POLICY ALTERNATIVES FOR LIVESTOCK DEVELOPMENT IN MONGOLIA (PALD)

A Research and Training Project

Research Report No. 7

Wheat Production in Mongolia :

AN ECONOMIC ANALYSIS

Neil A. Chalmers

Institute of Development Studies
at the University of Sussex
Brighton, BN1 9RE, UK

Research Institute of Animal
Husbandry, Zaisan,
Ulaanbaatar 36, Mongolia

Institute of Agricultural Economics
Zaisan, Ulaanbaatar 36
Mongolia

POLICY ALTERNATIVES FOR LIVESTOCK DEVELOPMENT IN MONGOLIA (PALD)

A Research and Training Project

Research Report No. 7

Wheat Production in Mongolia :
AN ECONOMIC ANALYSIS

Neil A. Chalmers

Macaulay Land Use Research Institute
Aberdeen, Scotland, UK

May 1993

Contents

List of Tables

Page

List of Figures

Page

Acknowledgements

There are a number of people whose assistance has been much appreciated in connection with this study. In Mongolia Messrs Minjigdorj, Shombadon, Jigjidsuren and Erdenbaatar of the RIAH. In particular I wish to thank Ms. Narangarel for her assistance in interpreting. Also Peter Sloane, Roger Martin, Mike Reynolds, Batbold, Bayersaikhan, Altensukh, Davardorj, Byambadorj, Erdenebat, Doligsuren and Ms. Buyanjargal made valuable and much appreciated contributions.

I am particularly grateful to Jeremy Swift of IDS for providing me with the opportunity to visit Mongolia in order to undertake this study. Jonathan Kydd has been most helpful in providing guidance on much of the analytical work. In addition I wish to thank Robin Mearns, Martin Greeley and David Evans, Nick Guyer, Mike Gregory and Tim Ash for various wide-ranging and helpful discussions over the last few months.

Finally, thanks are also due to Steve Stauber of Montana State University for providing a material on extensive wheat production in Montana and Carl Gotsch of Stanford University for clarifying some issues of methodology.

As is usual in these matters, the author acknowledges that any errors, omissions etc. remain his sole responsibility.

Abbreviations

ADB	Asian Development Bank
AERI	Agricultural Economics Research Institute
ASS	Agricultural Supply Service
cif	Cost, Insurance, Freight
CIS	Commonwealth of Independent States
CMEA	Council for Mutual Economic Assistance
CRI	Crop Research Institute (Darkhan)
CV	Coefficient of variation
fob	Free on board
FSU	Former Soviet Union
GDP	Gross Domestic Product
Ha	Hectare
IMF	International Monetary Fund
MoA	Ministry of Agriculture
RIAH	Research Institute of Animal Husbandry
UNDP	United Nations Development Programme

Note: The term *farmer* is used loosely throughout this report. At the present time farming is undertaken by a mixture of state, cooperative, private company, partnership and sole trader concerns. The term simply refers to those who farm and infers nothing about the business structure.

The initial research was carried in November 1992 and the conclusions are based on the conditions at that time. References to dollars ($) are US dollars.

Aimag is a Mongolian term for province or region. The country consists of 18 aimags.

1. SUMMARY

For the last 30 years Mongolian agricultural policy has followed a dual approach. The traditional rural economy based on semi-nomadic pastoralism has been augmented by the creation of State Farms primarily for the purpose of crop production. These units were modelled on the Soviet Sovkhozy pattern i.e. wholly state-owned and highly centralised and were developed with assistance from other members of the CMEA, principally the USSR. By the end of the 1980s over 80% of the cropped land was within the State Farm sector. Although some fodder is produced the principal role of the State farms is the production of crops for human consumption and dominant amongst these is wheat, accounting for 75% of the total annually cropped land (about 800,000 ha).

The level of domestic wheat production was driven by the requirement for self-sufficiency. Population growth and increasing urbanisation since the second world war brought with them a growing demand for wheat. Because of insufficient wheat production within the CMEA as a whole and the shortage of hard currency required for the purchase of wheat on world markets, substantial resources were devoted to improving domestic production. Both the area sown and the yields rose substantially during this period of expansion.

Cereal production in Mongolia is risky because of climatic factors. The country has a severe continental climate with a growing season of typically 100 days. Precipitation in the main cropping areas is around 300 mm per annum which necessitates management systems (including clean fallow) to conserve moisture. Average yields during the 1980s were around 1.2 tonnes per hectare.

The establishment of these large scale enterprises has meant a significant increase in the level of imports of agriculture inputs. Because Mongolia does not produce fertiliser or sprays nor assembles farm machinery, these items had to be imported from other CMEA countries. The coupling of the Mongolian economy to that of the USSR in particular was very close and the degree of interdependency and economic specialisation mirrored that of the republics of the former Soviet Union (FSU). Trade was, and remains, vital to the Mongolian economy.

Output targets (state orders) for each farm were set by central planners and the entire operation was administered by officials within the Ministry of Agriculture. This provided little opportunity for decision making at farm level with the result that farmer innovation tended to be suppressed.

Despite the introduction of new mechanised production systems the overall productivity has been disappointingly low. Capital productivity is particularly poor. The trade agreements and pricing systems in operation tended to hide this. The materials balance approach to resource allocation simply ensured that factors sufficient for the attainment of a prescribed output level would be allocated. Attention was not directed to the optimal allocation between production possibilities nor the need to improve the efficiency of production. Inefficient production persisted due to the existence of a soft-budget constraint i.e. the willingness of the State to subsidise loss-making enterprises and an economic system that did not provide the incentives to attain optimal resource allocation.

Reform of the economy began in the late 1980s inspired by Gorbechev's programme of *perestroika* in the USSR although little was achieved until the collapse of the socialist regimes in the CMEA and the USSR itself forced the pace of change. The withdrawal of economic assistance from the USSR has been very damaging to the Mongolian economy. One of the most significant effects has been requirement, since January 1991, to pay for all imports in hard currency. Theoretically the prices of these goods are based on those in world markets. However there are considerable differences between the prices of Russian-supplied imports and those from other sources. This may be in part a result of quality differences especially in the case of machinery. In practice bilateral barter trade (involving minerals) has been possible but it is often unpredictable and essential supplies cannot be guaranteed. The economy of the former Soviet Union (FSU) itself has undergone major upheavals and these effects are transmitted to countries such as Mongolia which are dependent on its trade.

Imports of fuel, fertiliser and machinery fell precipitously during 1991 and have not as yet recovered their former levels. Wheat production has understandably fallen over this period although the full effects of the input shortages are yet to be felt.

Reform measures within Mongolia are attempting to introduce a market economy and to privatise state and co-operative enterprises. To date this has been somewhat haphazard as the country attempts to both pursue internal reform and cope with major external shocks. Privatisation of the State Farms is proceeding with various forms of business emerging. The farms are not well suited to the creation of small units and many have a emerged as small companies in which the workers are shareholders.

In order to facilitate understanding of this sector, a simple model of wheat production systems has been developed. The approach involves identifying and costing the factors of production with an emphasis on separating domestic and imported tradables. The impact of divergences can then be assessed. The prevailing situation in 1992 shows negative private profitability if the cost of maintaining the pre-1991 machinery complement is included. If this is excluded (as has been the case) then small private profits are possible in the short term in the better wheat growing areas.

With regard to social costs, there are significant divergences which create negative protection in output markets and positive protection in input markets. By the autumn of 1992 price liberalisation was only partially completed. The price of flour along with other essentials was fixed by the State which continued to set procurement targets for basic commodities. This official price therefore implies a nominal protection coefficient (NPC) of 0.17. Two factors influence this situation. First, the Tugrik is obviously overvalued however the degree to which this is the case is difficult to estimate. Secondly the calculation of an import parity price for wheat was hindered by the lack of reliable data on transport costs between Tianjin (on the Chinese Pacific coast) and Ulaan Baatar. The overvalued exchange rate provides positive protection in input markets as the domestic price of inputs is calculated using the official rate. The net effect of these measures is an effective protection coefficient estimated to be 0.02. This reflects the very low value-added at financial prices. Actual levels of procurement by the State have been lower than hoped for principally because of lower production but also because of increasing leakage into parallel markets.

Excessively high transport costs importing via China presently underpin the case for growing wheat. If the costs of transhipment from Tianjin to Ulaan Baatar were to fall to $40 per tonne a yield of 1.2 tonnes per ha would be required to provide (low) social profits. Furthermore, were the costs of inputs from the FSU to rise as a result, for example, of increased competitiveness then short term profitability would decline sharply. More likely perhaps will be the need to turn increasingly to other sources for the supply of inputs if the situation in the FSU further deteriorates. The costs of such goods would be higher (as would the quality). Though the long term net result of the two effects is difficult to predict, in the short term the higher costs would be felt immediately whereas any productivity gains would take longer to achieve. Given that this yield level is the pre-transformation average, it is undoubtedly the case that large areas of land would show negative social profitability and a cessation of production (or a switch to other crops) would be advisable.

The critical issue therefore is whether the goal of economic efficiency is best served by devoting the current land area to wheat production. The shortage of high quality winter feed is seen as a major constraint upon livestock production and it is this which offers some insights into the other production possibilities. The demand for fodder is derived from the level of livestock production which has been and remains an important export. If the value of livestock exports increases then the demand for (and price of) fodder will also increase. If domestic prices are fully liberalised and an internal market for livestock feed continues to develop then a switch to fodder production may be attractive to many farmers. Improvements in transport systems will accelerate this process as they will raise the farm-gate price of exported livestock products and lower the cost of imported wheat.

This report concentrates on the analysis of a single, albeit important, commodity - wheat. Further work along similar lines is needed to assist in the development of policy alternatives in the arable crop sector. The following conclusions and recommendations are therefore offered on the basis of the work undertaken so far in this study.

- The existing production systems exhibit serious inefficiencies. With carefully targeted and appropriate technical assistance productivity gains are possible this would ease the pressure on scarce arable land. Areas identified for consideration include seed technology, fallow management, agro-chemical spraying and harvest and post-harvest losses.
- In some cases despite such gains it may nevertheless be better to switch to alternative crops. This would then necessitate importing a proportion of the wheat requirement. This will be worthwhile if the foreign exchange earnings from the resources freed for wheat production are greater than the costs of importing the equivalent quantity of wheat. Further work will be needed to establish the situations in which this is the case. Multi-commodity farm budgets in which livestock feed is a component offer one possible route to this end.
- What is likely in practice is that farming systems in which both cereal crops and fodder crops feature will become more prevalent. Much of the wheat land is monocultural. Preliminary work by the Asian Development Bank in planning a livestock feeds project suggests that wheat yields could be improved when combined with leguminous (and other) forage crops in rotations. The result may be a net loss in wheat output but this is more than compensated for by the value of fodder produced. Again these systems will need to be carefully budgeted as well as being assessed for technical viability and acceptability on the part of farmers.
- All of the preceding suggestions will require a effective research and extension service which will, in the short term, require funding from sources outwith agriculture.
- Finally, agricultural policy will be crucial in determining the direction and pace of adjustment. Price divergences tend to lead sub-optimal resource allocation. An insidious form of intervention can arise from the actions of state and parastatal agents in the agriculture and food chain. Monopolistic (and monopsonistic) positions allow such bodies to influence the range of options open to producers and to create a system of state orders by proxy. This tends to drive products into parallel markets or possibly acts as an incentive to cease production altogether. There is therefore an urgent need to build institutional capacity in agricultural policy analysis in Mongolia. The agricultural sector requires a well thought out and coherent set of policy objectives and instruments. This can only arise when the sector is viewed as a whole and in the context of those sectors on which it depends and *vice versa*. As the single most important aid initiative in this field, the ADB Feeds Improvement Project should consider the impact on cereal production of improvements fodder production as the two are inextricably linked.

2. INTRODUCTION

The series of studies in the Policy Alternatives for Livestock Development (PALD) programme have, to date, concentrated on the livestock sector of Mongolia. However it has been clear from the start of this project that a study of this type would need to encompass the agricultural sector in its entirety because of the inter-relationships between agricultural activities and the competition for the relatively scarce resource of good arable land. Although the land area of Mongolia amounts to some 160 million hectares, the land classified as arable is only 1.4 million ha and some of this is not well suited to long term cultivation. Land use is dominated by extensive pastoral systems, accounting for about 80% of the total area.

This latter reason is significant because of the fodder requirements of the livestock activities and the general shortage of good fodder for these animals. Of the 1.4 million ha of arable land available around 800,000 ha is cropped annually with nearly 600,000 ha fallowed. Approximately 75% of this area is given over to wheat production making it the single most important arable crop. An initial assessment of the situation suggests that, because of the poor performance of many of these wheat growing activities, there is an argument that economic efficiency goals would be better served by a transfer of resources into those activities in which the country enjoys a comparative advantage. This study attempts to determine to what extent such a proposition is justified in the prevailing economic conditions in Mongolia.

This report first provides a cursory overview of the current state of the Mongolian economy and the changes that are currently taking place during this period of transition. This is followed by a more detailed study of the production of wheat in Mongolia with particular emphasis on the agronomy and regional variations in performance. Chapter 4 is concerned with an analysis of some of the problems that beset the present methods of wheat production, in particular the reasons for poor performance and losses and the brief look at some of the environmental issues. Farm management problems are the subject of the next chapter. Chapter 6 is devoted to an economic analysis of wheat production as is stands at the moment. The model is described in detail with particular emphasis on the data sources and the assumptions used in assembly . Some results of the model are presented in chapter 7 with conclusions and recommendations following in chapters 8 and 9.

An important component of this study is a computer spreadsheet model that describes the wheat production system. The model has been automated and documented to make it accessible to readers who may wish to pursue the subject in greater detail. At present it is available in Microsoft Excel and Quattro Pro but conversion to other spreadsheet packages should be a relatively easy task and is available upon request from the author.[1]

The purpose of this study is to define the parameters of the problem and provide a framework for policy analysis on the issue. In order to do this it is important to understand the changes in the institutional and economic environment over the last two to three years and the organisation of the economy during the years of central planning as they create some particular problems for agricultural policy analysts. Throughout the years of the command economy the price system was entirely administered and, as a result, prices reflected neither scarcity value nor social utility. Current methods of assessing economic efficiency rely on identifying and correcting for distortions arising from interventions on the part of governments in what would be otherwise market-based systems. Within the command economies decisions about resource allocation were taken at government level and usually without reference to prices. As a result producers had little control over the activity mix or methods of production at farm level. Attainment of the prescribed physical output targets was the overriding aim of the farm managers and profitability, as it is understood in a Western context, was generally of secondary importance.

This study attempts to capture the technical and economic nature of this important commodity system during the time of economic transformation. The aim is to provide a basis for evaluating existing

[1]Neil Chalmers, MLURI, Craigiebuckler, Aberdeen, AB9 2QJ, UK. Phone: (+44) 224 318611, fax: 311556,
E-mail (Internet) : NAC@MLURI.SARI.AC.UK

forms of land use and identifying how and where change would result in economic benefits for Mongolians. These are difficult days for Mongolia as the country struggles to rediscover its identity and recover from a series of economic shocks. It is hoped that this report can contribute something of value in helping to chart the course ahead.

3. ECONOMIC BACKGROUND

In order to understand the present predicament of the Mongolian wheat production sector it is useful to consider the organisation of the economy of the whole over during the socialist period. The Agricultural Sector background paper (Sloane et al, 1991) provides a comprehensive overview of agriculture as a whole. Other works provide more detail on the wider economic and political situation of the country[2]. The Mongolian economy has a very narrow base, concentrating on primary products, most importantly minerals (the main source of foreign exchange is copper concentrate) and livestock products. There is very little manufacturing industry and so most manufactures and consumer goods were and are still, imported from other (former) CMEA countries, most notably the FSU. As a result the economy was quite open and integrated into the wider planning activities of the CMEA. The influence of external advisors was pervasive with every industrial sector and government department being organised along Soviet lines. Indeed, Mongolia was often referred to by western observers as the sixteenth republic in all but name. This paradigm is valuable in that it helps to elucidate the present predicament facing the country. There are a number of parallels with the member states of the CIS, the former Soviet republics. The degree of geographical specialisation, acknowledging the principle of comparative advantage, has been considerable. For a time this arrangement worked quite effectively, particularly as it served the geo-political interests of the USSR in connection with its relations with China. It is tempting to speculate that lying behind the assistance to Mongolia was an desire to ensure that Mongolia remained safely within the political and economic orbit of the USSR and to display to China the benefits of so doing.

3.1. Recent History

The Mongolian economy has been subjected to a number of serious shocks in recent years. The collapse of the CMEA and in particular the trading relations with the FSU has been very damaging to Mongolia. Various sources estimate that the assistance from the CMEA in financing the budget deficit during the 1980's amounted to 30-35% of GDP. The loss of this injection of economic aid has been very serious. In 1991 GDP fell by an estimated 15% in real terms. 1992 has also seen a further decline in output, believed to be in the region of 10%. Although the effect of this withdrawal differs throughout the economy there are a number of common features. Foreign exchange shortages have meant that the procurement of essential factors of production has been at best difficult and in many cases impossible. At the local level this problem has been often exacerbated by the collapse of the centralised ordering and distribution system with, as yet, no viable alternative to replace it. As a result the industrial sectors are presently undergoing a period of rapid disinvestment of a capital base which is already largely sub-standard and obsolete. The shortage of spare parts means that as machines fail they are not repaired but are taken out of use and are cannibalised in order to keep others operational. Neither are they able to obtain regular supplies of inputs such as fertiliser, fuel and sprays (in the case of crop farms). The overall effect of this is to further erode an already poor level of productivity. It is worth noting in this context that the State Farm sector shares much in common with light industry and many of the problems of the one apply equally to the other.

3.2. Inflation

The period of transition has brought with it serious price inflation. Prior to 1990 inflation was almost unknown as prices were centrally determined and administered. As price controls were eased inflation rose and much of the inflation in early 1992 were a direct consequence of price liberalisation. The increase in the consumer price index was estimated to be 130% during 1991. Inflation during 1992 appears to have been around 60% but the problem is still serious as Mongolia continues to allow its budgetary deficit to be financed by a growth in money supply.

[2]The papers prepared for the International Seminar on Mongolia's Transition to a Market Economy: Evaluation, Problems and Proposals, (October 1992), provide a very comprehensive overview of the progress of economic transformation in Mongolia. More details can be obtained from the UNDP, Ulaanbaatar

For many the effects of inflation are particularly difficult. Employees of the State have seen their incomes fall precipitously in the last few years. Some businesses have been able to fair little better as the differential nature of inflation tends to squeeze already slim margins ever more tightly. One of the side effects of inflation has been the emergence of parallel markets in which barter or hard currency transactions predominate. Producers have also withheld produce from sale where this is possible because of the declining value of the Tugrik (with negative real interest rates for savers) and the lack of consumer goods for sale. The continued activities of the state in intervening in factor and product markets has exacerbated this problem. Because of these emergence of parallel markets, coinciding with an erosion in the established methods of data collection, it is very difficult to measure with precision many important economic indicators.

3.3. Exchange Rates

In common with the other member states of the CMEA, the Mongolian Tugrik was non-convertible currency.

Table 1. Exchange rates, 1986-92

Year	1986	1987	1988	1989	1990	1991	1992
Official rate (=US$ 1)	3.1	3.1	3.1	3.1	7	40	40
Parallel rate	10	15	20	30	40	150	300

The exchange rate at November 1992 was Tg 40 = US$ 1 although street rates were around 350 Tg. Despite several devaluations the Mongolian authorities have so far failed to reach the IMF target of no more than 90 Tg per dollar difference between the official and parallel rates. The persistence of an officially overvalued currency and the existence of multiple exchange rates continue hamper economic reform. This exchange rate policy has necessitated foreign exchange rationing, export licensing and rationing of imported materials, all of which have a distorting effect on the economy and seriously prejudice the market reform process.

