8. MECHANISATION

8.1 Introduction

The study by WUFMAS of machine use and costs of mechanised operations on different crops and in different Central Asian Republics (CAR) was continued in 1997. The procedure for estimating tractor operational costs follows the pattern of that in the WUFMAS 1996 report; it is described in Appendix 5. The main changes in 1997 concerned the list of machinery and the prices for fuel and lubricants, and these are taken into account in the calculations.

The share of new, imported machinery in the agricultural production of the region increased in 1997. The number of “Magnum” tractors and “Case” combines from USA increased in Uzbekistan, new machines in Kazakhstan were mostly “John Deere” combines from USA (farm 4), and in Kyrgyzstan they were “Caterpillar” tractors and others from Canada and USA. The proportion of imported machinery in the machinery pools of the Central Asian republics is presently small and does not significantly influence labour productivity and the amount of mechanised work. In coming years, due to the effect of foreign investments, the machinery in the pool is likely to be replaced by machines imported from western countries and manufactured locally by joint ventures. Such machines may have higher productivity in mechanised operations and cause less harvesting losses, but are very expensive (up to 4 times higher than equivalent local and regional products). This is significantly influencing the variable costs in agriculture, and it is recommended that this matter should be studied in more detail during WARMAP 2. In the 1998 field monitoring it is necessary to keep separate accounts for machinery cost between imported and locally made machinery.

Some of the principles of mechanisation during the Soviet period were somewhat different to those in western economies and need to be understood before appropriate decisions can be made on the future needs of mechanisation in Central Asia.

8.2 Zonal Machinery Systems

In the centralised planned economy of the Soviet period, there was a system of customising machines for specific tasks, with norms for their operation. These principles were applied variously to crop and livestock production, and to land reclamation work in the different natural economic zones. It was considered that the machinery complex was functioning efficiently if their design, productivity and reliability corresponded to the natural and climatic conditions, and the requirements of the farming system. The following factors were considered:

- operating conditions;
- crop rotation, farm structure and crop areas;
- agricultural, biological, technological and organisational requirements;
- normative performance ratings of machinery and its annual use.

The machinery for crop production, harvesting and post-harvest operations, and for land reclamation included general purpose machines (tractors, machines for soil cultivation, seedbed preparation, applying mineral fertilisers and plant protection chemicals), and specialised machines for:

- cereals, legumes, buckwheat and grass seeds;
- herbs and silage crops;
- industrial crops (cotton, hemp, flax, kenaf and the others);
- field production of potatoes and vegetables;
- melons;
- orchards and vineyards;

- agricultural crops grown on steep slopes;
- tea, citrus, tobacco, hops, essential oil crops;
- livestock and poultry farms mechanisation;
- water supply to livestock farms and pastures;
- land reclamation work and forestry;
- irrigation.

This degree of machinery specialisation was justified by the size of the farms and regional specialisation in agricultural production; for example wheat in Kazakhstan, cotton in Central Asia, essential oil crops in Crimea. Central planning required central management of large irrigated areas, more than 10,000ha on some kolkhozes and sovkhozes, and mechanisation and supply of equipment was the responsibility of the state organisation Selkhoztechnika. Although there was some encouragement of honest workers in the machinery pools through bonuses, Government awards and diplomas, it has to be said that there were no effective economic incentives for careful treatment of machinery by drivers and mechanics.

After the USSR collapsed and privatisation began, small farms of 5 to 100 ha appeared, especially in Kazakhstan and Kyrgyzstan, and machinery was given to the farmers. The economic condition of the remaining state farms worsened greatly, resulting in the decay of the machinery pools. The purchase of new machinery and spare parts proved to be very difficult due to the lack of funds for both state and private farms. For this reason, the primary expedients during transition to a market economy and new forms of farming in the CAR (private farms, associations, leasing, etc.) are efficiency in machinery use and production of profitable crops. The approach to crop and livestock production under the new market conditions should be based on economic incentives to farmers.

8.3 Mechanisation Norms

Different understanding of the term “norm” is discussed in Section 2. Mechanisation “norms” were established during the Soviet period to determine

- the number, type and size of machines that were required on a particular farm,
- the amount and frequency of work that each was required to make in a particular crop, and
- the payment to be made to the operators.

The number and type of machinery depends upon the cropping pattern on the farm. The required normative number of tractors and implements, and other machines per ha of cultivated area is shown in Table 8.1. Rates vary from 167ha for a track-laying tractor required for lucerne production to 8ha per wheeled tractor for vegetable production. Tractor implements are expected to be more numerous with only 2 to 10ha allowed per implement.

The norms for tractor use on agricultural operations for the main crops of the CARs are given in Table 8.2. The total of tractor time working on the main crops varies from 20 to 58 hours per ha. Medium sized, wheeled tractors in the power range 60-100hp, are preferred to the larger track-laying tractors.

