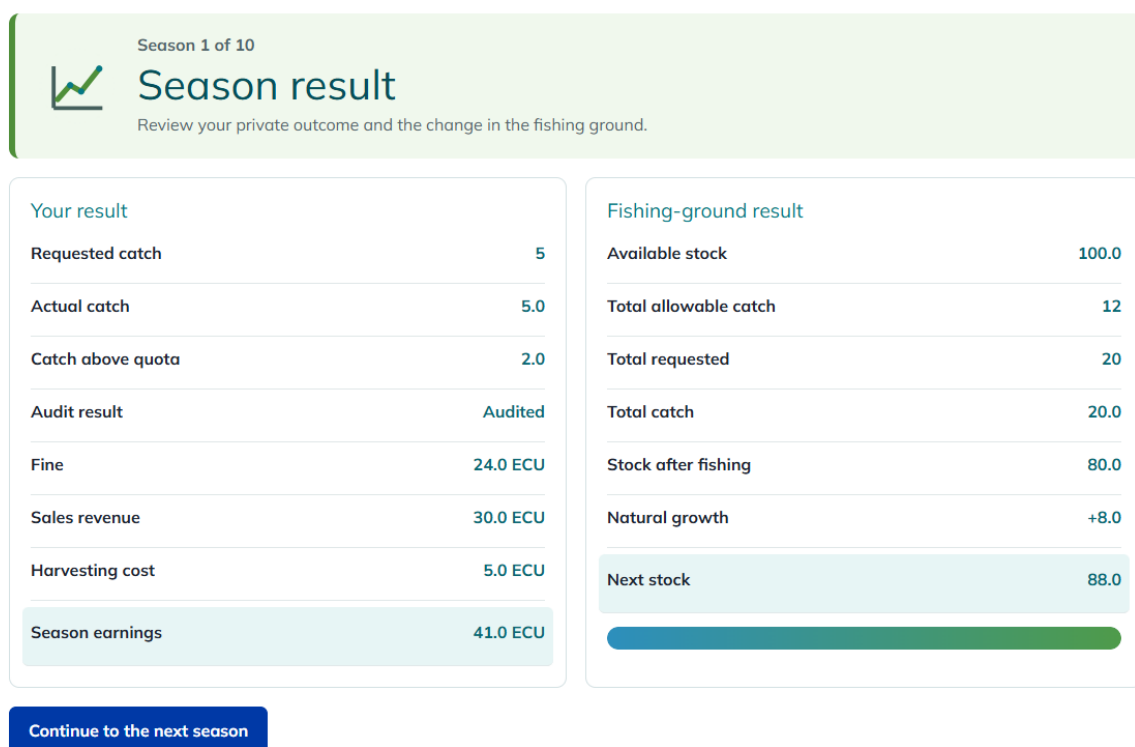
Powered by [oTree](#)

Figure 7.7: Outcome separating excess catch, audit, and fine.

Step-by-step implementation

8.1 Before class

Choose one central question and one comparison. Verify that computers reach the domain, the browser shows one page title, and configuration language is correct. Create a four-person rehearsal and reach Report. Prepare a slide with the room route rather than participant-specific links.

Decide what to do when attendance is not divisible by four. Observers can record predictions, or the instructor may complete a group in private windows. Document any intervention. Do not alter the rule after seeing choices because the procedure would become an endogenous response to outcomes.

8.2 During decisions

Give only essential oral instructions: remain quiet, use ECU, attend to stock, TAC, cost, and rights, and raise a hand for help. Do not explain which decision maximizes earnings. For markets and auctions, remind participants that an order may be partially filled. Under enforcement, do not predict who will be audited or interpret one random draw.

Monitor identifies stalled pages. If a browser closes, retrieve the current participant link. “This user does not exist in the database” indicates an old link or a reset database; create a new session or recover the current link rather than inventing a user.

8.3 Before revealing results

Request three predictions: final stock, TAC utilization, and the relation between unit cost and final quota. Add violation and fines under imperfect enforcement. Ask for numerical ranges when possible. Then confirm no observations are pending and reveal Report. This pause reduces hindsight explanations.

