

16. EFFICIENCY OF USE OF INPUTS

This section discusses the current use of inputs in crop production in Central Asia in the context of local “normative” values and levels that are considered typical from international experience.

16.1 Seed

Seed quality has both physical and genetic aspects, but both are required for high crop yield. Some institutes have specialised in breeding varieties adapted to the unusual climatic conditions of the area and some farms for many years have specialised in seed production for supply to the region’s farms. Recommended seed rates are shown in Table 16.1.

Table 16.1 Recommended Seed Rates

Crop	Seed rate (kg/ha)
1. Cotton (fuzzy seed)	45-60
2. Cotton (delinted seed)	20-25
3. Wheat	180-230
4. Barley	160-200
5. Rice	180-220
6. Maize grain	18-20
7. Lucerne	16-20
8. Onion	12-16
9. Tomato	0.5-3.0
10. Melons	4-5
11. Vegetables	6
12. Potato	2800-3500
13. Cabbage	0.5-2.5

Source: Ministry of Agriculture and Water Resources, Uzbekistan

In recent years, the standard of management in seed production has fallen, and very often farms are getting seed of poor viability and genetic purity, contributing to declining yields. Seed rates are very often above the level of the norms thereby raising the variable cost, directly through the extra cost of seed, and indirectly through use of extra labour for thinning. Table 16.2 compares the actual rates used for cotton and wheat with the normative rates.

Table 16.2 Actual Seed Rates Compared with Norms

Republic	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
(kg/ha)						
Cotton						
Delinted seed						
Normative rate	25	25	25	25	25	25
Actual rate	45	-	-	-	35	40
% of norm	180	-	-	-	140	160
Fuzzy seed						
Normative rate	50	50	50	50	50	50
Actual rate	-	133	103	78	118	108
% of norm	-	266	206	156	236	216
Wheat						
Normative rate	180	200	200	200	200	196
Actual rate	184	237	215	201	234	214
% of norm	102	118	107	100	117	109
Rice						
Normative rate	210				190	200
Actual rate	251				210	226
% of norm	119				105	112

Possible reasons for exceeding recommended seed rates for cotton might be as follows:

- low germination percentage and crop establishment due to poor quality of seeds and unfavourable weather conditions
- lack of precision seed drills for the desirable plant population
- hidden consumption on farms of untreated cotton seeds for cattle feeding or manual oil extraction.

16.2 Fertilisers

Good crop yields are very dependent on a high level of soil fertility, which in turn depends on the standard of management and the application of mineral fertilisers to supplement soil reserves where these are deficient. Much research in the past has determined the rates of fertiliser nitrogen, phosphorus and potassium to achieve maximum crop yields on different soil types. Efficiency of fertiliser use depends on the time of application, the nutrient content of the fertiliser and level of soil fertility.

Comparison between the actual rates of fertiliser used and the corresponding normative rates for cotton and wheat is made in Table 16.3.

Table 16.3 Actual Fertiliser Rates Compared with Norms

Republic	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Cotton						
Nitrogen (kg N/ha)						
Norm	220	220	210	220	230	220
Actual rate	46	96	86	69	142	88
% of norm	21	44	41	31	60	40
Phosphorus (kg P/ha)						
Norm	68	68	68	68	68	68
Actual rate	4	0	3	0	18	5
% of norm	5	0	4	0	26	7
Potassium (kg K/ha)						
Norm	17	17	19	19	17	18
Actual rate	0	0	0	0	8	2
% of norm	0	0	0	0	45	8
Wheat						
Nitrogen (kg N/ha)						
Norm	150	150	150	150	150	150
Actual rate	22	52	22	89	104	78
% of norm	14	34	15	59	69	52
Phosphorus (kg P/ha)						
Norm	45	44	44	44	44	44
Actual rate	10	0	0	0	26	7
% of norm	21	0	0	0	58	16
Potassium (kg K/ha)						
Norm	10		10	10	10	10
Actual rate	0	0	0	0	0	0
% of norm	0	0	0	0	0	0

Nitrogen is the nutrient absorbed in greatest quantity from the soil by the crop for its development, and it is appropriate that it should receive priority for its application as fertiliser. For cotton and wheat, about 40 and 50 percent respectively of the normative rates are being provided, most in Uzbekistan and least in Kazakhstan. By international standards for cotton, particularly at current yield levels in Central Asia, the normative rates are very high and the actual rates are much closer to international rates. The norms for wheat are closer to international values but only for much greater yield expectations. Therefore, based on

current yield achievement, local norms would also be considered too high, so that the overall average rates applied to wheat may be about at the financially optimum level. However, rates in Kazakhstan and Tadjikistan, where they are so much lower than the other republics, probably are so low as to be limiting yield.

