



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# JOURNAL OF RURAL COOPERATION



Centre international de recherches sur les communautés coopératives rurales  
International Research Centre on Rural Cooperative Communities  
המרכז הבינלאומי לחקר קהילות כפריות שיתופיות

**CIRCOM**

VOLUME 30

No. 1

2002

The **Journal of Rural Cooperation** is an international and multi-disciplinary bi-annual magazine. It welcomes articles, research reports and notes dealing with cooperatives and related rural organizations in developed and less developed countries. Topics of particular interest are cooperatives facing trends of globalization and privatization, the web of cooperative-community relationships, and cooperatives as part of such broader systems as mainstream economics or the "social economy" and related alternative paradigms.

### *Editorial Advisory Board*

BARRACLOUGH, Prof. Solon, UNRISD,  
Geneva, Switzerland.

BIRCHALL, Dr. Johnston, Stirling  
University, UK.

CERNEA, Prof. Michael, The World Bank,  
Washington, DC, USA.

CRAIG, Prof. Jack, York University,  
Ontario, Canada.

CRONAN, Garry, Australian Centre for  
Co-operative Research and Development,  
Sydney, Australia.

DON, Prof. Yehuda, Bar Ilan University,  
Ramat Gan, Israel.

FALS BORDA, Prof. Orlando, Punta de  
Lanza Foundation, Bogotá, Colombia.

KIM, Prof. Jung-Joo, Kon-Kuk University,  
Seoul, Korea.

KLATZMANN, Prof. Joseph, Institut  
National Agronomique, Paris, France.

KRESSEL, Prof. G.M., Ben Gurion  
University of the Negev, Be'er Sheva,  
Israel.

MARON, Stanley, Kibbutz Maayan Zvi  
and Yad Tabenkin, Ramat Efal, Israel.

MÜNKNER, Prof. Hans-H. Philipps-  
Universität Marburg, Germany.

PARIKH, Prof. Gokul O., Sardar Patel  
Institute of Economic and Social Research,  
Ahmedabad, India.

SCHIMMERLING, Prof. Hanuš,  
Agricultural University, Prague, Czech  
Republic.

SCHVARTZER, Prof. Louis, Universidad  
de Buenos Aires, Argentina.

STAVENHAGEN, Dr. Rodolfo, El Colegio  
de Mexico, Mexico.

STROPPIA, Prof. Claudio, Università di  
Pavia, Italy.

Editor: Dr. Yair Levi

Editorial Assistant: Daphna Bar-Nes

### **CIRCOM**

*Information for Subscribers:* The *Journal of Rural Cooperation* is a semi-annual periodical, aimed at the pursuit of research in the field of rural cooperation. Editorial enquiries and other correspondence should be addressed to CIRCOM, Yad Tabenkin, Ramat Efal 52960, Israel. Fax: +972-3-5346376. E-mail: yadtab@inter.net.il (attn. CIRCOM). Subscription rate: \$28 per annum (plus \$3.00 sea mail; \$6.00 airmail).



## JOURNAL OF RURAL COOPERATION

Vol. 30

No. 1

2002

### CONTENTS

#### 1. ARTICLES

- Agricultural Cooperatives in the County of Trento (Italy): Economic, Organizational and Legal Perspectives  
*Gios, G. and Santuari, A.* ..... 3
- Women's Agrotourist Cooperatives in Greece: Key Elements for Their Successful Operation  
*Iakovidou, O.* ..... 13
- Cooperative Societies in Greenland and Nunavik: A Lesson on the Importance of Supporting Structures  
*Winther, G. and Duhaime, G.* ..... 25
- Farmer Self-Organizing Innovation in the Marginal Areas of China: A Study of Farmer Communication Networks in Zhidan, Loess Plateau  
*Wu, B., Parnwell, M. and Bradley, P.* ..... 43

#### 2. BOOK REVIEWS

- Birchall, J. (ed.)    The New Mutualism in Public Policy  
                          *S. Maron* ..... 65
- Granberg, L.,        Europe's Green Ring: Perspectives on Rural Policy and  
Kovach, I. and       Planning  
Tovey, H. (eds.)    *J. Maos* ..... 66
- Tostensen, A.,       Associational life in African Cities: Popular Responses  
Tvedten, I. and       to the Urban Crisis  
Vaa, M. (eds.)       *A. Dubb* ..... 67

#### 3. CURRENT INFORMATION

- Dissertation Abstracts ..... 69

# **Farmer Self-Organizing Innovation in the Marginal Areas of China: A Study of Farmer Communication Networks in Zhidan, Loess Plateau\***

*by*

Bin Wu

Cardiff University, UK

Mike Parnwell and Phillip Bradley

University of Hull, UK

## **Abstract**

Farmer innovation involves communication on both the vertical (between farmers and outsiders) and horizontal (among farmers) planes. When faced with barriers to vertical communication, small farmers in marginal areas have to depend on their own communication networks for knowledge diffusion and sharing. It leads to "farmer self-organizing innovation" (FSI) – an innovation process which is initiated, controlled and implemented by farmers themselves. This paper attempts to indicate: (1) what position the FSI has taken in innovation studies; (2) how farmers use and develop their communication network (FCN) for technology learning and innovation cooperation; and (3) what lessons and policy implications can be learnt from farmer innovation and self-organization. Based upon an integrated survey in Zhidan, a poor county of the Loess Plateau, it is argued that the innovative capacity of the rural poor in China might be difficult to strengthen unless more attention is paid to the promotion of farmer communication and cooperation. This paper also draws attention to the policy implications of promoting farmer innovation and building self-organizing networks in respect of rural sustainability in China in the 21st Century.

*Key words: Marginal areas, Loess Plateau of China, farmer self-organizing innovation (FSI), farm communication networks (FCN), rural sustainability.*

## **Introduction: farmer innovation and organizations in marginal areas**

It is generally acknowledged that externally-driven rural development projects frequently fail to reach the rural poor and too often come to an abrupt halt at

---

\*Contact: Dr. Bin Wu, SIRC, School of Social Sciences, Cardiff University, Cardiff, CF10 3YP, UK; Wub@cardiff.ac.uk. The authors would like to express their sincere thanks to the Zhidan county government and the Shaanxi Academy of Social Sciences for their support for the fieldwork. This paper has resulted from a completed doctoral research project that was sponsored by ORS and University of Hull scholarships.

project completion date (ISNAR, 1994; Carney, 1996). Increased attention is now being paid to farmer organizations to address these problems and to improve the effectiveness of agricultural extension and participation (Oakley, 1990; Garforth, 1990; ISNAR, 1994; Carney, 1996). These organizations would seem to be of greatest importance in geographically marginal areas where unfavorable physical environments and "development biases" further block the inflow of external capital (finance, technology and professional services) (Chambers, 1983, 1997).

