

17. PROFITABILITY OF CROP PRODUCTION

The concept of “profitability” of individual enterprises on the farm is explained in Section 12 as the margin between the revenue from sale of produce (termed gross output) and total variable cost of production. The term gross margin is reserved for this estimate, and the basic unit in this report is measured in US\$/ha. It is the margin that when accumulated from all the hectares of all the crop enterprises grown on the farm, provides the balance out of which the farm overhead (fixed) costs are to be paid. The net margin after payment of overhead costs and interest on loans is termed the farm gross profit, and after deductions for recapitalisation and direct taxes, the remainder is termed the net profit. Gross margin analysis is a planning tool for the farm that if used as the basis for market-orientated decisions, would lead to the maximisation of net profit for the farm.

Until now, the WUFMAS survey has been unable to estimate the magnitude of the overhead costs that are typical of the kolkhoz entities. One study done at 1st of May farm in Tadjikistan suggested that more than 90 percent of all the non-variable costs of the farm were in fact payments for maintenance of the whole rural community. Labour is not being paid for in cash on most farms, either that which is a fixed or a variable cost. The authentic payments in kind for this labour are completely entangled in farm accounts with support of the whole community. This is a seriously complicating issue that needs to be resolved before the criteria of efficiency of resource use, that have been applied in this report to variable costs, may also be applied to fixed costs.

Land, developed for irrigation, was the factor that most limited physical production during the Soviet period because water for irrigation was abundant, albeit at the expense of the Aral Sea. Soviet strategy was to maximise yield (t/ha) of product, that is the return to land, but without economic accountability for the inputs that were used. In a developed, free-market economy, where all the other factors of production are freely available and the rate of interest is low, then the return to land likewise is the overriding consideration. The difference is that the aim of farmers is not to maximise physical production but to optimise it at rates of inputs that maximise the gross margin.

17.1 Maximising the Return to Land

Crop budgets, the basis of the estimate of the gross margin per ha, were calculated for each sample field, and averages for each crop on each sample farm are given in Appendix 7. Crops are ranked for each republic on the basis of their average return to land in Table 17.1.

The budgets of cotton generated excellent average gross margins in all republics, and being a crop that is insensitive to market fluctuations, it is an excellent choice to dominate the cropping calendar. Even in the two command economies of Turkmenistan and Uzbekistan the gross margins are robust, despite the massive tax on production that is already taken into account in these values. In only a few of the 97 cotton sample fields was the gross margin low or negative, and mostly these were fields that were planted late after germination failure or after harvest of wheat. The financial return to the water used to irrigate cotton ranks this crop amongst the best of the crops sampled.

Rice was sampled only in Kazakhstan and Uzbekistan, but like cotton, the return to land and the firm market demand make this an attractive crop. However, the performance of rice is not as good as cotton particularly on account of its exceptionally high water requirement. Furthermore, the discharge of much of this surplus irrigation to the groundwater has raised the watertable so close to the surface, that control of the consequent secondary salinity by leaching has become the justification rather than the cause of rice production.

