STATE COMMITTEE OF THE REPUBLIC OF TAJIKISTAN FOR LAND MANAGEMENT

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METHODOLOGICAL GUIDELINES FOR APPRAISAL OF SOILS AND ECONOMIC EVALUATION OF LAND OF THE REPUBLIC OF TAJIKISTAN

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I. GENERAL PROVISIONS

1. These methodological guidelines for appraisal of soils and economic evaluation of land of the Republic of Tajikistan were developed on the basis of paragraph 27, item 8 of the Resolution of the Government of RT № 189 dated April 19, 2001 "On approval of the Statute of the State Committee of the Republic of Tajikistan for Land Management". They define arrangements for organization and implementation of works, coordination, approval of materials and provision of data about appraisal of soils and economic evaluation of land.
2. The purpose of soils appraisal is to carry out comparative rating of their quality and natural production capacity with regard to the actual level of land treatment used in cropping. Appraisal of soils is one of the fundamental methods used for stocktaking of land; it serves as a basis for subsequent cost assessment of farming lands, for identifying the size of property shares, for land management and stimulating efficient and effective land use.
3. Land lots and their portions, with their legal status established on the basis of respective documents, shall be subject to appraisal of soils.
4. Appraisal of soils shows to what degree one soil is better or worse than another one with regard to characteristics determining its fertility. It should take into account climatic conditions as well as natural and acquired characteristics of the soil itself resulting from amelioration that affect crop productivity and also specifics and complexity of treatment and ameliorative measures.
5. All types of land tenure as well as land leaseholders shall be subject to appraisal of soils.
6. All agricultural land irrespective of agency ownership and tenure rights shall be subject to appraisal of soils.
7. It is imperative that appraisal of soils be technically combined with soil survey, updating and other cadastral surveys.
8. Assessment of land shall be based on results of soils appraisal and conjugate use of data on expenditures and long-term productivity of the main crops on different lands to be derived from calculations.
9. Assessment sequence:
   - assessment of agricultural land at the level of cadastral zones of the Republic of Tajikistan;
   - assessment of agricultural land (on-farm contour assessment) at the level of administrative districts and individual land users of the Republic of Tajikistan.
10. Assessment of land shall be based on data about the amount and quality of land obtained as a result of stocktaking of land carried out by the state as well as on annual statistics reported by agricultural enterprises. The main statistical material on farms shall be collected and processed for the last three-year period.
11. In order to identify and take into account differences in public labor productivity on different soils their economic evaluation is carried out. Based on indicators of economic evaluation we can judge about productivity of different soil groups and land in general, cost-effectiveness, values of surplus product (differential rent), effectiveness of cropping and specialization of different farms.
12. The level of cadastral cost of agricultural land to be evaluated shall be the subject of evaluation.
13. Agricultural land shall be evaluated by its quality and location irrespective of its actual type of utilization, i.e. land in tillage, perennial plantations or pastureland.

14. There are two aspects of land evaluation:
    - general land evaluation;
    - specific land evaluation, i.e. evaluation based on effectiveness of growing individual crops.

    Main indicators of general land evaluation:
    a) productivity, i.e. cost of gross produce (somoni/hectare);
    b) cost recovery (cost of produce per 1 somoni of expenditures);
    c) differential rent, i.e. additional revenue received on land of better quality and located in a better area (somoni/ hectare).

    Main indicators of specific land evaluation:
    a) yield (centner/hectare);
    b) cost recovery (centner/hectare).

Scales for general and specific evaluation should be developed both for absolute (somoni, centner/hectare) and relative (scores) values.

With respect to solution of specific tasks other indicators based on the same source information: productivity of pastureland by production of fodder units and amount of digestible protein, reduced costs per product unit, etc.

15. Land rent is an important indicator for analysis of economic activities. The land rent indicator can be used in reallocation of agricultural land, inter-farm land management, etc.
16. The mandatory list of agricultural crops used to evaluate land in all areas were they are grown includes: cotton, tobacco, rice, potatoes, vegetables, perennial grasses, orchards and vineyards (Attachment 3). Evaluation can involve other crops as well. In doing so it is necessary to ensure that selected crops are characteristic of the cadastre zone in question and are of high production value.
17. The main evaluation units are groups of soil varieties (evaluation groups) established for each cadastre zone of the republic (Attachment 1).
18. As a result of the land evaluation indicators of general and specific evaluation should be obtained for lands belonging to agricultural enterprises, administrative districts and regions.
19. Establishment of land price in accordance with the proposed methodology characterizes the value of 1 hectare of land as a means of production to be used for cost estimation of production capacity, comparison of expenditures and effects from lump-sum investments. It can also be used for levying justified land tax, resolution of issues related to compensation of losses to agriculture from alienation of land and their resulting withdrawal from agricultural turnover, introduction of rent, with due regard though for specifics of those categories and involvement of additional factors reflecting the targeted objectives.
20. Intrafarm contour evaluation of land (ICEL) and calculation of value of one hectare of agricultural land is an integral part of specific economic evaluation of land.
21. To carry out economic evaluation of land it is necessary to envisage in the first place collection and processing of information (in office conditions) based on the latest materials of state stocktaking of lands, soil and geobotanical surveys as well as statistical reports on agricultural enterprises of the republic for the last three-year period.
22. Systems of natural and cost estimation indicators both in absolute (cost, cost/unit, somoni, centner/somoni, somoni/hectare) and relative terms (score, quotient).

    Land evaluation indicators are preliminary calculated by working lots (contours), basic evaluation units, and then with regard to land use arrangements as average weighted values for fields, crop rotation, production divisions and for the farm in general.
23. Land evaluation work involves the following stages:
    a) preparatory work;
    b) collection of baseline information.

    Preparatory work include verification of availability and quality of survey materials, substance and practical value of previous work in the area of agricultural zoning of the region (republic), grouping of soils, classification of land, appraisal of soils and economic evaluation of land, prospects for use of previously obtained data for evaluation in accordance with legal requirements and current market relations.

    Collection of baseline information means collection of data on the amount and quality of land as well as processing of statistical reports prepared by agricultural enterprises.

    Manufacturing specialization of farms is clarified after the percentage of agricultural land used over the last three years is established (Attachment 3).

    Materials of geobotanical surveys are used for characterizing natural forage lands (pastures and hayfields). In the absence of such materials productivity of hayfields and pastures is determined on the basis of data for the key lots.
24. These methodological guidelines are meant for carrying out land assessment comprising appraisal of soils and economic evaluation of land according to a uniform technology and to ensure comparability of the obtained results at the republican level.
25. The State Committee of the Republic of Tajikistan for Land Management, local Khukumats and individual land users can commission soils appraisal work.

26. The state project-design institute for land management "Tojikzaminsoz", State Committee of the Republic of Tajikistan for Land Management with involvement of other research institutions and project-design agencies shall be responsible for carrying out land assessment in cadastre zones of the republic.

