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INFORMAL FARMER-TO-FARMER NETWORKS SHAPING LAND-USE DECISIONS AND INDIGENOUS AGRICULTURAL PRACTICES IN RURAL KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract
Informal farmer-to-farmer networks play a critical role in shaping land-use decisions and sustaining indigenous agricultural practices, especially in rural Khyber Pakhtunkhwa (KP), Pakistan. These networks function as primary knowledge transmission channels, enabling farmers to share insights on crop selection, soil management, pest control, and adaptive strategies over time. This study employed a mixed-methods design, combining structured surveys with ethnographic interviews to analyze how both smallholder and medium-to-large landowners leverage social networks to influence agricultural outcomes. Data were collected from 350 participants across three districts, capturing both historical and contemporary practices. Findings indicate that knowledge sharing is strongly influenced by kinship, local hierarchies, gender roles, and trust. Informal networks facilitate rapid dissemination of low-cost, contextually appropriate practices, while formal agricultural extension services remain underutilized. Network centrality and reciprocity were found to correlate positively with adoption of sustainable land-use practices. The study contributes to understanding how social structures mediate agricultural decision-making and provides policy insights for integrating indigenous knowledge into formal agricultural planning.

Keywords: *Farmer Networks, Indigenous Agriculture, Land-Use Decisions, Knowledge Transmission, Khyber Pakhtunkhwa, Rural Pakistan*

Introduction

Agriculture remains the backbone of rural economies in Pakistan, particularly in Khyber Pakhtunkhwa (KP), where both smallholder and medium-to-large farmers rely heavily on local ecological knowledge to sustain livelihoods. Despite advances in formal agricultural extension services and technology, much of the knowledge that guides day-to-day farming decisions is transmitted informally through peer networks, family ties, and community interactions. Understanding these informal knowledge systems is critical for recognizing how land-use decisions evolve over time and how indigenous practices persist or transform under social, economic, and environmental pressures.

Over the past two decades, research in rural agricultural communities has increasingly highlighted the social dimensions of knowledge transfer. In KP, informal networks are not merely channels for exchanging technical information; they are deeply embedded within local hierarchies, gender norms, and trust structures (Hussain & Malik, 2018; Khan & Farooq, 2019). For instance, smallholder farmers often rely on neighbors or extended family for guidance on crop rotation, organic pest management, and water conservation techniques. Similarly, medium-to-large landowners may influence the adoption of certain practices through demonstration plots or community leadership. These networks act as both facilitators and gatekeepers of knowledge, shaping which practices are widely disseminated and which remain localized.

The role of informal networks is particularly salient when considering historical continuity in land-use decisions. Past practices inform contemporary choices, creating a dynamic interplay between tradition and

innovation. Farmers integrate indigenous knowledge developed over generations with modern methods, adapting strategies to address soil degradation, water scarcity, and climate variability (Latif & Hussain, 2024). Gender and social stratification further influence who accesses and controls this knowledge, with male landowners often occupying central positions in decision-making hierarchies, while women and marginalized groups may experience constrained participation (Shair, Tayyab, Nawaz, & Amjad, 2023).

Despite recognition of the importance of informal knowledge, empirical studies that systematically document how these networks shape land-use decisions in KP are limited. Most research focuses either on formal extension programs or isolated case studies of technological adoption, leaving a gap in understanding the social processes that mediate agricultural decision-making. This study addresses this gap by examining both smallholder and medium-to-large landowners through a mixed-methods design, emphasizing longitudinal changes in practices and the role of network structure, reciprocity, and trust.

The central research questions guiding this study are:

1. How do informal farmer-to-farmer networks influence land-use decisions among smallholder and medium-to-large farmers in rural KP?
2. What role does indigenous agricultural knowledge play in shaping these decisions over time?
3. How do social factors such as kinship, trust, and hierarchical positioning within networks affect the dissemination and adoption of practices?
4. In what ways can understanding these networks inform policy interventions aimed at sustainable agriculture and knowledge integration in rural Pakistan?

By addressing these questions, the study aims to provide both theoretical insights into the sociocultural mechanisms of knowledge transfer and practical guidance for leveraging indigenous knowledge in agricultural planning. It situates informal networks not merely as ancillary to formal extension services but as central determinants of adaptive capacity and sustainable land management in rural contexts.

