WHAT'S NEW?? AT NATCAP

(Part I: Freshwater & Terrestrial)

New Models

Justin Johnson

Non-timber forest products model? "Foraging" Model? Other suggestions??

- We under-estimate the value of forests because we often miss the value of Non-Timber Forest Product (NTFPs)
- A new model is almost completed that will correct this

Why it is difficult to estimate the value of NTFP ecosystem services

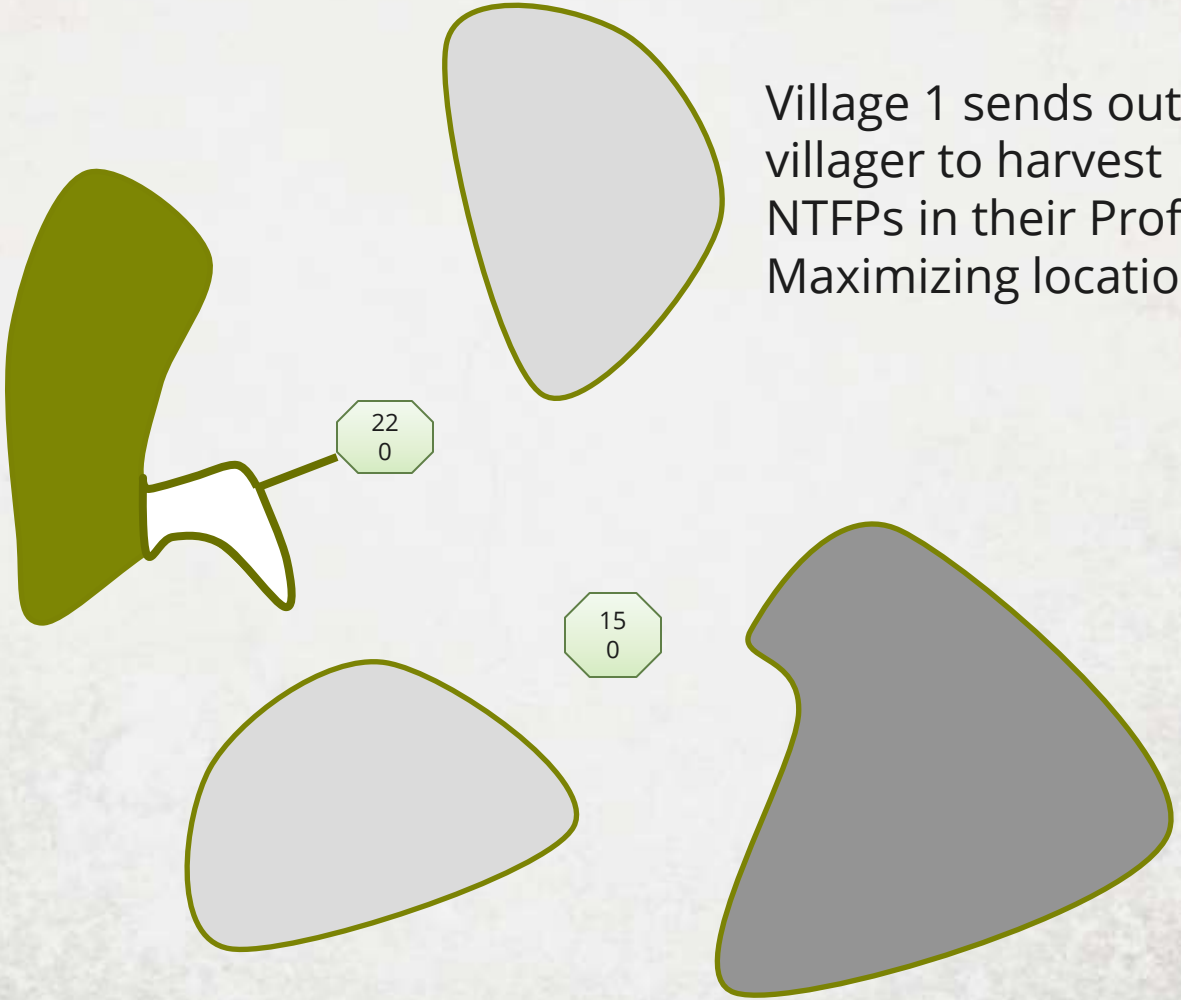
- The value of NTFPs depends on:
  - Proximity to population centers
  - Difficulty of traveling to location
  - Competition among agents

So … what do we do?

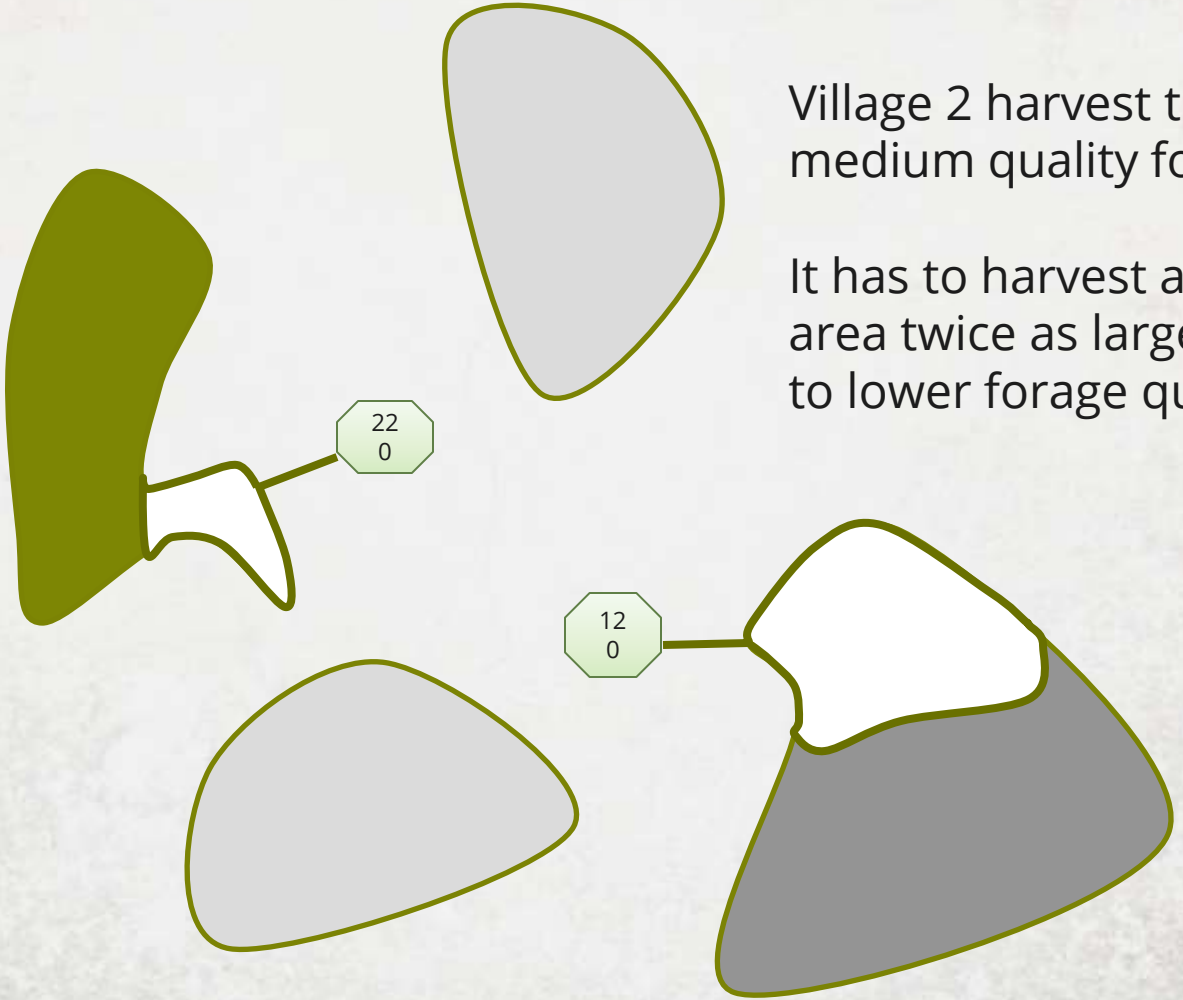
- Use “Agent-Based Simulation”
- Formal definition:
  - Analysis of how individual agents, defined by behavior rules, interact and affect the system in which they operate.

Defining an NTFP Foraging Simulation

- Hexagons= villages and NTFP demand
- Green= good forests
- Grey= lower quality forests



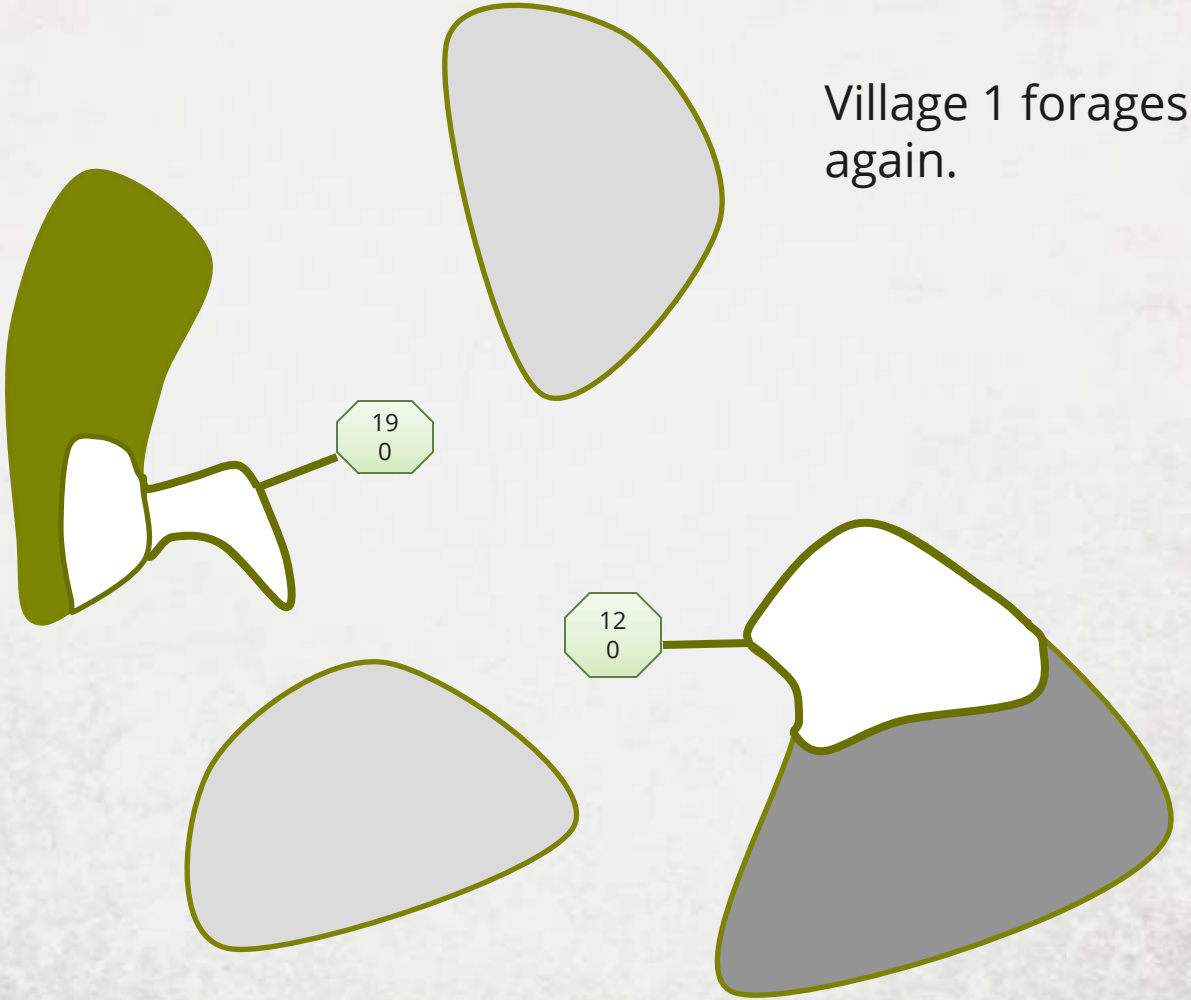
Village 1 sends out a villager to harvest NTFPs in their Profit Maximizing location