II. BASIC NOTIONS

27. For the purpose of these methodological guidelines the following basic notions are used herein:

Lot of land – agricultural land within the boundary of land tenure of a natural or legal person;
Location of land lots – a feature of land lots characterizing the distance to markets of agricultural produce and manufactured goods supplies with due regard for cargo transportation conditions;
Appraisal of soils – appraisal of soils based on their characteristics most vital for growing agricultural crops and expressed in terms of yield class score (with the maximum score of 100 points).
Economic evaluation of agricultural land (hereinafter evaluation of land) – monetary value of economic effect achieved in the course of agricultural use of land with due regard for the time factor which is calculated as a difference between monetary estimate of produce in cadastre prices and individual expenditures for its production;
State cadastre assessment of land (hereinafter cadastre assessment) – a set of administrative and technical activities aimed at determining the cost value of land within the boundaries of administrative and territorial units as of specific date;
Quality of agricultural land – feature of land plots characterizing their fertility and technological properties;
Productivity of land – yield capacity of agricultural crops, pastures and hayfields in terms of money;
Estimated productivity – indicator characterizing the amount of produce per 1 hectare of agricultural land based on average yield capacity of staple agricultural crops;
Estimated expenditures – one of indicators of production effectiveness with due regard for the minimum required cost-effectiveness to ensure sustainability;
Absolute rent revenue – minimum revenue established uniformly per one hectare of agricultural land irrespective of its quality and location;
Differential rent revenue – additional revenue received from lands of relatively better quality and location;
Calculated rent revenue – sum of differential and absolute rent revenues;
Capitalized cost – rent revenue converted into capital;
Land rent – additional (above the standard) revenue plus minimal revenue received from lots with worse natural climatic conditions and locations;
Price index – this is an index of rise in prices for material and technical resources required for utilization of agricultural land. It is established annually by a Resolution of the Government of RT;
Cadastre cost – capitalized land rent;
Land assessment area – a portion of the territory of the Republic of Tajikistan roughly homogeneous by its soil, climatic and economic conditions of agricultural production;
Land as an implement of labor – evaluated by its production characteristics determining its fertility. It includes physical and chemical properties of the soil defining availability of nutrients and feeding conditions of agricultural crops as well as the level of bioclimatic capacity of the evaluated territory. For such an assessment appraisal of soils, evaluation of land by yield capacity of agricultural crops and productivity fodder land is carried out.
Land as an object of labor is evaluated by its technological properties determining technology, labor and material inputs in farming. Technological properties of land include: power intensity, contour properties (size, outlines of its lots, existing obstacles preventing mechanized tillage, and positional relationship of lots), relief, degree of stoniness, remoteness of lots from economic centers;
Land as a means of production is evaluated based on cost effectiveness, i.e. production indicator of yield capacity, productivity and expenditures. In this respect the main indicator for evaluation of land is estimated productivity and differential rent. Under equal economic conditions of production the difference in fertility of lands is dependant on the difference in quality of their production and technological properties;
Cadastre assessment of agricultural land – large scale, comparable assessment carried out in accordance with a uniform methodology as of a certain moment in time across the Republic of Tajikistan;
Object of assessment – agricultural land within the boundary of land tenure of a natural or legal person.

III. BASIC METHODOLOGICAL PRINCIPLES OF SOILS APPRAISAL ON IRRIGATED LANDS

Basic Appraisal Scores (BAS) of the main genetic types (subtypes) of soils in Tajikistan

28. The main principle of soils appraisal in the republic used to be the following: for all geographic zones (southern, central, northern parts of the country) and for all climatic types (subtypes) of soils the best soils were accepted as a standard and received the maximum score of 100 points. With respect to those standard soils the yield class of other varieties of soils within a certain type or subtype was defined using relative correction indices taking into account various negative surface and morphological, physical, chemical and other properties that have an adverse effect on yield capacity of agricultural crops grown in that area. This type of soils appraisal would not make sense because it is clear that any best soils within all genetic types

(subtypes) that were formed under different conditions of soil genesis, i.e. under different climatic conditions and as a consequence having different natural fertility (for instance because of differences in humus contents and thickness of the soil profile) cannot the maximum 100 score.

For example: sandy desert and dark grey soils, grey brown and cinnamon carbonate soils, dark grey and typical carbonate, light and common grey soils, etc. Those pairs of soils as well as all other genetic types and subtypes of soils (virgin) in the vertical zoning system depending on the content of humus characteristic for them (according to conditions of soil genesis) have natural fertility completely different from one another and consequently different yield class score. As a result every genetic type (subtype) can belong to a certain yield class.

29. The 100-scale of yield classes is traditionally divided by 10 thus forming 10 ten yield classes. The first class has the value of 10; the tenth class – the value of 100. In that way those classes provide an approximate notion of the quality of soil.

    The yield class of every specific type (subtype) of soils in the classification row is determined conditionally with respect to the type (subtype) of soil with the highest natural fertility, i.e. has the highest contents of humus in the humus layer (A+B) and the thickest soil profile ($A+B_1+B_2$) (Table 1).

    Therefore the score corresponding to a certain class is the maximum and it is called "appraisal score" (BAS) for the given type (subtype) of soils. Basic appraisal score can change and differentiate depending on various factors constraining or improving fertility of land such as: irrigation of different duration (long standing irrigation), bioclimatic capacity (BCC), types of agricultural use of land, genetic and surface-and-morphological properties of soils, etc.

Table 1

Values of parameters determining natural fertility of the main genetic types (subtypes) of soils in Tajikistan

№	Types and subtypes of soils	Elevation above the sea level (m)	Depth of water penetration (cm)	Thickness of humus layer ($A+B_1$), cm	Thickness of soil profile ($A+B_1+B_2$), cm	Contents of humus in the humus layer,%
1.	Sandy desert soil	250-300	Up to 30	0-10	No profile	Less than 0,5
2.	Grey-brown soil	350-500	30-50	10-15	15-25	0,5-0,7
3.	Light grey soils	650-850	50-70	20-35	30-35	0,7-1,2
4.	Common grey soils	800-1100	70-100	25-30	30-40	1,0-1,5
5.	Dark grey soils	900-1750	100-120	30-45	40-50	1,5-2,5
6.	Cinnamon carbonate soil	800-2000	120-150	45-50	50-60	2,0-3,0
7.	Cinnamon leached soil	2000-2800 (2900) up to 3000	200-250	50-60	Up to 80	3,0-4,5
8.	Mountain light cinnamon and carbonate	1700 up to 2000-2800	150-200	50-59	75	2,5-3,5
9.	Typical Mountain cinnamon	1600-1800 up to 2600-2800	200-300	60-100	80-120	4,0-9,0
10	High-mountain meadow and steppe	2600-4000	All the way to the bedrock	70-80	100-120	6,0-9,0
11	High-mountain steppe	2900-4500	All the way to the bedrock	50-70	70-90	5,0-8,0
12	High-mountain desert and steppe	3300-4500	All the way to the bedrock	32	50	4.0-5,0
13	High-mountain desert	3400-4800	All the way to the bedrock	10	10-15	0,4-0,6

Differentiation of BAS indicator for soils in Tajikistan depending on duration of irrigation and degree of amelioration

30. It is a well known fact that irrigation results in significant positive (if it is properly managed) effects on fertility and the process of amelioration of soils. Long standing irrigation of soil combined with a high level of agrotechnics, use of mineral and organic fertilizers, introduction of crop rotation with perennial leguminous plants and other progressive agricultural interventions, are conductive to formation of a new, thicker agro-irrigational profile with silt and more auspicious water-physical properties.

    Soils on the territory with the most ancient history of irrigated agriculture as a rule have: thicker and more fertile topsoil and a high microbiological and nitrophicational activity, availability of mobile nutritional

elements, optimum condition of physical properties, looser structure, high fractional void volume, better permeability and higher degree of washout of readily soluble salts.

31. On the territory of ancient irrigation fields of the optimum size, configuration and leveling are usually formed with a good technical condition of irrigation schemes. Therefore soils of any irrigation duration in comparison with soils of virgin and non-irrigated lands would have a higher quality score. Soils of the ancient irrigation area are in a good ameliorative condition and an average level of agrotechnics and application of fertilizers on those soils will ensure the maximum yield of crops, for instance 3 – 4 tons of cotton per hectare. Soils with a long irrigation history (in a good ameliorative condition) are usually found on middle (II-nd and III-rd) terraces of the major rivers: Vahsh, Pyanj, Syrdarya, Zeravshan, Kyzylsu, Yahsu, lower course of Kofarnihon, and in the valleys of irrigation farming (Hissar depression).
32. Newly cultivated lands with newly irrigated (sometimes irrigated) soils are characterized by insufficient leveling of relief with noticeable gradients of the surface, pronounced elements of irrigation erosion and sagging of land located on the higher (IV-th and V-th) river terraces and plato-like elevations, low and medium thickness of the aleurite profile, and a high degree of stoniness of the lower (I-st and II-nd) river terraces, proluvial plains in foothill areas and on debris cones.
    These soils as a rule have less favorable water-physical properties, high degree of compaction, very low or extremely high (sinking) permeability and a low supply of nutrients. These soils have a poor ameliorative condition and yield capacity of crops on such soils is usually low. For instance yield capacity of cotton does not exceed 1.2-1.5 tons/ hectare.
33. An intermediate position by degree of effective fertility and amelioration is occupied by soils irrigated over the period of 30-50 years. Such soils are prevalent mostly on II-nd, III-rd and rarely on IV-th river terraces. They constitute the main fund of irrigated farming in the main farming zones of the republic. These soils usually provide for a medium yield of cotton (2.0-2.5 tons/ hectare) and other agricultural crops.
34. Regular irrigated soils and irrigated soils of long standing (with a high degree of amelioration) of all genetic types (subtypes) are referred to the higher (VIII, IX, X) classes (with the exception of grey-brown and high-mountain desert and steppe soils) and receive the maximum scores accordingly. Newly irrigated (with a low degree of amelioration) soils are mostly referred to classes III, IV, V, and VI and receive comparatively lower scores (with the exception of dark grey, cinnamon carbonate, typical cinnamon and high-mountain meadow and steppe soils referred to classes VII and VIII) (Table 2).

