Problems and Potentials of Crop Diversification for Marginal Farmholders in the Dry Mountains of Dingxi County, North-west China

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Introduction

Agriculture is the dominant sector of China's economy and accounts for 54% of GDP. About 72% of the population is directly involved in agriculture, although this number is slowly decreasing due to rapid urbanisation. Since the 1980s, government has taken many measures to develop agriculture . One is the readjustment of the cropping patterns. The basic principle is to develop diversified cropping patterns on the basis of enhanced food crop production. As a result of various efforts, agriculture has grown quickly in the past 20 years. According to the State Bureau of Statistics, the average income of farmers has doubled compared to before the 1980s.

However, agriculture is still underdeveloped in north-west China. Dingxi County is located in north-western Gansu Province where most farmers still perform low-profit farming and engage in a mono-cropping pattern. Some of the farmers are still living below the poverty line. The county is one of the poorest counties in China.

This paper aims to examine existing agricultural practices; to identify problems, gaps, and potentials of agricultural production; and to formulate strategies to promote crop diversification. Participatory and multidisciplinary approaches were used. The focus is restricted to the dry, mountainous regions of Dingxi County of mid-Gansu Province in north-west China.

Study Area

Dingxi county is located in the middle of Gansu Province. The average altitude is 1897m above sea level. It covers an area of 4225 sq.km, 0.9% of the province's land area. The total cultivated land is 114,933 ha, accounting for 27% of the total cultivated land in the county. It includes 20 villages. The county is a typical hilly and mountainous area, with only 14% as plains area. The population in 1998 was 400,000, of whom 89% were farmers.

The climate is very dry. The mean annual temperature is 6.3 °C; July is the hottest month with a mean temperature of 18.5 °C, and January is the coldest with a mean temperature of -7.9 °C. The average frost-free duration is 140 days. Total annual precipitation is 376 mm, about 60% of which occurs in summer, with the lowest rainfall of 8.3 mm in winter. Agriculture is typically rainfed.

There are four types of soil: limestone-based, black stony, yellow loess, and red loam. The soil on mountain tops is severely eroded and no more topsoil is left. Soil erosion, mainly induced by wind, is also severe.

Research Methodology

The study was conducted through reviewing secondary sources of data and interviewing key informants like agricultural officials, extension workers, village heads, farmer's groups, and so on. The secondary data were collected from different sources like the *Statistical Year Book*; various national five-year plans; and reports, documents, and research studies along this line. Problem tree analysis was applied to analyse the cause and effect relationships of monocropping. A potential matrix was used to identify the basic potentials and derived potentials helping to solve the problems. Some descriptive and statistical analyses were also employed.

Results

Existing cropping patterns

The main crops planted from 1995 to 1998 were food crops, they accounted for 83% of the sown farmland (Table 1). Among them, wheat ranked first, followed by potato, local oats, and so on. The total cropping area of cash crops was 11.9% of the total cultivated area. The main varieties were flaxseed and medicinal plants. The ratio of food crops, cash crops, and other crops was: 16.5:2.4:1.

Table 1: Cropping pattern in Dingxi county

	Area planted (ha)	Percentage of total cultivation area	Av. production (kg/ha)
Food Crops	**99,160**	**83.10**	**1214**
Wheat	31,247	26.19	1229
Potato	25,113	21.01	1529
Naked Oats	13,424	11.25	1114
Corn	9660	8.09	1795
Pea	8305	6.96	1354
Millet	4527	3.79	1147
Gruel	1960	1.64	1105
Cash Crops	**14,176**	**11.88**	--
Flaxseed	13,287	11.13	349
Medicinal plants	73	0.06	1115
Others	**5990**	**5.02**	--
Total	**119,327**	100	--

Source: Yearbook of Agricultural Economies of Gansu Province, 1995-1998

The areas for vegetables, grasses, and agroforestry are 267 ha; 14,600 ha; and 52,933 ha, respectively. However, due to poor management, poor soil, and low rainfall, most of the forestry stands are under-stocked and of poor quality, or cannot grow. Therefore, timber production is almost impossible.

Analysis of Problems

This area, like the rest of the province, experiences very low rainfall and long dry periods. The soil is of very low fertility and water holding capacity. Water for irrigation is sparse, and irrigation facilities are insufficient to meet the demand. All these factors have limited agricultural activities to food crops like wheat and potato. Monocropping is a major reason for low production and income. Analysis indicates that monocropping is caused mainly by limited natural resources such as rainfall; poor soil fertility; lack of farming inputs like high yield varieties (HYV), chemical fertilisers, and pesticide/insecticide; and lack of support

entities like research, extension, and credit services. These problems are not independent but are interlinked with one another. All these problems have resulted in monocropping and low incomes for farmers (Figure 1).

