# Supplementary File: Possible Extensions and Modifications

We provide the spreadsheet and all materials in editable and customizable formats so that the instructor can modify the game to their purposes. As noted previously, the instructor can cut some treatments or add repetitions of others, or change the later treatments to use auctions instead of flat payments. Parameters can also be changed to reflect situations of interest; for example, opportunity costs or externalities can be increased or decreased. It is also easy to modify the spreadsheet to create an increasing marginal cost of damages from the agricultural externality, though that requires more explaining to the participants.

Also, as noted earlier, the instruction text can be edited to highlight a different context; after all, ecosystem-based adaptation and the diffusion of new production techniques are as relevant in Indiana as in India. Indeed, the incentive structure of the game applies equally well to any setting in which technology could be adopted that yields uncertain private costs to the adopter but provides positive externalities to others, including many other cases of ecosystem service provision that have nothing to do with adaptation. In particular, the structure presented here translates well for water quality preservation in the context of developed countries and programs like Environmental Quality Incentives Program (EQIP)[[1]](#footnote-1) in the United States.

The game could be modified to receive participant decisions through cell phones, clickers, or a Google Form. This would speed up the game and would force participants to commit to their choices before they hear what others are doing. (There is, of course, a fixed cost associated with doing this, and we have found that verbal decisions work well enough for us.)

The instructor running the game can also invent their own treatments. There are infinite variations, but we list a few ideas here.

Negative Externalities with a Directional Flow

To emphasize a spatial or directional diffusion pattern for the flow of negative externalities, the instructor can make each row only affect some number of cells above and/or below that row in the spreadsheet. This is intuitive, because if the externality occurs through surface water quality, then there should be a downstream flow direction, and a limited diffusion, of the eroded sediment.

Additional Forms of Uncertainty

Additional uncertainty can be applied to different elements of the game and in different ways. Yield, in the case of no adoption, could be subject to risk, as it increasingly is in the era of climate change. That would bring up questions of risk-risk tradeoffs. Alternatively, the uncertainty could be a matter of risk-ambiguity tradeoffs. Depending on the degree of risk, the ecosystem-based adaptation practice could reduce the risk that the adopter faces while reducing average yield. Uncertainty could also be applied to the ecosystem benefits to highlight questions about whether government and individuals should respond differently to uncertainty. Uncertainty can also be added to the public benefits or costs of ecosystem-based adaptation. One way to do this would be say that each participant gets a randomly drawn amount of the total public benefits.

Technological Innovation

The instructor could bring endogenous innovation into the game rather than having the ecosystem-based adaptation technology be exogenously supplied. A group of participants can be designated to make decisions as the innovator instead of as farmers. The innovator chooses how much to invest, and this investment amount determines the systemic (shared) yield effect endogenously. Parameters should probably be set such that for some decisions, the average yield effect is positive so that participants would be willing to pay some positive price to adopt the technology; in this case, government payments would be replaced by a price paid to the innovator. There can be a first treatment in which this decision translates into productivity impacts without noise, and then a second with noise, to build complexity piece by piece. This version of the game might be best played using an auction in all rounds so that the price is endogenous.

Strategic Adoption

The game, as presented, is not strategic in a game theoretic sense because each participant has a dominant strategy: each participant’s decision affects others’ payoffs, but does not affect their best response (except through channels such as reciprocity and inequality aversion). The game can be modified to change that. For example, if early adopters can get property rights of the technologies they have adopted and then sell those technologies to others in later periods, this can set up a gold rush-type incentive. As another example, there could be multiple possible adaptation practices available at once, with complementarities such that more benefits are generated if more people coordinate on one practice.

1. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/> [↑](#footnote-ref-1)