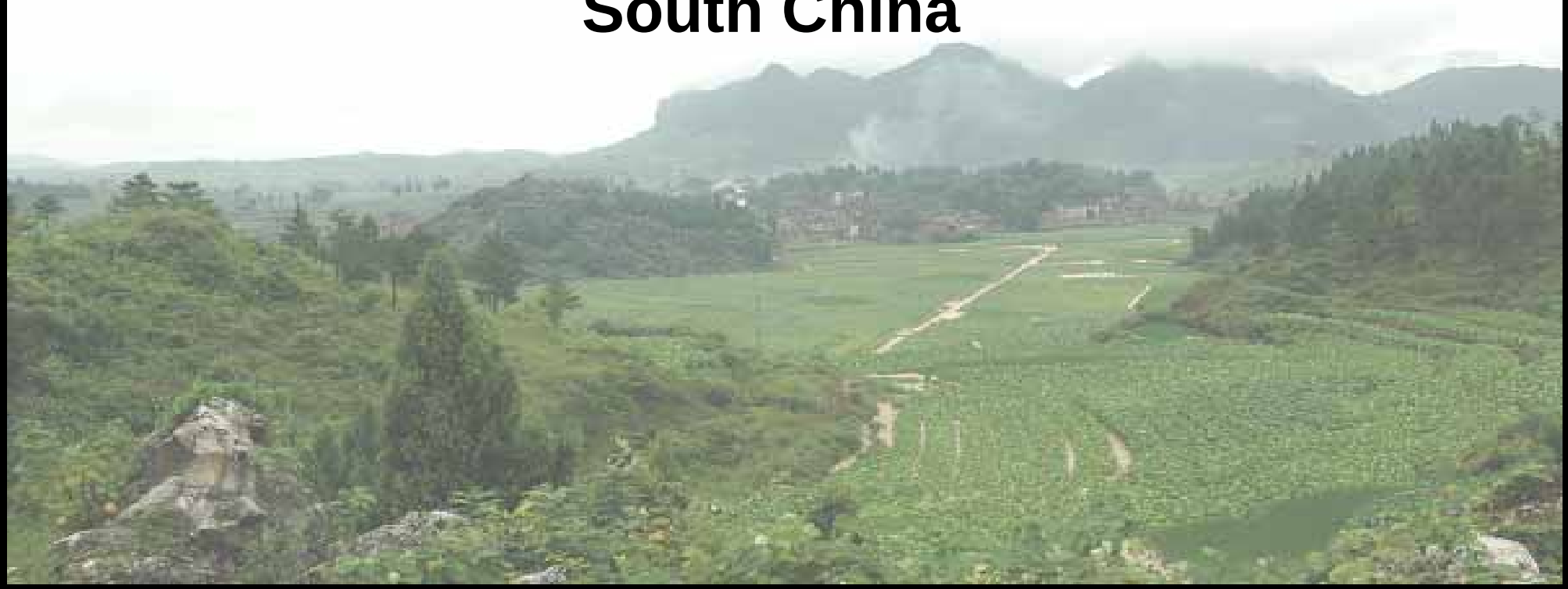
Developing a Multi-Agent Model for Land Use and Land Development Decisions in Rural South China



Lin Zhang, Jill L. Findeis, Penn State Population Research Institute.
In collaboration with Xiaolong Yan, Huixia Cui, and Nian Hai, Root Biology Center, South China Agricultural University, and the Guangxi Academy of Agricultural Sciences.

Project participants gratefully thank McKnight Foundation for project support.

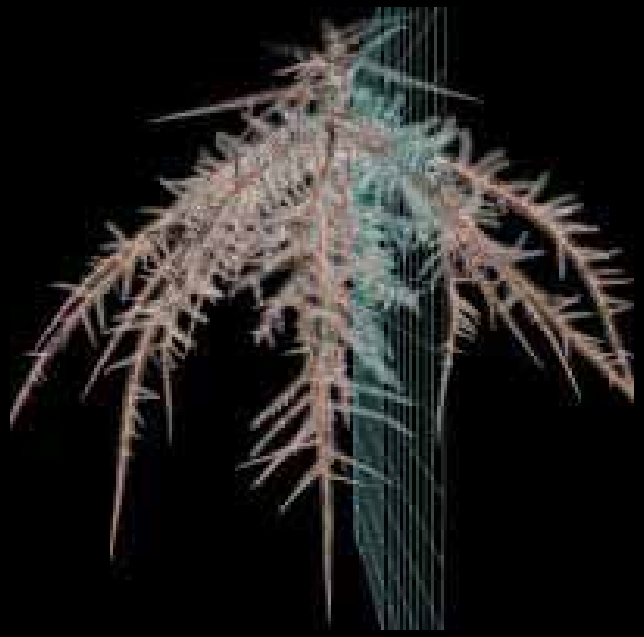
Presentation

1. Project description
2. Alternative methodological approaches
3. Data collection structure
4. Heterogeneity and decision-making
5. Work in progress

Project Description

Socioeconomic study part of larger multidisciplinary project:

- breeding for root architecture traits for low-P soils (non-GM low-input bean/soybean technology)