Phosphorus is by far the most expensive fertiliser nutrient, per kg about double the price of N, and as such its use at heavy rates has to be more carefully justified. The normative rates for both cotton and wheat would be impossible to justify at current yield levels so that it is not surprising that this fertiliser is being given little priority. It is estimated that average actual rates are only 7 and 16 percent of the norms for cotton and wheat respectively, with Uzbekistan average rates considerably greater than the other republics. No P fertiliser was applied in Kyrgyzstan and Turkmenistan and very little was used in Kazakhstan and Tadjikistan. Section 14 discusses the data on soil analysis and concludes that there is some evidence that soil reserves of P, once abnormally high, may be declining as crops deplete reserves. Of the 1997 soil samples, 18 percent were recorded as being in the "low" class on available P with a response to fertiliser P being very likely in most crops.

Local professional opinion is that soils of Central Asia are naturally rich in potassium and that the low normative rates reflect this. However, Section 14 provides some evidence that high levels of soil K may be more the consequence of secondary salinity from the groundwater enriching the topsoil than that soil reserve is intrinsically high. Cotton and potatoes are "gross feeders" of potassium, and care is necessary with these crops that soil deficiency should not become the factor limiting yield. Almost no potassium fertiliser has been used in the area for several years, and it was only on two farms in Uzbekistan in 1997 that some was recorded as being applied.

16.3 Machinery

In Uzbekistan before 1991 there was a policy of heavy mechanisation of crop production, particularly in the "new lands" where resettlement was taking place and labour was in a short supply. This is reflected in the very heavy rates of machinery in the norms for crop production. Since then, financial constraints have prevented farms maintaining normative levels of machinery use. Actual rates used in cotton and wheat are compared with the norms in Table 16.4.

Table 16.4 Actual Machinery Rates Compared with Norms (h/ha)

Republic	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Cotton						
Norm	53	53	53	53	53	53
Actual rate	17.3	20.5	19.8	22.9	24.3	21.0
% of norm	33	39	37	43	46	40
Wheat						
Norm	30	30	30	30	30	30
Actual rate	7.6	7.5	7.3	11.4	11.6	9.1
% of norm	25	25	24	38	39	30

The overall mean use of machinery is about 40 and 30 percent of the norms for cotton and wheat respectively and there is not much variation between farms and republics. These data show the sharp decrease of machinery use on crop production. The reasons of this decrease are as follows:

- deterioration of agricultural machinery during period 1991-1997 and lack of capital for purchase of new machinery
- lack of capital for purchase of spare parts and maintenance
- irregular supply of fuel and lubricants or lack of cash to purchase them.

Another probable reason for low achievement against the norms derives from the rigorous definition of "variable" cost by WUFMAS, in that only productive work by machinery and

labour is recorded. The corresponding local definition and method of calculation includes a substantial amount of the cost that by international definition would be termed a “fixed” cost, and it seems certain that the local normative values are similarly inflated.

16.4 Labour

The shortage of machinery has placed greater pressure on the labour resources but due to the lack of cash to pay wages, labour has not always been willing to respond to this demand. This is apparent when the actual labour use is compared with the norms, as in Table 16.5.