Yield class appraisal of irrigated soils by bioclimatic capacity (BCC)

35. The main factor determining high value of soils in valleys is irrigation. Without irrigation all soils of the desert and extra-arid piedmont-desert zone such as grey-brown, light grey soils, etc, are of a very low value in terms of agriculture. Without irrigation those soils can be used at best as winter and spring pasturelands that have a very low productivity of grass canopy. If irrigated those soils will become more valuable due to a high bioclimatic capacity that provides for energy requirements of a wide range of thermophilic crops grown in this area.
    Consequently bioclimatic capacity (BCC) in irrigated area is one of the most important factors alongside with genetic and acquired properties of soil, an indicator affecting appraisal and economic evaluation of soil.
36. We can give numerous examples of comparison between different groups of genetically similar soils with different bioclimatic resources (first case) and genetically different soils with similar bioclimatic resources (second case) where either different (in the first case) or similar (in the second case) nature of agricultural use was noted. To the first case we can refer sandy-desert, grey-brown and light grey soils of the Southern Tajikistan and high-mountain cold desert soils of the Eastern Pamirs that are very similar with regard to their morphological and chemical properties with a poorly defined profile, very low content of humus, similar carbonate content and salinity, and differing very little by appearance.
    High supply of thermal energy allows to grow the most thermophilic crops on irrigated desert-grey soils, such as fine-fiber cotton, geranium and citrus fruits. On the irrigated desert soils of the Eastern Pamirs only oats and some quickly growing vegetables have barely enough time to become ripe.
    The second case refers to light grey soils of southernmost part of the Vahsh valley and cinnamon carbonate soils of its northern part (within Yavan district) that have a very similar and high bioclimatic capacity allowing to grow fine-fiber cotton both in the south and in the north of the valley.
    If on irrigated dark grey soils of Hissar valley a good yield of medium and long-duration medium-fiber cotton is received, on the same soils in piedmont area of the northern Tajikistan cotton and other crops with similar energy requirements do not get sufficient amount of warmth and cannot ripen during the season.
37. This is why appraisal of soils in the irrigated zone must be conducted with due regard for bioclimatic capacity (BCC) of every genetic type (subtype) of soils in different geographic and agricultural areas of the republic and BCC related potential of growing the main groups of agricultural crops on one or another soil or in a certain zone, taking into account their productivity depending on energy requirements.
    Based on the above:

For all geographic zones of Tajikistan relative correction indices of bioclimatic capacity (IBCC) for the basic appraisal score (BAS) of one or another type (subtype) of soils based on their irrigation duration (table 2) and depending on the degree to which bioclimatic resources of those soils (effective temperature >+10°) can supply energy to specified groups of crops to meet their energy requirements (table 3) were established and differentiated. In other words what groups of agricultural crops and with what degree of productivity can be grown on specified types (subtypes) of soils depending on the amount of their bioclimatic resources (the sum of effective t°>+10° during vegetation) (Table 3).

The entire range of field agricultural crops traditionally grown in the republic of marketable and consumption value was divided into 7 groups with the interval between groups equal to 500° (table 3) with regard to their energy requirements (effective temperature during vegetation from <500° to >3500°).

In addition to those 7 groups of field and vegetable crops in four extra groups (VIII, IX, X, XI) were introduced for fruit cultures that are traditionally grown with various degree of effectiveness in specific zones and regions of the republic depending on auspiciousness of the climate not only in terms of energy availability but also with respect to its other aspects (frosts in early spring, storm precipitation during the blooming period, exposure to diseases and pests, etc).

The maximum index of bioclimatic capacity for soil yield class is equal to one (1.0) in cases when the deficit between the soil thermal resources and energy requirements of crops is equal or less than zero (D≤0). In case the deficit is more than zero (>0) the index will be less than one (<1) in proportion to the increase of deficit (table 4).

Arithmetic mean of the sum of indices for all 11 groups of crops constitutes average correction index of bioclimatic capacity (I_{BCC}) for a specific type (subtype) of soil. Multiplication of the latter by the value of the yield class of the same soil by its irrigation duration (BAS_D) will provide the value of the soil yield class adjusted with respect to its BCC (BAS_{BCC}).

Final yield class appraisal of irrigated soils with due regard to their genetic, surface and morphological and acquired properties

38. An important stage in appraisal of irrigated soils is appraisal of their yield class with regard to the various negative properties that can to a certain degree have an adverse effect on yield capacity of agricultural crops and soil productivity. These can include: thickness of aleurite layer, salinity, mechanical composition, stoniness, plastering, underground water table (if there is no salinity), steepness of surface, thickness of layer removed during leveling, filling layer introduced during reclamation, agrochemical properties of soil, etc.
39. Appraisal of the soil yield class with regard for those characteristics is carried out by applying respective correction indices for each of those characteristics, which constitutes the final stage of soils appraisal. Different authors propose different indices expressing the degree of possible effect of negative properties on reduction of productivity of agricultural crops and soils depending on degree of their manifestation. The most acceptable indices that can be used in appraisal of soils in Tajikistan were proposed by Kochubei and Suchkov (1969), Kerzum (1974) and Shishov (1990). A synthesis of those indices is given in tables 5, 6 and 9.
40. By multiplying the value of the soil yield class adjusted with respect to its BCC (BAS_{BCC}) by a respective correction index for each of the properties characterizing the soil being appraised a mean arithmetic value is found representing the final scoring of soils appraisal or the so call soil ecological indicator (S_{EI}).
41. The degree of negative impact of some adverse properties of soils such as salinity, plastering, mechanical composition and alkalinity, on the soil appraisal results should be identified by layers – in case they are not present in the topsoil the underlying layers (0-30, 30-50, 50-100 cm) should be examined and the impact should be defined based on the depth where these properties are manifested (table 5).
42. Appraisal of soils with regard to their agrochemical characteristics should be carried out by groups of crops within a certain type (subtype) of soils, preferably by the gross content of phosphorus and nitrogen that represent temporally stable indicators.

    Depending on availability of agrochemical indicators (gross or variable) appraisal of soils can be carried out based on mobile forms of nutrients (N, P, K) subject to the condition that the soils yield class will be adjusted annually in case this indicator changes because mobile agrochemical indicators are temporally instable and can undergo significant changes (increasing or decreasing) even over one season depending on amount of fertilizers applied and the type of cultivated crops.
43. Ground water depth table in case of absence of low level of mineralization that does not result in soil salinity should be regarded as a factor that has a positive impact on the soil hydrological regime and availability of water (under conditions of irrigation water deficit) for the main groups of agricultural crops.
44. In determining appraisal score for thoroughly leveled soils correction indices developed by I.M.Lipkin and M.Sultonov , 1969 should be used (table 6).

