Report

Economic Considerations for Rural Planning and Development in the Mu Us Shamo Desert in Inner Mongolia, the People's Republic of China

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Summary It is critical to analyze and identify the pattern of rural life from the economic point of view for rural planning and comprehensive development. This research was conducted to investigate the current situation of rural life in the Mu Us Shamo Desert, Inner Mongolian Autonomous Region, China, based on interviews with 61 farm households regarding their activities in the calendar year of 1990.

According to the results, average total income was 4,346 yuan per household. While their main business activity is sheep raising and shearing, new agricultural sectors such as crop production bring a stable and fairly large amount of income to the residents, suggesting that rural planning and development for this society should take this into consideration. Interestingly, off-farm income accounts for 13% of total income. Further, the higher total household income was, the more off-farm work was involved, suggesting that income sources are diversified. Employing the logit model, it was estimated that 94% of households would purchase TV sets if gross income reached the 5,000-yuan level, indicating that a TV set is becoming a part of everyday life in this remote area.

These findings may be quite valuable pieces of information, and they should be incorporated into rural planning.

I. Introduction

Implementation of desertification control was initiated by the Mu Us Shamo Research Center during 1980 and 1990 (**Figure 1**). The evolution of desertification control and some agricultural activities is well documented by the Inner Mongolian Research Group.[1,2] According to their reports, the effects of the control measures were marked. Rates of sand-fixation and revegetation increased from a range of 15—20% to a range of 40—50%. More recently, Yamamoto et al. reported on development of a model farm which was constructed at the Center in 1991, and the research has been extended to study a more

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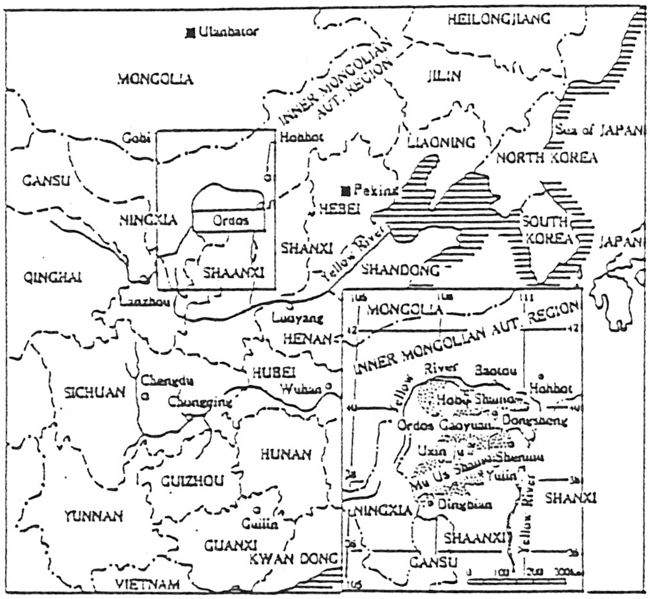

Figure 1 The location of the Mu Us Shamo Desert in Inner Mongolia, China.

prosperous type of farm for the future.[3] This model farm is for investigation of a new style for sustainable agricultural development and regional planning under control of desertification in this area.

Agriculture in the Mu Us Shamo Desert is primarily based on animal husbandry.[1,2] Raising sheep is the traditional industry. Despite the hardship of undesirable climate in this semi-arid area, however, the recent trend raising is a composite of goats for casimir, cows for beef, and crops as well as sheep. Crops, in particular, are prominent in the whole economy due to substantial amount of groundwater.[4] Although shepherds in this area used to move from one place to another with their flocks of sheep, they recently tend to set up stable houses and settle down in their permanent residences.

Along with this new pattern of residence, the local government has been considering comprehensive rural planning in this region. The major purpose of rural development is to provide welfare and stable and greater income for the residents. Welfare implies environmental protection with control of desertification by maintaining groundwater resources, implementing some measures for reducing salinization, and further developing revegetation and reforestation in the area. It is indispensable for any rural planning to investigate and identify the current economic situation and activities of the residents. Results from such an investigation often allow us to obtain some important clues for further development planning.

Given the importance of economic analysis of a rural community for the purpose of rural planning, an interview survey was conducted of individual households in the Mu Us Shamo Desert from May 1991 through October 1991, regarding their transactions in the 1990 calendar year. Items included in the interview included structure of family, management of livestock and agriculture, farm size, usage of groundwater, sources of energy, TV installation at home, transportation, and farm/off-farm incomes, all of which were critical factors in grasping the households' life styles. Based on raw data collected from interviews, statistical analyses were conducted not only to identify the factors important for rural planning but also to quantify the relationships among them.