Table 8.3 shows that there are differences between republics and that norms are being modified as time goes on. The differences largely reflect agro-ecological zoning, but the degree of farm mechanisation has declined since the period 1960-1980, especially in Kyrgyzstan and South Kazakhstan. In addition to land preparation and crop operations, sprinkler systems were used extensively: mainly DDA-100MA and DDN-100 sprinklers powered by the DT75M tractor, and “Cuban” with diesel and “Voljzanka” with petrol engines. A special study of non-traditional irrigation methods in the CAR during WARMAP1 showed that before 1992 the sprinkler area in Kyrgyzstan was 110,000ha, in Kazakhstan 33,000ha and in Uzbekistan 5,000ha. Current use of sprinklers in Kyrgyzstan is 6,000ha with none in

Kazakhstan and Uzbekistan. Normative values were changed in 1996/7 to reflect the return to manual irrigation.

Table 8.1 Crop Machinery Requirement Norms (no. units/ha)

Type of machine	Crop								
	Cotton	winter wheat, rice	grain maize, silage maize	lucerne for forage, for seeds	Potato	vege-tables (tomato, cabbage)	winter interim crops (triticale, winter rye, sorghum)	sugar beet (for seed)	tobacco
Track-laying tractors	0.025	0.016	0.022/ 0.02	0.006	0.018	0.016	0.021	0.039	0.018
Wheeled tractors	0.04	0.028	0.066/ 0.091	0.041	0.034	0.133	0.055	0.017	0.03
Harvesters (self-propelled)	0.023	0.009	0.002/ 0.009	0.006	0.011	0.09	0.022	0.018	
Other self- propelled machines (vehicles, excavator, loaders etc.)	0.032	0.03	0.002/ 0.001	0.04	0.139	0.217	0.075	0.01	0.048
Implements (plough, harrow, ditcher, planter, grain cleaner, sprayer etc.)	0.266	0.105	0.256/ 0.196	0.208	0.366	0.52	0.286	0.229	0.293

Source: Ministries of Agriculture, Central Asian Republics

Table 8.2 Norms of Tractor Use by Operations on Main Crops (in hours/ha)

Crops	Operations	Tractors		Total
		track-laying	Wheeled	
Cotton in 90cm rows	Primary land preparation	7.86	16.02	23.88
	Seedbed & crop operations	0	12.68	12.68
	Harvesting	3.08	9.08	12.16
	Total	10.94	37.78	48.72
Winter Wheat	Primary land preparation	2.96	10.93	13.89
	Seedbed & crop operations	0	3.48	3.48
	Harvesting	0	12.6	12.6
	Total	2.96	27.01	29.97
Rice	Primary land preparation	24.49	11.53	36.02
	Seedbed & crop operations	1.33	1.58	2.91
	Harvesting	0	18.65	18.65
	Total	25.82	31.76	57.58
Mature Lucerne	Crop operations	0	3.59	3.59
	Harvesting	0	26.6	26.6
	Total	0	30.19	30.19
Maize for grain And silage	Primary land preparation	7.04/5.84	16.04/22.99	23.08/28.83
	Seedbed & crop operations	0	5.29/4.91	5.29 / 4.91
	Harvesting	1.29/3.49	18.67/21.0	19.96/24.49
	Total	8.3 / 9.33	40.8 / 48.9	48.33/58.23
Sorghum	Primary land preparation	4.13	0.18	4.31
	Seedbed & crop operations	0.55	0.88	1.43
	Harvesting	8.92	1.43	10.35
	Total	13.6	2.49	16.09

Source: Ministries of Agriculture, Central Asian Republics

Comparison of the Central Asian normative values, given in Table 8.1 to 8.3, with international values given in Table 8.4 shows that machinery use is locally expected to be far greater than in western producing countries. The design of local equipment resembles those available many years ago in free-market economies, where today the productivity of implements is significantly greater. A second reason for the difference is that, as explained in Section 2, the local “norms” are an instruction or recommendation to operators, but international norms are an estimation of values typically in use. A third reason is that local

"norms" aim to maximise crop yield (or avoid loss of yield for want of extra crop operations), whereas free-market farmers aim to maximise their profit and are more concerned with economic efficiency of machinery use.

Table 8.3 Norms of Tractor Use by Crop from Different Sources (hours/ha)

Crop	Uzbekistan Ministry of Agriculture (1997)			Kyrgyzstan Ministry of Agriculture (1992)		
	Tractors		total	Tractors		Total
	track-laying tractor T-4A, DT	wheeled tractor MTZ, T-28x4		Track-laying tractor T-4A, DT	Wheeled tractor MTZ, T-28x4	
Cotton under plastic sheets in 60cm rows	7.04	38.49	45.53			
Cotton in 60cm rows	12.85	45.25	58.1	4.29	54.21	58.5
Cotton in 90cm rows	10.94	37.78	48.72			
Ditto but from 1987	*10.32*	*41.60*	*51.92*			
Winter wheat, irrigated	2.96	27.01	29.97	12.49	7.82	20.31
Winter wheat, rain fed	5.43	3.92	9.35	2.64	5.19	7.83
Rice	25.82	31.76	57.58			
Rice planted under water	21.73	35.04	56.77			
Maize grain	8.30	40.00	48.33	6.76	23.05	29.81
Silage, maize	9.33	48.90	58.23	5.13	19.72	24.85
Lucerne for fresh forage		30.19	30.19	14.04	6.85	21.3
Forage beet	3.57	30.26	33.83			
Sugar beet				23.95	3.16	27.11
Sorghum for green forage				13.60	2.49	16.09
Onion	3.53	6.98	10.51			
Spring wheat				21.33	6.85	28.18
Spring barley				21.33	6.85	28.18

