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**SOIL SURVEY AND SOIL CLASSIFICATION
IN THE
U. S. S. R.**

**STUDY TOUR TO THE U. S. S. R.
OF AGRICULTURAL SCIENTISTS FROM INDIA**

Report of Study Tour

By

**Dr. S. V. Govinda Rajan
Chief Soil Survey Officer, I. A. R. I. NEW DELHI**

PERIOD

23rd October, 1964 to 8th November, 1964

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A team of four agricultural Scientists was deputed by the Government of India to proceed to the Soviet Union to study the developments in Scientific and Research Institutions. I, along with the undermentioned three members, proceeded on this delegation and I was deputed to study the special aspects of Soil Survey and Soil Classification.

- 1) Dr. G.S. Randhawa : Grapes and Fruits
- 2) Dr. V. Santhanam ; Cotton Breeding.
- 3) Dr. O.N. Singh : Sheep and Goat Development.

I was nominated the Leader of the delegation and the team left New Delhi for Moscow on 23-10-1964 and returned to New Delhi in the morning of 8-11-1964. The team was in Moscow between 23-10-1964 and 27-10-1964 and again between 2-11-1964 and 7-11-1964. The periods between 28-10-64 and 1-11-64 were spent in Tashkent and Samarkand in Uzbekistan. Since each of the team members had different subjects to study and follow, excepting for the periods when we had common discussions with officials of the Ministry of Agriculture in the U.S.S.R. and visits to places of common interest like the Exhibition of Economic and Agricultural Developments, the reports in respect of the studies of each of the Members of the Delegation are given separately by the concerned members.

During the period of my stay in Moscow and Uzbekistan the following places were visited:

I. MOSCOW:

1. Ministry of Agriculture, Govt. of U.S.S.R.
2. Exhibition of Economic and Agricultural Developments.
3. The Dokuchaiev Institute for Soils
4. The Geographical Institute
5. The Timiriazev Agricultural Academy.

II. UZBEKISTAN:

1. The Ministry of Agriculture, Tashkent.
2. The Middle Asia Institute for Soil Studies, Tashkent.
3. The All Union Cotton Breeding Institute, Akkovoc.
4. The "Politim Del" Collective Farm, Akkovoc.

1. Visit to the Ministry of Agriculture, Moscow.

Detailed discussions about the organization of research work and studies on soils in the Union were had with the following:-

1. Mr. A.F. Charchenko, Chief of Foreign Delegates Section
2. Mr. M.G. Shamonin, Dy. Chief " " " "
3. Mr. Nicolai Smirnov, Foreign Delegates Section.

The information obtained from them revealed that with regard to soil studies for soil classification and soil mapping on an All-Union basis, the Dokuchaiev Institute of Soils is the one concerned in coordinating the activities in the constituent Republics of the U.S.S.R. in regard to Large Scale and Small Scale soil mapping and that actual field work in this direction also proceeds from this Institute. Each of the 15 Republics also have their own Institutes for soil studies and soil mapping and they look to Dokuchaiev Institute to furnish guide lines in cases of need and for coordinating the work involving other Republics. The Geographical Institute has a close link with the Dokuchaiev Institute in the geographic aspects of soil mapping, though the classificational aspects are left entirely to the latter Institute.

2. Visit to the Permanent Exhibition of Economic and Agricultural Developments.

This exhibition is located in the northern part of Moscow and covers an extent of over 600 acres where ground space is allotted to each of the 15 Republics to permit them to display inside permanent buildings, the achievements of each State in the field of industrial and agricultural production and to demonstrate by growing in the fields attached to the buildings actual crops characteristically cultivated and raised in their respective areas. The conditions in which cotton and grapes are raised in different Republics and the soil conditions obtaining therein, the agronomic practices followed and the level of yields obtained under different conditions

of fertilization were noted:

3. Dokuchaev Institute for Soils.

The following officers of this Institute were met and useful discussions as incorporated in this Report, were had with them.

1. Prof. S.S. Sobolev, Acting Director and Head of the Deptt. of Soil Erosion Studies.
2. Prof. Pak, Deputy Director.
3. Dr. Troitsky, Soil Scientist, Deptt. of Large Scale Soil Survey.
4. Dr. Karmanov, Soil Scientist, " " " "
5. Dr. Simakova, Cartographer, " " " "
6. Prof. Ivanova, Head of the Deptt. of Small Scale Mapping.
7. Prof. LoboVa, Deptt. of Medium Scale Mapping.