This type of overall survey regarding life style was the first trial in this area./1 These data may become quite helpful in grasping the overview of life styles in the region. The interview was done with 61 farm households randomly chosen in the Tokusumu region, where slightly over 1,000 households reside. Some farmers were unable to answer certain portions of the questionnaire; however, interviews were painstakingly conducted and most of the answers were satisfactory.

The purpose of this research is to analyze life style and current agricultural management and to explore, based on the results, some important clues to sustainable rural planning. The results of this research are unique and informative, providing important suggestions for rural planning.

II. Approaching Methods

Various types of statistical methods were employed to analyze the answers in the interviews, for which farm households were chosen at random from the list of residents kept by the Yi Ke Zhao League Government of Inner Mongolia. Interviews were conducted with each head of household in person. First, for an overview of the residents, means and maximum, minimum, and standard deviations for the means of the individual households were applied.5) The items, as mentioned above, ranged from family organization, type of farming, and source of incomes to installation of agricultural equipment and family-use goods. Sources and income levels were examined in detail. In particular, shares of off-farm incomes relative to total incomes were analyzed.

Second, multiple regression analysis was used to investigate the contributions of sheep, goat, cow, and crop production.5) In this regression, the model is specified as follows:

$$YFT_i = f(NS_i,\ NG_i,\ NC_i,\ AC_i) \cdots\cdots\cdots\cdots\cdots\cdots (1)$$

where

YFT = total gross farm income for individual farm,

/1. Although each question was asked by a Chinese researcher, the language barrier between Chinese and Mongolian was quite thick and high. Each interview took about two hours. When interviews were with farmers who did not speak Chinese well, it took far more time to complete.

NS = number of sheep,
NG = number of goats,
NC = number of cows,
AC = areas for crop production in mu, /2
$i = 1, 2, \ldots. n$.

Based on this regression, the marginal contribution of each sector can be estimated.

Third, the relationship between installation of TV sets in individual households and their income levels was analyzed, on the assumption that TV sets can play an important role in providing entire families with substantial amounts of information on not only national but worldwide government policies and economics, as well as with entertainment. The result of the analysis should indicate how fast TV sets are installed at home relative to income levels in this remote region, and also whether or not improvement of the TV network system should be an urgent consideration for rural planning in this area.

The logit model was employed to estimate installation of TV sets at individual households depending upon income levels.[7] The model is specified as follows:

$$P_i = 1/(1+\exp(-(a+bX_i))) \quad \cdots (2)$$

where

P = rate of TV installation among the households at a certain income level,
X = level of income,
$i = 1, 2, \ldots. n$.
a, b = estimated coefficients.

In this equation, P increases drawing an S-type of curve approaching 1 as X increases. Equation (2) is transferred into:

$$\log(P_i/(1-P_i)) = a + bX_i \quad \cdots (3)$$

To apply this model, farms were classified into eight income classes: 0—1,000 yuan, 2,001—3,000 yuan,.... 6,001—7,000 yuan, and 7,001 yuan or more. Then, the average income and the rate of TV installation in each income class were calculated, and these data were used for regression in the form of equation (3).

III. Results of Statistical Analyses

1. Structure of Family

Table 1 shows the general overview of the households chosen at random in the region. The average age of the farmers is 44.7, with the youngest and oldest at 21 and 76, respectively. The number of children in each household was 3.28, with the largest at 9 children. Generally speaking, older parents have more children, while for young couples childbearing is restricted to 2 children. Given that each

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/2. A mu is a areal unit used in China. A 15 mu area corresponds to one hectare.

Table 1 Overall situation in the Mu Us Desert

Items	Mean	Max.	Min.	S.D.[4]
Age[1]	44.7	76	21	12.7
No. of children	3.28	9	0	2.00
No. of laborers	2.61	6	1	0.94
Years of resid[2]	21.5	65	2	14.6
Areas[3]				
All	1426	3621	287	761
Pasture	390	1123	100	214
Crops	12.9	25	0	5.1
Trees	247	1253	0	245
No. of sheep	86.0	250	20	45.8
No. of goats	13.5	80	0	20.2
No. of mules	0.82	2	0	0.62
No. of cows	3.64	12	0	3.28
No. of horses	1.61	14	0	2.07

1) Age of the master in each household.
2) Period of years residing in the same residence area.
3) Areas in mu: A 15 mu area corresponds to one hectare.
4) Standard deviation.