8.4 After the session

Record configuration, attendance, timing, incidents, oral additions, and instructor actions. Download data if the course will use follow-up exercises. End by separating classroom outcome, compatible mechanism, and external evidence. The session is neither causal evaluation nor policy advice.

Feedback scripts and class plans

9.1 Fifteen-minute feedback script

Begin with the physical trajectory: “How much could be caught, how much was requested, how much was actually caught, and what stock remained?” Continue with allocation: “Did rights move toward lower-cost fishers?” Move to payments: “Who earned from harvest and who earned by selling?” End with policy: “Did the institution control quantity, allocate efficiently, and distribute rents defensibly?”

For enforcement, replace allocation with: “What was the private gain from excess and the expected sanction?” Contrast observed violations, audits, and fines. For permissive quotas, ask whether anyone violated the rule. The answer can be no even as stock deteriorates, separating legality from sustainability.

9.2 Fifty-minute class

Use ten minutes for instructions, fifteen for ten seasons, twenty for Report, and five for closure. Select one extended institution. Ask observers to predict trajectories and allocation. During feedback, reconstruct one complete season on the board and connect every line to the report.

For transferable quotas: predict buyers and sellers; execute; inspect volume; compare quota by cost; reconstruct one buyer and one seller payoff; discuss efficiency and equity. For auctions, add uniform price and revenue. For adaptive quota, draw stock and TAC as two lines.

9.3 Ninety-minute comparison

Split the class into simultaneous treatments or run two consecutive sessions with fresh instructions. Recommended comparisons are collective versus individual quota, conservative versus permissive limit, free allocation versus auction, and perfect versus imperfect enforcement. Keep biology and costs constant so that differences can be connected cautiously to the institution.

Comparative feedback should display denominators and dispersion. Two groups are not a large sample, and a trajectory can depend on group composition. Present contrasts as illustrations and use published evidence to discuss patterns observed in larger samples.

9.4 Discussion questions

1. Does a TAC guarantee sustainability? What information does the manager need?
2. Why can collective TAC induce maximum requests even while actual catch is capped?
3. Which initial allocation would you choose: historical catch, equality, auction, community shares, or lottery?
4. When does transferability improve efficiency, and when can it concentrate economic power?
5. Should auction revenue support fishing communities, monitoring, or the general budget?
6. How would compliance change if audit probability were unknown?
7. Which missing variable most limits direct application to a real fishery?

Feedback script

Require each claim to name an indicator. “The market worked” should become a testable statement: low-cost types held more final quota, trading volume was positive, and net earnings rose without increasing TAC.

Solved exercises

10.1 Exercise 1: reconstruct a season

Starting stock is 100, TAC is 12, and catches are 3, 3, 2, and 0. Total catch is 8 and 92 remain. Growth is $0.5 \times 92 \times 0.08 = 3.68$, so next stock is 95.68. With unit costs 1, 2, 4, and 7, ECU are 55, 52, 44, and 40. Quota utilization is $8/12 = 66.7\%$. Allocated rights and actual harvest are not synonyms.

10.2 Exercise 2: collective TAC

Requests are 10, 8, 6, and 4 under TAC 12. Total demand is 28. Proportional catches are 4.29, 3.43, 2.57, and 1.71, which sum to 12. If everyone doubles a request, shares are unchanged. If only one person increases, that person gains a larger share. Relative competition persists under a hard aggregate cap.

10.3 Exercise 3: trading

Everyone starts with quota 3. At price 3, the cost-1 type buys two units from the cost-7 type. If rights are used optimally, the buyer catches 5 and earns 59 ECU; the seller catches zero and earns 46. Without trade, they would earn 55 and 40. Their joint earnings rise from 95 to 105, and the payment redistributes rent.

10.4 Exercise 4: uniform-price auction

Four participants demand four units with bids 5, 4, 2, and 0. TAC is 12. The twelve units demanded by the first three bidders win, and uniform price is 2. Each receives four. The cost-4 type has gross margin 2 and pays 2, leaving zero incremental surplus. Ask what happens if the cost-7 type mistakenly bids 8.