This Institution which bears the name of V.V. Dokuchaev, the Russian Soil Scientist of the 19th Century is an old institution working on various problems of soil and acts as a Coordinating Central Institute for various types of soils work in the U.S.S.R. There are 13 Departments in this Institute, each one concerned with a different aspect of soil studies, like soil classification, soil surveys, soil erosion research, etc. Dr. Troitsky, Dr. Karmanov, Soil Scientists and Dr. Simakova, the Cartographer attached to the Department of Large Scale Soil Survey explained the procedure of their classification and mapping. They explained that according to the scale of base maps used, survey work was differentiated as follows:

<u>Ranges of Base Map Scales.</u>		<u>Designation of survey work.</u>
1:3000	Y	Detailed Soil Survey
1:4000	I	
1:5000	Y1	Large Scale
1:50,000	X	
1:100000	Y	Medium Large Scale.
1:300000	I	
1:500000	Y	Small Scale.
or smaller scale.	I	

Further with regard to the classificational standards

and nomenclature of such soil classificational units, the Russians had their own system and these were found to differ characteristically from those adopted by American and the Western countries. Thus the term soil Type referred to the highest classificational unit in the Russian system, while the same term is used in the American and Western system to denote a soil series variant based on textural variations. The terms "Podsol", "Chernozem", "Grey Forest Soil", etc., referred to the soil Type according to Russian classificational standards. The terms indicated above would however correspond to the "Great Soil Groups" according to the American and Western classifications. The soil Subtype referred to the next lower unit. Thus, classification as Light Grey Forest soil or Humic Chernozem would indicate the "subtypes". The sub-types divided the types according to intensity or degree of podzolization, humus accumulation etc. The next lower classification according to the Russian system related to where subtypes are further divided and these are referred to as the "Species". Thus terms like "Deep humic" or "Shallow humic Podsol" or "Low Humic Chernozem" are intended to bring out differentiations based upon the thickness of podsollic horizons and also contents of humus. The next lower category is the Textural Group, where the Species are differentiated on the basis of variations of texture.

In field survey, carried out by Russians, profiles are studied to fix the "Soil Types" according to the above classificational standards, and the mapping units adopted in soil mapping are based on differentiating subtypes, Species and the Textural groups, if each one of these subdivisions is warranted, and mapping them in the soil map as separate units.

Drs. Troitsky and Karmanov during these discussions showed a Detailed Soil Map prepared of one Collective Farm measuring about 2000 hectares and also "Agricultural Production

Maps". The soil map showed the soil boundaries delineating the soils following above classificational units, while the "Agricultural Production Maps" showed the distribution of soils of the same area differentiated by suitable colour schemes to show three levels of available phosphoric acid (P_2O_5), three levels of available potash (K_2O) and three levels of hydrolytic acidity. The three levels differentiated in each case were low, medium and high, each level fixed partly on arbitrary basis and partly on the basis of experience.

The distribution of the above constituents and the others to be mentioned below, are determined from large fields or blocks of land treated as unit, from which samples of soil are collected during soil survey for subsequent laboratory analysis. The size of these fields, which are demarcated on the maps by field boundary lines may vary from 10 to 50 ha. The category into which the fields are included on the basis of their nutrient status, are distinguished from one another by suitable colouration or hatching on the maps. These maps are considered to have practical utility for recommendation of lime application to reduce the acidity or the different manurial schedules considered optimum for the cropping scheme recommended and needed to correct the soil deficiencies. The detailed physico-chemical analysis of the surface soil samples, collected from the fields or large blocks of land demarcated on the soil map, include the following items. These items of determination are representative of what are carried out on (acid) forest soils.

- a) pH
- b) Texture
- c) Humus content
- d) Total N
- e) Exchangeable bases (Ca + Mg)
- f) Exchangeable Hydrogen
- g) Hydrolytic acidity
- h) Exchangeable Acidity (Exchange H+ / 1 by Sokolov method)
- i) Available P_2O_5 .
- j) Available K_2O .

The details and the items of these analysis vary with the

area surveyed and the nature of soil Types involved.

One very important thing to be noticed in the case of the soil descriptions made by the Russian Scientists is that they do not have quantitative means of describing the colour of soil. The colour standards adopted in the Munsell colour charts and the colour notations distinguishing colour, hue and chroma that are standard part of the systems followed in the United States of America and adopted by us do not find a place in the Russian system. In fact they do not appear to describe the soil colours in anything more than approximate, verbal, descriptions.

