2. SUMMARY

Aim of the Report

The aim of the present report is the generalization of some data collected during agricultural year since October, 1997 till November 1998, including all operations on growing of winter crops during the season of 1997/1998 and all spring crops. There are also the results of preliminary analysis and interpretation of data, though it is proposed that special items should be studied in more details than it is done in the present report. This report differs from the report for 1997 by the fact that many of the data are given in the retrospective for the period since 1996 till 1998 in order to have understanding about the tendencies in agriculture and water use management.

Methodology and Farm Characteristics

Due to the limits of the budget allocated in 1998 only 24 farms were covered by programming monitoring in comparison with 36 farms selected for that purpose in 1996. Nevertheless all the farms participating in monitoring were reflecting the principle of their allocation by pairs in oblast and they were representative for the region. In 1998 all the farms in the Republic of Kazakstan were shared into separate private farms, cooperative and peasant farms.
Only small additions related to data collection were made in the methodology of monitoring, and as a whole it was similar to the approaches in 1996 – 1997. The data, which were characterizing the farms as a whole, were collected on monthly basis from official farm reports. The detailed measurements were carried out by the specialists and technicians of WUFMAS, they were measuring and fixing of actual use of all the inputs on each of 10 sample fields in each farm. Five monitoring plots were created on each sample field, and all agronomic measurements were carried out on those plots, including actual harvesting. Soil surveys were carried out on each field, they were taking soil samples periodically, samples of drainage and ground water with their further analysis in SANIIRI chemical laboratory. The climatic data were collected from the nearest to the farms meteorological stations, and the data on evaporation were measured by the technicians directly in the farms. All obtained data were recorded in the special set of tables with corresponding codes, which were designating the materials used, machinery, operations, produce and etc. The filled tables were sent every month into central office of the project for the entry of the information into WUFMAS database.

Climate and evapotranspiration

The territories of WUFMAS farms are located approximately on 80 thousand hectares of lands of Central Asian region in typical climatic zones from 44”53’ of northerly latitude in the north to 37”34’ of northerly latitude in the south and from 62”11’ of E longitude in the west to 74”33’ of E longitude in the east with the range of elevation from 75 m to 958 m.

Average monthly climatic data submitted in the report, like in the previous years of survey, were collected from the nearest to the farms meteorological stations. In some cases those data were replaced by more reliable information of Glavhydromet.

During all three years of monitoring (1996 - 1998) the sum of **air temperature** exceeded similar average multiyear sum. The closest to the average multiyear temperature was 1996. The warmest was 1997.

The coldest month in the monitoring period was January 1996 with the range of temperature from – 10.7”C to 4.3”C.
The hottest month was July with the range of temperature from 26.7”C to 32.4”C.
During all three years **relative air humidity** in summer was higher than average multiyear values, and in winter it was (except 1998) lower.
During the period of survey the highest humidity was in January 1998, varying from 94% to 68%. The lowest humidity was in July 1997, varying from 26% to 47%.
According average monthly **wind speed** the considered region is classified as the zone of mild winds with the range from 175 to 425 km per day.
April 1996 was the most intensive month in relation to wind activity during the period of 1996 – 1998 with the range wind speed changes from 95 km/day to 328 km/day.

The changes of **solar radiation** are defined by seasonal changes of day time duration, it is maximum during June – July in the Aral Sea basin.
The values of average daily solar radiation estimated according measured duration of daily sunshine in hours for the period of 1996 – 1998 are characterized as follows: in 1996 solar radiation was close to average multiyear values, in 1997 it was higher, and in 1998 it was lower than average multiyear values.
Its maximum was in July 1997, varying within the range from 26 MJ/m2/day to 28.6 MJ/m2/day. Its minimum values were in December 1998 within the range from 4.9 MJ/m2/day to 8.0 MJ/m2/day.

March and April are the most rainy months in the region. According average multiyear data the maximum monthly norm of **precipitation** is changing from 15 mm per month to 63 – 72 mm per month.
During the period of 1996 – 1998 maximum precipitation rate was in February 1998 and their norms were changing in the range between 10.4 mm and 108 mm. The driest month was September, 1997, there was no rainfall except the farms located in Karakalpakistan (Uzbekistan), precipitation rate there was 1.7 mm.
The wettest year was 1998, the driest year was 1996, and the closest to average multiyear rate was 1997.