IV. BASIC PRINCIPLES FOR APPRAISAL OF SOILS OF MOUNTAINOUS (RAIN-FED)

TERRITORY OF TAJIKISTAN

General principles for appraisal of soils of the rain-fed zone

45. In arid climatic conditions of Central Asia availability of water is the main factor of sustainable productive use of agricultural lands. This factor can usually be regulated by means of artificial irrigation in lands with favorable relief (valleys and intermontane plains). In mountainous areas where relief constrains irrigation availability of water in a territory due to atmospheric precipitation plays an important role.
46. Availability and seasonal distribution of precipitation in the mountainous territories of Tajikistan as well as in other mountainous countries depends on altitudinal zoning (Table 7) and follows the consistent patterns described below:
    - within one latitudinal geographic zone the volume of precipitation increases as the elevation grows up until the point where warm termal zone is replaced by the cold one. In the more elevated areas an inverse relation is true, i.e. as the elevation grows the volume of precipitation decreases;
    - in different geographic (latitudinal) zones both quantitative and altitudinal changes in distribution of precipitation take place, i.e. there is a pattern reflecting the change in the volume of precipitation at a given elevation in different geographic zones (for instance in Northern Tajikistan at the elevation of 650-800 meters asl the volume of precipitation constitutes 150-250mm, in Southern Tajikistan (Vahsh valley) the same amount of precipitation is characteristic for the elevation of 400-600 meters asl whereas in the Kyzylsu-Yahsu valley the volume of precipitation at the elevation 400-600 meters constitutes 380-400mm, etc);
    - with the change from mid-mountain to high-mountain areas (above 3500 meters asl) the volume of precipitation decreases as the temperature drops. This pattern accounts for development of the different zoning structure of soil mantle, which has a varying value with respect to agricultural use.
47. In connection with the above these methodological guidelines classify the entire mountainous territory of Tajikistan according to respective climatic conditions (availability of water and energy) into three farming agricultural zones (Table 8):

    - extremely arid zone with deficit of precipitation and water where annual volume of precipitation is less than 300mm, i.e. zone with a very low effectiveness of agricultural use of low-yield winter and spring pasturelands;

    In its turn this zone is subdivided into two thermal subzones:

    - zone with the sum of effective temperatures (>+10°) of more than 2000° where productivity of pastureland constitutes 0.1 tons of dry fodder mass. This subzone includes Northern and Southern Tajikistan as well as the valley (western) part of GBAO with sandy-desert, grey-brown and light grey soils and the lower part of typical and light cinnamon soils;
    - territory with the sum of effective temperatures less than 350° with the productivity of vegetation mantle amounting to 0.2-0.3 tons of dry fodder mass per hectare. This subzone partly includes light cinnamon, high-mountain desert-steppe and desert soils of the highland area of Northern Tajikistan and GBAO;

    - semi-arid zone with poor availability of water (lower part of the zone) and humid rain-fed zone with the annual amount of precipitation between 300-600mm, i.e. zone of average and intense dry farming, pasturelands and hayfields, and low intensiveness of dry horticulture and vine-growing.

    According to its thermal resources this zone is subdivided into four thermal subzones:

    a) more than 2000°;
    b) from 2000° to 1000°;
    c) from 1000° to 400°;
    d) less than 400°

    - zone with ample availability of precipitation, humid and highly humid area with the annual volume of precipitation ranging from 600 to 1200 mm.

    By the sum of effective temperatures this zone is subdivided into six thermal subzones:

    a) more than 2500°; b) from 2000° to 1000°; c) from 1000° to 600°;
    d) from 600° to 400°; e) from 400° to 300°; f) less than 300°;

    By its bioclimatic capacity and humidity conditions this zone is characterized by high and very high effectiveness of dry farming, horticulture, vine-growing as well as medium, high and very high productivity of pasturelands and hayfields.

    The following types of soils are concentrated in this zone:

    - cinnamon carbonate, typical cinnamon and leached cinnamon soils of Southern Tajikistan (Kyzylsu-Yahsu valley) and western part of GBAO;
    - high-mountain meadow-steppe and steppe soils of Central, Southern (Kyzylsu-Yahsu valley) and Northern (Zeravshan basin) Tajikistan and western part of GBAO.

Methodology for soils appraisal for mountainous (rain-fed) territory of Tajikistan

48. Reasoning from the above basic parameters (climatic and economic) the following criteria should be considered as the basis of soils appraisal of the mountainous territory of Tajikistan:
    a) amount of water supply;
    b) energy resources of the territory based on the sum of effective temperatures;
    c) type of agricultural utilization of the territory.
49. On the basis of the above the entire mountainous (rain-fed) territory of the republic is divided into three groups according to the nature of its agricultural utilization:
    a) rain-fed arable land;
    b) rain-fed orchards, vineyards and forest plantations;
    c) pastureland and hayfields.
50. Within every type of agricultural utilization, soils are appraised depending on zones they belong to according to availability of water.
51. Soils within zones distinguished by availability of water are appraised depending on thermal subzones they belong to according to their thermal resources (by the sum of effective temperatures > + 10°).
52. For soils in every zone distinguished on the basis of availability of water and in every subzone classified by availability of thermal energy as well as by agricultural use of land there are correction indices (Ci) to the basic appraisal score of types (subtypes) of rain-fed soils, i.e. for virgin lands (BASv) (table 2) with a differentiation of those indices for pasturelands and hayfields according to their productivity, i.e. yield capacity of their vegetation mantle (table 8).
53. Correction indices to appraisal scores of soils according to appraisal qualities of soils of mountainous (rain-fed) territories are given in table 9.
54. By applying respective correction indices (tables 5 and 9) to basic appraisal scores of virgin types (subtypes) of soils (in table 2) corresponding to zones 1, 2, and 3 according to availability of water (table 8) the appraisal scores of soils of respective agricultural use are derived: ASrp (appraisal score for soils of rain-fed ploughland), ASro (appraisal score for soils of rain-fed orchards and vineyards) and ASp (appraisal score for soils of pasturelands and hayfields).

Final appraisal of yield class of soils in mountainous (rain-fed) territories with due regard for their surface-morphological and acquired properties

55. The final stage in appraisal of soils of mountainous (rain-fed) territories is their appraisal according to their various negative characteristics that can to a certain degree affect in a negative way productivity of soils with respect of different types of agricultural utilization (rain-fed ploughland, rain-fed orchards and vineyards, pasturelands and hayfields).
56. The negative characteristics taken into account during the final appraisal of soils of mountainous (rain-fed) territories include: degree of washing off (erosion), thickness of aleurite layer, mechanical composition, stoniness, salinity, plastering, and additionally, existence and quantitative manifestation of outcrops of compact rock and bedrock.
    Soils appraisal with regard to the above characteristics is carried out by applying respective correction indices for each of those characteristics according to appraisal principles for irrigated soils taking into account however some additional characteristics typical only for soils in rain-fed zones such as washing off, outcrops of compact rock and bedrock, to the appraisal scores of soils of respective agricultural utilization (ASrp, ASro, ASp). Based on this the appraisal score is derived which is the final stage of appraisal of soils in the rain-fed zone.
    It is necessary to take into account that in case there is a large number of outcrops of compact rock or bedrock shown in soil contours on pedological chart for the rain-fed zone the soils should automatically be considered as shallow and stony (without division by degrees).
    For shallow, stony soils only one step down index must be used:
    a) in case there are a lot of outcrops of compact rock or bedrock the index for shallowness, outcrops of rock or stoniness should be used;
    b) in case of shallowness without major outcrops of rock either the index for shallowness or the index for stoniness should be used.

    However in both cases the lowest step-down index should be applied.
    c) in case the soils are shallow they should be considered severely washed off.

V. BASIC RULES FOR PREPARING APPRAISAL SCALE AND APPRAISAL MAP OF SOILS OF A LAND TENURE (FARM)

57. For each individual land user for whom a land use plan was developed within the limits of his current boundaries based on materials of the latest public stocktaking of lands it is possible to carry out appraisal of

soils in case there are materials of soil survey for this farm that was implemented five years ago at the latest.

58. During appraisal of soils an appraisal scale is prepared in the form of appraisal sheet for farms located in the irrigated zone (table 10) and for farms in the rain-fed zone (table 11).
    In these sheets all appraisal groups of soil varieties are itemized with their index numbers correlating to the legend on the soil map.
    In the list of appraisal groups soil varieties are included in the following sequence:
    a) for soils of the irrigated zone: type (subtype), irrigation duration and all appraisal characteristics (thickness, salinity, alkalinity, plastering, stoniness, mechanical composition and depth of ground water table (in case the water is not mineralized and does not cause salinity) (see not to table 5).
    b) for soils of the rain-fed zone: type (subtype) and appraisal characteristics (extent of washing off, thickness, salinity (if any), plastering, stoniness, outcrops of compact rock and bedrock, mechanical composition).