For calculations of social profitability it is important to have some measure of the shadow exchange rate. That the official rate is substantially over-valued is universally accepted. The parallel markets however almost certainly under-value the currency. The true market rate probably lies between these extremes. Work by the Boston Consulting Group (BCG) on behalf of the Asian Development Bank suggests of rate of 150 Tugriks per US dollar as a market rate for the industrial sector[3]. In the absence of any superior information this rate has been used in calculations in this study.

3.4. Price Control and State Orders

Perhaps one of the most serious characteristics of this transition period is the uncertainty and volatility of government policy and its implementation at local level. The dismantling of the planned command system has created a vacuum which has promoted the attainment of short term goals and opportunism to a dominant position. For many emerging private businesses the economic environment is so unpredictable and hostile that long term planning appears a luxury that cannot be afforded. The external pressures on the Mongolian government from the donor agencies generally comprise a pattern of macroeconomic stabilisation measures designed to address the serious ills of the economy. In many cases these measures are perceived to run counter to the interests of particular groups within society and the result is, very often, a set of policy instruments which are compromised in their effectiveness because of failure to implement them in a consistent manner.

There is also a more insidious difficulty in the reformation process. Mongolia has been a socialist state since the 1920's and before that a pastoral feudal society. There is consequently little

[3]The work of the BCG is not at present in the public domain and cannot therefore be cited. The author acknowledges the assistance of economists working in Ulaan Baatar for the contribution of this information and discussions on the subject.

understanding or tradition of the market economy as it is understood in the West. The immediate impact of this deficiency is that the country appears to exhibit many of the ills of market economies with very few of the benefits. This is a pattern that has best most of the former CMEA countries although it is interesting to note that the effect has been less pronounced some of the Eastern (more correctly "Central") European nations[4]. Murrel et al (1992) address these problems in relation to price reform. Their conclusions are noteworthy. In particular they identify a dissonance between the policy measures and their implementation at local level. The actions of local officials are often seen to be inconsistent with the stated policy objectives as laid down by government. Instead there has been a widespread tendency to see price controls as a "quick fix" for various political and economic problems both at local and indeed at national level. That the political and economic culture of the past has a profound influence on the present is widely accepted but identifying means of addressing this problem has proved to be much more difficult. This paper does not address itself to these issues directly but the reader is encouraged to pursue the subject further elsewhere.

This matter has a direct bearing on the subject addressed in this paper because the farmers have to operate with the prevailing policy environment and will react accordingly. The evidence from the last two years affirms this. Unlike the pastoralists who to a certain extent have the capacity to insulate themselves from the adverse economic conditions, the arable farms are very dependent on imported inputs. Furthermore, because of the importance of wheat as a staple foodstuff, it has, until recently, been subject to price control to ensure affordable prices to consumers. The effect of this together with limited availability of highly priced inputs has been to put a squeeze on farm margins.

The state order system enforces a rigidity that often undermines efficient resource allocation. State orders were still effective at the beginning of 1992. The plan for wheat for example included the production of 555,000 tonnes although the harvest appears to have been around 430,000 tonnes in total. This would provide around only 200,000 tonnes for flour milling, well short of the requirement. The prices at which procurement takes place have been well below the economic price and there is evidence of a growing trade in the unauthorised export of agricultural products thereby depriving the domestic processing industry of its raw materials and exacerbating the problem of food shortages, and the emergence of a parallel domestic market for agricultural products in which prices are four to five times that of the state price.

The government has indicated its intention to remove all price controls, although this has so far proved difficult to achieve. During 1992 many agricultural products remained within the state order system, a measure deemed desirable to ensure supplies of essential products. Unfortunately the inadequacy of input supply together with the low output prices have tended to undermine this objective.

3.5. Privatisation

The auctioning of the State farms and cooperatives has been part of the first stage in the Mongolian privatisation. By the summer of 1992 over 75% of the State farms and 90% of the cooperatives had been transferred to private or semi-private ownership. Stable businesses forms have yet to emerge as former state farms split and then merge again as they attempt to identify a workable structure. Table 2. below provides a summary of the restructuring as at November 1992. It is certain that this is no longer the case and many more changes are likely in the near future. The viability of businesses is a serious issue as there are many factors which militate the success of farm businesses forged from the former State Farms. To begin with they inherit the failings and deficiencies of the State Farms in the form of the technology of production and capital investment. These problems are elucidated

[4]This is in no way meant to be an indictment of the Mongolians themselves merely a comment on the magnitude of the problem. Perhaps the most enduring impression of the current state of the nation is their ingenuous expectation of the benefits that will flow from economic reform although the emergence of a grow economically and socially disadvantaged sub-class is worrying. One of the features of the years of Soviet assistance was the tendency for the Soviets to run the country on behalf of the Mongolians thereby creating a dependency. The sudden removal of this assistance has left Mongolia with little choice other than to go it alone and attempt to build a viable economy. The analogy of an abandoned child is perhaps helpful in this context. A number of recent events point to the naiveté and lack of experience in international business reinforcing the impression of vulnerability of the country.

elsewhere in this report. Secondly, there are very real deficiencies in management ability, of both a technical and financial nature. The statist system did not advance managerial skills at farm level and the new businesses face a very severe skills shortage. There is no extension service in that the technical was provided by the State Farm management team which included technical specialists such as agronomists and veterinarians. Thirdly, the State Farms do not lend themselves to easy dismantling for the purpose of creating small businesses. The investment in fixed capital reflects the large-scale, centralised approach of the former regime. Thus State Farms have more in common with small townships based around an industrial centre than farms in the sense that the term is understood in the West. In many cases the creation of small, family based units is impossible and the emerging business form usually owes much to the former brigade structure (salaa).

Given the difficulties of establishing viable businesses under the present conditions, there are likely to be a number of early bankruptcies in this sector. Table 2. shows the state of farm break-up at November 1992 although this is merely a snapshot of a very fluid and uncertain process.

Table 2. Summary of breakup of State Farms into private businesses as at November 1992

Aimag	Original Farms	New Farms	Prvte Cmpy	Public Cmpy	Co-op Unlim	Co-op Ltd	State Farm	Sole Trader
Arhangai	1	3	3					
Bulgan	4	6	6					
Bayan Ulgeii	3	8	2					
Govi Altai	3	3	3					
Dornod	4	49	11	15	1	4	1	4
Zarhan	2	2	2					
Overhangai	1	5	4	1				
Sukhebataar	2	4	1	3				
Selenge	16	99	35	57		1	1	4
Tuv	13	45	29	12				4
Uvs	5	12	10	2				
Hovd	2	2						
Hovsgol	2	9	7	2				
Hentii	4	26	9	16				1
Erdenet	1	8	2	4			1	
Ulaanbaatar	6	25	14	9			2	
Darkhan	2	20	1	17		1		
Other	4	4	4					
Total	75	330	143	138	1	6	5	13

The nature of privatisation in other sectors is also proving to be difficult for agriculture. The most obvious single problem is that the process often leads to the creation of private monopolies and monopsonies (with many of the characteristics of their State precursors). These organisations invariably continue to behave much as they did before but without the constraints of being part of the state system. At present there is no effective anti-monopoly legislation and the effects on smaller businesses at local level can be very serious indeed.

In the context of monopolisation as in that of price control, the work of IRIS[5] offers some valuable perspectives. The use of an evolutionary approach to understanding reform policy as propounded by Murrel et al (1992) yields some useful insights into the agents of change in society. A society's inventory of knowledge is the sum total of the personal knowledge of individuals within it. This knowledge has been shaped and governed by the institutions and organisations that operate within the society. The behaviour of economic actors is determined by the long history of accumulated collective experience. As a result there is an implicit knowledge of the expected action and reaction whenever economic activity takes place. When radical changes in the economy are made the actors no longer have a pool of experience relevant to the new set of conditions upon which to draw. The inherent tendency is to revert to that which was known before but modified according to the degree of understanding of the new order. Although the rules may change the instinctive behavioural patterns of the players remain much the same. For many, especially the unskilled and semi-skilled

[5]Institutional Reform and the Informal Sector, at the University of Maryland, USA.

workers, the reforms are leading to a situation of increasing hardship. There are those who have been able to see opportunities for self-advancement under the new regime but this is often by means of exploiting deficiencies in the system rather than genuine wealth creating activities. To state that the private sector is entirely comprised of short-term opportunistic activities is perhaps unfair and unduly pessimistic.

Murrel and his colleagues conclude that anti-monopoly legislation could be counter-productive because of the lack of understanding and experience on the part of those charged with the task of enforcing of such a law. This argument is well reasoned but it does not address the very real problem faced by farmers when having to deal with monopolies.

3.6. Infrastructure

The general state of infrastructure represents a serious problem for the Mongolian economy. The country is remote, sparsely populated and has a poorly developed infrastructure. Furthermore, the recent external shocks to the economy have lead to serious disinvestment in this already meagre resource. Most international freight is carried by rail, on the branch of the Trans-Siberian railway which links Russia to China. An estimated 30% of internal freight is also carried by rail with the remainder being assigned to trucks. One of the most serious limitations to the development of trade with China and the Pacific rim region is the change in rail gauge at the border between China and Mongolia. All freight has to be unloaded and reloaded, a process that can take as long as two months to complete although the transfer of 'priority goods' takes only two weeks!

Once goods destined for farm use are in the country they have to be unloaded and transferred to trucks for delivery. 70% of all freight in Mongolia is carried by truck often over rough tracks which exact punishing wear and tear on the vehicles. The fleet consists of over 25,000, mostly Russian, vehicles many of which are small (5 tonne) units and are old and inefficient. More than half the trucks are over 10 years old and with the shortages hard currency for replacements, fuel and spare parts the transportation sector is becoming increasingly fragile.

At the present time all farm inputs have to be collected by the farms themselves from the state distribution centres effectively transferring to the farms the some of the distribution costs. It also means that the farms must maintain fleets of trucks for on and off-farm transport.

4. WHEAT PRODUCTION: AN OVERVIEW

4.1. History of Wheat Production

The growing of wheat in Mongolia on the present scale is a relatively recent phenomenon. Before the 'Virgin Lands' programme of the late 1950s and early 1960s the area of wheat was of the order of 20,000 ha. The area grew rapidly (Fig 1.) during the early '60s and thereafter at a steady rate until the late 1980s. This enabled Mongolia to become more or less self sufficient in wheat production, a position that it has enjoyed until the recent break up of the CMEA and the withdrawal of Russian assistance. The creation of the State Farms together with the extension of the cropped area was based on the Soviet Sovkhozy model in which the means of production are wholly state owned. As with their Soviet counterparts, the Mongolian State farms were characterised by substantial investments in fixed capital in an attempt to lift land and labour productivity. The problem of low land productivity was simply addressed by bringing more marginal land into production. The result of this has been to reduce the productivity of capital and to create a set of environmental problems, the impacts of which are now becoming increasingly apparent.

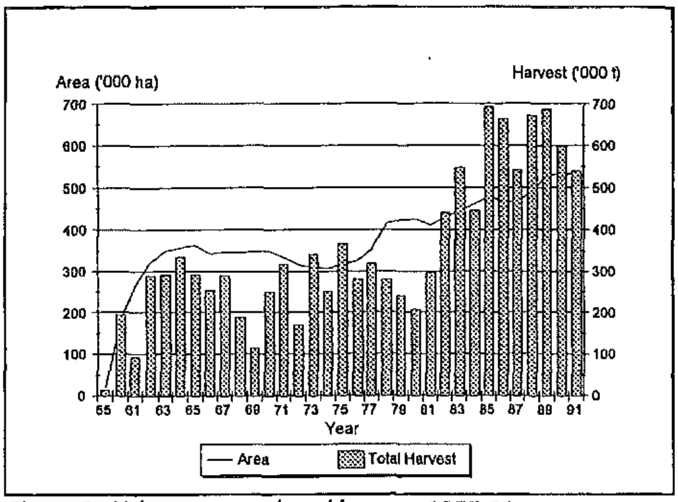


Figure 2. Wheat area and total harvest, 1955-91
Source: Ministry of Agriculture

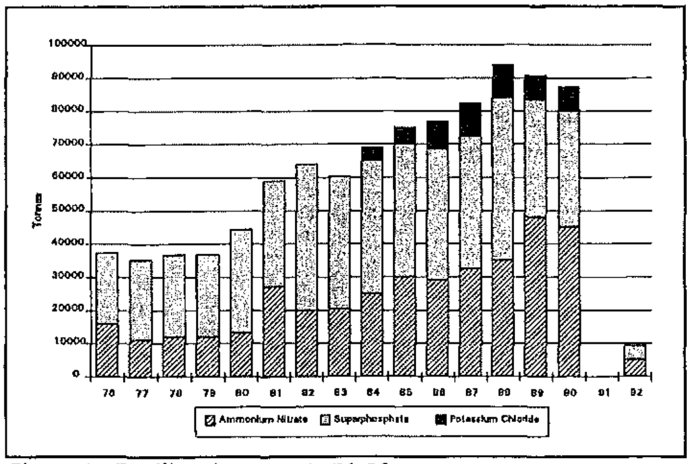


Figure 1. Fertiliser imports, 1976-92
Source: Ministry of Agriculture

One important result of this form of development has been the creation of an agricultural sector heavily dependent on imported inputs and technologies. The pattern generally followed involved the creation of facsimiles of the production systems being introduced in the Soviet Virgin and Idle Lands programme in Western Siberia. In most cases Soviet experts were involved in the process, often responsible for running the farm enterprises on behalf of the Mongolians rather than attempting to develop in-country expertise together with ecologically and economically sustainable production systems.

The immediate legacy of this pattern of development, in the aftermath of the sudden and complete withdrawal of Soviet support, is a sector of agriculture which is extremely vulnerable to external economic forces. There is also a dearth of appropriate management and technical expertise in crop farming.

Evidence from the FSU (Brooks and Johnson, 1983) suggests that total factor productivity in mechanised agriculture does not compare well with that of western agriculture. By comparing areas in the former USSR with those of similar agro-climatic characteristics in North America, they estimate that productivity in Soviet agriculture is around half that of its American counterpart[6]. Given the similarities these conclusions are assumed to apply to Mongolian agriculture. This represents a serious situation given the level of capital investment in the Mongolian agriculture and present need to service and renew this capital with hard currency.

4.2. Geographical Distribution

The main wheat growing areas are in the central northern part of the country, with the aimags of Selenge and Tuv assuming the greatest importance. These areas enjoy higher levels of precipitation than would be typical for the country as a whole. The distribution of cereal growing by aimag is shown in table 3.

Table 3. Total cereal harvest by Aimag, 1987-89

	1987 '000t	1988 '000t	1989 '000t	3 yr Av '000t	Dist %	1987 t ha^{-1}	1988 t ha^{-1}	1989 t ha^{-1}
Arhangai	39.7	28.5	46.7	38.3	5.1	1.15	0.82	1.27
Bayan Ulugei	0.7	0.8	0.8	0.8	0.1	0.85	0.78	0.89
Bayanhongor	0.1		0.1	0.1	0.0	0.39	0.8	1.00
Bulgan	72.9	88.2	112.4	91.2	12.1	0.95	1.23	1.56
Govi Altai	1.0	0.7	0.8	0.8	0.1	1.56	1.19	1.33
Dornogovi								
Dornod	15.4	45.2	65.6	42.1	5.6	0.42	1.18	1.64
Dundgovi								
Dzavhan	18.2	11.6	6	11.9	1.6	0.77	0.50	0.28
Uvurhangai	29.9	15.7	25.2	23.6	3.1	1.56	0.82	1.25
Omnogovi								
Sukhbaatar	11.6	13.4	17.9	14.3	1.9	0.86	0.98	1.19
Selenge	211.3	323.4	199.3	244.7	32.6	1.27	1.82	1.10
Tuv	177.7	139.6	206.9	174.7	23.3	1.33	0.98	1.28
Uvs	26.7	27.2	36.1	30.0	4.0	0.82	0.84	1.07
Hovd	3.7	2.1	3.2	3.0	0.4	1.11	0.63	1.03
Hovsgol	20.1	36.2	35.9	30.7	4.1	0.87	1.62	1.58
Hentei	34.4	42.2	57.9	44.8	6.0	0.88	1.06	1.35
Total	663.4	774.7	814.8	751.0	100.0			

Source: Central Statistical Board MPR National Statistics 1989

4.3. Climate

Climate is one of the most serious constraints upon crop production in Mongolia. The extreme continental climate means a short growing season, typically around 100 days. This usually affords only narrow windows of opportunity for many time-critical operations, especially sowing and harvest, and so timeliness and efficiency of field operations are of the essence. The fluctuation in weather during the growing season can be both severe and unpredictable. In 1992 for example a sudden frost (-12 deg Celsius) in June led to a significant loss of yield. Harvesting takes place during September when the average daily temperature is down to 8 deg C and snow falls are not unknown. One of the effects of frosts during the harvest period is to hasten ripening which may lead to small grain size. The highly peaked requirements for field operations in part explains the level of investment in machinery.

The rainfall data in Fig 3., collected at Jargalant State Farm in Tuv Aimag, illustrate both the low mean level of precipitation and the degree of year to year variability. Over the period 1976-89 the mean rainfall was 261 mm with a standard deviation of 93. The minimum value was 145 mm and the maximum 492. Further data are shown in table 6. for each of the agro-climatic zones in which wheat is grown.

[6]In the case of Mongolia, the most comparable region on an agro-climatic basis is Montana in the USA. There are slight differences in the rainfall regimes and annual temperatures but these are minor. Agro-climatic homologues can be useful in that differences in the performance of agricultural systems can certain caveats, be attributed to managerial, technological and economic factors rather than the physical environment.

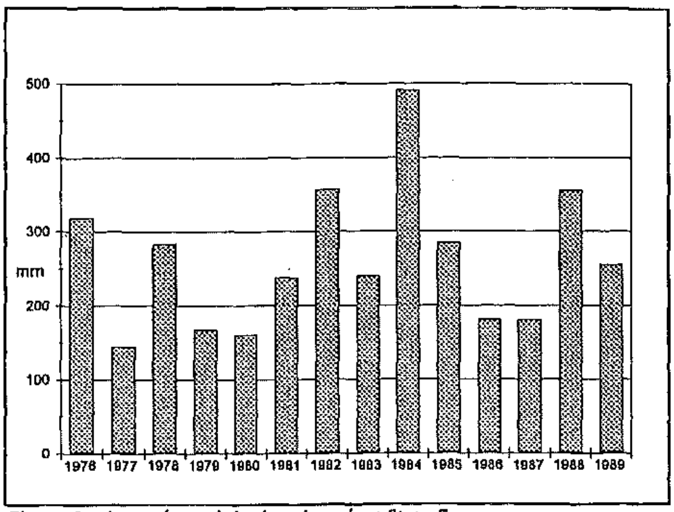


Figure 3. Annual precipitation, Jargalant State Farm

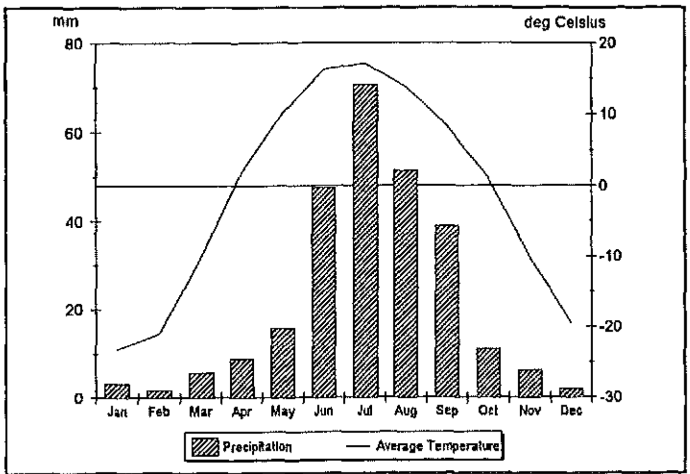


Figure 4. Monthly precipitation and temperature, Jargalant State Farm

Because of the peaked distribution of rainfall with over half the annual amount falling in the summer months and very little in the spring, the soil moisture at sowing time tends to be low. The months of April and May as well as being dry are also the amongst the most windy with average windspeeds of over 2 m sec^{-1} and greater than 10 m sec^{-1} for more than half the month. This can mean problems with wind erosion particularly on the fallowed land and measures must be taken to minimise the soil loss. The most common response to this problem is to plant the crop in strips about 30 metres wide with the fallowed land in between. This allows the crop to act a a wind break preventing wind run over large areas of exposed soil thereby minimising the amount of soil picked up by the wind. The strong, dry winds also mean that the potential evapo-transpiration rate is high at this time. This can have the effect of desiccating the crop at the time of establishment. Heavy frosts during this time can also mean the crop would be set back leading to reductions in yield.