Evapotranspiration of reference crop was estimated according the method of Pemann – Montiff (CROPWAT 7.0, (FAO, 1997)) on the basis of the available data about latitudinal and altitudinal location of the farms, average monthly data about temperature and relative air humidity, wind speed, duration of sunshine.
Values of Eto estimated according measured climatic data for the period of 1996 – 1998 mainly were higher than the values estimated according corresponding multiyear values.
The maximum values were in July, 1997 within the range between 5.4 mm/day and 9.2 mm/day. Maximum evapotranspiration was in January 1998, within the range 0.3 mm/day and 1.1 mm/day.
According the sum of values of reference evapotranspiration the year of 1996 was the closest to average multiyear values. Summarized values were higher than multiyear values in 1997 and lower in 1998.

Deficit of moisture, defined as difference between the evapotranspiration of reference crop and the sum of precipitation for particular period, characterizes indirectly the requirements in artificial moistening of irrigated lands. The peak of moisture deficit according average multiyear data is in July. The biggest deficit of moisture during the period of 1996 – 1998 was in July, 1997. It varied from 161 mm/month to 284 mm/month. From three years period there was deficit exceeding average multiyear values in 1996 and 1997, and in 1998 the deficit was less than average multiyear deficit.

Soil resources, salinity, fertility and fertilizer use

The main results of soil survey carried out on the fields of Subproject WUFMAS included: general characteristics and zonal allocation of water and physical, chemical and agrochemical features of soils necessary for the assessment of their productivity, and also for the management of irrigation and fertility processes.

It was discovered by the survey that in Central Asian region prevail the following soil types: dusty – loamy (ZL), loamy (L), dusty – silty - loamy (ZCL) soils, and they have the range of accessible moisture within 15 – 16% from total mass. According local classification of soils on soil texture the following types are prevailing: medium loams (37%), heavy loams (20%) and light loams (16%).

On the basis of survey of soil profile density the significant allocation of ploughpans was defined, they represent by themselves puddle soil layers located on the lower level of the plough layer, and formed by multiyear plough on one and the same depth. Ploughpans discovered at the depth of 30 – 50 cm have volumetric mass more than 1.5 gr/cm3 and high values of soil resistance to pressure (up to 3000 kN/m2). Puddling influences negatively on the development of rooting zone of plants and consequently on yields. The summarized results of surveys, earlier carried out in Uzbekistan, show that mass density of soil higher than 1.6 gr/cm3 leads to the reduction of yield of cotton for 40 – 60%. In order remove ploughpans deep plough and chiseling are recommended.

The progressing processes of soil salinity on irrigated fields of horizontal part of the territory were confirmed by the surveys. On particular fields, mainly on the territory of Uzbekistan (Surkhandarya, Syrdarya, Bukhara oblasts and Karakalpakistan) for three years of monitoring soil salinity (on ECe) increased from 1 to 10 dS/m and more. And the soils were transferred from the class “non saline” to the class “strongly saline”. Present tendency for salinity increase will be creating serious problems for obtaining planned yields of main crops in the region.
According actual data of the project, it was defined that with the medium soil salinity (Ece = 6 dS/m, FAO classification), in relation to types of soils, groundwater level and salinity, the losses of yields of cotton may reach 10 – 30%.
It was discovered that salt accumulation in the soils of the region is influenced by the salinity both as groundwater as well as irrigation water, especially with the irrigation drainage water.
The processes of salinity are worsened due to insufficient water deliveries to the fields both as for irrigation during vegetative period in summer as well as for leaching in winter. In spite of the fact that water is delivered in sufficient volumes to farm boundaries, inside the farm it is used inefficiently with big organizational losses. Due to that fact the leaching regime, necessary for salt management of the lands subject to salinity, is not provided in many cases.

For the period of 1996 – 1998 it was defined that humus contents in the soils of the region is not increasing significantly. Though it does not make significant changes in the situation with soil fertility as the soils of the majority of surveyed fields (81%) contain humus in the amount not more than 1.35%, and according the criteria accepted in the local methodology they are assessed as medium and poor.

