Modelling Shrimp and Paddy farming in coastal zones
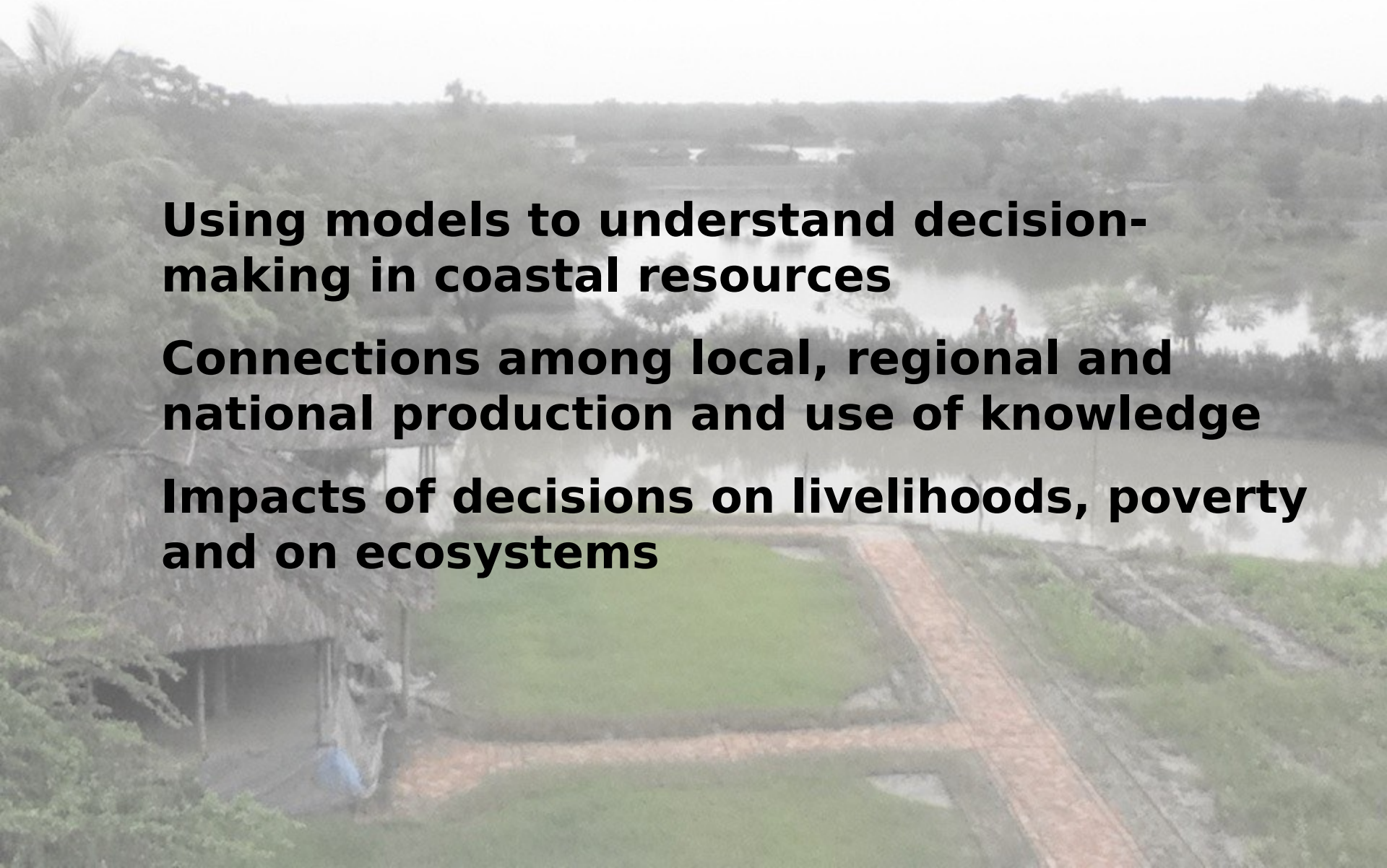
WD-NACE team
ESPA Programme Framework project

