



**Evaluating social network to transfer
conservation agriculture practices among
smallholder farmers in central mid-hills of Nepal**



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Outline

- Introduction
- Problem
- Objective and methodology

- Results
 - Network analysis – visual
 - Analysis of network density
 - Analysis of other network parameters

- Conclusion

Introduction

- ❑ Agriculture is mainstay of Nepalese economy by contributing 33% of GDP, employing 65% of labor force (MoF, 2011; CBS 2008)
- ❑ About 60% of cultivated land is slopping land (Pratap, 1998), so degradation of ag. land is common
- ❑ Low crop productivity and limited land has created immense push for intensification of agriculture
- ❑ Intensification in soil degradation prone areas add to the problem of unsustainability (MoEST, 2006; Manandhar et al, 2009) → poverty, malnutrition

Problem

- CA possesses potential for sustainable agro-ecological development in Nepal [Atreya et al., 2008], can increase profit in long run [Das and Beur, 2012] & CA fits well in economic constraints of smallholder farmers [Paudel et al., 2013]
- BUT, actual adoption of improved CA practices in hilly region is very low
- farmers had practiced traditional conservation practices (e.g. shifting cultivation, agroforestry, terracing) in Nepal, but few farmers have knowledge about improved CA practices
- lack of information about improved CA practices can be a major reason for low adoption







Problem

- Social network are important source of information to farmers [Adger, 2010]; act as catalyst for adoption of new agriculture technology [Ramirez, 2013]
- Farmer-to-farmer extension has been success in Nepal (Shrestha, 2013); hence informal farmers networks can be used to reduce the cost of CA transfer [as Magnan et al., 2013]
- Weak public agriculture extension, inaccessibility & high poverty makes informal networks and connections even more important for Nepalese farmers

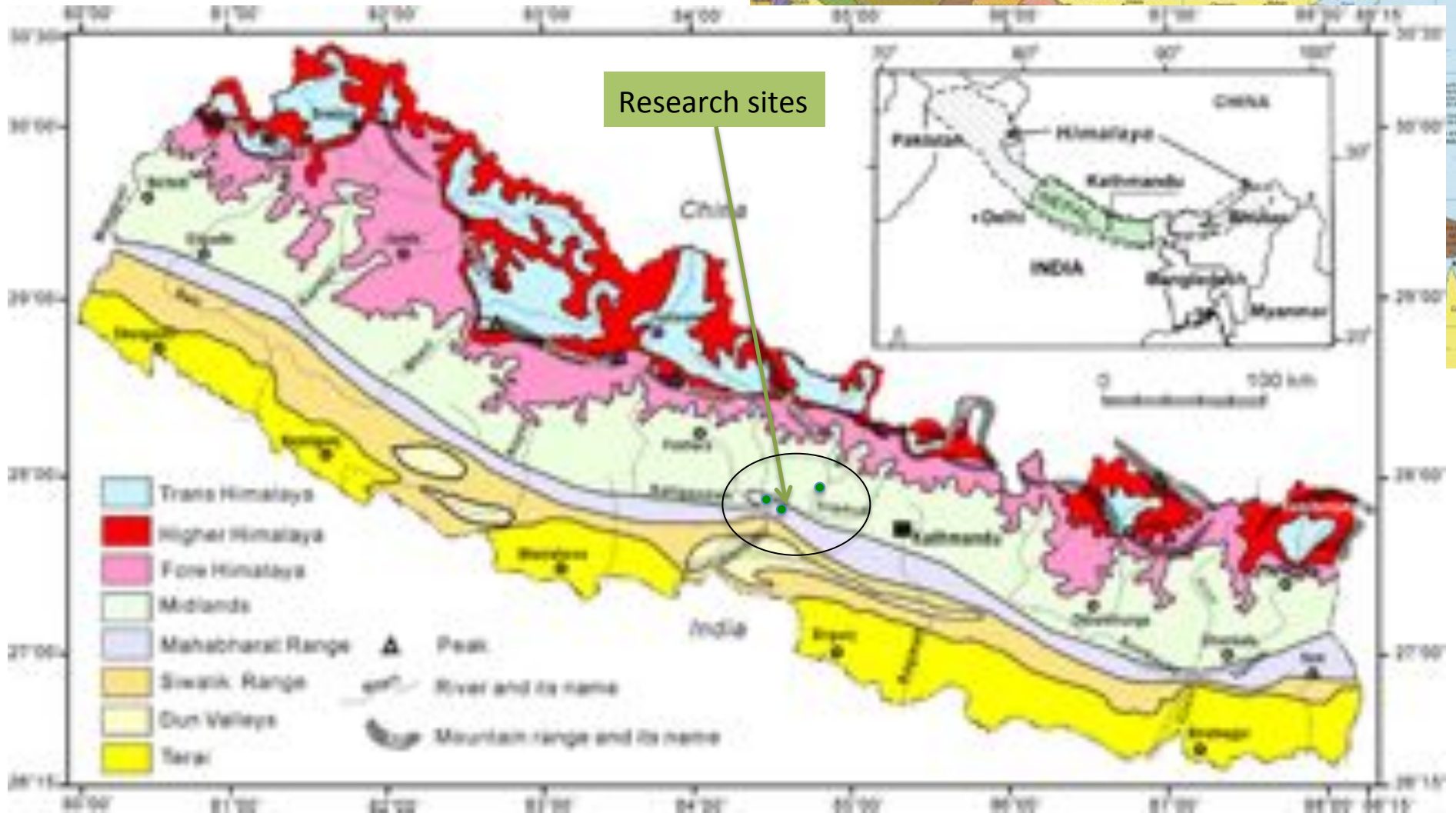
Objectives of the study

- To determine the existing social network through which smallholder farmers get information about new agriculture technology
- To assess the status of information flow about CA practices through existing social network capital
- To evaluate the effects of gender, group mobilization and farmers' training on information flow of CA

Methodology

- **Social Network Analysis (SNA)** [Borgatti et al. (2013) & Hanneman and Riddle, (2005)] was used to determine social network through which new agriculture information flows to the villages
- Compared 'whole network' parameters for 'any new agriculture technology' and 'CA technology using using UCINET i.e. ANOVA density model & Bootstrap probability test
- Visualization done by NetDraw
- Data collected through personal interviews of decision makers; 1 male and 1 female from each households in 3 villages in central mid-hills of Nepal (Thumka, Hyakrang and Kholagun)

Nepal: research sites



Socio-economic characteristics of the farmers in study villages

	Thumka	Hyakrang	Kholagaun	Overall	National level
Sample size for survey					
Sample size (N)	41/45	26/30	27/31	94/105	
Demographic information					
Average HH size	9.6	7	5.75	8.13	4.88
Level of Education (% of total population)					
None	35.40%	45.80%	39.50%	41.00%	34.10%
Pre-school	45.00%	32.20%	34.90%	39.00%	
Primary	7.90%	8.50%	7.00%	8.00%	
Secondary+	11.10%	8.50%	9.30%	10.00%	65.90%
Informal	0.50%	5.10%	9.30%	5.00%	
Land resources					
Agriculture land (hectare)	0.685	0.68	0.4375	0.631	0.8

Technology network survey

Step 1

Selected farmers were asked to nominate 3-10 other farmer or person with whom she/he acquires the information about new agriculture technology to determine agriculture technology network (ATN)

- How strong is the social network for flow of new agriculture technology in study villages?*