According the availability of nutritious elements (NPK in the slip form) the soils with low availability are also prevailing. Since 1996 till 1997 it was noticed that there was the decrease in the content of nitrogen and phosphate in the soils. The increase in the introduction of nitrogen and phosphates in 1997 (compared with 1996) improved the mentioned indices of fertility in 1998. It was defined that local classifications on the assessment of the availability of NPK in the soils are more strict, and as a result, according western assessments, the availability of phosphates and potassium in the soils are rather higher.
And unlike western approaches the norms for nitrogen introduction, according local recommendations, do not consider the contents of nitrogen in the soil. On the basis of data processing on influence of the norms fore nitrogen introduction on yields of cotton on Subproject WUFMAS fields, it was proposed to reconsider local recommended norms for their reduction.[*)]

Water Resources Quality

The data of monitoring for irrigation water quality during four years show the obvious increase of its salinity from upstream to downstream, with the change of electric conductivity of water from 0.4 to 1.7 dS/m in the Syrdarya river basin, and from 0.7 to more than 2 dS/m in the Amudarya river basin. There is no distinct tendency for salinity increase according years for particular objects. In some farms they use for irrigation locally drainage water with salinity of 3 gr/litre.

The salinity of drainage and ground water also has zonal differences: with its minimum in upstream, maximum in midstream, and relatively not high values in downstream of the rivers. For the period of monitoring the minimum values of electric conductivity of drainage and ground water were 2 – 4 dS/m, and maximum values were 8 – 10 dS/m.
Within the project the special experimental survey was carried out in order to give more precise definition of the zonal coefficients for soil and water while measuring salinity on electric conductivity of soil suspensions and water. On the basis of that development the internationally accepted express method for the assessment of soil and water salinity is being successfully introduced in the region *)

Groundwater

The character of groundwater regimes is mainly defined by the schedules of water delivery and by the intensity of the processes of evaporation from groundwater surface.
On the fields representing South Kazakstan the groundwater tables are very close to the surface (in average 1.5 m) during the period of February – April. It is conditioned mainly by heavy leaching and preirrigation during intervegetative period with specific volume of water deliveries reaching 4 – 4.5 thousand m3/ha. Then the processes of evaporation from groundwater surface start to be prevailing above infiltration feeding as water deliveries during vegetative period are two – three times less than during intervegetative

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[*)] In 1999 and 2000 the main scientific – practical results of carried out survey were published in the form of articles (in two foreign and two local editions), reported and discussed at two international conferences.
On the fields representing Uzbekistan in the zone of old irrigation of Khorezm oasis the peak of high groundwater tables (in average about 1 m) is during the peak of vegetative period (July - August), with gradual increase from February (beginning of leaching and preirrigation) to July. In December groundwater tables go down to 2.5 m.

period. By the end of vegetative period groundwater goes down up to three meters and lower.

On the fields representing Turkmenistan in the zone of Kairakkum canal the situation is similar, but the period of high groundwater tables (in average 1.5 m) is shifted a bit for March – April during mass preirrigation. By the end of vegetative season groundwater goes down up to the level of 2.5 m.

On the fields representing Uzbekistan in the zone of Golodnaya Steppe newly developed lands the peak of high groundwater tables (in average 1.5 m) is in May, with gradual increase of groundwater tables towards surface from December to May.

In the majority of farms monitored by WUFMAS during the period of 1996 – 1998 survey there is stable increase of groundwater tables towards daily surface.

In the report for 1997 we marked that drainage systems constructed on the lands of midstream and downstream of the rivers are designed in order to keep groundwater level at the depth of 2.5 – 3.0 m, i.e. to promote semihydromorphic type of land reclamation regime. . Though only 10 of the fields have groundwater level within those ranges. The survey of 1998 shows that the situation continued to be worse. That witnesses about unsatisfactory conditions of drainage network, which is getting worse from year to year.

Some exclusions are only several farms of Uzbekistan, in which in 1998 there was the reduction of average levels of groundwater depth. And this was conditioned mainly by the reduction of water deliveries, but not by the improvement of drainage network conditions.