Table 16.5 Actual Labour Rates Compared with Norms
(mandays/ha)

Republic	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Cotton						
Norm	121	121	121	121	121	121
Actual rate	22	225	81	135	67	106
% of norm	18	186	67	112	55	88
Wheat						
Norm	13	13	13	13	13	13
Actual rate	1	5	7	9	7	6
% of norm	8	38	54	69	54	46

The pattern by republics is very variable. In Kyrgyzstan, the fragmentation and privatisation of land took place earlier and more completely than in the other republics. Loss of common machinery resources coupled with the personal incentives arising out of land ownership have had a marked impact on the consumption of labour for cotton production, and actual use is almost double the local norm. The average for Kyrgyzstan is at the top end of the range in labour requirement for non-mechanised cotton production of 120-200 mandays/ha from international experience, but it is in line with yield expectation. However, only one third of labour was used for harvesting, rather than half, as would be expected. Either there were systematic errors in recording labour data by the Kyrgyzstan enumerators, or an abnormal amount of labour was used in land preparation and crop operations. Land leaching is not necessary in Kyrgyzstan so that this is not contributing to labour use. Furthermore, the heavy use of labour for crop operations in Kyrgyzstan is associated with an abnormally high level of machinery use for the same tasks (see Figure 11.1). In contrast, the expected pattern of increased labour use to compensate for the lack of machinery for harvesting cotton is seen in Figure 11.2. Farms, both in Kyrgyzstan and Turkmenistan, used no machinery for harvesting cotton but double the amount of labour on average of the farms in the other republics for harvesting approximately the same yield.

Although most farms are using less than half the normative amount of machinery for producing wheat, labour use also is mostly less than half the norms. By international standards, the local norms for both machinery and labour use in wheat are excessively high. For example, the UK average wheat yield is about 8t/ha but uses only about 8-10h/ha of machinery and only 15 manhours of labour. This machinery use is much the same as is currently used in Central Asia, about 30 percent of local norms, but the labour use is much less at only about 15 percent of local norms. This is clear evidence, that local norms are unrealistic and that financial circumstances have forced farms to reappraise their investment needs in machinery and labour use.

16.5 Other Agrochemicals

Before 1992, a wide range of different chemicals was available in Central Asia and in some cases, they were applied to crops at excessive rates, causing harm to the environment and human health. The WUFMAS programme has recorded current usage as accurately as possible by the proprietary name of the product, its formulation and the rate applied. These data show that there has been a sharp reduction of application rates during recent years. Comparison between actual rates used and norms is summarised in Table 16.6.

Table 16.6 Actual Agrochemical and Biological Control Rates Compared with Norms

Republic	Kazakhstan	Kyrgyzstan	Tadjikistan	Turkmenistan	Uzbekistan	Overall
Cotton						
Insecticide (kg/ha)						
Norm	1.5	1.5	1.5	1.5	1.5	1.5
Actual rate	0.15	1.34	1.75	0	0.07	0.42
% of norm	10	89	117	0	5	28
Biological Control (boxes/ha)						
Norm	0.15	0.15	0.15	0.15	0.15	0.15
Actual rate	0.19	0	0	0	0.01	0.03
% of norm	127	0	0	0	7	20
Defoliant (kg/ha)						
Norm	8	8	8	8	8	8
Actual rate	6.4	5.3	0	0	3.1	3.3
% of norm	80	66	0	0	39	41
Wheat						
Herbicide (kg/ha)						
Norm	3	3	3	3	3	3
Actual rate	0	0.25	0	0	0.01	0.06
% of norm	0	8	0	0	0	2
Insecticide (kg/ha)						
Norm	2	2	2	2	2	2
Actual rate	0	0.12	0	0	0	0.03
% of norm	0	6	0	0	0	2
Fungicide (kg/ha)						
Norm	2	2	2	2	2	2
Actual rate	0	0.11	0	0	0.02	0.04
% of norm	0	6	0	0	1	2

The normative values shown are only nominal, as rate depends on product, but are intended to give an indication of the general level of use. No herbicides were recorded as being used on cotton even though the norms recommend banding of a post-plant, pre-emergence product for weed control in the rows. Herbicides were used on wheat in Kyrgyzstan and a small amount in Uzbekistan, but the overall average was a tiny percentage of the norm.

Some insecticides were applied to both cotton and wheat, but the overall averages were only 28 and 2 percent of the norms respectively. Most of the use was in Kyrgyzstan and Tadjikistan, with very little in Kazakhstan and Uzbekistan, and none in Turkmenistan. The laboratories propagating the biological control agents, *Trichogramma* and *Gabrobrachon*, are mostly not working but it seems that those in Kazakhstan produced enough for the norm to be exceeded overall the sample fields of cotton.