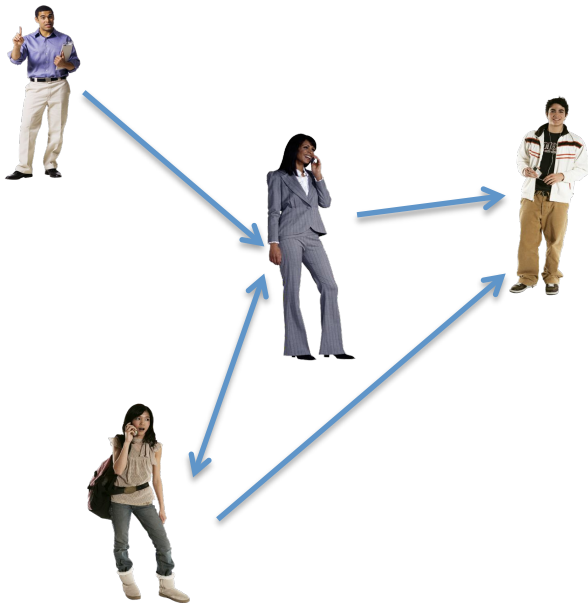
Technology network survey

- **Step 2**

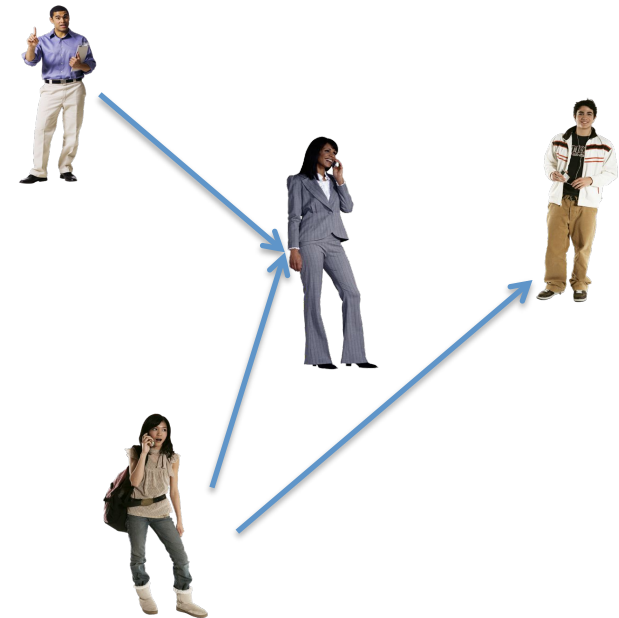
Same farmers were then asked whether she/he asked about any CA practices (i.e. crop rotation, cover crop management, reduced tillage and intercropping) with the nominated person to determine conservation agriculture technology network (CATN)

- Does existing network of information flow works for transfer of knowledge on CA?*

Compare ATN and CATN



Network for any agriculture technology



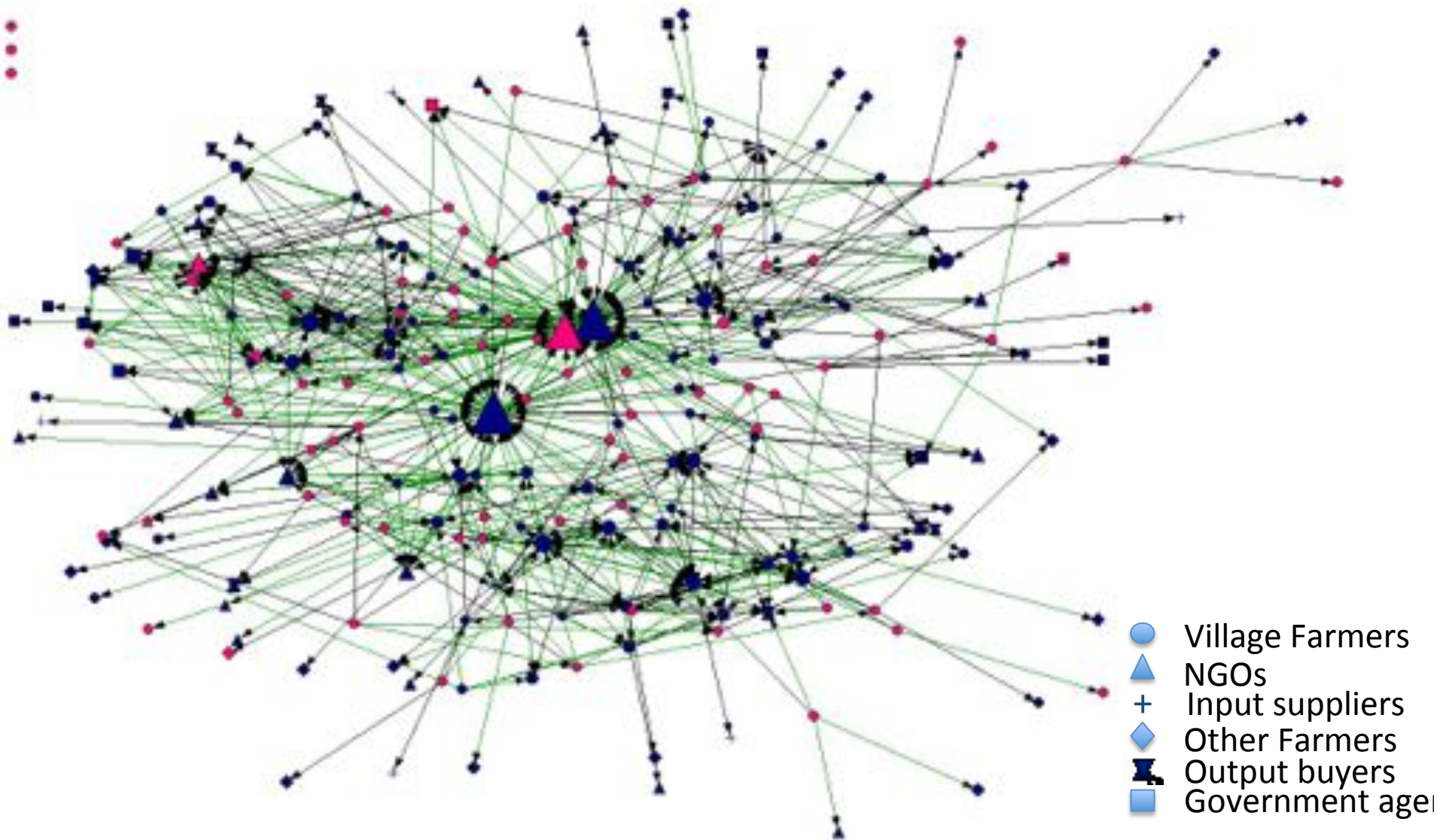
Network for CA technology

- ❑ ***CATN is part of ATN, hence expected to be less dense than ATN***
- ***How weak?***
- ***How the role of different stakeholders differ?***