In the course of discussions with Prof. Sobolev, I indicated the nature of the problems besetting soil survey work in India and particularly the question of making soil survey work, the soil Maps and the Reports useful to cultivators. The organization of our survey work is to concentrate on the priority areas in the catchments of River Valley Projects was also explained to him. Dr. Sobolev said that their problem was also to make the soil survey work useful for planning the cropping patterns and for increasing the output of crops. The subject was one in which they were working in close cooperation with their Division of Agro-Chemistry. They were preparing in some cases upto 16 maps to interpret the soil maps of an area. They were preparing "Soil productivity" maps to interpret the soils information to guide in crop planning, soil management, fertilizer use etc. However, it was only since recently they were thinking in these lines and much remained to be done. As an example, Dr. Sobolev mentioned that where pasture and grazing only used to be practiced in parts of Moldavia, where the land slopes varied from 17° to 20° , they were now planting orchards and terracing the lands to protect the soil, and the farms were yielding higher profits.

Later discussed with Dr. Trietsky and Dr. Karmanov the use

of air-photographs for detailed survey work. Actually they were using as base maps only line maps showing the boundaries of fields and large sized blocks of land within a collective farm, the scale being approximately 15" = 1 mile. They have used air-photographs taken on colour film using ultra-violet filters to help interpretation of vegetation. But after comparing with black and white photographs taken under normal conditions, the colour photographs were abandoned as being relatively more expensive and having no special advantages. Later I looked into their Cartographic Laboratory to study what equipment is being used for transferring soil details from air-photographs on to the line maps. It was seen that a very useful equipment called the "Phototransformator" was being used for their purpose, which instrument helps to project the image from air-photographs on to a translucent screen, from where tracings can be carried out, the instrument having the means for reducing or enlarging 2 to 2½ times maps of original sizes of 9" x 9" and provided with a tilting table device by which simple rectifications can be effected. This instrument was said to cost only 500 roubles or approximately Rs. 2600/-. The details of this equipment were noted and later on when the Charge d' Affairs of the Indian Embassy was met, he was requested to obtain information about how one of these instruments could be obtained for our organization either by purchase or as a gift.

Later the Department of Small Scale Mapping was visited and there met Prof. Ivanova, the Head of this Department. She has 10 Soil Scientists, 6 analysts, 3 professors and 2 cartographers working in her department, which is working on projects of compiling small scale maps of the U.S.S.R. in the scale of 1:4 million and 1:12.5 million. For this work, they were largely dependent upon the information furnished by the concerned soils institutions in the various Republics, which are compiled and coordinated in these mapping operations. The

staff from this Department themselves do not carry out any survey operations, except, in so far as is needed for examining areas where doubts exist or where they have to coordinate the nomenclature and delineation of soil boundaries of adjoining Republics or territories. From this Department, they also serve to give guide lines in fixing the characteristics of soil types and in some cases to help in deciding on nomenclature and associated work which facilitates providing explanation of the soils to other workers and make the terms acceptable to all concerned.

With reference to the completed soils map of the U.S.S.R. which contains over 60 mapped units, the characteristics of some of the soils of desert areas delineated in their map were discussed by me with the objective of obtaining information which could be of use to us in our own classification. They have differentiated three or four soil types in the desert regions viz., the Desert soils, the Grey Brown Desert Soils, the Takyr and the Sierozems. The desert soils have carbonate accumulation in certain horizons, while Sierozems are having general distribution of carbonate. Grey brown desert soils are ancient alluvial soils. Detailed examinations were also made of the names given to soils of the types having similarity to those met with in India, and it was found that in these descriptions they were associating vegetation types. Thus description like "Red-Yellow Lateritic mainly ferralitic soils of humid forest soils", "Red lateritic ferralitic and ferritic soils of seasonally humid tropic forests and high grass savannah", "Red brown soils of dry savannah", "Red-brown soils of Semi-desert Savannah" and "Mountain Lateritic soils of constantly tropic dry regions", with climate-vegetational details. Also other descriptions were used combining soil descriptions like "Alluvial soils" were used by them in much the same manner as descriptions are given by us to the concerned types of Indian soils. The Soil Map of India together with the descriptions given to the various soil groups delineated therein, were shown to Prof. Ivanova and

these details discussed. Prof. Ivanova agreed largely with the descriptions given, and stated that these are sufficiently adequate, in much the same manner as Prof. S.V. Zonn of the Geographical Institute expressed when these points were discussed with him during his stay in Delhi just prior to my departure for Moscow.

Since in soil studies actual observations in the field, in regard to the descriptions being made, the characteristics observed for classificational purposes, are important the possibility of going out to the field to follow actual field studies and field mapping was suggested to the soil scientists. They agreed that such field visits are very necessary, but they do not undertake such work when the temperature falls below 5°C and such climatic conditions were prevailing at this time of the year. In view of this discussions were continued in regard to the details of laboratory analysis carried out during soil surveys in respect of different soil types, to aid their characterization.