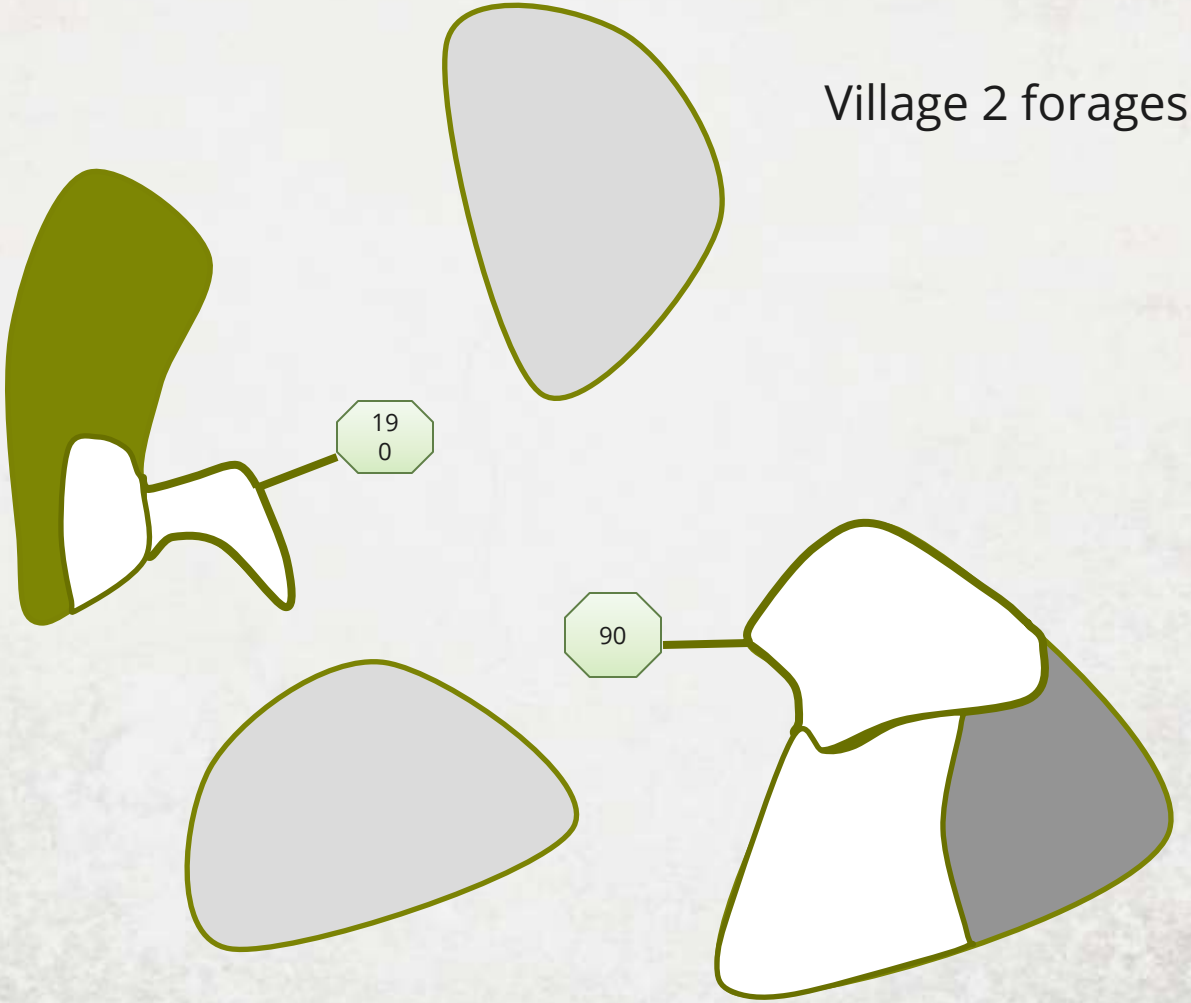
Village 2 harvest the medium quality forest.

It has to harvest an area twice as large due to lower forage quality.

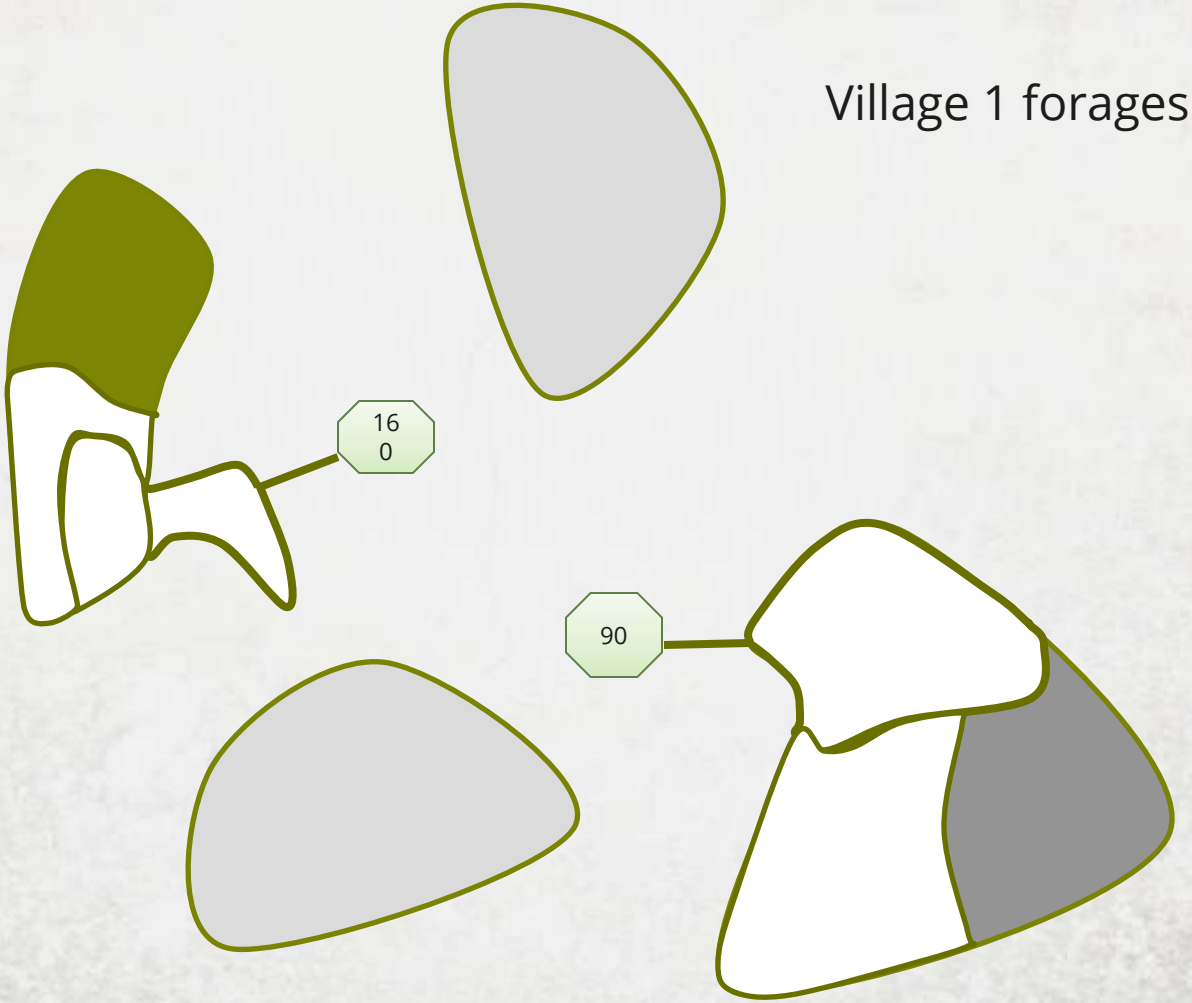
Village 1 forages again.

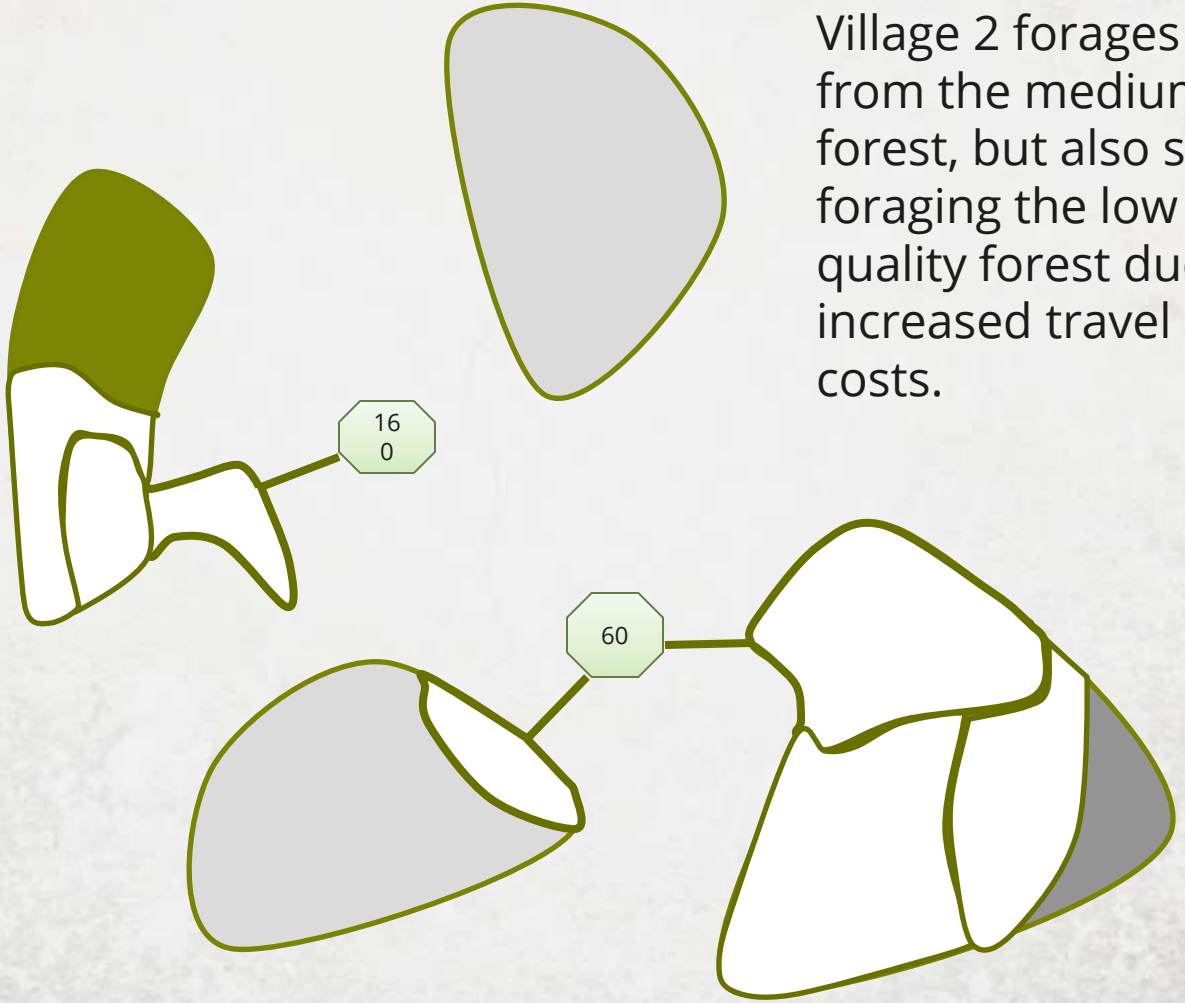


Village 2 forages.