Agronomic Data

All sample farms, covered by monitoring, are located in 5 agro - climatic zones, and due to that fact the records of the data about plant development were summarized according that zonal principle. The biggest plant population in cotton in June was registered in the 2-nd zone (up to 201 000 plants per ha), though by autumn after thinning and loss from root – rot the plant population in cotton decreased up to 175 000 plants per ha in the 2-nd zone and up to 140 000 plants per ha in the 3-rd zone. In the other agro-climatic zones the plant population of cotton after germination was 103 – 114 000 plants per ha in June and 94 – 104 000 plants per ha in October, 1998. Mostly in rows 0.9 m apart, this population is very high by international standards, but is deliberate practice for maximizing yield where the growing season between early June and September, is very short for this technical crop. The development of rooting closely mirrored that of plant height cm per cm, height lagging slightly behind root depth in May and June, reaching equality in early July and moving slightly ahead thereafter until topping restricted shoot development. This was generally true except on the coarse soils of Tadjikistan farms (zone 4) where roots were about 50% deeper than plants were tall. Such difference has practical significance as rooting depth is used for the calculation of optimal irrigation schedules. The speed of vegetative growth and development is defined by temperature conditiond, and in this connection in the south zone rapid development of cotton starts in the beginning of June, and on the lands located in the north zone 20 – 25 days later. As common tendency discovered during monitoring period in all natural – climatic zones, it should be marked that the opening of greater number of flowers in cotton is in June, unopened bolls in August and opened bolls in October. The rapid fall in temperature from September limits development of later bolls, so that the majority of the revenue from cotton derives from the first set bolls that are larger and of better fibre quality. The number of opened bolls rises to an average of 7 per plant by the end of

October so that with 111 000 plants per ha and an average boll weight of 3.3 gr, and an average yield of 2.5 ton/ha was recorded in the sample plots.

Weeds, Pests, Diseases and their Control

In the early season , weeds were as numerous or even higher than cotton crop seedlings. This is usual phenomena for the region and the struggle against weeds is carried out by chemical methods, and also by interrow cultivation and hand-weeding. In 1996 – 1998 herbicides against weeds were used very seldom due to their high prices, and the struggle against weeds was carried out mainly by hand – weeding and with the help of interrow cultivators. In the early July the increased number of weeds was marked in the 2-nd zone (up to 16.4 plant/linear m), in autumn great enough number of weeds (8.0 – 8.1 plant/linear m) was registered in the 1-st and 2-nd zone, and that brought certain loss to yield.

14 types of pests and 3 types of diseases were registered in cotton: the most numerous were – Americal bollworm, spider mite, aphid, cutworm and leaf-eating caterpillar. Leaf-eaters appear in early May causing quite serious damage to the crop in June, followed shortly after by cutworms and aphid, and later by spider mites and bollworms. The first damage from American bollworm was reported in June, rising in intensity thereafter but reaching a serious level in only 8% of fields assessed. Damage from spider mites and aphid was rarely serious. Loss of seedlings from root-rot was commonly reported and was quite serious during wet, cold weather in May,but damage from high plant population was not. Thirteen pest spices, four fungal diseases and one virus were reported in winter wheat, with mildew, stem rust, harlothrips, aphid and leaf beetles being the most common. Some pests and stem rusts appeared before flowering but most in April, with damage rising into May in some cases at moderately severe levels. Seventeen insect pests were recorded on Lucerne crops but no diseases, and of these the lucerne beetle, aphids and sucking bugs were the most common, all causing moderate to fairly serious damage in most months of the season. Where it appeared, the lesser army worm cause moderately severe damage in Lucerne and American bollworm was reported to be causing moderate damage in August in two fields.

No herbicides were used in the cotton sample fields. The overall average use of herbicide on wheat was only 2% of the norm mostly in a few fields in Kyrgyzstan at 1.5 kg/ha where the crop was for seed. However , about half of the fields of rice were treated at about 3 kg/ha.

Overall, only 28% of the normative rate for insecticide was used in cotton. All cotton fields in Kyrgyzstan were sprayed to control insects at an average rate of 5.1 kg/ha, but the proportion was much less in other republics and much lower rates were used. No insecticide was used in Turkmenistan. Insecticides were rarely substituted by release of biological control agents as this was at only 20% of the norm overall, restricted to all cotton fields in Kazakstan and a few in Uzbekistan. A small quantity of insecticide was used on wheat in Kyrgyzstan on average at only 6% of the norm and although 2 out of 3 lucerne crops in Uzbekistan were sprayed, the rate of application was very low, suggesting spot spraying.

23% of cotton fields in Kyrgyzstan were treated with fungicide at an average rate of 7 kg/ha, and some was applied to wheat but the overall rate, as percent of the norm was negligible. Some growth regulator was applied in a few fields of cotton in Kazakstan at 2.1 kg/ha on average. Defoliant (magnesium chloride) was applied to assist maturation and harvesting in all cotton fields in Kazakstan and Kyrgyzstan and in one third of fields in Uzbekistan at average rates from 7 to 14 kg/ha.