In the Chinese context, farmer organizations are particularly important because of the dissolution of the collective commune system in the late 1970s. Since then, farmers have become independent producers, while collective economic organizations in the majority of rural communities have faded away and may exist in name only (RDI, 1992; Wang, 1994). This change has two immediate consequences for rural innovation. On the one hand, vertical technological networks have broken down at the grassroots level and agricultural extension increasingly relies on administrative intervention (Delman 1993). On the other hand, many kinds of farmer organizations have emerged in response to market opportunities. It is these that now support farmer innovation (RCRE and CECAT, 1996; Yao *et al.*, 1996).

Given the great variety of regional resource endowments and environmental constraints, it is not surprising that the development of farmer innovation and organization is uneven in post-reform China. For example, township and village enterprises (TVEs) have provided a sound organizational basis for rural industrialization and non-farm employment in the eastern coastal zone. Alternatively, a range of farmer-based technical associations (FTAs) have mushroomed in other resource-rich areas, which offer opportunities for specialized production households to exchange technical information and to develop reciprocal and cooperative innovation. Unfortunately, the marginal areas of China suffer from poor resource endowments and infrastructure and have few TVEs or FTAs. In fact, small farmers in these areas are in a state of "disorganization" (RDI, 1992). Unlike other developing countries, furthermore, China leaves little scope for non-government organizations to help and organize dispersed farmers (Zhu and Jiang, 1994).

In facing these challenges, we may ask how farmers in marginal areas can develop alternative strategies for technology learning and cooperation for innovation? What kinds of organizational forms and mechanisms are used to foster innovation; and what lessons and policy implications can be learnt from farmer practice in this regard? These issues are addressed through the concept of farmer self-organizing innovation (FSI). Firstly, debates on farmer innovation and organizations are briefly reviewed, in order to provide a locus for the FSI. Among many elements that lead to FSI, this paper concentrates on the "farmer communication network" (FCN), as revealed through field studies in Zhidan, a poor county on the Loess Plateau. In combining the results of field observations, a household questionnaire survey and case studies,

the innovative function of the FCN and its varied responses to environmental and technological change is identified. The final section considers the theoretical and policy implications of the FCN.

### **Farmer innovation and self-organization: a framework**

The notion of innovation contains two interconnected dimensions: knowledge (or methods, "know-how"), and organization (communication channels, mechanisms for the diffusion of knowledge, the exchange of information, and production cooperation). Concerning the latter, farmer innovation refers to two kinds of communication: vertical – between farmers and outsiders (extension staff, change agencies, etc.) and horizontal – among farmers themselves.

In conventional models of technology transfer, rural innovation is seen as a linear process, extending from research centers via change agencies to rural users. Farmers are viewed as passive receivers of new technologies with little choice and feedback opportunity (Ellis, 1992). The limitations of this one-way technology transfer suggest that two-way communication between farmers and professionals is needed. This in turn leads to a call for farmer organization, because working with groups (rather than as individuals) is considered more efficient, cost-effective and sustainable (Carney, 1996).

Farmer organizations can be approached in different ways, however. At the one end, formal organizations (*e.g.* rural cooperatives, unions) are known to be "captured" by "progressive" farmers who are often already wealthy or powerful. The representation of the rural poor is usually weak, or even absent, not least because of a market-oriented environment and efficiency considerations (ISNAR, 1994; Carney, 1996). At the other end, farmer organization may adopt a less formal format or mechanism, such as: rural people's organizations (Garforth, 1990), self-supporting farmers' organizations (IFAP, 1992), small farmer groups (FAO, 1999).

Oakley (1990) distinguishes between conventional and participatory approaches to farmer organization. Conventional organizations are designed and directed by outsiders, and tend to favor large farmers. They may therefore be less suited to a widespread anti-poverty strategy. In contrast, participatory organizations are based upon locally existing patterns of social organization and are controlled by farmers themselves. The main difference between these two approaches is summarized in Table 1.

The participatory approach above, however, has its limitations which can be illustrated by small farmer group associations, "an informal, voluntary and self-governing association of small farmer groups" (FAO, 1999). Despite some advantages compared with large and formal farmer organizations, the application of this approach is questionable in marginal areas. First, because it targets income generation and financial self-sufficiency, remote and inaccessible villages tend to be excluded in order to ensure project "success" and "sustainability". Secondly, in

**Table 1.** Comparison between conventional and participatory approaches to farmer organization

| Variables         | Conventional                     | Participatory                         |
|-------------------|----------------------------------|---------------------------------------|
| Nature            | externally designed and directed | based on indigenous organizations     |
| Purposes          | people contribute to development | participatory development             |
| Expansion through | government support               | internal organic growth               |
| Membership        | often large farmers              | small farmers                         |
| Leadership        | strong leadership                | more collective basis                 |
| Management        | centralized and formal           | informal and self-governing           |
| Consequence       | working through legal structures | challenge to existing rural structure |

Source: Derived from Oakley (1990)

stressing the “homogeneity” of group members the tension between rich and poor is “hidden”. In reality, marginal areas are usually more heterogeneous (in innovative capacity), more dispersed (in terms of the location of farmers) and more diverse (in farmer demands) than normative imagery would suggest. Finally, the establishment of these types of farmer organizations needs a group promoter or another catalyst, which in turn is dependent on outside training and support. For most marginal areas, the lack of opportunity for outsider-engagement means that the rural poor have little chance of establishing and developing their own organizations.

Outside the realm of agricultural extension studies, communication theory provides a useful means of addressing informal and horizontal social networks for technology exchange and diffusion among farmers. Linking communication with innovation, for example, Rogers (1983) highlights the role of inter-personal networks. Examining components of the networks, he notes (*Ibid*:19) that “more effective communication occurs when two individuals are homophilous” in terms of beliefs, education, social status, etc., while the diffusion of innovation often takes place where “the participants are usually quite heterophilous.” As a result, the homophile [similar] is “a barrier to diffusion” while the heterophile [different] faces dilemmas “in securing effective communication.” Rogers also employs a notion of proximity to reflect the degree to which personal communication networks overlap (*Ibid*:295). Thus, communication generally occurs within cliques through strong ties (*e.g.* clan, close friends), in which people “seldom know much that the individual does not also know.” As a result, the weak tie is “strong” (Granovetter, 1973, 1982) because of “its potential for carrying information between the two unlike cliques and thus [it] plays a crucial role in the diffusion of innovativeness” (Rogers, 1983:298).