Note:
1) Normative use of track-laying tractors in Kyrgyzstan is higher due to use for irrigation of lucerne and wheat by sprinkler systems DDA - 100 M, DDN - 100, mounted on track-laying tractor DT - 75;
2) Fertilisers, pesticides and harvested product are transported in Kyrgyzstan by lorries (SAZ 3502, GAZ – 53 and others) and in other CARs tractor & trailers are used for this purpose;
3) Maize for silage: autumn in Uzbekistan & Kazakhstan but spring in other republics.
Source: Ministries of Agriculture, Central Asian Republics

Table 8.4 International Norms for Tractor Use

Type	Machinery use Hour/ha
By operation:	
Land preparation, ploughing (tractor 45-50 kW, 60-79 hp)	
Light soils	1.0-1.5
Medium soils	2.0-3.0
Heavy soils	3.5-4.5
Seedbed preparation	1.0-2.0
Making furrows	1.0-2.0
Seeding, applying fertilisers	1.0-2.0
Interrow cultivation	1.0-2.0
Harvesting	1.0-2.0
Rice harvesting	2.0-4.0
By crop:	
Cotton (making furrows and 4 cultivations)	25
Winter wheat	8
Lucerne (5-6 cuttings) fresh/hay	12.0 - 16.0
Maize for silage/grain	9.0 - 10.0
Rice (with a lot of manual labour use)	5

Source: Agricultural Compendium, 2nd Edition, 1994, Elsevier, Amsterdam

8.4 Availability and Condition of Machinery

The number and current condition of agricultural machinery was recorded on the WUFMAS 22 sample farms in April 1997. The data on tractor numbers are summarised and compared with the normative requirements in Table 8.5.

Table 8.5 Tractors per Farm: Norms and Number Actually Operating

	Type	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Norms	Tracked	62	59	53	79	82	71
	Wheeled	102	96	84	126	133	116
Actual operating	Tracked	23	14	8	9	16	16
	Wheeled	41	74	29	27	52	49
Operating as % norm	Tracked	38	24	14	11	20	22
	Wheeled	40	77	35	21	39	43

Overall, the tractors that are actually operating and available on the sample farms are only 22 and 43 percent of normative values for tracked and wheeled tractors respectively. The situation is most serious in Turkmenistan where the proportion for both types is only half the overall average. For tracked tractors the situation is best in Kazakhstan and for wheeled tractors it is best in Kyrgyzstan, the two most liberalised economies where crop gross margins are generally higher and where foreign exchange is relatively easily available. The total number of machines, including those that are not in operational condition, also is far short of the normative requirements. This suggests either that the farms were always under-supplied or that some of the older and derelict machines have been removed without being replaced.

Western criteria do not consider the number of units per farm but rather the cultivated area per tractor and their annual hours of use. Table 8.6 summarises machinery availability on the sample farms in terms of the irrigated crop area per machine.

Table 8.6 Irrigated Crop Area per Machine (ha)

Category	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Machines of all condition						
Wheeled tractors	225	119	211	201	98	159
Tracked tractors	380	587	662	539	303	465
Harvesters	283	429	618	460	217	358
Other SP machines	566	343	no data	230	165	370
Implements	30	33	124	84	18	37
Other machines	1074	893	1159	1043	444	872
Operational machines only						
Wheeled tractors	297	145	320	295	123	209
Tracked tractors	523	766	1236	920	396	668
Harvesters	439	631	976	1303	334	584
Other SP machines	811	482	no data	602	247	609
Implements	33	42	155	119	20	44
Other machines	1352	1128	1426	1422	507	1077

Farms in Uzbekistan, on average, were the best equipped with machinery and implements of all types, and the farms in Tadjikistan were the least well equipped. Wheeled tractors were overall three times more popular than tracked tractors in terms of numbers supplied, but the latter were much more popular in Kazakhstan and Uzbekistan than in the other republics. Combine harvesters likewise were most commonly supplied to Kazakhstan and Uzbekistan and were least popular in Tadjikistan. Farms in Uzbekistan received a large number of implements in contrast to Tadjikistan where they are seven-times less common on average. The Ist May farm in Tadjikistan was a particularly large and important dairy farm up to

independence, and with a large fruit tree orchard, which may explain the lower level of mechanisation.

Maintenance of farm machinery is one of the most important priorities for the farm management, in the light of a shortage of cash and the increasing age of machinery. Table 8.7 presents the average current condition of machinery of different types in terms of the proportion operational, repairable and derelict. Wheeled tractors are in marginally better state of repair than tracked tractors, which may reflect the greater rate of replacement of wheeled tractors and younger average age of the fleet. Tracked tractors are still preferred for heavier work, mainly ploughing, but recent imports of large tractors from USA and Europe are intended to take over this role. About three-quarters of tractors on the farm are operational and only 5 percent are derelict. The situation is marginally worse in Tadjikistan and Turkmenistan, and better in Kyrgyzstan and Uzbekistan.