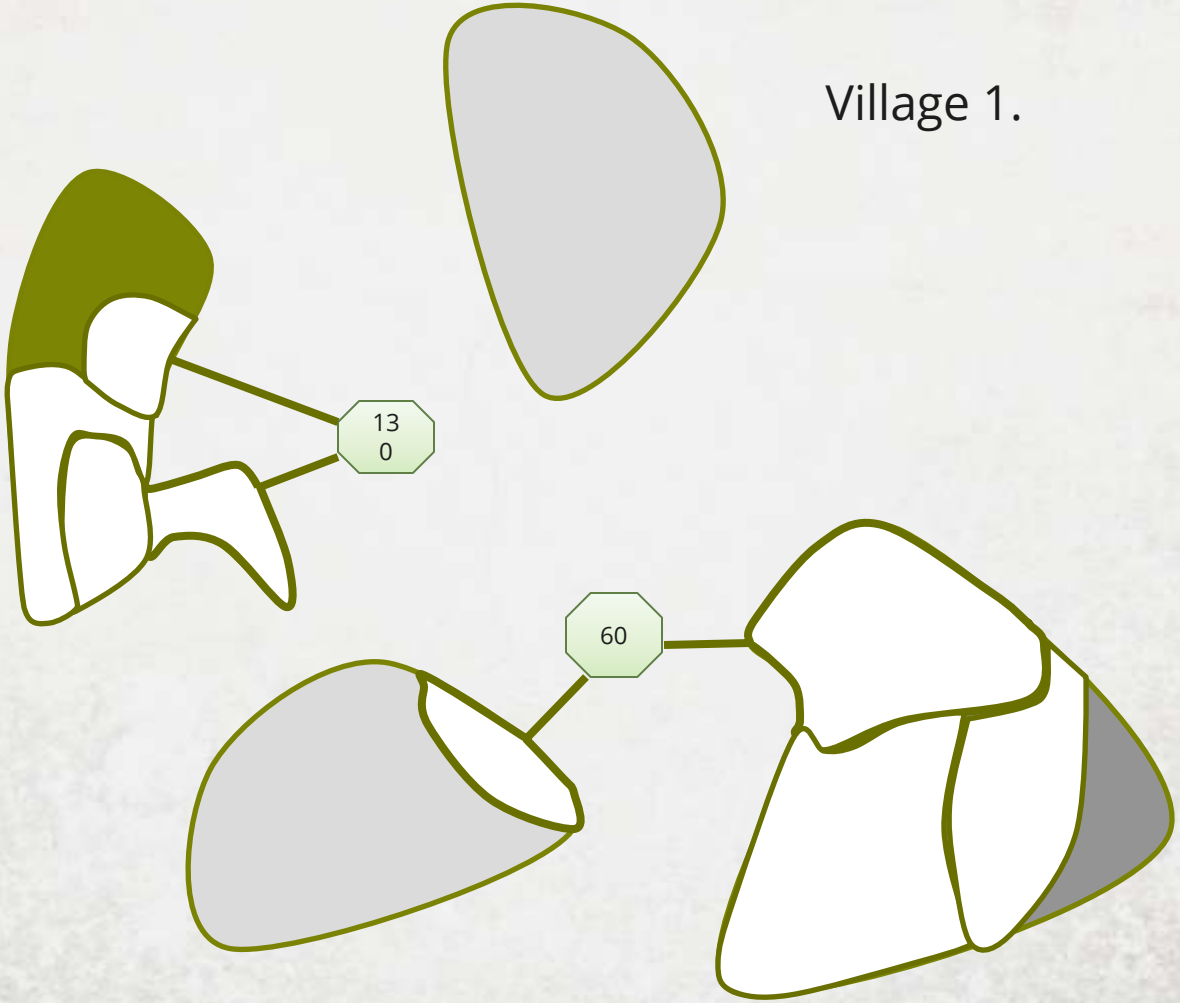
Village 1 forages.





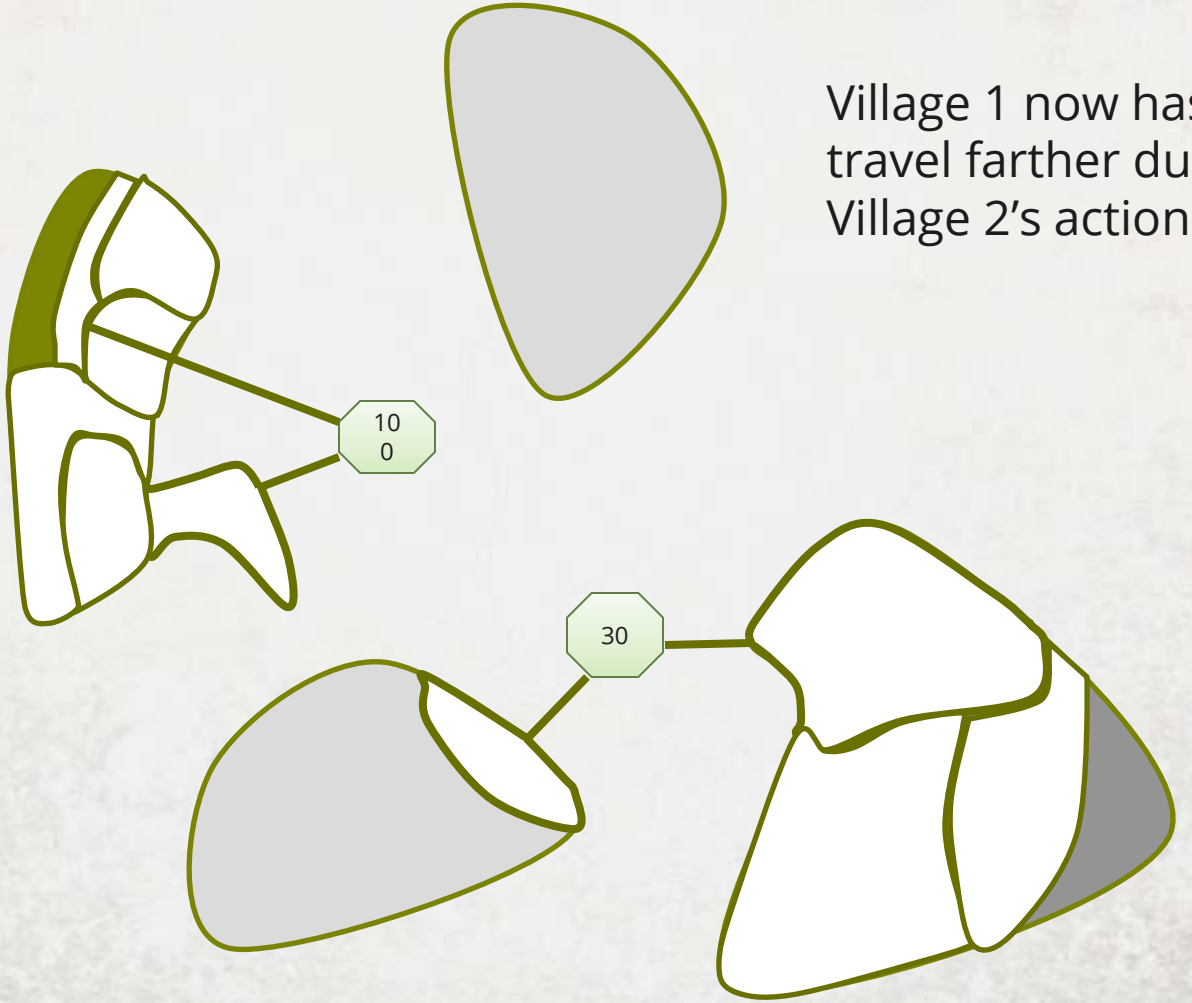
Village 2 forages from the medium forest, but also starts foraging the low quality forest due to increased travel costs.

Village 1.

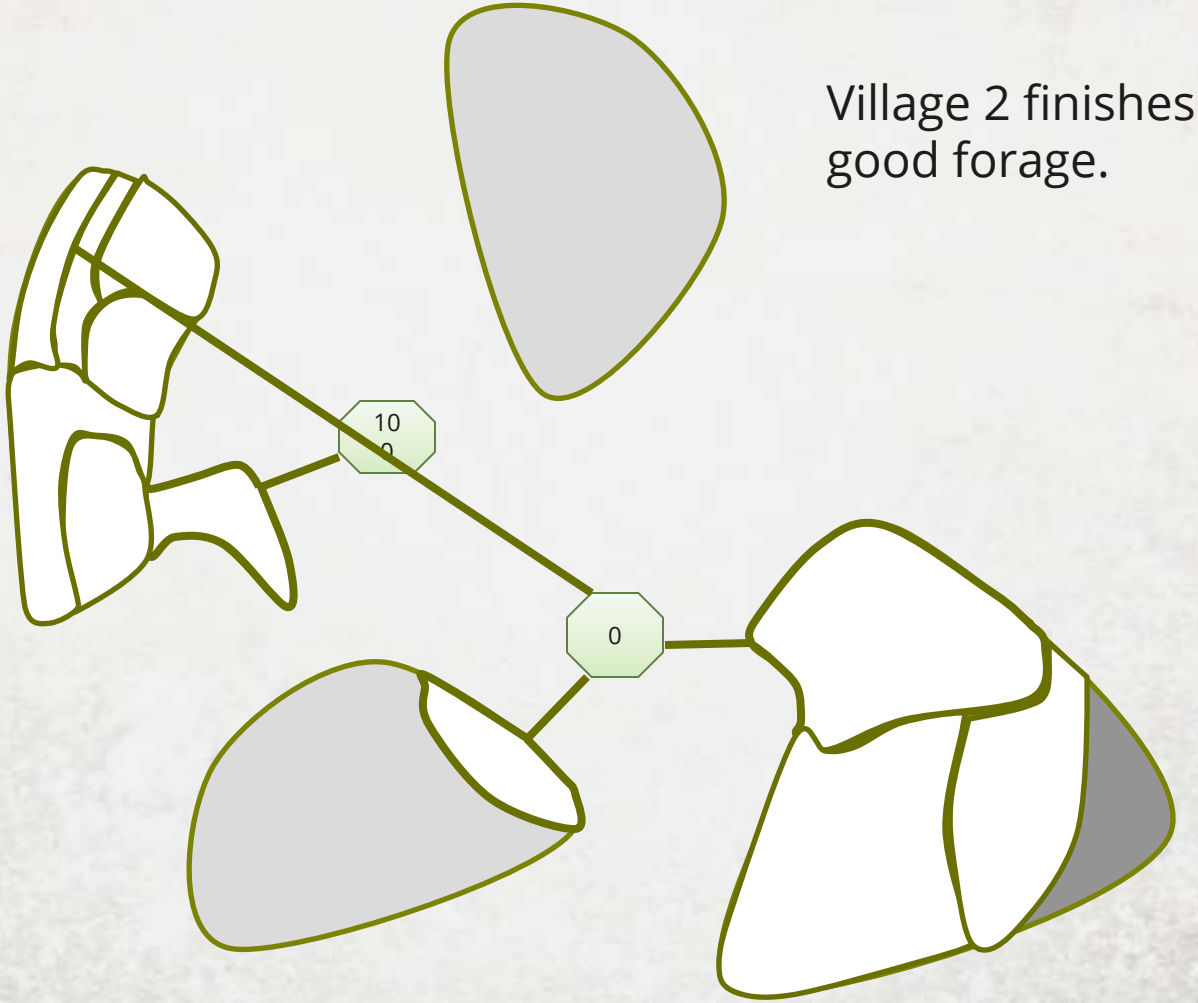


Village 2 “steals” from to good forest.