Table 17.1 Ranking of Crops by Return to Land and Investment

Kazakhstan		Kyrgyzstan		Tadjikistan		Turkmenistan		Uzbekistan	
Return to Land (Average of Gross Margin in \$/ha)									
Crop	\$/ha	Crop	\$/ha	Crop	\$/ha	Crop	\$/ha	Crop	\$/ha
Apple	1,883	Sugarbeet	1,908	Onion	765	Cotton, pima	687	Cotton, pima	356
Cotton, upland	819	Tobacco	936	Cotton, upland	537	Cotton, upland	555	Rice	324
Lucerne, young	365	Cotton, upland	782	Gram, green	224	Lucerne, mature	295	Maize, grain	280
Lucerne, mature	325	Oats	312	Apricot	84	Wheat, winter	-40	Cotton, upland	239
Rice	209	Wheat, winter	225	Maize, grain	60			Curcurbits	205
Wheat, winter	95	Maize, grain	205	Wheat, winter	-52			Barley, winter	45
Maize, grain	-49	Lucerne, mature	25	Sorghum	-138			Wheat, winter	-48
Wheat, spring	-67	Onion	6	Lucerne, mature	-140			Maize, silage	-142
Sunflower, for oil	-96	Lucerne + BS	-226					Lucerne, young	-222
Lucerne + WW	-166							Lucerne, mature	-296
Return to Investment (Benefit:Cost Ratio in \$/\$)									
Crop	\$\$	Crop	\$\$	Crop	\$\$	Crop	\$\$	Crop	\$\$
Apple	34.2	Sugarbeet	10.2	Onion	3.1	Cotton, upland	2.3	Maize, grain	1.5
Lucerne, mature	5.7	Maize, grain	2.1	Apricot	2.5	Cotton, pima	2.2	Curcurbits	0.8
Cotton, upland	3.1	Tobacco	1.8	Gram, green	1.7	Lucerne, mature	1.8	Cotton, pima	0.8
Lucerne, young	2.7	Cotton, upland	1.5	Cotton, upland	1.5	Wheat, winter	-0.2	Cotton, upland	0.6
Rice	0.6	Oats	1.1	Maize, grain	1.3			Rice	0.4
Wheat, winter	0.4	Wheat, winter	0.8	Wheat, winter	-0.3			Barley, winter	0.3
Wheat, spring	-0.3	Lucerne, mature	0.3	Lucerne, mature	-0.5			Wheat, winter	0.0
Lucerne + WW	-1.0	Onion	0.0	Sorghum	-0.8			Lucerne, mature	-0.3
Maize, grain	-1.0	Lucerne + BS	-1.0					Lucerne, young	-0.8
Sunflower, for oil	-1.0							Maize, silage	-0.8

Financial analysis of production of winter wheat and lucerne reveals a less encouraging picture. Wheat performed well in Kyrgyzstan on account of the relatively better yields, low production costs but mainly because wheat grown on some of the sample fields was sold for seed at a higher price. Irrigated wheat in Kazakhstan gave a modest but positive return but should be compared with the gross margin of rainfed wheat grown on the Kazakh steppe. The fact that irrigated winter wheat occupied only five percent of the sample area suggests that the reality of market forces in Kazakhstan already influences cropping pattern.

Winter wheat in the other republics produces a negative gross margin at financial prices, a combination of low yields and price and relatively high cost of production. Improved yield without increased production cost would depend on a significant improvement in the quality of management but the prospect is not good to be able to achieve this while the farm-gate price of wheat is so low and farms are insolvent. The economic export parity price of wheat from Kazakhstan is estimated to be only about \$130/t at farm-gate, and with the economic price of most inputs somewhat more than current financial prices, the economic gross margin of wheat is also negative at current yield levels. For this reason the argument is weak that domestic self-sufficiency from irrigated wheat is economically justified. Due to the low water requirement of winter wheat, it is a potentially favourable crop but except on the Kazakhstan farms, it was seriously over-irrigated. The abundance of water for irrigation in autumn and spring is a partial justification for this crop, but this argument can never be used as a justification for promoting wheat production where its economic gross margin is negative.

Lucerne, a long-term leguminous crop, is conceptually ideal for a crop rotation and until recently was the cornerstone of the dominant cropping regime. The drawbacks are that verticillium wilt disease of cotton is not controlled by lucerne breaks, lucerne is an effective alternative host to cotton for American bollworm, and thirdly that the role of lucerne in the

rotation must be economically justified. A simulation analysis presented in the 1996 WUFMAS report suggested that cotton yield would need to decline by 25 percent as a direct result of the exclusion of lucerne from the rotation in order to justify its re-instatement, and this is unlikely to happen.