Rogers’ approach provides a worthy but disheartening picture in which different societies transform into an individualistic society if the improvement of innovative capacity (innovativeness) is listed as the objective of development. There seems little doubt that there is a positive relationship between heterophily and innovation



because modern technology (*e.g.* “green revolution” technology), especially new emerging technology (*e.g.* information technology, biotechnology, GM food, etc.), has led to a plural technological system, meaning more technological choice for rural societies (Bhalla and James, 1988). It is questionable, however, whether traditional social relationships and a collectivist value system necessarily conflict with or are incompatible with technology innovation. In adopting a linear interpretation of “innovativeness”, the diffusion school is unfortunately unable to uncover the capacities that exist in a traditional society, even where an indigenous network is acknowledged.

In short, farmer participation and innovation diffusion represent two different efforts to revise the conventional technology transfer model. The former shares a vertical dimension with the transfer model but reverses innovation procedures from top-down to bottom-up in order to absorb and use indigenous knowledge (Richards, 1985). The latter, in contrast, offers a horizontal dimension to include informal or indigenous communication networks, but shares a common limitation with technology transfer in terms of excluding or devaluing indigenous knowledge and technology. It seems that both have their own advantages and disadvantages. One lesson learnt from the innovation studies above is that farmer innovation cannot be properly understood unless knowledge systems and communication networks can be tightly combined and, furthermore, vertical (between farmers and outsiders) and horizontal (among farmers) communication can be integrated. This is particularly true for marginal areas, where traditional knowledge still dominates farm systems, and external capital (information, technology, financial and professional support) is often difficult to reach. Present models are thus unable to address innovation phenomena derived by small farmers as they use and develop their own communication networks for technology learning and innovation cooperation.

Different from the above innovation types, farmer self-organizing innovation (FSI) may be defined as an innovation that is initiated, controlled and implemented by farmers themselves without outsider engagement or intervention. The FSI is thus different from either top-down agricultural extension (dominated and controlled as it is by government), or farmer participation (often engaged by outside NGOs), or again, individual innovation (which relies on personal qualities, market opportunities and individual entrepreneurial drive). The FSI is not a new concept at all: many scholars have already contributed valuable theoretical analyses. Examining various composition styles between knowledge systems and communication channels, for instance, Mundy and Compton (1995) identify an indigenous communication of indigenous information. Reviewing agricultural history, furthermore, Pretty (1995) suggests that local organizations (“indigenous collective management systems”) played the dominant role in agricultural development until the establishment of modern agriculture extension institutions in the 20th Century.

In the special case of rural development in marginal areas, the FSI model emphasizes the following features of farmer innovation:

*Self-organizing network.* The focus of the FSI is paid neither to what kinds of knowledge or technological systems farmers use nor to individual innovation activities or capacities, but to what kinds of channels, networks or mechanisms they use and develop to satisfy their innovative demands, even if there is no outside assistance or intervention;

*Mutual aid and cooperative mechanisms.* In contrast to Rogers' framework, a close and advanced cooperative network means that there are more opportunities for participants to exchange technologies and share benefits;

*Gradual process* in terms of both adopting new technical elements (knowledge, methods, processes or products), and reshaping social organization. Compared with the former, the latter seems more complex, diverse and uncertain due to historic, social and cultural factors;

*"Open" system* because the FSI neither refuses modern technical elements nor external assistance. Rather, it is argued that external elements might not be able to satisfy the innovative demands of the rural poor unless their intrinsic potential can be identified and a proper interface between internal and external elements is constructed.

In summarizing the discussion above, Table 2 provides a comparison of the various models of farmer innovation. It is suggested that the FSI is a particularly suitable construct for marginal areas. Moreover, rather than rejecting or excluding other models, the FSI offers an insight into the interfaces between exogenous and indigenous elements, and between top-down development intervention and bottom-up farmer self-organization.

**Table 2.** Model comparison of farmer innovation and organizations

| Variables     | Transfer        | Diffusion      | Participatory    | Self-organizing  |
|---------------|-----------------|----------------|------------------|------------------|
| Knowledge     | exogenous       | exogenous      | indigen.+exogen. | exogen.+indigen. |
| Communication | top-down        | horizontal     | bottom-up        | horizontal       |
| Networks      | institutional   | inter-person   | groups           | inter-household  |
| Participants  | homogeneous     | heterogeneous  | homogeneous      | heterogeneous    |
| Initiatives   | change agencies | entrepreneur   | NGOs             | farmers          |
| Focus on      | community       | individuals    | group            | various          |
| Farmer roles  | receiver        | adopter        | participator     | actor+director   |
| Controlled by | upper           | farmers        | farmers+NGOs     | farmers          |
| Benefits      | large, rich     | innovators     | small, poor      | remote, poorest  |
| Key variable  | appropriateness | innovativeness | new professional | cooperation      |

Farmer self-organizing innovation incorporates self-learning, self-management, mutual aid and cooperation, and is dependent on social links, traditions of cooperation, local norms, innovative talent, leadership, and so on. Despite great

variation in technical and organizational causes, all FSIs are founded on a farmer communication network (FCN), through which individual farmers can exchange and share technologies (information, experience, know-how), and develop mutual aid and cooperation for the purposes of income growth and livelihood security. As a part of daily life of rural households, the FCN comprises a number of family and personal linkages, including:

- Village Kin are male-line members of an extended family in the same or nearby sub-village, including brothers, father, father's brothers and sons;
- Close Relatives are mainly family and kinship in-laws, who are often outside the village and keep in frequent contact with the household;
- Close Villagers include close neighbors within the community and friends outside of the village.

Rather than being separate from each other, these components are interconnected and interwoven as a system. As a vehicle for farmer survival and development, the FCN has many functions, including: information exchange (both social and production-oriented); production collaboration (*e.g.* collaborative sowing or harvesting to overcome labor shortages); resource mobilization (for farm tool buying, house building and wedding costs); emergency aid (*e.g.* to offset food shortages, natural disasters, severe diseases, etc.). Technological learning and innovation is merely one of its multi-functions. The central task of this paper is thus to identify the innovation function of the FGN and self-organizing mechanism through an empirical survey conducted in China.

## **Environment and farmers' innovation in Zhidan County, Shaanxi Province**

In order to reveal the innovative functioning of the FCN, fieldwork was conducted in Zhidan County in the northern part of Shaanxi Province, northwest China, during 1996 and 1997. Zhidan is a mountainous county dominated by ridges and gullies lying between 1741 and 1093 meters above sea level. Nearly half of its land area of 3781 km<sup>2</sup> consists of very steep slopes (*i.e.* greater than 35°). Of its total population of 116,000 (1995), about 90 percent live in rural areas.