Results

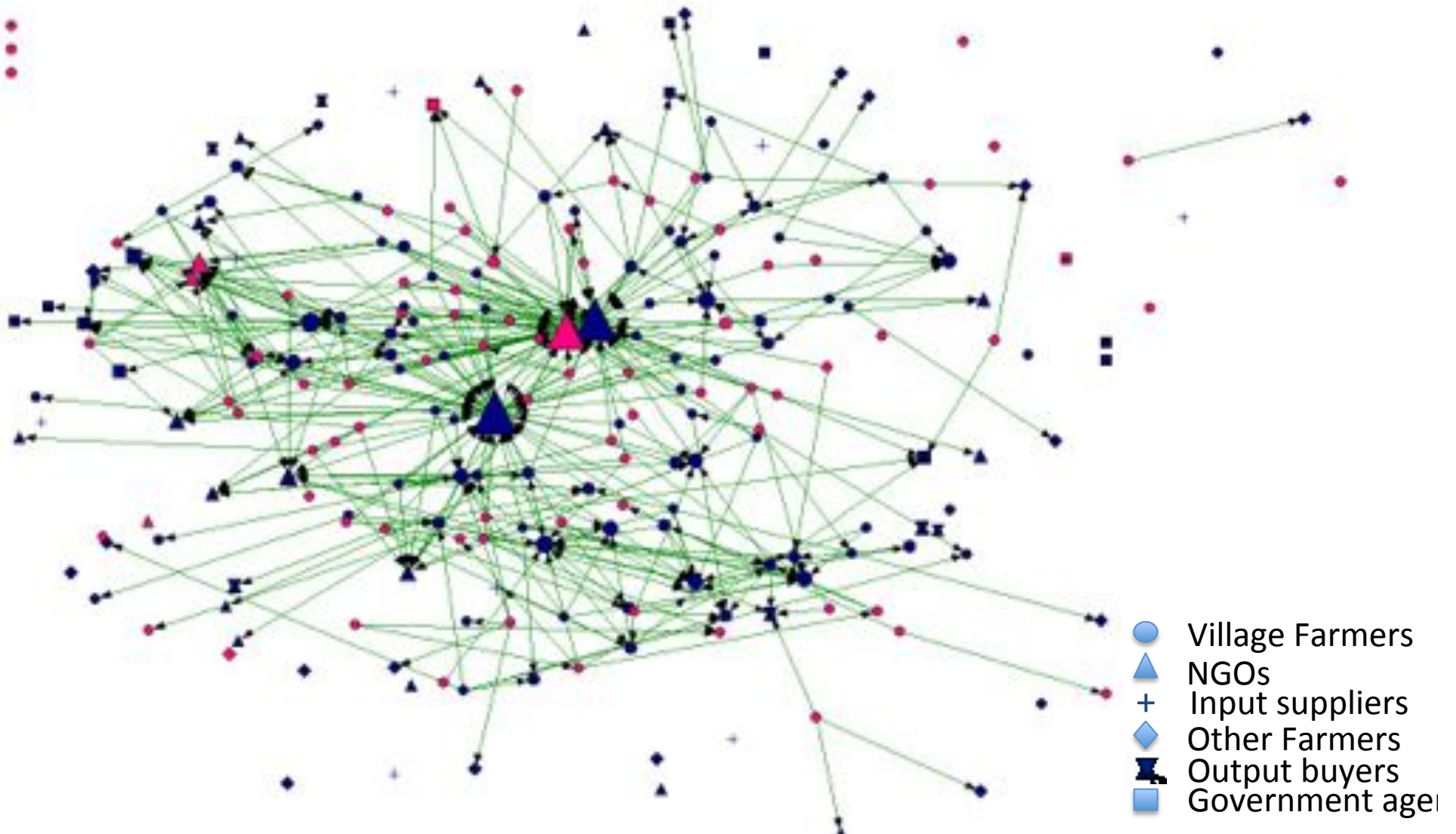
Visual networks

ATN of three villages in central mid-hills of Nepal



Note: Size of node indicate in-degree centrality; CA information flows only from green lines
Blue = male; red = female

CATN of three villages in central mid-hills of Nepal

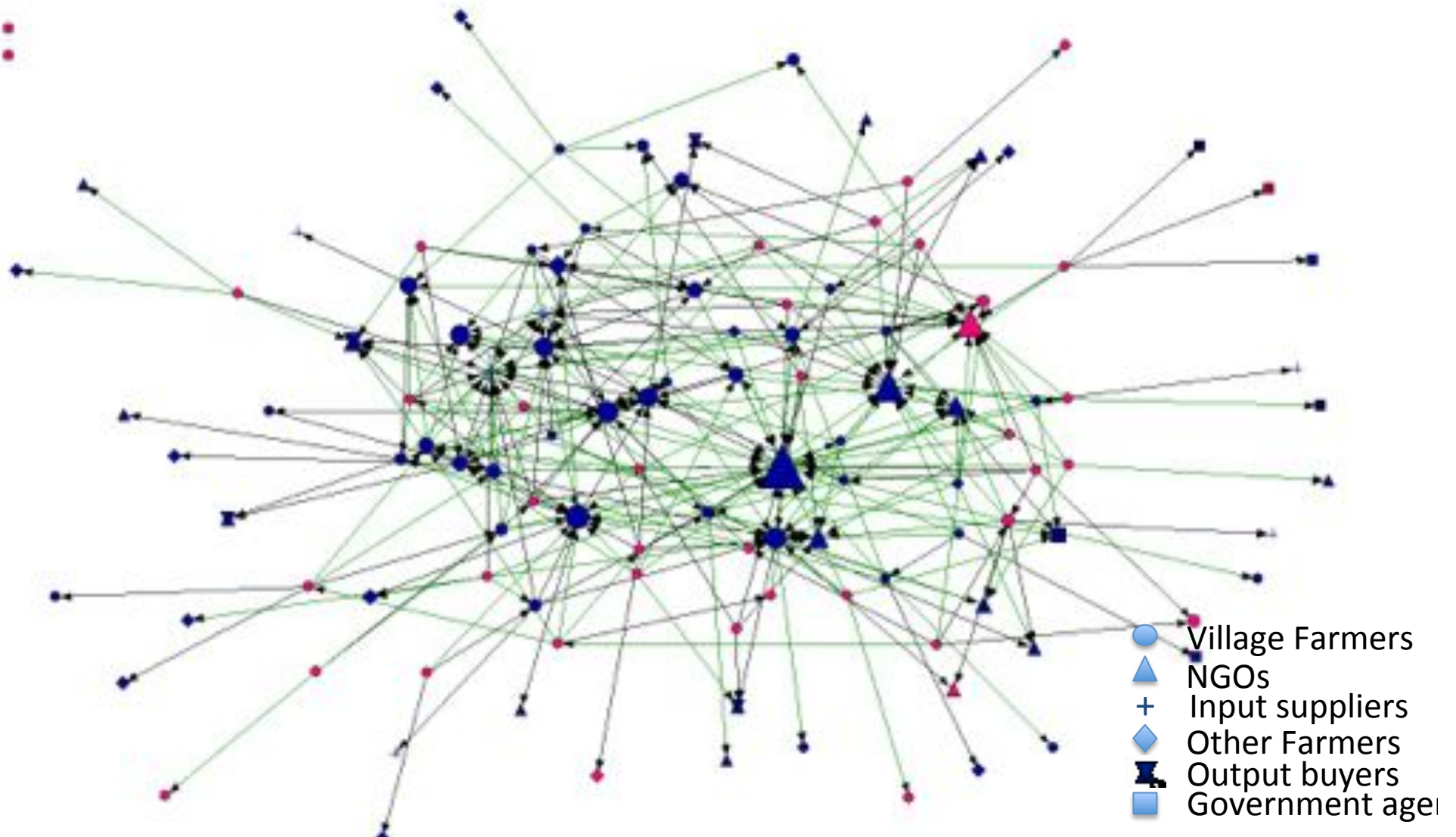


Note: Blue = male; red = female;

CA information flows only from green lines

Size of node indicate in-degree centrality (# of people who ask for information)