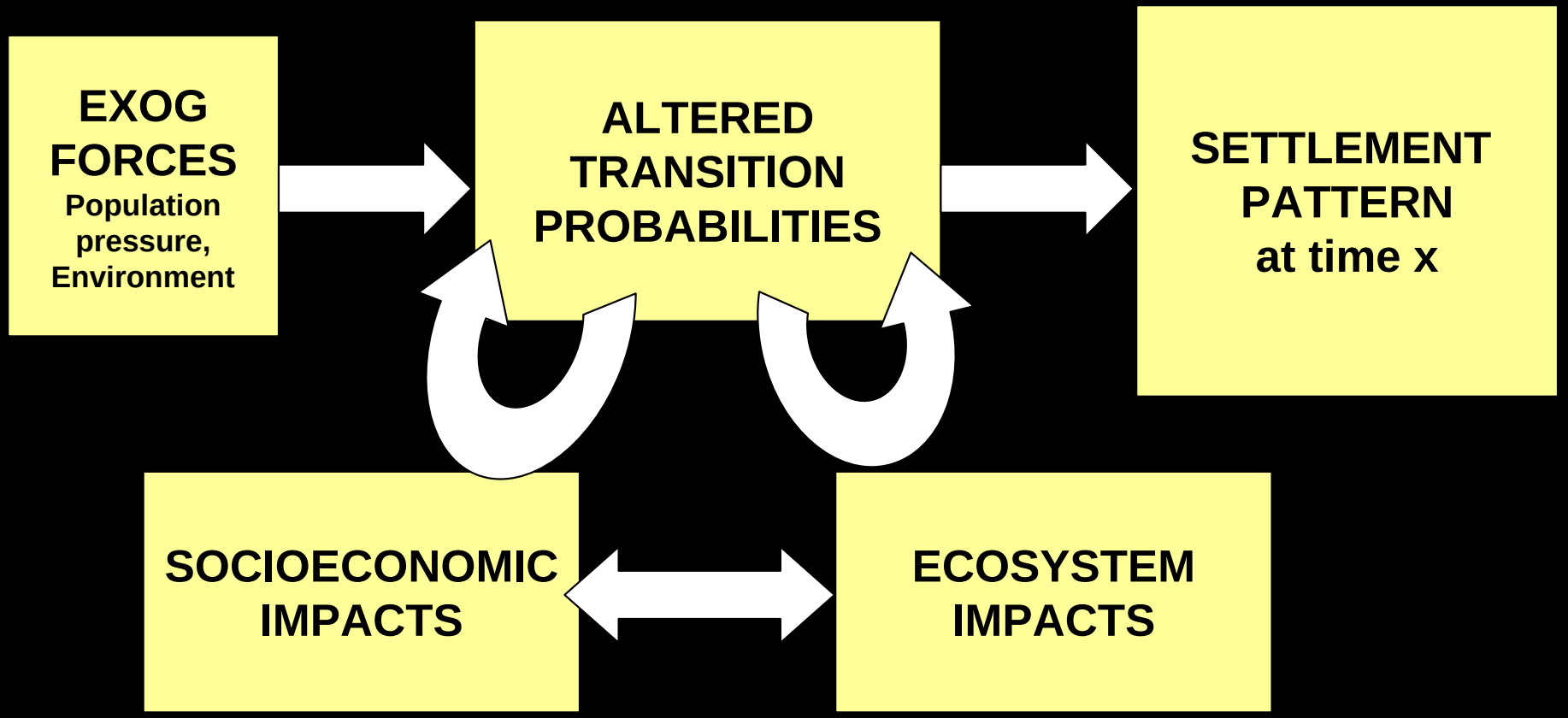
Project sites:

- South China – 11 village sites
- Mozambique – 4 village sites

Particularly interested in effects of demographic differences and intra-household interactions.

Project in a Rapid Change Transitional Zone (T-Zone)

Timeline T_0.....T_{0+n}.....T_x



Two sets of focal questions: 1) how do population pressure and <u>starting</u> environment interact to alter T-probabilities? 2) what are the mechanisms linking the S-E and ecosystem loops and their ongoing modification of T-probabilities?

Source: Penn State T-Zone Initiative

One of the most important issues facing China today is the growing number of people on the move, especially those moving from rural to urban areas.

Population Reference Bureau, 2004

China, the most populous developing country in the world, has entered the stage of aged society where it hosts the largest elderly population in the world, and experiences a series of challenges brought along by rapid population aging.

Jiang Fan, Vice Minister of National Population and Family Planning Commission of China, 2007

Project Description

China Project socioeconomic component examines:

- **adoption/diffusion patterns**
- **migration flows**
- **intra-household decision-making**
- **land policy**

Research Questions

Q1: What population is 'left behind'? How does their demographic composition affect village food production, adoption/diffusion of more sustainable production systems, and land use decisions?

Q2: To what extent do out-migrants and household members with local off-farm jobs influence the outcomes in Q1? For own households and for other households remaining in village?

Q3: How will out-migration affect food production and adoption of sustainable production systems in the longer-term with no change in land ownership policy?

Q4: If land is being used as a 'job loss' strategy or for old-age security, what are the implications of a change in land policy?

Alternative Methodological Approaches

Household Approach:

Separable household model

Nonseparable household model:

- **detail on (farm) production, consumption sides**
- **off-farm employment, remittances, credit**