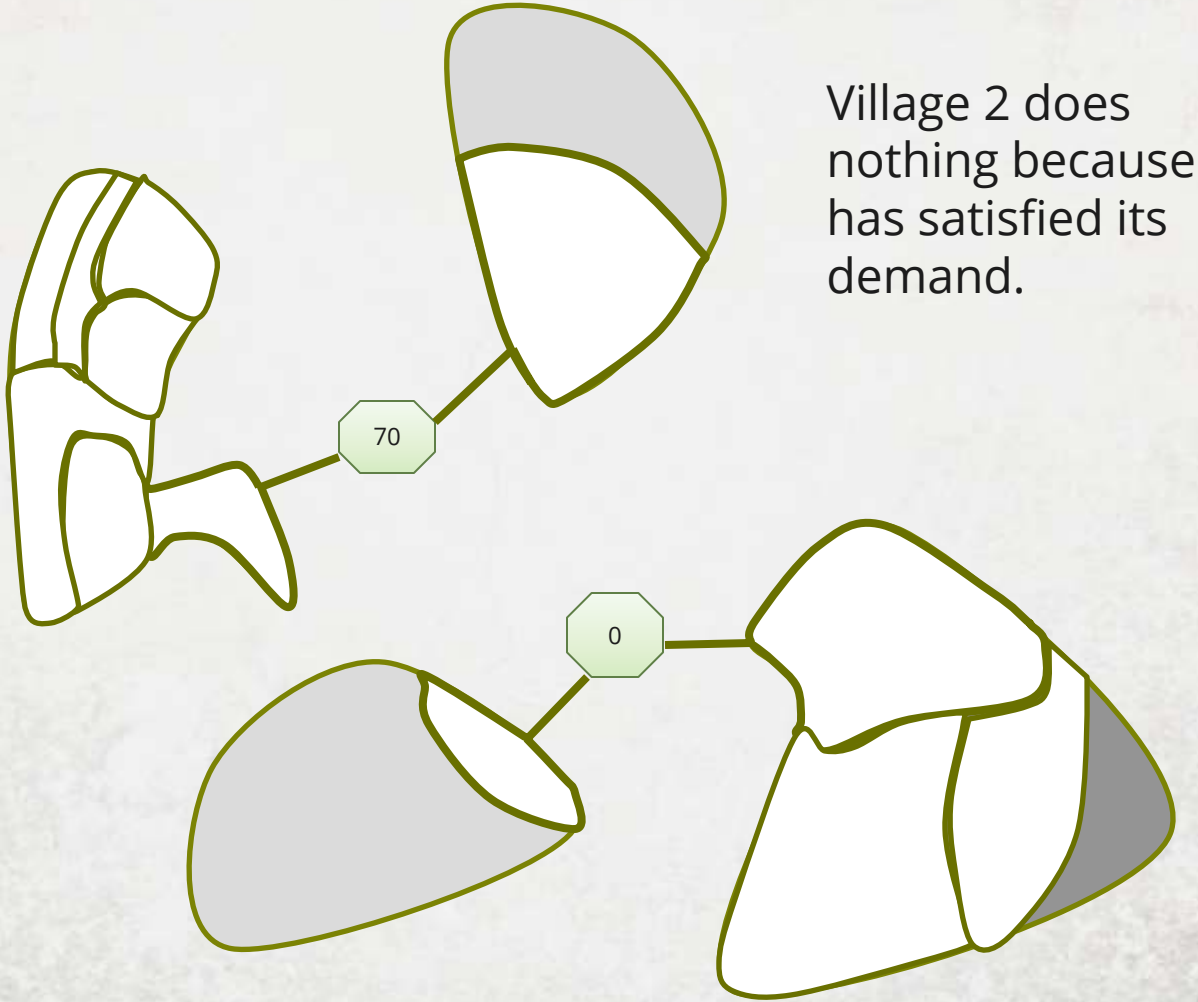
Village 1 now has to travel farther due to Village 2's action.



Village 2 finishes the good forage.



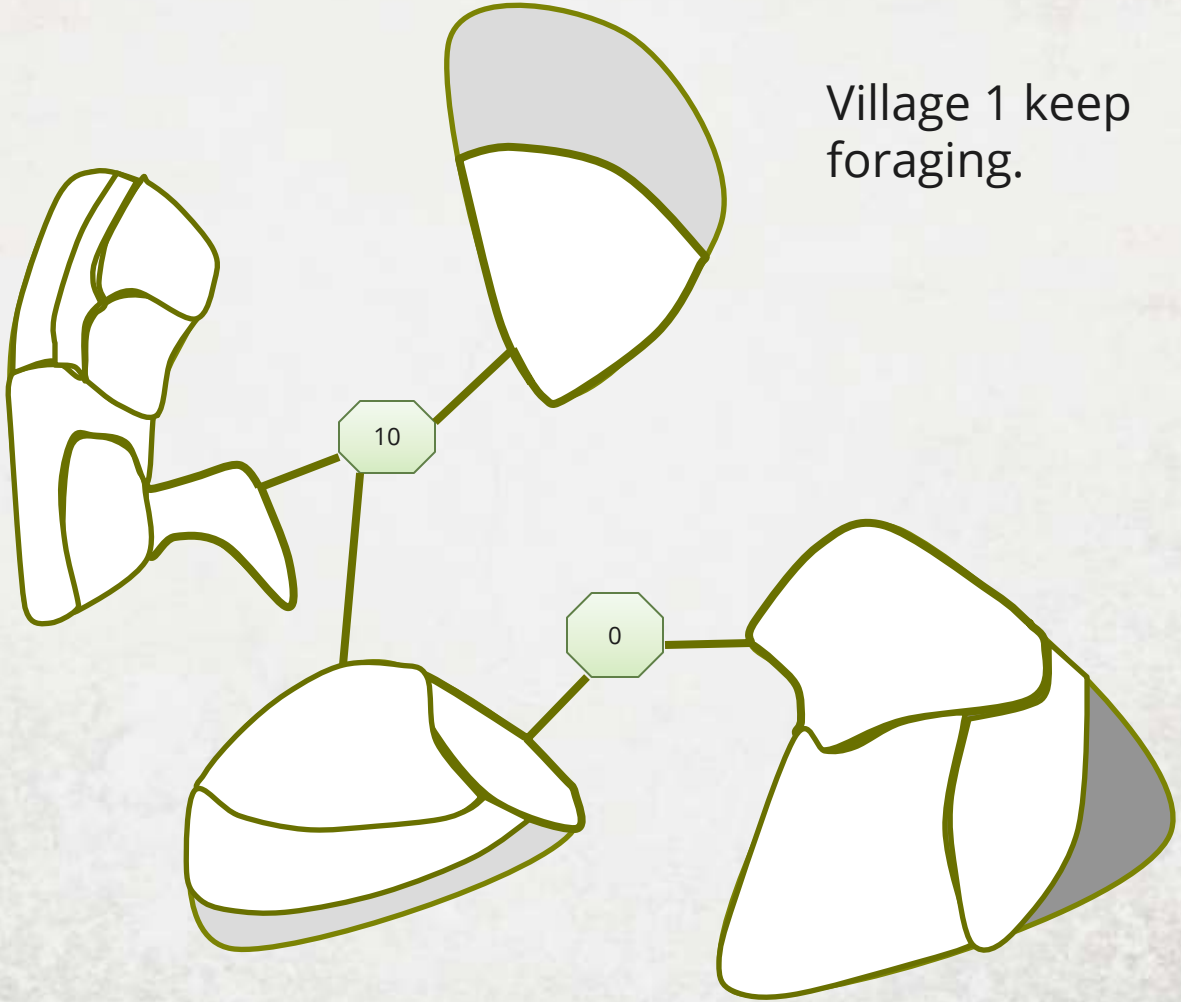
Now Village 1 switches to the low quality forest.



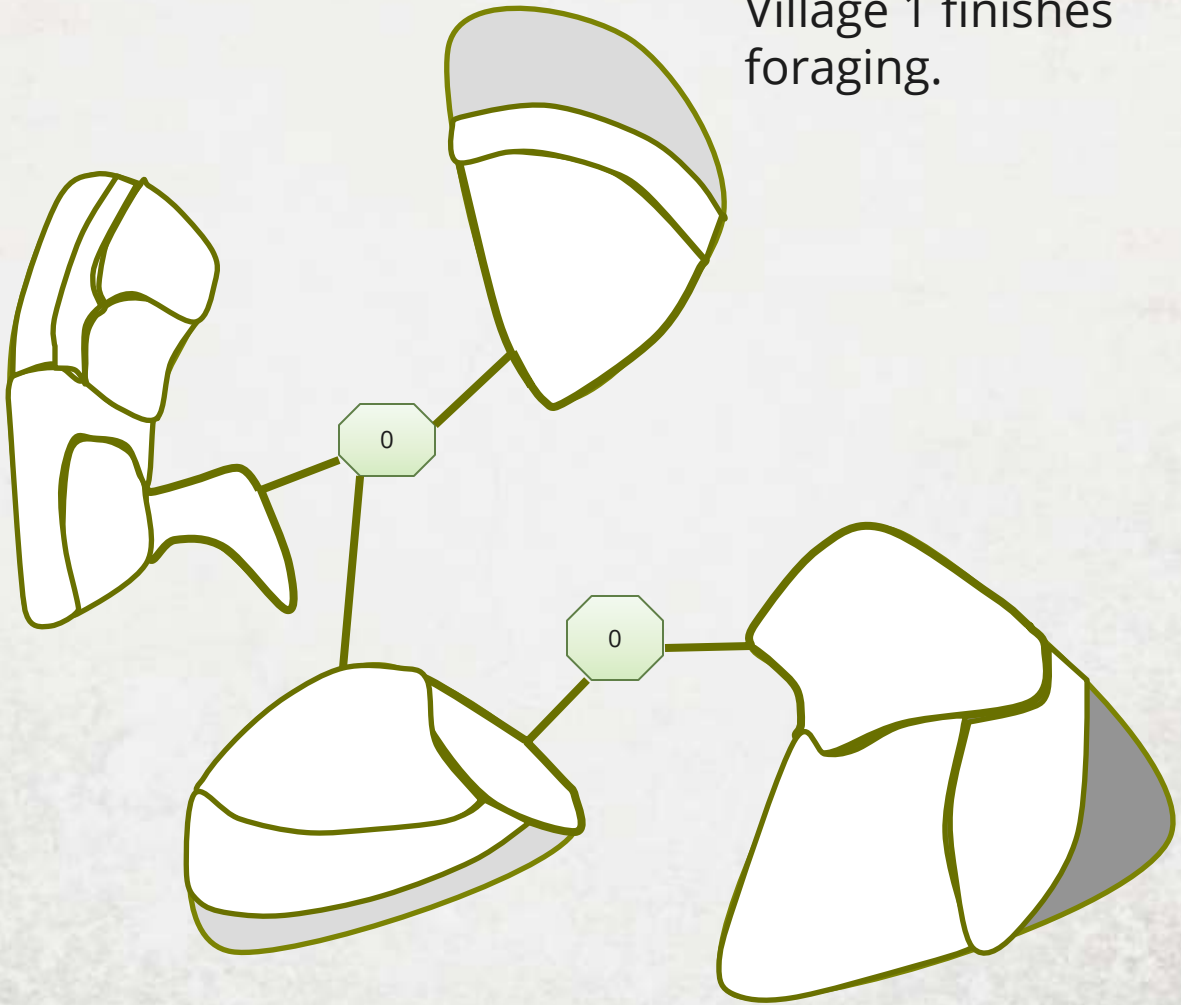
Village 2 does nothing because it has satisfied its demand.