4.4. Soils

Soils in the northern belt of Mongolia are of the Mollisol order. The surface horizon is usually thick and dark with a granular, soft structure. This soil type tends to develop under prairie type grassland vegetation and hence is also found in the Great Plain states of N. America, parts of S. America as well as a large belt of central Asia including Mongolia.

Mollisols are inherently fertile soils with reasonably high organic matter and are well suited to cereal production if managed effectively. When first brought into crop production reasonable yields are possible with minimal fertiliser application. Continuous cropping leads to a reduction in soil organic matter and values of 3-4% are typical for cropped soils. In general soil fertility is not a constraint to crop production, low precipitation and low temperatures being much more significant. It should be noted however that these soils are susceptible to wind erosion and measures must be taken to minimise soil loss. The relatively poor moisture retention together with the low rainfall means that fallowing is a necessary component of crop husbandry.

In the main crop growing areas the soil types are Brown Chestnut, Dark Brown Chestnut and Meadow Brown Chestnut.

Table 4. Some technical data on arable soils

Soil Type	Org Matt %	Tot N2 %	Ca ppm	Mg ppm	pH	P_2O_5 ppm	K_2O ppm
Dark brown chestnut soil							
Slightly loamy	3.9	0.20	20.1	2.1	6.8	2.7	11.0
Middle loamy	4.3	0.28	21.5	8.9	6.9	16.3	5.9
Brown chestnut soil							
Slightly loamy	2.4	0.20	18.7	8.8	6.8	16.7	16.0
Middle loamy	2.5	0.20	21.0	9.4	6.9	9.2	17.1
Meadow brown chestnut soil							
Slightly loamy	4.5	0.30	24.0	12.2	6.8	14.5	10.0
Middle loamy	3.5	0.30	23.2	5.4	6.7	5.3	9.7

Source: UNDP/FAO Agricultural Sector Background paper

Arable soils in Mongolia are classified into three groups according to suitability for cropping. Soil class I is the best, accounting for 35% of the arable area. 31.1% is Class II and 30.4% Class III. The designation of suitability is a function of the soil and other factors such as climate and topography. In the most important cropping aimags of Selenge and Tuv cereal crops are grown on Class I & II land using a *crop:crop:fallow* rotation whereas on class III land a *crop:fallow* rotation only is possible. The principal reason for the summer or clean fallow period is to allow the build up of moisture in the uncropped land. The low precipitation is a serious constraint to crop production and the moisture deficit in the early part of the growing season is particularly problematic. Second year wheat in the 2:1 rotation will yield 30-40% less than first year crop as a result of both lower moisture availability and diminished soil fertility. The fallow period also permits weed control by cultivation.

4.5. Regional Production Data

In this section the agro-climatic zones are referred using the numbering system found in the MoA/FAO Agricultural Sector Background paper. Brief summaries of the zones in which wheat production occurs are found in table 5 with climatic data in table 6 . Production data are available in the MoA, Ulaan Baatar on an aimag basis. Summary data abstracted from these records are presented below. Selenge and Tuv were chosen because of their pre-eminence as areas of crop farming, the others as examples of the broad zonal categories used in the country.

Table 5. Description of agro-climatic zones

Zone	Description
3	The Khuvsgul mountain, taiga, forest and steppe regions. Major activities are production of yaks, cattle and reindeer.
4	Western Hangai steppe and arid steppe areas. Sheep, early-ripening cereals and fodder production are the most suitable agricultural activities.
5	Southern Hangai steppe and arid-steppe and semi-desert areas are suitable for sheep and cattle activities, early-ripening grain and fodder crops.
6	Selenge forest and steppe sub-region is suitable for cattle and sheep activities and rainfed crop production. The Selenge valley if the largest crop area in the country.
7	Onon low mountains arid steppe sub-region is suitable for rainfed crop production and cattle and sheep activities.
8	Hentii mountain forest and steppe sub-region is suitable for cattle production and rainfed cropping.
9	Ulz-Tuul steppe and arid steppe sub-regions are suitable for sheep, cattle, early-ripening grain and fodder production.
13	Southern part of Central Halha is suitable for sheep, goat and cattle production.
14	Kherlen-Khukh-Nuur in the north is suitable for sheep and cattle production. Rainfed crops can be produced in good years.
15	Menen-Dari'ganga arid steppe region is suitable for sheep and goat raising and rainfed cereal and fodder crop production.

Source: UNDP/FAO Agricultural Sector Background paper

Table 6. Climatic information for agro-climatic zones

Zone	Av Elev '000 masl	Mean Annual deg C	Temp Jan deg C	Temp Jul deg C	Heat Sum >10 degC	Growing Season days	Frost free days	Precip tation mm	Snow Cover mm	Wind Speed m/sec
4	2.0:2.5	0.0:2.5	-16:-20	15:19	1400:2000	80:100	80:100	200:250	>15	2:4
6	1.5:2.0	2.5:5.0	-20:-24	15:19	1000:2000	80:100	100:120	300:400	5:10	4:6
7	1.5:2.2	0.0:2.5	-16:-19	15:19	1400:2000	70: 90	80:100	250:400	5:10	4:6
8	1.5:2.2	2.5:5.0	-20:-24	13:15	1000:2000	70: 90	100:120	300:400	5:10	4:6
9	1.5:2.0	2.5:5.0	-20:-24	13:15	1000:2000	80:100	100:120	300:400	5:10	4:6
14	0.5:1.1	0.0:2.5	-20:-24	19:22	2000:2600	90:110	120:140	150:250	5:10	4:6
15	0.9:2.0	0.0:2.5	-20:-24	19:22	2000:2600	>130	120:140	150:250	>5	6:8

Source: UNDP/FAO Agricultural Sector Background paper

The tables (7 to 12) below show the areas and yields of wheat in selected aimags based on MoA records over a seven year period. Unfortunately changes in the institutional structures in recent years have meant that the equivalent data from 1990 and onwards were not readily available. The tables do however illustrate the relative importance of the wheat in each aimag and also the level of yields attained. Of course there is considerable within-aimag variability which is lost when presenting these aggregate data. The tables are useful in showing something of the performance within the various agro-climatic zones.

Selenge Zones 6 & 7

Selenge in the central, northern part of Mongolia, is the single most important aimag for wheat, accounting for around 40% of all production. Zones 6 and 7 are amongst the most favourable for growing wheat, enjoying reasonable rainfall (300-400mm) and growing seasons of 100 days or more. The mean yield over the years 1983 to 1989 is 1.18 t ha^{-1}. Rotations of 2:1 wheat:fallow are typical as illustrated by the mean value of 1.74 ha wheat to 1 ha fallow[7].

The aimag is also reasonably close the main centres of population and therefore enjoys (together with Tuv) lower transport costs for both inputs and outputs.

Table 7. Wheat production data for Selenge aimag, 1983-89

	1983	1984	1985	1986	1987	1988	1989	Average	C.V.
Area sown (ha)	159882	161889	169485	255179	146054	155968	170759	174174	0.19
Area harvested (ha)	155589	135877	163465	255079	127128	151014	132836	160141	0.25
% of sown area harvested	97	84	96	100	87	97	78	91	0.09
Yield (area sown) (t ha^{-1})	1.45	0.99	1.45	0.82	1.13	1.69	0.75	1.18	0.28
Yield (area harvested) (t ha^{-1})	1.49	1.18	1.5	0.82	1.3	1.75	0.96	1.29	0.23
Total production (t)	231828	160335	245198	209165	165266	264275	127523	200513	0.23
Area fallow (ha)	92775	98814	97063	101164	110852	102765	101529	100709	0.05
Ratio cropped:fallow (:1)	1.72	1.64	1.75	2.52	1.32	1.52	1.68	1.74	0.20

Tuv Zones 7/8/9

Tuv Aimag also includes some of the best wheat growing land in the country and, together with Selenge is relatively close to the main population centres. This has the advantage of lower transport costs. Yields are relatively high with a mean of 1.33 t ha^{-1} over the 1983-89 period. The mean yield level is slightly higher than Tuv at 1.33 t ha^{-1}, however the area fallowed is much higher with a crop to fallow ratio of 0.92.

[7]These figures were compiled from MoA records held in Ulaan Baatar. In the time available it was not possible to put together detailed crop rotations. Of course wheat is often grown in rotation with other crops such as other cereals, potatoes and forage crops and so the ratio can be an approximation only. However, given that wheat is the most important crop they provide a useful indication of the fallowing requirement.

Table 8. Wheat production data for Tuv aimag, 1983-89

	1983	1984	1985	1986	1987	1988	1989	Average	C.V.
Area sown (ha)	70549	60623	66456	68702	64437	69297	92905	70424	0.14
Area harvested (ha)	67332	59607	62035	68702	63484	68247	92160	68795	0.15
% of sown area harvested	95	98	93	100	99	98	99	98	0.02
Yield (area sown) (t ha^{-1})	1.44	1.23	1.46	1.44	1.43	0.99	1.31	1.33	0.12
Yield (area harvested) (t ha^{-1})	1.51	1.25	1.56	1.44	1.45	1.01	1.32	1.36	0.13
Total production (t)	101671	74509	96775	98931	92052	68929	121651	93503	0.17
Area fallow (ha)	80117	78728	73504	69737	85785	81114	72329	77331	0.07
Ratio cropped:fallow (:1)	0.88	0.77	0.90	0.99	0.75	0.85	1.28	0.92	0.18

Bulgan *Zone 6*

Bulgan enjoys similar climatic conditions to those of Selenge (zone 6) although much less land is available for cropping. Official estimates suggest that 4% of the country's arable land is found in Bulgan with 16% in Selenge

Table 9. Wheat production data for Bulgan aimag, 1983-89

	1983	1984	1985	1986	1987	1988	1989	Average	C.V.
Area sown (ha)	23596	23316	23257	31282	12630	11920	13001	19857	0.35
Area harvested (ha)	23596	16956	23257	30914	12038	11920	11771	18636	0.37
% of sown area harvested	100	73	100	99	95	100	91	94	0.10
Yield (area sown) (t ha^{-1})	1.39	0.83	1.25	1.31	1.05	1.55	1.56	1.28	0.19
Yield (area harvested) (t ha^{-1})	1.39	1.14	1.25	1.33	1.1	1.55	1.72	1.35	0.15
Total production (t)	32798	19330	29071	41116	13242	18476	20246	24897	0.36
Area fallow (ha)	15670	17482	16600	15400	14118	14937	14335	15506	0.07
Ratio cropped:fallow (:1)	1.51	1.33	1.40	2.03	0.89	0.80	0.91	1.27	0.32

Uvs (Baruun turuun) Zone 4

Uvs is in the North West of the country, lying to the north of the Altai mountains and is not a major wheat growing area. As is the case with many outlying regions, the primary purpose for growing wheat is for local consumption.

Table 10. Wheat production data for Uvs aimag, 1983-89

	1983	1984	1985	1986	1987	1988	1989	Average	C.V.
Area sown (ha)	21766	27611	24170		27232	27375	28484	26106	0.09
Area harvested (ha)	21146	19724	23073		27232	26895	27395	24244	0.13
% of sown area harvested	97	71	95		100	98	96	93	0.11
Yield (area sown) (t ha^{-1})	1.53	0.51	1.19		0.70	0.76	0.98	0.95	0.36
Yield (area harvested) (t ha^{-1})	1.58	0.72	1.25		0.70	0.77	1.02	1.01	0.32
Total production (t)	33411	14201	28841		19062	20709	27943	20595	0.50
Area fallow (ha)	15193	14300	15400			15563	15807	15253	0.03
Ratio cropped:fallow (:1)	1.43	1.93	1.57			1.76	1.80	1.70	0.10

Data for 1986 were unavailable

Hentii Zone 8

Hentii lies to the east of the main cropping areas of Tuv and Selenge and enjoys reasonable rainfall but short growing seasons (70 to 90 days).

Table 11. Wheat production data for Hentii aimag, 1983-89

	1983	1984	1985	1986	1987	1988	1989	Average	C.V.
Area sown (ha)	22350	21546	25380	29127	26993	26899	27433	25675	0.10
Area harvested (ha)	17996	21494	25380	26191	25632	24352	27433	24068	0.13
% of sown area harvested	81	100	100	90	95	91	100	94	0.07
Yield (area sown) (t ha^{-1})	0.54	1.25	1.30	0.87	0.84	0.83	1.20	0.98	0.27
Yield (area harvested) (t ha^{-1})	0.67	1.25	1.3	0.97	0.88	0.92	1.2	1.03	0.21
Total production (t)	12057	26868	32994	25405	22556	22404	32920	25029	0.27
Area fallow (ha)	23500	25336	27904	28234	27727	26033	25588	26332	0.06
Ratio cropped:fallow (:1)	0.95	0.85	0.91	1.03	0.97	1.03	1.07	0.97	0.07

Dornod **Zones 14 & 15 (some 9)**

Dornod, a large aimag in the extreme east of Mongolia, tends to be a drier region with precipitation often well below 250 mm per annum. Although 22 per cent of Mongolia's arable land is found in Dornod, it provides less than 6% of the total cereal harvest because of this severe climatic constraint. A single wheat crop followed by a fallow tend to be the dominant rotation (the crop/fallow ratio is 0.86). The coefficient of variation for yield is 0.51 suggesting that year to year variability is greater than in other regions. The mean area of unharvested crop is 15% of the sown area a figure which is heavily influenced by the major losses in 1987 and (less so) in 1983. The variability of yield rate together with risk of significant areas of unharvested crop combine to give a C.V. for total production of 0.68. Thus Dornod can be considered a particularly marginal area for cereal cropping.

Table 12. Wheat production data for Dornod aimag, 1983-89

	1983	1984	1985	1986	1987	1988	1989	Average	C.V.
Area sown (ha)	17820	10672	12820	14328	21927	18968	23758	17185	0.26
Area harvested (ha)	12329	10119	12820	13357	8254	18968	23026	14125	0.34
% of sown area harvested	69	95	100	93	38	100	97	85	0.25
Yield (area sown) (t ha^{-1})	0.48	1.25	0.84	0.46	0.27	1.04	1.52	0.84	0.51
Yield (area harvested) (t ha^{-1})	0.69	1.32	0.84	0.49	0.72	1.04	1.57	0.95	0.37
Total production (t)	8507	13357	10769	6545	5943	19727	36151	14428	0.68
Area fallow (ha)	14409	12195	16170	26518	21864	25895	27183	20605	0.28
Ratio cropped:fallow (:1)	1.24	0.88	0.79	0.54	1.00	0.73	0.87	0.86	0.23

4.6. Cultivars

Three cultivar types, all originating from the former USSR, are grown in Mongolia, these being:

- Skala & Albitum 43 — early ripening (83 days)
- Orhon & Saratovskaja 29 — medium ripening (92 days)
- Buryatskaja 34 — late ripening (>92 days)

Later ripening varieties would provide higher yields but can be grown only in those areas in which the growing season is long enough. Most seed is farm saved rather than bought in. The common practice is to buy in a relatively small amount of good quality seed and use the crop from this as entirely as seed. This would provide a "bulking up" ratio of about six to one. The resulting grain is termed "first class" seed. The process is repeated for two further years yielding "second" and "third class" seed after which it is abandoned. This practice is likely to lead to a loss in performance through loss of seed vigour, build up of seed-borne diseases and contamination with other seeds. MoA agronomists suggested that field germination rates are around 60-65 percent.

Sowing rates are typically 180 to 200 kgs per ha. This is very high in relation to the yield obtained and does not compare well with Montana where for similar spring wheat yields a rate of 50 kg per ha would be more typical. The need to set aside around 15-20% of the crop for the following year's seed is costly, not only in terms of the lost revenue but also because of the need to provide extra storage facilities. There is an urgent need for research into many agronomic aspects of wheat production and seed technology is but one. Improving seed viability and reducing the required seed rate would be very beneficial.

Winter wheat varieties with sufficient hardiness are not available as yet and so this means of improving yields is not an option. The very low winter temperatures together with the risk of insufficient snow cover for the crop during this period suggest that the use of autumn sown crops is less likely than has been the case in other parts of the world with similar climatic conditions.

4.7. Fertiliser Usage

The recommended application of fertiliser is:

• Nitrogen	60 kg ha^{-1}	usually as	urea or ammonium nitrate
• Phosphorus	60 kg ha^{-1}		single or triple super-phosphate
• Potassium	40 kg ha^{-1}		potassium chloride

These recommendations are apparently based on trials to establish the response of the crop to fertiliser use carried out in the 1970s. The rates are in fact designed to give maximum rather than optimal output. In practice the restrictions on availability of fertiliser meant that actual rates were often much lower. On farms with intensive livestock the farmyard manure is also used as a supplementary fertiliser.

Fertiliser use more than doubled between 1978 and 1988 but has declined sharply in both 1991 and 1992. Though it was not possible to obtain data for 1991 it appears that the amounts imported in 1992 were around 15% of the 1990 level; a problem brought about as a result of the shortage of foreign exchange.

4.8. Agrochemicals

The use of sprays and other chemical treatments tends to be low, mainly because of difficulties in securing supplies. The most important operation is the application of a herbicide (2,4-D) for the control of broad-leaved weeds. Additionally seed is treated for the control of seed-borne diseases by using an organo-mercuric (or zinc) dressing.

Improving the effectiveness of spraying is one means by which substantial productivity gains could be made. Anecdotal evidence suggests that weed control is often neglected or poorly done. Calibration and operation of spraying equipment as well as timing of application are all critical in effective weed control. However, on many farms the job is not done at all because either the machinery is non-operational or the materials cannot be obtained. Weed infestation will certainly reduce yield as the weeds compete for soil moisture and nutrients and the problems will be carried forward into subsequent years.

Spraying at the wrong time can also lead to loss of yield. The Montana Extension service estimate that by delaying the application of 2,4-D until after jointing can damage the crop, resulting in a yield loss of up to 4.5 centners per ha. Losses will also arise from the incorrect application rate and incomplete or patchy coverage.