Located at the heart of the Loess Plateau, in an ecologically fragile region of China, Zhidan suffers from severe soil erosion. This is partly attributable to the characteristics of the natural environment, but this problem has been compounded by the nature of human activity over the last half-century or so. The county's population grew from 35,000 to 90,000 between 1949-90, and as a result the cultivated area expanded to 1,810,000 mu (1 ha = 15 mu), or 31.8 percent of the total land area, compared with only 9 percent some 40 years ago (ZCAD, 1990). Approximately 40 percent of the cultivated area is in zones of steep (>25°) topography. This land is not suitable for grain cultivation, and its use for this purpose therefore contributes to soil

erosion. The expansion of cultivation has also contributed to extensive deforestation. Before 1949, 56 percent of the land area in Zhidan County was forested, but this had fallen to less than 20 per cent by 1994 (ZPSO, 1995; ZCEG, 1997). There has been a parallel increase in the area prone to erosion, from 44 percent of the county's total land area in 1949 to 73.5 percent in the 1980s (ZARO, 1985:327). As a result, Zhidan has become a main source of sediment to the Yellow River, and on average its soil loss is 9,664 ton/km<sup>2</sup> yearly (ZPSO, 1995).

Zhidan is a "national poor county",<sup>1</sup> with an annual net income of 816 yuan per capita in 1995, about a half of the national average. Thirty percent of its rural population were in absolute poverty, compared with 12.8 percent for the province as a whole and 7.1 percent nationally (ZPSO, 1996; RDI *et al.*, 1996:70). No doubt, rural poverty involves many factors, of which the extension of agriculture and traditional technology are an important contribution. A rural survey was conducted in Zhidan in the summer of 1997 in order to reveal the relationship between rural poverty and household innovative capacity. Results from a household questionnaire survey show that the distribution of rural income in Zhidan is very uneven, with a coefficient of variation of 81 percent and a mean of 757 yuan per capita. To understand the unevenness of rural income distribution in Zhidan and the extent to which a household's income is related to its innovative capacity, all households have been divided into four groups according to household net cash income. Table 3 provides a summary of these data and analysis.

Table 3 shows that rural economic differences in Zhidan are not the result of differential grain production, but of varied cash generation opportunities and capacity. The variation in the latter is so large that the bottom group receives only 30 percent of the mean, or just 14 percent of the top group. In very simple terms, the uneven distribution of household income and innovative capacity is related to household

---

<sup>1</sup>National poor counties were designated by the central government in the mid-1980s mainly according to rural net income per capita. Nearly 700 counties were selected as targets for governmental assistance. These counties were reassessed in the early 1990s and have since received increasing assistance aimed at eradicating national poverty by the end of the 20th Century. Zhidan has been on the list since 1985 (NRDI, 1996). The rural survey in Zhidan consisted of village investigations, case studies and a household questionnaire. Sample villages and households were selected through a standard procedure. All townships and then all administrative villages in each township, were divided into three groups according to their physical environment, resource endowment and household income. One of each group was designated for further enquiry. To avoid "road biases" and to develop participatory observation, all sub-villages (or natural villages) in each selected administrative village were listed as "sample villages" and then one in five households in each sub-village were sampled through a systematic random sampling method. As a result, a total of 50 sub-villages and 150 households were selected as a sample for the village investigation through group interviews and a household questionnaire survey. The use of the W-house for early production yields profits from both the sale of products one or two months earlier than competitors, and from producing an extra harvest. For W-house owners, raising and supplying seedlings enables them to share the cost of W-house utilization with those needing seedlings.

**Table 3.** Characteristics of the household economic system in Zhidan (1996)

| Income Group                  | Bottom | Low  | High | Top  | Mean | Prob. |
|-------------------------------|--------|------|------|------|------|-------|
| No. of Households (hh)        | 37     | 38   | 37   | 37   | 149  | —     |
| Net Cash Income (yuan/capita) | 226    | 442  | 761  | 1607 | 757  | —     |
| Grain Production (kg/person)  | 313    | 335  | 366  | 376  | 347  | .1940 |
| Grain Income (yuan/hh)        | 1008   | 1335 | 1449 | 1739 | 1382 | .0267 |
| Livestock (yuan/hh)           | 556    | 725  | 1188 | 1116 | 895  | .0559 |
| Cash Crops (yuan/hh)          | 8      | 205  | 876  | 1586 | 666  | .0029 |
| Non-Farm (yuan/hh)            | 207    | 584  | 1849 | 3888 | 1625 | .0000 |
| Cash Balance (yuan/person)    | -23    | 67   | 217  | 845  | 275  | .0000 |
| Production Inputs (yuan/hh)   | 535    | 669  | 1074 | 1087 | 840  | .0020 |
| Special Skills (% of group)   | 10.8   | 26.3 | 48.6 | 70.3 | 38.9 |       |

Notes:

(1) All data are derived from a household questionnaire survey that was undertaken in 1997. The total sample size was 149 households. The probabilities in the final column are from a one-way analysis of variance, with the exception of the special skills component that is derived from a crosstabulation;

(2) Net cash income = total household cash income - cost of production inputs;

(3) Cash balance = total household cash income - total *normal* expenditure. The utilization of "normal" here is intended to exclude the distortion resulting from unusual events such as weddings, house building, large medical expenses;

(4) Skilled households are defined as those whose income is derived mainly from either cash crops (including tobacco, specialized village crops, herb plantation, fruit tree plantation, etc.) or skilled non-farm activities (including traditional crafts such as carpentry, brick and stone work, blacksmithing, wool weaving, etc.; motor transportation, retail business, etc.), or a combination of both.

production structure: the rural rich gain income through commercial agricultural and non-farm activities, whereas those who depend on traditional grain and livestock (sheep and goats) production are the most disadvantaged and vulnerable.

In addition to the uneven distribution of income, farmers also have to contend with income insecurity which, in turn, constrains their ability and potential to maintain, let alone enhance, agricultural production. According to Table 3, 25 percent of households are in a situation of financial deficit. The income status of a further 25 percent is so fragile as to constrain their ability to cope with natural and economic downturns and their propensity to innovate and take risks. Thus, without external assistance it is difficult to imagine how households will be able to enhance their economic standing by making organizational or technical improvements in the production process.

It is clear from the Table 3 that speeding the transition from traditional subsistence agriculture to commercial farming and non-farm activities is of crucial importance to the poorest farmers in the marginal areas of Zhidan County. However, and quite typically, these farmers lack the knowledge, financial and technical means to undertake and benefit from this transition. Table 3 indicates, for instance, that the production inputs of the rural poor (the two lowest income groups) are only just over half those of the higher income groups. It would be reasonable to assume that external financial assistance would be helpful for the rural poor to strengthen their innovative

capacity. According to the Zhidan Poverty Alleviation Office, in fact, the total level of funding (including infrastructure funds and subsidized loan) for Zhidan's poverty reduction project jumped from 2-3 million yuan in the early 1990s to 10 million yuan in 1997, and 4 million yuan was directly applied to poor households for agricultural production and innovation (*e.g.* the application of plastic sheet covering techniques, soybean plantations, and sheep breeding). It was said, however, that 80 percent of farmers were reluctant to accept government assistance because of poor profits from grain production, high drought risk, and short loan-repayment terms. It appears that government intervention departs from the demands of the rural poor who desire more opportunities for generating a cash income and the structural transformation of the rural economy.