Village 1 forages in the southern low-quality forest. This will continue until either all villages have met their demand, or the forests are fully
ted

Village 1 keep foraging.

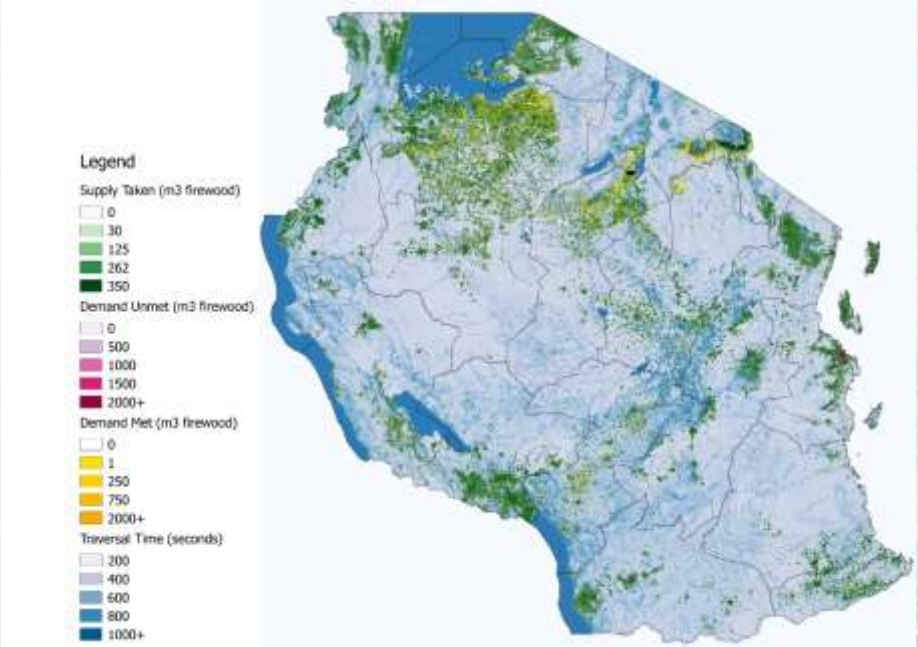


Village 1 finishes foraging.



EXAMPLE: TANZANIA

- The yellow pixels represent agents that gather firewood
- By foraging in green cells

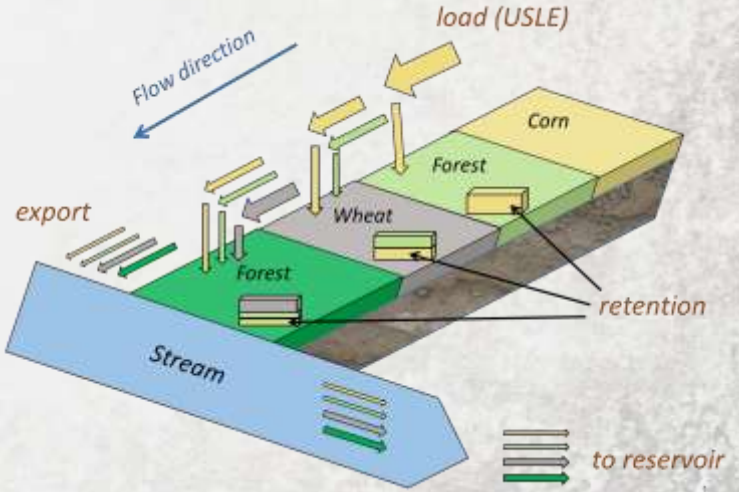


MODEL CHANGES

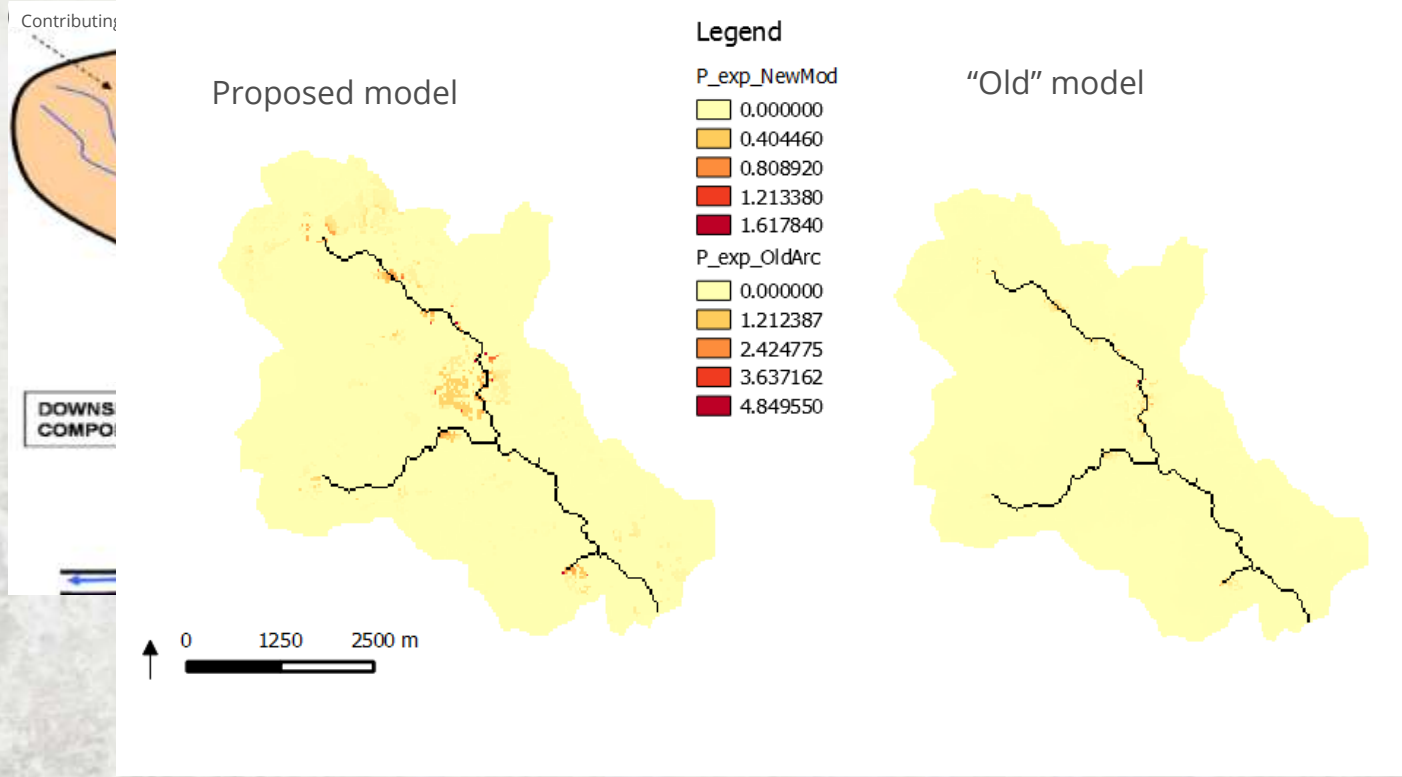
Perrine Hamel

NUTRIENT/SEDIMENT
WHY (SLIGHTLY) CHANGE THEM?

- Model structure
  - values of retention depend on the cell size
  - overestimates retention (does not cap the retained nutrients)
- Processes:
  - difficult representation of instream processes
  - hydrologic sensitivity score?
- Parameter values:
  - poor guidance for retention values



NUTRIENT/SEDIMENT
PROPOSED MODELS (BEING TESTED)



s:

s

neters (more literature)

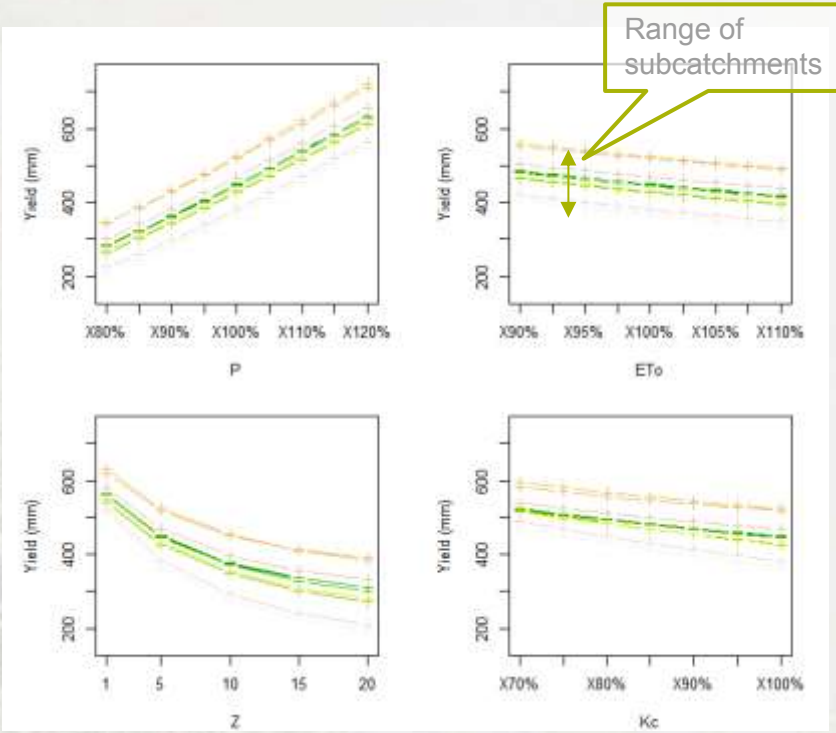
ty for the user model nutrient rent flow path)

sediment)

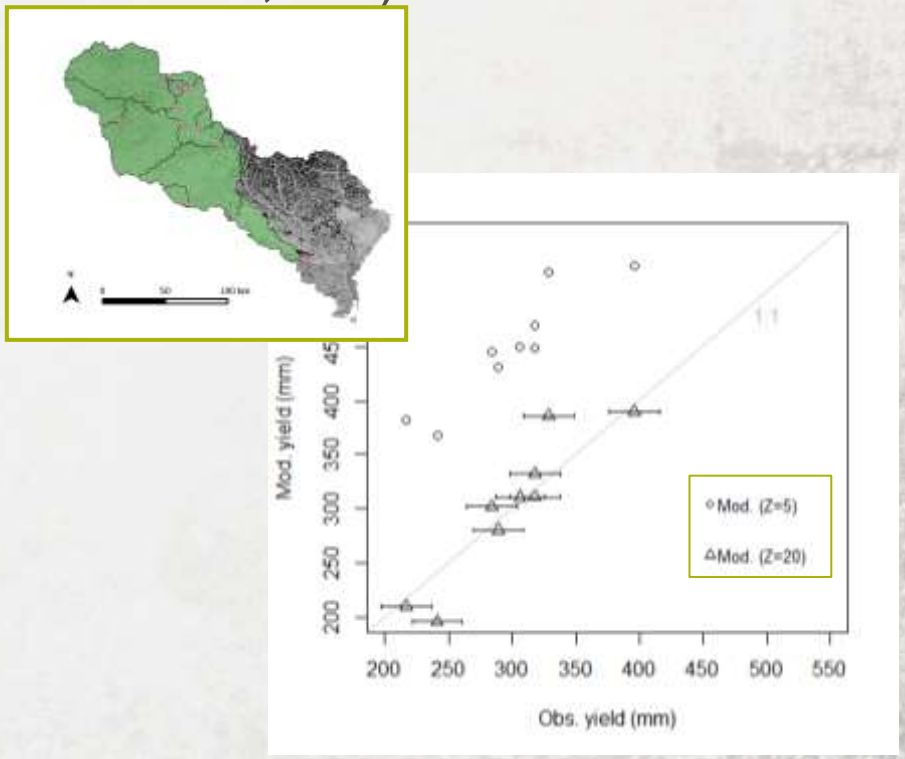
nent models
ucture

MODEL SENSITIVITY, CALIBRATION

BATCH RUNS (E.G. WATER YIELD IN CAPE FEAR, NC)