It was found that in Chernozems (black soils), Cinnamon soils (bright red loamy soils), Krasnozems (red soils) etc, the items of determinations vary somewhat. They determine in these (a) pH, (b) texture, (c) Humus content, (d) Total N, (e) Exchangeable bases (Ca+Mg), (f) Exchangeable sodium, (g) Carbonate, (h) water extractives. In Saline and Alkali (the solozetz, solonchak and solodi) soils, the items (a) to (g) above are carried out and in addition content of gypsum is determined in the water extractives.

With regard to the laboratory work they indicated that 50 to 70% of the time allotted for completion of survey of a specified area in the podsollic and chernozem areas, is spent for analytical work.

In field work, slope is measured by an instrument referred to as "Acclinometer" which is apparently similar to Abneys Level and the slopes are described by degrees, as against the percent-

ages given under the International procedures. The slope classes are also linked with degrees of erosion, though in some cases the loss of the humus is taken to represent degree of erosion. For example in Grey Forest soils, the following standards are adopted:

<u>Slope</u>	<u>Degree of erosion</u>
0° to 2°	: Usually slight or no erosion
2° to 4°	: Mostly slight erosion.
4° to 7°	: Mostly moderate erosion.

In deep humic podsoils and related soils, the following standards appear to be adopted:-

- (1) 0 to 50% of humus layer lost - slight erosion
- (2) 50 to 100% of humus layer lost - moderate erosion
- (3) 100% of humus layer lost and B-horizon exposed or beginning to be removed - Strong erosion.

4. Visit to the Geographical Institute:

The following Scientists were met at the Geographical Institute in Moscow:

1. Academician I.P. Gerassimov
2. Prof. S.V. Zonn.

The problems about our soil classification were discussed with Prof. Gerassimov with particular reference to the formation of red soils under different climatic conditions, of laterites and the black soils derived from basaltic rocks and the strong influence that parent rocks have in deciding the characters of many soils in India. The Academician agreed that conditions in India are obviously different from those in European Russia where they consider that climate and vegetation have helped soil development on materials which are largely of loessal nature and consequently more or less of similar mixed composition.

Prof. Zonn who had just then returned from his visit to India exchanged views on his impressions of Indian soils. Prof. Zonn in particular made mention of the large amount of work on soils which had been carried out in Russia during the recent

pest about which soil workers in India are largely not aware of. He made an offer that from his end he could arrange to supply us with copies of these papers duly translated into English, if at our end we could undertake to make a large number of copies of these and issue to the various Scientific Institutes in India interested in such studies. This offer was subsequently communicated to the Agricultural Commissioner of the I.C.A.R. and he has agreed to cooperate with the Soviet workers in making their work better known to Indian soil scientists.

5. Visit to the Timiriazov Agricultural Academy.

The Pro-Rector gave a history of this Academy which is now 99 years old and will be celebrating its Centenary in 1966. The chief aim of this Academy is to prepare students in higher education and to provide for scientific research. It has six faculties as follows: (a) Agronomy, (b) Animal Husbandry, (c) Economy, (d) Agro-Chemistry and Soil Science, (e) Horticulture and (f) Pedagogy or teaching. Besides these, there is a private correspondence course. After obtaining full information about each of these faculties, the team broke up to visit the different faculties. I spent a day in the Soil Science Section studying the particulars of the various soils described in Russia in respect of the characters of their formation. Further detailed descriptions of the soils occurring and the conditions prevailing in the areas where: a) Cotton cultivation is practiced in Uzbekistan and Ukraine were obtained on behalf of the Team member interested in Cotton and (b) the areas in Uzbekistan and Georgia which are important sheep rearing and breeding centres on behalf of the Team member interested in Sheep and Goat Development.

II. UZBEKISTAN:

At the Uzbekistan Ministry for Agriculture, Mr. Peter Timofeyev, First Deputy Minister was met and he detailed at length the progress achieved by the State in various fields of Agriculture.

The First Deputy Minister highlighted the achievements of his State in producing 3,600,000 tons of Cotton and thereby reaching the target set for it. Cotton is grown under irrigation over 1.1 million hectares in this State and this acreage will increase in the future also. The production of cotton represents 70% of the Unions' output. Land reforms were introduced in 1924 and 1.7 million little farms were developed and available water resources utilized in full. A number of irrigation projects have been developed and extensive canals dug up. The Cherckuk Project on the Chervak river is providing water for 1,60,000 hectares to name only one among the numerous projects. The Firganov Project in the "Hungry Steppe" region under execution will transform the agricultural pattern of that area. Improved irrigation practices were coming more in vogue. Flood irrigation is giving place to sprinkler and syphon irrigation. Extensive reclamation of saline lands are being taken up and the Ingier Saline Soils Reclamation Project is one such. Land utilization is made on the basis of scientific soil surveys and cropping done on proper technical advice. The State which was using only 500 tons of fertilizers in 1930 is today using over 2 million tons. Large factories at Samarkand and Firganov are producing these fertilizers. Mechanisation has been introduced extensively and all the machinery needed for this is manufactured in the State itself.