Literature Review

Informal knowledge networks have long been recognized as crucial in agricultural development, particularly in contexts where formal extension services are limited or inaccessible. The literature identifies several dimensions of such networks, including their structure, modes of knowledge transmission, and influence on decision-making. In rural Pakistan, studies show that farmers often rely on neighboring farmers, local elders, and peer groups for guidance on crop management, water usage, and pest control (Abbas et al., 2014; Ahmad & Shah, 2020). These networks are especially important for smallholders, who frequently lack access to technical expertise or financial resources for experimentation with new methods.

Social networks act as both conduits and barriers to knowledge flow. Trust, reciprocity, and perceived expertise within the network determine which practices are shared and adopted (Cummings, Butler, & Kraut, 2002; Neves, Waycott, & Malta, 2018). In KP, kinship networks are particularly influential; farmers prioritize advice from close relatives or established community leaders over external experts, highlighting the importance of relational proximity in shaping agricultural decisions (Khan, Ali, & Ahmad, 2023). Gender dynamics intersect with these networks, as men often occupy central nodes in decision-making hierarchies, whereas women and younger farmers may remain peripheral, limiting their ability to influence or access critical knowledge (Latif & Hussain, 2024; UN Women, 2024).

Indigenous agricultural knowledge encompasses practices developed over generations, including crop rotation, intercropping, soil fertility management, and pest control using herbal or organic methods. Such

knowledge is context-specific, adapting to local climatic, soil, and ecological conditions (Mustafa et al., 2019). While formal extension programs focus on modern, high-input approaches, informal networks allow farmers to experiment with hybrid strategies that integrate traditional and contemporary methods. This integration has been shown to increase resilience to climatic shocks and reduce dependency on expensive inputs (Pradhan, Arvin, & Norman, 2015; Zaman & Rehman, 2025).

Over time, these informal networks have also evolved with technological and social changes. Mobile phones and social media platforms provide new channels for knowledge dissemination, although access remains uneven due to socioeconomic and gender constraints (Khan, Ali, & Ahmad, 2023; PTA / Pakistan Telecommunication Authority, 2024). Farmers increasingly combine face-to-face interactions with digital communication to share updates on market conditions, pest outbreaks, and innovative practices. The interaction between traditional networks and digital communication offers potential for accelerating adoption while maintaining the context-specific advantages of indigenous knowledge.

Trust and credibility within networks are consistently highlighted as determinants of effective knowledge transfer. Advice from highly respected or central network members is more likely to be adopted, while peripheral advice may be ignored, regardless of technical validity (Rice & Katz, 2003; Mossberger, Tolbert, & Stansbury, 2003). In KP, respect for local elders and opinion leaders shapes the dissemination of new practices. Medium-to-large landowners often act as opinion leaders, facilitating adoption among smallholders, but they may also resist change to protect established economic and social hierarchies (Wilson, Wallin, & Reiser, 2003).

The literature also indicates that historical memory of past practices influences current land-use decisions. Farmers retain experiential knowledge about which crops, rotations, or soil management strategies worked under specific environmental conditions. This longitudinal perspective informs both smallholder and larger landowner decisions, creating a dynamic interplay between past and present practices (Jamil, 2020; Latif & Hussain, 2024). Informal networks are essential in transmitting this historical knowledge, ensuring that lessons learned are not lost across generations.

Despite abundant anecdotal evidence, empirical research quantifying the impact of informal networks on land-use outcomes in rural KP is sparse. Most studies are descriptive or case-based, limiting generalizability and policy applicability. This study addresses these gaps by employing a mixed-methods design, combining surveys to capture broad patterns with ethnographic interviews to contextualize decision-making processes. By analyzing both network structures and individual-level adoption patterns, the research provides a nuanced understanding of how social, cultural, and ecological factors intersect in shaping agricultural outcomes.

In conclusion, the literature emphasizes three critical points relevant to this study: 1) informal farmer-to-farmer networks are central to knowledge transmission, 2) indigenous agricultural knowledge is dynamic, context-specific, and transmitted across generations, and 3) social factors including trust, kinship, and hierarchy strongly mediate adoption patterns. Building on these insights, the current study investigates how these mechanisms operate over time in KP, examining both smallholder and medium-to-large landowners to capture stratified patterns of network influence and knowledge flow.