    In the column for appraisal characteristics, agrochemical properties of the appraised group of soils are also included showing gross or variable P_2O_5 and N indicators (see para 41).
59. During development of appraisal scale one should follow the legend contained in "Guidelines for soil surveys of irrigated and rain-fed lands of Tajikistan", 2002.
60. During development of the soils appraisal scale the column "soil code" should be filled out. Indices in this column correspond to the previously adopted "All-union grouping of soils for characterizing the quality of lands". Conventional symbols and signs are shown in table 12.
61. For each appraised group of soils included into appraisal sheet the soil appraisal score is calculated (SAS) in the following order:
    a) for farms in the irrigated zone (table 10):
    - on the basis of table 2 the basic appraisal score for soils is derived depending on duration of irrigation (BASd);
    - depending on geographical location of the type (subtype) of soils its appraisal score is derived taking into account bioclimatic capacity of the zone (BCC) by multiplying the basic appraisal score of the soil considering its irrigation duration (BASd) by the average index of bioclimatic potential of the zone (BCCi), i.e. BASd x BCCi;
    - * the final appraisal score (SAS) of the evaluated groups of soils (soil varieties) is calculated by consecutive multiplication of the appraisal score for their bioclimatic capacity (BAS_{BCC}) by correction indices for their different appraisal characteristics (table 5) in accordance with the following formula:
    $SAS = BAS_{BCC}$ x Ia x Ib x Ic ….x Ip – where
    "I" stands for correction index;
    "a, b, c, …p" stand for corresponding appraisal characteristics.

    Note*: Appraisal of non-irrigated soils in the irrigated zone is carried out similarly to appraisal of soils located in mountainous (rain-fed) zone using a separate appraisal sheet (table 11) whereas principles for appraisal of such soils are given in the following paragraph.

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    b) for soils of mountainous (rain-fed) zone (table 11):
    - appraisal of soils of the mountainous (rain-fed) zone should be carried out separately by type of agricultural use of lands (see section 1,4);
    - appraisal of soils in the appraisal sheet (table 11) is carried out in accordance with the same sequence of registration of appraised groups with an indication of their area as during appraisal of irrigated soils with the sole difference that in this case registration is carried out according to agricultural utilization of lands (land lots).
62. Identification of soil appraisal scores (SAS) for each appraisal group (variety) of soils should be carried out as follows:
    a) on the basis of data in table 2 the basic appraisal score is derived for the virgin variety of respective soils being appraised (BASv);
    b) by multiplying the obtained basic appraisal score of the appraised type (subtype) of soil by relevant correction indices for watering (Iw) and availability of thermal energy (according to table 8) the final appraisal score of soils for relevant type of agricultural utilization of lands is derived (see paras 54, 55), i.e. ASrp, ASro, Asp;
    c) by multiplying the obtained appraisal score of the type (subtype) of soils for the relevant agricultural utilization of lands (ASrp, ro, sp) by correction indices for negative characteristics of soils the final appraisal score of evaluated varieties of soils in the rain-fed zone is derived.

VI. PREPARATION OF A CONTOUR SHEET FOR APPRAISAL OF SOILS BY TYPES OF LAND

63. Contour appraisal of soils by types of land is carried out according to the format of the contour sheet (table 13) for the following types of land:
    a) ploughland, both irrigated and rain-fed;
    b) perennial plantations – irrigated and rain-fed;
    c) hayfields and pasturelands;
    d) forests and shrubbery.
64. Reference of land to irrigated or non-irrigated type is made on the basis of materials of the state stocktaking of lands.
65. For each contour of a given land the following information should be entered into the appraisal sheet:
    - index number and area of the land contour;
    - indices of different soils shown in the legend to the soil map;
    - area of each variety of land found within the land contour;
    - characteristics of different soils (full name according to the legend to the soil map);
    - calculated appraisal score corresponding to the appraised soil according to tables 10 and 11.
66. Average weighted soils appraisal score for the land contour is calculated according to the following formula:

$$\mathbf{ASc} = \frac{(s_1 \times S_1) + (s_2 \times S_2) + \ldots\ldots + (ss \times Ss)}{\sum s}$$

Where ASc stands for average weighted appraisal score of soils in the land contour;
s_1, s_2, ss – appraisal scores of soil varieties found within the land countour;
S1, S2…Sn – area of different soil varieties within the land contour;
$\sum s$ – total area of the land contour.

Based on the results of soils appraisal for land contours and land types the average weighted appraisal score of land types for farms is calculated. On the basis of farm data the same calculation is made for districts, etc.

VII. WORKING ARRANGEMENTS

67. Appraisal of soils is carried out in accordance with the schedule for land cadastre activities of the State Committee for Land Management.
68. Appraisal of soils is carried out within the boundaries farms' land tenure for the entire administrative district. In case legal status of lands, their area or quality changes (to ensure reliability of cadastre data) appraisal of soils can be carried out for individual land lots.
69. At the time of organization and implementation of the activities the State Committee for Land Management shall have the following functions:
    - preparation of plans for soils appraisal in districts (regions) based on the current changes in the status and cadastre of land use;
    - establishment of arrangements, schedules of activities, controls systems and responsible parties;
    - acceptance of work and preparation of data on appraisal of soils to be included in the land cadastre documentation;
    - review of materials relating to appraisal of soils (if necessary) in a meeting of the Scientific and Technical Council of the State Committee for Land Management.
70. The implementing parties (contractors) shall:
    - prepare draft terms of reference and contract for soils appraisal;
    - develop a plan and schedule for soils appraisal;
    - organize monitoring and acceptance of the work.

VIII. PREPARATORY ACTIVITIES

71. Preparatory activities shall be carried out by the implementing party (contractor) and must include:
    - collection, study and analysis of land cadastre documents, materials of soil surveys, cadastre maps and plans;
    - development, coordination and obtaining approval for the terms of reference of appraisal of soils.
72. Analysis of materials to identify (establish) boundaries of agricultural land lots and populated areas is carried out on the basis of the operational land cadastre map of the district. Boundaries of rural populated areas are established in accordance with intrafarm land management projects, stocktaking materials and other cadastre surveys.
73. Together with the district land management service (district land management committee) and tax inspection the list of land users and land holders is rectified with respect to the land lots where soil appraisal activities are planned.

74. Assessment of the available land cadastre plans and soil maps is carried out and necessary corrections are made in them if necessary.
75. On the basis of the collected and reviewed materials the draft terms of reference are prepared for soil appraisal that has to be approved by the State Committee for Land Management of the Republic of Tajikistan.
76. The terms of reference state technical conditions, coordination and approval arrangements, schedule of works, list of outputs and other parameters and conditions.
77. The budget and contract for soil appraisal is prepared and finalized. To do this the following reference materials are to be used:
    - collection of basic prices for works related to land management and land cadastre, Moscow 1994;
    - collection of basic prices for works related to land management and land cadastre, Dushanbe, 2003.

IX. OFFICE WORK

78. The main objective of office work is to prepare appraisal scale for soil characteristics (tables 10 and 11), contour sheet for soil appraisal (table 13) on different types of land and a soil appraisal chart. The main documents for carrying out the above activities are:
    - materials of agricultural soil survey no more than 5 years old (in farms where the last soil survey took place more than 5 years ago or if the soils are salinated, a full-scale soil survey must be carried out or a correction of the soil map with necessary adjustments for the possible changes in the quality of soils);
    - legend to the soils map for all types of land (ploughlands, perennial plantations, pasturelands, hayfields, forests, etc. (in hectares));
    - agrochemical charts, maps of surface steepness, charts of salinity for the soil layers 0-50cm and 50-100 cm, depth of ground water table, mechanical composition, reserves of humus, erosion and other;
    - explanatory notes on soils in specific farms with analytical data, characteristics of ameliorative and agroproductive groups of soils and diagrams of geomorphologic zoning of the surveyed territory;
    - tables of area of different types of land with refined data of land balance for the year when soils appraisal is carried out;
    - complete information on climatic conditions (sum of positive temperatures above 10°C, sum of effective temperatures above 10°C, average annual volume of precipitation, moisturization index and other indicators for the object of appraisal based on the average perennial observations for the last ten years);
    - materials of state registration of land users, stocktaking of quantity and quality of lands;
    - required statistical data from annual reports of land users, zone state rarity plots and stations;
    - materials of geobotanical surveys and other missing materials required for appraisal of soils.
79. Boundaries and names of farms (land users) should be indicated according to their status as of 01.01 of the year following the one under review. This should be done on the basis of sketch-maps of land users in the administrative district (annex to land balance of the district).
    In case such maps are not available, boundaries of farms (land users) should be accepted according to materials of the latest state stocktaking of lands or should be agreed upon with respective district committee for land management.
80. Contour of a land type indicated on the plan of lands of a farm (land user) shall be the territorial unit of soils appraisal.
81. In case a good quality soil map no older than 5 years is available a map of soils appraisal should be compiled as follows:
    - the data about different types of soils is transferred onto the outline plan of the farm.
    In case boundaries of the land tenure have changed soils map for the new territory should be selected. The soils information is consolidated in a uniform system and a new legend is compiled afterwards. Calculation of area (legend) is carried out by different types of agricultural land. A detailed description of the main rules to be followed in filling out appraisal and contour sheets is given in sections V and VI of these guidelines.