Most agro-chemicals used in the region are of-patent products and are not expensive. Most international producers are represented in the region and their modern products that have been registered are relatively expensive and sales are insignificant at present.
As a common tendency for the period of 1996 – 1998, the immoderately low use of means for chemical protection of plants from diseases, pests and weeds should be marked, and this resulted in significant losses in yields and crop growing.

Crop Yields and Prices

More than 20 crop types were grown in 1996 – 1998 in WUFMAS fields, but 85% of them were under only four main crops (upland cotton, winter wheat, lucerne and rice), so reliability of estimates foe these is much greater than the others. The average yields in the region for upland cotton were 2.7 ton/ha (1996), 2.4 ton/ha (1997) and 2.3 ton/ha (1998); for winter wheat 2.5 ton/ha (1996), 2.3 ton/ha (1997) and 1.8 ton/ha (1998); for lucerne 24.3 ton/ha (1996), 22.4 ton/ha (1997) and 21.7 ton/ha (1998); for rice 3.8 ton/ha (1996), 3.6 ton/ha (1997) and 3.7 ton/ha (1998). As common tendency in the region, we should mark the reduction of average yields of such main crops as cotton for 30%, winter wheat for 28% and Lucerne for 11%.
Most farm gate economic crop commodity prices are close to their estimated financial equivalent. Farm gate price for cotton in all CAR went down due to the fall of price in the world market. Special reaction on for the fall of world prices was in the countries with market economies. In Kazakstan and Kyrgyzstan farm gate prices went down almost for 50%. In the countries with command – administrative economies and state regulation (Uzbekistan, Turkmenistan) the fall of price for cotton was only 10 – 15%. The prices for wheat also reacted for the fall of prices in the world market and were reduced in 1998 for 7 – 18% in each republic, and thus in the conditions of free market are merging with world prices (130 – 140$/ton) for the republic with free economies (Kazakstan< Kyrgyzstan) and for the rest is 80 – 120$/ton. The prices for rice stay high enough. There was short – term fall of farm gate prices in the middle of the year in Kazakstan. Prices for vegetables and fruits went down due to the complicated conditions for export of produce and saturation of the market, though they are still high for processed fruits.

Variable Costs

According western definition, variable costs are the costs related to the production of some particular produce or crop. The distribution between the categories of variable costs with the existing correlation between areas under crops in the region is as follows: machinery – 66%, seeds – 14%, fertilizer – 12%, hand labour – 6%, agro-chemicals – 2%.
The scheme for allocation of costs according crops is different. The biggest overall costs were recorded in 1998 while growing rice (850 $/ha), the smallest while cultivating orchards (about 40$/ha). Costs for cotton were 257$/ha in average, for wheat 199$/ha, for Lucerne 238$/ha, for tobacco 371$/ha, for sugar beets 272 $/ha. It is quite obvious that during the transition from state enterprise to private farm variable cost for growing of main crops go down. Though the prices for inputs are not changing significantly, the reduction of variable costs refers to the reduction of the inputs use and reallocation between them, more cheaper hand labour and reduction of machinery use.

Crop Gross Margin

Crop gross margin is a measure that a crop makes to the profitability of the farm. It is strictly defined as the margin between the gross output (revenue) of the crop and its total variable cost and is calculated per ha as a return to land. Alternatively it is expressed as a return to physical inputs such as a unit of water used to produce the crop, as a finacial return on the investment in a particular input, and as a return to the annual investment in the crop (benefit: cost ration). Gross margin at economic prices (as it was calculated in 1996 report) have not been calculated in this report, but financial crop budgets have been calculated for the crop in every sample field rather than by using average inputs for each republic as it was done in 1996 report.
Average gross margin for each main crop is positive. The most profitable crop for the region is cotton. Gross margin while growing cotton was (according years): 392.7$/ha, 396.8$/ha, 201.3$/ha.
Robust gross margin was obtained while growing rice in Kazakstan and Uzbekistan, according the results of 1998 it was 390.9$/ha and 572.3$/ha respectively. Tobacco and sugarbeet are highly profitable crops for Kyrgyzstan, and they give gross margins in 824.8$/ha, 1065.9$/ha on tobacco and 1962.8$/ha on sugarbeet. The attempts to cultivate secondary forage crops do not bring expected results on gross margin increase.