As expected, no fungicides were applied to cotton but a little was applied to wheat, but overall only about 2 percent of the norm.

These average actual rates are indicative only of the general level of use of pesticides and biological control, and give no indication of the rate of application of these products in the fields where they have been applied. Table 16.7 summarises the percentage of all the fields of particular main crops in each republic that were actually treated with agro-chemicals or biological control agents.

Gabrobrachon was released in all the cotton sample fields in Kazakhstan, half of fields received *Trichogramma* and more than one third had pheromone traps, all measures to

control American bollworm. A small proportion of cotton fields in Uzbekistan was similarly treated.

Table 16.7 Treated Fields as Percentage of Total Fields

Republic	Crop Name	Biological control			Defoliant	Fungicide	Growth regul'r	Herbicide	Insecticide
		Gabro-brachon	Trichogramma	Traps					
Kazakhstan	Cotton - Upland	100	46	38	100	0	15	0	38
	Rice	0	0	0	0	0	0	36	0
Kyrgyzstan	Cotton - Upland	0	0	0	100	23	0	0	100
	Winter Wheat	0	0	0	0	0	0	15	0
Tadjikistan	Cotton - Upland	0	0	0	0	0	0	0	40
Uzbekistan	Cotton - Upland	2	4	4	34	0	0	0	12
	Lucerne	0	0	0	0	0	0	0	67
	Rice	0	0	0	0	0	0	67	0
	Winter Wheat	0	0	0	0	0	0	3	0

Note: no agro-chemicals were used on the sample fields in Turkmenistan.

Insecticide was used in all cotton fields in Kyrgyzstan, in only 40, 38 and 12 percent of cotton fields in Tadjikistan, Kazakhstan and Uzbekistan respectively, but not at all in Turkmenistan. Table 16.8 shows the average rate used, based only on the fields where any product was used. Significant rates were used in Kyrgyzstan and Tadjikistan, around 5kg or l/ha. Rates in Kazakhstan and Uzbekistan were extremely low, suggesting either that it was spot sprayed by knapsack sprayer or that enumerators miscalculated the quantity of product being applied. Sulphur was used on a quarter of cotton fields in Kyrgyzstan as an acaricide at an average rate of 6.8kg/ha, but sulphur has been entered into the database as a fungicide. Two thirds of lucerne fields in Uzbekistan received insecticide but at a very low average rate.

A substantial number of the sample fields with rice in Kazakhstan and Uzbekistan were treated with herbicide and at a reasonable rate of about 3kg or l/ha. A few wheat fields in Kyrgyzstan were treated with herbicide and even fewer in Uzbekistan. The average rate of herbicide in the former was reasonable, but was very low in Uzbekistan.

Magnesium chlorate was applied as a defoliant to all cotton fields in Kazakhstan, Kyrgyzstan and to a third of fields in Uzbekistan, at rates at or above the normative rate.

Table 16.8 Rate of Agrochemicals and Biological Control Where Applied

Republic	Crop Name	Biological control			Defoliant kg/ha	Fungicide kg/ha	Growth regul'r kg/ha	Herbicide kg/ha	Insecticide kg/ha
		Gabro-brachon units/ha	Trichogramma g/ha	Traps units/ha					
Kazakhstan	Cotton – Upland	343	2.1	0.14	13.6	0	2.1	0	0.6
	Rice	0	0	0	0	0	0	3.0	0
Kyrgyzstan	Cotton – Upland	0	0	0	7.1	6.8	0	0	5.1
	Winter Wheat	0	0	0	0	0	0	1.5	0
Tajikistan	Cotton – Upland	0	0	0	0	0	0	0	4.7
Uzbekistan	Cotton – Upland	600	0.9	0.2	9.5	0	0	0	0.7
	Lucerne	0	0	0	0	0	0	0	0.3
	Rice	0	0	0	0	0	0	2.7	0
	Winter Wheat	0	0	0	0	0	0	0.2	0

There may be inadequate crop protection that is leading to loss of crop yield, particularly in the two command economies of Turkmenistan and Uzbekistan. The main reason is believed to be the shortage of finance for the products, equipment and protective clothing.