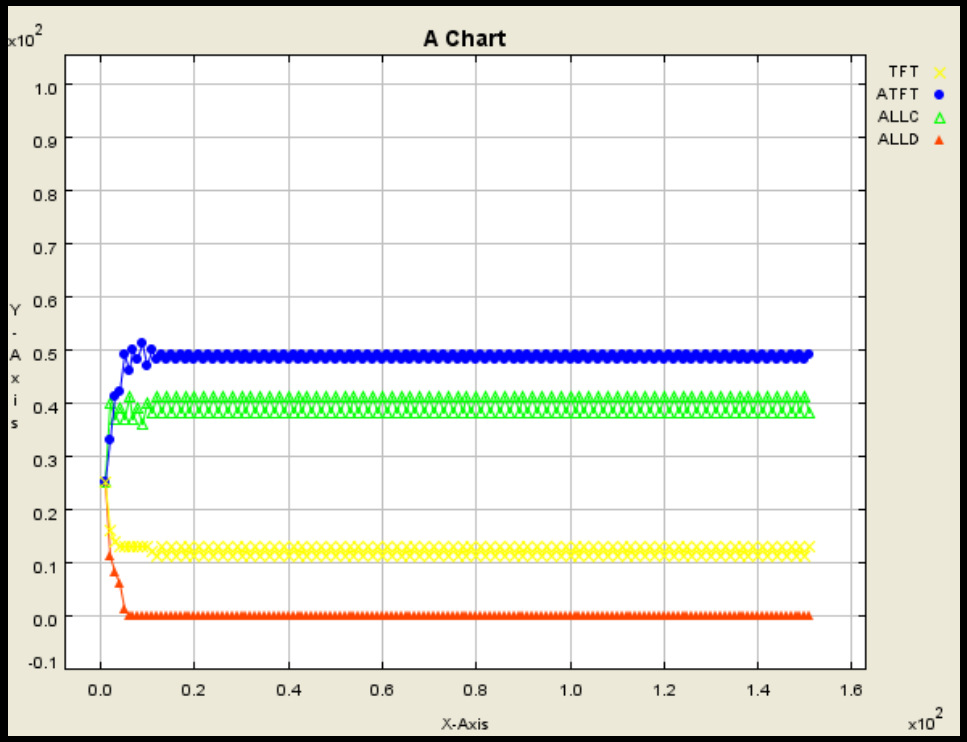
Alternative Methodological Approaches

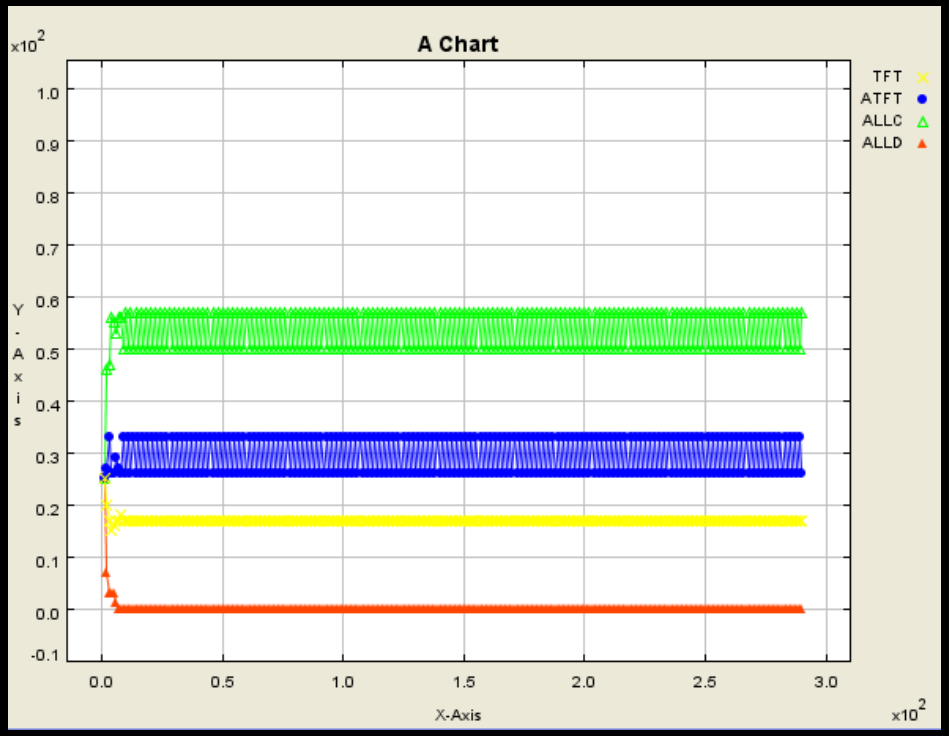
Intrahousehold decisions, interactions:

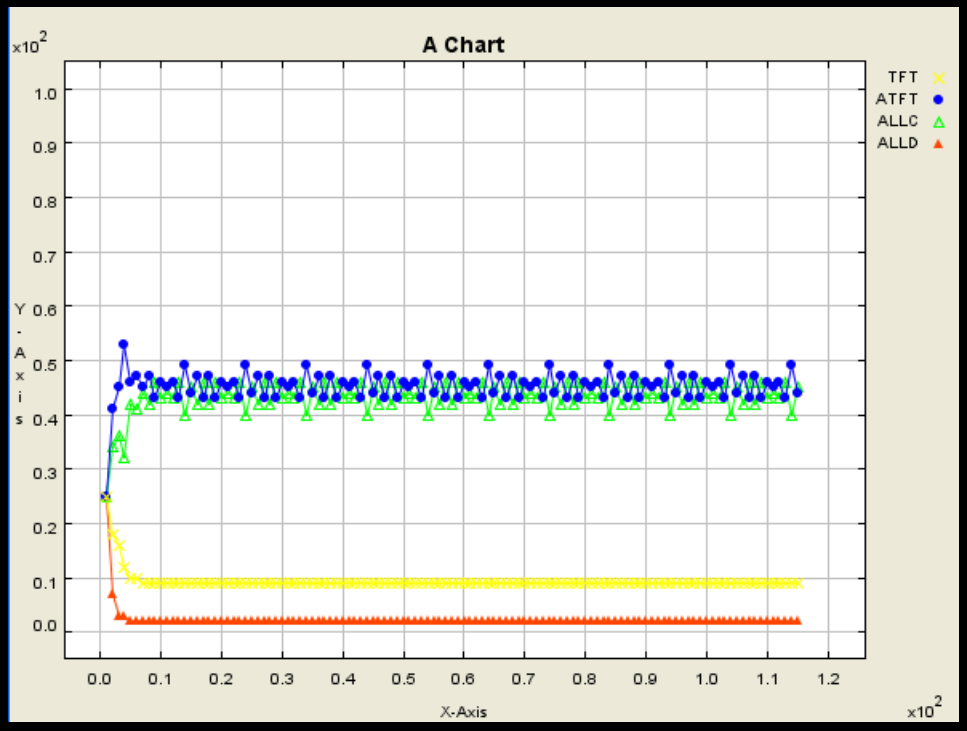
- Off-farm labor decisions (male, female)
- Intergenerational transfer (parent, young adult)
- Household bargaining, cooperative models
- Migration decisions (male, female)

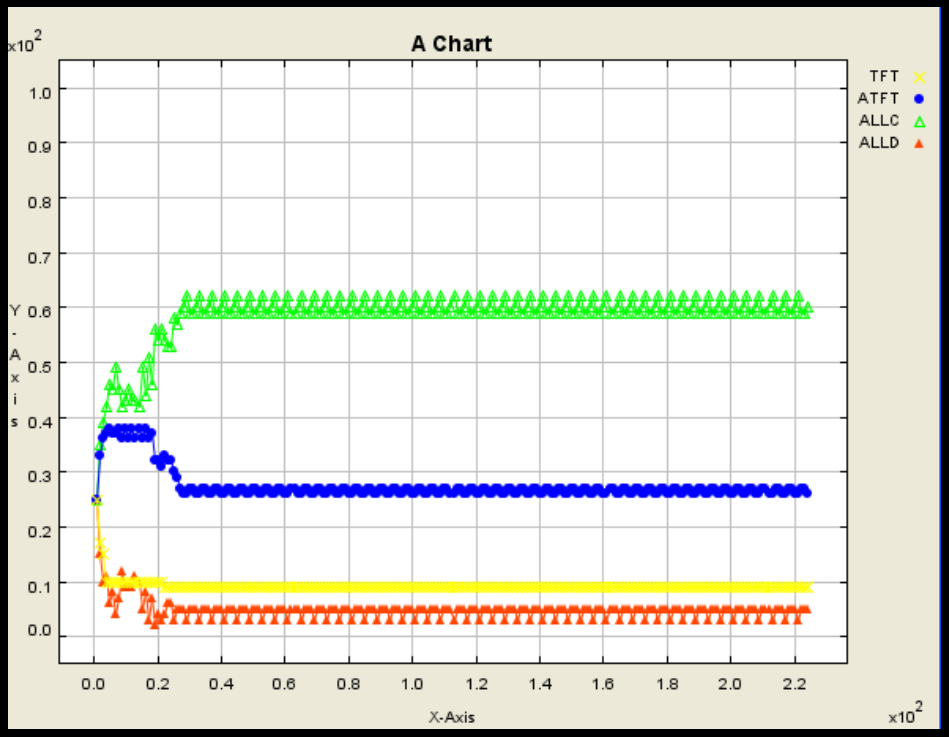
Use of panel data, multi-level modeling, spatial modeling, life-cycle models.