The condition of harvesters and other self-propelled machines (farm vehicles, draglines, graders, etc) is less favourable, with only 61 percent overall operational. With these categories of machinery, the situation in Turkmenistan is markedly worse than in the other republics, where only about one third of such machines is operational. Shortage of fuel and cash for repairs tends to limit the use of these machines even though they may be operational. Implements generally are in a relatively good state of repair with only 2 percent overall abandoned and 85 percent operational. Implements generally are simple and out-of-date, and although operational, they often are not very efficient. Stationary and trailed (other) machines, such as pumps and concrete mixers, are mostly operational and few have been abandoned.

Table 8.7 Current Condition of Farm Machinery

(percent of total number)

Condition and Type	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Operating						
Wheeled tractors	76	82	66	68	79	76
Tracked tractors	73	77	54	59	77	70
Harvesters	65	68	63	35	65	61
Other SP	70	71	No data	38	67	61
Implements	92	78	80	70	87	85
Other machines	79	79	81	73	88	81
Repairable						
Wheeled tractors	14	14	34	24	17	19
Tracked tractors	20	18	46	34	18	25
Harvesters	31	28	37	65	30	35
Other SP	27	28	No data	35	28	30
Implements	6	22	20	18	11	13
Other machines	18	21	19	20	12	17
Derelict						
Wheeled tractors	10	4	0	8	3	5
Tracked tractors	7	5	0	7	5	5
Harvesters	5	4	0	0	5	3
Other SP	3	1	No data	26	5	10
Implements	2	0	0	12	2	2
Other machines	3	0	0	7	1	2

Table 8.8 compares the average number of working tractors per 100ha and the number of tractor working hours per year in each republic with the approximate corresponding norms. Most tractors work fewer hours annually than the norm, because of the shortage of cash to buy the necessary spare parts and diesel and perhaps to reduce costs.

Table 8.8 Tractor Availability and Annual Use

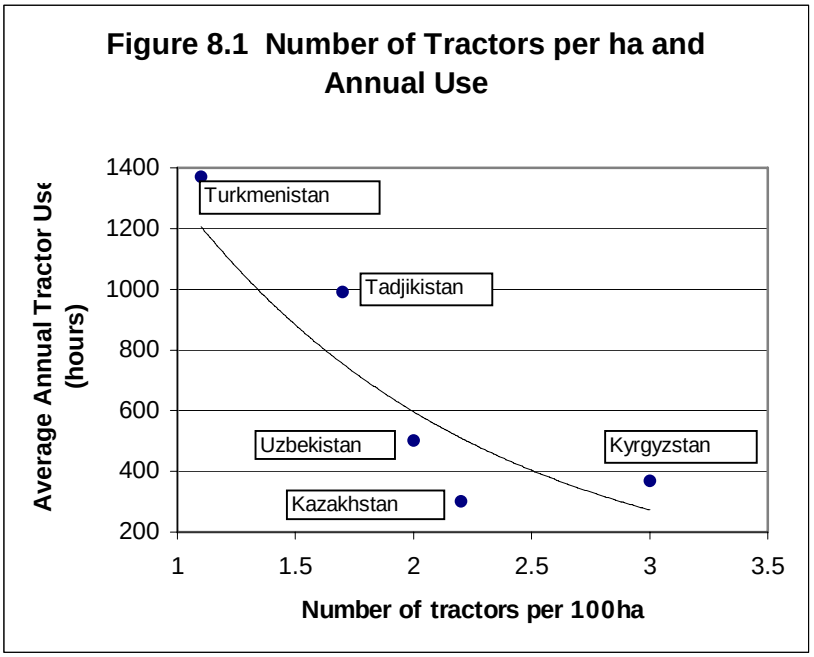
Republic	Predominant crops	Norm		Actual	
		Unit/100ha	annual work hours	Unit/100ha	annual work hours
Kazakhstan	Rice, lucerne, cotton	5.0	900	2.2	301
Kyrgyzstan	Winter wheat, lucerne, cotton	5.0	1000	3.0	369
Tadjikistan	Cotton, winter wheat	6.5	1100	1.7	990
Turkmenistan	Cotton, winter wheat	6.5	1100	1.1	1370
Uzbekistan	Cotton, winter wheat	6.5	1100	2.0	502

However, the effect of the deteriorating machinery situation may be that operational tractors are forced to work for more hours in the year, most notably in Turkmenistan and Tadjikistan. This is illustrated in Figure 8.1 using mean values for the five republics. The WUFMAS programme only records the **"productive use"** of machinery, that is, as a variable cost in crop enterprises. The use of machinery as a fixed cost is not recorded, that is, in operations that are not directly involved in crop production, such as in maintenance of farm roads, canals and drains, transport to and from market. The WUFMAS programme at present also does not record the variable cost (use) of machinery in livestock enterprises, other than in production of fodder. The total annual use of machines therefore is unknown. However, it is something of a paradox that a crisis in maintenance and availability of machinery may be necessary to force a reassessment of priorities for use of machines. The evidence is that in Kazakhstan, Kyrgyzstan and Uzbekistan, average use of operational tractors for only 400h annually is well below the norm of about 1000h, suggesting that farms alternatively are

- still over-equipped (certainly by international standards, but also by local "norms",
- over-equipped in relation to the cash available to buy fuel,
- using machinery inefficiently,
- allocating priorities for machinery use around the farm without regard to the financial implications, or
- making rational economic decisions to reduce cost and increase gross margins.

