11. VARIABLE COSTS

11.1 Definition

The term “variable cost” is used in both Russian and English but has a different definition in terms of the method of its calculation. As an example from local farm accounts, the variable cost of machinery is the total annual cost of machinery allocated to cotton according to the proportion of cultivated area occupied this crop, and to its “normative” use of machinery. According to the western definition, this estimate includes an amount for the use of machinery that is not directly associated with any enterprise, a “fixed” cost, for example on road maintenance. The full explanation of “variable” cost in western parlance appears in the 1996 report. The critical difference is that it includes only costs that are directly associated with producing the crop, costs that would not be incurred if the crop is not grown. This excludes the cost of road maintenance, for example. Taking as a real example, crop operations in one specific brigade in May 1997, the entries in the farm report compare with the WUFMAS record sheet as follows:

Report of brigadier	WUFMAS record sheet
1. Ploughing	1. Land levelling
2. Land levelling	2. Chiselling
3.Chiselling	3. Making temporary field canals
4. Harrowing	4. Irrigating
5. Making temporary field canals	
6. Cutting of furrows	
7. Irrigating	
8. Discing	

Variable costs are estimated as the product of the rate of each input used per ha and its price. In the gross margin calculated for each field, each item is costed separately.

11.2 Input prices

These are given and discussed in Section 9, with the exception of hourly operating costs of different machines and implements, which are presented in Section 8.

There is a significant imputed component to the operating cost of farm machinery in Central Asia. Firstly, the majority of machines currently in use are now very old and their value has already been written off. However, they need to be replaced so that the operating cost of a machine used here includes a realistic depreciation component, despite the lack in most republics of an effective financial mechanism for doing so. Secondly, a major part of the maintenance cost of machines is imputed because many spare parts are “cannibalised” from derelict machines or are manufactured locally using materials and machinery that have already been written off. Thirdly, the engineers and mechanics, like farm labour, mostly are not paid cash salaries. Estimated operating costs for local machinery far exceed local perceptions of the cost. Unless the work output of the expensive machines imported from USA and Europe is substantially greater than from local machines, their hourly operating cost is much greater than machines originating in the CIS. With machinery representing the single largest component of total variable cost, the gross margins of crops are much less when imported machines are used.

It is important to note that the gross margins include an imputed cost for labour. Payment in kind for labour is more important at present than payment of wages in cash. Payments in kind are difficult to measure but contribute heavily to the farm fixed costs. They also are part

of the real variable costs of enterprises, but the only effective way to account for them is to use an imputed cost of labour.

11.3 Physical Inputs in Crop Production

The quantities of the inputs used in producing the crop have been measured at the boundary of the sample fields by the enumerators and converted to rates per ha in the database. Details of the variable costs for all sampled crops are given in Appendix 7. Variable costs of the main crops are summarised and discussed below.

11.4 Seed Rates

Average seed rates are given in Table 11.1. Rates vary significantly between farms for cotton and rice. They are markedly greater than in comparable areas abroad.

Table 11.1 Average Seed Rate for Main Crops

(kg/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Cotton	45	133	103	78	87	89
Rice	248				203	226
Wheat, winter	190	238	215	202	235	216

Lucerne is planted only once in three to five years, so that an annual average seedrate would be meaningless.

11.5 Use of Machinery

On every occasion when machinery was used in crop production, it was separately recorded, with details of the tractor size and type, and the type of implement, and the time between its arrival and departure from the field. For the purpose of this summary and because hourly rates vary greatly between types of operation, machinery use is aggregated by the operation code as follows:

- Primary land preparation
- Secondary land and seedbed preparation
- Crop operations from sowing to plant protection
- Harvesting of the crop
- Post-harvest operations specific to the crop in that field or after carting it away.

The use of machinery in these categories is summarised for the main crops in Table 11.2.

Cotton and lucerne, overall, use almost double the machinery of the grain crops. The differences between the farms within the republics were mostly highly significant whereas, for most crops, the differences between republic means are not significant. This indicates that machinery use mostly varies according to the circumstances of the farm. The exceptions are the marked and highly significant differences between the five republics in machinery for harvesting cotton and lucerne, mainly due to the preferred methods of harvesting the crop.

Machinery use on the main crops in 1997 was greater than in 1996: cotton by 14 percent, lucerne by 59 percent, wheat by 48 percent. These differences are more likely to be explained by improved recording by enumerators in 1997 than by any real increase in machinery use.