Sensitivity of the annual water yield model to main inputs



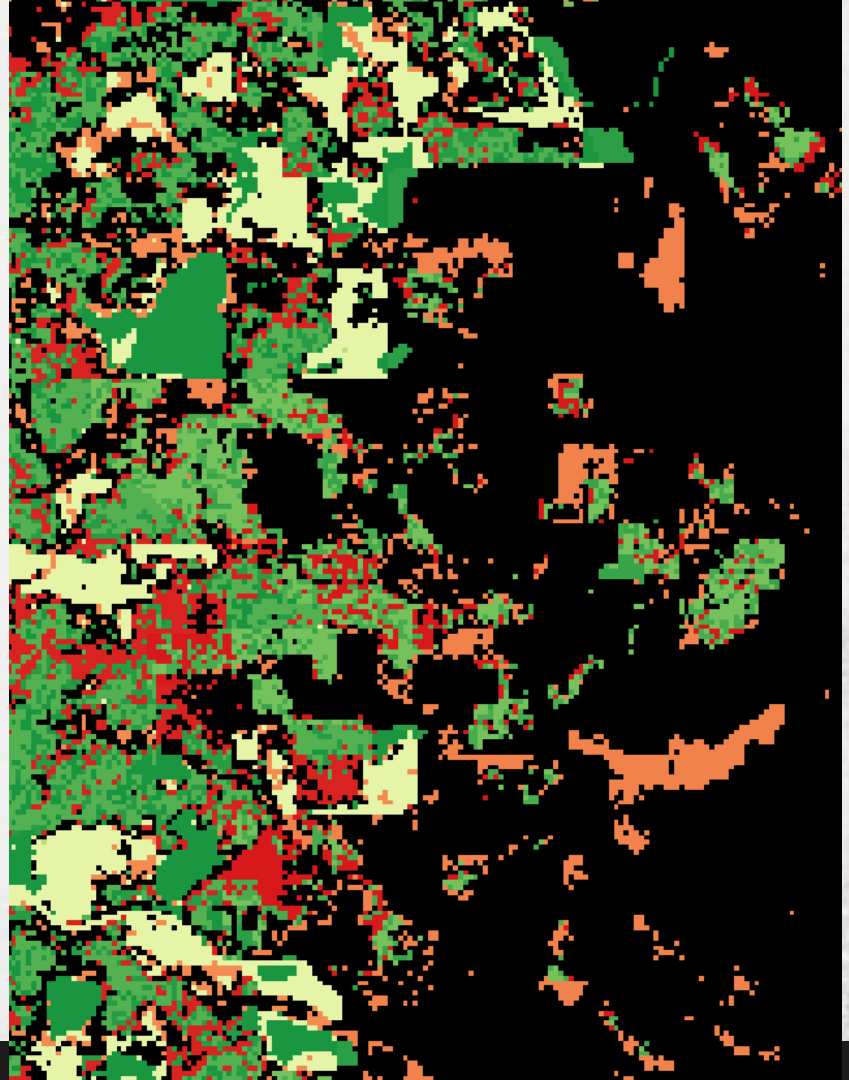
Calibration of the water yield model (error bars represent observations being corrected for groundwater withdrawals)

CARBON MODEL

Uncertainty analyses

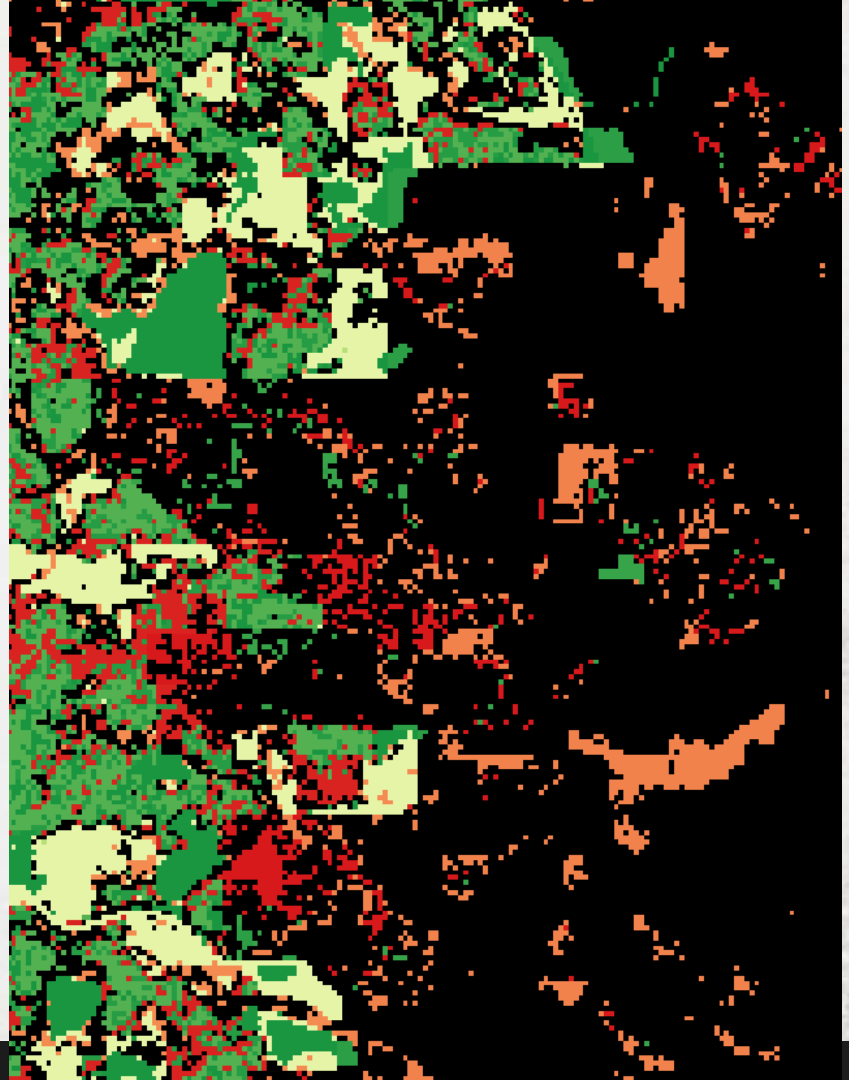
CARBON MODEL

Confidence interval: 90%

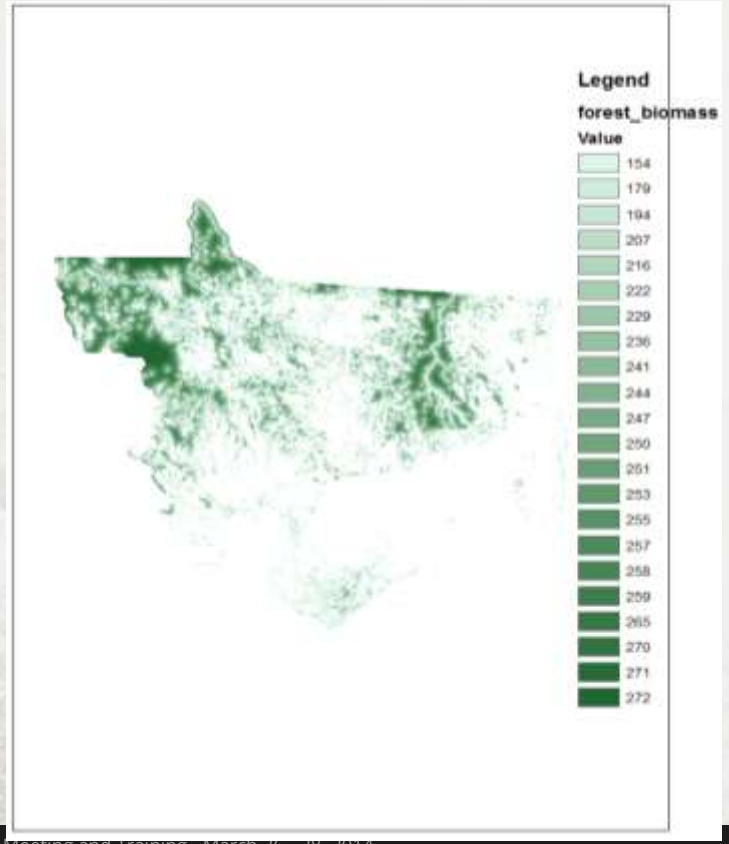


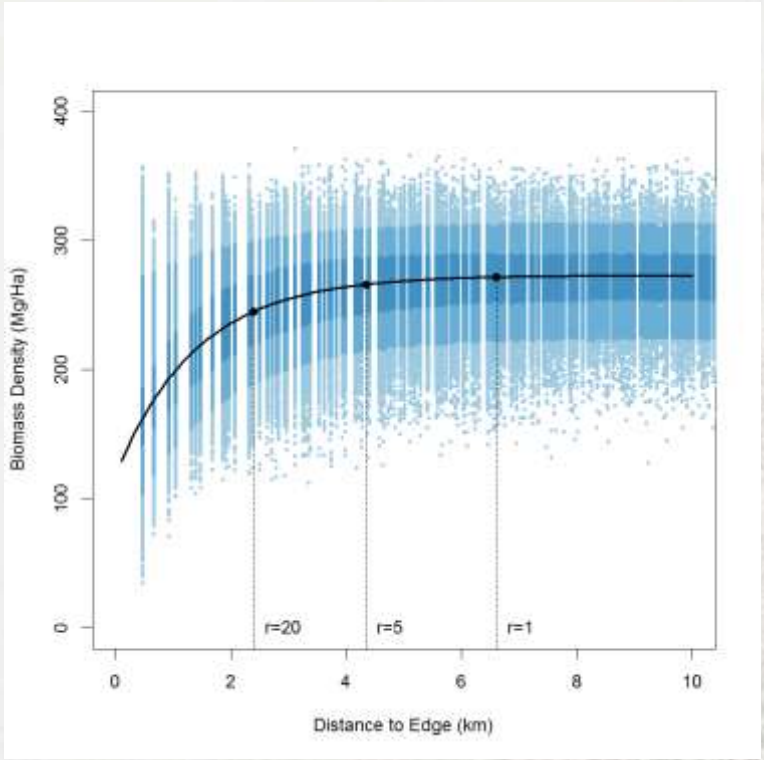
CARBON MODEL

Confidence interval: 95%



CARBON MODEL
exploring edge effects





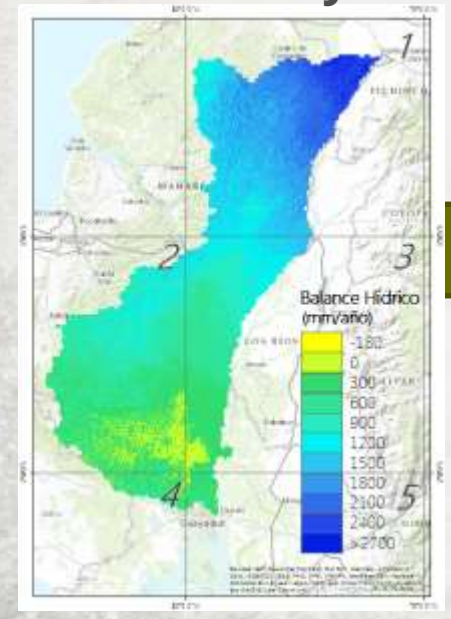
LINKING MODELS

Adrian L. Vogl

RIOS + WATERWORLD

WaterWorld

Sensitivity



Spatial Allocation

RIOS

Test Case:

Investing in the Daule River Water Fund in Ecuador

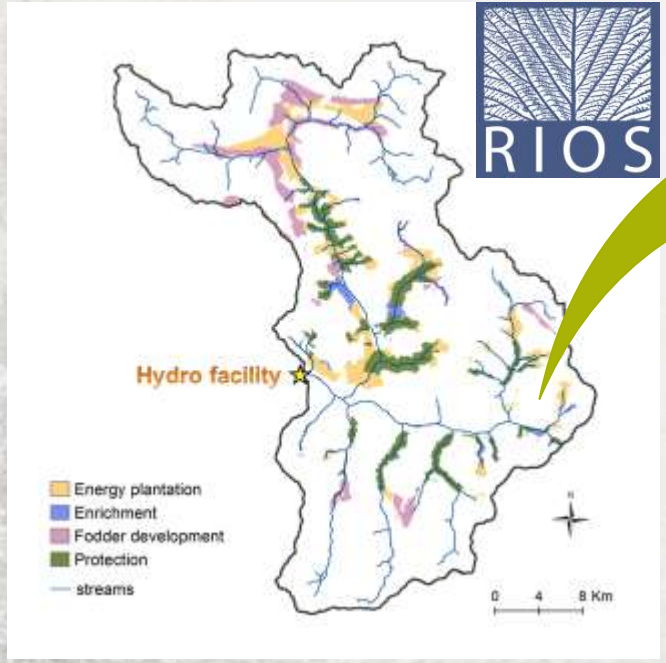
WaterWorld

Impacts on Services

	Scen1	Scen2
Soil erosion	+	−
Soil deposition	−	+
Water quality	−	+

Leo Zurita, Beth-Sua Carvajal and Mark Mulligan (King's College London)
Silvia Benitez, Juan Sebastian Lozano, Jorge Leon (The Nature Conservancy)

RIOS + SWAT + VALUATION



Test Cases:

Hydropower Production in India

Water Funds Return on Investment in Kenya

Stacie Wolny, P. J. Dennedy-Frank, Perrine Hamel, Justin Johnson, Martha Rogers, Johannes Hunink, Peter Droogers

OPTIMIZATION

Peter Hawthorne

Landscape Optimization & Spatial Prioritization

Key questions:

How to coordinate changes across a landscape?

How to balance multiple objectives?

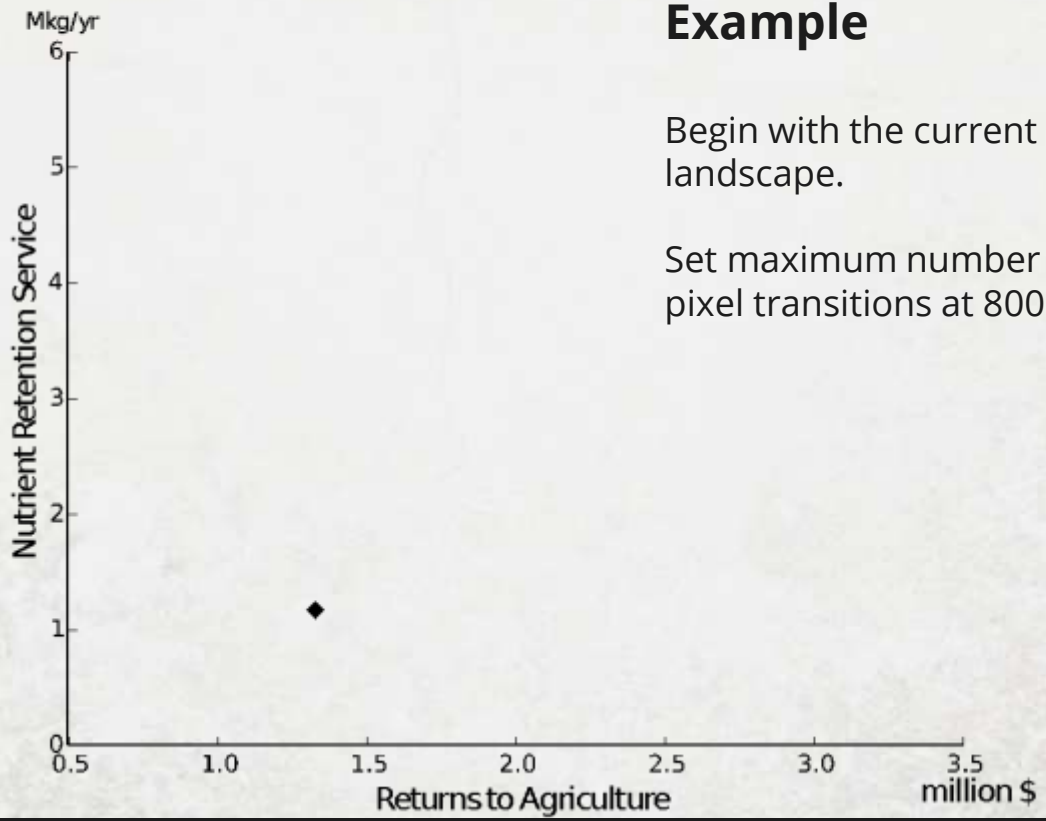
How to optimally select offset areas or reserves with a budget constraint?

New set of tools:

Account for spatial-dependence in service values.

Built on marginal change in landscape services given pixel LULC change

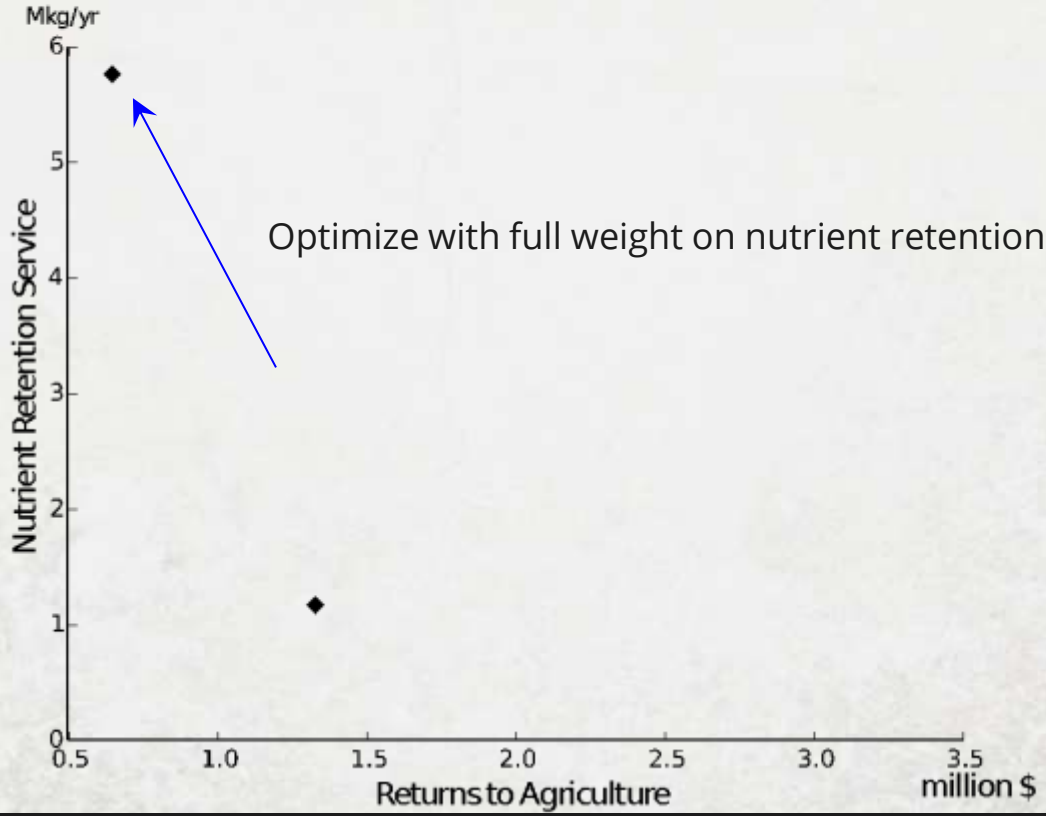
Use core InVEST models (no extra data requirements)



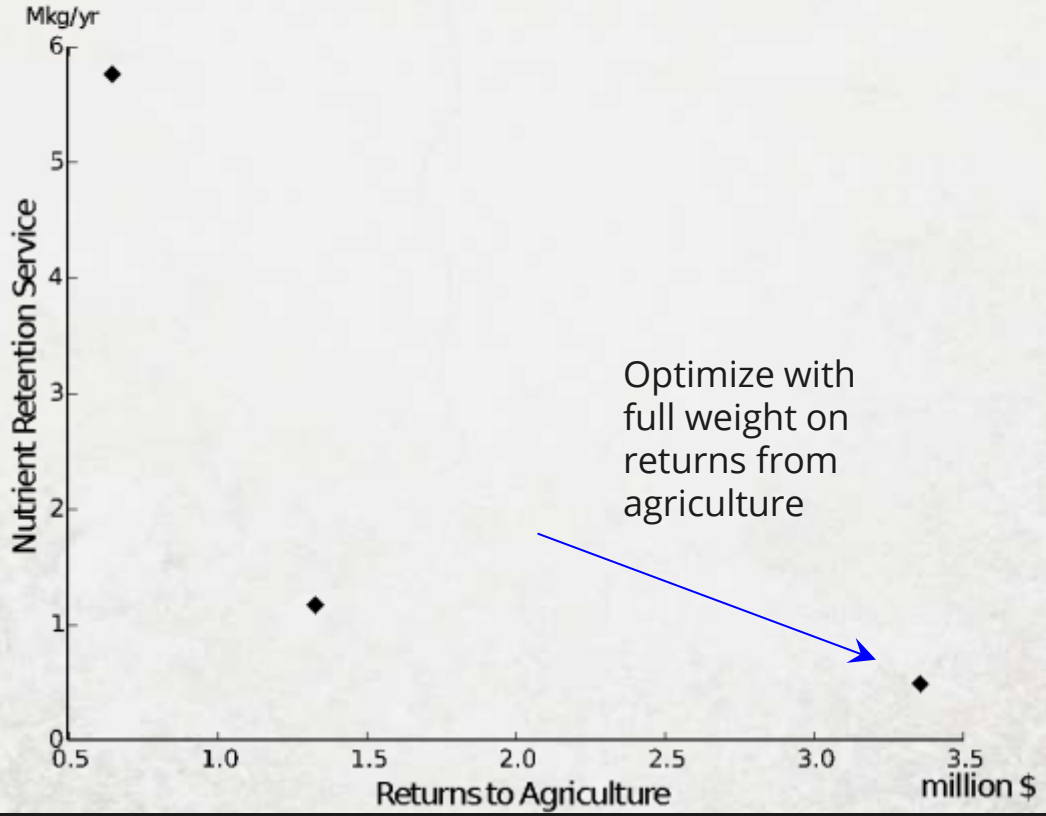
Optimization Example

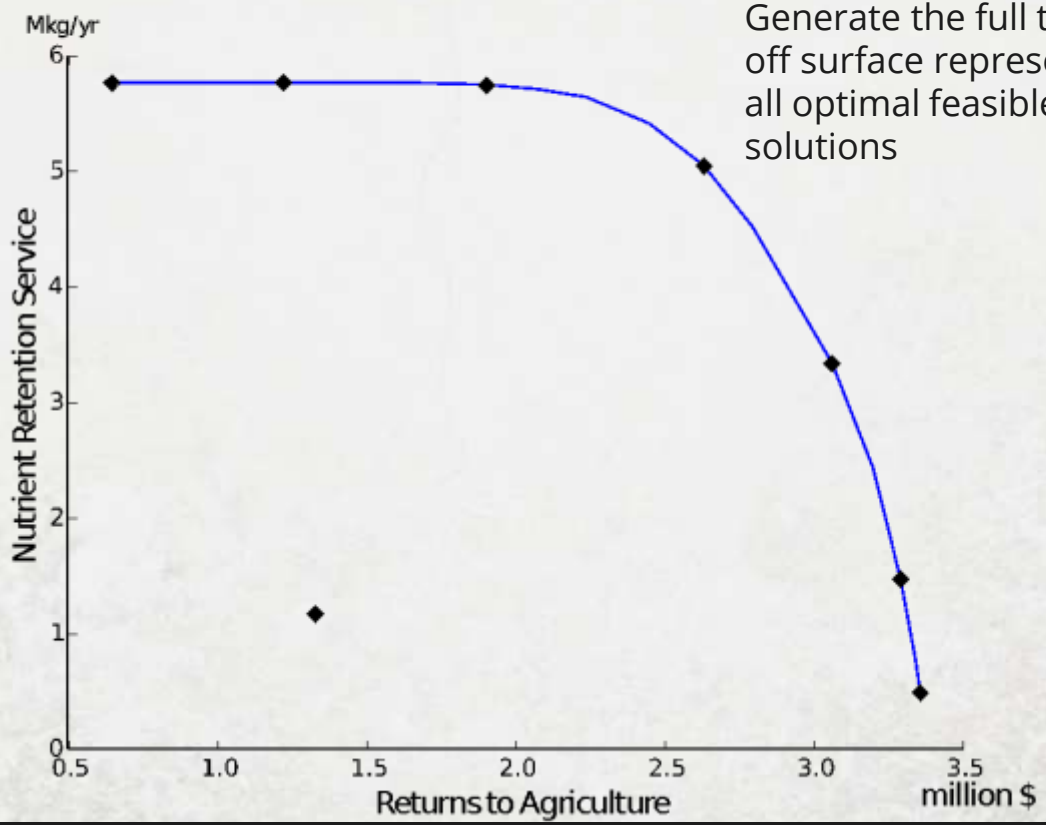
Begin with the current landscape.