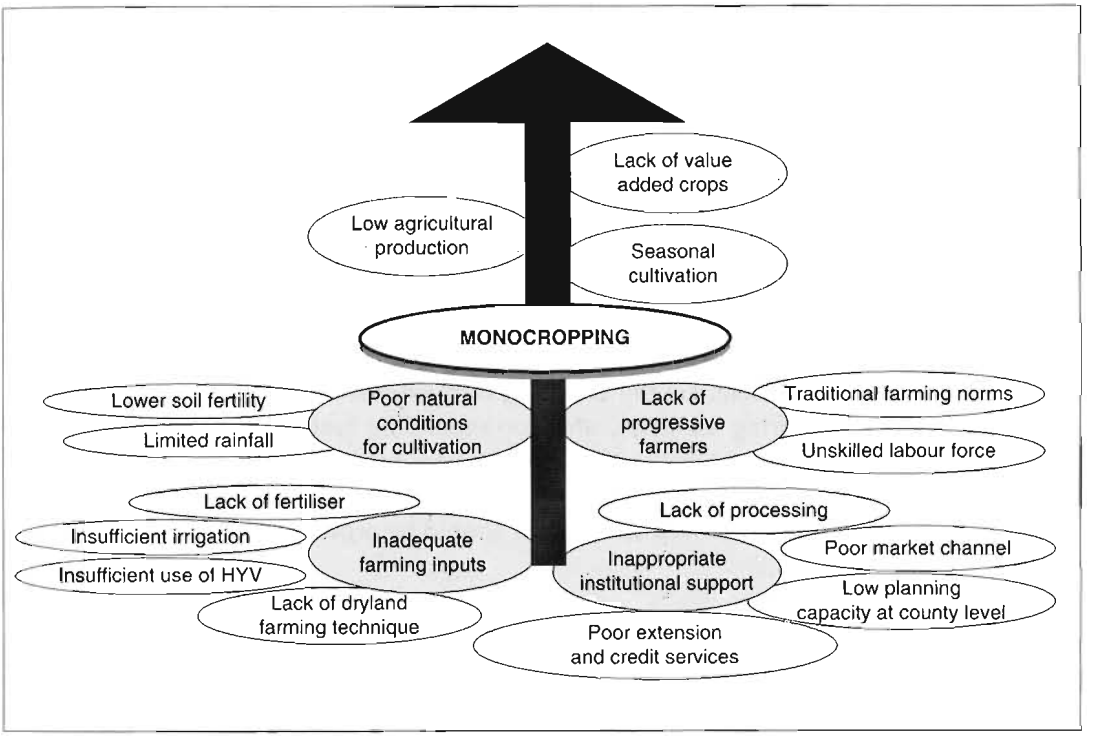

Figure 1: **Causes and effects of monocropping**

Analysis of Potential

Problems always include potentials. The natural potentials are mainly long sunshine duration (69% of the total annual duration), strong solar radiation (15.2 cal/cm² monthly during May to August), rich terraces that cover a large area (2533 ha), and larger land holdings (0.20 ha higher than the national figure). Infrastructure potentials are roads, railways, and all kinds of transport facilities; existing agro-markets in each township; and a central market in the county centre. Human potentials are a labour force (200,000 or 56% of the total farmers) and their knowledge of dryland farming. Institutional potentials include new policies, seven existing agricultural schools, 20 farmer's training centres, several research centres and extension stations, and banks and rural credit co-operatives.

One big potential is the sustainable rainfall resource management experience. A project on effective use of rainwater was initiated by the provincial government, and was jointly implemented by several research institutes and local governments. It promotes more efficient use of rainwater through runoff collection techniques, water storage tank construction, devices for lifting and conveying water, micro-catchment water conservation with polythene film mulching, and multi-use crop products and bi-products for livestock.

All farm households have adopted these techniques, which have made both irrigation water and drinking water available for people and animals. Additional benefits include reduced soil erosion, decreased pesticide and fertiliser use, increased options for crop diversity, and increased capacity of women to play a major role in fruit and vegetable management and livestock rearing.

Strategies to Promote Crop Diversification

Enhance governmental support

Government policy for efficient use of agricultural resources like land and water should be stressed to enhance diversified crop production. More grace policy in the provision of short-term credit and loans should be made in the future to support application of inputs like HYV, fertiliser, pesticides, and irrigation. Local government should adopt participatory approaches to make policies more attractive to farmers.

Enhance agricultural research and extension

The main efforts should focus on the breeding and extension of drought- and disease-resistant and early-maturing varieties, and corresponding techniques such as dry land tillage, rainwater harvesting, water-saving irrigation techniques, and soil and water conservation. These techniques should be practical and acceptable to farmers. On-farm services regarding extension of new techniques should be provided to farmers regularly in a timely manner.

Establish effective market networks both inside and outside the county

Most effective local markets can be promoted to small market centres to establish a market network. Local government could invest for this purpose. Local farmer's cooperatives and groups should participate in marketing activities from collection of products to the sale of these products to protect farmer's benefits.

Strengthen the training and education of planning staff and farmers

Better training is needed for extension staff and farmers. The education and training of farmers could be conducted in existing centres. Basic background knowledge and skills can be taught during slack seasons. Specific farming techniques could be promoted during farming seasons through on-site demonstration. Farmer technicians should be responsible for the education and training of farmers. Local government should increase investment for this purpose.

Establish value-added processing enterprises

The enhanced production of cash crops, fruits, grass and forage, and livestock make the establishment of value-added processing enterprises necessary and possible. Starch processing plants using potatoes as raw material, oil processing plants, flax processing plants, and carpet making factories are all potential considerations. The establishment of processing plants could in turn promote crop diversification.

Conclusions

Monocropping in the area limits crop production and farmer income. Crop diversification is an alternative way to enhance production and increase incomes of small farms, and to improve off-farm income. The efficient use of existing potentials and derived potentials, together with the adoption of certain strategies, will facilitate diversified crop production. It must be emphasised, however, that other means such as agro-industry, transportation, and other business are alternative ways to increase the income of small farms.

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