4.9. Harvest

The harvest operation is one the most important in determining the overall efficiency of production. Sloane et al (1992, p48) describe the operational procedures as organised by the State Harvesting Commission. This was a truly national effort being co-ordinated centrally in Ulaan Baatar. Agronomists from each farm would indicate likely harvest dates and requirements for transportation services. Trucks would then be re-assigned from other duties to help with the harvest. Military conscripts and students would be posted to the farms to provide unskilled labour. In total some 4600 trucks and 2600 trailers are involved in the harvest operation. These trucks are predominantly five tonne units and, even with trailers, the capacity is quite low. The whole transport operation tends to be inefficient and the problems referred to elsewhere in this report are felt particularly at this peak time.

The usual harvesting technique is to mow and wilt the crop for three to five days before threshing. This is important when the risk from frost damage or head loss and shatter is high. The crop would normally be cut at around 35 to 40% moisture and allowed to desiccate naturally. The wilted crop is then headed with combines fitted with pick-up headers and the grain carted by truck to the grain dressing centres, usually at or near the State Farm complex. The combination of poor combines and fairly green (and often contaminated) crops means that the sample needs to be dressed a second time using static dressing machines operated by casual labour. This process is recognised as a serious bottleneck in the process and another source of inefficiency in the process. Sometimes direct-cut combining is possible but this is the exception rather than the norm.

Harvest losses are thought to be high and are covered in more detail in the section on losses.

4.10. Input Supply

The supply of all inputs to agriculture has been under the sole control of the Ministry of Agriculture until very recently. Allocation of inputs was dependant on the production targets set for each farm and would be handled centrally. Because so many of the inputs were imported there were obvious foreign trade implications which influenced the trading agreements within the CMEA. Most of the items in table 13. for example would need to be imported. During the 1980's there was substantial investment in the capacity of the State farm sector as illustrated by the rise in fertiliser imports during this period (see figure 2.).

At the present time the supply of imported inputs remains largely centralised through the actions of a parastatal, the Agricultural Supply Service (ASS), although there is a growing number of private concerns involved in the supply of agricultural inputs. Not unnaturally the present *modus operandi* of the ASS owes much to its role under the Ministry of Agriculture. One of the problems of the ASS is that it enjoys a monopolistic position which presents potential problems for farmers although there have been considerations on splitting it into a number of competing parts (Sloane et al, 1991). However, the structure and remoteness of farms in Mongolia make it unlikely that competing businesses supplying the agricultural sector will emerge at least in the short term. This problem is brought into focus when conflicts of objectives find their realisation in policies that disadvantage farmers and create a new set of distorting conditions. An example of this type of problem can be found in the case of a shipment of 10,000 tonnes of nitrogen fertiliser that was arranged through a Japanese trading company. Apparently the MoA and ASS were fully involved in the price negotiations but nevertheless agreed to a price of $196 per tonne cif Ulaan Baatar. (It was not clear whether the fertiliser was urea or ammonium nitrate but the price is substantially higher than prevailing world prices for both these products.) The MoA proceeded to charge farmers a price of Tg 11,800 per tonne, made up of the basic cost of $196 plus 15% import duty, 10% surcharge and a 25% handling charge, the resulting figure being converted to domestic prices at the official rate of 40 Tg to $1. Although the overvalued exchange rate provided an implicit subsidy, the effect of the other charges together with the low price expectation for the product, meant that purchasing fertiliser at this price was uneconomic in that the marginal value product would be lower than the marginal cost at any rate of application. As a result only 3,000 tonnes were sold, the remainder being left in

Ministry stores[8]. In short there has been an attempt to extract benefits from the supplier's monopolistic advantage although this is most likely a result of the a failure to understand the impact of these pricing decisions.

Table 13. Average use of fuel and fertilisers in agriculture, 1987-89

Item	State Farms tonnes	Co-ops tonnes	Total Quantity tonnes	Total Value Tg '000
Fuel				
Diesel	44980	49460	94440	128439
Petrol	18735	46701	65436	98154
Oils	2900	3384	6284	28558
Lubricants	57	28	85	325
Total	66672	99573	166245	255476
Fertiliser				
Nitrogen	26049	5256	31305	15026
Phosphorus	16401	3150	19551	12806
Potash	2953	390	3343	1170

Source: Sloane et al (1991), Agricultural Sector Background Paper

At the time of writing the Agricultural Supply Service, a department of the Ministry was still heavily involved in the procurement of farm equipment and inputs. According to their records no new machinery was imported (and distributed by the ASS) during 1991 and only $1,500,000 worth during 1992. Interestingly, a significant proportion of this came from China. For a more detailed study of the input supply to agriculture see Sloane et al (1991) p 40.

As new farming businesses are established and the number of agents increases so inter-farm transactions as well as those between farms and non-farming interests take on increasing importance. To cater for this a commodity exchange has been setup to provide the infrastructure to host these market activities. The exchange has branches in all 18 aimags and in 9 urban centres comprising 330 in total. The organisation was established in 1991 with the rules for trading widely publicised in newspapers. It now estimates that it now handles 60-70% of all agricultural transactions. The need for an organisation such as this is manifest when it is realised that such a function was largely redundant under the former system of central planning and state orders. Without the means for allowing the forces of supply and demand to be resolved, the viability of an agricultural sector operating on market based principles would be low. Operating costs of the exchange are met by commission charges of between 0.2 and 1% of the value of the transaction. Selected prices are published in newspapers on a regular basis. One of the important side effects of the Agricultural Commodity Exchange is the collection of valuable price data. This should be of particular value to policy analysts although as yet there is no established system for the capture (as a time-series database) and analysis of these data within the MoA.

4.11. Processing and Marketing

Perhaps more than any other aspect of the wheat sector, the processing and distribution of grain displays centralist organisation and management. The losses and inefficiencies at this stage are also substantial. Although there is a very close linkage between the production of grain on the farms and the processing into flour and other products in the flour and feed mills, the latter is not studied in detail. There are serious logistical and organisational problems that are likely to result in this area with the move away from central planning.

It is worth considering the nature of imports that would result from a reduction in the area of home grown wheat. The approach adopted in this study is assumes that imported whole grain wheat would substitute for domestically produced wheat and that this would then be processed in Mongolia. For completeness, a thorough study of the efficiency of the processing sector would need to be

[8]Although it is not possible to provide a documented account of this particular case, the story was authenticated by at least two persons with whom the author discussed the matter.

undertaken to determine the degree to which failings at this stage impact upon the overall commodity system. There appear to be considerable inefficiencies in the processing and storage of grain. In common with other sectors of the economy, this area is suffering from a shortage of capital for re-investment. In the time available it was not possible to include this aspect and so it remains an issue for further investigation. It has another impact on the study in that there has been a recent move towards on-farm processing of wheat rather than selling to the millers who represent a monopsony. There is a perception on the part of producers of the benefits of adding value on the farm and then selling directly to urban wholesalers, retailers or even consumers. If the incentives are sufficiently strong enough then this should also be a stimulus for improved efficiency at the processing stage which should benefit the sector as a whole. At the present time the degree to which this has occurred is difficult to determine but it is probably quite small. The main constraint is the shortage of the foreign exchange needed to purchase the small Chinese flour mills that seem to be preferred.

The existing processing capacity is found in ten flour and animal feed combinants located in the main wheat producing areas. Table 14. shows the nominal processing and storage capacity of each mill together with the recorded deliveries between 1986 and 1990. (Note that this is total grain not just wheat.) The siting of the mills has been made on the basis of serving the local grain production in an attempt to minimise the requirement for expensive transportation (see the map 1.). Even so, the mills estimate that, under the former price regime, transport costs accounted for over 8 per cent of their total costs. The practice of the mills covering the costs of transport of grain from the dressing centres to the mill offered to the farms a form of pan-territorial price uniformity. The future of this following privatisation is unclear. If the transport element were to be separated and run as an independent business then the incentive to fully recover costs would be more apparent. Assuming that the millers retain a significant degree of monopsony power we may reasonably conclude that these costs would be passed on to the growers, lowering the farm gate price, especially for farms remote from processing sites and centres of consumption.

Table 14. Supply of grain to flour and feed milling combinants

Combinant	Prod Cap '000 t	Store Cap '000 t	1986 '000 t	1987 '000 t	1988 '000 t	1989 '000 t	1990 '000 t	Five Yr Av '000 t
Ulaanbaatar	42.0	64.0	110.8	72.9	47.5	115.1	67.4	82.7
Sukhbaatar	41.0	82.0	74.4	57.3	109.4	58.4	50.4	70.0
Kharkhorin	16.0	12.0	28.7	29.2	23.0	35.8	32.6	29.9
Bulgan	11.5	38.7	26.6	24.2	27.0	28.1	25.5	26.3
Ulaangom	9.0	4.0	20.3	11.5	14.5	17.5	8.1	14.4
Dornod	9.0	7.0	6.8	3.0	19.5	38.9	14.4	16.5
Moron	9.0	6.5	26.5	8.5	15.5	14.8	18.2	16.7
Ondorkhaan	9.0	4.0	23.2	17.2	21.6	24.2	22.8	21.8
Darhan	54.0	82.0	135.2	86.0	153.4	79.1	62.8	103.3
Barunhaara		12.0	28.5	16.7	11.4	14.8	10.3	16.3
Total	200.5	312.2	481.0	326.5	442.8	426.7	312.5	397.9

Source: Corporation of Flour and Feed Milling Enterprises

Table 15. below shows deliveries of wheat to each of the 10 main milling combinants over the period 1980-90 . It is worth noting that nearly 37% of the grain is considered unsuitable for milling and is therefore used for animal feed. This represents a serious efficiency loss in the system in so much that the land would be better used for growing specific animal feed crops rather than relying on what is effectively a by-product.

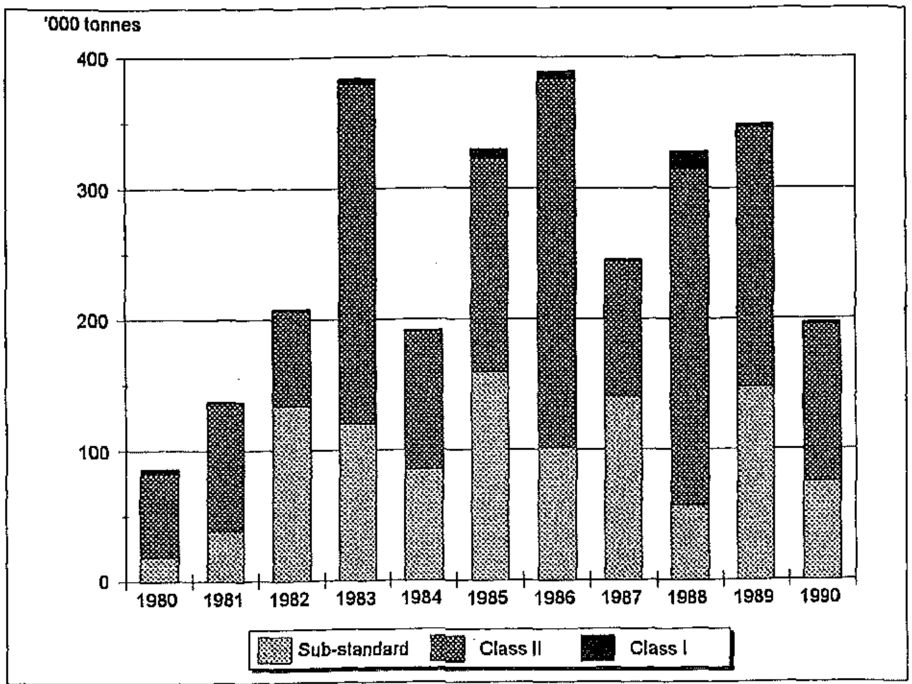


Figure 5. Total wheat deliveries to mills, 1980-90

Table 15. Wheat supplied to flour combinants - unweighted averages 1980-90

Combinant	Quantity ('000 tonnes) Class I	Class II	Sub Standard	Total	Moisture %	1 litre weight	Gluten %	Rubble %	Screenings
Ulaanbaatar	0.1	33.9	16.6	50.5	16.9	735	22.0	2.3	11.9
Sukhbaatar	0.8	33.8	16.8	51.4	18.2	728	20.9	3.6	7.6
KharKhorin	0.0	9.2	11.3	20.4	18.2	727	21.6	3.8	16.5
Bulgan	0.3	11.1	4.4	15.8	16.8	733	20.2	3.2	10.1
Ulaan Gom	1.0	7.8	4.6	13.4	16.9	738	25.7	4.0	6.4
Dornod	0.0	4.6	4.6	9.2	17.2	736	23.1	4.4	10.1
Moron	0.7	6.3	3.9	10.9	17.8	728	21.3	2.7	8.5
Ondorkhaan	0.0	6.2	6.5	12.6	18.3	742	22.8	4.1	10.8
Darhan	0.4	38.6	28.0	67.1	17.6	721	21.1	5.4	10.3
Barunhaara	0.0	6.9	2.9	9.8	15.0	646	18.1	2.8	8.1
Total/Average	3.3	158.2	99.6	261.1	17.3	723	21.7	3.6	10.0

Source: Ministry of Agriculture

Table 16. shows the typical pattern of grain utilisation over the period between 1985 and 1991. The figures were not complete for 1991 hence the somewhat large discrepancy arising from unallocated usage.

Table 16. Distribution of wheat harvest, 1985-91

	1985	1986	1987	1988	1989	1990	1991	Average	CV
Net harvest	632900	607000	482600	616000	615300	526000	466932	563819	0.11
Seed	90200	95100	84200	98900	104400	95800	96500	95014	0.06
Consumed on farm	30700	32900	40200	40600	37700	58100	37500	39671	0.21
Sale to state	511900	469700	358200	476500	473200	372100	332932	427790	0.15
of which:									
to flour factory	410900	409800	254300	340300	350800	262100	289600	331114	0.18
to fodder factory	61200	36200	74400	97800	83200	75900	8400	62443	0.45
seed	20400	13700	2500	13500	13500	3800		11233	0.55
food factory	10200	7300	6300	9100	10200	9800		8817	0.17
Pig farm	2200	1200	2700	3100	1300	3000		2250	0.34
Poultry farm	4400	1500	3400	4600	6600	7000		4583	0.41
Plant protection	2600		800	2500	1300			1800	0.43
Bio-combinant		10	100	200	900	100		262	1.24
Other farms				2500	3200	2400		2700	0.13
Other fodder		9300	10700	2900	3400	8000	21000	9217	0.65
Total	511900	479010	355200	476500	474400	372100	319000	426873	0.16
Discrepancy	0	-9310	3000	0	-1200	0	13932	917	

Source: Ministry of Agriculture

Table 17. Wheat deliveries to flour and feed combinants 1985-90

	1985	1986	1987	1988	1989	1990
Class I	7200	4300	1000	13600	1800	1300
Class II	162300	282000	102200	257400	198400	120300
Sub-std	160300	102300	141700	57200	148500	75600
Total	329800	388600	244900	328200	348700	197200

Source: Ministry of Agriculture

Tables 16. and 17. reveal a number of anomalies in the data relating to the processing and distribution of grain. Table 16. is based on data supplied by the AERI within the MoA (and reported in the UNDP Agricultural Sector Background paper) whereas table 17. is based on records returned from the ten milling combinants. The differences are shown graphically in fig 6. The reason for this discrepancy is unclear although it does serve to underline the some of the difficulties in using secondary data sources. 1985 and 90 stand out as years in which there is a substantial difference (e.g. in 1985 the amount delivered to the flour factory is 410,900 in table 16. but only 329,800 in table 17.)

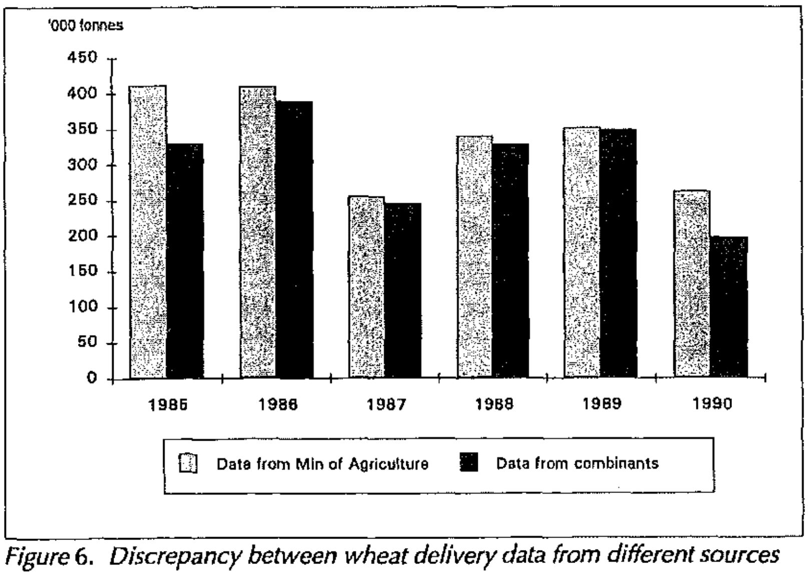


Figure 6. Discrepancy between wheat delivery data from different sources

Table 18. Wheat deliveries to mills by grain quality class, 1980-90 ('000 tonnes)
Amounts adjusted to moisture content of 14%

Combinant	Class I	Class II	Sub Standard	Total
Ulaanbaatar	0.1	44.5	17.9	62.5
Sukhbaatar	1.1	41.6	18.4	61.1
KharKhorin	0.0	10.6	10.9	21.5
Bulgan	0.0	9.0	6.8	15.8
Ulaan Gom	1.4	8.5	4.9	14.9
Dornod	0.0	4.5	5.6	10.1
Moron	1.0	4.9	3.8	9.8
Ondorkhaan	0.0	8.3	7.9	16.1
Darhan	0.6	48.9	33.8	83.3
Barunhaara	0.0	8.6	3.0	11.6
Total	4.3	189.4	113.0	306.7

Source: Ministry of Agriculture

The amounts of wheat processed at the ten mills is shown in table 18. These quantities have been converted to 14% moisture content so that they are comparable with internationally traded wheat.

The inadequacy of storage facilities within the ten main flour and feed mills is also a cause of some concern as it results in wastage and loss of quality. Further analysis of the processing and marketing component of the wheat system is not covered in this study, although they are obvious candidates for a rigorous investigation. The nature of state farms is such local processing could fit in well if capital for investment can be obtained. It would provide employment during the winter months and reduce losses during transport.