Use of simple game theory models: land rent in vs. hire labor out


A Chart
x10^2
TFT
ATFT
ALLC
ALLD
Y-Axis
X-Axis
x10^2


A Chart
x10^2
TFT
ATFT
ALLC
ALLD
Y-Axis
X-Axis
x10^2


A Chart
x10^2
TFT
ATFT
ALLC
ALLD
Y-Axis
X-Axis
x10^2


A Chart
x10^2
TFT
ATFT
ALLC
ALLD
Y-Axis
X-Axis
x10^2

Our Approach

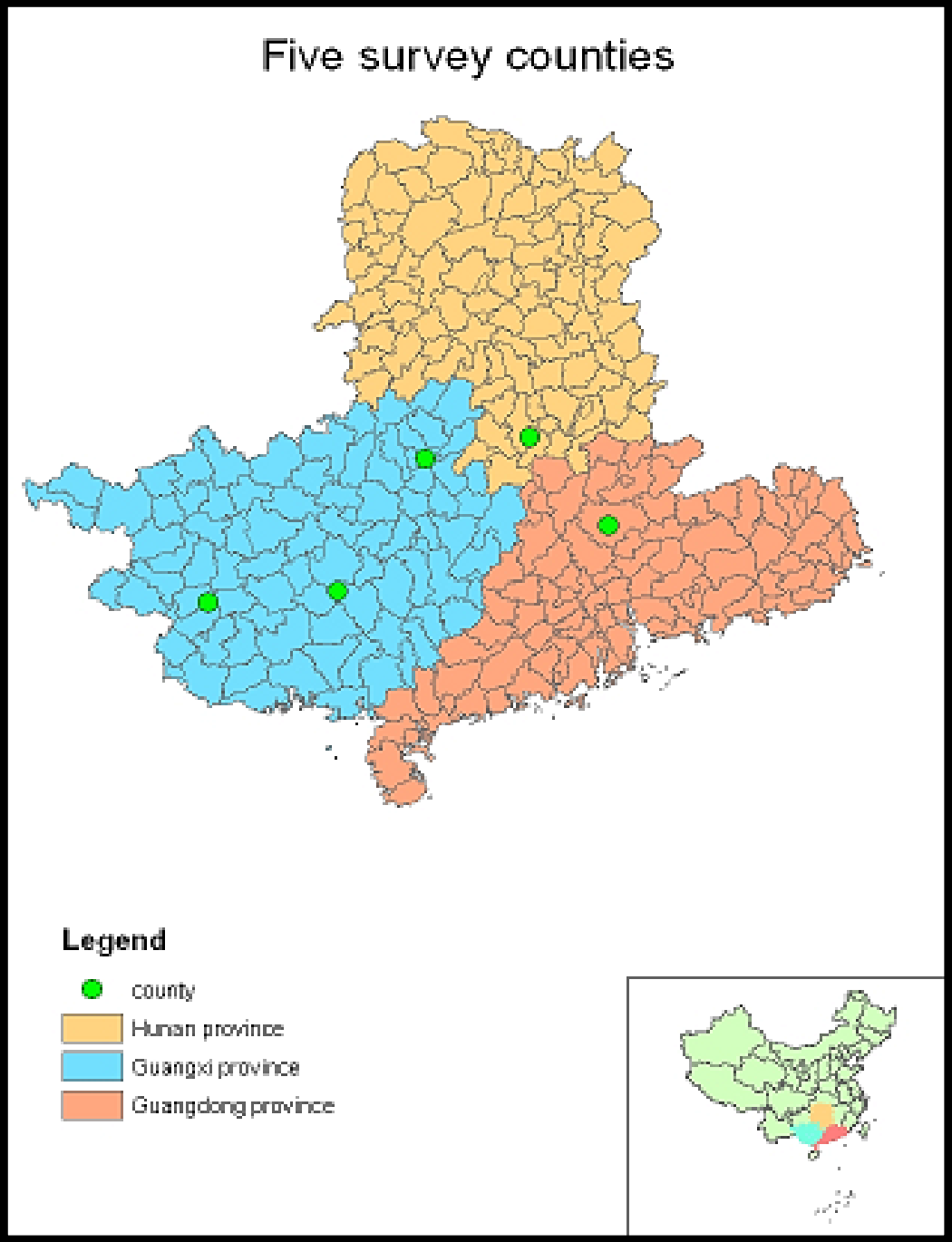
Employ a mixed method approach for data collection:

- **Face-to-face surveys of primary decision-makers (rounds 1, 2, 3)**
- **Key informant interviews**
- **Face-to-face surveys of 'potential' secondary decision-makers (rounds 2, 3)**

Nonseparable econometric household model estimation, and decision-making models

Develop MAS focusing on household heterogeneity

Study sites



Used a mixed method design:

1. **Face-to-face surveys conducted in summer 2006 among men and women in agricultural households in:**

- **3 provinces: Hunan, Guangdong, Guangxi**

- **11 villages in 5 counties: Yingde, Xintian, Longan, Laibin, and Guilin**

2. **Conducted key informant interviews**

Data collection structure

Interviewed adult men and women in villages, asking questions regarding ALL household members.

<u>Three clusters:</u>

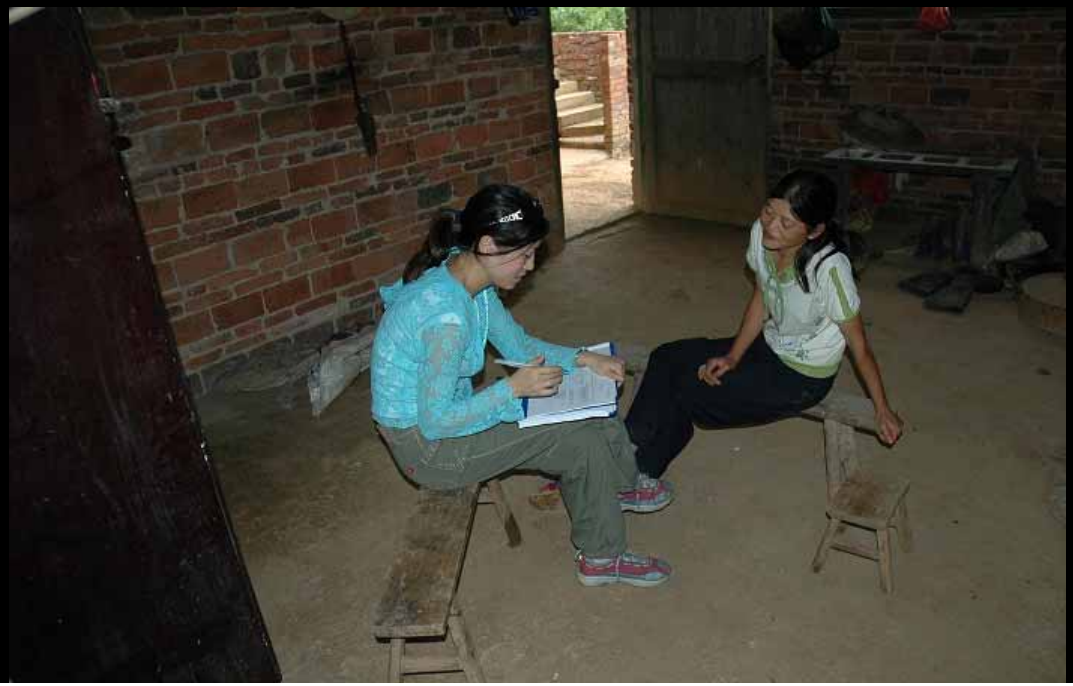
- **Male and female in same household. Interviewed separately.**
- **Male in household with female absent/no female.**
- **Female in household with male absent/no male.**

<u>Panel design:</u>

Initial interviews in 2006.