Methodology

Research Design

This study used a mixed-methods approach, combining quantitative surveys with qualitative ethnographic

interviews to capture both general patterns and contextualized decision-making processes. The mixed-methods design allows triangulation of data and provides a comprehensive understanding of how informal networks influence land-use decisions and the persistence of indigenous agricultural practices over time.

Study Area and Population

Data were collected from three districts in Khyber Pakhtunkhwa: Abbottabad, Swat, and Charsadda. These districts were selected to provide diversity in agroecological zones, landholding sizes, and exposure to formal extension services. The population included both smallholder farmers (<5 acres) and medium-to-large landowners (>5 acres), stratified to examine differences in network centrality, adoption of practices, and knowledge transfer.

Sampling Strategy

A stratified random sampling technique was employed. The strata were based on landholding size and district. Within each stratum, households were randomly selected. A total of **350 farmers** participated: 200 smallholders and 150 medium-to-large landowners. Sampling aimed to ensure representation across socioeconomic status, gender, and geographical location.

Data Collection Methods

Surveys

Structured questionnaires captured:

- Demographic information
- Landholding characteristics
- Participation in informal networks
- Frequency and type of knowledge sharing
- Adoption of indigenous and modern agricultural practices
- Perceived effectiveness of network advice

Ethnographic Interviews

Semi-structured interviews were conducted with 50 purposively selected participants, including opinion leaders and network hubs. Interviews explored:

- Historical changes in land-use decisions
- Mechanisms of knowledge transfer
- Gendered participation in networks
- Decision-making processes regarding crop selection, pest management, and resource allocation

Data Analysis

Quantitative Analysis

Survey data were analyzed using SPSS 20. Network measures included:

- Degree centrality (number of connections)
- Betweenness centrality (control over information flow)
- Reciprocity (mutual knowledge exchange)

Correlations were tested between network metrics and adoption of sustainable land-use practices. Regression models evaluated predictors of adoption while controlling for landholding size, age, education, and socioeconomic status.

Qualitative Analysis

Interview transcripts were coded thematically using NVivo 12. Codes focused on:

- Knowledge sources
- Adoption decision rationale
- Historical practice evolution
- Network influence dynamics

Triangulation of quantitative and qualitative data enabled identification of convergent and divergent patterns.

Results

Introduction to the Results Section

The results of this study illustrate how informal farmer-to-farmer networks shape land-use decisions and the adoption of indigenous agricultural practices in rural Khyber Pakhtunkhwa. The findings integrate both quantitative survey data and qualitative ethnographic insights, highlighting the interactions between network structures, trust dynamics, gender, and landholding size. Before presenting each table, detailed interpretations are provided to contextualize the numerical and categorical data. The analysis emphasizes patterns across smallholder and medium-to-large landowners, revealing the mechanisms through which social networks facilitate or constrain the adoption of sustainable practices.

Network Participation and Knowledge Sharing

Interpretation: Survey results indicate that participation in informal networks is nearly universal among the sampled farmers, with 94% of respondents reporting at least weekly interactions with peers for agricultural advice. Smallholder farmers relied heavily on neighboring farmers and kin for knowledge, while medium-to-large landowners often served as opinion leaders. These patterns underscore the centrality of relational trust and social hierarchy in mediating the flow of information. Furthermore, network participation was positively correlated with reported adoption of low-cost, contextually adapted practices, indicating that informal knowledge transfer directly influences decision-making.

Table 1: Frequency of Participation in Informal Networks (N = 350)

	Smallholders (n=200)	Medium-Large Landowners (n=150)	Total (N=350)
Daily	82 (41%)	73 (48.7%)	155 (44.3%)
Weekly	94 (47%)	61 (40.7%)	155 (44.3%)
Monthly	20 (10%)	10 (6.7%)	30 (8.6%)
Rarely	4 (2%)	6 (4%)	10 (2.9%)

Adoption of Indigenous Practices

Interpretation: Data indicate that 87% of smallholder farmers consistently implement traditional soil fertility, crop rotation, and pest control methods, whereas 73% of medium-to-large landowners integrate these practices alongside modern interventions. Interviews reveal that smallholders perceive indigenous methods as cost-effective and ecologically sustainable, while medium-to-large landowners are motivated by efficiency and market-driven considerations. The findings demonstrate that network centrality enhances the likelihood of adopting innovative adaptations of indigenous practices, particularly when opinion leaders actively demonstrate new approaches.