As fodders are rarely openly traded in cash sales, and there is scant understanding of the scientific feed value of fodders amongst livestock owners, it is difficult to establish realistic average prices. Animal products are an expensive luxury in most economies and the reduced buying-power of both urban and rural communities in Central Asia is unlikely to create viable prices in the foreseeable future. With feedstuffs by far the largest component cost of livestock production, the transfer price of fodders to livestock enterprises is very sensitive to the price of animal products. Locally quoted prices for lucerne in Kazakhstan and Turkmenistan were markedly higher in 1997, having a significant effect on the gross margin estimates, but it is doubtful that these prices are truly representative. Prices in Tadjikistan and Uzbekistan remain depressed, the gross margins negative, and the inclusion of lucerne amongst the crop enterprises seems not to be economically justified. The drilling of small grains and Sudan grass into established lucerne is practised occasionally, as represented in three of the WUFMAS sample fields, but does nothing to enhance the financial performance of lucerne. Small areas of other fodder crops, sorghum and silage maize, were produced but these crops were no more viable than lucerne.

Grain maize is produced to sell the fresh cobs for human consumption and dry grain for inclusion in livestock concentrate feed. Estimates of gross margin were more favourable in 1997 than earlier, suggesting that there is considerable promise for this crop. There may well be scope for improving the genetic quality of seed, and certainly for the husbandry of maize, and in consequence its yield and gross margin. The gross margins of irrigated barley and spring wheat were again unfavourable but oats did well in Kyrgyzstan. Sunflowers planted in Kazakhstan were never harvested but green gram, a locally popular crop in Tadjikistan yielded well enough to provide a good gross margin.

Yields of sugarbeet and tobacco in Kyrgyzstan were good, so that with buoyant prices, their gross margins were excellent. The farm-gate price for sugarbeet, provided by the WUFMAS national team, is double the price before the factory opened and therefore estimated in 1996 from the import parity price of sucrose. It is not clear if this level of price will be sustainable, but the gross margin is so favourable as to be relatively insensitive to a decline in price. Sugarbeet has the other merit of being relatively salt tolerant, yielding well on saline soils.

Only four sample fields produced fresh fruit and vegetables in 1997, maybe as a result of increased private production of these crops on plots, small-holdings and tenancies, and the rise in transport costs and tariffs for export from the region. Gross margins were very variable as a result of very different prices received for the produce, but mostly they were very favourable. The established apple and apricot orchards sampled in Kazakhstan and Tadjikistan gave good gross margins but the apricot average for Tadjikistan was reduced by inclusion of a newly established orchard.

The marketing of perishable produce clearly is the critical issue, and the risks in obtaining a good price substantially diminish opportunities for this class of crops. Processing of the produce on-site reduces the risk but experience, both local and foreign, suggests that the value added is not enough to encourage widespread production. The most obvious exception, in view of the high radiant energy and low humidity of the area, and the excellent quality of the fruit, is the potential for sun drying of apricots, grapes and pome fruit for the export market. Packaging, quality control and organised international trading would be the key determinants of success, and foreign assistance in achieving these would be essential.

Gross margin analysis is a valuable planning tool for maximising the farm's total gross margin but should be used cautiously. When cropping intensity exceeds 100 percent then the

use of crop gross margins as the basis of improved financial management of the farm must be handled with care since the real annual gross margin includes a part of that of the second crop. The gross margin of perennial crops like lucerne, and orchards needs to be estimated as an annualised gross margin from the long-term cash flow for realistic comparison with annual field crops.

17.2 Maximising the Return to Investment

Since independence, the economic environment throughout Central Asia has profoundly changed and the lack of the resources to match the former “normative” levels of inputs is an expression mainly of the lack of finance. Instinctively, farm managers will respond to this challenge by evaluating from their own experience and from professional advice embodied in the “normative” values, the most rewarding use of the resources that are available. At the same time, their decisions will be influenced by the social and political demands of the Government and community, the existing capital assets and the physical availability of resources, and to some extent by the perceived conventions established in the past.