Productivity of Irrigation

In average for all 117 fields water deliveries “gross - field” while irrigating **cotton** were in 1998 6.15 thousand m3/ha (compared with 7.07 thousand m3/ha in 1997), i.e. it was reduced almost for 1 thousand m3/ha.
There was also certain reduction of water use per unit of crop and it was 2.72 thousand m3/ton (compared with 2.97 thousand m3/ton in 1997).
Water use productivity (in physical values) also increased up to 0.37 ton/000m3 (compared with 0.34 ton/000m3 in 1998). Although due to the reduction of yields (from 2.38 ton/ha in 1997 to 2.26 ton/ha in 1998) and the increase of costs for agricultural production the benefit per unit of water used decreased to 59.1$/000m3 (compared with 67.0$/000m3 in 1997).
With the account of the contribution into crop water use of the effective share of precipitation and capillary feeding from close located groundwater sources on the majority of cotton fields in Kazakstan, Turkmenistan and Uzbekistan the actual water availability of the fields was close to potential water use. But due to disagreed water delivery schedules and crop requirements the share of efficiently used water for plants was not big, though is higher than in 1997. The costs per unit of agricultural production were less correspondingly to the reduction of specific water deliveries. The exception is Tadjikistan where the costs per production of one ton were 8.77 thousand m3/ton, and that is higher for 2.39 thousand m3/ton than in 1997. Though these more or less good indices of 1998 are accompanied by the data that indicate on the reduction of yields, and especially sharp in Kazakstan (1.41 ton/ha in 1998 compared with 2.58 ton/ha in 1997) and Kyrgyzstan (1.86 ton/ha in 1998 compared with 2.42 ton/ha in 1997).
Some increase in yields is recorded in Tadjikistan (2.06 ton/ha in 1998 compared with 1.77 ton/ha in 1997) and Uzbekistan (41 ton/ha in 1998 compared with 2.03 ton/ha in 1997).
Practically in all the countries (except Uzbekistan) benefit per unit of water used in comparison with 1997 reduced:

- in Kazakstan for 40.4 $/000 m3
- in Kyrgyzstan for 36.4 $/000 m3
- in Turkmenistan for 14.2 $/000 m3

- in Tadjikistan for 5.6 $/00 m3

In Uzbekistan in comparison with 1997 the benefit increased for 7.9 $/000 m3.
Nevertheless, the highest benefit per unit of water used (141.4 $/000 m3) was fixed in Kazakstan in 1998 where cotton fields were represented by private farms. And that explains such difference as many of the costs that accompany agricultural production in big state farms, are not available in relatively small private farms.

In average for all 38 fields water deliveries “gross - field” while irrigating **wheat** were in 1998 3.97 thousand m3/ha (compared with 4.76 thousand m3/ha in 1997). In comparison with 1997 the costs per unit of agricultural production decreased for 1.64 thousand m3/ha (compared with 1.89 thousand m3/ha in 1997).
Water use productivity (in physical values) increased up to 0.61 ton/000m3 (compared with 0.53 ton/000m3 in 1997) and benefit per unit of irrigation water use up to 7.5 $/000m3 (compared with 2.5 $/000m3 in 1997).
Together with that, the decrease in yields on irrigated fields of wheat was recorded:

- in Kyrgyzstan for 2.91 ton/ha (compared with 3.16 ton/ha in 1997)
- in Turkmenistan for 1.40 ton/ha (compared with 1.67 ton/ha in 1997)
- in Uzbekistan for 2.57 ton/ha (compared with 2.60 ton/ha in 1997)

Benefit per unit of irrigation water used decreased in Kyrgyzstan to 45.1 $/000 m3 (compared with 61.7 ton/ha in 1997).
The losses increased in Turkmenistan for 4.9 $/000 m3 (compared with 4.3 $/000 m3 in 1997)
The losses while irrigating wheat decreased in Uzbekistan for 0.2 $/000 m3 (compared with 18.4 $/000 m3 in 1997).