Which of these possible explanations is true cannot be answered at present, but it seems likely that all are relevant to a greater or lesser extent.

Figure 8.1 Number of Tractors per ha and Annual Use



8.5 Age of Machinery

The age distribution of machinery at farm Garfar Guliyam, Syrdariya Oblast, is illustrated in Figure 8.2. This sample farm is the research station of the Central Asian Institute for

Irrigation Research (SANIIRI), and as such it continued to receive machinery during the last 5 years, tractors and cotton harvesters in particular.

Figure 8.2(a) Age of Machinery, Farm No 23, Syrdariya

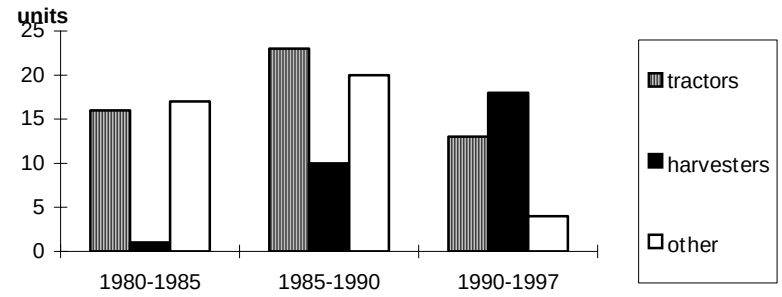


Figure 8.2(b) Age of Machinery, Farm No 23, Syrdariya

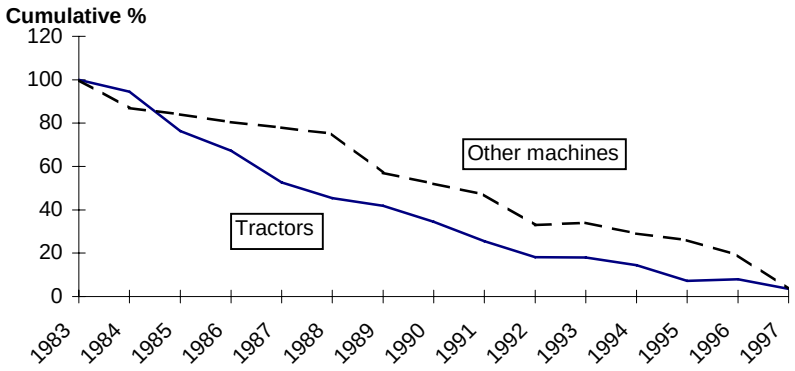
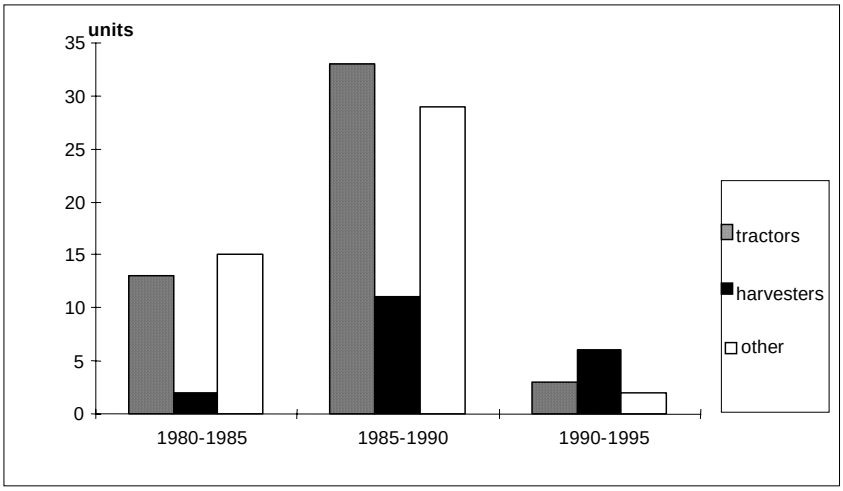


Figure 8.3 Age of Farm Machinery, Farm No 7, Kyrgyzstan



The situation on the state farm Rassvet, near Bishkek, is more typical of most sample farms and is illustrated in Figure 8.3. After independence, almost no new equipment was received due to the shortage of finance and the lack of a long-term financing procedure. The average age of machinery is now well beyond the normal operating life and 90 percent is now more than 8 years old.

8.6 Machinery use in 1997

Overall average recorded time inputs of all machines used on specific crop operations in the WUFMAS sample fields in 1996/97 are summarised in Table 8.9. For comparison, the table shows the corresponding totals of recorded inputs in 1995/96, local “norms” and typical values from international experience.