Table 2 Installation rates of various types of equipment

Items	Rate (%)
TV sets	72
Cars	5
Wind-generators	60
Radios	91
Motorcycles	22
Sewing machines	85
Bicycles	57
Gas ranges for kitchen	0
Diesel engines	67

couple is practically restricted to have only one child in other regions in China, the policy allows the Mongolian people to have more than one child.

In the interviews, it was asked whether TV sets, radios, cars, motorcycles, sewing machines, gas ranges, and diesel engines were installed on ividual farms. It was found that TV sets were installed by 72% of the 61 farmers, while radios were owned by as many as 92% of the farmers (**Table 2**). 57% of farms had at least one bicycle, while 22% had motorcycles. Two households had automobiles. 67% of farms have installed diesel engines, which may be used for irrigation and generating electricity.

2. Farm Incomes

Incomes were divided into two major categories, farm income and off-farm income (**Table 3**). Total gross farm income was 3,799 per household in 1990. Out of

Table 3 Incomes of the Mu Us Desert households
(Yuan)

Sources	Mean	Max.	Min.	S.D.[1]
Gross farm income				
Anml. hsbndry.	2699	7000	620	1448
Crops	817	2963	0	731
Trees	11	300	0	49
Others	272	1200	0	268
Off-farm income	547	4000	0	802
Days employed	149	760	0	182

1) Standard deviation.

the total gross farm income, 2,699 yuan (71%) came from livestock such as sheep, goats, and cows. The second largest source, 817 yuan (7%) of total gross farm income was from production of such crops as corn, potatoes, millet, and various kinds of vegetables. Despite sizable area planted in trees, income from timber is minor at 11 yuan on average.

The result of multiple regression analysis in equation (1) is as follows:

$$YFT_i = 556.4 + \underset{(5.10)}{21.14}\, NS_i + \underset{(9.01)}{6.00}\, NG_i + \underset{(69.40)}{62.31}\, NC_i + \underset{(40.50)}{90.12}\, AC_i \quad \cdots\cdots\cdots(4)$$

No. of obs. = 56 $R^2 = 0.493$ ( ) = standard errors

This result indicates that an increase of one sheep (*NS*), one goat (*NG*), one cow (*NC*), and one mu area of crop (*AC*) would increase the gross farm income by 21.14 yuan, 6.00 yuan, 62.31 yuan, and 90.12 yuan, respectively. The sign of the coefficient for each independent variable is the same as expected. However, coefficients for goats (*NG*) and cows (*NC*) are not significant, suggesting that income increases that originate from increases in numbers of goats and cows are not stable. This also suggests that the technology of raising goats and cows is not well established at the farm level. On the other hand, the coefficients for sheep (*NS*) and crop area (*AC*) are significant, indicating that increases in numbers of sheep and in crop areas steadily led to additional gross incomes. While an increase of one sheep should lead to an additional 21 yuan of gross farm income, an increase of one mu of crop area adds 90 yuan. In other words, one mu of crop production is worth as much as an increase in of approximately 4.5 sheep, according to the estimated equation./3

Nonetheless, however, given stable income from crop production and abundant groundwater resources, increases in crop production areas may be promising in the future./4 It appears that technological assistance to farmers for the raising of goats and cows should also be encouraged.

3. Off-farm Incomes

Off-farm incomes account for a considerable share relative to the total incomes in

Table 4 Classification of households by income level
(Per household, Yuan)

Class	No. of households	Total1) (*A*)	Farm2) (*B*)	Off-farm (*C*)	Rate3) (*C/A*)
0~2000	7	1523	1364	158	10.4%
2001~4000	20	3025	2546	479	15.8%
4001~6000	15	4795	4518	276	5.8%
6001~8000	12	6616	5831	785	11.9%
8001~Over	2	9356	7352	2004	21.4%

1) Total of gross farm income, *B*, and off-farm income, *C*. The total is not necessarily the same as adding *B* and *C* due to rounding.
2) Gross farm income.
3) Share of off-farm income, *C*, relative to total income, *A*.

the region. On average, each on household spent 149 days on off-farm labor and earned 547 yuan in 1990. This accounted for 13% of total gross income, which was 4,346 yuan. 34 households were involved with off-farm employment. The average days of work among these households was 266 days, and earnings were 982 yuan, accounting for almost one quarter of total gross income, 4,476 yuan. This also suggests that those with off-farm incomes may be enjoying more income than the other households. Off-farm incomes are indeed quite important income resources in the region.