10.5 Exercise 5: expected sanction

For the cost-1 type, an excess unit yields 5 ECU before penalties. With 50% audit and fine 12, expected sanction is 6. Expected incremental value is $5 - 6 = -1$. For cost 4, it is $2 - 6 = -4$. A

risk-neutral participant should comply, but a person may misunderstand probability, extrapolate from a no-audit streak, or doubt enforcement.

10.6 Exercise 6: compare catch limits

Compute one transition from stock 100 when every right is used. Under TAC 8, 92 remain, growth is 3.68, and next stock is 95.68. Under TAC 12, next stock is 93.28. Under TAC 20, 80 remain, growth is 8, and next stock is 88. Repeat ten times. Cumulative differences show why first-season outcomes understate the danger of permissive limits.

10.7 Exercise 7: design a policy

Propose a TAC, allocation rule, transferability condition, accumulation cap, audit system, and destination for revenue. For every element, state the objective, required information, strategic response, and evaluation metric. A complete answer recognizes tradeoffs: precaution preserves biomass but restricts income, while auctions collect rent but may exclude liquidity-constrained participants.

Interpretation, limitations, and responsible use

11.1 What the session can support

The report establishes what choices occurred under known rules. It can show that requests exceeded TAC, trade occurred, quota moved toward lower-cost types, or stock declined. These facts are compatible with theoretical incentives, learning, or norms. One class session does not identify motivation or generalize to populations of commercial fishers.

Do not treat each season as independent. Choices by the same person and stocks of the same ground are correlated. Formal research should analyze the level of treatment assignment. In class, state that repeated observations illustrate trajectories and do not automatically multiply sample size.

11.2 Efficiency, distribution, and conservation

Productive efficiency asks whether authorized catch is produced at lower cost. Dynamic efficiency asks whether harvesting maximizes present value including future stock. Distribution asks who receives rents, pays for rights, and bears adjustment. Conservation asks what biomass and risk remain. An institution may improve one dimension and worsen another.

Auction payments are private costs but transfers to the authority, not automatic destruction of social surplus. Fines are also transfers when collected, although enforcement consumes resources. The application reports private ECU and does not construct complete welfare. State this limitation before summing payoffs.

11.3 Privacy, accessibility, and debriefing

Never project participant codes or personal links. Describe aggregate patterns and avoid moral labels. Ensure adequate contrast, readable numbers, and enough time for comprehension. Offer private assistance without choosing for a participant. Debrief by explaining the educational purpose, random audit rule, and simplified nature of the model.

11.4 From the classroom to policy

Real fisheries involve multiple species, scientific uncertainty, unreported catch, market power, credit, coastal communities, safety, and cultural goals. Catch shares may lengthen seasons and reduce racing, while also concentrating rights or displacing labor. Use the activity to organize design questions rather than to claim universal superiority for one tool.

Data, reproducibility, and diagnostics

12.1 Exported variables

The export includes session, participant, round, language, edition, treatment, matching, ground, position, unit cost, stock, TAC, initial quota, trade request, quota change, final quota, price and payment, auction bid and demand, requested and actual catch, excess, audit, fine, aggregate request and catch, remaining stock, growth, next stock, revenue, harvesting cost, and ECU. Codes are necessary for file structure but must not be projected.

To reproduce the report, retain active rounds and completed groups. Build choice histograms from decisions, trajectories from ground-seasons, and final biomass from one observation per ground. Separate treatments before averaging. In markets distinguish quota change from catch; under enforcement distinguish excess from audit realization.

12.2 Frequent problems

If someone remains on a wait page, check Monitor and confirm the other three submitted the corresponding page. “This user does not exist in the database” means the link belongs to an old session or reset database. If Report will not reveal, an expected observation is pending. If Demo lists other games, the instance is not isolated. If English screens use decimal commas or Spanish footer text, restart the updated server and verify the shared localizer.