5. AGROCLIMATIC POTENTIAL FOR WHEAT PRODUCTION

This chapter explores the reasons why productivity in wheat production is low and offers some suggestions as to how this situation may be addressed. As with other aspects of this study, these suggestions are based on interviews with experts and secondary data sources. This chapter also draws heavily upon the findings of the ADB team planning the Livestock Feeds Improvement Project (TA MON 1646)

5.1. Losses

Losses of grain between the time immediately prior to harvest and the milling process represent one of the most important causes of poor factor productivity. Figure 7. shows these losses in a diagrammatic form. Sloane et al (1991) estimate on-farm losses to be in the region of 8 to 11 per cent. Agronomists at the Crop Research Institute, Darhan suggested that the figure could be as high as 20% or even 25 %. Taking 20% as the loss rate, a crop yielding 1 tonne per hectare would offer the potential of 1.25 tonnes if these losses could be eliminated. This level of yield would be consistent with the biological potential under conditions in the Tuv/Selenge region. The specific causes of losses include:

- Poor control of grazing animals near to growing crops. The idea of enclosing land by fences is rather alien in Mongolia and the lack of specific responsibility for crop damage has led to a somewhat lax approach to this problem.
- The poor quality of machinery has been mentioned in other contexts but the costs of breakdowns and inefficiency during harvest can be especially severe. A number of sources suggested that the NIVA combines do not perform well. They can be difficult to set up correctly and, because of poor engineering, tend to lose optimum adjustments very quickly. The losses of grain because of incomplete separation become worse when operated on slopes. These problems tend to become more pronounced as the machines age, particularly if they are not properly maintained. As a result the grain sample tends to be badly cleaned and unacceptable losses through grain being shed on the ground can occur. Inadequate operator training and indifference resulting from a lack of incentives only serve to exacerbate the problem.
- Given the climatic conditions in Mongolia the "weather windows" for operations such as harvest can be very narrow indeed. It is therefore essential that the equipment be both effective and serviceable. The combination of inadequate machinery capacity and poor harvesting conditions can lead to serious crop losses. The work rate for combines (windrowing and threshing) is around 1 hectare per hour. This figure, based on the MoA norms, corresponds to about 1 hour for every tonne harvested; a rather poor rate of operation[9]. Given that the work rate in practice is likely to be significantly lower the degree of weather related losses is not surprising. The season change is very quick in Mongolia and snow fall in September is not unusual. As daily temperatures drop and overnight frosts become more common, so the probability of crop loss and impaired quality of harvested grain increases. One of the reactions to this problem is to suggest that the number of combines is insufficient. In fact there are about 4 combines per 1000 hectares of grain crop and this should ordinarily be ample although the NIVA combines do tend to be smaller than those used in similar conditions in North America. The excessively peaked machinery demand is a common problem associated with monocultures and it only serves to underline the case for reducing some of the losses and reducing the area of wheat.
- The weather conditions may actually cause losses in some cases. Hail storms, for example, can have a disastrous effect. If the harvest is not completed by the onset of regular frosts and snow fall then the crop may need to be abandoned all together.

[9] A combine harvester with a 1.05 m drum and a cutter bar of 3m would be able to harvest about 1 ha per hour in UK conditions (direct cutting rather than swathing and picking up later). UK crops would be much heavier (say 5 to 8 tonnes per ha) and so the effective work rate in terms of grain harvested per hour for similarly specified combines is much poorer in Mongolia.

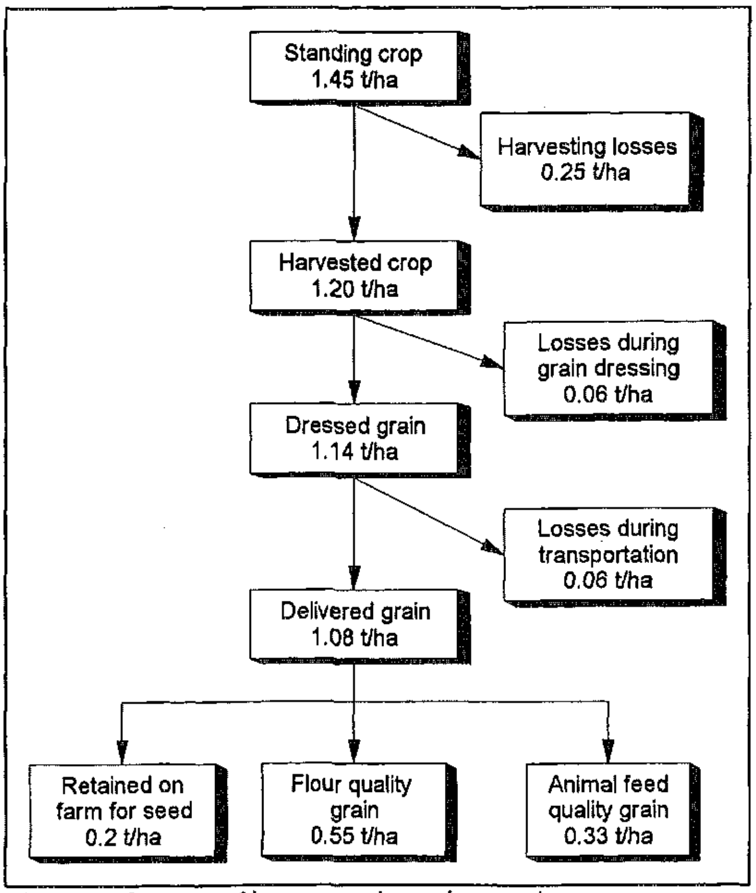


Figure 7. Sources of harvest and post-harvest losses

- Losses also occur during the transportation of grain. Moving grain long distances over rough tracks in leaking trucks may account for further losses.
- Damage to grain during dressing accounts for about 5% of the grain that has been delivered to the cleaning site. The combination of poor combines and damp straw at harvest time can lead to contaminated grain samples. To deal with this the grain is cleaned using electric dressers in the open air. Losses arise because of inadequate handling facilities and poor quality casual labour. The lack of concrete floors mean that grain is contaminated and lost whilst loading trucks etc. It has been suggested that the casual workers, often unskilled conscripts or students who have been assigned to this work rather than volunteering, show little enthusiasm for the work and consequently tend to be rather lacking in diligence. The dressing machines also tend to be slow and subject to frequent breakdowns.
- Inadequate storage facilities and practices both on farms and at the combinants account for further losses. The mean moisture content for grain delivered to the mills is about 18%. This is too high for safe storage unless the temperatures are consistently very low. For much of the winter this is indeed the case however there is risk of mycotoxin infection before the temperature falls and this can lead to rejection of the grain for human consumption and a significant reduction in animal feed value. It must be assumed that the grain retained for seed and other on-farm use is also at risk to moisture related problems. Another problem often occurring on the farms is that animals can sometimes gain access to the grain. As well as the losses due to animals eating the grain they also damage and contaminate it. This could be simply remedied by the introduction of animal-proof storage facilities.
- Some of the apparent losses may result from unrecorded consumption on the farm. The rearing of livestock by workers is not unusual and it was common practice to make use of grain in store for animal feed.

5.2. Opportunities for Improving Performance

One of the most intriguing aspects of this analysis is the extent to which productivity gains in mechanised crop production are attainable. Comparative studies on Soviet agriculture and observation of the production systems in Mongolia confirm that total factor productivity in this sector is poor. It is the expectation of government that the move towards a market economy will create an environment that will better stimulate improvements in productivity. The problem of poor incentives appears to be well recognised. On this basis, it is therefore helpful to consider the degree to which this has occurred so far and will do so in the future.

It has been suggested elsewhere (Ash et al, 1991) that the centrally planned agricultural sector cannot be readily separated from those sectors which supply it and it in turn supplies. The failings of one sector often create a knock-on cost in other sectors, for example, frequent and prolonged power cuts will reduce output and therefore productivity in industries that require electricity. The failings of one sector therefore impact as a negative externality in other, related sectors. In formerly centrally planned economies this effect is particularly pronounced as the many goods and services are supplied by state (or former state) monopolies offering the farmers little choice.

It is axiomatic then that producers will have little incentive to improve efficiency if they see no means of benefiting from their efforts. If they see that, despite their best efforts in trying to farm, the quality of service provided by suppliers is erratic and uncertain, the quality of goods provided is shoddy and then the only outlet for their produce is to sell to a private or state monopsony at a low price, it is little wonder that many are reluctant to farm on their own account.

The components of this system most amenable to improvement at the present time are those of harvesting and processing losses. On the basis of Figure 7., the situation in which only 36% of the potential yield is used for flour milling contains considerable scope for improvement. Measures should be taken to further identify the specific causes of losses and devise remedial action plans. Any improvements that can be made at the farm level will require the vehicle of an effective extension service for successful propagation (see below). There is a pressing need for a detailed study of the nature of losses and how best to proceed in addressing these problems.

An important issue at the present time is that of de-monopolisation. It can be argued that, because of the remoteness of many farms and the lack of sufficient local demand for farm services, it will be difficult to establish effective competition in supply and processing industries within rural areas. Largely this is true and therefore care needs to be taken in ensuring that such monopoly power is not abused. However in attempting to understand the reasons for poor performance in agriculture it is appropriate to compare again with the situation in North America. In the states of the great plains in The USA and the Canadian provinces the problems of remoteness are similar and in many cases farmers have little choice but to use their local supplier or travel large distances in search of an alternative. The farmer does benefit however from the competition amongst machinery manufacturers at the wider, national level.

In the context of processing industries, low prices which in part may be due to monopsonistic actors in this area, will act as an incentive to move processing onto the farm. This has the effect of adding value as well as by-passing the large flour mills. Success in doing do will require capital for investment and opportunities to sell into the wholesale and/or retail sectors.

5.3. Alternative Farming Systems

Assuming that it is possible to capture some of the losses in the present system and/or to acknowledge that economic efficiency would be better served by ceasing wheat production on the most marginal land, it becomes appropriate to consider the alternative possibilities for land use. The problem is very complex and there is no easy "quick fix" solution. The suggestions that follow are explored in outline only and will require detailed study to assess their true viability. All these suggestions are predicated upon the following set of assumptions:

i) the external resources for financing the necessary investments can be secured;

ii) that there would not be undue resistance to the adoption of new ideas on the part of farmers; and

iii) that necessary infrastructure in the form of research, extension and training facilities be in place to ensure that the expected benefits of improved agronomic practice can indeed be realised.

5.3.1. Research and Extension

This last point impinges upon the very important subject of agricultural research and extension. It is very clear that there are opportunities for improving the performance of arable farming systems in Mongolia and it is also clear that there is no one easy solution to this problem. It is possible that farming methods that have been found to be effective in other parts of the world with similar growing conditions could be applied. However, these will need to be tested, evaluated and adapted for use in Mongolian conditions. Such tasks would ordinarily fall to an extension service however this is not so straightforward at the present because there is no extension service as the term is generally understood.

Technical advice at farm level was generally provided by a team of specialists within the State Farm management structure. Agronomists, engineers, livestock specialists and veterinarians would be responsible for day-to-day decision making in relation to crop and animal husbandry. The 70 State Farms were fully integrated into the Ministry of Agriculture and so many decisions (including all those of a strategic nature) were taken at this level. The diffusion of new ideas came via a top down route and technological packages were imposed upon the farms rather than being adopted by them. In addition to this many of the techniques in use have been transferred from other CMEA countries for use in Mongolia with little adaptation to local conditions.

A crop research station was established at Darkhan in 1942 and was upgraded to institute status in 1963. It is the remit of the institute to carry out trial work on all forms of crop production relevant to Mongolia, and it is here (and at field stations elsewhere in the country) that work has been done to determine appropriate crop husbandry. Despite the efforts of Mongolian scientists the production systems do rely very heavily on Russian dryland farming methods, often developed more then twenty five years ago. It is perhaps worth mentioning that there are other production systems in place on the State Farms that are simply direct transfers of Eastern European technology. Mechanised dairy production would be a good example. The ADB feed improvement project intends to include the strengthening of the research and development capacity of such bodies.

Whatever the most appropriate course of action for addressing the problems the present weakness in the institutional capacity will act as a serious constraint upon agrarian development. Privatisation alone will not deliver more efficient and sustainable farming systems. Because conditions of employment in the public sector have seriously deteriorated in recent months, the existing institutional capacity is fast being eroded. Therefore the immediate objective will be to retain staff as well as to retrain them.

5.3.2. Conservation Tillage Systems

The standard practice in Mongolia at present is to employ a form of stubble mulching methods together with mechanical weed control during the fallow period. The residue from the previous crop is mulched to provide a cover during the fallow period. This can be effective in reducing risk of wind erosion and improving soil moisture retention. However in practice the fallow is not well managed and many of the potential benefits are lost. If weeds and volunteers are allowed to grow the result is a loss of soil moisture and nutrients and the purpose of the fallow is undermined. Mechanical weed control is also undesirable as it is costly, can lead to loss of soil moisture and it exposes the soil to the possibility of wind erosion.

No-till and minimal tillage systems are beginning to be adopted in North America. They offer the benefits of improved weed control, reduced moisture loss and a lower risk of soil erosion using less machinery. Three main types may be identified, these being *stubble mulch, ecofallow* and *no-till.* Stubble mulching employs minimal tillage operations designed to retain as much of the crops residue as possible. Ecofallow uses a combination of tillage and chemical sprays such as glyphosate, a translocated, systemic general purpose herbicide, to control weeds. In this way soil disturbance is minimised. The final method, no-till, relies entirely on chemicals for weed control.

Conservation tillage methods require a high standard of husbandry to be effective. This is particularly true at sowing time. The drill penetration, sowing depth and seed rate need to be carefully monitored. Specially adapted seed drills able to cut through the crop residue are also needed. The benefits are however attractive. Data from the Montana Extension Service suggest that no-till methods can increase soil moisture storage by 49% over conventionally tilled fallow, and stubble mulching by 40% .

The decision about sowing a crop or fallowing land can be made subject the soil moisture conditions at the time. Decision support systems to enable informed judgements on cropping strategies are available and could be introduced relatively easily.

5.3.3. Legume Rotations

The ADB Feeds Improvement project proposes some interesting ideas for improving the overall productivity of arable land. They suggest some rotations in which both wheat and leguminous fodder crops feature. They conclude that much of the fallow management is poorly done and the potential benefits are lost. An alternative offering more productive use of the fallow period would be plant a legume crop such as field pea (ADB, 1992, Appendix III p42). By harvesting the legume crop for hay in late August a potential yield of 2 tonnes per ha would be available. This would then leave time for moisture accumulation for the following grain crop which would also benefit from the additional nitrogen from the legume crop. The effect of this is estimated to be worth about 0.5 tonnes per ha extra yield in the following wheat crop. Alternatively the legume crop could be allowed to mature and be harvested a a pulse grain crop but with a reduced amount of nitrogen available for the following crop.

Amongst other agronomic possibilities is the inclusion of brassicas in the rotation. These include rape, kale and turnips and beet (which is not a brassica but offers similar possibilities). These crops are more suited to grazing *in situ* rather than harvesting and using for fodder, although if distance permits zero-grazing for housed dairy cattle would be possible.

Another crop identified by the ADB team is canola, a high quality rapeseed. It is suggested that a *pea-wheat-canola* rotation could be suitable for Mongolian conditions. Canola yields of about 1 tonne per ha should be possible. Of this 30% would be oil and 70% meal for animal feed.

Long ley rotations are also suggested in the ADB report. A long-term legume ley (i.e. 4 to 6 years) would followed by a period of similar length of continuous wheat cropping. Lucerne appears to be the most suitable legume currently available. During the legume phase both soil fertility and structure should be improved. Yields of lucerne hay would vary between 2.5 and 4.0 tonnes per ha depending on rainfall. The wheat yields should average 1.25 tonnes per ha over a 4 to 5 year wheat cropping phase.

On the face of it these possibilities appear very attractive. However more work is needed to further quantify the potential and identify the problems in relation to introducing workable rotations. This is likely to include:

- identifying the areas in which particular packages are most suitable and tailoring recommendations to local conditions; and

- addressing the problems of unfamiliarity and caution on the part of farmers. It has already been suggested that farmer-innovation was not a common feature on the State Farms. Because of the uncertain economic climate there are not likely to be a great many innovators in agriculture in the short term.

Careful planning and canvassing of farmer opinion will be needed to prevent inappropriate and unattractive solutions being offered. A thorough audit of the land resources, opportunities and threats will also lessen the risk of unhelpful interventions.

5.4. Environmental Implications

Reference has been made to some of the environmental problems that have been associated with arable cropping in Mongolia. Improved agronomic management should both address the problem of low productivity and environmental degradation at the same time. The Mongolian authorities are aware of environmental damage resulting from certain forms of land use. In the most extreme cases, crop land has been abandoned because of degradation.

An exhaustive analysis of the social costs and returns within agriculture should embrace environmental impacts. In practice these effects often remain externalities, uncosted within the accounting framework and this is indeed the case also in this study. However, such is nature of wheat production that it is the most economically marginal areas that are those most at risk of environmental damage. Examination of the history of cropping together with accompanying records of problems of erosion, fertility etc. and expert judgement should identify those sites where these problems are most pressing. Where there is a history of declining yields as a result of environmental degradation one possible method of incorporating this effect into the economic analysis would be to project forward the declining yield (together with any additional costs) and calculate the annual budgets from the present value of the future flows. The Aimag production data presented in this paper are too aggregated to permit such an approach at this stage.

It is ironic that one of the fears of the authorities as agriculture privatised is that private farmers may not manage the land in a sustainable manner. Mongolia has not suffered some the excessive environmental disasters which have beset some of the other former centrally-planned economies. Perhaps because it is sparsely populated and did not undergo a rapid industrialisation it was spared these problems. However, the ingredients for such were in place and did result in localised problems. The irony follows from the role of the state, which has a tendency to become confused in these matters. The setting of production targets and responsibility for allocating resources proved difficult to reconcile with the role of protector of the environment. Often the short term objective of output was achieved at the expense of the environment (and the well-being of workers in many cases). Environmental conservation appears to be high on the agenda at the present time. This should form an significant element of the rubric governing developments in agriculture.

6. FARM MANAGEMENT

Many of the problems of poor performance can be traced to deficiencies in the organisation and quality of management on the farm. This is in turn is a result of constraints within which the farm managers have had to operate and poor incentives and rewards structures for success. In practice the command economy created a reward system which was linked to the attainment of pre-determined targets and usually ignored more important indicators of technical and economic efficiency. The lack of rigour in critically assessing the performance of farm businesses together with the lenient budgetary constraints imposed these enterprises have allowed the inefficient and unprofitable to remain in business. Ultimately it was not possible to countenance enterprises in State ownership to go bankrupt although many were and are technically insolvent.

One of the effects of having farm production targets determined by central planners was that local managers had responsibility for only the most immediate, day-to-day decisions. And even in this respect there was often little room for manoeuvre because of external constraints. The farm inputs supplied were based on a prescribed package rather than allowing managers to determine requirements and purchase items accordingly. Similarly there was little scope for improving returns by better marketing or adding value on the farm.

Figure 8. (adapted from Daw, 1990) provides a breakdown of the management problems that tend to beset State Farms. The problems that beset the large scale farms are multi-factorial and generally complex. Understanding the relative importance of different constraints and assessing the ease with they can be addressed is a pressing requirement. As far as farm performance is concerned, a simple classification is helpful in understanding the reasons for poor achievement.

i) Factors endogenous to the farm system, for example:

- skills and training of staff in particular those required to operate and service machinery and those charged with production management decision making;
- poor incentives for staff due to lack of appropriate remuneration and insufficient responsibility for decision making, leading to low morale;
- remote and ineffective management.