Table 8.9 Machinery Use by Crop (h/ha)

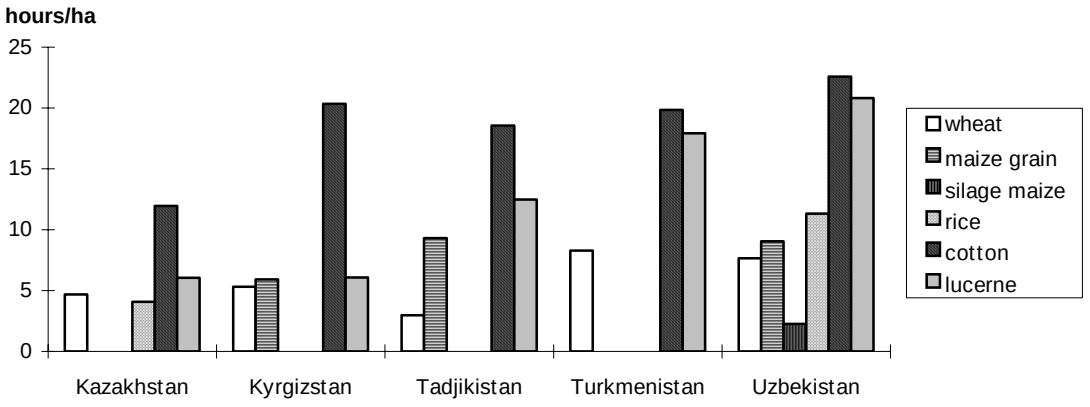
Crop	Primary land tillage	Seedbed preparation and growing	Harvesting	Operations after harvesting	Total recorded tractor use 1997	Total recorded tractor use 1996	Local "norm"	Interna-tionally typical value
Apple	0.0	0.0	1.4	2.9	4.3	3.6		
Apricot	0.0	0.0	0.0	0.0	0.0	0		
Apricot with maize	1.1	0.0	0.0	0.0	1.1	6.6		
Barley, winter	0.0	3.8	0.8	2.7	7.3	3.8		
Barley, spring, with lucerne	1.0	1.7	1.2	3.5	7.4			
Cotton, upland	3.1	11.7	0.9	4.2	19.8	19.1	49-58	25
Cotton, pima	5.5	14.6	0.0	4.5	24.6	22.8		
Cucurbits	8.0	0.7	0.0	13.1	21.8	22.4		
Green gram	1.8	0.8	0.0	0.0	2.7	8.3		
Lucerne	0.1	0.5	8.3	10.6	19.5	11.5	30	12-16
Maize, grain	2.2	3.2	1.1	1.6	8.1	11.0	48	9-10
Maize, silage	1.9	1.7	1.4	4.0	9.0	8.9	58	9-10
Oats	2.9	1.5	1.0	8.5	13.9			
Onions	1.9	1.2	0.0	0.0	3.1	4.6		11
Rice	1.7	2.0	2.0	6.3	12.0	10.9	58	5
Sorghum	0.0	2.9	2.3	3.9	9.0	3.1	16	
Sugarbeet	3.3	2.9	2.4	0.0	8.6	9.5	27	
Sunflower	0.8	2.4	0.0	0.0	3.2			
Tobacco	2.5	3.8	0.0	0.0	6.3			
Wheat, spring	0.7	1.3	2.0	2.0	6.0	5.4	28	
Wheat, winter	1.7	2.0	2.2	3.0	8.9	5.4	30	8

In the previous season there were 36 sample farms compared with only 22 in 1997, and data for crops in the 1995/96 period were estimates, as WUFMAS began only in April 1996. It is believed that on balance, the data for 1997 are the more reliable. Total machinery use is much the same in both years for the main crops, excepting lucerne and winter wheat, which showed a substantial increase (but this is due to under-estimates made for winter 1995/96, before enumeration began).

Measured rates of machinery use on average are only 15 to 38 percent of local “norms”. This largely reflects the serious condition of the Central Asian machinery pools and the lack of cash for fuel and spare parts. However, it is likely that operators of the privatised farms of Kazakhstan and Kyrgyzstan have become aware, as their counterparts in other free-market economies, that the use of expensive machinery needs to be justified by visibly good marginal returns, and that “normative” rates are economically unrealistic. This is confirmed in Table 8.9 where local rates correspond more closely with “typical” values from international experience than with local “norms”. Nonetheless, there is some evidence with cotton, maize and wheat that the current financial situation is constraining machinery use to a level below that regarded as normal in other producing countries. This may reflect the substitution of machines by labour as machine costs and labour resources increase.

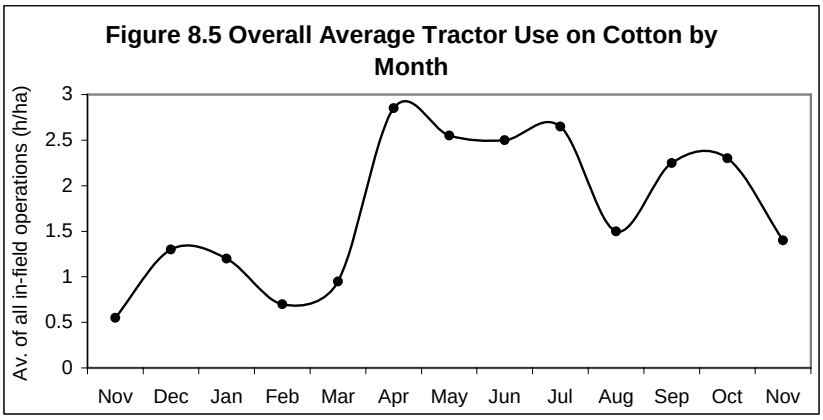
Considerable variation exists between republics in the average use of machinery on different crops as illustrated in Figure 8.4. As observed earlier, it is in the two command economies of Turkmenistan and Uzbekistan where machinery use is greatest and closest to the “norms”. In Turkmenistan, this is despite the relatively poor state and number of operational farm machines, which leads to operational machines being used more intensively.