ATN of Thumka village

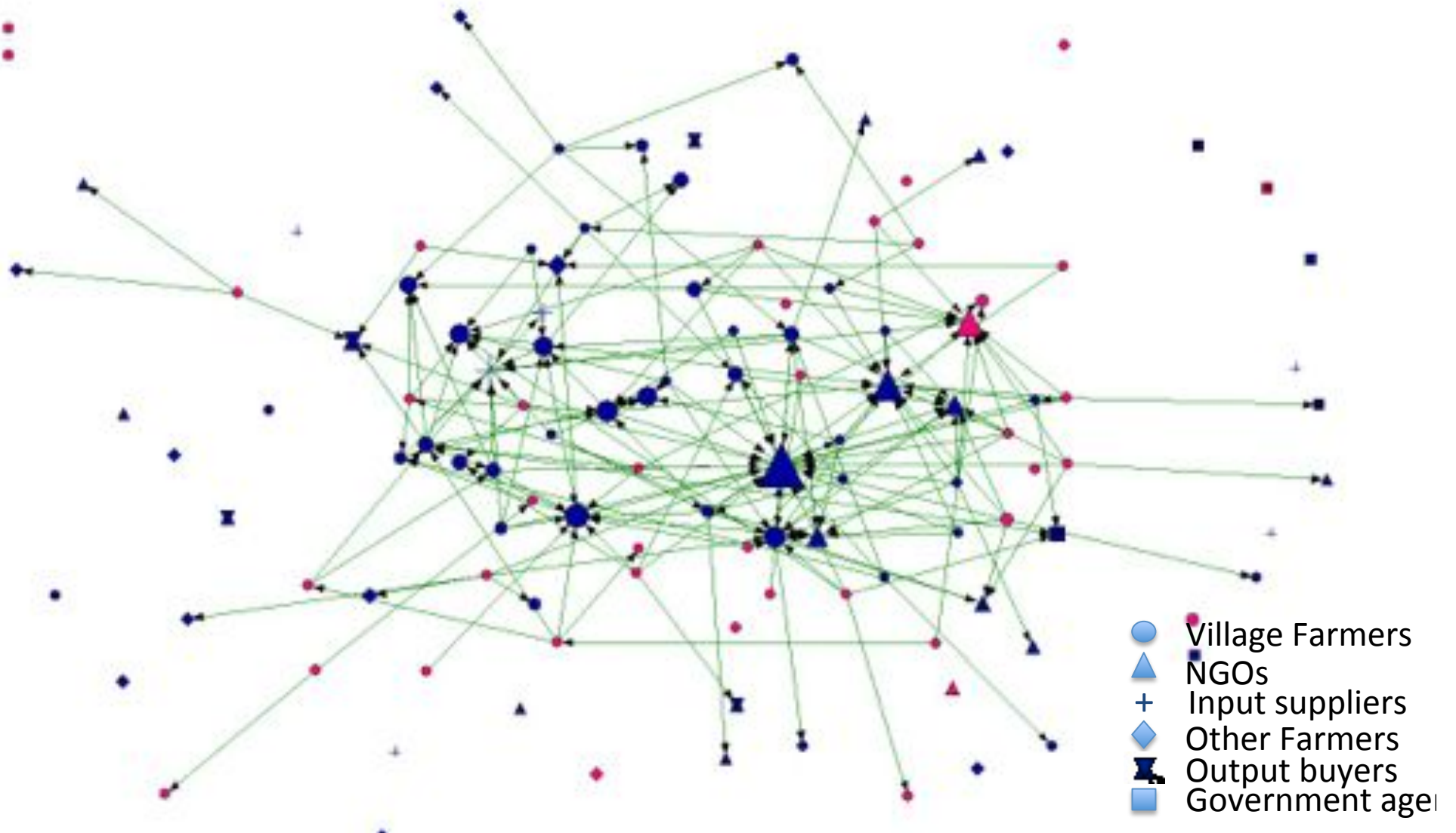


Note: Blue = male; red = female;

CA information flows only from green lines

Size of node indicate in-degree centrality (# of people who ask for information)

CATN of Thumka village

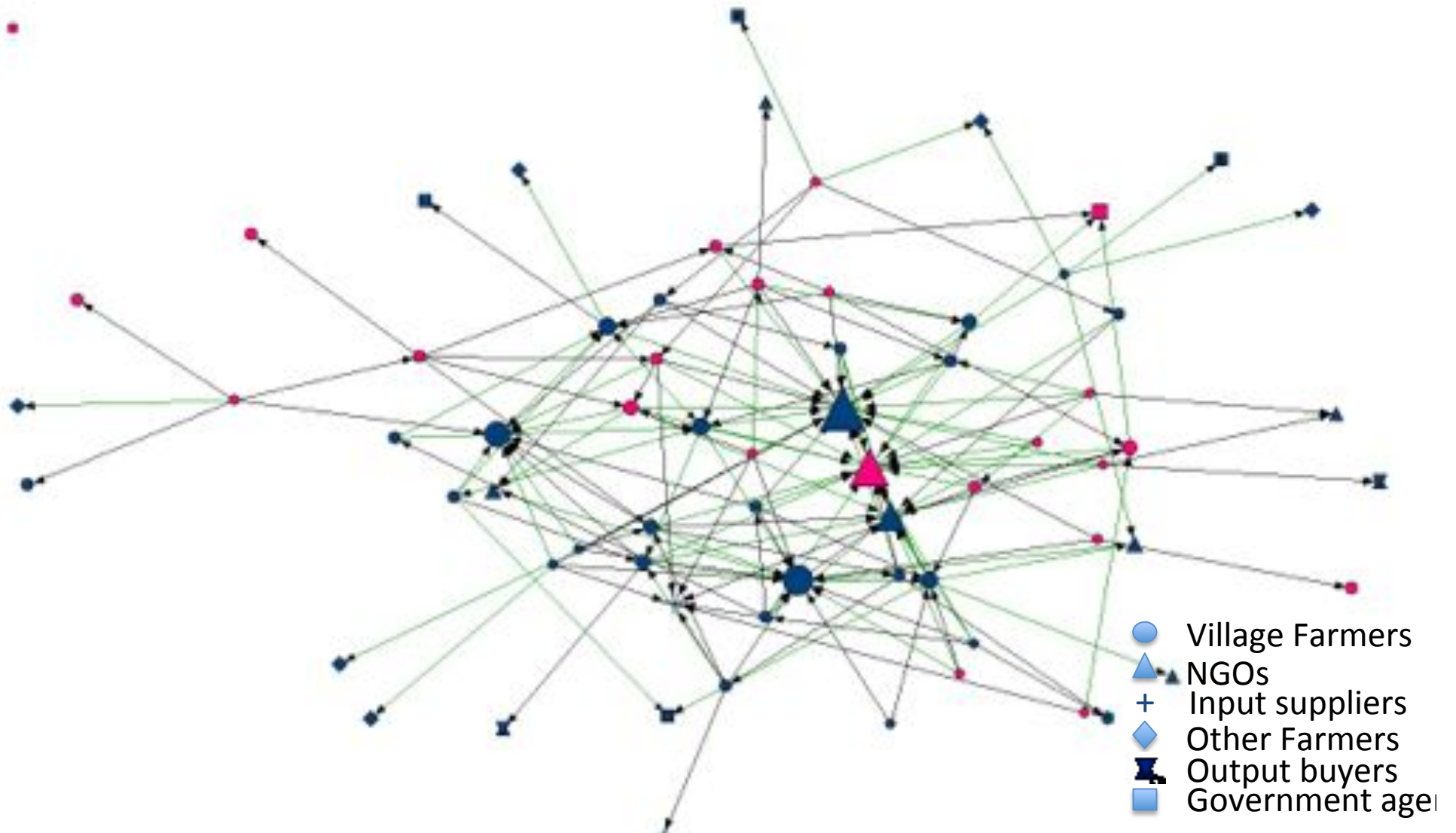


Note: Blue = male; red = female;

CA information flows only from green lines

Size of node indicate in-degree centrality (# of people who ask for information)