In average for 14 fields water deliveries “gross - field” while irrigating **lucerne** increased and were in 1998 6.15 thousand m3/ha (compared with 4.51 thousand m3/ha in 1997). The volumes of irrigation water per unit of agricultural production increased up to 0.22 thousand m3/ton (compared with 0.20 thousand m3/ton).
Water use productivity (in physical values) decreased to 4.50 ton/000m3 (compared with 5.01 ton/000m3 in 1998). Although due to the reduction of yields (from 2.38 ton/ha in 1997 to 2.26 ton/ha in 1997), though the benefit per unit of irrigation water use increased up to 14.7 $/000 m3 (compared with the loss of 17.7 $/000 m3 in 1997). This is explained by the fact that in 1998 in the majority of 14 fields Lucerne was grown for seeds.
In Tadjikistan specific water deliveries to the irrigated fields with lucerne decreased to 13.28 thousand m 3/ha (compared with 13.44 thousand m3/ha in 1997). In uzbekistan water deliveries increased up to 5.35 thousand m3/ha (compared with 4.06 thousand m3/ha in 1997).
Correspondingly to the reduction of water deliveries the costs per unit of agricultural production decreased:

- in Kyrgyzstan for 0.15 thousand m3/ton (compared with 0.33 thousand m3/ton in 1997)
- in Tadjikistan for 0.52 thousand m3/ton (compared with 0.53 thousand m3/ton in 1997)

In Turkmenistan and Uzbekistan specific volumes per unit of agricultural production increased:

- in Turkmenistan for 0.26 thousand m3/ton (compared with 0.22 thousand m3/ton in 1997)

- in Uzbekistan for 0.22 thousand m3/ton (compared with 0.12 thousand m3/ton in 1997)

With general increase in average yields on irrigated fields with lucerne up to 25.40 ton/ha (compared with 22.58 ton/ha in 1997), the reduction of yields was recorded in Uzbekistan down to 24.22 ton/ha (compared with 35.27 ton/ha in 1997). In the other republics the yields in 1998 were recorded at the following levels:

- in Kyrgyzstan 27.49 ton/ha (compared with 22.04 ton/ha in 1997)
- in Tadjikistan 25.42 ton/ha (compared with 25.42 ton/ha in 1997)
- in Turkmenistan 26.47 ton/ha (compared with 16.18 ton/ha in 1997)

Benefit per unit of irrigation water used (according the reasons mentioned above) increased significantly in Kyrgyzstan up to 72.4 $/000 m3 (compared with 21.7 $/000 m3 in 1997).
The losses for cultivation of irrigated lucerne decreased:

- in Turkmenistan to 1.3 $/000 m3 (compared with the loss of 33.8 $/000 m3 in 1997)
- in Uzbekistan to 12 $/000 m3 (compared with the loss of 57.0 $/000 m3 in 1997)

In the farms of Tadjikistan the growth of losses to 13.4 $/000 m3 (compared with the loss of 57.0 $/000 m3 in 1997) while cultivating irrigated lucerne was recorded.

The assessment of 20 fields with **rice** in 1998 (1997 was assessed according 22 fields) was carried out in WUFMAS fields included in the monitored fields of two countries Kazakstan and Uzbekistan.
In average for all assessed fields water deliveries "gross - field" increased significantly up to 29.17 thousand m3/ha in 1998 (compared with 19.52 thousand m3/ha in 1997). The volumes of irrigation water per unit of agricultural production increased up to 7.88 thousand m 3/ton (compared with 5.50 thousand m3/ton in 1997)
Water use productivity (in physical values) decreased to 0.13 ton/000m3 (compared with 0.18 ton/000m3 in 1998), though the benefit per unit of irrigation water use increased up to 16.7 $/000 m3 (compared with the loss of 16.1 $/000 m3 in 1997).
Specific water deliveries to the irrigated fields with rice increased in Kazakstan up to 31.74 thousand m3/ha (compared with 5.50 thousand m3/ha in 1997), and in Uzbekistan up to 26.04 thousand m3/ha (compared with 5.50 thousand m3/ha in 1997).
Correspondingly the volumes of water per unit of agricultural production increased:

- in Kazakstan up to 10.17 thousand m3/ton (compared with 5.60 thousand m3/ton in 1997)
- in Uzbekistan up to 5.92 thousand m3/ton (compared with 5.39 thousand m3/ton in 1997)

With general increase in average yields on irrigated fields with rice up to 3.70 ton/ha (compared with 3.55 ton/ha in 1997), the reduction of yields was recorded in Kazakstan down to 3.12 ton/ha (compared with 3.37 ton/ha in 1997) and the increase of yield was recorded in Uzbekistan up to 4.40 ton/ha (compared with 3.83 ton/ha in 1997).
Though the benefit per unit of irrigation water used increased in Kazakstan up to 14.1 $/000 m3 (compared with 11.3 $/000 m3 in 1997) and decreased in Uzbekistan down to 19.8 $/000 m3 (compared with 24.5 $/000 m3 in 1997).