In addition to the need for improved access to rural credit, the access of the rural poor to new and more diverse production techniques must urgently be improved. Table 3 shows a close relationship between income distribution and the availability within households of special production skills. Because the government still controls the grain market, farmer innovation tends to be concentrated on cash crops and non-farm activities, and is highly dependent on the capacity to learn, adopt, adapt and manage the new technologies. Distinguishing between "skilled" households (with specialized techniques for cash crops and/or non-farm activities) and "unskilled" households (no specialization for cash crops and/or off-farm income, but dependent on traditional production) is thus helpful in identifying and measuring the relevant factors that influence household innovative capacity.

With regard to improving the rural poor's access to new techniques, little faith can presently be placed in the (top-down) agricultural extension system in this part of rural China, because the network is still in a broken-down state following the dissolution of the commune system; its branches at the township level in Zhidan exist in name only. Due to the county's fiscal deficit, for instance, the professional staff in the County's Agricultural Extension Station have no means of transport nor any budget for overheads, and even the telephone line has been disconnected. Their limited extension activities, furthermore, are typically focused on systems that are already advanced and located in the best quality farmland in close proximity to major roads. Their activities have little impact in remote and high mountain villages. The virtual collapse of the agricultural extension system was further confirmed by the household questionnaire survey in which only 13.5 percent of households identified professional or government officers as the primary source of new technological information. By contrast, 59.7 percent of all households identified their kin or relatives as the principal source of information and innovation, and a further 26.8 percent mentioned neighbors as having been influential in this regard.

To improve access to new techniques and to strengthen the rural poor's innovative capacity, there is little doubt that education must also play an important role.

Table 4 shows that illiteracy and low education levels are very high among the sample households. It also confirms that illiteracy is proportionally lower in skilled households. Comparing the preliminary with the middle education receivers, however, the difference in household skills narrows. This appears to suggest that household innovation capacity is related to many factors other than length of education.

**Table 4.** Relationship between households capacity and education levels

|             | Unskilled (%) | Skilled (%) | Total (% / No.) |
|-------------|---------------|-------------|-----------------|
| Illiteracy  | 79.6          | 20.4        | 100/49          |
| Preliminary | 54.7          | 45.3        | 100/53          |
| Middle      | 48.9          | 51.1        | 100/47          |

Note: This table is derived from the household questionnaire survey. All samples are simply divided into skilled and unskilled households according to the definition in the footnote of Table 3. The division of education level is based up on the length of school enrolment of the household head: illiteracy =  $\leq$  year; preliminary = 2-5 years; middle =  $\geq$  6 years.

Given this circumstance, of major deficiencies in the top-down system for improving production conditions and prospects in marginal locations and environments, it is reasonable to suggest that the Farmer Communication Network (FCN) has a role to play in technical diffusion in rural Zhidan, and in (the many) parts of rural China which are beset by similar economic and organizational difficulties. How farmers in Zhidan use and develop their FCN for innovation purposes will be the theme of the following sections.

### **The role of the FCN: a case study of greenhouse adoption**

The innovation function of the FCN can be illustrated through a case study of new technology adoption and diffusion. It might be difficult to imagine how DWG (Dongwugou), a village 8 km from the county town, could come to dominate the urban vegetable market in the face of strong competition from producers in the peri-urban areas, but this has been precisely the case since 1993, when the county government introduced winter greenhouse (hereafter W-house) technology for vegetable production in several villages along the Zhouhe Valley, including DWG.

As with all forms of permanent accommodation, the W-house requires significant investment in construction and maintenance. To sustain vegetable production during the long, cold winters (usually below  $-20^{\circ}\text{C}$ ), internal heating facilities are required, along with exterior insulation sheets. Due to the technical complexity of cultivation in greenhouses (particularly a greater proneness to infectious plant diseases), and weaknesses in extension support, the introduction of the W-house technology was at first problematic and unsuccessful. A considerable number of participants suffered economic losses, and several quickly destroyed their W-houses.

However, in contrast to failures and decline in most other villages, the majority of

W-houses in DWG have survived, and the number of vegetable-producing households has continuously increased, reaching 50 by the summer of 1997, or approximately 50 percent of village residents. Meanwhile, another 20 households are involved indirectly with service activities linked to the W-houses (*e.g.* the delivery of organic manure). One of the most important factors behind the successful adoption of the W-house in this village was the introduction of the “summer house” (S-house – a simple greenhouse used only temporarily between late spring and early autumn) which was already functioning in this village, giving farmers a technological preparedness. Moreover, it was in DWG that the W-house function of raising seeds to supply S-houses and non-greenhouse producers (No-house) was developed and utilized. As a result, more and more S-houses and non-greenhouse plots were set up around the W-houses, in order to share technological progress.

The FCN has been instrumental in the successful adoption of greenhouse technology in DWG, and within the village one key individual has played a pivotal role. Mr. Wang acquired a good reputation in his home community not only because he was the first to adopt the S-house and was the first supplier of vegetable seedlings in the county, but also because of his role in the organization of innovation diffusion. His W-house was actually a center for his village kin, neighbors and friends to join together during the long winter to raise seedlings. As a result, a stable cooperative relationship has emerged among participants, which Mr. Wang oversees as “leader”. Meanwhile, his W-house is referred to as “*xiao tian di*”, meaning a small but very convenient place. According to Mr. Wang and his colleagues, the main benefits from group cooperation can be summarized as follows:

*Technology sharing.* Because of close communication and cooperation in W-house activities, participants have more opportunities to exchange and share techniques with each other. According to Mr. Wang, many technological problems had been solved through group discussion and diagnosis, rather than by himself alone;

*Labor concentration.* Seasonal labor shortages are more serious in greenhouse production because few households employ laborers from outside due to the limited scale of production. To overcome these difficulties, an informal regulation was introduced in Mr. Wang’s group. If a household needs extra labor inputs (*e.g.* for greenhouse construction, sowing, etc.), all members contribute their services voluntarily. According to Mr. Wang, this voluntary labor contribution, which goes beyond the principle of “equal labor exchange”, is only possible because of their long term cooperation relationship;

*Responsiveness.* Cooperation within the group can be further understood in relation to its ability to respond quickly to external opportunities. Individual households are generally responsible for the daily selling of produce in the urban market. It often occurs, however, that demand information from a large purchaser



(*e.g.* an oil exploitation team operating nearby to Zhidan) is first circulated within the group. Thus, the group gains a competitive advantage by being responsive and flexible, a reputation for which has quickly been developed in the local area. Similarly, group members enjoy cooperation benefits from joint purchase of fertilizers or pesticides at a discount.