Return to *same* households:

- **2009**
- **2012**



Econometric observations

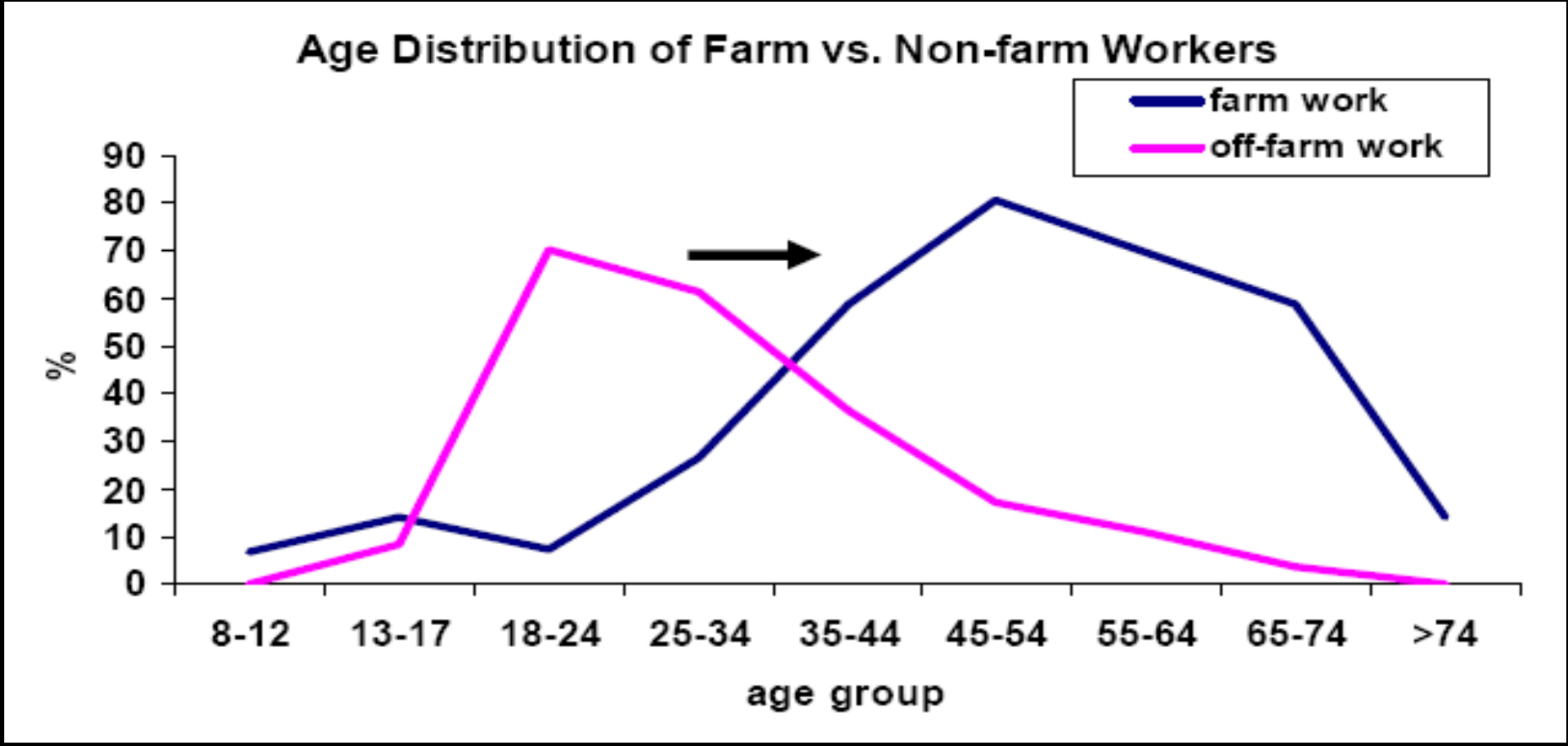
Nonseparable household model results:

- **Land: Proximity to Guangdong city, demographic characteristics of household**
- **Off-farm labor supply: nonfarm wage (reflection of demographic characteristics)**
- **Family labor on-farm: soil quality, livestock**
- **Remittances**

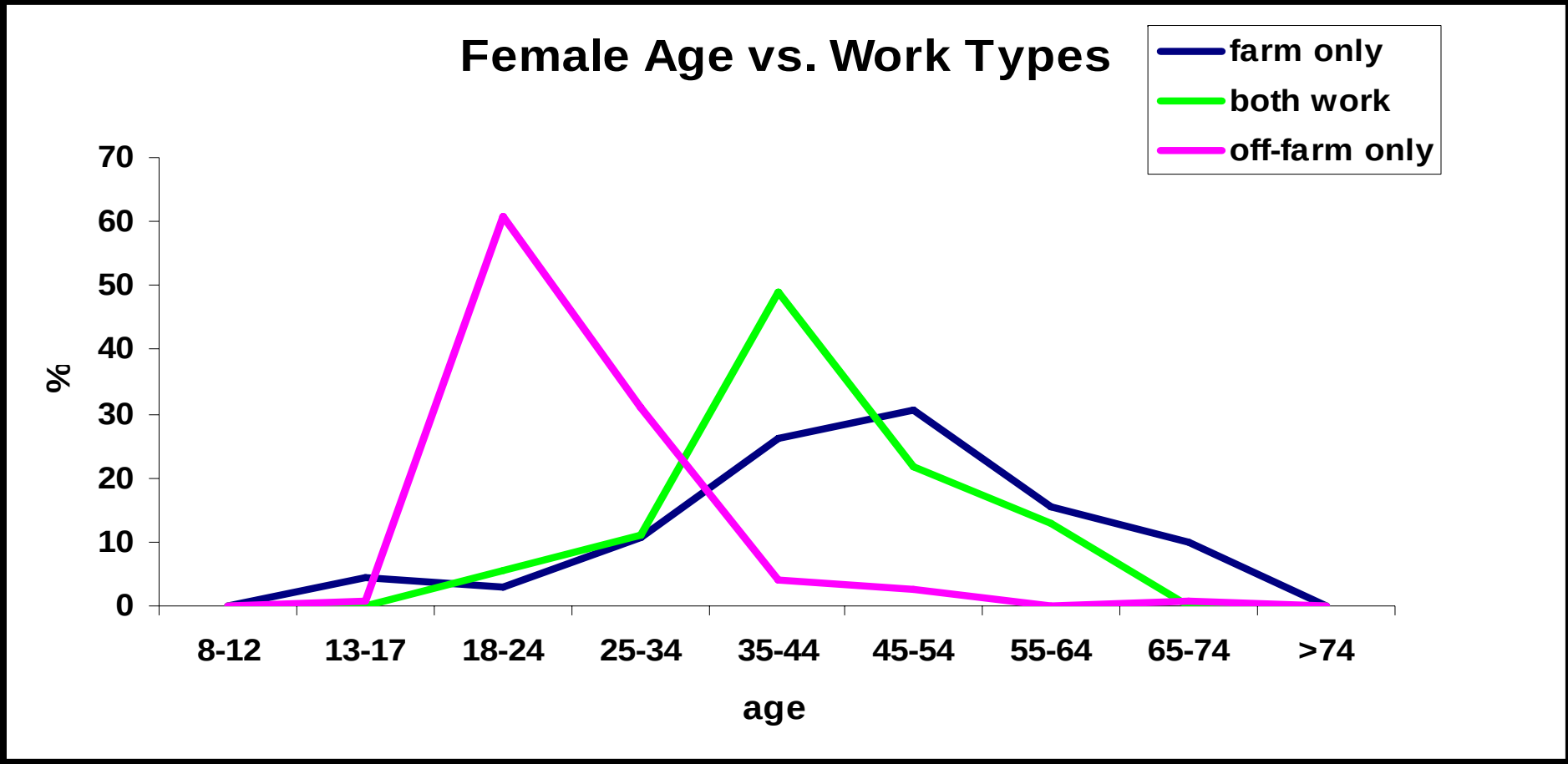
MAS modeling: focus on labor-land-innovation-farm outcomes:

- **Heterogeneity related to demographic characteristics: age, education, gender (-)**
- **Influence of out-migrants, off-farm workers via remits (+)**
- **Intra-household decision-making: who makes different types of decisions, and how is remittance income shared**

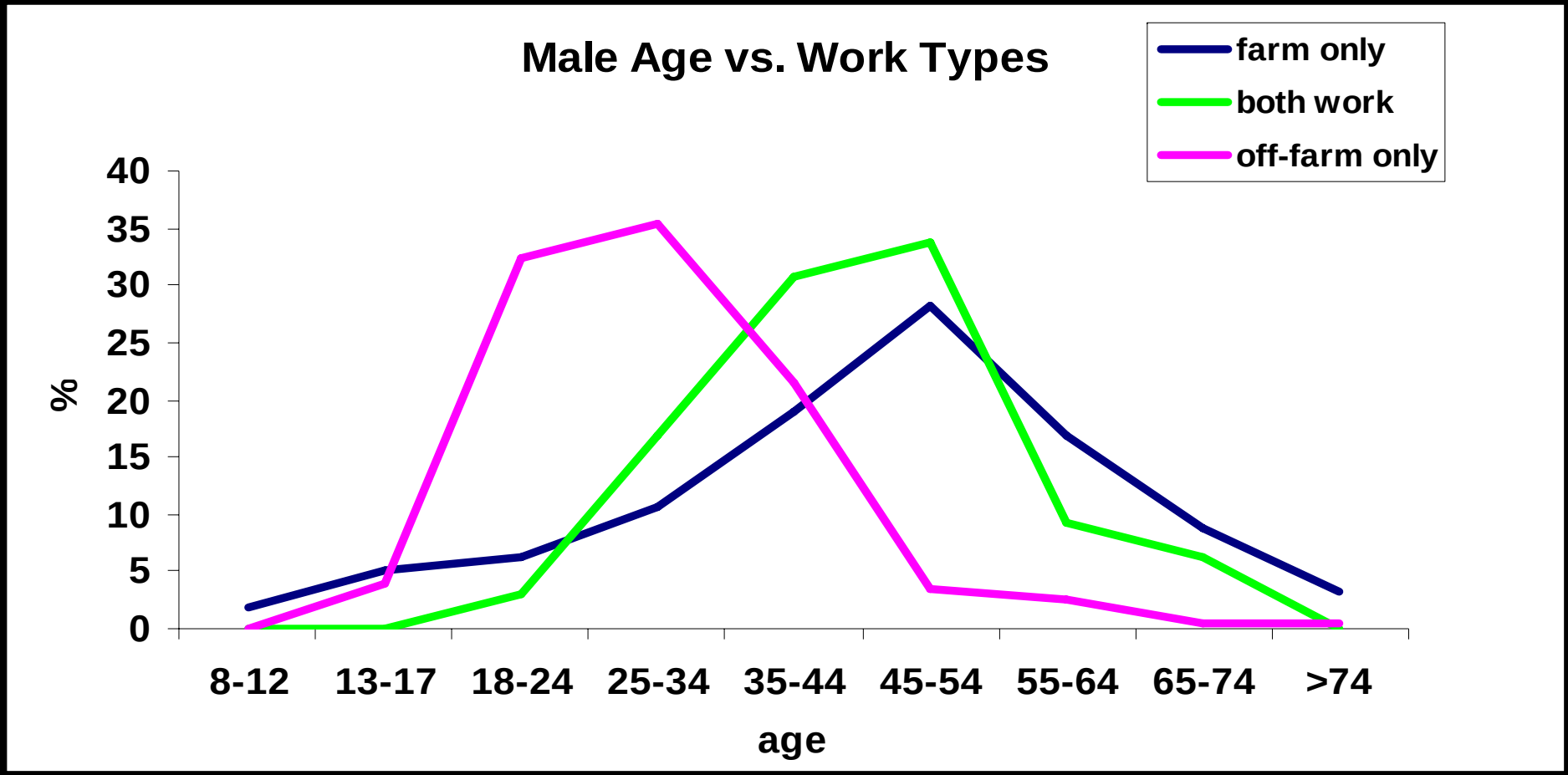
Strong out-migration trends and work-age distribution: surveyed households