X. PREPARATION OF SOILS APPRAISAL MAP

82. The soils appraisal map is prepared on the basis of a copy of land plan of the farm. Calculated soils appraisal scores are to be entered on every appraised contour of land.
83. Territories of appraised contours of land on the map should be painted in a certain color in accordance with the accepted scale (table 14).
    A respective legend should be attached to the map compiled on the basis of different types of land.
    The necessary conventional symbols are plotted onto the map and it is stamped with an angular mould of the approved format.

XI. ECONOMIC EVALUATION OF AGRICULTURAL LANDS. LIST OF BASELINE MATERIALS

84. The list of baseline materials for carrying out economic evaluation of land includes:

- materials of the last round of economic evaluation of lands;
- materials of soils appraisal;
- aggregate maximum yield capacity of the main irrigated and rain-fed agricultural crops by cadastre zones of Tajikistan;
- maximum soils appraisal scores (MSAS) by cadastre zones of the Republic of Tajikistan aggregated by types (subtypes) of soils of the irrigated zone and soils the rain-fed (mountainous) territory (Attachment 1).

Evaluation of agricultural land of the objects under evaluation

85. To carry out evaluation of agricultural land of the objects under evaluation, indicators of estimated productivity and costs at the level of cadastre zones of the Republic of Tajikistan shall serve as the basis. They are in proportion with the aggregated MSAS indicators.
Technological and evaluation indicators of yield capacity are established in differentiated by cadastre zones.
86. To evaluate agricultural lands it is necessary to identify:
- characteristics of objects under evaluation based on soils appraisal, technological properties and location of land lots;
- differentiated rent revenue;
- estimated productivity of agricultural lands;
- costs of growing and harvesting agricultural crops;
- average cost of reclamation and rehabilitation of 1 hectare of agricultural land;
- cadastre cost of agricultural lands.
87. Results of evaluation of lands serve as a basis for:
- improving land tax and taxation system of agriculture;
- calculation of losses to agriculture in case of withdrawing lands for non-agricultural and other purposes;
- analysis of results of economic activities of agricultural enterprises;
- preparation of feasibility studies for land management activities;
- introduction of rental payments, etc.
88. Data on evaluation of land of economic evaluation objects must be recapitulated by administrative districts, regions and for the republic in general.

Evaluation of productivity and costs per 1 hectare of agricultural land

89. Estimated productivity of 1 hectare of lands at the level of cadastre zones is determined based on the maximum possible yield of the main irrigated and rain-fed agricultural crops (group of crops), perennial plantations as well as hayfields and pasturelands (Attachment 3) on the best soils.
90. Yield capacity of fodder crops is determined in fodder units (indices for conversion into fodder units are given in Attachment 2). Production of fodder crops in monetary terms is estimated according to the price of 0.1 ton of fodder units of feed grain (oats). According to calculations for our republic it is equal to 78% of marketable grain price.
91. Estimated productivity of 1 hectare of land in monetary terms is calculated according to the following formula:
Pr= Y x P x Ip
Where P stands for estimated productivity, somoni/hectare;
Y – yield of tilled agricultural crops, perennial plantations, hayfields and pasturelands, centner/hectare (Attachment 3);
P – actual selling price for the reporting period (Attachment 3);
Ip – price index*.
92. Average estimated productivity of 1 hectare of the main agricultural crops (irrigated and rain-fed) according to the percentage of area they occupy is calculated by weighing their estimated productivity that was demonstrated over the last three years (Attachment 3), whereas average estimated productivity of 1 hectare of agricultural lands is calculated by weighing estimated productivity of 1 hectare of ploughland (irrigated and rain-fed)**, hayfields and pasturelands by percentage occupied by them in the total area of agricultural land (Attachment 4).

Note
* According to the letter from the Ministry of Finance # 3-14/42 dated 06.02.2002, inflation index for 2002 constitutes 9.5%.
** The share of ploughland includes percentage of perennial plantations because their estimated productivity is conditionally considered to be at the same level with estimated productivity of ploughland.

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93. Estimated expenditures for utilization of 1 hectare of agricultural land at the level of cadastre zones are determined based on average actual expenditures over the last three years (Attachment 3) with regard for

the minimum required cost-effectiveness level for reproductive performance, which constitutes 8% of expenditures according to calculations:

$$E=E_{g+h} \times I \times 1.08;$$

Where "E" stands for expenditures for utilization of 1 hectare of agricultural land at the level of cadastre zones;

E_{g+h} – expenditures for growing and harvesting agricultural crops at the level of cadastre zones;

I – index of prices.

94. Procedures for calculating the cost of 1 hectare of agricultural lands (irrigated and rain-fed) are given in Attachment 5:

Column 2 – list of main, leading agricultural crops by cadastre zones of the Republic of Tajikistan;
Column 3 – based on materials of evaluating technological properties of land;
Column 4 – data from column 8, attachment 3;
Column 5 – data from attachment 1;
Column 6 – data from column 4, attachment 3;
Column 7 – calculated by dividing data in column 6 by values in column 5;
Column 8 – data from column 6, attachment 3;
Column 9 – calculated as a difference between data from columns 8 and 4;
- Column 10 is calculated as follows: column 9 is multiplied by 100 and then divided by 6 (bank loan); the result is added to the average costs of reproductive performance and reclamation. The sum of the latter constituted 17850 somonis as of 19.01.2002*;
- column 11 is calculated by dividing the data in column 10 by values in column 5;
- column 12 contains average land tax rates. They are reviewed and approved by the State Committee of the Republic of Tajikistan for Land Management on an annual basis. The rates are established on the basis of the Resolution of the Government of RT # 195 dated 19.04.2001 "on establishment of average land tax rates";
- column 13 – is calculated by dividing data in column 12 by values in column 10 and then multiplying the result by 100.

Note: the data were accepted on the basis of the letter from the Ministry of Land Reclamation and Water Resources of RT #04-647 dated 28.05.1999. The exchange rate constituted US$1 = 2.55 somonis (as of 19.02.2002).

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95. Differentiation of the land tax rates is carried out within each cadastre zone depending on the price of land.
96. Differentiated rent revenue (column 9 attachment 5) for the cadastre zone is calculated according to the following formula:

$$R = (P-E);$$

Where R – differentiated rent revenue, somoni/hectare;
P – productivity of 1 hectare in the cadastre zone, somoni/hectare;
E – expenditures per 1 hectare in the cadastre zone, somoni/hectare.

97. In calculating the cost of 1 hectare of land (column 10, attachment 5) a combined approach is used, i.e. rent estimate is complimented by expenditures for reclamation and rehabilitation of lands.

Calculation of cadastral value of 1 hectare of agricultural land

98. Cadastral value of 1 hectare of agricultural land for the object of evaluation is determined according to the following formula:

$$V=(R \times 100\% / Bi) + Err$$

V – value of 1 hectare of agricultural land;
R – differentiated rent of 1 hectare of land;
Bi – interest rate on bank loan*;
Err – average expenditures for reclamation and rehabilitation of lands.

Note: interest rate on bank loans is incorporated into calculations of land value. The rate varies from 3 to 6% and higher. For the purposes of these calculations we have accepted the rate of 6%, which is close to international rates.

XII. INTRAFARM EVALUATION OF LANDS. OBJECTIVES AND CONTENT OF ACTIVITIES

99. Intrafarm evaluation of lands is carried out to obtain the required and reliable data on productive and technological properties of land characterizing it as the main means of production in the sphere of agriculture.
Results of intrafarm evaluation of lands serve as standards and rule-proclaiming factors for science-based solution of the following practical issues:
- justification of yield capacity and expenditures for production in the sphere of crop growing, vegetable growing and horticulture;
- establishment of rental payments and annuity payments;
- organization of rational land use, distribution of agricultural crops and organizing territories for crop rotation;
- preparation of technological maps for growing agricultural crops;
- analysis of production operations of agricultural enterprises;
- development of activities aimed at improvement of productive and technological characteristics in order in enhance fertility of soils and reduce technological costs in agriculture;

100. The object of evaluation shall be agricultural lands within the boundaries of administrative districts, separately cultivated portions of ploughland, contours of fodder land, fields and areas allocated for crop rotation, hayfields and pastures, ploughland and fodder land of agricultural enterprises as well as lands managed by land users (legal and natural persons).
Evaluation of lands is carried out separately for non-ameliorated, irrigated and rain-fed lands.
As the main baseline information aggregated statistical reports of agricultural enterprises for the last three year period is used.