Figure 8.4 Average Machinery Use on Main Crops by Republic



There is considerable variation month by month in the use of machinery in crop production. This is illustrated in Figure 8.5 by the average monthly tractor hours/ha recorded in cotton fields on 22 sample farms. Preparation of the seedbed, planting, fertilising and making temporary irrigation canals during April requires marginally more tractor time than in other months. Side dressing of fertilisers, ridging and interrow cultivation takes much the same amount of tractor time in each of the months of May, June and July. In the absence of any significant crop protection, the need for tractors during August is much less, but demand again increases during September and October for harvesting operations. Another feature of monthly machinery use is that there is considerable variation between fields of the same crop on a farm, and particularly between farms, even neighbours.

Figure 8.5 Overall Average Tractor Use on Cotton by Month



The proportional use of wheeled and tracked tractors in the main crops is shown by republic in Table 8.10.

Overall, the pattern of use of tractors reflects the availability of operational machines on the farm, with wheeled tractors being more important than tracked tractors. Tracked tractors are used mainly for grading, ploughing and seedbed preparation and almost all other operations are by wheeled tractors. Tracked tractors are relatively more important in Kazakhstan than in other republics, where they provide almost half of tractor time. Tracked tractors are used more heavily in grain crops because most of the machinery use for these crops is for land

and seedbed preparation. The very small use of tracked tractors in lucerne reflects the small proportion of land preparation in this crop of typically four years duration.

Table 8.10 Average Use of Different Tractor Types by Crop
(% of all tractors)

Crop	Kazakhstan		Kyrgyzstan		Tadjikistan		Turkmen-istan		Uzbekistan		Overall	
	wheel	track	wheel	Track	wheel	Track	wheel	track	wheel	track	wheel	track
Cotton	62.3	37.7	91	9	82.3	17.7	76	24	83.1	16.9	78.9	21.1
Lucerne mature	99.8	0.2	96.8	3.2	100	0	98.9	1.1	99.2	0.8	98.9	1.1
Rice	67.4	32.6	-	-	-	-	-	-	78.8	21.2	73	26.9
Winter wheat	38.2	61.8	71.5	28.5	100	0	74.5	25.5	79.5	20.5	72.7	27.3
Maize grain	16.4	83.6	47.1	52.9	73.1	26.9	-	-	60.7	39.3	49	50.6
Average	56.8	43.2	76.5	23.5	88.8	11.2	83.2	16.8	80.3	19.7		

8.7 Variable Costs of Machinery

The international definition of “variable cost” is significantly different to the same term that is locally familiar and this can lead to misunderstanding.

8.7.1 Definition of Variable Cost of Machinery

WUFMAS calculates the variable cost of machinery as the product of operating price and the hours of **productive use** on the crop. Operating price is a unit rate, US$ per hour, and the method for estimating values for different machines and machine combinations is presented in Appendix 5, and includes imputed as well as visible costs. Productive use of machinery is summarised in Section 8.6. It is also a unit rate, in hours per ha, the total of inputs recorded by enumerators from the time of arrival of machines in the sample field until their departure (less any down time), plus any machinery use on the crop product after harvest. All other machinery use on the farm is unrelated to a specific crop enterprise and is either part of a livestock variable cost or is a farm fixed or “overhead” cost.

By contrast, as a “variable cost” in the Soviet system, total machinery cost for the farm is subdivided on the basis of cropping pattern and machinery “norms” and allocated to each crop enterprise. It therefore includes a portion of fixed costs as understood internationally, and takes no account of imputed costs.

8.7.2 Machinery Operating Prices

Individual farms choose to use different machines and combinations of machines to do specific land and crop operations, partly from personal preference and partly on account of the machinery available. For this reason, the most likely combination of machines is used to summarise the machine operating prices shown in Table 8.11. The basis of this approach is that even on a kolkhoz, the machinery is “notionally” rented to the field that is producing a crop, as a hire charge from the machinery pool. This approach is more obviously necessary where the machinery pool has been privatised, and where individual leaseholders are farming the land on their own account and hiring machinery from neighbours or machinery pools. The types of operation are summarised in terms of the four main categories, but the values disguise considerable variation within the categories, caused mainly by the type of tractor. Machines of high capacity and imported from western countries are very much more expensive than those of CIS origin and this reflects in higher price per hour, but for heavy tasks, the greater productivity of larger machines more than compensates. Variation in rates between republics is caused mainly by the difference in the financial price of fuel.

Table 8.11 shows that average prices for 1997 have increased compared with those estimated in 1996, particularly for Turkmenistan. The main reason is the change in the price

of fuel in dollar terms since 1996. The use of expensive imported machines so far has had little impact on average price as they represent a small proportion of total machines in use. However, if this proportion increases in future and unless greater attention is paid to using these machines more efficiently, the average price of operations is likely to rise.