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Table 2: Adoption of Indigenous Agricultural Practices

	Smallholders(n=200)	Medium-Large Landowners (n=150)	Total (N=350)
Consistent Adoption	174 (87%)	110 (73%)	284 (81.1%)
Occasional Adoption	20 (10%)	30 (20%)	50 (14.3%)
Rarely Adopted	6 (3%)	10 (6.7%)	16 (4.6%)

Influence of Network Centrality on Land-Use Decisions

Interpretation: Regression analysis indicates that degree centrality and betweenness centrality are significant predictors of the adoption of sustainable land-use practices ($p < 0.01$). Farmers occupying central positions within networks were more likely to implement crop rotation, organic pest management, and intercropping. Interviews highlight that centrality confers both informational advantage and social legitimacy, enabling these farmers to influence peers and disseminate innovative approaches effectively.

Table 3: Regression Analysis of Network Centrality on Adoption of Sustainable Practices

	Coefficient (β)	Std. Error	t-value	p-value
Degree Centrality	0.41	0.08	5.12	<0.001
Betweenness Centrality	0.36	0.09	4.00	<0.001
Age	0.05	0.02	2.50	0.013
Education (years)	0.12	0.04	3.00	0.003
Landholding Size	0.28	0.07	4.00	<0.001

Gendered Participation and Knowledge Flow

Interpretation: Gender emerged as a critical factor influencing network participation. Male farmers were significantly more central in networks, often serving as primary knowledge sources. Women's participation was largely peripheral but concentrated on domestic-scale crops, livestock management, and kitchen gardening. Despite limited centrality, women's contributions were highly specialized and contextually significant. These gendered patterns suggest that interventions aiming to enhance agricultural knowledge dissemination must account for both centrality and the unique contributions of women in maintaining household food security and ecological stewardship.

Table 4: Gendered Network Participation

	Male (n=290)	Female (n=60)	Total (N=350)
Central Node	172 (59.3%)	4 (6.7%)	176 (50.3%)
Peripheral Node	98 (33.8%)	48 (80%)	146 (41.7%)
Isolated	20 (6.9%)	8 (13.3%)	28 (8%)

Historical Continuity and Practice Evolution

Interpretation: Ethnographic interviews reveal that farmers retain historical knowledge of past agricultural practices and adapt them according to contemporary ecological and market conditions. Practices such as crop rotation and intercropping are informed by both ancestral experience and peer experimentation. The integration of historical knowledge with informal network insights allows farmers to mitigate risks associated with climate variability, soil degradation, and pest outbreaks. Notably, medium-to-large landowners often act as custodians of historical knowledge, while smallholders selectively adopt these strategies based on resource availability.

Table 5: Historical Practice Adoption Patterns

	Smallholders (n=200)	Medium-Large Landowners (n=150)	Total (N=350)
Fully Integrated	160 (80%)	120 (80%)	280 (80%)
Partial Integration	30 (15%)	20 (13.3%)	50 (14.3%)
Minimal/None	10 (5%)	10 (6.7%)	20 (5.7%)

Discussion

Introduction to Discussion

This discussion integrates the quantitative and qualitative findings to contextualize the role of informal social networks in shaping agricultural decision-making and the adoption of sustainable practices among farmers in Ghizer, Pakistan. The results reveal a dynamic interplay between network structure, gender, landholding size, and historical knowledge, highlighting how informal networks operate as critical conduits for agricultural knowledge, innovation, and resource optimization. These findings are considered in light of existing anthropological, agronomic, and social network literature, emphasizing both theoretical and practical implications.

Network Participation and Knowledge Dissemination

The high level of network participation observed in the survey (94% engaging weekly or more) underscores the centrality of informal social structures in agricultural knowledge sharing. This aligns with studies emphasizing relational trust and reciprocity as drivers of effective knowledge transfer in rural communities (Granovetter, 1973; Borgatti & Halgin, 2011). Farmers occupying central positions not only received knowledge but also acted as opinion leaders, influencing peers' adoption of practices. These findings reinforce the theoretical framework of social capital, where network centrality confers both informational advantage and social legitimacy (Coleman, 1988; Lin, 2001).

Importantly, the interpretive ethnographic data suggest that smallholder farmers rely heavily on peer guidance to reduce uncertainty and adapt practices contextually. This confirms prior evidence that in resource-constrained settings, trust-based networks often substitute for formal extension services (Pretty & Ward, 2001). Medium-to-large landowners, by contrast, exhibit both leadership and custodial roles, suggesting a hierarchical knowledge transfer dynamic, consistent with Bourdieu's (1986) conceptualization of symbolic capital within rural communities.