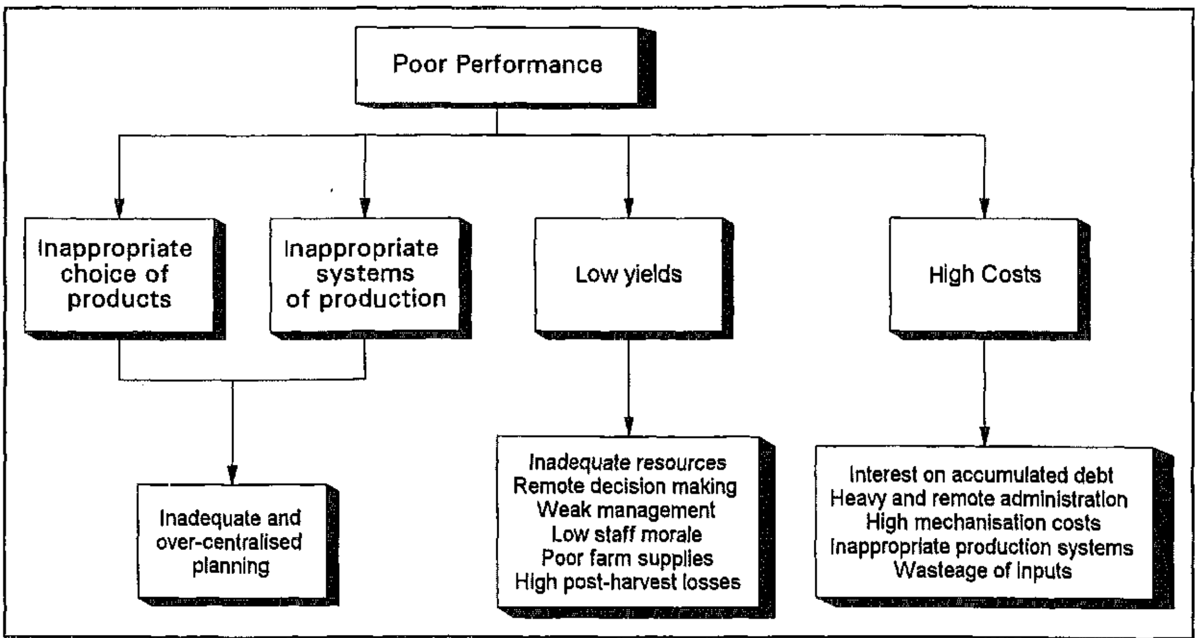


Figure 8. Problems of management on State Farms

ii) Factors external to the farm but within the food-chain hierarchy, for example:

- the cost, quality and reliability of supply of factors of production;
- inappropriate and rigid farm plans determined by central planners;
- the efficiency of the food processing, distribution and marketing system;

iii) Macroeconomic policy measures, including:

- exchange rate policy;
- commodity price policy;
- interest rates and fiscal policy.

In practice the actual performance of farms is a result of the interaction of all of these with the added risk and uncertainty of a severe and often unpredictable climate. So far this does not seem to have been well understood in Mongolia. Given the radical and unpredictable nature of economic transformation on the one hand, and the inherent inertia and naiveté on the other, it is not surprising to find that the effects of many policy decisions can be quite difficult for farmers to cope with.

The problem facing the policy analyst is that of understanding the nature of the interaction of these three sets of forces. The focus of this study has been primarily on the production side with some reference to the wider issues that impinge upon farmers.

7. ECONOMIC ANALYSIS OF EXISTING SYSTEMS OF WHEAT PRODUCTION

This chapter explains in detail the adopted approach in modelling the economics of wheat production in Mongolia.

7.1. Methodology

A widely used approach to the analysis of agricultural policy, particularly in developing countries, involves the construction of partial equilibrium models based on micro-level commodity systems. These can be used to provide estimates of comparative advantage once the appropriate social prices for items in the budget have been estimated and these items have been classified (and decomposed where necessary) as domestic (non-tradable) and tradable. Convention lays down that social prices for tradables be derived from prevailing world market prices with appropriate adjustments for transport costs. Non-tradable domestic factors should ideally be valued at their opportunity cost to the economy as a whole though this is intrinsically a much more difficult task. The Policy Analysis Matrix (PAM) (see Monke and Pearson, 1989) provides a systematic approach to the investigation of these issues. The PAM incorporates two accounting identities providing measures of profitability on the one hand and the effects of divergences on the other.

As with any model the PAM represents an abstraction from reality and as such is inevitably flawed. Any analytical technique is open to criticism on the basic of theoretical rigour and effectiveness of implementation. In many cases it is the availability and quality of data that have the greatest bearing on the validity of the model. The present situation in Mongolia poses a number of problems which make the analysis of policy both difficult and error-prone. The first point is that these analytical tools are predicated on there being a consistent and managed policy environment. In the last two years the policy environment has been somewhat unstable, and even when policy measures have been clearly determined there has often been a manifest failure to implement them in a universally consistent manner. The means that the opportunities available to producers at the local along with the constraints placed upon them can vary markedly. Any 'representative' sectoral model will fail to capture these facets. Because of the short shelf-life of many policy instruments during the transition period, an important feature of the wheat sector model is the ease with which key assumptions can be varied and the results recalculated. The highly disaggregated nature of the model also allows the user to examine fundamental assumptions in the technology of production and make adjustments as required.

The command economy was characterised by the propensity to collect large quantities of data, much of which were unformed and little used in analysis. Unfortunately the accounting conventions employed also often lead to performance indicators that were not suitable for either farm business analysis or agricultural policy analysis. Even measures of physical performance were often inappropriate and, without access to the raw, disaggregated data at farm level, recalculation of improved indicators would not be possible.

The wheat sector model therefore has been built from first principles and is based on data and information from three main sources, these being:

- Ministry of Agriculture records

  The Ministry of Agriculture retains aggregate records from the State farms. Unfortunately these tend to be mostly financial statements with minimal physical data. Data for a number of aimags were abstracted for the period 1983 to 1989 and from these records estimates of resource use and output were obtained. The aimags were chosen to represent the range of agro-climatic zones in which wheat is grown. The choice of seven years was considered sufficient to indicate the variability of production over time. Physical input-output coefficients were estimated by dividing the aggregates by the unit price at the time. The values obtained were then compared with those estimated by other means.

- Norms and standards

  Certain data such as fertiliser application rates and machinery requirements and work rates were based on published standards (usually referred to as 'norms'). One problem with these standard work rates is that they appear to be invariably optimistic, most probably because they capture what may be termed "best practice" rather than the poorer performance that would be typical. As a result there is usually a discrepancy between the norms and the records of aggregate labour and machinery use on the farms. For this reason the norm coefficients have usually been modified to reflect more realistic work rates. Similarly the fertiliser usage indicated by the records is often well below the recommended levels, often because of supply failures.

- Interviews with local experts

  A series of interviews were arranged to ensure that estimates derived from other sources were consistent with expert opinion. Discussions took place with Ministry of Agriculture economists and agronomists, staff of the Agricultural Supply Service, the Crop Production Research Institute and the Agricultural University.

Wherever possible estimates were based on a resolution of data from all three sources, although in a number of cases there were some anomalies that could not be easily resolved. In particular these were the result of substantial differences between the norms and the historic averages.

7.2. Model Structure

In order to allow the investigation of changes in both prices and technical coefficients a disaggregated spreadsheet model has been constructed. This model is an important companion to this report because it permits the investigation of various policy scenarios. In particular it was considered an important component for the following reasons.

- The single commodity system budget is based on representative average values. The model permits sensitivity analysis to be carried out thereby permitting the investigation of production in different agro-climatic zones, under differing economic circumstances etc.
- Although every effort was made to ensure the validity of components of the model, it is accepted that some of the assumptions may be flawed. A disaggregated approach permits the examination and alteration values should this be required.
- The model is based on the technical input-output relationships that prevailed during the 1980's which, for reasons explained elsewhere, are unlikely to remain representative. Because these coefficients are explicitly defined in the model, they can be readily examined and altered as appropriate.
- The wheat budget can be used as a template for the construction of other agricultural commodity system budgets

The components of the model that follow represent the baseline configuration from which the scenario results have been derived.

7.3. Crop Output

The main output, grain, is generally classified into one of three categories. Classes I and II are considered suitable for milling for flour. The third category is wheat which is sub-standard and therefore used for animal concentrate feed. Only 2% of the grain is premium quality, 58% is class II and the remaining 40% is downgraded to animal feed. The price of wheat is taken as referring to the class II quality with a premium of 15% payable for class I and a deduction of 10% for sub-standard[10]. The criteria for the classification are shown in table 19.

Table 19. Classification of wheat quality

	Class I	Class II	Animal Feed
Wet Gluten (%)	> 28	18-28	< 18
Screenings (%)	< 2	2-15	> 15
Rubble (%)	< 2	2-5	> 5
Moisture (%)	<= 17	17-19	> 19
1 litre wt (g)	> 740	700-740	< 700

Data from the flour and feed combinants show the mean moisture content of delivered grain to be in the region of 18%. Internationally traded grain would have a moisture content of 14% or lower and so the yield rate is adjusted to account for this. The budget provides for the inclusion of an estimate of losses between harvest and the delivery to the mill.

For this initial analysis no account has been taken of the value of the straw, although the model does provide for the inclusion of this if desired.

Historically grain is sold "off the combine" as storage for seed only is available on farms. The price therefore is based on sale in October. No information on seasonal variations in grain price was obtained.

7.4. Variable Costs

7.4.1. Seed

A seed rate of 200 kg ha^{-1} is used. The seed is assumed to have the same value as class II milling wheat .

7.4.2. Fertiliser

The Ministry of Agriculture agronomists recommend application rates of 50-60 kg ha^{-1} of nitrogen, 40-60 kg ha^{-1} of phosphorus and 30-40 kg ha^{-1} of potassium.

The cost of fertiliser in the Aimag summaries is shown as a per hectare cost for all fertiliser and the costs (and therefore the amounts) of individual crop nutrients cannot be identified. In order to determine typical (as opposed to recommended) application rates it was necessary to assume a constant ratio of N:P:K and by using the unit cost of each nutrient, estimate the total quantity of fertiliser applied. During the period 1983-89 the domestic prices of N, P and K were 480, 650 and 350 Tg per tonne respectively. Taking a ratio of nutrients of 55% N, 30% P and 15% K , the mean cost of 34 Tg per ha for Selenge and Tuv aimags suggests that application rates of 39 kg ha^{-1} N, 21 kg ha^{-1} P and 11 kg ha^{-1} K are more representative of recent practice[11]. The data on total fertiliser imports during this period reinforce this assumption as the quantities imported do not correspond with the recommended application rates.

[10]These adjustments are based on typical differentials for grain traded in international markets. The author is grateful to Cargills Technical services for this information.

[11]In the report on the Jargalant State Farm by the MoA/FAO Farm Management team, the authors indicate that first year wheat receives 100 kg ha^{-1} of urea (i.e. 46 kg of N) together with 20 kg $ha^{-1}$of phosphorus. The higher rate of nitrogen would be consistent with the fact that this farm enjoys better than average growing conditions. (Mean yields are around 1.25 t ha^{-1}). The conclusion to be drawn is that fertiliser usage, in common with other aspects of farm production, can differ substantially from officially stated norms and standards.

7.4.3. Sprays and Chemical Treatments

The only chemical application is 2,4-D for the control of broad-leaved weeds at a recommended rate of application of 1 kg per ha. The data for Tuv and Selenge suggest a value of 1.5 litres per ha, which is more or less comparable.

Seed is treated with organo-mercuric (or possibly zinc-based) compound as a precaution against seed-borne diseases such as black smut.

7.5. Machinery Costs

Machinery costs are a major component of the overall costs of wheat production, and in keeping with the approach of this study, they have been decomposed so that the performance and usage assumptions are transparent. Machinery costs are also an area in which variability between farms can be most pronounced.

7.5.1. Machinery Complement and Work Rates

An inventory is used as the basis calculate the annual holding costs of farm machinery. The inventory is based on the requirements of 1000 ha of wheat together with the associated fallow land. This approach assumes a wheat monoculture which in most cases is justified. In the situation of mixed cropping systems it would be necessary to apportion the machinery on a *pro rata* basis. These machinery complements are based on State farm inventories reconciled to national statistics on agricultural machinery. The spreadsheet model allows easy modification of the machinery data in order to permit the analysis of farm-specific situations.

The values in table 20. can be modified by the user as required. Each machine has an alpha-numeric code to allow specific identification. The initial cost is shown in dollars at the prices quoted by the ASS in November 1992. Standard practice at this time would be to convert to domestic currency at the official exchange rate with an import duty of 15%.

Table 20. Machinery Complement for 1000 ha of wheat production and associated fallow land

Machine code	Description	Number per 1000 ha	Intial Cost ($)	Mean depn rate % per annum	Working life (years)	Repairs % new Value
CK-5	Combine	4.0	20000	20	7	10
DT-75	100hp Crawler Tractor	3.0	16000	20	8	14
MTZ-50	55 hp Wheeled Tractor	2.5	6000	20	8	16
T-150	Large wheeled (4WD) tractor	1.0	25000	20	8	16
	Truck	0.6	10000	15	10	10
BIG-3	Harrow	3.0	1250	12	7	6
KPS-5	Cultivator	4.0	1500	12	7	6
OVT-1A	Sprayer	1.0	1500	18	7	8
VNB-3	Straw loader	2.5	1200	12	7	7
2PTS-4	Trailer	2.0	2100	12	7	5
CBY-2.6	Snow sweeper	1.5	1000	12	7	5
CZC-2.1	Drill (combine)	4.0	4000	15	7	9
PSB-1.6	Baler	2.5	2000	18	7	9
ZKK-6A	Roller	2.0	1000	12	7	6
BOG	Caravan	1.0	3000	12	10	3

7.5.2. Annual Capital Charge and Repair Costs

The machinery inventory is used to calculate the annual costs of owning machinery. The annual capital charge is based on the standard annuity calculation (sometimes referred to as the Capital Recovery Factor)[12] and repair costs use an estimate derived form Ministry of Agriculture records. The repair cost estimates do not provide any information as to their composition. Most of the labour for repairs and servicing would be supplied by specialist units within the State Farm. It is important to understand that these figures are based upon a turnover of machinery based upon the normal expected working life of the asset. The salvage value is notional representing the potential for resale that exists at the end of the machine's working life. In practice many machines are retained on farms until they are no longer serviceable at which point they may be cannibalised for spare parts.

Table 21. Machinery inventory for 1000 ha of wheat and fallow

Machine code	Description	Salvage Value ($)	PV of Salvage ($)	Net Initial Cost ($)	Capital Recovery Factor	Annual Capital Cost ($)	Repair Cost $/year
CK-5	Combine	4194	1676	18324	0.233	17092	8000
DT-75	100hp Crawler Tractor	2684	941	15059	0.216	9739	6720
MTZ-50	55 hp Wheeled Tractor	1007	353	5647	0.216	3043	2400
T-150	Large wheeled (4WD) tractor	4194	1470	23530	0.216	5072	4000
0	Truck	1969	531	9469	0.192	1089	600
BIG-3	Harrow	511	204	1046	0.233	732	225
KPS-5	Cultivator	613	245	1255	0.233	1171	360
OVT-1A	Sprayer	374	149	1351	0.233	315	120
VNB-3	Straw loader	490	196	1004	0.233	585	210
2PTS-4	Trailer	858	343	1757	0.233	819	210
CBY-2.6	Snow sweeper	409	163	837	0.233	293	75
CZC-2.1	Drill (combine)	1282	512	3488	0.233	3253	1440
PSB-1.6	Baler	499	199	1801	0.233	1050	450
ZKK-6A	Roller	409	163	837	0.233	390	120
BOG	Caravan	836	225	2775	0.192	532	90
Total						45175	25020

Capital Recovery Factor is based on an interest rate of 14 %

Fuel consumption and work rate data are derived from the norms and standards provided by the MoA. In order to verify these data the representative budgets were compared with fuel costs aggregates for the selected aimags. The discrepancies were considered to be within the accepted parameters given the variable nature of agricultural production. As with other aspects of the model,

[12]The method employed for calculating the Annual Capital Cost (ACC) is as follows

$$ACC = \frac{(P - S(1+i)^{-n})i}{1-(1+i)^{-n}}$$

where P is the purchase price of the asset, S is the salvage value, i is the (decimal) interest rate and n is the working life in years. The salvage value is calculated on the basis of a diminishing balance depreciation charge. The ACC is a constant annual charge that, over n years, will repay the capital outlay and cover interest due on the outstanding debt each year. If the capital repayment is considered analogous to depreciation then this represents the annual share of the cost of the machine, which in this case is a tradable. The interest however is treated as a domestic factor. To this end the (average) depreciation (D) is calculated on a simple straight-line basis, viz.

$$D = \frac{P - S(1+i)^{-n}}{n}$$

and the interest is simply ACC-D

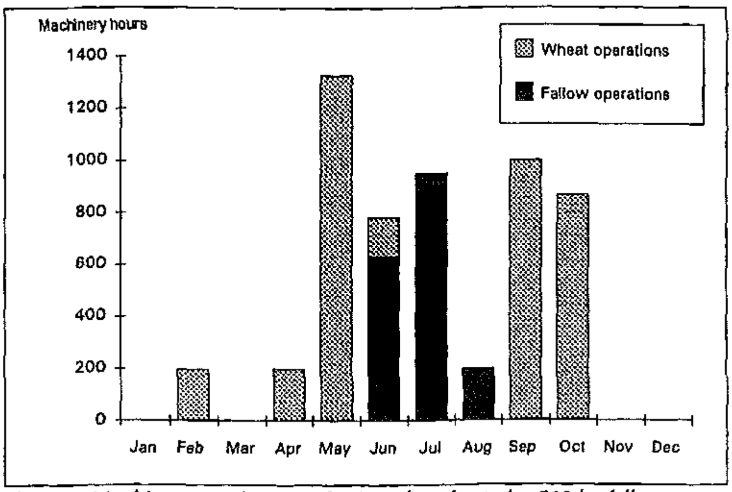


Figure 9. Machinery requirements for 1000 ha wheat plus 500 ha fallow

the highly disaggregated nature of these data allows easy examination and alteration if desired. The data are held in tables that state the per ha requirement for the use of a particular implement with a given power unit. For each combination the fuel consumption (litres ha^{-1}), operator labour (hours ha^{-1}) and supplementary labour requirement are stored. In table 22. below, the first four columns can be readily altered to represent the sequence of operations that take place. The *implement* and *power unit* columns contain the codes that match those in the look-up table. The remaining columns show the calculated values that are used in the budget.

The cost of lubricants has, for the present, been ignored. The facility to add a coefficient to represent efficiency losses also provides a method for including items such as this.

Table 22. Machinery hours and fuel usage for wheat production and fallow management

Wheat growing	Timing	Implement	Power unit	Fuel/ha	Hrs/1000 ha	Supp hrs	Days/ha	Days reqd
Snow sweeping	Feb	CBY-2.6	DT-75	2.5	196	0	25	8.2
Harrowing	Apr	BIG-3	DT-75	2.9	200	0	25	8.3
Cultivation - first	May	KPS-5	DT-75	8.0	476	0	60	19.8
Cultivation - second	May	KPS-5	T-150	6.9	238	0	30	29.8
Rolling	May	ZKK-6A	MTZ-50	2.0	161	0	20	8.1
Sowing	May	CZC-2.1	DT-75	5.2	455	455	57	18.9
Spraying	Jun	OVT-1A	MTZ-50	0.9	154	154	19	7.7
Windrowing	Sep	CK-5	CK-5	5.2	526	0	66	16.4
Threshing	Sep	NIVA	CK-5	7.5	476	0	60	14.9
Baling	Oct	PSB-1.6	MTZ-50	3.5	556	556	69	27.8
Bale loading	Oct	VNB-3	MTZ-50	1.3	313	313	39	15.6
Total				45.9	3751	1476	469	176

Fallow management	Timing	Implement	Power unit	Fuel/ha	Hrs/1000 ha	Supp hrs	Days/ha	Days reqd
Cultivation	Jun	KPS-5	DT-75	8.0	476	0	60	19.8
Spraying	Jun	OVT-1A	MTZ-50	0.9	154	154	19	7.7
Cultivation	Jul	KPS-5	DT-75	8.0	476	0	60	19.8
Cultivation	Jul	KPS-5	DT-75	8.0	476	0	60	19.8
Harrowing	Aug	BIG-3	DT-75	2.9	200	0	25	8.3
Total				27.8	1782	154	223	76

Figure 9. shows the machinery requirements for 1 hectare of wheat together with 0.5 ha fallow. May and September are the peak months because of sowing and harvest. The summer months tend to be dominated by operations to manage the fallow land, although the wheat crop itself requires little attention at this time. Being a monoculture based system constrained by the narrow growing season the need for timeous field operations is paramount and so equipment needs to be both serviceable and efficient.