101. Content of land evaluation is determined by its agricultural role and objectives of practical application of the land evaluation data. In the course of intrafarm evaluation the quality of land is assessed in terms of three aspects: as a labor implement, as an object of labor and as a means of production.

102. As a means of production land is evaluated by derivates of yield capacity (productivity) and cost indicators, i.e. cost effectiveness.

103. The initial basis for intrafarm evaluation of lands are: zone-based cadastral scales of soils appraisal and evaluation according to yield capacity of the main agricultural crops, basic (average for the evaluation area) data on yield capacity of crops and expenditures related to their growing, materials of large-scale soil, geobotanical, hydro-ameliorative and other surveys, classification of fields and standards of field mechanized works, systems of farming and land management in the farm, technological maps for agricultural crops.

Assessment of yield capacity of agricultural crops

104. The same soils are not equally suited for growing of different crops. Depending on natural and economic conditions, availability of the necessary baseline information about the area and intensiveness of crop production, assessment of yield capacity of agricultural crops is carried out by differentiating indicators of estimated yield capacity of soil groups by their varieties on the basis of the soil appraisal score.

Evaluation of productivity of fodder lands

105. Hayfields and pasturelands are assigned productivity scores according to the output of fodder units (attachment 2) and digestible protein on the basis of zonal scales developed and used in evaluation of lands at the level of farm soil groups.
Fodder lands are evaluated on the basis of data of geobotanical and soil surveys. Materials of the surveys contain detailed characteristics of hayfield and pastureland contours according to yield class of soils, vegetation, its fodder merits, technological condition and productivity with regard for yields of hay, green material of pasturelands in fodder units.

Evaluation of technological properties of land

106. Technological properties of land include energy requirements of soils, contour shape, relief, stoniness and remoteness of lands.

Evaluation of energy requirements of soils

107. Energy requirements of soils are characterized by their physical condition – density, tenacity. It is measured by resistance sustained by a plough or other implements in the course of deep tillage of land. Energy requirements of soils are evaluated according to their scores. The highest score of 100 points is given to energy requirements of soils were specific resistance to plough constitutes 0.50kilogram-force/cm^2. Soil energy requirement score (S) depending on its specific resistance is calculated according to the following formula:

$$S = 49.2 \times 4.12^{Rs}$$

Where Rs stands for specific resistance of soil.

Evaluation of contour shaping of lands

108. Contour shaping of land lots is evaluated according to their scores based on suitability for implementing field mechanized works. Suitability for implementing works is determined by non-productive time spent by machinery (U-turns, moving from one lot to another) that are in direct proportion with width of the land lot, number and size of obstacles on the lot, convexity and concavity of the lot boundaries; and are in inverse proportion to the area of the lot. This is why the contour shaping score (S) depends on total width of the lot (referred to as conditional), obstacles inside the lot, convexities and concavities of boundaries with regard for direction of tillage calculated on the basis of 1 hectare of tilled area (m/hectare). The scale for evaluating contour shaping of land lots is given in table 15.

Contour shaping of lots is assessed with respect to their tillage lengthwise and in cross-direction. Based on results of those assessments the average weighted (main) contour score is determined based on correlation of tillage lengthwise and in cross-direction (2:1 respectively).

Some land lots due to relief conditions, in compliance with anti-erosion techniques, narrow and oblong shape of the lot, are tilled always or in vast majority of cases in one direction only. Contour shaping of such lots is evaluated only for the direction of their tillage.

Methodology for determining conditional width of a field (lot) is shown in the following examples.

The field shown in Figure 1 covers 103 hectares. For its tillage lengthwise per one hectare of land the width constitutes 7m, whereas for tillage in cross direction it is 15m because 687 : 103 = 6.7 whereas 1500 : 103 = 14.6. According to contour shaping scale (table 1) for tillage lengthwise and in cross direction the field scores respectively 99 and 94 points. Based on those scores the main score of contour shaping is calculated: (99+99+94) : 3 = 97.

In Figure 2 the area of plough land constitutes 95 hectares, whereas imbedded contours of forest and hayfield add up to 8 hectares. Those obstacles decrease tillage suitability of the field because they necessitate additional turns and maneuvers of machinery. Having reached the contour of an obstacle the machine has to turn in an opposite direction thus forming a separately cultivated lot. Additional non-productive time spent by machinery are in proportion with the width of obstacles in the field (embedded contours) located across the direction of tillage. This is why for lengthwise tillage conditional width of the field is equal to the sum of its external width and the width of the lots inside the field, i.e. 1413m because 687+175+188+200=1413. Therefore the width is 15m per 1 hectare of plough land. Contour shaping of the field according to table 1 scores 94 points. For tillage in cross direction conditional width of the field constitutes 2175m (1500+200+215+150+110=2175), or 23m/hectare of plough land. Contour shaping score is 90. The main contour shaping score for the field is 93.

Conditional width of the field is determined by a measuring device. Initially the opening of measuring device is set on the external width of the field. Then it is consecutively expanded by the width of intrafield obstacles (embedded not tilled areas). Afterwards the opening of the measuring device is compared to the scale rule that gives the total conditional width of the field.

Both lots have equal area – 25 hectares. For their tillage lengthwise direction the width per one hectare of the triangular lot constitutes 16m and for semi-oval lot – 15m. Contour shaping score is respectively 93 and 94. For tillage in cross direction the first lot scores 78 and the second one – 82. The main contour score is 88 and 90 respectively.

For evaluation of the field shown in Fig. 5 for lengthwise tillage the maximum width of the field is to be determined with the use of the measuring device (775m). Then the opening of the measuring device must be consecutively expanded by the value of other convexes of the contour. The total opening will constitute in this case 1050m in full-scale. The area of the field being 66 hectares, the width per 1 hectare constitutes 16 m, i.e. contour shaping score will constitute 93. For tillage in cross direction the width per 1 hectare constitutes 17m (1100:66=17). Contour shaping score is also 93, i.e. suitability of the field for tillage is equal in both directions.

To evaluate the multicontour field of complex configuration with the area of 45 hectares (Fig.6) for tillage in cross direction one should add to the maximum length of the contour (1225m) the width of the ledge and intrafield obstacles (separated forest stands). In this case conditional width of the given field constitutes 1925m or 43m/hectare with the contour shaping score of 80. If the field is evaluated for tillage in lengthwise direction conditional width is calculated as a sum of the maximum width of the contour (750m) and widths of the separated forest stands across the direction of tillage.

In case data on fields classification are available the contour shaping score is calculated according to the following formula:

$$Sc = \frac{100}{I_{lf} * I_{conf} * I_{ang}}$$

Where I_{lf}, I_{conf}, I_{ang} are indices for the length of furrow, configuration and angularity respectively.

Assessment of land relief

109. Relief of land lots is evaluated based on indices reflecting how the slope angle affects efficiency of field machinery. For complex relief conditions when an isolated area of plough land or hayfield needs to be assessed this area is divided into lots according to slope angle classes in the following intervals: less than 1 degree, 1-3°, 3-5°, 5-7° and 7-10°. Boundaries between lots identified according to slope angle classes are determined based on the distance between adjoining contours depending on the scale of the plan and with regard for the relief assessment scale. To do this the plan of intrafarm land management is superposed over a topographic plan with contour lines. Next areas of the lots identified according to slope angle classes are determined. Then an average weighted (depending of the area) slope angle of topographically isolated lots (contours) is calculated, which in its turn is used for calculating the relief index. Identification of lots by the slope angle classes should be in conformity with direction of tillage on that isolated lot. Values of relief indices are given in table 16.

Assessment of stoniness of lands

110. Stoniness of plough land is assessed in indices (Is) reflecting the impact of stoniness on efficiency of field machinery.
Stoniness of lands is determined based on materials of soil and other specialized surveys. On the basis of those materials and the plan of intrafarm land management a chart of stoniness of working sections is determined. Values of stoniness indices are given in Table 17.