Adoption of Indigenous Practices

The widespread adoption of indigenous practices 87% among smallholders and 73% among medium-to-large landowners demonstrates both the resilience and adaptability of traditional agricultural knowledge. Farmers' motivations differ by landholding size: smallholders value cost-effectiveness and ecological sustainability, while larger landowners combine these methods with productivity-driven innovations. This finding resonates with previous research highlighting that indigenous knowledge is not static; it evolves in response to environmental pressures, market opportunities, and peer influence (Chambers et al., 1989; Warren, 1991).

Furthermore, the data reveal that network centrality significantly predicts the adoption of sustainable practices. Farmers positioned at network hubs tend to adopt and demonstrate innovative techniques, facilitating diffusion through social contagion (Valente, 1996). This observation supports prior studies in African and South Asian contexts where central network actors play pivotal roles in agricultural innovation adoption (Moser & Barrett, 2003; Conley & Udry, 2010).

Gendered Participation and Knowledge Flow

The gendered patterns of network participation are particularly revealing. Male farmers dominate central network positions, while female farmers participate peripherally yet provide specialized knowledge, often related to kitchen gardening, livestock management, and household-level crop practices. These results corroborate feminist anthropological perspectives that emphasize the invisible yet critical labor of women in sustaining agrarian livelihoods (Agarwal, 1994; Whitehead, 2000).

Peripheral female participation, despite its limitations, indicates a latent capacity for knowledge exchange that could be leveraged through gender-inclusive interventions. Community-based participatory programs that create safe, culturally sensitive spaces for women's engagement could enhance both their centrality in networks and the overall diffusion of sustainable practices (Meinzen-Dick et al., 2011). The findings also reflect intersectional constraints: women's network positions are influenced by age, marital status, and land access, echoing the broader literature on gendered social capital in rural South Asia (Allendorf, 2007).

Influence of Historical Knowledge

Ethnographic evidence emphasizes the integration of historical agricultural knowledge with contemporary innovations. Medium-to-large landowners often serve as custodians of ancestral practices, passing them down informally to neighboring smallholders. This observation aligns with the concept of cultural transmission in anthropology, where knowledge is preserved and adapted across generations (Cavalli-Sforza & Feldman, 1981). Such hybridization of indigenous and modern practices enhances resilience against environmental variability, soil degradation, and pest pressures, demonstrating the adaptive potential of social networks in mitigating risk.

The co-existence of historical and contemporary knowledge also highlights the role of social memory in agrarian communities. Practices such as crop rotation and intercropping are informed by both lived experience and peer experimentation, emphasizing that knowledge adoption is not merely technical but embedded in relational, historical, and ecological contexts. This insight has implications for agricultural extension programs, suggesting that interventions should respect and incorporate local knowledge systems rather than imposing purely top-down innovations (Pretty, 1995).

Policy and Practical Implications

The study's findings carry significant policy implications. First, strengthening informal networks through farmer cooperatives, peer mentoring programs, and local demonstration plots can enhance knowledge diffusion, particularly for smallholders. Second, targeted interventions to increase women's participation in networks through training, microfinance support, and culturally appropriate engagement strategies can unlock underutilized expertise and promote more equitable decision-making. Third, recognizing the value of historical and indigenous knowledge in policy frameworks ensures that development programs are contextually grounded, socially legitimate, and environmentally sustainable.

Finally, extension services and NGO programs in Pakistan should consider a hybrid approach: leveraging central actors in informal networks while providing technical support and resources that align with local practices. Such strategies not only accelerate adoption but also strengthen community resilience and adaptive capacity in the face of climatic and economic uncertainty.

Theoretical Contributions

The study advances anthropological and social network theory by demonstrating how informal networks operate as multi-dimensional systems that integrate knowledge, social hierarchy, and historical continuity.

Network centrality, gendered participation, and historical knowledge function as interdependent determinants of practice adoption. By combining quantitative survey analysis with ethnographic insights, this research provides a nuanced understanding of the mechanisms through which social structures mediate the adoption of sustainable practices.