The First Deputy Minister then detailed their production of grains like wheat, barley and rice; of rough fibre crop like Kenaf, of vegetables, potatoes, of tobacco and of orchard crops including grapes. The vegetables and fruits produced in this State are supplied to places all over the U.S.S.R. Of grapes he said the Institute Schrader was largely working on this. Over 100 varieties are produced, of which most are table varieties. Over 120,000 Kgs of grapes are produced per year and they have plans of stepping up this production to 260,000 Kgs

by 1967. Of industries closely allied to agriculture, he mentioned of Sericulture and how 77% natural silk production of the whole Union is from this State.

Proceeding further he mentioned of the extensive work in Animal breeding, Cattle production and of poultry. Of sheep, the Karakul breed is the most paying. More than 1 million heads of these sheep are produced in a year and the pelts are a big foreign exchange earner. As regards poultry, 14 poultry factories are under construction and these will produce 200,000 birds and these are expected to be sufficient to meet the State's demands. Cattle however are not highly productive. The "Black and White" and the "Bushuif" breeds are the popular ones. The State has been allotted certain annual targets and of these so far 76% are achieved. They expect to achieve their targets in milk and wool production soon.

2. The Middle Asia Institute for Soil Studies.

At this Institute which is the premier Institute for Soil Studies, Prof. Umarov the Director was met. This Institute has developed since 1919 from being a Soils and Botany Institute under Prof. Dimov, attached at first to the Middle Asian State University of Tashkent and since 1943 the Uzbekistan Academy of Sciences. Subsequent to this date it was made into a National Institute attached to a Special Committee. Early soil investigations were largely geographical studies, with a bias on the location of rivers, their flow etc., which could be used for irrigation purposes. There are few scientists to begin with and gradually specialists were trained and sent to Tadjakistan, Turkmenia and Kazhakstan. As the basis of research work broadened they developed separate State Institutes for Water Utilization, Cotton, etc. In 1943 when this Institute came under the Uzbekistan Academy of Sciences, the different departments were developed and the following 9 research laboratories were

formed:

- (1) Laboratory of Geography and Genesis of Soils.
- (2) Laboratory of Saline Soils (this is important because of Uzbekistan lands have saline soils).
- (3) Laboratory of soil Physics.
- (4) Laboratory of Chemical and Physical Studies.
- (5) Laboratory of Soil Chemistry.
- (6) Laboratory for Study of erosion of soils.
- (7) Laboratory of Micro-elements.
- (8) Laboratory of Biochemistry and Microbiology, and
- (9) Laboratory of preparation of soil maps and evaluation of lands.

Over 30 scientific workers are at this Institute, which provides facilities for "Aspirants" (Post-graduate workers), to work for their "Candidate of Science" which corresponds to our Doctorate.

Later met Prof. B. B. Goussek, the Professor of Erosion Studies, and Mr. Garbonoff, in charge of Cartography. The discussions held with these scientists on the 30th were continued on the 31st October also, both in respect of soil survey methodology, soil classification and soil mapping and also in respect of the classificational units followed by us in preparing the Soil Map of India.

Prof. Goussek and Mr. Garbonoff in discussing the work carried out by them indicated that survey of the following areas were carried out in connection with the projects for development of irrigated agriculture in collective farms:-

- (1) The Karshinskaya Steppe area to be developed. Detailed Soil Maps had been prepared.
- (2) Amur Darya Delta area- Soil maps prepared for taking up -cultivation of lands.
- (3) The Yangiar area (Golodnaya, Hungry Steppe)- Development of irrigated agriculture from Syr Darya. About 35,000 ha of lands have been developed including many large state Farms and soil survey has been carried out.
- (4) The Firganovsky Valley- Soil mapping in the scale of 1:25,000 is in progress.
- (5) Karakalpak Autonomous Republic- The maps will be completed in 2 or 3 years.

The various soil studies, as also geographical studies made here, are coordinated by the Dekuchaiev Institute. In

regard to obtaining detailed information for recommendations for fertilization, soil management etc for Cotton and other crops, which are essential parts of the Soil Survey recommendations, these are worked out at the different experiment stations.