espa
ecosystem services
for poverty alleviation

Background - WD-NACE

Using models to understand decision-making in coastal resources

Connections among local, regional and national production and use of knowledge

Impacts of decisions on livelihoods, poverty and on ecosystems

Shrimpfarming in SW Bangladesh

Export-driven cultivation of shrimp
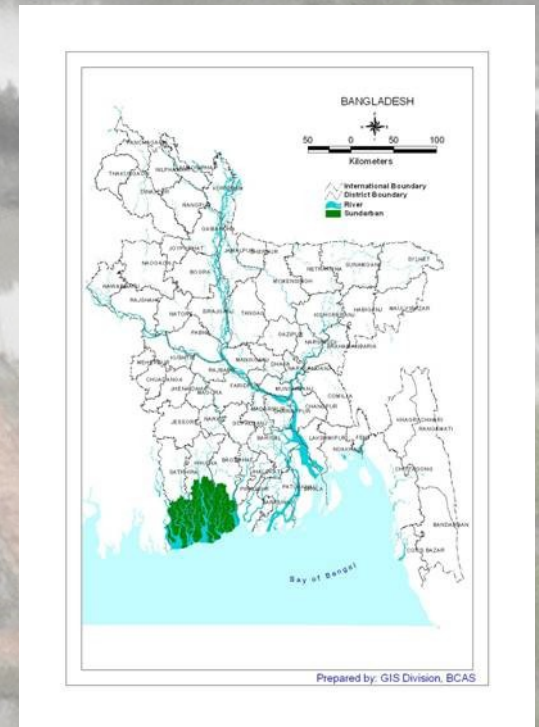
Conversion of paddy field to shrimp gher

Deforestation in Sundarbans

Increase of salinity

Loss of biodiversity

Availability of nutrition

Power and contestation

The farm view

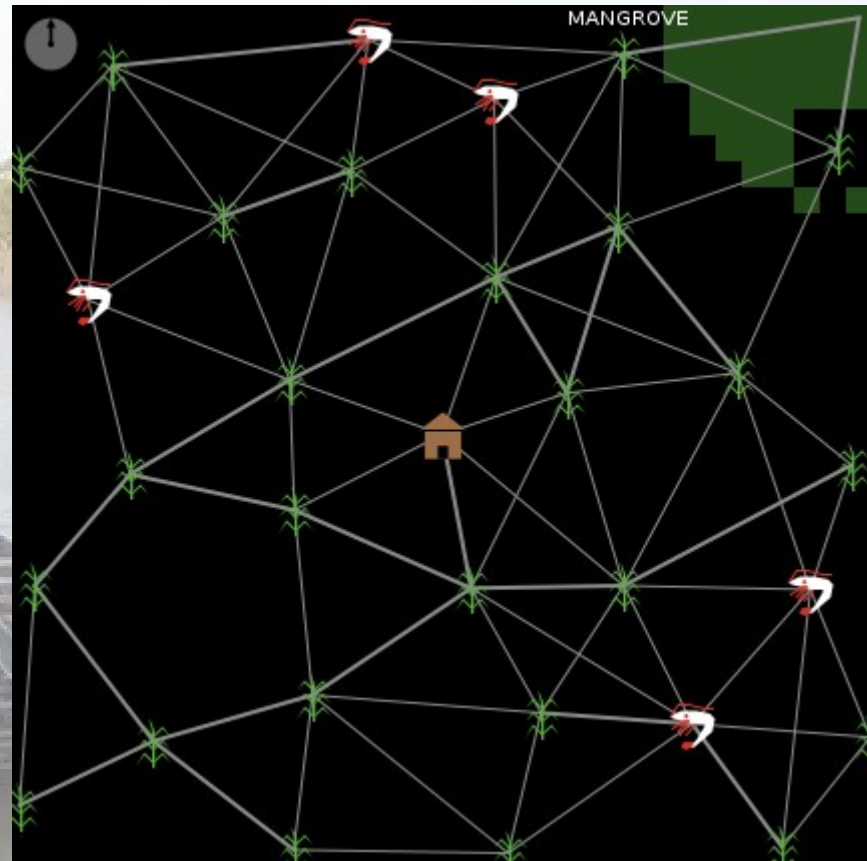**Entities in the farm view include:**

Farms

(Shrimp)

(Paddy)

(Paddy-cum-shrimp)