Petrol use on farms is nominally quite high. Table 13. shows that over the years 1987-89 the amount of petrol used on the State Farms was about 40% the level of diesel usage. Much of this results from the requirement to collect farm inputs from central depots rather than having them delivered by the supplier. The full costs of owning and operating a fleet of farm-based trucks therefore appear in the farm accounts. Because of the desirability of separating the farm production costs from those costs which are essentially ancillary, the transport costs for inputs and outputs have been included in the calculation of farm gate prices. Fuel for trucks used on the farm however is entered separately.

Machinery costs are important in the context of wheat production and merit further consideration. The agricultural technology in place in Mongolia will necessitate continued reliance upon Russian manufactures unless and until they are replaced by those of Western origin. The degree to which this will occur is a matter of some conjecture. Although it is widely acknowledged that the Russian equipment is inferior to its western counterparts it is also considerably cheaper. A factor of three would not be at all unusual. In the long term, under market conditions, this price difference should reflect the additional costs of operating these machines. In the short term western machines are only likely to make inroads when funded by external sources such as aid projects. The inferior quality of equipment does however lead to a set of costs which are difficult to both identify and quantify but would include:

- Higher repair costs
- Higher fuel consumption
- More frequent breakdowns leading to loss of timeliness (in an agro-climatic situation such as Mongolia being able to exploit weather windows can be critical and the effect of this problem should not be under-estimated)
- Operational inefficiency e.g. difficulty in adjusting machines optimally, grain losses from combines, incorrect sprayer and fertiliser calibration.

It is also interesting to note that this situation represents a serious cost to the Russian economy in terms of the earnings foregone because of price discounting for inferior quality. In building a tractor, for example, inputs of metal, labour, energy etc. would be needed much the same as in the construction of a US tractor. The difference is that the US model commands a higher end price. If the factors of production were costed at world price levels then the Russian industry would show significantly lower value-added than its US equivalent. In extreme cases, many of manufacturing activities can actually be value-subtractors in which case the logical course of action would be to cease production.

Because the slack budgetary constraints of the past there has been a tendency to over-invest in machinery to provide apparent over-capacity as form of insurance. The quality deficiency has been compensated by quantity. With the move to trading on a hard currency foreign exchange basis it is likely this will change. Despite the relative cheapness of Russian farm equipment, the scarcity of foreign exchange has meant that imports during the last few years have plummeted. This disinvestment means that the over-capacity will soon be eroded and the already poor productivity is likely to be further undermined.

7.6. Buildings and Fixed Capital

The buildings and fixed plant complement proved difficult to determine. The minimum requirement would include.

- grain dressing equipment
- on-floor storage for 200 tonnes for every 1000 hectares sown
- garaging and workshops for farm machinery

As with the farm machinery, these cost of these items of durable capital are converted to annual amounts using a capital recovery factor. Domestic labour costs are more likely to account for a significant proportion of the total costs than is the case with machinery. For this reason a coefficient is introduced into the schedule to denote the proportion of total cost which is considered domestic.

Table 23. Schedule of plant and buildings for 1000 ha of wheat

Description	Intial Cost ($)	Working life (years)	Repair % new Value	Proportion Domestic	Capital Recovery Factor	Annual Capital Cost ($)	Repair Cost $/year
Grain cleaning equipment	5000	8	7	0.2	0.216	1078	350
Grain storage for 200 tonnes	14000	20	2	0.5	0.151	2114	280
Machinery garaging	20000	20	2	0.5	0.151	3020	400
Total						6211	1030

7.7. Prices

The estimation of prices poses a number of problems. Private prices are normally obtained by observation of markets and to some extent this is straightforward. The problems of poor dissemination of price data have been already intimated. The collapse of the administered price system has meant that pan-territorial price uniformity has been largely supplanted by prices which reflect distribution costs, if only implicitly. Because farms have to arrange the collection of farm inputs from central distribution centres the effective farm-gate price is high than the quoted price. This will clearly disadvantage those farms located in remote areas and/or served by poor communications. Further to this, the emerge of unofficial markets and the growing volume of barter transactions make the collection of actual prices being paid very difficult. Barter trade is by its nature often localised and opportunistic and the 'deals' available at any one place at any one time reflect local supply and demand. The private prices used in this study have been based primarily on data available at the MoA and the Agricultural University.

The standard practice with regard to price setting of imports is to convert into domestic currency at the official rate and to add a universal import duty, currently standing at 15%. This has been done with the machinery and plant costs. For the other tradables, table 24. shows the relationship between observed prices and the domestic price calculated using the above method. There is reasonable correspondence although for some goods, notably petrol, the observed price is much higher. The reason for this is simple: the shortage has necessitated a system of rationing but there is considerable leakage into parallel markets which seems to be widely tolerated.

Table 24. Comparison of observed prices and calculated prices using the official exchange rate

	Wheat	Amm Nitr	TSP	KCl	Diesel	Petrol	Sprays	Seed Tr
Observed price (Tg)	7000	10000	12000	8000	10000	26000	200	600
Calculated price (Tg)	10580	7820	12420	6900	9430	11730	193	377

Prices for inputs appear to be on the basis that the purchaser collects the goods. For wheat grain transport costs from the dressing centre to the mill are borne by the combinant. The domestic farm-gate prices for inputs have been calculated by adding a haulage charge of 4 Tg per tonne per kilometre.

The calculation of social prices also presents a number of methodological problems. Mongolia suffers considerable geographical disadvantages in respect of international trade. It is a land-locked country with no guaranteed access to a sea port. Goods must pass through either Russia or China. In the past the majority of trade was with the CMEA countries and therefore the links with the FSU assumed greatest importance. In terms of the volume of trade this is likely to remain the case for the short to medium term given that the activities of the Mongolian economy were integrated into the CMEA trading bloc.

In the spreadsheet model the farm gate social prices are calculated on the following basis.

For inputs the steps are:

FOB price at recognised exporting port for the good concerned

plus Freight and insurance costs from this port to a nominated port in China or appropriate location in Russia

plus Unloading, freight and insurance for transport from this location to Ulaan Baatar (ULN)

equals Wholesale price in ULN

To this are added the transportation costs of moving the goods from Ulaan Baatar to the farm. The costs have been calculated using a schedule in the spreadsheet model. The costs per kilometre are calculated as follows:

Table 25. Transport costs schedule based on a five tonne Russian truck

Five tonne Russian truck	
Domestic haulage charge (Tg per t per km)	4
Truck capacity (tonnes)	5
Initial cost of truck ($)	10000
Servicing & Repair cost as % of initial cost	10
Life (years)	10
Fuel consumption (litres/km)	0.37
Annual distance covered (kms)	20000
Annual cost ($)	1770
Summary of non-domestic costs (US cents per tonne per km)	
Amortisation	1.77
Repairs	1.00
Fuel	1.36
Total	4.13

The resulting amount is converted to domestic currency at the official exchange rate and then adjusted to account for estimated over-valuation of the Tugrik.

Import parity prices for the output (grain) is calculated on the same basis with the difference that the point of consumption is assumed to be Ulaan Baatar and so transport costs are subtracted from the wholesale price to give the farm gate price.

Specific problems associated with the estimation of prices include the following:

- Obtaining data on the costs of transport from Tianjin to Ulaan Baatar proved to be very difficult. To date very little grain has been brought in via this route although it would be the only one practical for the importation of wheat. Anecdotal evidence suggested that charges of up to US$ 100 per tonne for the transport of grain could be expected. The ADB project document attempts to estimate farm gate economic prices for hay and other products and, in doing so, use values which corroborate a cost of this magnitude. A number of factors contribute to this situation.

First, the change in rail gauge at the border necessitates unloading and reloading of cargo. This is costly and time-consuming because of the inadequacy of facilities at the border. Because so little bulk freight has crossed the border in the past there has not been the incentive to address this problem. As a result the process is extremely inefficient and these costs would tend to be passed. Secondly, this monopoly position affords the Chinese opportunity to seek high rents for this service. There are of course number of political considerations, beyond the scope and remit of this study, that further complicate this issue[13]. In the long term investment in improving the efficiency of this transport link should bring the cost down.

Strictly the costs of transport from Tianjin should be split between the Chinese part of the journey and the remainder which is in Mongolia. The latter would be partly dependent on domestic resources (mostly labour) and partly on imports (fuel, spares, equipment etc.) Because of the difficulties in identifying a single charge for the transport and the fact the domestic costs represent a small fraction of the total cost, a single rate per tonne has been adopted.

- Because the infrastructure in Mongolia is poorly developed and the distances between farms and centres of population can be substantial, the costs incurred in moving materials between them can have an important bearing on the real costs and returns of crop production. These costs are often borne by the farms themselves although the cost of moving grain from the collection centre to the mill is covered by the milling combinant. Wherever possible these costs have been explicitly calculated.
- A feature of the prices of imports from the FSU is that they appear to be significantly cheaper than the equivalent products manufactured in Western countries. In many cases the price differential reflects the difference in quality; in order to clear in competitive markets many goods from the ex-CMEA countries need to be discounted. It has been noted elsewhere that machinery may be as much as three times cheaper than equivalent western items. For other goods the reasons for the price differential are less obvious. A good example would be nitrogenous fertiliser. The world price of ammonium nitrate is around US$120 per tonne whereas it can be obtained from the Russians at the equivalent of US$90 per tonne. On the face of it is difficult to understand why there should be this difference. It may be explained in part by quality differences, especially because of poor packaging resulting in spoilage. Another possible reason for this discrepancy is the fact that for the large part many of the ex-CMEA countries have not developed significant trading links with the rest of the world. Although all trade is supposed to be on a hard currency basis, many of the operational trading practices owe much to the former system. Prices of traded goods were denominated in transferable roubles and were reviewed on a five year basis. This would tend to instil a degree of inertia and lack of price response. In the long term one might reasonably argue that, provided the goods are of competitive quality, then the opportunity cost to the exporting country is the world price for the good. In order to capture this, world prices have been used for all imported tradables with the exception of machinery. In this analysis world prices have been used for all items apart from machinery.
- Ultimately price may be irrelevant if supply cannot be secured. During the transitional phase many enterprises have found it increasing difficult to obtain essential supplies, even if the finance for procurement is available. Failures at a national and international level lead to insurmountable problems at farm level. This is a legacy of the high degree of dependency on the FSU in this sector. The true picture is very confused as there have been instances of farms by-passing state procurement procedures and importing machinery and spare parts directly. Statistics on these activities are understandably difficult to obtain but it appears to be a growing trend. In these cases much depends on the local opportunities and therefore there is much variability. Cross-border trading, for example, is only available to those close enough to the border and have goods or services worth bartering.
- This last issue of barter merits further consideration. The use of barter trading is a rational response to conditions of high inflation in the economy. It is also likely to be attractive when

[13]It is interesting to note that a Canadian farmer would have to pay a charge of US$ 14 per tonne for the transport of grain over a distance of one thousand miles (i.e. the distance between Ulaan Baatar and Tianjin). This figure represents 35% of the estimated economic cost of the rail transport (i.e. US$ 40 per tonne). Obviously there are many differences between Canada and China/Mongolia but the figure does provide a useful benchmark for transport costs for a longer term analysis.

there is apprehension about new forms of taxation. In some sectors of the economy the scope for barter is greater than it is in others.

Table 26. below shows the baseline prices schedule for tradable inputs and outputs. Machinery is treated separately. Wheat is assumed to be fob US west coast with shipping to Tianjin and then rail freight to Ulaan Baatar. All other inputs are sourced in the in the CIS although the actual locations are unspecified. For this reason there is no explicit charge for the freight and insurance to an intermediate port as there would be with imports via China, and the cost is treated as fob at Irkutsk near the Russian-Mongolian border. In practice the imports would be loaded onto rail wagons on the Trans-Siberian railway and routed via Irkutsk into Mongolia.

Table 26. Schedule for parity prices used in wheat production model

Item	Wheat	Amm Nitr	TSP	KCl	Diesel	Petrol	Sprays	Seed Tr
Units	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	litres	litres
Domestic price (Tg)	7000	10000	12000	8000	10000	26000	200	600
Domestic farm-gate price (Tg)	7000	10800	12800	8800	10800	26800	201	601
International prices (US $)								
fob at ..	WC-USA	CIS	CIS	CIS	CIS	CIS	CIS	CIS
Fob price at above	120	160	250	140	180	230	4	8
Freight & Insurance	27	0	0	0	0	0	0	0
cif at ..	Tianjin	Irkutsk	Irkutsk	Irkutsk	Irkutsk	Irkutsk	Irkutsk	Irkutsk
Unloading	3	0	0	0	0	0	0	0
Freight & insurance overland to ULN	80	20	20	20	25	25	0.2	0.2
Wholesale price at ULN (cif)	230	180	270	160	205	255	4.2	8.2
Transport costs								
Farm -> mill	4.9							
Mill -> ULN	7.3							
ULN -> farm		9.7	9.7	9.7	9.7	9.7	0.0	0.0
Farm gate price (social) (Tg)	41392	36046	53146	32246	40796	50296	800	1560
Density (kg/l)					0.84	0.72		

7.8. Credit

Credit for farmers is available through an agricultural bank. Interest rates at November 1992 were in the region of 36% to 40% which, with inflation at 60%, allowed farmers to borrow at negative real rates thereby providing subsidised credit. The private cost of working capital is therefore negative.

The agricultural bank is one of the larger lending institutions in Mongolia. Loans are available for both fixed capital investments and working capital although the uptake of the former has been generally low because of the tendency to disinvest in farm machinery at the present time. Working capital credit is typically taken for a period of 1 to 6 months and is secured on livestock and/or machinery (and in some cases on buildings). As with many other infant services in Mongolia there is a lack of experience of good professional expertise in banking. Although the theory of assessing credit risk, appraising investment viability etc. has been addressed it will take time for bankers to develop and hone these skills. The negative real rates mean that the incidence of bad debts has been so far low (a figure of 4% has been suggested).

It appears that, at least in some sectors, the banking practices tend to favour state-owned enterprises. Another problem, arising from the negative real interest rates, is that deposits by savers are low and this is leading to a shortage of credit. This has serious implications for producers who are faced with the need to secure inputs timeously. In some cases the problem may be one of lack of availability of the inputs themselves. In other cases shortage of credit means that the purchase cannot be made. In the past state farms received credit in the form of advance payments from the mills, amounting to between 25 and 70% of the total value of the contract.

The social cost of capital has been set at a figure of 14% per annum. This is set at a level to reflect a reasonable rate with premiums to account for risk and transaction costs.

7.9. Labour

The amount of labour conventionally used in the production of wheat has been estimated using records held at the MoA. The staff complement is assumed to consist of one manager together with 8 full time, skilled workers (mainly tractor driving). Casual labour, employed at harvest time is the only other form of on-farm labour.

As a purely domestic factor of production the social value of labour is notoriously difficult to estimate. Contributing to this difficulty are following issues:

- The highly seasonal nature of farm production means that the marginal value product of a unit of labour can depend on when that labour is available. Monoculture systems in particular exhibit highly peaked labour demands usually around sowing and harvest time. The opportunity cost of labour at these times can be very high indeed. In Mongolian crop farming the pattern of development has involved the substitution of capital for labour.
- Unwaged labour is often found in family units. On the State Farms all the workers were waged employees and also received other benefits in kind. Where new forms of business structure emerge and these structures are such that the workers enjoy some form of stake in the business then there is often an incentive to the
- In the long run labour can move into and out of agriculture. Thus the time scale to which the analysis refers will have a bearing on the estimated social value of labour.

Problems of transition present some particularly difficult problems for the policy analyst when attempting to value labour. If we assume that the social value of labour is defined as the next most attractive means of using that labour (i.e. the opportunity cost) then we must identify such an activity. The Mongolian economy has suffered some major shocks over the last two years and as a result the general level of economic activity, as measured by GDP, has fallen. The country is in the unfortunate position of seeing increasing rates unemployment and at the same time serious shortages of basic consumer goods. It will take time and prudent economic management to remedy this situation by putting labour back to work in a productive manner. In the meantime the immediate prospects for alternative uses of labour are not good and so one would surmise that the opportunity cost of labour would therefore be low. The problem is determining just how low is low.

Conventional wisdom has it that agriculture is one of the first sectors to respond favourably to transition to a market economy. This is probably based in part on experience with the household responsibility system in China which brought about substantial improvements in farm productivity during the 1980's. Such an analogy is inappropriate for the State Farm sector in Mongolia which owes more to industrial organisational structures than to family-based farm holdings. If this assertion were true, however, then the effect would be that marginal value products for labour would rise fastest in agriculture. Anecdotal evidence suggests that this is certainly not the case at the present time.

The DRC ratio is calculated using the formula

$$DRC\ ratio = \frac{social\ value\ of\ domestic\ factors}{value\ added\ at\ social\ prices}$$

in other words, the social value of domestic resources needed to earn (or save, through import substitution) one unit of foreign exchange.

A value less than 1 suggests that the system earns super-normal profits and enjoys a comparative advantage. Obviously both the quantity and estimated social value of domestic resources need realistic before such a judgement is made. The irony of this type of analysis is that a low (or zero) opportunity cost will tend to increase the apparent comparative advantage of the commodity system. As the value of domestic resources become closer to zero so the DRC ratio approaches zero also. This has the effect of diminishing the value of the measure as an indicator of economic efficiency. Its only value in this case is for comparison when it can be used to asses the relative performance of systems in which domestic resources have been valued on the same basis.

Under these conditions a more satisfactory approach when considering multi-commodity farming systems is use mathematical programming to investigate issues of economic efficiency. Optimising techniques such as linear programming and its derivatives offer the analyst the possibility of constructing models of the farm systems using both private and social prices for factors and products (Gotsch, 1989). Despite the problems associated with aggregation of indicative farm models, the formulation of optimal farm plans based on these price systems can yield valuable insights into the welfare losses arising from policy induced divergences.

In the specific case of Mongolian agriculture it would be necessary to construct input-output budgets for other activities which require arable land most notably fodder crops for animals. Because the fodder is an intermediate product in the production process it will be necessary to estimate input-output coefficients for the complete livestock activities until a market for traded fodder develops. Even then, some kinds of fodder are not traded because they do not transport easily (e.g. silage) or the costs of doing so would be such that transport over large distances would be uneconomic.

Data from interviews with members of recently (semi-) privatised farms provided an estimated for a monthly wage of around Tg 3,500. At the official wage rate this is equivalent to US$ 87.50 but only US$ 23 at the shadow rate. The estimation of the social value of labour therefore remains a serious problem at the present time.

7.10. Land

The problems associated with the economic valuation of land are similar to those affecting labour only worse. To date neither land nor the right to use it has been traded and so there is no private market that can be used as a starting place for valuation. Under the socialist system, the ownership of land was firmly retained in state hands. Individuals were not allowed ownership of land and this remains the case at the present time. With the privatisation of land-using sectors the state has assumed the role of landlord and land lease legislation has been enacted to facilitate the establishment of agricultural tenancies. In part the letting of land is seen as a potential source of government revenue and to this end the AERI has been charged with the development of a coherent system for determining rental values based on the productive capacity of land (ADB, 1992)

During 1992 the average annual rent for cereal crop land was Tg 50 per ha. In the light of the price paid for wheat (Tg 7000 per tonne) this is a very low figure indeed and it probably reflects historic rather than current prices.

Land use practices which damage the environment are a cost to society and strictly need to be captured within a social valuation of land as a factor of production.

Even in economies in which there is a mature land market, there are problems in estimating a social value of land. For example, subsidies to farmers, which are transfer payments, often become capitalised into land values.