In detail, I discussed the techniques adopted by them in regard to Soil Survey field work, the strength of field parties, the targets of outturn of field work, and particulars of the classificational units and mapping details, with particular reference to some of the soil maps prepared by them. One of these soil maps related to the "Eighth March" Collective Farm of Samarkand District covering an area of 400 ha, the map being in scale of 1:10,000. On this map the different individual fields in the collective farm were demarcated by boundaries and the fields were numbered. Also the contours were found marked. The area has been under irrigated cultivation for many centuries. The demarcation of soil boundaries is based upon soil "types" and "sub-types", the subtypes reflecting the influence of agro-cultivation degrees. Thus the mapping units have such differentiation as "Meadow-Oasis soils deep, heavy and middle loam", "Meadow-Oasis soils moderately deep-heavy loam", "Bog-Meadow-Oasis soils", etc.

The basis for differentiation of the depth classes by description simply as "deep" or "moderately deep" was discussed and it was that if the top "agro-irrigation" horizon was 1 metre in depth, then it was considered "deep", if 30 cms to 100 cms deep, as "moderately deep", and if below 30 cms, it was "shallow". The "agro-irrigation" horizons are distinguished by the presence of humus rich layers on the deep alluvial profile which characterises the Sturozem-Oasis soils. For those familiar with the systems of depth classification of soils based on A and B horizons of the type followed in the international system and by us in our country, the above standards appear strange and arbitrary.

The other criteria used to distinguish one soil unit

from another are based upon (a) variations in salt content of the soil, (b) depth of water table. The criteria used for mapping differences in soils and the distinction made between mapping soil units, are not the same for different surveyed areas and they vary from area to area depending upon the need to bring out specific properties associated with the soils or the land features. The stress upon differentiating the soils in an area under survey on the basis of soil properties and land features have a practical bearing, because these information are used for making recommendations for use of the land. One thing is clear that they do not carry out extensive or continuing soil survey in any area, excepting as the demands of cultivation require. Hence they carry out detailed surveys only for the Collective Farms and such other areas as are brought under intensive or irrigated cultivation and prepare standards in regard to the mapping units as required by the conditions prevailing in each area.

The Soil Map of another area viz., that of the Yangi Yuloki Collective Farm, which was described as the "Erosional Map" was also examined in detail. The soils on this map are distinguished on the following lines by adoption of different mapping units.

- (1) Sierozem Typical developed on Loess-Old irrigated-No erosion-Depth of coloured horizon(A+B)more than 75 cms. Water table- 5 to 10 metres.
- (2) Sierozem Typical developed on Loess-New irrigation-No erosion-Depth of coloured horizon more than 75 cms-Water table- 5 to 10 metres.
- (3) Sierozem Typical developed in Loess-New irrigation-slightly eroded-Depth of coloured horizon(A+B)-50 to 75 cms-Water table 5 to 10 metres.
- (4) Sierozem Typical developed on Loess-New irrigation-moderately eroded-depth of coloured horizon(A+B) 25-50 cms-Water table 5 to 10 metres.
- (5) Sierozem Typical developed on Loess-New irrigation-severely eroded-depth of coloured horizon(A+B)-25 cms-water table 5 to 10 metres.
- (6) Sierozem Typical developed on Loess-New Irrigation-slowly colluviated.
- (7) Sierozem Typical- Newly opened- New irrigation.

Detailed discussions were had on the utility of each of the above items of differentiation for practical use and management recommendations. It was found that the basis of recommendations which are developed from the information furnished by the maps, is a supplementary table, and the Report itself which goes with the maps, and which elaborates "Agro-productional characteristics" of the soils provides further guides for land use and management. These tables contain recommendations about application of fertilizers to supply the N, P and K nutrients and these were found to be somewhat broad recommendations. Recommendations are made about the following also; (a) nature and periodicity of crop rotation. Recommendations are made for Lucerne and Cotton to be grown in rotations of the following intervals 3:7 or 3:6 or 3:5 i.e. 3 years of Lucerne followed by 7 years Cotton and so on, as suited to the soil conditions, (b) Recommendations about dosages of bulk manures which range from 10 to 12 tons per ha, (c) Recommendations about depth of ploughing as suited to the different soil units mapped. Depths ranging from 29 to 30 cms or 25-28 cms or 23 cms only are recommended, (d) Recommendations about quantity of water application as suited to the soil conditions distinguished by the different soil units. These are as follows:

4 to 5	irrigations	to supply	5700	Cu.m./ha.
5 to 6	"	"	5700 to 6000	Cu.m/ha.
6 to 7	"	"	6000 to 7000	Cu.m/ha.