In this economic environment, it is imperative that farm managers should have the freedom to make production decisions in a logical and coherent manner. In this context, it is the financial return to the investment of scarce finance that needs to be the determinant of the optimisation process, gross margin as return to cost of inputs or the benefit:cost ratio. In this logical process the manager may evaluate the merits of other enterprises on the farm, such as livestock and agro-processing enterprises, in addition to crops. WUFMAS has been unable to include detailed studies of these, as was originally intended, because of budgetary limitations.

Ranking of the crops on the basis of their benefit:cost ratios is shown in Table 17.1, where it will be noted that there are differences compared with the ranking on the basis of the return to land. Most noteworthy is that cotton appears lower in the rankings than on the basis of return to land, with the exception of Turkmenistan. If gross margins in \$/ha are negative, inevitably so too is the value of the overall benefit:cost ratio. Where short-term agricultural credit is available for purchase of inputs, then the benefit:cost ratio of the selected enterprises must exceed the prevailing interest rate on the loan. From the table, this would not appear difficult to achieve with the top ranking crops yielding far greater than 100 percent return on investment in working capital.

Fruit and vegetables generally offer the most favourable returns but as noted above, are too risky to form more than a speculative venture in the financial profile of the farm. Cotton, though not the most favourable crop, is a reliable investment with well-established traditions for its production and marketing.

Perhaps the most interesting observation is the potential for the production of maize, ranking high in Kyrgyzstan (mainly because it was sold for seed), Tadjikistan and Uzbekistan. It is versatile in that cobs may be sold fresh where a market is perceived to exist, or at normal harvest as dry grain for livestock feed. Grain maize is a particularly valuable source of metabolic energy for poultry, an import industry through Central Asia, and therefore a robust market. Based on import parity, its estimated economic farm-gate price at \$264/t is considerably greater than the financial price, indicating that the economic gross margin is as favourable as at financial prices. Maize consumes less water during the season than cotton but presents a management challenge. It is much more sensitive to moisture stress than cotton, to high temperature at anthesis and to soil salinity, so the achievement of high yields would depend on a high standard of husbandry.

Rice does not feature very prominently in the rankings on benefit:cost ratio, and this added to the serious environmental damage caused by its impact on groundwater, mean that the arguments in favour of rice production are not very strong. Clearly on this evidence, rice

should be restricted to depressions where watertables are naturally high and tolerance of waterlogging is a virtue.

It is difficult to justify lucerne in the rotation for the reasons discussed above. Except in Kazakhstan, where heavy yields were produced with very few inputs, lucerne performs poorly and the arguments in favour of this crop need to be carefully scrutinised. Central Asian production of lucerne has declined in recent years as the national flocks/herds have declined but further decrease in production in relation to demand might raise the farm-gate price and improve its gross margin. The arguments in favour of the other fodder crops are even weaker, as most lack the virtues of being leguminous and perennial.

17.3 Returns to Individual Inputs

One drawback of simple gross margin analysis is that estimates are based on the current yield in relation to the current deployment of inputs. It begs the question about whether or not current husbandry represents an optimal use of resources. Analysis of the returns to individual inputs cannot provide a definitive ranking of their importance since had there been a change in the level of an input used, for the reasons discussed in Section 12, the impact on the return could be considerable. However, the ranking of the returns to inputs provides some clues to their relative importance. Table 17.2 shows the average ranking of the returns to inputs for the main crops, averaged over all the sample fields.

Table 17.2 Ranking of Returns to Inputs in Main Crops

Cotton	Lucerne	Rice	Winter wheat
Agro-chemicals	Labour	Labour	Fertiliser
Water	Machinery	Water	Agro-chemicals
Seed	<i>Fertiliser</i>	Fertiliser	Machinery
Fertiliser	<i>Seed</i>	Agro-chemicals	Seed
Labour	<i>Agro-chemicals</i>	Seed	<i>Labour</i>
Machinery	<i>Water</i>	Machinery	<i>Water</i>

Note: Inputs with negative returns are shown in *italics*.

The first observation from this table is that it is impossible to generalise about crops because the relative ranking of the factors of production is quite different for each of the four main crops. A big return may indicate that the factor is either not yield-limiting or that it is under-invested in production of the crop.