ATN of Hyakrang village

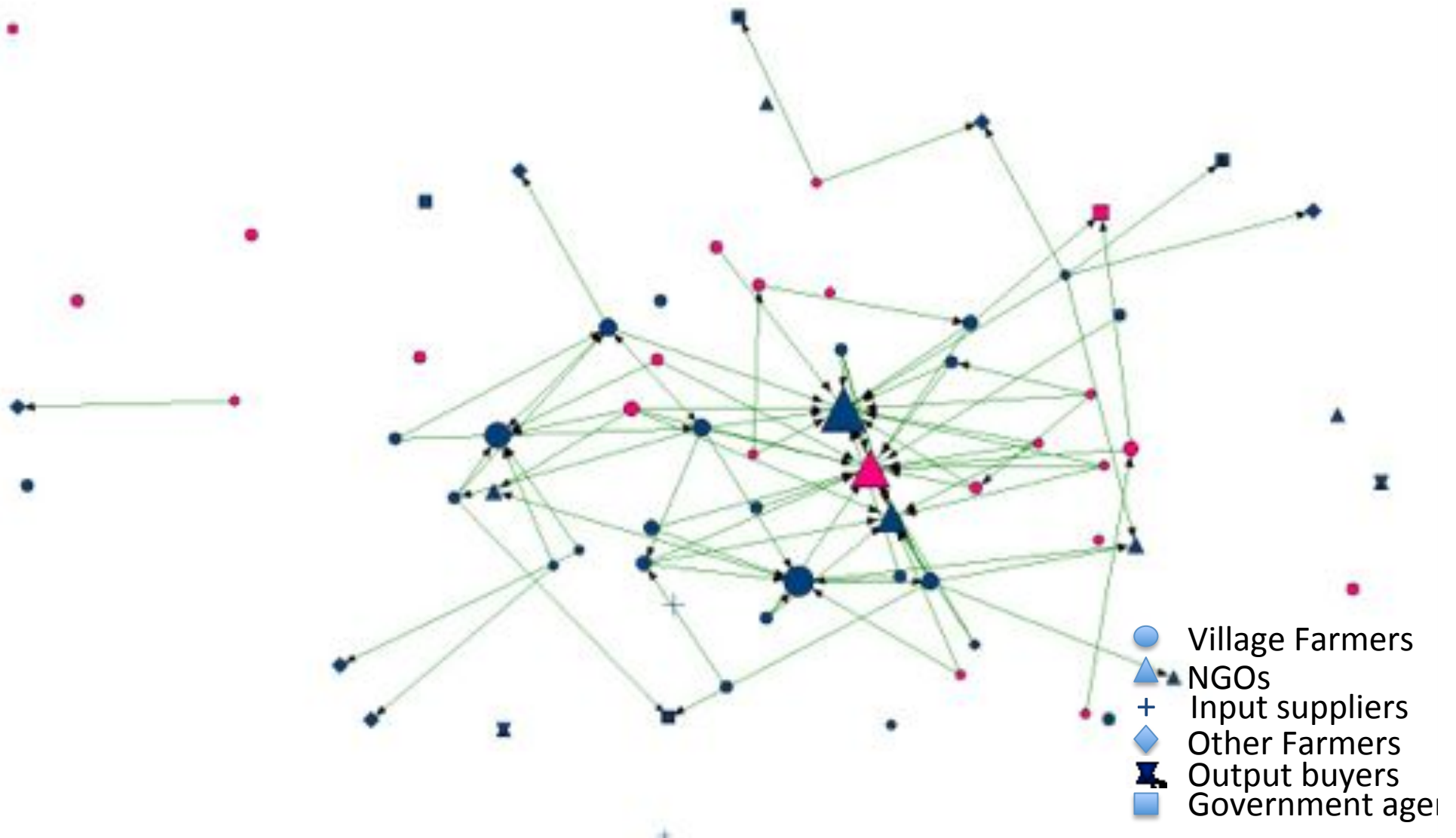


Note: Blue = male; red = female;

CA information flows along green ties

Size of node indicate in-degree centrality (# of people who ask for information)

CATN of Hyakrang village

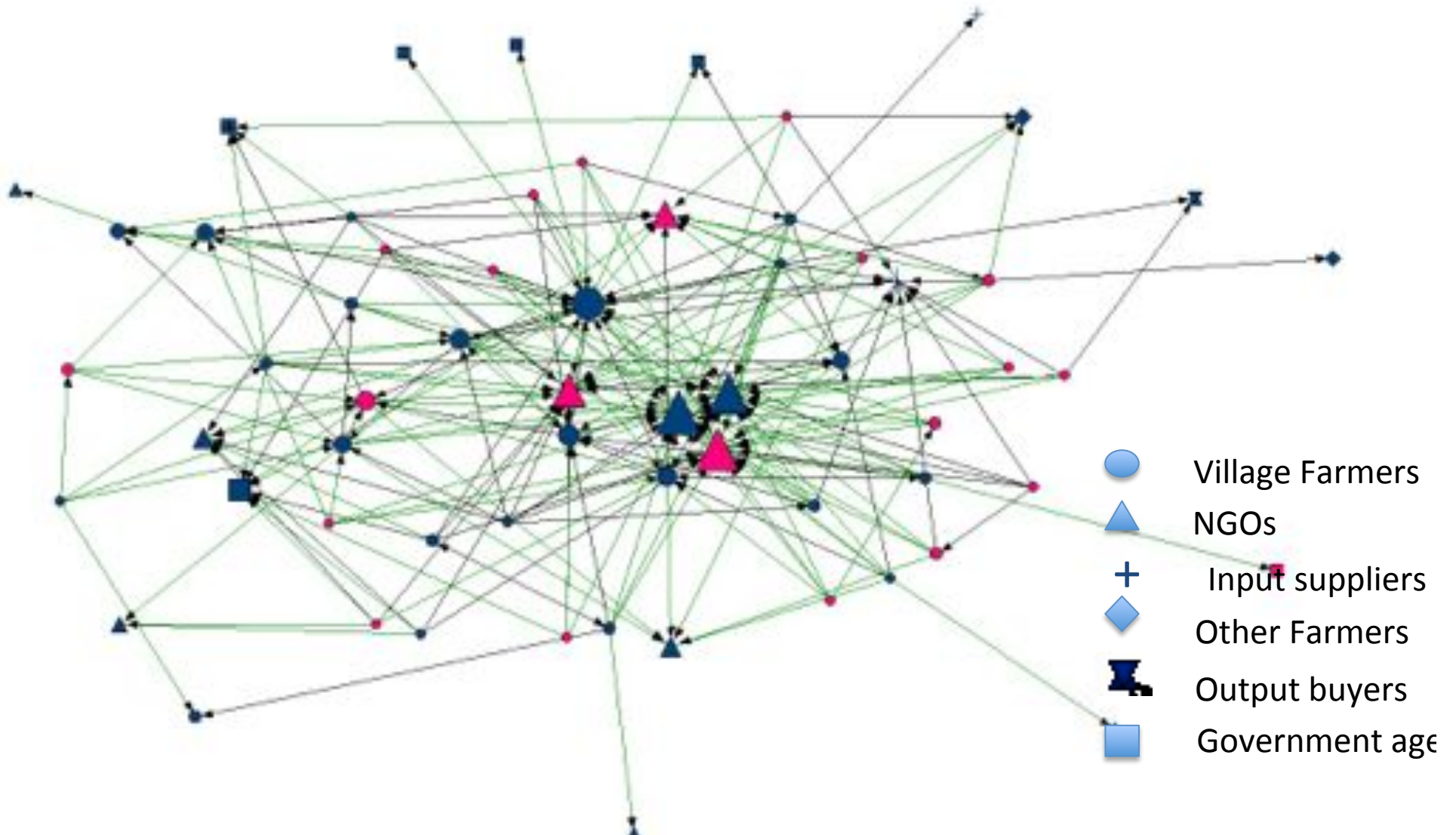


Note: Blue = male; red = female;

CA information flows only from green lines

Size of node indicate in-degree centrality (# of people who ask for information)