An "organizational structure" is evident in this group, with 30 members ranked in various positions or roles. Five core members are closely allied with Mr. Wang in terms of new technology exploitation and cooperative marketing, while fifteen learners are benefiting from regular visits and seasonal demonstrations in Mr. Wang's W-house. In between these two loose groups are twelve close-member households, which are mainly S-house operators, who frequently exchange experiences, seek joint solutions, cooperate in production, and sometimes sell cooperatively. The core members are actually Mr. Wang's sons and close neighbors, the close members are mainly his neighbors and some friends from nearby villages, while the outer members are mainly from other villages, some of them being his relatives. The features of Wang's FCN are summarized in Table 5.

**Table 5.** Organizational structure of Mr. Wang's innovation group (FCN)

| Membership           | Core                         | Close                          | Outer                         |
|----------------------|------------------------------|--------------------------------|-------------------------------|
| Number of households | 5                            | 12                             | 15                            |
| Technical nature     | W-house                      | S-house                        | No-house                      |
| Position in group    | Partners                     | Participants                   | Learners                      |
| Cooperative scope    | New techniques/<br>marketing | Problem-<br>solving/production | Demonstration/<br>information |
| Living location      | DWG                          | DWG and nearby<br>villages     | Nearby villages               |
| Meeting frequency    | Daily                        | Weekly                         | Monthly                       |

Mr. Wang's group is only one of three informal groups in DWG which specializes in vegetable production cooperation. Among these groups, there is a somewhat competitive relationship in terms of the circulation of information, technology sharing, production cooperation and marketing alliances. Interestingly, one of Mr. Wang's competing groups is actually led by his younger brother, who was a partner with his elder brother before establishing his own group.

The DWG case provides a clear illustration of the constructive role played by the FCN in introducing and disseminating agricultural innovations in marginal areas and in the face of the severe deficiencies of the top-down extension service. Far from being an isolated and atypical example, however, many similar cases (*e.g.* tobacco-farming, apple orchards) were identified during the survey.

The success of W-house adoption in DWG is related to many conditions and factors. From the viewpoint of strengthening the innovative capacity of the rural poor in marginal areas, several conclusions can be drawn. Firstly, the appropriateness

of a new technology is relative and changeable, and thus there is an important need for the organizational dimension of technology adoption and refinement to be flexible and responsive to changing circumstances. The case study suggests a strong interaction between technical and marketing aspects (seedling supply and demand) and a cooperative relationship between W-house and S-house owners and non-greenhouse operators.

Secondly, innovative capacity cannot be narrowly understood as the capacity of individuals. It is, in fact, shaped by farmer communication and cooperation. The innovation group thus provides opportunities for participants to exchange information and technology, to share scale benefits, to overcome labor and input shortages, and to initiate and undertake technological experiments and to demonstrate outcomes to others within the group.

Thirdly, the innovation group is not only rooted in, but also developed from, the FCN. Before the W-house came to DWG, farmer communication and cooperation was centered on dispersed, individual-orientated and household-centered activities that had limited wider impacts. The emergence of the W-house and seedling supply-demand relationships provided a unique opportunity for all participants to develop a close and stable cooperative relationship, which led to the emergence of the innovation group(s).

Finally, the establishment and development of an innovation group is largely dependent on an innovative focus or leader, who not only leads technical adoption and advancement, but also attracts additional participants and harmonizes relationships among them. This seems to suggest that although the FCN is shared and used by all farmers, it can be too loose, dispersed and private to produce effective innovation dynamics. To strengthen farmers' innovative capacity, it seems important that individual FCNs should fuse together as a close group with clearly defined innovation objectives and responsibilities. In this regard, the innovative focus or leader becomes a crucial factor in group development. It was Mr. Wang's techniques, communication networks and personality that proved so strongly attractive and influential with his fellow villagers.

### **Variety in FCN structure and function**

The DWG case indicates that the FCN can be used and developed to strengthen innovative capacity among farmers, while the transition process from FCN to innovation group may be dependent on certain conditions and factors. Compared with much of rural Zhidan, for instance, DWG has many unique conditions and advantages, including a valley location, an effective irrigation system, reasonable proximity to an urban center with its increasing demand for vegetables, the focus of government initiatives, and so on; in addition to Mr. Wang's personality. This raises several questions about the extent to which the FCN is shaped by different physical and social environments; and the kinds of strategies that farmers employ in

the development and exploitation of FCNs.

Inevitably, the structure and function of the FCN is shaped by the prevailing geographic environment. In mountainous areas, for example, there are considerable differences between valley, low and high mountain villages in terms of topographic features, resource endowments, dwelling patterns and accessibility. Table 6 compares these three zones, derived from a cross-section of sample sub-villages in Zhidan County. The variety of locations inevitably affects the household production structure and innovative capacity, which in turn leads to differentiation in household income levels. In the high mountains, more than two-thirds of household income comes from traditional grain production and sheep breeding, whereas in the valleys this proportion falls to 20 percent. Differentiation in production structure can be further explained by the fact that more than 75 percent of farmers in high mountain areas lack special techniques for commercial production, whilst this is the case for less than 25 percent in the valleys.

**Table 6.** Comparison of marginal environment and household capacity

| Variables                       | High Mountain | Low Mountain | Valley    | Means/Totals |
|---------------------------------|---------------|--------------|-----------|--------------|
| Altitude (m)                    | 1506          | 1364         | 1256      | 1404         |
| Size of village (no. hh)        | 14            | 20           | 29        | 18           |
| Road grade                      | 50% no road   | simple road  | main road | —            |
| Skilled households (%)          | 22.2          | 42.2         | 77.3      | 38.9         |
| Net annual income (yuan/person) | 578           | 740          | 1318      | 757          |

Geographic location may influence, but does not determine, household innovative capacity, otherwise it is difficult to explain the differences between households in the same location. The following case provides an insight into the differences in innovative capacity in similar geographic conditions and the roles of the FCN. Box 1 shows that two adjacent villages with the same geographic conditions (and in the same administrative unit) pursued the same technology (apple plantations) but with different technologic adoption patterns. It seems that the difference in social and organizational environments plays a predominant role. Village A adopted a “neighbor cooperation” strategy to share technological experience and expertise, whilst Village B was dominated by “kinship alliance” for technology learning and service discounting. This case suggests that technological diffusion in marginal areas is dependent not only on the physical environment and distance/accessibility, but also on “social distance” and the prevailing organizational environment. Rather than any predetermined organizational and innovation patterns, it points to the need for “social network analysis” in order to identify household FCN patterns and interfaces with outside assistance.