The findings also extend the concept of social capital by highlighting its intersection with gender and historical knowledge. Traditional measures of network effectiveness often neglect peripheral actors and historical continuity; this study demonstrates that both are critical to understanding diffusion processes in rural agricultural contexts.

Limitations and Future Research

Despite its contributions, the study has limitations. The focus on a single district may limit generalizability to other regions of Pakistan with different ecological, social, or economic conditions. Additionally, while the mixed-methods design provides depth, it relies on self-reported adoption of practices, which may be subject to recall bias or social desirability effects. Future research should consider longitudinal designs to capture temporal dynamics of network influence and adoption behavior, as well as incorporate participatory mapping of networks to triangulate self-reported data with observed interactions.

Further studies could explore the impact of digital networks and mobile technologies on knowledge dissemination, as rural Pakistan increasingly integrates ICT tools into agricultural decision-making. Comparative studies across districts and provinces would also provide a broader understanding of regional variations in network structure, gender dynamics, and historical knowledge integration.

Conclusion

This study demonstrates that informal social networks are central to agricultural decision-making and the adoption of indigenous practices in Ghizer, Pakistan. Network centrality, gendered participation, and historical knowledge interact to shape patterns of knowledge diffusion, practice adoption, and adaptive resilience. Smallholders benefit from trust-based peer interactions, medium-to-large landowners serve as opinion leaders and custodians of historical knowledge, and women contribute specialized but under-recognized expertise.

These findings reinforce the importance of contextually grounded, socially informed interventions that strengthen networks, enhance women's participation, and respect historical knowledge systems. By bridging anthropological insights with practical policy considerations, the research provides both theoretical and applied contributions, offering pathways for sustainable agricultural development, community empowerment, and knowledge-based resilience in rural Pakistan.

References

Agarwal, B. (1994). *A field of one's own: Gender and land rights in South Asia*. Cambridge University Press.

Allendorf, K. (2007). Do women's land rights promote empowerment and child health in Nepal? *World Development, 35*(11), 1975–1988. https://doi.org/10.1016/j.worlddev.2007.05.004

Borgatti, S. P., & Halgin, D. S. (2011). On network theory. *Organization Science, 22*(5), 1168–1181. https://doi.org/10.1287/orsc.1100.0641

Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241–258). Greenwood.

Cavalli-Sforza, L. L., & Feldman, M. W. (1981). *Cultural transmission and evolution: A quantitative approach*. Princeton University Press.

Chambers, R., Pacey, A., & Thrupp, L. A. (1989). *Farmer first: Farmer innovation and agricultural research*. Intermediate Technology Publications.

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology, 94*, S95–S120. https://doi.org/10.1086/228943

Conley, T. G., & Udry, C. R. (2010). Learning about a new technology: Pineapple in Ghana. *American Economic Review, 100*(1), 35–69. https://doi.org/10.1257/aer.100.1.35

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology, 78*(6), 1360–1380. https://doi.org/10.1086/225469

Lin, N. (2001). *Social capital: A theory of social structure and action*. Cambridge University Press.

Meinzen-Dick, R., Quisumbing, A., Behrman, J., Biermayr-Jenzano, P., Wilde, V., Noordeloos, M., ... & Beintema, N. (2011). Engendering agricultural research, development and extension. *International Food Policy Research Institute (IFPRI) Discussion Paper 01104*. https://doi.org/10.2139-/ssrn.1962041

Moser, C., & Barrett, C. (2003). The complex dynamics of smallholder technology adoption. *World Development, 31*(6), 987–1001. https://doi.org/10.1016/S0305-750X(03)00010-9

Pretty, J. (1995). Participatory learning for sustainable agriculture. *World Development, 23*(8), 1247–1263. https://doi.org/10.1016/0305-750X(95)00046-F

Pretty, J., & Ward, H. (2001). Social capital and the environment. *World Development, 29*(2), 209–227. https://doi.org/10.1016/S0305-750X(00)00098-X

Valente, T. W. (1996). Social network thresholds in the diffusion of innovations. *Social Networks, 18*(1), 69–89. https://doi.org/10.1016/0378-8733(95)00256-1

Warren, D. M. (1991). Using indigenous knowledge in agricultural development. *World Bank Discussion Paper 127*. World Bank.

Whitehead, A. (2000). Continuities and discontinuities in gendered livelihood analysis. *IDS Bulletin, 31*(4), 59–69. https://doi.org/10.1111/j.1759-5436.2000.mp31004006.x