8. RESULTS

The following results are based on simple 'what if?' analyses using the data in table 26. below as a baseline position. Particular emphasis has been paid to the relationship between performance indicators and:

- Yield levels and rotations;
- Transport costs for imported wheat;
- Distance of farm from population centres;

For the reasons outlined elsewhere greater weight can be given to the valuation of traded items in the commodity than to that of domestic factors. Intermediate measures such as value-added will therefore be more reliable than the more complete estimates of profitability.

The baseline assumptions for the model are shown in table 27 with the results in table 28. This is based on a typical farm situation in either Tuv or Selenge aimags.

Table 27. Baseline assumptions within the model

GENERAL ASSUMPTIONS					
ECONOMIC VARIABLES					
Exchange rate	Official		**40**	Tg/US$	
	Shadow		**150**	Tg/US$	
Exchange premium			3.75		
Import duty on machinery			**15**	%	
Interest rate - private short term			**40**	%	
Inflation rate			**60**	%	
Real rate of interest			-12.5	%	
Social cost of capital			**14**	%	
FARM VARIABLES					
Distance of farm from processing site			**100**	kms	
Distance of farm from Ulaan Baatar			**200**	kms	
Distance of processing site from Ulaan Baatar			**150**	kms	
Area of fallow associated with 1 ha wheat			**0.50**	ha	
Number of days credit required			**150**		
OUTPUT					
Harvested yield			**1.20**	t/ha	
Moisture content of harvested grain			**18**	%	
Moisture content of imported grain			**14**	%	
Yield at	14 % moisture		1.14	t/ha	
Post harvest losses			**5**	%	
Saleable yield			1.09	t/ha	
Grain		Prop (%)		Discount (%)	
quality	Class I		**2**	**15**	
	Class II		**58**	**0**	
	Sub-standard		**40**	**-10**	
INPUTS					
	Seed rate		**200** kg/ha		
	Fertilizer		Nutrient rate	Active sub	Amount
			kg/ha	%	kg/ha
	N = Ammonium Nitrate		**40**	**34**	**118**
	P = Triple Superphosphate		**21**	**47**	**45**
	K = Potassium Chloride		**11**	**60**	**18**
			Wheat	Fallow	
	Sprays - 2,4-D		**1**	**0.5**	litres/ha
	Seed treatment		**1.5**		litres/t
			Private	Social	
Labour	Management		**6000**	**6000**	Tg/month
	Full time staff		**3500**	**3500**	Tg/month
	Casual labour		**100**	**75**	Tg/day
Land			**50**		Tg/ha rent

Figures in bold type can be altered by the policy analyst.

Table 28. Commodity budget based on the baseline assumptions

				Private		Social	
OUTPUT		units	units/ha	Tg/unit	Tg/ha	Tg/unit	Tg/ha
Grain	Class I	t	0.02	8050	175	47601	1035
	Class II	t	0.63	7000	4413	41392	26095
	Sub-standard	t	0.43	6300	2739	37253	16197
Straw		t					
Total					7327		43327
TRADED INPUTS		units	units/ha	Tg/unit	Tg/ha	Tg/unit	Tg/ha
	Seed	kg	200	7.0	1400	41.4	8278
	Fertiliser Amm N	kg	118	10.8	1271	36.0	4241
	SP	kg	45	12.8	572	40.8	1823
	KCl	kg	18	8.8	161	32.2	591
	Diesel	litres	75	9.1	678	34.3	2562
	Petrol	litres	6	19.3	116	36.2	217
	Electricity	KWhr	12	5.0	60	10.0	120
	Sprays	litres	1.3	200.8	251	799.8	1000
	Repairs	Tg			1198		4950
DEPRECIATION		units	units/ha				
	Machinery	Tg			1239		5119
	Buildings and plant	Tg			62		257
Total traded					7009		29157
Value Added					319		14170
DOMESTIC FACTORS		units	units/ha	Tg/unit	Tg/ha	Tg/unit	Tg/ha
Labour							
	Managers	man-months	0.012	6000	72	6000	72
	Full-time workers	man-months	0.096	3500	336	3500	336
	Seed dressing	man-days	0.010	100	1	75	1
	Buildings	Tg			45		185
Capital							
	Interest on working capital				-293		328
	Interest on durable capital				1062		4388
Land					50		
Profit					-954		8860

Summary of PAM Indicators

Measures of protection	
Nominal Protection Coefficient on tradable OUTPUTS	0.17
Nominal Protection Coefficient on tradable INPUTS	0.24
Effective Protection Coefficient	0.02
Measures of efficiency	
Private Profitablity Coefficient	3.99
Domestic Resource Cost ratio	0.37

The measures of protection show negative protection in both factor and product markets, which, in the case of factors, acts as a subsidy to producers. The divergence (tax) in the output market is the greater however and results from low, fixed producer prices.

As far as efficiency measures are concerned, private profit levels are currently negative if the replacement costs of the full machinery complement is included. In practice very little machinery and buildings have been replaced in the last few years thereby permitting small, positive margins. This scenario can be easily modelled by removing these items from the budget. If this is done then a small profit can be shown in those areas in which yield levels are high enough (see table 29). Fertiliser use has also declined markedly in the last two years resulting in lower yields. It is as yet too early to assess the long term effect of this but it is extremely unlikely that output can be sustained without recourse to the use of fertilisers again.

Table 29. Estimates of profit with and without machinery replacement costs

Aimag	Yield (t ha^{-1})	Crop:fallow (:1)	Private profit (Tg per ha) with	without	Social profit (Tg per ha) with	without
Selenge	1.2	1.75	-982	1426	8745	18694
Tuv	1.3	1:10	-541	1868	11663	21612
Bulgan	1.3	1.30	-450	1959	12036	21985
Uvs	1.0	1.70	-2210	198	1496	11445
Hentii	1.0	1.00	-2373	36	832	10780
Dornod	0.9	0.90	-3027	-618	-2958	6990

Non-replacement of machinery is only practicable in the short term and to the extent that there is existing over-capacity. This is a matter of some conjecture in that it is impossible to say what proportion of the total machinery inventory is actually operational. With the present difficulties in obtaining spare parts it is most probable that the number of serviceable machines in use is declining rapidly.

Table 30. The relationship between transport costs, yield and social profit

	Social profitability (Tg per ha)								
Yield t ha^{-1}	Transport costs from Tianjin to Ulaan Baatar (US$ per tonne)								
	20	30	40	50	60	70	80	90	100
0.70	-13874	-13094	-12314	-11533	-10753	-9973	-9193	-8413	-7633
0.80	-11258	-10312	-9366	-8420	-7474	-6528	-5582	-4636	-3690
0.90	-8641	-7530	-6418	-5307	-4195	-3083	-1972	-860	252
1.00	-6025	-4748	-3471	-2193	-916	362	1639	2916	4194
1.10	-3409	-1966	-523	920	2363	3806	5250	6693	8136
1.20	-793	816	2425	4034	5642	7251	8860	10469	12078
1.30	1823	3598	5372	7147	8922	10696	12471	14245	16020
1.40	4439	6380	8320	10260	12201	14141	16081	18022	19962
1.50	7056	9162	11268	13374	15480	17586	19692	21798	23904

The results in Table 30. provide an indication of the impact of two important determinants of social profitability, namely the crop yield and the cost of importing wheat. At a freight cost of $80 per tonne wheat appears to be just profitable at 1.0 tonnes per ha. This transport cost is excessively high and is likely to drop in the long term if rail links are upgraded and the volume of trade with and through China increases. At US$40 per tonne the activity is barely break-even at 1.2 tonnes per ha. Unless efficiency gains can be made then case for growing wheat on all but the very best land becomes extremely weak.

9. CONCLUSIONS

This study has provided a framework for further investigation of the of mechanised arable farming in Mongolia. In particular the approach adopted, i.e. that of desegregating the components of the commodity system should allow the evaluation of specific geographical and agronomic scenarios in which superior data are available.

Because of difficulties in quantifying certain elements of the production system together with the transient (sic) and often unpredictable nature of economic transition, the results should be treated with caution. However a number of valuable insights into the international competitiveness of this sector do emerge from the exercise and it is hoped that the work done in developing this approach may act as a resource to others wishing to study this subject.

Wheat production in Mongolia has been demonstrated to be a marginal activity both because of the low level of output and the degree of risk involved. However, there are other areas of the world, with similar physical conditions, in which superior performance has been consistently obtained. We may reasonable conclude therefore that, given an advantageous economic and policy environment and the appropriate technological packages, performance could be raised on much of the land currently cropped. It is also important to remember that with the present high costs of transporting grain to Mongolia the economic case for domestic production is actually strengthened. Investment in improving transport links to China will be necessary for the development of the Mongolian economy in the years to come. This will reduce the cif cost of imported goods and so undermine this position.

The current systems of production are undergoing rapid disinvestment as a result of the loss of economic and technical assistance from former CMEA countries. During much of the 1980's yields of wheat were around 1.2 t ha^{-1}. It is important to realise that this was achieved with substantial amounts of imported fertiliser and other inputs. The established methods of production are highly dependent on imported inputs which were often inefficiently used. Given the present trade arrangements there is considerable doubt as to the economic sustainability of the existing methods of production.

Capital productivity is, in reality, very low but historically this has been hidden by means of the accounting systems used and existence of the *soft budget constraint* (i.e. the practice of not allowing the bankruptcy of state enterprises). The present financial position of many State Farms is precarious, as a result of both poor performance on the farm and the need to operate with a price system that acts as a subsidy to consumers and a tax upon producers. Despite the recent price reforms to date there remains a high degree of distortion principally as a result of the overvalued domestic currency. The problems of price inflation and unpredictability of supply serve to reinforce the problem.

The existing scale of wheat production was the result of a drive to achieve self-sufficiency. Thus the issue of food security is worthy of consideration in this context. In the past the main problem was that there was usually no surplus wheat within the CMEA and so imports required scarce hard currency. Such was the political and economic cohesion between Mongolia and the USSR that importing the inputs required to grow wheat was quite straightforward. (Until very recently 5% of the population were CMEA expatriates, most Russian military personnel). The shift from this to the present arrangement in which all imports require payment to be made in hard currency means that a new set decisions arise. In simple terms the choice is whether to import the wheat or (most of) the inputs required to grow it. The food security argument from a strategic stance is only partially tenable in that the means of the production are largely imported themselves. Shortage of adequate grain storage capacity and the tendency for grain to deteriorate in storage further undermine the logic of attempting to further increase the area of land devoted to domestic production.

As recently as 1991, the Mongolian authorities intended to meet the demand for grain needs by extending the land area and raising yields (Sloane et al, 1991 pp 29-30). It is very unlikely that the cropping of additional would be either economically viable or ecologically desirable. The best arable land is currently in use and any new land brought into production using the present technology will probably be incapable of growing wheat profitably. This is unlikely to be the answer. The following recommendations outline some possible means by which these problems can be addressed

10. RECOMMENDATIONS

On the basis of the findings of this study the following recommendations are offered in the hope that they may help guide further thinking on this important subject. An obvious prerequisite to all of the following suggestions is the strengthening of the national capacity for agricultural policy analysis combined with an effective means of assessing the potential for and impact of technical change in agriculture. The PALD project is assisting in attaining this objective, especially in the livestock sector.

i) More detailed work is required on the nature of inefficiencies in the existing production systems. This should be followed up by the design of strategies for addressing these problems. Some of this could take the form of training and guidance and implementing low-cost appropriate solutions without the need for large scale capital investment. Within the present production systems some practices stand out as being badly done and would show a good response to well targeted training (for example crop spraying).

ii) On the premise that a proportion of the wheat crop is farmed using unsuitable methods, there is a need to identify and test improved agronomic packages. These could include: reduced tillage systems with more efficient fallowing and improved rotations incorporating the use of complementary fodder crops. Minimal tillage systems require fewer inputs such as machinery and fuel but are more difficult to manage. Careful consideration of the potential adoption of such systems needs to made before embarking on research, development and extension based on these systems.

iii) Storage losses are also serious. The current state of grain processing and storage requires investigation. There is insufficient storage capacity to cover the entire domestic requirements. Given this situation, it may be appropriate to reduce production to bring it into line with existing storage capacity and import the balance. This reduction would be focused on the most marginal land and so the reduction in land area devoted to wheat production would be *pro rata* greater. Where the social value added (using imported tradables only) is negative, this move will actually save foreign exchange.

iv) It is worth considering the option of taking out of production the most marginal areas. A judgement needs to be made as to viability of improving the efficiency of the system or whether a change of land use is more prudent. The wheat production model provides a means of assessing the specific characteristics of a farm situation. With the use of farm-specific, superior data the policy analyst can test assess the impact of various policy scenarios within define geographical and agro-climatic contexts. For example, it can help identify situations in which social value added is negative in which case there is an argument for the reallocation of fixed resources to more profitable activities.

v) The producer price for wheat in 1992 was well below the c.i.f. world price and so this transfer acts as a tax on producers. The over-valued exchange rate provides producers with an degree of subsidy on imported inputs which in part counteracts the negative protection in the output market. The establishment of a coherent, stable and equitable price policy for agricultural producers will do much to improve confidence in this sector and promote more economically efficient resource allocation.

vi) Shortage of foreign exchange and unpredictability of input supply have further aggravated what is already a risky activity. This perception of risk acts as severe deterrent to farm privatisation and new investment in agriculture. Measures to improve the reliability of farm input supply will be needed to ensure business viability in this sector regardless of the actual business structures. In particular, the activities of monopolies and monopsonies will require close monitoring.

vii) The economic analysis of wheat production along the lines developed in this study is new to Mongolia. In order to investigate the entire agricultural sector in a more thorough and systematic manner, it would be valuable to construct similar commodity budgets for other significant commodity production systems. This would facilitate the estimation of opportunity costs of agricultural resources. Such models could be used to investigate the issues of comparative advantage in agriculture (for example, to assess the case for growing more fodder crops and less wheat) as well as providing a valuable resource for project planning and assessing the impact of economic policy. The fundamental question to be answered is whether wheat is the most appropriate crop in a given farm context and this require a sound method for evaluating the alternatives, principal amongst which is fodder production. This represents the next step for this study.

11. REFERENCES

Ash, T ,Howe, K and Lewis, R (1991) *Conditions for Technological Change in Soviet Agriculture* Unpublished paper presented to the Agricultural Economics Society conference.

Asian Development Bank (1992) *ADB Livestock Feeds Improvement Project - Mongolia (TA 1649 MON)* Project proposal document

Brooks, K and Johnson, J G (1983) *Prospects for Soviet Agriculture in the 1980's* Bloomington, USA: Indiana University Press

Daw, M E (1990) *Review of Large Scale Farm Management Problems - 1 Ethiopia* Rome: AGSP, FAO

Gotsch, C (1989) *Agricultural Policy Analysis on Electronic Spreadsheets: Commodity and Farming Systems Models* Rome: AGSP working paper, FAO

Kydd, J (1990) *Background Notes for Agricultural Policy Analysis in Developing Countries* Unpublished course notes, Wye College, University of London

Monke, E A and Pearson, S R (1989) *The Policy Analysis Matrix for Agricultural Development* Ithaca, NY: Cornell University Press

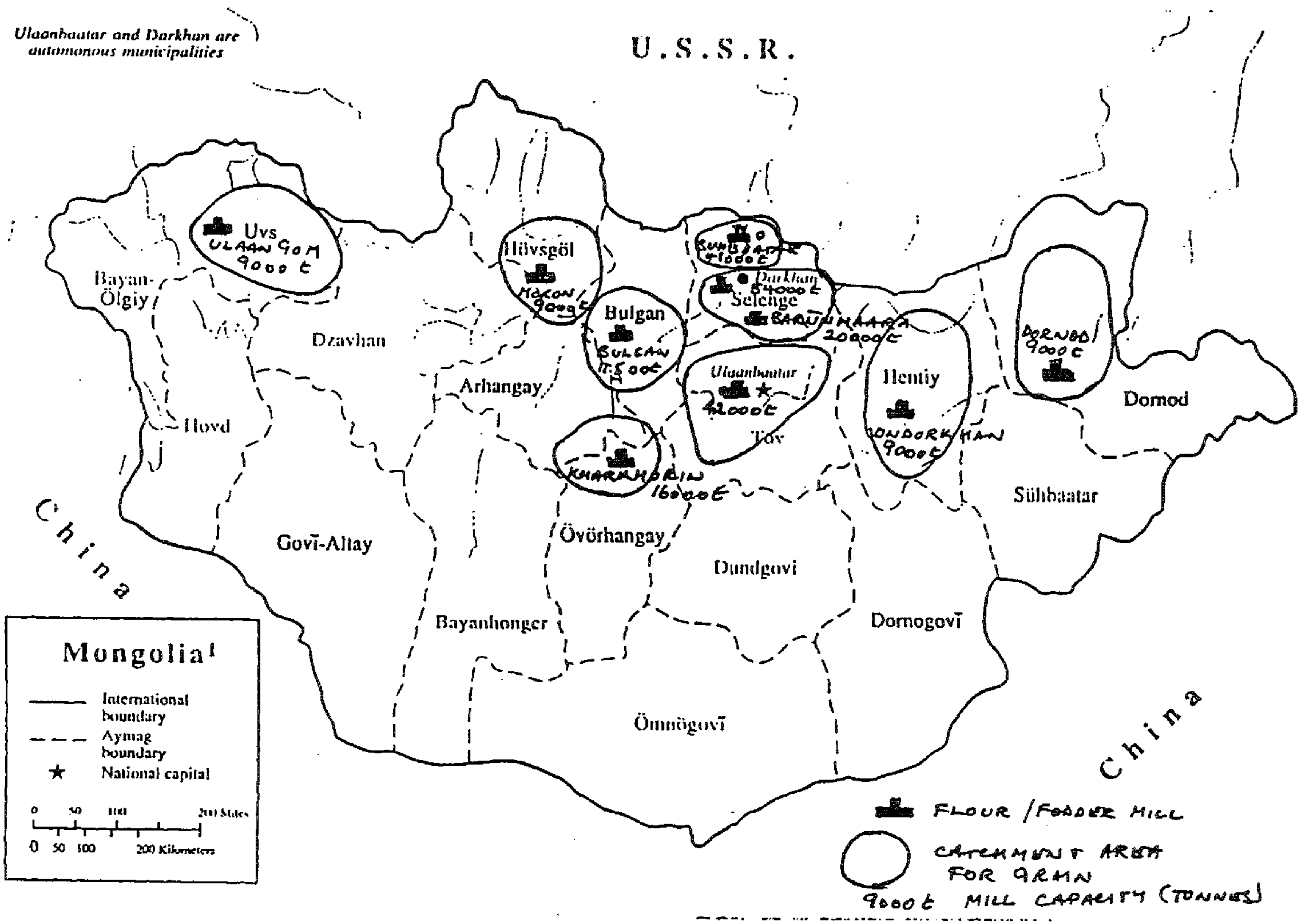
Murrel, P, Dunn, K and Korsun,G (1992) *Does Mongolia Need a Law on Pricing?: An Evolutionary Approach to Regulatory Change* Maryland: IRIS

Montana Cooperative Extension Service (1985) *The Montana Small Grain Guide* Bozeman: Montana State University Bulletin 364

Sloane, P H and 8 others (1991) *Agricultural Sector Background Paper* , Ulaan Baatar: UNDP/FAO Project MON/89/007 report for Donors' Conference 1991

12. APPENDICES

12.1. Appendix 1. Map of Flour Mills



Map 6. Distribution of Grain Milling Combinants in Mongolia