Table 11.2 Average Use of Machinery on Main Crops
(h/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Primary land preparation						
Cotton, upland	2.3	2.1	2.4	5.6	3.2	3.1
Lucerne	0.3	0.0	0.0	0.0	0.4	0.1
Rice	1.6				1.9	1.6
Wheat winter	2.7	1.3	0.3	2.3	1.7	1.6
Seedbed & crop operations						
Cotton, upland	8.7	17.0	10.1	12.4	10.4	12.0
Lucerne	0.3	0.5	0.0	0.4	1.3	0.3
Rice	1.8				2.2	1.8
Wheat winter	1.1	2.1	0.5	3.5	2.7	1.8
Harvesting						
Cotton, upland	3.7	0.0	0.5	0.0	0.1	1.0
Lucerne	3.9	2.8	12.5	11.2	10.9	7.6
Rice	2.6				1.5	2.6
Wheat winter	2.7	1.3	3.1	2.0	2.1	2.3
Post-harvest operations						
Cotton, upland	1.8	1.2	5.6	2.6	9.5	2.8
Lucerne	2.8	4.1	12.5	13.2	20.5	8.2
Rice	1.1				11.5	1.1
Wheat winter	0.8	3.7	1.6	3.5	5.4	2.4
Total machinery use						
Cotton, upland	16.5	20.3	18.6	20.6	23.2	19.0
Lucerne	7.4	7.3	25.1	24.8	33.1	16.1
Rice	7.0	0.0	0.0	0.0	17.0	7.0
Wheat winter	7.4	8.4	5.5	11.2	12.0	8.1

11.6 Labour Use

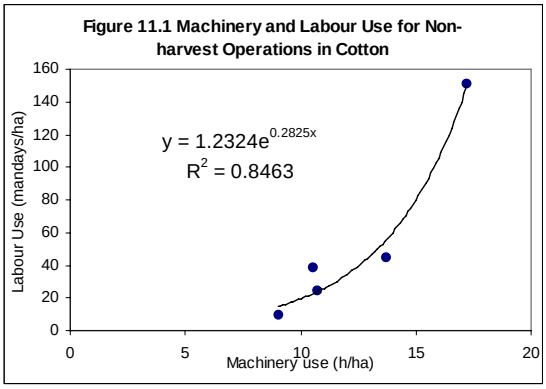
Labourers are partly full-time employees of the farm and partly casual workers from the village and elsewhere. WUFMAS makes no distinction when they are working in the field, but

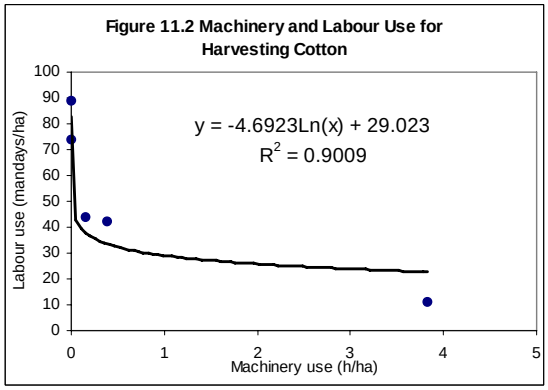
Section 6 gives details of the levels of employment on the farms by category of labour. As with machinery, from times of arrival to departure from the field, enumerators record the total time in man-hours spent there. Data are summarised for the main crops by non-harvesting and harvesting classes, in Table 11.3.

Table 11.3 Average Use of Labour on Main Crops
(mandays/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
For non-harvesting operations						
Cotton	10	151	39	45	25	54
Lucerne, mature	2	5	4	3	5	4
Rice	4				12	8
Wheat, winter	1	4	3	9	7	5
For harvesting						
Cotton	11	74	42	89	44	52
Lucerne, mature	0	0	0	0	1	0
Rice	0				4	2
Wheat, winter	0	1	3	0	1	1
Total Labour						
Cotton	22	225	81	135	67	106
Lucerne, mature	2	5	4	3	5	4
Rice	4				16	10
Wheat, winter	1	5	7	9	7	6

Very much more labour is used to produce cotton than the other crops, but the overall average is weighted somewhat by heavy use of labour in Kyrgyzstan. The rate of labour use for non-harvesting operations in cotton in Kyrgyzstan is three times higher than the overall average due to repeated manual weeding and topping. It is associated with increased use of machinery for crop operations as illustrated in Figure 11.1, using means for the republics.





Considerable hand-labour was used for harvesting cotton in Turkmenistan and Kyrgyzstan because there were no operational harvesting machines and the relationship is illustrated in Figure 11.2. The consequence to the average variable cost of producing cotton in Kyrgyzstan is that the level is more than double the overall average. Farm labour is paid in cash only for handpicking of cotton, which is a financial incentive that diminishes the need to use city-dwellers for cotton harvesting as in the past. Labour use on cotton is significantly greater in 1997 in comparison with last year.

Excepting cotton, the differences between the republics in crop labour use are not significant but differences between farms mostly are highly significant. With the exception of cotton, labour rates are generally in accordance with mechanised production of these crops.