Mangrove forest

Village

Physical links

The village view

Entities in the village view include:
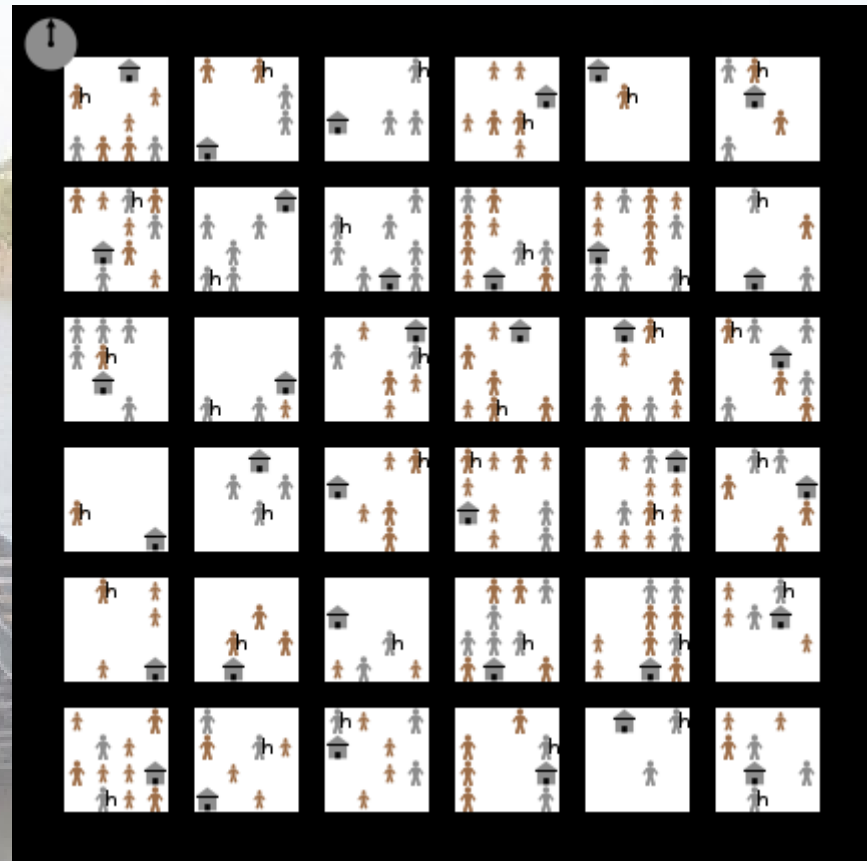
Households

Individuals

(h = household head)

(Young adult)

(Elder adult)

(Child)

Inter-linkages in the ABM

Direct resource use by actors, eg.

- Mangrove work: fishing, crab hunting, fry collection

- Homestead production – see 'nutrition rules'

- Farming: shrimp/paddy/paddy-cum-shrimp

Resource availability affects livelihood choice

- seasonal availability of food or income

- access to saline water / salinity condition of farm

Individuals are linked by kinship relations

Market relations also link actors

Modelling decision-making

1. Paddy farmer decision to convert/lease to shrimp farming for economic reasons or due to infeasibility of paddy in saline conditions

2. Shrimp farmer decision to resalinise in wet season illegally for higher profit .

3. Decision to protest/resist shrimpfarming which is disliked by some farmers/villagers

4. Shrimp farmers' negotiation of access to saline water river and streams

5. Decision on payment (or not) of lease agreement by the tenant farmer

Initialising the simulation

The user chooses rules of the simulation: E.g. Number of SF? Region? Management plan?