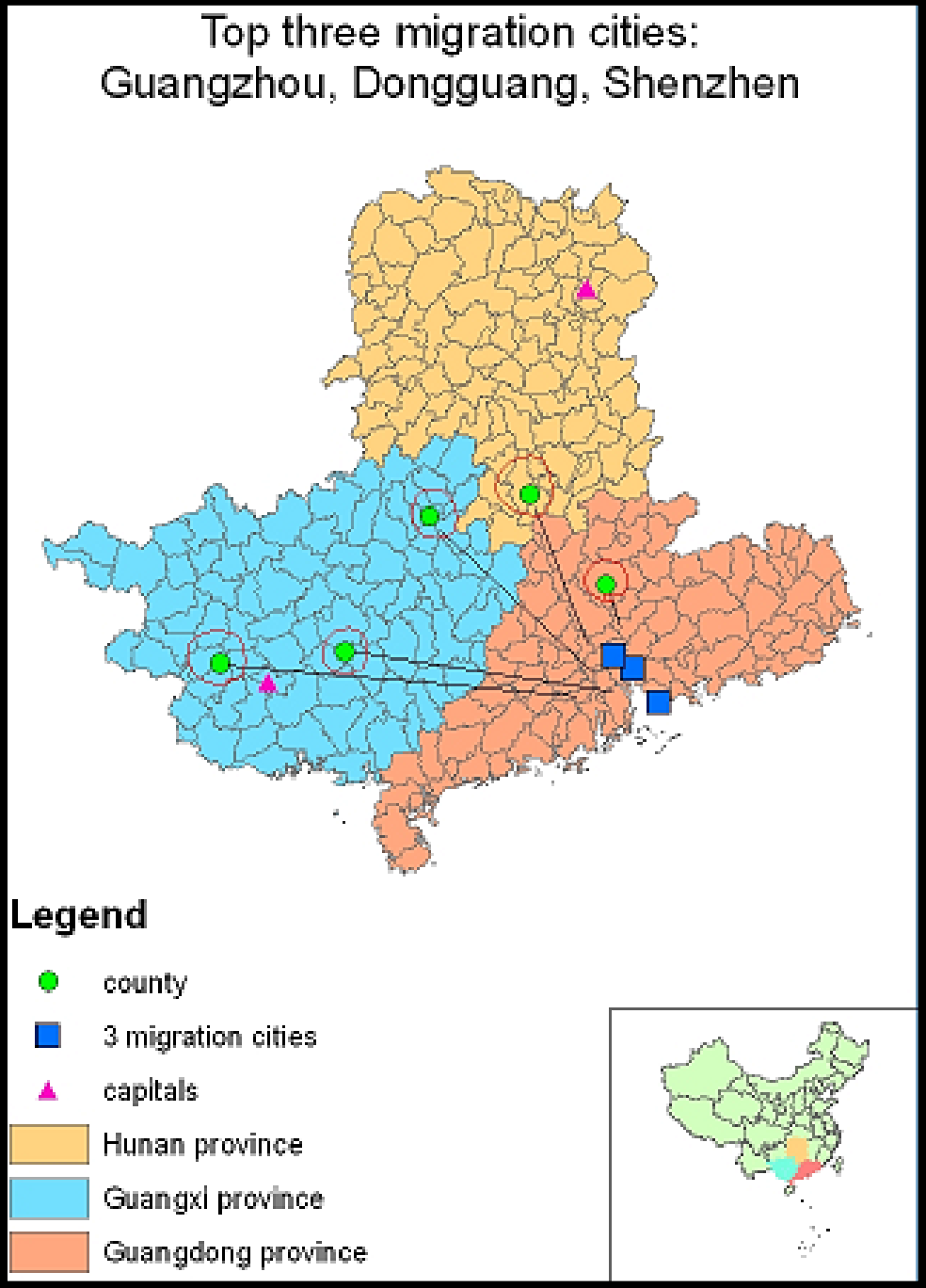
Strong out-migration trends and work-age distribution: surveyed households