Table 8.11 Average Price of Types of Machinery Operation (US$/h)

Oper-ation	Kazakhstan		Kyrgyzstan		Tadjikistan		Turkmenistan		Uzbekistan		Overall		Change from 1996 (%)
	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	
Primary land preparation	11.2	9.1	9.2	8.7	14.7	13.1	9.2	17.6	15.6	16.5	12.0	12.8	6
Seedbed & crop operations	4.9	6.3	4.9	5.7	7.0	10.5	3.6	7.6	6.1	9.1	5.3	7.9	49
Harvesting	12.3	12.7	12.3	16.6	15.5	11.2	10.5	19.4	14.0	20.9	12.9	16.2	25
Post-harvest operations	6.2	7.0	6.2	7.4	9.6	5.5	4.3	7.7	8.0	8.8	6.9	7.7	13
Average	8.7	8.8	8.1	9.6	11.7	10.1	6.9	13.1	10.9	13.8	9.3	11.1	23
Change from 1996 (%)		1		18		-14		89		26		20	

8.7.3 Variable Costs of Machinery

Section 12 discusses crop gross margins, the calculation of which uses the estimates of the variable cost of machinery made in each sample field. These estimates are summarised by average values for crops and republics in Table 8.12. Just as records of machinery use vary widely between fields and between farms, so too these averages disguise considerable variation for the possible reasons discussed above. The main crops, upland cotton, winter wheat, lucerne and maize, provide the most reliable averages being based on a larger sample. Gaps in the table indicate that some crops were not sampled by the WUFMAS programme during1997 in all republics.

This table also shows the values for the main crops as estimated in WUFMAS 1996. The increases in both the price per hour of machinery and increase in recorded use of machines in 1997 together are responsible for the big increase in the variable cost.

In nearly all estimates of total variable cost of different crops, the machinery component is by far the largest, as illustrated in Table 8.13. There is considerable variation between farms for the reasons discussed above, but also between crops and republics. For example, machinery costs for cotton and winter wheat respectively are 35 and 38 percent in Kyrgyzstan, and 74 and 83 percent of total variable cost in Tadjikistan.

For comparison of local machinery costs with a typical international value, Table 8.14 gives details of the machinery costs for winter wheat in UK. The total is $308/ha compared with the range in average costs from $138 in Turkmenistan to $215 in Uzbekistan. In UK, the machinery is about 36 percent of total variable cost, a somewhat lower proportion than in Central Asia.

Table 8.12 Average Variable Cost of Machinery Operations by Crop

($/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan
Apple	42				
Apricot			0		
Apricots with maize			33		
Barley, winter					115
Cotton, pima				192	
Cotton, upland	166	177	319	130	229
Ditto in 1996	*107*	*127*	*187*	*95*	*154*
Green gram			90		12
Maize, grain	33	105	149		128
Ditto in 1996	*157*	*66*	*142*	*78*	*54*
Maize, silage					329
Lucerne, mature	129	125	283	343	545
Ditto in 1996	*49*	*70*	*200*	*83*	*173*
Lucerne, young	106				76
Onion		151	47		
Rice	336				408
Sorghum			117		
Sugar beet		95			
Sunflower	34				
Tobacco		69			
Wheat, spring	141				
Wheat, winter	190	152	246	138	215
Ditto in 1996		*68*		*55*	*95*

Table 8.13 Cost of Machinery Operations by Crop and Year

(as Percent of Total Variable Cost)

Crop	Kazakhstan		Kyrgyzstan		Tadjikistan		Turkmenistan		Uzbekistan	
	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Upland cotton	42	55	37	35	61	74	69	63	51	55
Winter wheat	-	65	42	38	-	83	75	76	55	44
Spring wheat	51	37	53	-	-	-	-	-	-	-
Rice	38	51	-	-	-	-	-	-	30	33
Maize for grain	61	87	45	72	68	68	81	-	40	67
Maize for silage	75	-	76	-	66	-	66	-	62	52
Lucerne (mature)	85	85	89	93	87	100	98	99	95	97

Table 8.14 Typical Machinery Costs for Winter Wheat in UK

Machinery operation	Cost $/ha
Ploughing	57
Harrowing by disc	20
Drilling	25
Harrow by spring tine	20
Fertiliser broadcasting	11
Spraying (twice)	22
Combine harvesting	117
Baling, round	20
Transport	18
Total machinery	308

Source: from Nix, J. Farm Management Pocketbook, Univ of London, 1993
Inflated by 10% and converted at £=$1.63

8.8 Conclusions

It is clear that the existing norms for mechanised operations in the CARs are 1.5 - 2 times higher than in developed economies. Scientifically justified farming systems developed for the different zones of the USSR aimed to produce maximum possible crop yields. They either did not consider the economic interests of individual farms, or manipulated prices in

order to show a nominal surplus or subsidised operations directly. Moreover, the agricultural sector was regarded as a repository for industrial production, particularly of machinery.

In developed countries, the farmer is master of the land and is trying to use advanced technologies with minimum cost of operations to produce economically profitable crop yields. Soviet technical manuals show the ideal degree of mechanisation in terms of weight of metal (in kg/ha) and energy capacity (kWh/ha), operational costs, total farm costs, cost per t of production. However, for the operators of unprivatised farms these indices are abstract, as they lack economic incentives, and there is no personal interest in productive use of machines, reduction of labour cost and obtaining high yields. With improved legislation, tax policy and other conditions, it is obviously possible to move towards more efficient mechanisation. This is likely to involve the use of new, medium size, wheeled tractors with versatile implements for reducing costs and the production of profitable crops.