ATN of Kholagaun village

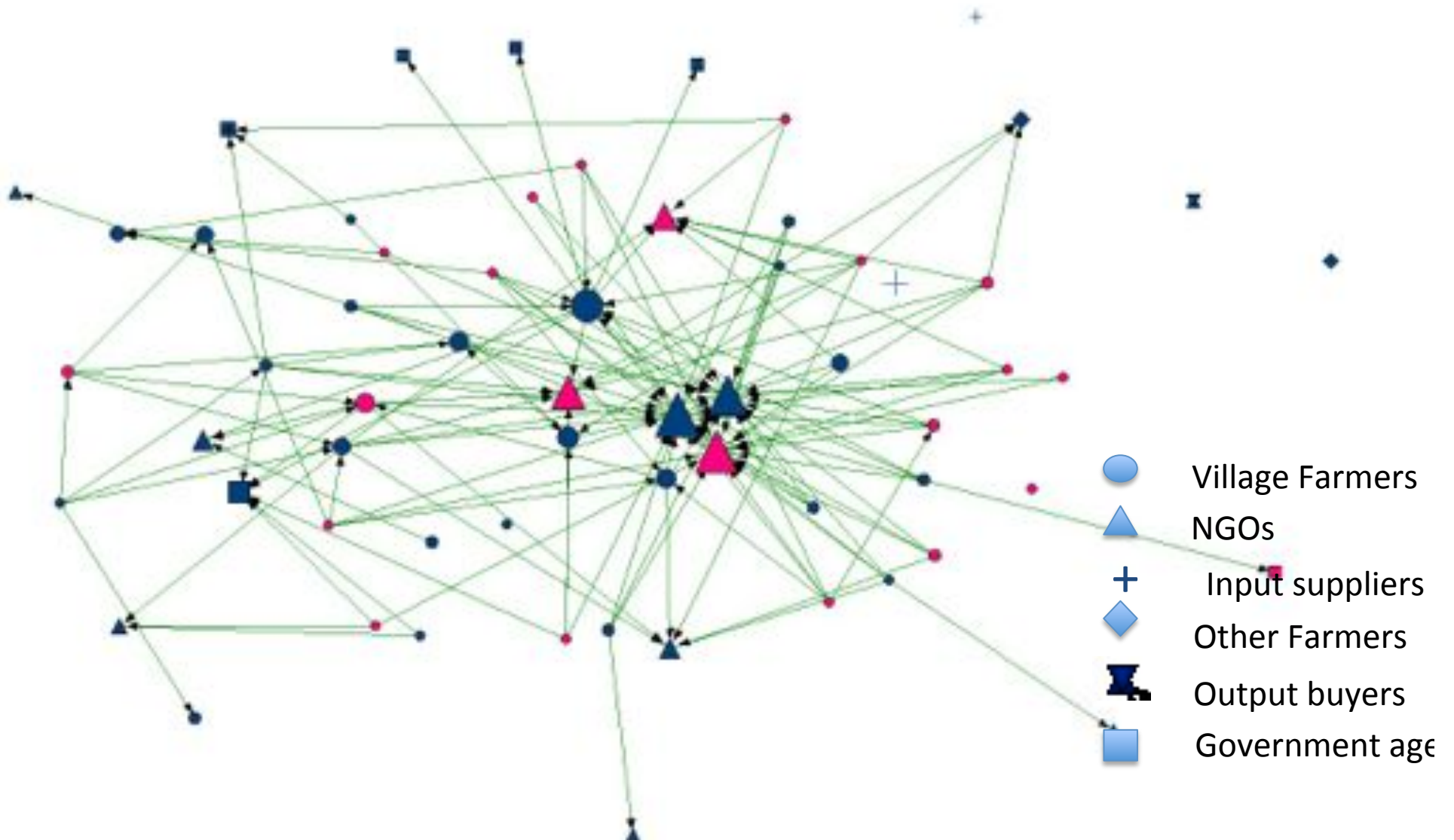


Note: Blue = male; red = female;

CA information flows only from green lines

Size of node indicate in-degree centrality (# of people who ask for information)

CATN of Kholagaun village



Note: Blue = male; red = female;

CA information flows only from green lines

Size of node indicate in-degree centrality (# of people who ask for information)

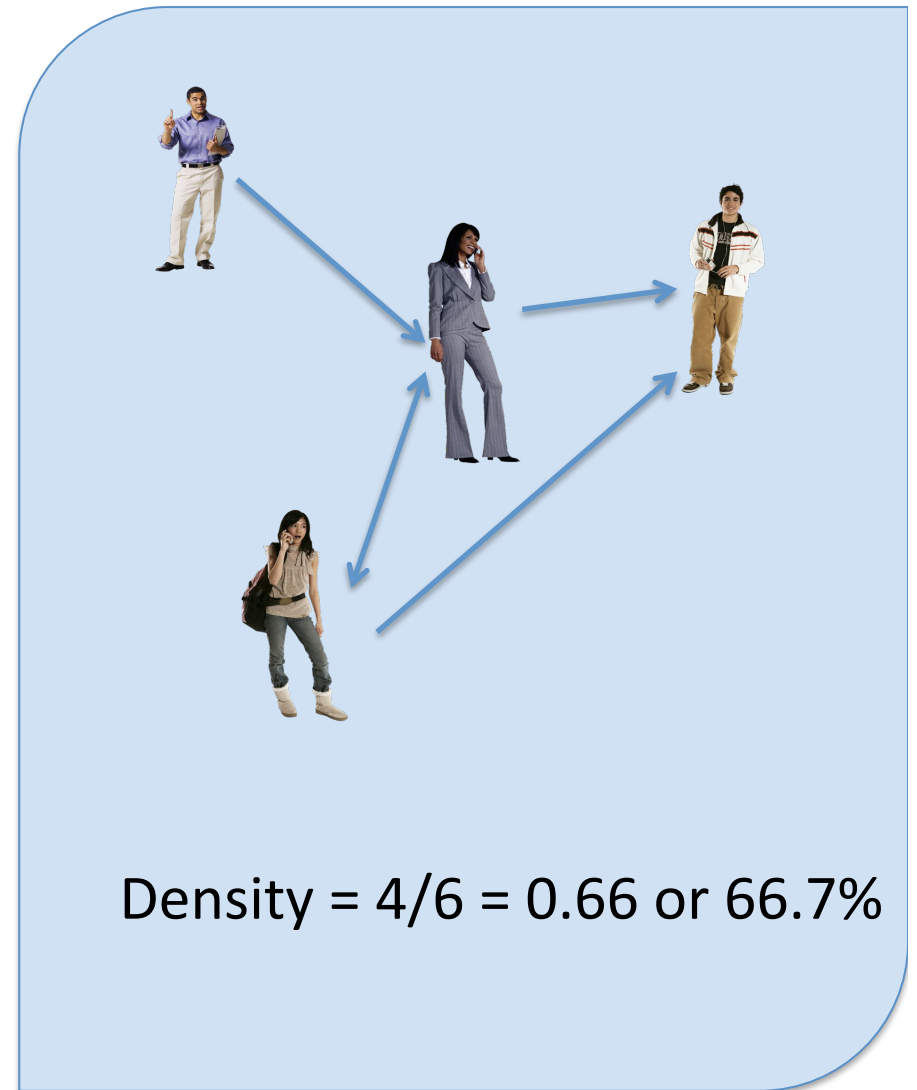
Observations

- CATN is much less dense and fragmented network than ATN
- NGOs and input suppliers plays major part in network
- Male members are better connected in network than female members

Network density analysis

Density

- ❑ density is defined as the sum of the ties divided by the number of possible ties
- ❑ very commonly used quantitative measure of SNA
- ❑ statistical tests exist for comparing the densities



Comparison of network density of ATN and CATN

Village	ATN	CATN	Difference (ATN-CATN)
Thumka	0.023	0.014	0.009***
Hyakrang	0.036	0.019	0.017***
Kholagaun	0.061	0.037	0.024**
Overall	0.014	0.008	0.006***

ATN = agriculture technology network, CATN = CA technology network

** and *** indicate the difference was significance at the probability of 0.05, 0.01 and <0.001 according to **bootstrap probability comparison**

Density of network for information about different CA practices

Village	Crop rotation	Conservation tillage	Cover crop	Intercropping
Thumka	0.90% ^a	0.40% ^c	0.60% ^b	0.80% ^{ab}
Hyakrang	1.30% ^b	0.70% ^a	0.70% ^a	1.30% ^b
Kholagaun	2.30% ^{ab}	1.70% ^a	1.50% ^a	2.50% ^b
Overall	0.50% ^b	0.30% ^a	0.30% ^a	0.50% ^b