11.7 Fertiliser Rates

Rates of fertiliser are particularly variable between different farms and crops so that these differences are highly significant while those between the means of republics are not. As the range in types of fertilisers available is quite broad, and their nutrient contents are different, the Systeme International (SI) convention of pure nutrients, N, P and K, is used to summarise rates of use. Simple averages for each main crop and republic are shown in Table 11.4.

Table 11.4 Average Fertiliser Rates on Main Crops
(kg of pure nutrient/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
			Nitrogen			
Cotton	46	96	86	69	142	110
Lucerne, mature	0	0	0	0	6	2
Rice	40				201	103
Wheat, winter	22	51	22	89	104	57
			Phosphorus			
Cotton	4	0	3	0	19	11
Lucerne, mature	0	0	0	0	5	2
Rice	3				50	21
Wheat, winter	10	0	0	0	26	7
			Potassium			
Cotton	0	0	0	0	8	4
Lucerne, mature	0	0	0	0	0	0
Rice	0				19	8
Wheat, winter	0	0	0	0	0	0

Note: Average fertiliser rates are expressed in pure nutrients because of the different types of fertilisers used. Pure nutrients are N, P and K, so values in P_2O_5 and K_20 would be respectively 2.3 and 1.2 times greater than values shown in this table.

In accordance with crop demand, very much more nitrogen is applied than the other two main nutrients. Overall average rates of nitrogen for cotton and rice are in the “typical” range by international standards, but the considerable variation between farms indicates that rates, particularly on some Uzbekistan farms, can be very high. Given the modest yields of cotton, these high rates are excessive. This cannot be said of the applications of phosphorus and potassium, where average rates are on the low side of international values. No P and K

fertilisers were recorded as being applied on the main crops in Kyrgyzstan and Turkmenistan, and almost none in Tadjikistan. Potassium was only recorded as being applied on a few farms in Uzbekistan. These observations with respect to P and K could be serious in view of the results of soil analysis presented in Section 5 and discussed in Section 14.

The most profitable cash crops, cotton and rice, get priority for available fertiliser in all republics. As the cultivated area of cotton is much greater than rice, cotton receives the bulk of the fertiliser resources of the area. Wheat exceeds the cotton area on the sample farms of Kyrgyzstan (and probably nationally) but the difference in fertiliser rate far exceeds the difference in crop area. Most of the fertiliser manufacturing capacity in Central Asia is located in Uzbekistan, which is where the bulk of the fertiliser is used.

11.8 Use of Agrochemicals

As in 1996, very few agrochemicals were used on the main crops or indeed on the minor crops on the sample farms. The small quantities recorded are summarised as averages in Table 11.5.

Table 11.5 Average Use of Agrochemicals on Main Crops
(kg or l/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Herbicides						
Cotton	0	0	0	0	0	0
Lucerne, mature	0	0	0	0	0	0
Rice	1.1				1.8	1.3
Wheat, winter	0	0.3	0	0	0	0.1
Insecticides						
Cotton	0.2	1.3	1.8	0	0.1	0.42
Lucerne, mature	0	0	0	0	0.1	0.03
Rice	0				0	0
Wheat, winter	0	0.1	0	0	0	0.03
Fungicides						
Cotton	0	0	0	0	0	0
Lucerne, mature	0	0	0	0	0	0
Rice	0				0	0
Wheat, winter	0	0.1	0	0	0	0.04
Defoliants (1)						
Cotton	6.4	5.3	0	0	3.1	3.3
Biological Control Agents (2)						
Cotton	0.19	0	0	0	0.01	0.03

Notes: (1) The bulk of defoliant used is inorganic magnesium chlorate.
(2) Biological control agents *Trichogramma* and *Gabrobrachon* are released in units of standard boxes.

Only rice received any significant amount of herbicide, mainly for control of bullrush and barnyard grass that are endemic in the paddy fields. Cotton received the majority of the insecticides used, to control the main pests, American bollworm, aphids and mites. These rates are very modest by international standards. The laboratories scattered around Central Asia for producing the main biological control agents, are mostly out-of-action and only a few were released in the sample fields of cotton in Kazakhstan. A little fungicide was used in Kyrgyzstan on wheat to control mildew, but other diseases (rusts, septoria and bunt) are prevalent in some varieties.

The need to enhance maturation in cotton, even as in most cases it is to be hand-picked, is reasonable justification for the use of desiccants and defoliants. However, the small average rates in Kazakhstan, Kyrgyzstan and Uzbekistan indicate that most fields received none.

11.9 Use of Water

This topic is covered separately in Section 7 for water resources, and Section 15 for water management. Average use for irrigation (not leaching) of the main crops is summarised in Table 11.6.