Set maximum number of pixel transitions at 8000.



Optimize with full weight on nutrient retention


Mkg/yr
6
5
4
3
2
1
0
Nutrient Retention Service
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Returns to Agriculture
million $
Optimize with full weight on returns from agriculture



Generate the full trade-off surface representing all optimal feasible solutions

BATCH PROCESSING

Rich Sharp

Batch Scripting in InVEST 3.0.0

InVEST Scripting Guide and API

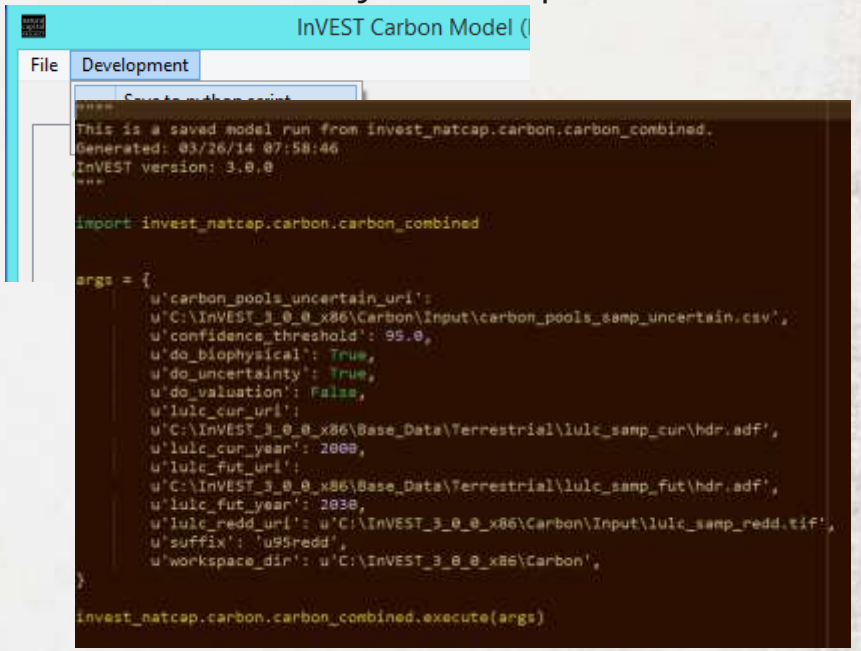
Summary

```
        error_message = (
            "The following files do not exist on the filesystem: " +
            str(not_found_uris))
        raise exceptions.IOError(error_message)


def [redacted]asets(
    dataset_uri_list, dataset_pixel_op, dataset_out_uri, datatype_out,
    nodata_out, pixel_size_out, bounding_box_mode, resample_method_list=None,
    dataset_to_align_index=None, dataset_to_bound_index=None, aoi_uri=None,
    assert_datasets_projected=True, process_pool=None, vectorize_op=True):

    """This function applies a user defined function across a stack of
        datasets.  It has functionality align the output dataset grid
        with one of the input datasets, output a dataset that is the union
        or intersection of the input dataset bounding boxes, and control
        over the interpolation techniques of the input datasets, if
        necessary.  The datasets in dataset_uri_list must be in the same
        projection; the function will raise an exception if not.

        dataset_uri_list - a list of file uris that point to files that
            can be opened with gdal.Open.
        dataset_pixel_op - a function that must take in as many arguments as
            there are elements in dataset_uri_list.  The arguments can
```

Introduction

While there is a user interface for all the InVEST models, we also provide a Python application p

Each InVEST model's user interface can "save" itself as a Python script



The resulting script IS a call InVEST except it can be customized like any Python script.

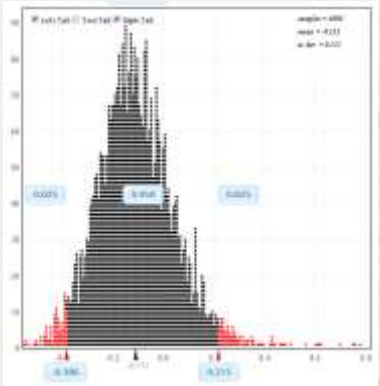
For example…

Applications of the InVEST 3.0.0 API/batch script

```
"""
This is a saved model run from invest_natcap.carbon.carbon_combined.
Generated: 03/26/14 07:58:46
InVEST version: 3.0.0
"""

import invest_natcap.carbon.carbon_combined


args = {
        u'carbon_pools_uncertain_uri':
        u'C:\InVEST_3_0_0_x86\Carbon\Input\carbon_pools_samp_uncertain.csv',
        u'confidence_threshold': 95.0,
        u'do_biophysical': True,
        u'do_uncertainty': True,
        u'do_valuation': False,
        u'lulc_cur_uri':
        u'C:\InVEST_3_0_0_x86\Base_Data\Terrestrial\lulc_samp_cur\hdr.adf',
        u'lulc_cur_year': 2000,
        u'lulc_fut_uri':
        u'C:\InVEST_3_0_0_x86\Base_Data\Terrestrial\lulc_samp_fut\hdr.adf',
        u'lulc_fut_year': 2030,
        u'lulc_redd_uri': u'C:\InVEST_3_0_0_x86\Carbon\Input\lulc_samp_redd.tif',
        u'suffix': 'u95redd',
        u'workspace_dir': u'C:\InVEST_3_0_0_x86\Carbon',
}

invest_natcap.carbon.carbon_combined.execute(args)
```

Start with the default script generated by the InVEST model user interface. Then…

…modify for a sensitivity analysis of the biophysical parameters on an InVEST model



… or build your own application using InVEST or parts of InVEST

- RouteDEM takes a DEM as input
- Output:
  - D-infinity flow direction
  - D-infinity flow accumulation
  - Stream thresholds / slope

- Routing Memory Footprint and Runtime Performance:
  - Willamette Valley
    - (1081x1669) (~6MB)
    - Routes in 5.5s
  - Peru
    - (7008x4411) (118MB)
    - Routes in ~5min
  - Colombia
    - (15030x20631) (1182 MB)
    - Routes in ~13 min

RouteDEM can be scripted with the InVEST API!

- Outperforms TauDEM by several orders of magnitude
- Peru dataset on TauDEM routed in 8+ hrs
- Did not attempt Colombia DEM…

LINKING MODELS

Adrian L. Vogl

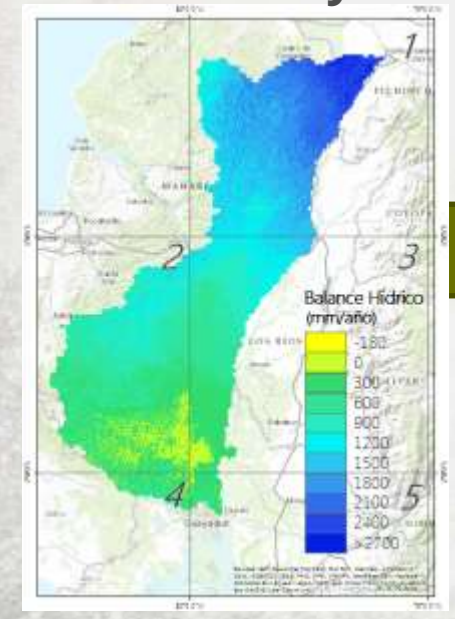
RIOS + WATERWORLD

Test Case:

Investing in the Daule River Water Fund in Ecuador

WaterWorld

Sensitivity



Spatial Allocation

RIOS

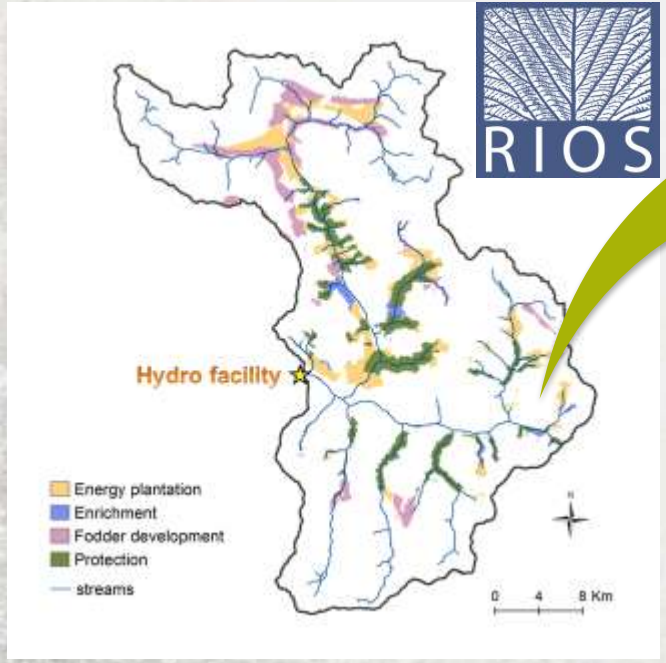
WaterWorld

Impacts on Services

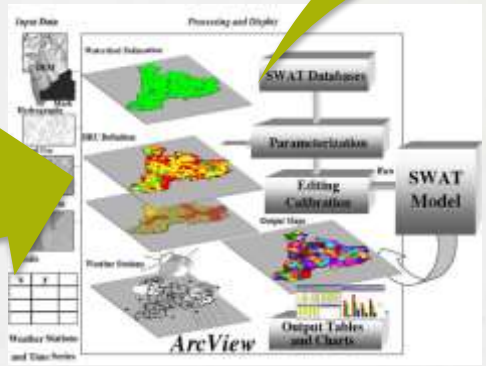
	Scen1	Scen2
Soil erosion	+	−
Soil deposition	−	+
Water quality	−	+

Leo Zurita, Beth-Sua Carvajal and Mark Mulligan (King's College London)
Silvia Benitez, Juan Sebastian Lozano, Jorge Leon (The Nature Conservancy)

RIOS + SWAT + VALUATION



SWAT | Soil & Water Assessment Tool



Test Cases:

Hydropower Production in India

Water Funds Return on Investment in Kenya

Stacie Wolny, P. J. Dennedy-Frank, Perrine Hamel, Justin Johnson, Martha Rogers, Johannes Hunink, Peter Droogers