### **Box 1**

#### **The Case of Apple Plantation Diffusion**

With the same topographic conditions and resource endowments, two remote villages are close to each other (only 3 km apart) in the same administrative unit of north-west Zhouhe Township. It is obvious to a visitor from outside that there are different features between them in terms of both natural scenery and social environment. Village A is surrounded by trees and planted grass and all residents have enjoyed a considerable income from apple cultivation (which accounts for one quarter of household income). By contrast, its neighbor, Village B, had only just begun to develop apple orchards (3 households) when the village surveys took place. The main reason for the difference seems to be related to the organizational pattern of the FCN. The former was dominated by "neighbor cooperation", leading to a collaborative reforestation and pasture scheme planned and implemented by all residents. The latter operated through "kinship alliance" consisting only of one extended family within the village and one outside relative. The difference in FCN patterns can be further recognized through innovation sources and organization. Village A has an "innovation center", a retired administrative village head who was also an expert in apple cultivation. It was surprising, however, that the technical sources for the apple plantation in Village B were not related to nearby village A, but derived from the outside relative in another township (10 km away). This unusual technology transfer, according to an initiator in Village B, was mainly related to two interconnected factors. One was the scale of the village orchard: a graft technician would seldom go to a village if the size of the orchard is too small (less than 5 mu). The other is the cost of the graft service and the availability of discounted support. The normal price of 6 yuan per tree was too expensive for the farmers in Village B. Thus, the transition to commercial apple production might not have happened had not the initiator's relative (brother-in-law) offered a cheap service (only 2 yuan per tree), and his father and brother in the same village joined in the orchard construction with him, thus bringing certain scale advantages.

The role of the FCN cannot be overstated, however, because it is also related to government performance in technological supply and innovation intervention. Due to the complexity and diversity of environmentally marginal areas, in fact, administrative intervention leaves considerable scope for the FCN. The wide-furrow plough (WFP, or Da Long Gou in Chinese), for instance, is a new sowing technology extended by the government in recent years for the purpose of supporting high and stable grain production in mountainous areas. Related to "location biases", new technology demonstration plots are often far away from high mountain villages. To adopt such technology, the FCN has played a positive role which can be illustrated

by a statement from a housewife in a remote mountain village: "The wide furrow program has interested this village for many years, but we were uncertain of the technical details and cost-benefits until a relative of mine from a low mountain area came to my plots to put on a demonstration last year. Seeing the good results, all the residents in the village have adopted it this spring." In her opinion, farmers do not like to adopt new technology without the opportunity to subject it to close and personal scrutiny. A lack of professional consultation in her village meant that her relatives' views were crucial in encouraging her family and neighbors to adopt the new method.

## Box 2

### Statistical Evidence for the Distribution of Contour Ploughing Adoption

Contour ploughing has been utilized in Zhidan since the early 1980s as a substitute for local sowing methods that simply broadcast seed onto the land. The new method first necessitates the construction of a horizontal furrow, with a seed-fertilizer mix then being spread with the use of a single-line seeding machine. Finally, the seeds are covered by a deep furrow to avoid evaporation and soil loss. Compared with the traditional sowing method, contour ploughing can double grain production, although greater inputs of labor and draft animals are needed. This is often beyond the capacity of most individual households, and therefore requires cooperation between two or three households. However, in terms of both grain productivity and external inputs, contour ploughing is better viewed as an intermediate form of technology compared with the later wide furrow method. Although the use of contour ploughing is still encouraged by the government, there is neither financial support nor administrative intervention to facilitate this, which is quite different from the case of the wide furrow. The household questionnaire survey indicated that the adoption rate of contour ploughing is related to both location and farmer communication. Contour ploughing was adopted by 71.4 percent of the sampled households in remote high mountain areas, about 10 percent higher than that in the low mountains (62.5 percent). The result contrasts with the situation with the wide furrow, to which the government has contributed a lot of administrative and economic intervention. Furthermore, the use of contour ploughing is closely related to the size of the FCN. For instance, adoption rates are low (52.3 percent) where the FCN is small ( $<23$ ), compared with 61.0 percent for mid-sized (24-32) and 72.1 percent for the large-sized groups ( $\geq 33$ ). Focusing on the high mountains, furthermore, the "clan village" (consisting of a very large proportion of kin-related households) and friend/neighbor relationships have obvious advantages in facilitating the adoption of contour ploughing, which was found to be at least 10 percent higher than the local average.

Besides the geographical environment and governmental performance, the pattern and roles of the FCN are also related to the nature of the technology itself. Different innovations seem generally to be dominated by different FCN patterns. For instance, neighbor cooperation seems more popular in cash crop production than kinship alliances, whereas kin networks would appear to have an advantage in non-farm innovation (*e.g.* carpentry, construction). Compared with the extension of modern technology, which is often dependent on exogenous elements and development intervention, the adoption of an “intermediate” technology seems to be more suitable for the context and functioning of the FCN. Box 2 provides some statistical evidence regarding the adoption of contour ploughing, an intermediate technology lying between local traditional sowing methods and the more recently introduced wide-furrow plough.

## **Conclusions and policy implications**

In the context of farmer innovation in the marginal areas of the developing world, less attention has been paid to the intrinsic dynamics and organizational demands of the rural poor, which leads to dependency on either top-down development intervention or external NGO engagement. Because of limited opportunities for vertical communication between farmers and outsiders (or professionals), small farmers in these areas have to use and develop their own communication networks for technology learning and innovation cooperation. This phenomenon may be called “farmer self-organizing innovation” (FSI), referring to an innovation which is initiated, controlled and implemented by farmers themselves. The main purpose of this paper has thus been to reveal the existence and roles of the FSI through a focus on the Farmer Communication Network.

The innovation function of the FCN has been revealed through an examination of household innovation capacity and its relevant factors. Some conclusions and policy implications can be drawn:

1. The FCN provides a social and organizational basis for farmer innovation and self-organization. It is argued that external factors and intervention might be ineffective in marginal areas unless farmer communication and cooperation relationships are given more attention. FSI offers an insight into the intrinsic dynamics and innovative potential which exists in marginalized societies. Rather than refusing external assistance and engagement, it calls for an interface and integration between vertical and horizontal communication linkages through the promotion of farmer cooperation and self-organization;
2. The FCN enables marginalized people to meet their innovation demands and secure their livelihoods. In lacking “insider” observation and indigenous network analysis, both the conventional technology transfer and alternative technology schools neglect the existence and roles of the FSI, which leads to

an underestimation of farmer innovation potential and organizational needs. A lesson which can be learnt from post-war development practice is that poverty alleviation and technology innovation in marginal areas need methodological improvement aimed at combining knowledge systems and communication networks generally, and integrating vertical and horizontal dimensions in particular;