Table 11.6 Average Use of Water on Main Crops
(tcm/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Cotton	1.2	9.4	14.3	7.9	3.5	7.3
Lucerne, mature	1.0	5.8	13.4	3.6	3.5	5.5
Rice	18.2				20.9	19.5
Wheat, winter	0.3	3.4	2.8	8.0	2.9	3.5

Differences between farms are more striking than between republic means and are highly significant for all main crops, but the average rates for cotton differ significantly between republics. The sample farms in Tadjikistan are heavy users of water, but the rates for rice production far exceed other crops. Uses of water in the fields for leaching of salinity and for wetting soil prior to ploughing are not considered to be variable costs since they would need to be done whatever crop is grown.

11.10 Summary of Variable Costs

Total variable cost is the sum of all the component variable costs of production of an enterprise. Values estimated in all sample fields are summarised by crop and republic averages in Table 11.7.

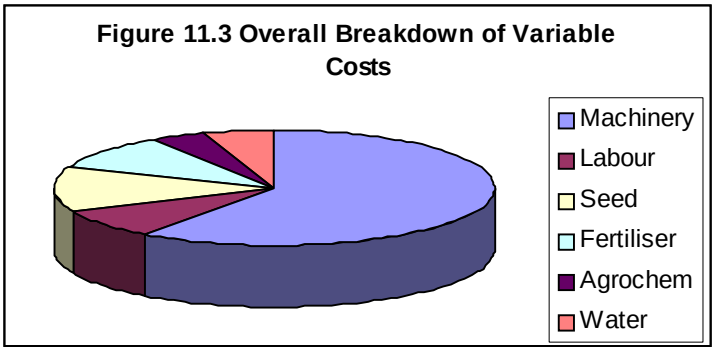
Table 11.7 Average Total Variable Cost of Crop Production
($/ha)

Crop	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Apple	55					55
Apricot			27			27
Barley, winter					155	155
Cotton, pima				307	469	347
Cotton, upland	244	534	394	245	386	376
Curcurbits					255	255
Gram, green			135			135
Lucerne + Barley, spring		226				226
Lucerne + Wheat, winter	166					166
Lucerne, mature	141	179	293	345	555	336
Lucerne, young	137				286	212
Maize, grain	49	195	200		182	173
Maize, silage					166	166
Oats		292				292
Onion		242	248			245
Rice	465				651	547
Sorghum			164			164
Sugarbeet		187				187
Sunflower, for oil	96					96
Tobacco		518				518
Wheat, spring	235					235
Wheat, winter	298	304	270	183	381	322
Overall	287	351	268	245	414	351

There is wide variation between averages for farms between crops but less so between fields of the same crop. The variation between farms with the same crop is more significant than the variation between averages by republics. Estimates of variable costs of production vary from US$27/ha for established apricots in Tadjikistan to $651/ha for rice in Uzbekistan.

The breakdown of the component variable costs as percentage of the average total for each crop sampled is shown in Table 11.8. The overall picture is illustrated in Figure 11.3. The pattern is very similar to that estimated from the 1996 data, with machinery as a bigger

proportion of the total due to the revised estimates of operating cost, and other costs proportionally less.



Some 60 percent of the variable cost of crop production is in machinery, the remaining part being fairly evenly distributed between the other component costs. However, the pattern varies so much between crops and between farms that it is only the importance of machinery cost that is worth generalising. Even the cost of machinery as a proportion of the total is very variable: none was used in apricots in Tadjikistan whereas it was more than 80 percent in the highly mechanised crops, such as fodders. Labour was proportionally more important in cotton, tobacco and fruit crops, whereas seed was an important cost in crops where specialist rather than home-produced seed was used. Fertiliser is not as important as may be it should be, except for cotton and rice.

Table 11.8 Breakdown of Financial Variable Cost (% of total)

Data	Machinery	Labour	Seed	Fertiliser	Agrochem	Water
Apples	76	24	0	0	0	0
Apricot	0	22	0	0	0	78
Cotton - Upland	55	16	7	11	8	3
Cotton-Pima	58	18	11	13	0	0
Curcurbits	90	9	0	0	0	1
Green Gram	53	5	31	3	0	8
Maize Grain	61	2	8	5	4	21
Mature Lucerne	88	3	1	0	0	8
Mx Apricots + Maize	70	15	0	0	0	16
Mx Spring barley + lucerne	71	0	28	0	0	0
Oats	80	0	14	0	0	5
Onion	24	7	37	21	3	9
Rice	63	2	15	10	4	6
Silage Maize	54	4	34	6	0	2
Sorghum	86	1	3	5	0	5
Spring Wheat	60	0	39	0	0	1
Sugar Beet	51	8	9	0	0	32
Sunflower (for oil)	36	15	31	18	0	0
Tobacco	13	25	24	11	0	26
Winter Barley	74	1	5	19	0	1
Winter Wheat	58	2	25	12	0	2
Young Lucerne	52	0	26	22	0	0
Overall	60	8	13	10	4	5