The computer creates coastal cartography, resources, and actors
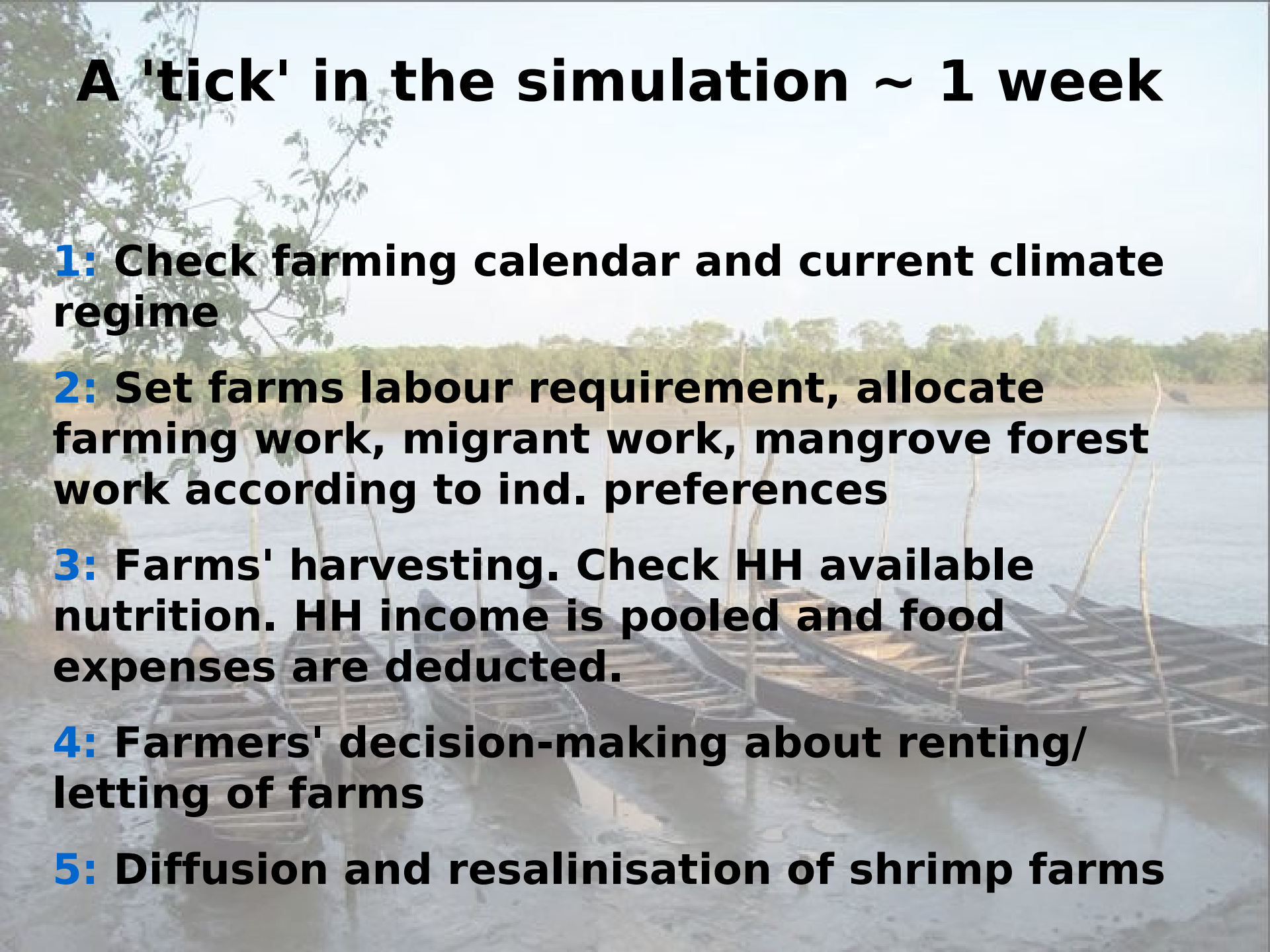
Create structured households: elders, young (adults), children

Set farms (assets) ownership

Set actors' occupations: farmer, casual labourer, migrant, forest work

Create social networks among actors

A 'tick' in the simulation ~ 1 week

1: **Check farming calendar and current climate regime**

2: **Set farms labour requirement, allocate farming work, migrant work, mangrove forest work according to ind. preferences**

3: **Farms' harvesting. Check HH available nutrition. HH income is pooled and food expenses are deducted.**

4: **Farmers' decision-making about renting/ letting of farms**

5: **Diffusion and resalinisation of shrimp farms**

Seasonal calendar in the simulation

id	month name	calendar	Climate regime	shrimp	paddy	other
0	Baisakh	APR-MAY	pre monsoon	harvest		
1	Jaistha	MAY-JUNE	pre monsoon	harvest		
2	Ashar	JUNE-JULY	Monsoon-saltrinse	harvest		
3	Sraban	JULY-AUG	Monsoon		plant aman	desal. law
4	Bhadra		Monsoon		cultivate	desal. law
5	Ashwin		post monsoon		cultivate	desal. law
6	Kartik	OCT - NOV	post monsoon	cultivate	Aman harvest	
7	Agrahayan		fourth	cultivate		
8	Poush		fourth	cultivate		
9	Magh	JAN-FEB	fourth	cultivate		
10	Falgoon		fourth	cultivate		
11	Chaitra	MAR-APR	fourth	harvest		

Parameter table in the simulation

On face, just numbers.