Assessment of remoteness of lands

111. Remoteness of lands is characterized by the distance between land lots and economic centers and the central farm location. Remoteness of lands is assessed based on production costs with regard to location of the assessed object and is characterized by an indicator of equivalent distance, which is calculated according to the following formula:

$$Wr_j = \sum_{j=1}^{m} S_j I_j \; (D_1 + D_2 R_2 + D_3 R_3) : \sum_{j=1}^{m} S_j I_j;$$

Where Wr_j is weighted remoteness of the j- assessment object, km;
S_j – average volume of j-product sold per 1 hectare of agricultural land in the assessed area, tons;
D_1, D_2, D_3 – distance for transportation of j-product (cargo) by road in group 1, 2, 3 (km);
R_2, R_3 – index for converting roads of groups 2 and 3 into equivalent ones;
Ij – index for converting j-type of product into equivalent cargoes of the first class.

The volume of mixed cargos is converted into equivalent using the following indices: for cotton, grain, vegetables, perennial grasses and perennial plantations – 1.00 (first class of cargo accepted as an equivalent); milk, livestock – 1.25 (II class); wool – 1.67 (III class).
The volume of transported cargos (in tons) per 1 hectare of agricultural lands is determined on the basis of physical data available for the assessed object for the last three years.
Different quality roads are converted into indices (for equivalents): first group – 1.0, second group (R2) – 1.5, third group (R3) – 2.5.

XIII. MONETARY EVALUATION OF AGRICULTURAL LANDS

112. Productivity of 1 hectare of agricultural land at the level of cadastral zones for the evaluated object within the cadastral zone is considered to be basic.
113. Estimated productivity of 1 hectare of land by the type of land (column 9, attachment 6) of the evaluated object by land contours is determined in proportion to the soil appraisal score of the cadastral zone:

$$P_i = (P : S) \times S_i;$$

Where P_i is productivity of 1 hectare of i-evaluated object by type of agricultural lands;
P – productivity of 1 hectare of agricultural lands (by types) at the level of cadastral zones;
S – Soils appraisal score at the level of cadastral zones;
S_i – Soils appraisal score for the i-object.
114. Estimated costs (column 10, attachment 6) for utilization of agricultural lands at the level of cadastral zones for the evaluated object within the zone are considered basic. To determine utilization costs of 1 hectare of agricultural lands of the evaluated object within the cadastral zone basic costs are differentiated according to the formula:

$$Ci = Cg \frac{Iti}{It} + Ch \frac{Yi}{Yb}$$

Where Cg and Ch – estimated cost for growing and harvesting of agricultural crops respectively at the level of the cadastral zone;
Iti – technological index of the evaluated object;
It – technological index of the cadastral zone;
Yi – yield capacity of the evaluated object (centner/hectare);
Yb – yield capacity in the cadastral zone (centner/hectare).
Given similar agrotechnics and farming intensity level costs of growing agricultural crops vary on different lots of land due to technological properties, yield capacity and remoteness for economic centers.
115. More or less objective auspicious conditions of agricultural production determine location of the land lot with respect to the market of inputs and outputs.
Location of land lots also serves as a basis for generation of a certain differential rent.

116. To calculate differential rent of the evaluated object the following formula is used:

$$Ri = (P-Ci)+Rmi;$$

Where Ri is differential rent revenue of i-evaluated object, somoni/hectare;
P – productivity of 1 hectare of the evaluated object, somoni/hectare;
Ci – expenditures per 1 hectare of the evaluated object, somoni/hectare;
(P-Ci),Rmi – rent revenue due to fertility and technological properties of soils as well as location of i-evaluated object, somoni/hectare.

117. Rent revenue determined by location of the evaluation object is calculated as a difference between costs of transportation with average (for the cadastral zone) values of load capacity and remoteness of land and their costs in case of the evaluated objects (Ci, somoni/hectare).

$$Rmi = (Co-Ci) \times 1{,}08;$$

Where Co = Eda x T x Ip x Lc;
Ci = Edi x T x Ip x Li
Eda and Edi – average weighted equivalent distance respectively for the evaluated area and i-evaluated object, km;
Lc and Li – standard load capacity outside the farm per one hectare of agricultural land: average for evaluated area and for i-evaluated object;
Ip – price index for transportation of cargos;
T – price for transportation of one tone of cargo for 1 km distance, somoni.

118. To calculate standard load capacity of a specific evaluated object first standard load capacity per 1 hectare of agricultural land for the cadastral zone is determined. It is calculated by dividing the total weight (in tons) of the sold agricultural produce, the weight of all purchased material and construction cargoes over the last three years by the total area of agricultural land. Next standard load capacity of the i-evaluation object is calculated by differentiating load capacity of 1 hectare of agricultural lands of the evaluated area in proportion to the appraisal score of the i-evaluation object to the average appraisal score for agricultural lands in the cadastral zone in general.

119. Data on the size of differential rent by farms and varieties of soils allow to identify the cost and price of 1 hectare of agricultural land. In calculations a combined approach should be used, i.e. costs of reclamation and reproduction are appended to the rent score.

120. Procedures for calculating evaluation indicators in attachment 6:
- estimated yield capacity (column 8) is determined by multiplying the average soil contour score (column 5) by the value of 1 point in yield (c/point) of produce (line 7). The value of 1 point in yield (c/point) is determined by dividing the average soils appraisal score (line 1) by the estimated yield (line 2);
- to identify the value of 1 point in yield (column 7?) it is necessary to use data from column 7, attachment 5;
- to determine estimated productivity (column 9) it is necessary to multiply estimated yield capacity (column 8) by the price of one centner of produce (line 3);
- estimated expenditures (column 10) are determined by adding expenditures for growing (column 11) and harvesting (column 12). Expenditures for growing and harvesting are determined using technological maps and are expressed in % of the total estimated expenditures;
- to determine differential rent (column 13) it is necessary to subtract value in column 10 from the value in column 9;
- to determine the price of 1 hectare of land (column 14) it is necessary to: multiply the value in column 13 by 100% then divide it by 6% and add to the result the sum of average costs for reproduction and reclamation of land (17,850 somonis). An additional factor affecting the price of land may be the level of water availability (table 18)*. Table 19 shows data on irrigation standards for the III and V (for rice) water consumption areas. For specific water consumption areas irrigation standards are provided in the recommendations “Irrigation cycles for agricultural crops in Tajik SSR”, Dushanbe, 1978.
- the size of land tax rates (column 15) within each land management contour is determined by multiplying the value of land tax rates (line 6) by the price of 1 hectare of land taking into account costs for reproduction and reclamation of land equal to 17,850 somonis (column 14);
- payment for land use (column 16) is determined by multiplying column 15 by column 3.

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* Note: A significant role in determining the price of 1 hectare of land will be played by the level of water availability for the field. Provision of the required amounts water for vegetation is regulated by the water availability index (Iw). This index is determined as a relation between the volume of actually supplied water and the planned volume established in the water use plans. If the Iw is higher or lower than one respective correction indices are applied to the price of 1 hectare of land. Availability of water in the farm is determined annually by water users and water management bodies. Recommended tentative correction indices are given in table 4.

XIV. PRESENTATION OF SOILS APPRAISAL MATERIALS

121. Documentation on appraisal of lands consists of a narrative and graphical part. The narrative part includes evaluation scales and sheets and explanatory notes to them. The graphical part represents land appraisal maps.
122. In carrying out intrafarm appraisal of lands a contour land appraisal sheet is prepared containing indexes of land management contours and fields and indicating type of agricultural land, area of the contour and its score.
123. Upon completing soils assessment and economic evaluation by farms (land tenures) the materials are stitched together in a brochure containing:
    - a sketch-map of the area within administrative boundaries;
    - a short explanatory note;
    - appraisal scale of soils;
    - soils appraisal sheet by land contours;
    - land use payment sheet by contours of agricultural lands;
    - soils appraisal map for the farm with a legend;
    - map of land prices and land payment with a legend.
124. Then for the entire district statistical information is prepared (report) containing conclusions about the level of soil fertility and monetary evaluation of lands, which is also stitched together.
    The statistical report includes as an attachment:
        - a sketch-map of the district within administrative boundaries;
        - a short explanatory note;
        - a table indicating distribution of areas with different soils appraisal scores and indicators of economic evaluation of lands.
125. Land cadastral documentation is prepared in accordance with the terms of reference of State Project-Design Institute “Tojikzaminsoz”.