Same letter in superscript shows the density was not significantly different at 0.05 probability level according to bootstrap probability test (pairwise comparison between CA practices)

- ❑ Conservation tillage and cover crop management were the CA practices that were least discussed among farmers

Stakeholder in ATN and CATN

Village	Asked by	Asked to	ATN	CATN
Thumka	Farmers	Farmers (n=87)	2.20% ^{***}	1.30% ^{**}
		NGOs (n=15)	5.20% ^{***}	4.00% ^{***}
		Input Suppliers (n=6)	3.80% [*]	1.30% ^{NS}
		Others (n=12)	1.00% [*]	0.40% ^{NS}
Hyakrang	Farmers	Farmers (n=46)	3.80% ^{***}	1.30% [*]
		NGOs (n=8)	6.10% ^{***}	4.60% ^{***}
		Input Suppliers (n=2)	1.90% ^{NS}	NS
		Others (n=6)	1.40% [*]	1.00% [*]
Kholagaun	Farmers	Farmers (n=41)	4.90% ^{***}	2.10% ^{***}
		NGOs (n=11)	11.90% ^{***}	9.50% ^{***}
		Input Suppliers (n=2)	3.30% [*]	NS
		Others (n=8)	1.90% ^{***}	1.30% ^{**}
R-square			3.70% ^{***}	3.10% ^{***}

*, ** and *** indicate significance at the probability of 0.05, 0.01 and <0.001 according to the ***ANOVA test of structural block model***.

Stakeholder in ATN and CATN

- Other farmers from the village and staffs of NGOs were major sources of information
- Input suppliers were main information source for ATN, but they were almost non-existent in CATN

Gender roles in technology network

Network of ties		Network densities	
Asked by	Asked to	ATN	CATN
Male (n=148)	Male	1.60% ^{NS}	1.00% ^{NS}
	Female	0.50% ^{***}	0.30% [*]
Female (n=83)	Male	1.90% ^{NS}	1.20% ^{NS}
	Female	1.20% ^(base)	0.60% ^(base)
	R-Square	0.20% ^{**}	0.10% [*]

*, ** and *** indicate significance at the probability of 0.05, 0.01 and <0.001 according to the ANOVA test of structural block model

- Male-to-male and female-to-male ties were common, while female-to-male & female-to-female ties were found weak
- ATN and CATN both had similar type of gender implications

Effect of group membership

Network of ties		Network densities	
Asked by	Asked to	ATN	CATN
Member (n=53)	Member	1.80% ^{NS}	1.00% ^{NS}
	Non-member	0.90% ^{NS}	0.40% ^{NS}
Non-member (n=178)	Member	2.50% ^{***}	1.70% ^{***}
	Non-member	1.10% ^(base)	0.70% ^(base)
	R-Square	0.20% [*]	0.20% [*]

*, ** and *** indicate significance at the probability of 0.05, 0.01 and <0.001 according to the ANOVA test of structural block model

□ The density of group non member–to-member was found to be significantly higher than non member-to-non member network

Effect of farmers training

Network of ties		Network densities	
Asked by	Asked to	ATN	CATN
Trained	Trained	1.90% ^{NS}	1.00% ^{NS}
(n=49)	Non-trained	0.90% ^{NS}	0.40% ^{NS}
Non-trained	Trained	2.50%^{***}	1.70%^{***}
(n=182)	Non-trained	1.10% ^(base)	0.70% ^(base)
	R-Square	0.20% [*]	0.20% [*]

*, ** and *** indicate significance at the probability of 0.05, 0.01 and <0.001 according to the ANOVA test of structural block model

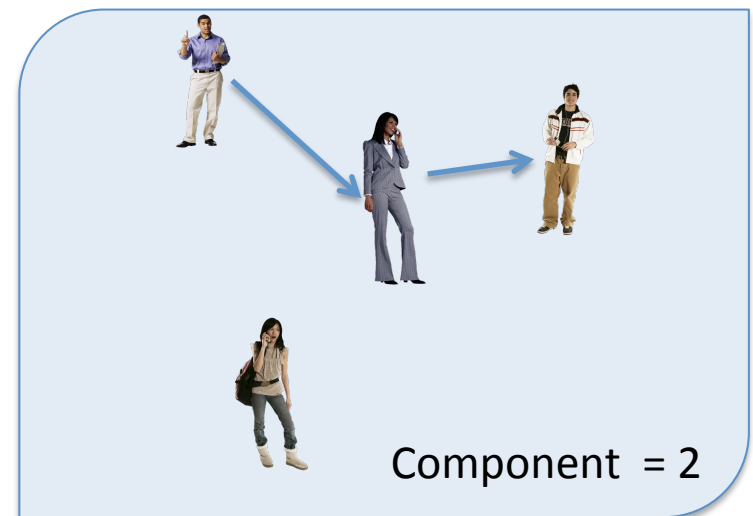
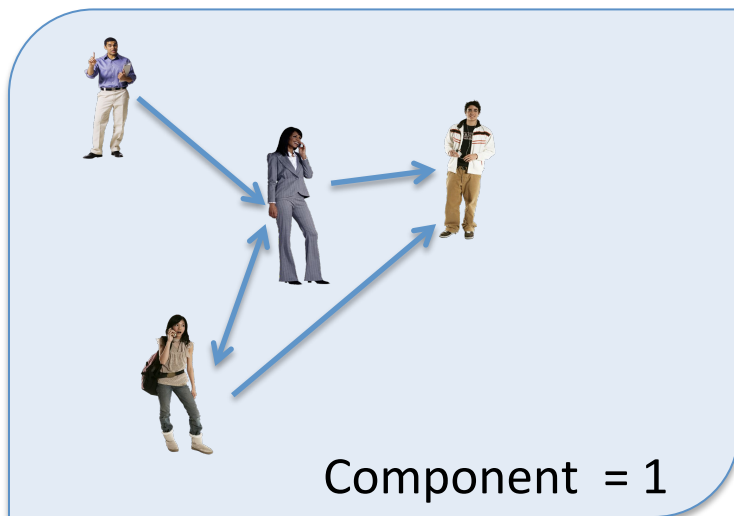
- The density of network with non-trained farmer to trained farmer was significantly higher than baseline
- indicate positive effect of training to strengthen information flow

Other network parameters

- **Component**
- **Centrality**
- **Centralization**

Component

- ❑ Components are the number of completely disjoint subgroups or member in the network
- ❑ Component ratio is a normalized measure
 $CR = c-1/n-1$, where c = number of components, n =number of nodes
1 = all nodes isolated
0 = all nodes connected



Component

Study villages	Network for	Component	Component ratio
Thumka	ATN	3	0.94
	CATN	31	0.98
Hyakrang	ATN	2	0.94
	CATN	20	0.97
Kholagaun	ATN	1	0.92
	CATN	7	0.98
Overall	ATN	4	0.93
	CATN	50	0.98