These irrigations are recommended to be applied on the land evenly.

Soil Survey and Mapping Operations:

Soil survey field work is carried out by a brigade consisting of 5 persons, a Soil Scientist (Graduate) and 4 Asstt. Scientists, who do the mapping and field work and later on at the Laboratory analyse the soils. The mapping in detailed survey in Uzbekistan is carried out in the scale of 1:10,000. Each person in the brigade will complete about 40 ha per day or about 800

ha per month. A brigade will complete 4000 ha per month. They work for 3 months in the field for mapping and then 1 month is taken for report writing.

The Professors at this Institute mentioned that it was very important for me that the type of field work and the descriptions of the soils, drawing up of the soil units and mapping the soils are best followed by accompanying a brigade in the field. As the season of my visit was not suitable for field work, and the time was too short to go to the field, it was suggested that a longer visit should be arranged during next summer.

The Soil Map of India and the classificational units and the details drawn up by me for each of these units were discussed with them and they generally agreed that the definitions are fairly adequate but could not agree on the names given by us to such units as "Chestnut brown" and "alluvial soils" in the absence of detailed profile descriptions. They suggested the inclusion of terms like "dry-steppe" and "Savannah" relating to vegetation types to bring out the connection between soil and the climate or natural vegetation, but it was indicated to them that in the absence of natural vegetation which has long disappeared over the regions which have been under cultivation for many centuries continuously, it appeared unwise to link up with such terms which could not have any real or specific connection with the prevailing conditions.

During further discussions, Prof. Goussek described his experiments on the use of various chemicals as soil erosion amendments. He mentioned that (a) Hydrolysed products of Polyacrylonitrile, (b) Bitumen and (c) Inferior Coal at dosages of 150 Kg/ha had been experimented with and that these treatments were found to build up structure in the soil which remains stable for about 4 years. He also mentioned of a Tashkent preparation labelled as "K₄" which is a cheap material and which is found to reduce erosion in irrigated lands while at the same time

giving 30-50% higher yields with Cotton(3 to 5 quintals/ha increases in Cotton had been obtained). He desired to show this product to me and the trials with its treatment but as there was no time, it was not possible to see these.

3. The All Union Cotton Breeding Institute, Akkoc:

This Institute is located about 30 Kms from Tashkent. We met the Director, Dr. Mannanov, the Deputy Director, Mr. Zakiroff, the Chief of Irrigation Department, Mr. Gildiv and the Chief of Agri-Technical Department, Mr. Kandaturk and the Chief of Laboratories, Mr. Madrayem at this Institute. This is the only Cotton Breeding Institute of the Union having been founded in 1929 and which Institute till 1960 was located at Tashkent itself. Attached to this Central Institute are 8 experimental stations on this territory and two branches. They conduct coordinated research work in other Republics also. There are sixteen laboratories within this Institute which perform the following functions:

- (1) The Agro-Technical Laboratory) which is the largest and has the Laboratories for soils work and agronomy).
- (2) Laboratory for crop rotation.
- (3) Laboratory for Irrigation.
- (4) Laboratory for Soil Physics.
- (5) Laboratory for Fibre Technology.
- (6) Laboratory for Defoliation.
- (7) Laboratory for Agro-chemical studies.
- (8) Laboratory for Fertilizers including organics.
- (9) Laboratory for Soil Fertility.
- (10) Laboratory for Radiobiology.
- (11) Laboratory for Botany.
- (12) Laboratory for Entomology.
- (13) Laboratory for Economic factors.
- (14) Laboratory for Plant Protection.
- (15) Laboratory for Selection and Seed Breeding.
- (16) Laboratory for Agronomic Extension.

There are 1500 ha of land attached to this Institute, of which 630 ha are under Cotton and the remainder under fruits, vegetables etc.

The soils are described as Light Sierozem, which has got carbonate layer in the form of concretions at depths below 30 cms. The pH is 8.0 and 15% of carbonates is found in layers below 30 cms. The top soil is largely heavy loam (clay loam) and the soil below 50 cms depth is found in varying sizes of rounded water worn stones of sand stone & shales. The annual rainfall is about 650 mm which are received largely between December & March. The temperature ranges in Summer are approximately as follows:

April	:	15 to 25°c
May	:	20 to 25°c
June	:	27 to 30°c
July	:	30 to 40°c.