4. Range of Incomes

Table 4 shows a classification of the farmers interviewed. The classifications were done based on the 56 farmers who answered income questions satisfactorily. It was found that income levels ranged quite widely: There were 7 households (12.5%) with incomes less than 2,000 yuan, followed by 20 (36%), 15 (27%), 12 (21%), and 2 (4%) farmers with incomes ranging from 2,001 to 4,000 yuan, from 4,001 to 6,001 yuan, from 6,001 to 8,000 yuan, and 8,001 yuan or over, respectively. This whole group of farmers can be almost equally divided into two groups with incomes above and below 4,000 yuan. Interestingly, those with higher incomes tend to have higher off-farm incomes, except for the class with incomes of 4,001—

/3. For this multiple regression analysis, net income data instead of gross income would have been more appropriate. However, not all households have a good record of expenses for farming such as fertilizer, chemical, fuels, etc., or on annual depreciation rate for machinery. In this research, therefore, gross imcome date were used as the best data currently available. According to our experience, gross income is a good indicator of net income in this region, where heavy investment in agriculture is not really common. For future research, however, it is desirable to investigate costs of production in each sector of farming as whole focusing on a small number of household.

/4. Crop production in this region is often supported by irrigation utilizing groundwater. Plentiful groundwater, therefore, is an important resource for further development of agriculture.

6,000 yuan.

5. TV Installation at Home

Regarding the rate of TV installation, the logit model was applied. The result for equation (3) was as follows:

$$\log(P_i/(1-P_i)) = -2.909 + \underset{(0.00035)}{0.00115}\, X_i \quad \cdots\cdots (5)$$

No. of Obs. = 7 $R^2 = 0.684$ ( ) = standard error

The estimated coefficient of income level, X, is statistically significant, indicating a strong positive relationship between income level and TV installation rate: the higher the income level, the more likely the household is to have a TV set at home. Based on this equation, it is estimated that 63%, 85%, and 94% of farmers would purchase TV sets if their total gross income level reached 3,000 yuan, 4,000 yuan, and 5,000 yuan, respectively.

IV. Conclusion and Implications

The results of the interview shed light on the life style and economic situation in the Mu Us Shamo Desert of Inner Mongolia. These pieces of information often give us clues to better strategies for rural planning.

Incomes from sheep and crops may be quite stable and important, depending on the regression result. It is strongly encouraged that crop production be expanded by taking advantage of abundant groundwater. Vegetables, in particular, are generally scarce in arid areas. High demand for vegetables from consumers in the region should bring stable incomes to the producers.

On the other hand, efficient methods of utilizing groundwater need to be developed. Pumping groundwater require fuel, which the farmers must pay for. It is already clear from the example of some innovative farmers in this region that use of fuel engines for pumping water is economically feasible due to increases in yields and reasonable market prices of agricultural products. Because there are quite strong wind throughout the year, it is also possible to employ wind-power wells, which generally incur very low running costs and provide substantial amounts of water for livestock, in particular.

The important fact of large off-farm incomes should not be overlooked. In practice, all types of farmers across the board depend on off-farm income. This implies that the residents in this region are not always practitioners of traditional agriculture. Although raising sheep is a traditional industry, agriculture in general is not necessarily these households' way of life any longer. Their ideas on life style are diversified, indicating that they are ready to be employed in non-agricultural industries if jobs are available. Accordingly, development of agri-business industries such as processing food for higher value added and better marketing would create new jobs for the residents and would bring more income into the region.

The high rates of installation of TV sets and radios despite the lack of public electric facilities in the region and a positive relationship between income level and TV installation suggest that a TV set is becoming more and more a part of everyday life. TV and radio can play a vital role in conveying abundant information on all sectors of the society, if broadcasting programs are properly orgartized. However, the current TV programs are quite limited in terms of the number of channels to choose from and the length of broadcasting time that can be received in this area. Accordingly, this result suggests that improvement of the TV network system to provide more information and entertainment will become much more important for the future. It is also likely, therefore, that the residents are becoming more exposed to current political and economic issues through TV programs despite the fact that most of them have very limited chances to directly contact people outside the region. It may not be unreasonable, therefore, to estimate that diversified ideas and activities of residents will be more accepted in the society.

Rural planning and comprehensive development of a remote area require an insight analysis of the community in the region. While the Mu Us Shamo Desert area is reaching a new stage of development planning, the results found in this research should provide some valuable information.

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