But some information came out that looked more like rules of conditionality

More complicated than we thought
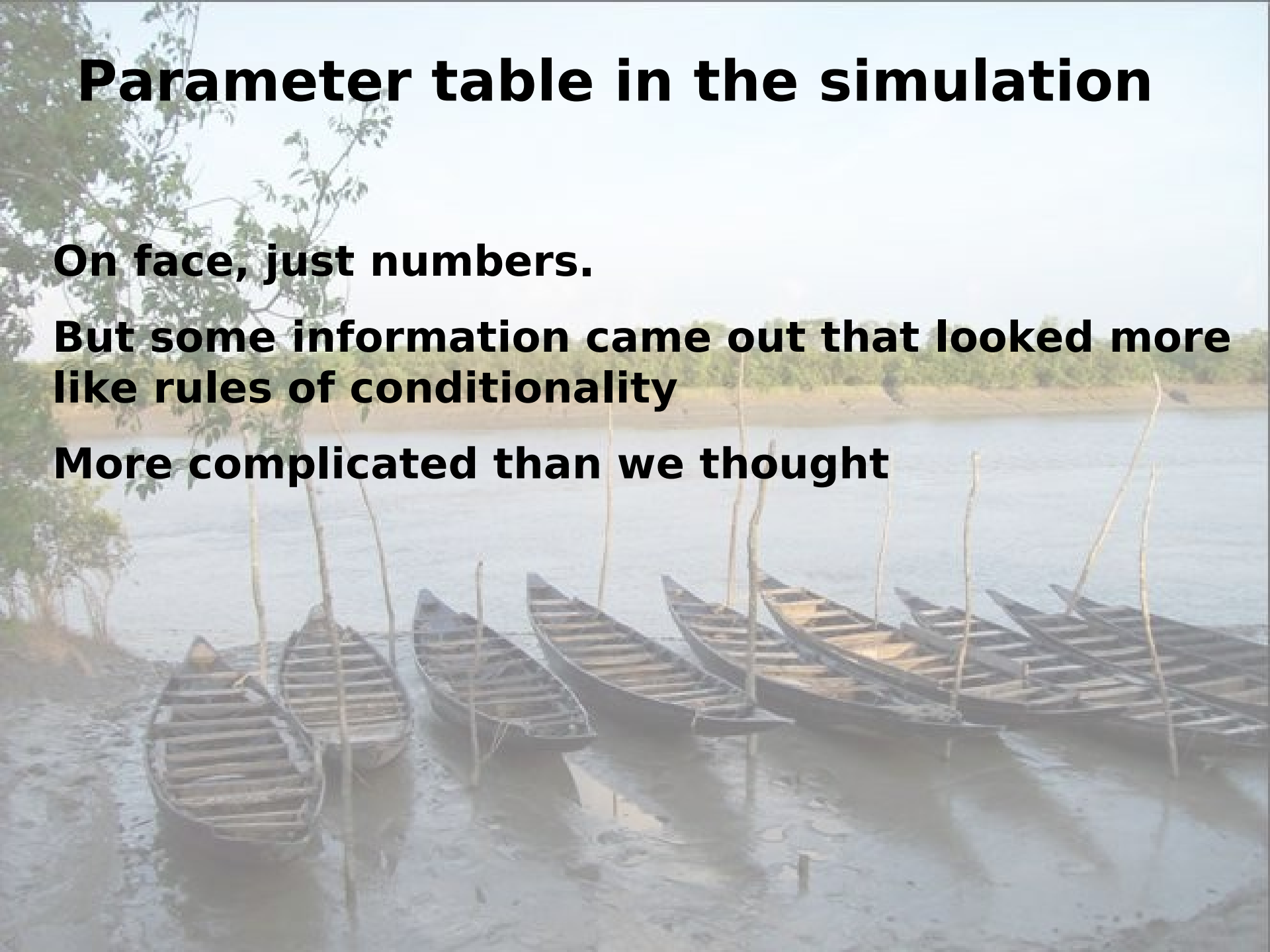
Variable	Value/range	What it is + comment	Data source	Actor
size-small	1-5 80%	distance (in acres) of farm's length and breadth	Akhter	farm
Area medium	6-15 15%		Akhter	
Area big	16-1000 5%		Akhter	
rotation	paddy/shrimp/paddy-cum-shrimp			farm
landuse	Paddy, shrimp			farm
farm-workforce		set of individuals employed, not including those from the occupier's household		farm
salinity	0-1	amount of salinity in water		farm
health	0-1	assume quadratic: health= 1- (salinity)sq.		farm
Min-food-cost	100/60/30	Cost per person to buy food for adequate nutrition	100 - meeting in Munshigong	model
Max-food-cost	200/60/30	Cost per person to buy food for excellent nutrition	200 - meeting in Munshigong	model
labour-farm		Labour needed in addition to own household labour	Akhter	household
Labour-guard	1 or 2	Shimp guard - 1 per 5 acre 2 for more than 5	Akhter	
Labour-paddys	15-20	Days of labour per month during season, per acre	Akhter	
labour-shrimp	5 days cleaning	Days of labour per month during season, per acre	Akhter	
max-paddy-harvest	1.8 mt (amon)	Yield per acre	Akhter	
rental-rate-shrimp	15-24,000 Tk access to water	seasonal cost per acre for rent of farm	Akhter	
rental-rate-paddy	paddy half-share crop	seasonal cost per acre for rent of farm	Akhter	
price-paddy	15-20 paddy	The price the farmer gets/ the local pays, per kg	Akhter	model
No. households	200/350/450 6 person av	Number of households in the village	Akhter	model
village land area	2,000 acres	6000 bigha (Shrimp 5000, residents 1000) + (7-10 acre boro 50 acre aman)	Akhter	
input-larvae	4000 larvae 2000 Tk (seasonal)	Cost of other inputs to shrimp larvae, fertiliser, per acre	Akhter	model
input-fertilizer	3000 per year	Per acre (scale of economy operates)		