3. The FCN offers a new construct for gaining a better understanding of rural development and sustainability in the marginal areas of China. Under the Household Responsibility System, present innovation policies have to grapple with the organizational dilemma posed by both collective and individual innovation. Public agricultural extension cannot work well due to the dissolution of the collective economy system, whilst administrative intervention finds it difficult to deal with the complexity and diversity of small farmers' demands. By encouraging commercialized agriculture and entrepreneurship, government innovation projects suffer from "location biases" which may serve to exacerbate economic and social inequality. In this context, neither re-collectivization nor privatization can offer a sound basis for sustainable development and innovation in China. Instead, this paper suggests a "third way", of farmer collaboration and self-organization, which focuses on the intrinsic dynamics and innovative potential that exists in marginal societies;
4. The innovation functions of the FCN cannot be oversimplified and overstated for several reasons. Firstly, the components and structure of the FCN are complex, varying from household to household, village to village. Secondly, the innovation function of the FCN is shaped by specific objectives, the geographical environment, and local historic, social and cultural factors, leading to different patterns of FCN use and effectiveness. Finally, the FCN may not always have a "positive" function in fostering rural cooperation and mutual aid. Rather, it can also be seen as a measure of rural competition, which may be linked to social exclusion or conflict. It suggests that farmer communication, cooperation and self-organization cannot solve all rural institutional contradictions or conflicts, but may offer conditions and opportunities for institutional change. It raises further questions: how can farmer self-organizing innovation lead to technical and institutional change in the marginal areas of the developing world? What lessons can be learnt from farmer innovation and self-organization in China's "experiment" with institutional change at the turn of the century?

## References

- Bhalla, A.S. and James, D. (1988). *New Technologies and Development: Experiences in 'Technology Blending*. Boulder/London: Lynne Rienner Publishers.
- Carney, D. (1996). "Formal Farmer Organizations in the Agricultural Technology

- System: Current Roles and Future Challenge". *Natural Resource Perspectives*, No. 14, London: ODI.
- Chambers, R. (1983). *Rural Development: Putting the Last First*. London: Longman.
- (1997). *Whose Reality Counts? Putting the First Last*. London: IT Publications.
- Delman, J. (1993). *Agricultural Extension in China: A Study of Agricultural Extension and Administrative Intervention*. Beijing: Nongye Publication (English translation).
- Ellis, F. (1992). *Agricultural Policies in Developing Countries*. Cambridge: Cambridge University Press.
- FAO (1999). Small Farmer Groups Associations: Bring the Poor Together, E-mail conference, 18 September, 31 October. Available on-line: <http://www.fao.org/sd/PPdirect/ppfo0002.htm>.
- Garforth, C. (1990). "RPOS: why the fuss? how rural peoples organizations can play a role in extension", Bulletin No. 30, University of Reading Agricultural Extension and Rural Development Department, Reading, UK. Available on-line: <http://wbln0018.worldbank.org/essd/essd.nsf/producer/home>.
- and Best, J. (1990). "The why and the how of RPOs", editorial Bulletin No. 30, University of Reading Agricultural Extension and Rural Development Department.
- Granovetter, M.S. (1973). "The Strength of Weak Ties". *American Journal of Sociology*, 78:1360-1443.
- (1982). "The Strength of Weak Ties: A Network Theory Revisited" in Marsden and Lin (eds.) *Social Structure and Network Analysis*. London: Sage, pp. 105-130.
- IFAP (International Federation of Agricultural Producers) (1992). *Towards Self-Supporting Farmers' Organizations*. Paris: IFAP.
- ISNAR (International Service for National Agricultural Research) (1994). *Strengthening the role of farmers' organizations in technology development and transfer: report of a workshop*. Briefing Paper No. 15.
- Mundy, P.A. and Compton, J.L. (1995). "Indigenous Communication and Indigenous Knowledge" in Warren, M.D. et al. (eds.) *The Cultural Dimension of Development: Indigenous Knowledge System*. London: IT Publications.
- NRDI (National Resource Development Institute at National Planning Committee) (1996). *China's Environment Report in 1995* (in Chinese).
- Oakley, P. (1990). "Rural organizations and peoples participation: A review of a decades progress for cooperatives and rural workers organizations". Bulletin No. 30 (November). University of Reading Agricultural



- Extension and Rural Development Department, Reading, UK. Available online: <http://wbln0018.worldbank.org/essd/essd.nsf/producer/home>
- Pretty, J.N. (1995). *Regenerating Agriculture: Policies and Practice for Sustainability and Self-Reliance*. London: Earthscan.
- RCRE and CECAT (Research Center for the Rural Economy and China-EU Center for Agricultural Technology) (1996). "Farmer's Technical Associations in China's Agricultural Development: Putting Farmers First". Prepared to ODI *Research and Farmers' Organizations*. London: ODI (December).
- RDI (Rural Development Institute) (1992). *Nongcun Shequ Zhenghe yu Fazhan* (Community Integration and Development in Rural China), Taiyuan: Shanxi Jinji Press.
- *et al.* (1996). *Annual Report for China's Rural Economy in 1995 and Forecast for 1996*. Beijing: Zhongguo Sheke Press (in Chinese with an English summary).
- Richards, P. (1985). *Indigenous Agricultural Revolution*. Hutchinson and Colorado: Westview.
- Rogers, E.M. (1983). *Diffusion of Innovations*. New York: Free Press (3rd ed.).
- Wang, G. (1994). *Zhongguo Nongcun Xiandaihua yu Nongmin* (Rural Modernisation and Peasants in China). Guiyang: Guizhou Renming Press.
- Yao, J., Xiu, H., Yang, L. *et al.* (1996). *Zhongguo Nongcun Minjian Zhuzhi: Nongcun Zhuanye Jishu Xehui de Yanju* (Rural Non-Governmental Organizations in China: A Study on Rural Specialized Technology Associations). Beijing: Nongye Keji Press.
- ZCAD (Zhidan's County Agricultural Department) (1990). *Zhidan Nongye Zhi* (Zhidan County's Agricultural Annals). Unpublished internal document.
- ZCEG (Zhidan's Chronicle Edition Group) (1996). *Zhidan Xianzhi* (Annals of Zhidan County). Xian: Shaanxi Renmin Press.
- Zhu, L. and Jiang, Z.Y. (1994). *Yigong Daizhen Huanje Pinkun* (Public Works and Poverty Alleviation). Shanghai: Shanlian and Renmin Presses.
- ZPSO (Zhidan's Planning and Statistical Office) (1995). *An Introduction to Zhidan's Resources, Environment and Development*. Unpublished internal document (in Chinese).
- (1996). *Statistical Yearbook of Zhidan in 1995*. Unpublished internal document (in Chinese).
- ZRPO (Zhidan's Rural Policy Office) (1996). *A Summary Report on Zhidan's Property Reform*. Unpublished internal document (in Chinese).