Strong out-migration trends and work-age distribution: surveyed households



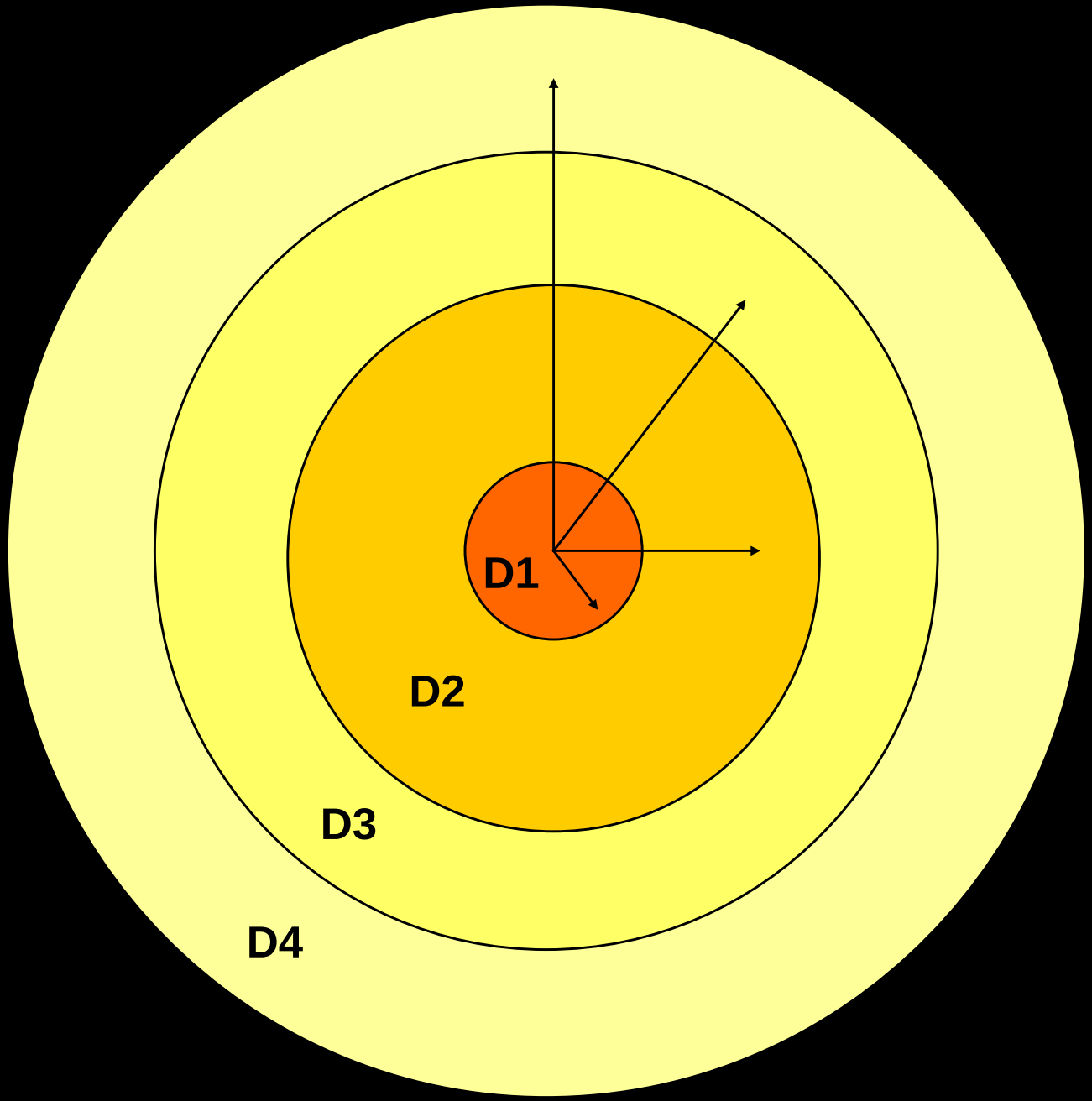
Out-migration destinations



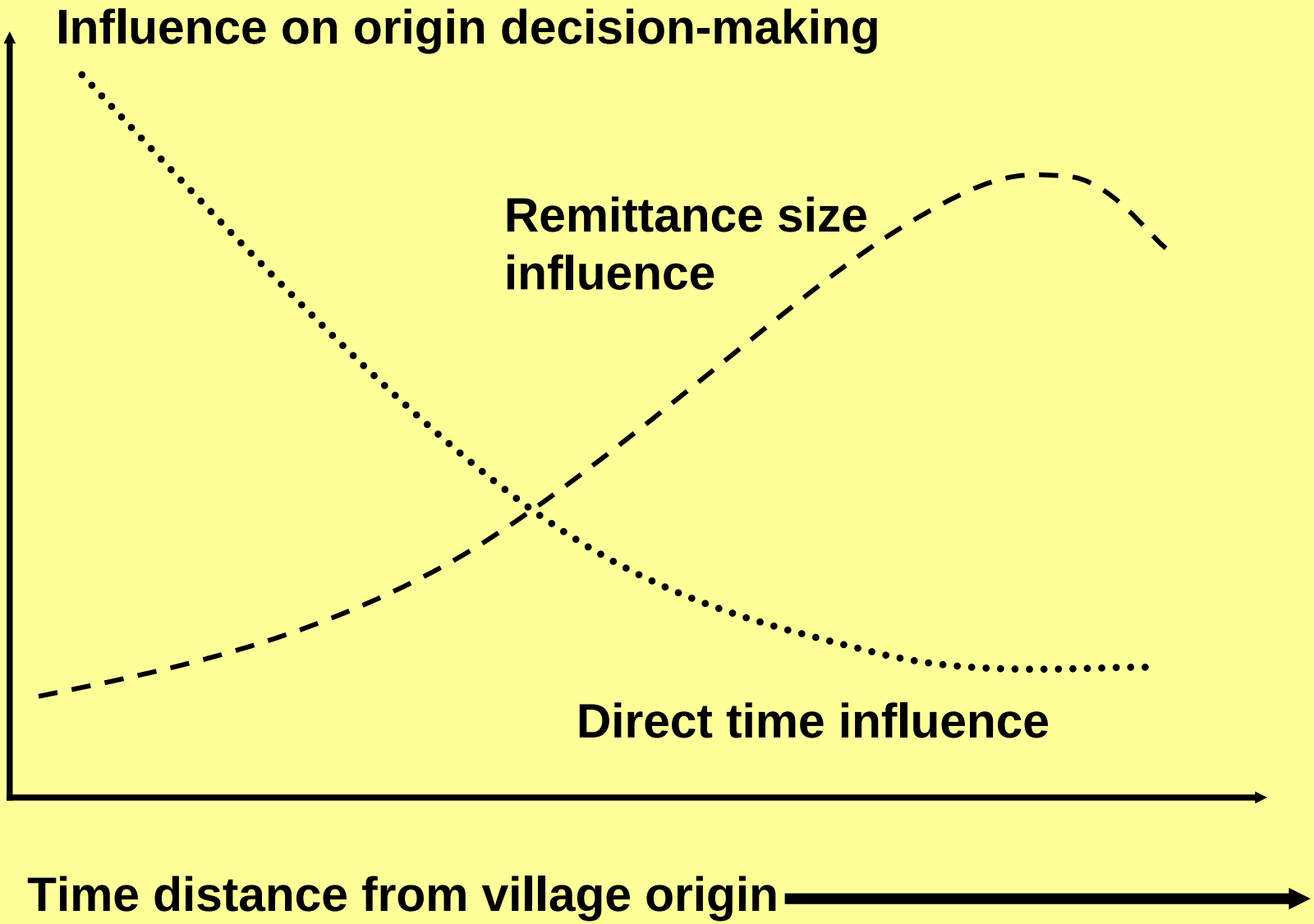
- **Guangzhou , Dongguan, and Shenzhen are most often cited migration destinations for off-farm jobs**
- **All three urban centers are well-developed and located in the Pearl Delta development region, Guangdong province.**
- **Adjacent labor markets also absorbing prime-age and more highly educated labor but to lesser degree.**

Out-migration destinations

- Time distance
- Remittance magnitudes
- Kinship ties – demographic characteristics



Variation across space



Intra-household Decision-making: M-Response

Land use decision	HH unit	M & F (alone)	Male	Adult males	Female	Adult females
Crop selection	8.33	23.81	50.79	2.78	10.32	2.38
New crop adoption	8.73	21.83	53.57	3.57	8.33	2.38
Pesticide, herbicide use	7.97	19.12	55.38	3.19	9.56	1.99
Fertilizer use	8.33	19.44	54.37	3.17	9.92	1.98
Add livestock	8.37	22.71	46.80	2.79	10.80	2.40
Innovate - farm	8.00	24.00	52.80	3.20	7.60	1.60
Invest - farm	7.97	27.49	50.20	2.39	7.17	1.59
Contract farm	8.00	24.80	52.80	2.80	6.80	2.00

Intra-household Decision-making: F-Response

Land use decision	HH unit	M & F (alone)	Male (alone)	Adult males	Female (alone)	Adult females
Crop selection	5.02	26.78	25.94	7.11	25.95	6.69
New crop adoption	4.22	29.41	26.58	7.17	22.36	4.22
Pesticide, herbicide use	2.54	26.69	32.63	8.05	20.76	5.93
Fertilizer use	2.54	26.27	33.05	7.20	20.76	6.36
Add livestock	3.77	30.13	15.90	5.86	34.73	7.11
Innovate - farm	3.40	30.64	32.34	7.23	17.02	3.40
Invest - farm	5.49	28.69	36.29	6.33	15.61	4.22
Contract farm	4.64	28.69	36.29	6.75	14.35	5.06

Couple-interviewed households

1. Unit decision-making remains low – overall
2. Low perceived sharing of short-term decisions outside of couple
3. Women in couple-interviewed households less likely to respond that she is making decision alone than overall adult female sample
4. Women in couple-interviewed households more likely to view decision as shared couple decision than men

Conclusions

1. Understanding intrahousehold differences and interactions – opening the household ‘black box’ – MAY BE important for understanding significant world issues
   - Impacts of human population dispersion/concentration patterns
   - Aging, fertility, nutrition, disease, distribution of resources
2. Econometric models can only go so far
3. MAS provides an alternative, which can be combined with econometric methods to understand outcomes.
4. Agents can reflect heterogeneity in human population: life-cycle stage, educational attainment and gender (decision rules vary)
5. Spatial influence on decision rules likely - long-term vs. short-term
6. Understanding intra-household decision-making structure may provide additional insights


龙秀工作站