Nutrition rules (household level)

1. 'market' provision

Compare household income with daily food cost

If income > max-expenses [set nutrition=4]

If income > min-expenses [set nutrition=3]

Otherwise [set nutrition=2]

Nutrition rules (household level)

2. 'subsistence' provision

Check access to 4 independent food types:

R(ice): True if hh member manages or works paddy

F(ish): True if fish stock 'abundant' in forest rivers

L(/stock): True if paddy is healthy and no nearby SF

V(eg): True during summer if homestead is healthy

set nutrition = occurrences [R F L V] true

ABM is based on other assumptions:

Farm-level decision is taken in Kartik/Oct which is post-monsoon (most food secure?).

Resalinisation of shrimpfarms is done once monthly during Jaisthra - Bhadra

If there are no willing local actors, 'outsider' agent will always rent available land

A child may not be able to attend school if household income is low and savings low

Available farm work is allocated randomly

Please tell us what is wrong with the model and what is missing !

Qualitative evidence: Q-Method

A way of reducing the dimensionality of information that can be applied to qualitative statements

1. collect variety of statements from respondents

2. ask a variety of stakeholders to sort these

3. use factor analysis program to identify factors

4. do qualitative interpretation of the statistics

5. use results to set beliefs of agent sub-groups

Sustainability Perspectives in Satkhira, SW Bangladesh

Group S1 "Forest conservation and salinity" ... focusing on forest conservation but also repeatedly raises the problem of high salinity.

Group S2 "Shrimp antagonists" .. forthcoming in their views about negative effects of shrimp farming; saw this as open to contestation.

Resp. included civil servant, teacher and farmer

Group S3 "Business as usual" ... a preference to maintain current policy and rule-making as it is now, in both forestry and agriculture.

Qualitative evidence: Narratives

Kabir's father started earning his livelihood by catching fish and crab that were abundant in the rivers and creeks of the area. He also gathered wood, reeds and honey from the Sundarbans. Shrimp farms also provided employment for about two months in a year.

Kabir and his brother Shahid, started going with their father to the rivers and forests from early childhood and learned these trades. When their father grew old, the sons took over.

Narratives are constructed from interviews

Source: Neela Matin, SEI

What a respondent says can be formed into rules

18/10/11

Validation questions:

How is farm work allocated, and which work allocation patterns have sustainability or poverty implications? Is there long-term joblessness? Labour exchange networks?

How do migrants get work? How long do they typically spend away?

Ordering priorities of household spending (food provision, schooling, investment ...)

What are 'other' main poverty outcomes (social indicators) of interest

What set of coping strategies / adaptations can currently be observed?

Validation questions:

What are the land use conversion costs? Are there other constraints on conversion?

Could implementation of management plan 'land buffer zoning' & 'resalinisation' work?

Which actors would be involved, and how could they obtain an income?

What could be consequences of violation of laws: resalinisation / shrimpfry collection / rental non-payment?

Possibilities with this model

Do a 'baseline' simulation with no shrimp

Explore different initial number of SF

Combine using this parameter with different choice of 'management plan'

Threshold where paddy is no longer possible

Improve the diffusion rule for salinity and the calculation of yield based on salinity

Other factors impacting on soil degradation?

What might happen if population grows?

Add a river, gates, channels and pipes

Summing up

Modelling shrimp and paddy farming

Sharing and checking different kinds of data:

- Seasonal calendar: context of decisions

- Parameter table

- Q Method approach

- Narratives approach

However none of these are systematic approaches!