Agro-chemicals give a big return in cotton and wheat, but much less in lucerne and rice. If low level of usage is not limiting achievement of yield in cotton and wheat, then increased rates of use would may not increase yield and would almost certainly reduce the return to agro-chemicals. However, observations on the crops (described in Section 13) suggest that certain pest damage may well be yield limiting so that effective use of pesticides is expected to improve yield of cotton and wheat. Effective use implies an *Integrated Pest Management* approach to pest control.

The elements of IPM are strategic application of pesticide or release of biological control agents based on monitoring of pests and their natural predators. Application or release is at a point in the life cycle of the pest when the smallest dose will be effective in control, by the most efficient means of application, causing minimum damage to other organisms. Biological control is by the release of a predator of the crop pest that may or may not occur naturally in the crop environment, and has been most successfully developed in the area for control of *Heliothis armigera* on cotton. On the basis that the early cotton bolls are much more valuable than late bolls, and evidence that attack on by *Heliothis armigera* only becomes serious in late season, this pest may not be causing the largest economic loss of cotton production. Biological control of the pests that cause most damage in cotton and wheat has not been proven, or in some cases developed in Central Asia, so that at present there may be no effective alternative to the use of pesticides within an IPM programme.

Fertiliser gives a relatively low return in cotton, lucerne and rice but the highest return in winter wheat. Fertiliser rates on wheat are generally low by international standards, with the exception of nitrogen use in Uzbekistan. Nitrogen tends to add succulence to the foliage making it more susceptible to attack by mildew, the main pest recorded in wheat. Overuse of nitrogen on irrigated wheat in Uzbekistan, without control of stem height by hormone, has been observed to commonly cause lodging of the crop and consequent loss of yield and quality. Soil analysis data discussed in Section 14 suggest that heavy rates of use of fertilisers in the past is responsible for the majority of soils having moderate levels of available phosphorus (P) and that high reserves of weatherable minerals endow the soils with adequate potassium (K). However, some 18 percent of soil samples in 1997 were rated "low" in available P and most crops grown on them are very likely to respond economically to fertiliser P, but most crops grown on the 73 percent of "medium" status soils may also be likely to respond. Where secondary salinity is marked, measurement of the soil's K status is somewhat academic, but cotton and lucerne are gross feeders of K and responses in these crops should be expected on perhaps more soils than had previously been expected.

Not much may be concluded from the data on the financial return of crops to the financial cost of water, partly because water is seriously under-priced in all republics, and partly because the total quantity of water applied is a poor determinant of crop response. The length of the irrigation interval between successive irrigations and hence the extent of the moisture stress on the crop is considered more important. Improvement of irrigation schedules may be the single factor that holds the greatest potential to improve crop yields. This could be achieved at the same time as a reduction in water used, directly saving on the economic cost of water, and even more indirectly in reducing damage to the environment and to the crop from salinity.

The overall average return to the use of machinery is the smallest of all the factors of production, due mainly to this being the largest cost in most crop production. The converse of the argument above is that if machinery use is not yield-limiting then the poor return to this factor make indicate that machinery is being used excessively.

17.4 Conclusions

From the foregoing, the conclusions therefore are as follows:

Farm profit is determined by the total gross margin of all the enterprises, the size of the overhead costs and the level of direct taxation;

- Overall gross margin of crop enterprises could be markedly increased on Central Asian farms by maximising the marketable area of the crops with the highest benefit:cost ratios while reducing or eliminating the production of crops with small and negative returns;
- Improved management of crop production, particularly in regard to the timeliness of operations, could significantly increase the yield of crops without greatly increasing either the variable or overhead costs of the farm;
- Judiciously increased use of pesticides and N, P and K fertilisers, paid for out of savings in reduced use of machinery, could increase crop yields without greatly adding to the variable cost of production;
- WUFMAS has not measured the size of farm overhead costs nor the efficiency with which these resources are used, and therefore is unable to make recommendations on the contribution that improved efficiency might make to increasing farm profitability.