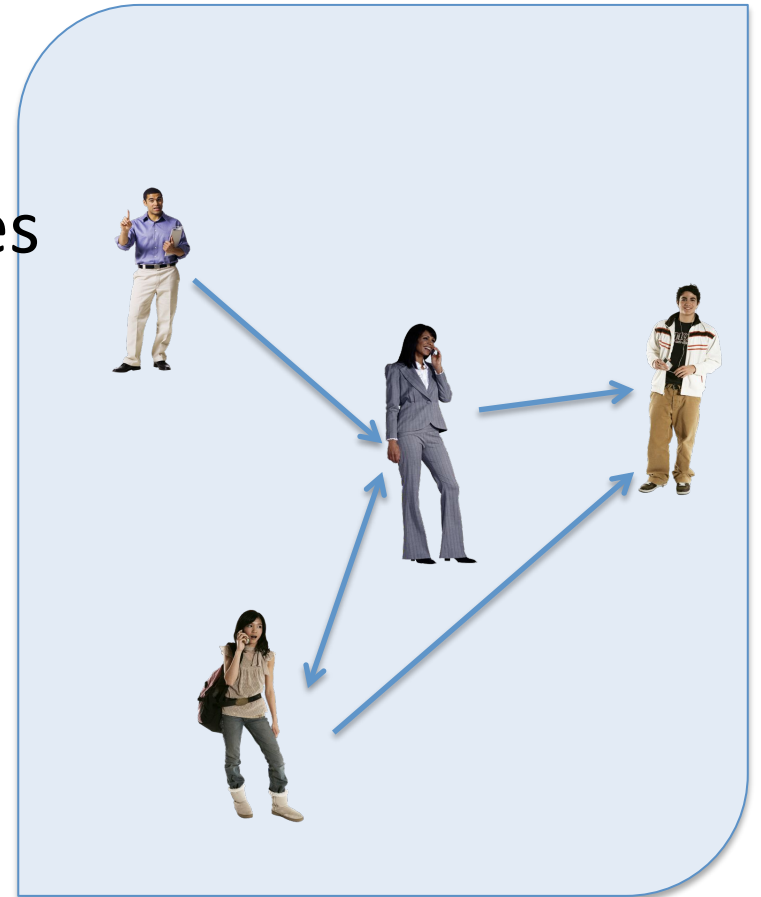
- CATN has very high disjoint components than ATN; hence the network is much more fragmented

Centrality

- ❑ Average # of ties of a farmer
- ❑ It is 'individual network parameter' but the average gives idea of 'whole network'

Three centrality parameters were investigated

- Av. degree centrality ($8/4=2$)
- Av. 2-step centrality ($=3$)
- Av. Betweenness centrality ($3/4=0.75$)



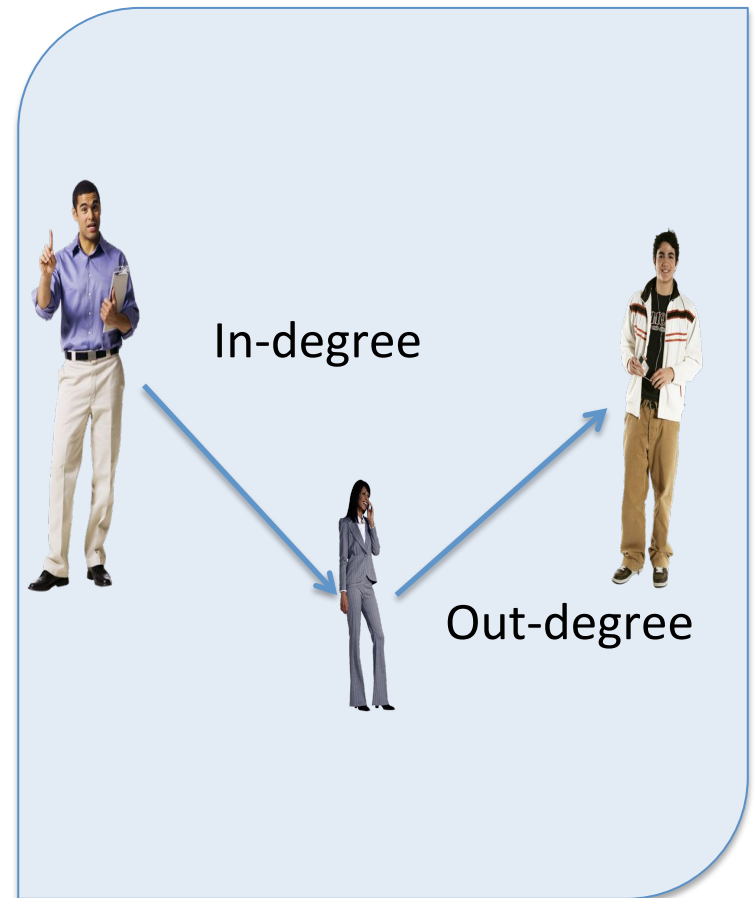
In-degree & out-degree centrality

In-degree centrality

- ❑ # of people who ask information with a given farmer

Out-degree centrality

- ❑ # of people with whom a given farmer ask for information



Average centrality of ATN and CATN in 3 villages of Nepal

Study village	Network for	Centrality (mean)				Betweenness
		Out-degree	In-degree	Out-2-step	In-2-step	
Thumka	ATN	3.66	1.92	9.23	4.48	36.6
	CATN	2.27	1.17	4.3	2.17	5.2
Hyakrang	ATN	3.47	1.84	6.96	3.27	10.4
	CATN	1.82	0.71	2.88	1.06	3.1
Kholagaun	ATN	5.35	1.88	11.93	3.81	17.9
	CATN	3.3	0.86	5.56	1.09	3.2
Overall	ATN	4.01	1.89	9.26	3.99	25
	CATN	2.39	0.97	4.21	1.61	4.2

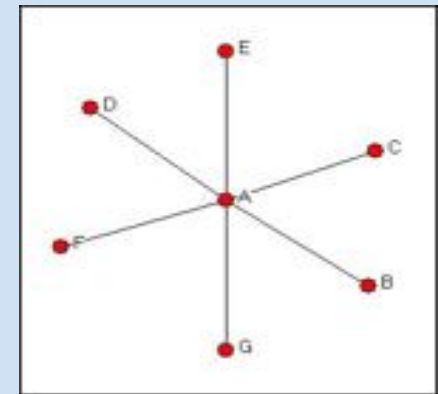
Centrality

- The result indicate even less than half direct sources as well as indirect sources of of new agriculture technology provide information about CA
- Very weak 'betweenness' centrality of CATN compared to ATN, indicate weak farmer-to-farmer transfer of knowledge about CA

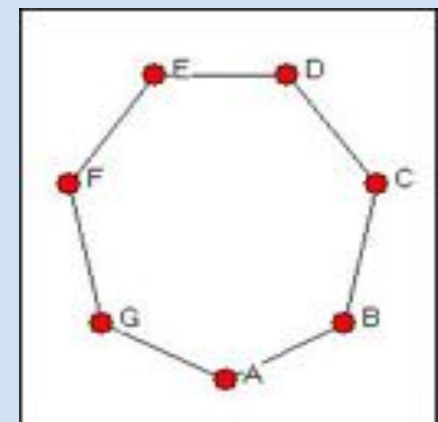
Centralization

- ❑ A very **centralized** network is dominated by one or a few very **central** nodes
- ❑ Higher centralization shows vulnerability of the network to behavior of certain central members

Highest



Lowest



Centralization of ATN and CATN in 3 villages of Nepal

		Centralization	
	Network for	out-degree	in-degree
Thumka	ATN	0.0271	0.1391
	CATN	0.0272	0.1134
Hyakrang	ATN	0.0267	0.1554
	CATN	0.0356	0.1189
Kholagaun	ATN	0.0702	0.3511
	CATN	0.1139	0.1803
Overall	ATN	0.0156	0.1576
	CATN	0.0195	0.1362

Centralization

- Low out-degree centralization indicate only few members in network are repeatedly ask for information about CA
- Higher in-degree centralization of CATN compared to ATN indicate that there were very few farmers who provide information of CA to other farmers

Conclusion

- Existing technology transfer network was found to be weaker, fragmented and poor to disseminate knowledge of CA practices
- Key player for agriculture technology transfer, such as market (input suppliers) and government extension are out of the information network of CA

Conclusion

- conservation tillage and cover crop management principles are poorly understood and discussed
- organizing stallholders farmers in groups, and providing training to key members of the community would improve information network
- capacity building of females & involvement of market stakeholders would be another important way forward



Thank you !

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-  Village Farmers
-  NGOs
-  Input suppliers
-  Other Farmers
-  Output buyers
-  Government agencies