A market can have zero volume even with orders when everyone wants to buy or everyone wants to sell. An auction can allocate less than TAC when total demand is insufficient. Collective rationing can produce decimal catches. These outcomes follow from the rules and are not calculation errors.

12.3 Technical validation

Before deployment, compile Python, run bots for all 22 configurations, and traverse every branch in a browser. Check Demo, Rooms, and all four room routes under `GAME_FAMILY=fisheryquotas`. Restart the local process after changing code or templates; `prodserver` and `devserver_inner` do not hot-reload.

Glossary and references

13.1 Glossary

TAC	Total allowable catch for one ground in one season.
Individual quota	Exclusive privilege to catch a quantity within TAC.
Transferable quota	Right that can be bought, sold, or leased under the rule.
Uniform price	Common price paid by all winning auction units.
Stock	Biomass available at the beginning or end of a season.
Flow	Harvest or growth occurring during a season.
Resource rent	Surplus associated with access to a scarce natural resource.
Quota use	Catch within rights divided by allocated units.
Excess catch	Actual catch beyond an individual quota.
Enforcement	Monitoring and sanctions that sustain a rule.

13.2 Core readings

- Gordon, H. S. (1954). “The Economic Theory of a Common-Property Resource: The Fishery.” *Journal of Political Economy*, 62(2), 124–142. <https://doi.org/10.1086/257497>.
- Moloney, D. G., and Pearce, P. H. (1979). “Quantitative Rights as an Instrument for Regulating Commercial Fisheries.” *Journal of the Fisheries Research Board of Canada*, 36(7), 859–866. <https://doi.org/10.1139/f79-124>.
- Dewees, C. M. (1998). “Effects of Individual Quota Systems on New Zealand and British Columbia Fisheries.” *Ecological Applications*, 8, S133–S138. [https://doi.org/10.1890/1051-0761\(1998\)8\[S133:EOIQS0\]2.0.CO;2](https://doi.org/10.1890/1051-0761(1998)8[S133:EOIQS0]2.0.CO;2).
- Costello, C., Gaines, S. D., and Lynham, J. (2008). “Can Catch Shares Prevent Fisheries Collapse?” *Science*, 321(5896), 1678–1681. <https://doi.org/10.1126/science.1159478>.
- Moxnes, E. (1998). “Not Only the Tragedy of the Commons: Misperceptions of Bioeconomics.” *Management Science*, 44(9), 1234–1248. <https://doi.org/10.1287/mnsc.44.9.1234>.
- Moxnes, E. (2012). “Individual Transferable Quotas versus Auctioned Seasonal Quotas: An Experimental Investigation.” *Marine Policy*, 36(2), 339–349. <https://doi.org/10.1016/j.marpol.2011.07.003>.
- NOAA Fisheries. “Catch Shares” and “Glossary: Catch Shares.” Institutional reference for

TAC, IFQ, ITQ, transferability, and accumulation caps. <https://www.fisheries.noaa.gov/insight/catch-shares>.

Attention

The sources support the mechanisms and related evidence. This activity is a classroom adaptation rather than an exact replication of one paper. The posted-price market and one-bid auction deliberately simplify real institutions.

13.3 Printable checklist

13.4 Preparation

- ☐ I selected a comparison aligned with the course objective.
- ☐ I confirmed language, edition, treatment, and capacity divisible by four.
- ☐ I tested Demo, room, first decision, completion, and Report.
- ☐ I prepared the stable route, attendance contingency, and prediction questions.
- ☐ I opened Monitor and Report in private instructor tabs.

13.5 Implementation

- ☐ I explained silence, ECU, and the distinction among stock, TAC, and quota.
- ☐ I avoided suggesting a choice and handled questions privately.
- ☐ I confirmed everyone completed the session before revealing results.
- ☐ I recorded incidents, oral additions, and instructor interventions.

13.6 Closure

- ☐ I requested predictions before projecting Report.
- ☐ I separated sustainability, efficiency, distribution, and compliance.
- ☐ I explained denominators and limitations.
- ☐ I stored data and notes with appropriate privacy.