The increases of Cotton yield in the State as a result of various improvements are reflected by the following average yield figures:

<u>Year</u>	<u>Average yield</u>
1913	12.2 quintals per hectare.
1921	17.6 " " "
1953	20.3 " " "
1963	22.7 " " "

I enquired about the details of irrigation and manuring practices followed in Cotton production and the following information was obtained. Seven irrigations are given mainly between April and September in the Cotton growing season. For each irrigation 1000 to 1200 Cubic metres per hectare are given, at intervals of a fortnight. The moisture determinations of the soil are made by examining samples and determining gravimetrically, and when it is 78% of field capacity, irrigation is given. It was noticed that they were not using the more refined & modern method of using porous blocks or tensiometres for these determinations. The irrigation would supply approximately 24 inches of water during this season. In sprinkler irrigation, fourteen irrigations are given at intervals of about a week. Fertilizer applications are on the following lines:

Nitrogen 120 to 150 Kgs per ha,
Phosphoric acid 100 to 120 Kg/ha, and
Potash 50 to 70 Kgs/ha.

Sixty percent of the phosphoric acid and potash are given during ploughing and the remainder after the plant has come up. No nitrogen is given in the ploughing period but the total quantity is applied in two doses at sowing time and subsequently during the growing period.

As regards the cropping pattern, in these cotton growing areas, Lucerne and Cotton are grown in rotation—approximately 3 years continuously under Lucerne followed by Cotton for 7 years. For the first 3 years, after Lucerne no manures are applied to the fields, the fertility of the soil itself being depended upon for this. In the fourth year organic manure, viz compost at the rate of 10 tons per hectare are applied and continued annually during the subsequent years. The fertilizer treatments are followed independently of the organic manure applications for the cotton crop. It was further ascertained that mineral mixtures to supply adequate quantities of the micro-elements like manganese, molybdenum and zinc are also applied to ensure that these micronutrients are not in short supply in the soil.

4. Visit to "Dolitic Del" Collective Farm:

The Team visited the above farm located about 50 Kms from Tashkent and there we were met by Mr. Pak, the Deputy Chairman who explained that the farm which was founded in 1933 extends over 12,000 ha, of which 4000 ha are irrigated. Kenaf, maize, Cotton, Lucerne, rice etc. are grown besides vegetables and fruits. There are 2500 heads of cattle, 2000 sheep, 10,000 poultry. The average milk yield per animal is said to be 2800 litres per year; the annual production of semi-fine wool from sheep is 2½Kg per sheep, and they gave 400,000 eggs to the State from the poultry. The yield of grain is 50 to 60 quintals per ha, used for making silage. Cultivation is carried out through 180 tractors and 82 other vehicles. There are also 29 Cotton harvesters, 11 machines for final picking of cotton and 10 grain harvesters. The maintenance of these vehicles is attended to by their own people. The

variety of cotton grown is 108-F, which is considered highly productive. We made enquiries about the cost of cultivation of different crops and were informed that these had been worked out.

SUMMARY OF OBSERVATIONS AND RECOMMENDATIONS

1. Detailed Soil Survey work: Detailed and Large Scale Soil Survey work is undertaken in different scales normally varying between 1:4000 to 1:10,000. The base maps used are planimetric maps showing the boundaries of fields or large blocks of lands. Air photographs are used in some cases to interpret vegetational features. Detailed survey work of specified areas like Collective Farms and State Farms are undertaken with a view to make recommendations about land management, a cropping patterns, fertilizer use and irrigation practices, as needed. The classification of soils and their nomenclature have a bias on genesis and this is reflected in the soil units adopted for mapping soils in detailed survey also. There are marked distinctions in the standards and units followed by the Russian Scientists for denoting different kinds of soils, erosion, slope classes etc., compared to systems followed by us. Our system appears to have many advantages and suited to our conditions. Land use capability classification of the type followed by us, adopting the U.S. standards, is not in vogue in the U.S.S.R. However, the preparation of maps to guide the use of the land, management of the soil, use of fertilizers etc., based upon the soil maps would appear to recommend as being worthy of being adopted. Intensive work on limited areas or on sample areas representative of large tracts is needed, if useful follow-up recommendations are to be given by us to make the soil maps of the concerned areas really useful to our Extension Workers or the Cultivators.

2. Small Scale Soil Surveys: A strong organization exists both at the Centre and the constituent Republics for Small Scale Soil mapping. The scales of mapping adopted varies depending upon the ranges of differentiation of soil formations, reflecting

their genesis and depending upon vegetation and climatic factors, and these maps are prepared in detail for each Republic and this work is coordinated by the Central (Dokuchaiev) Institute. The importance given to this type of information and work appears large and is related to the very vast size of the country and the large extent of undeveloped areas existing about which specific information is not available in detail for development purposes.

3. Scope for adoption of Russian methods of Detailed Soil Survey under Indian conditions.

The methods of detailed soil survey adopted in Russia relate to conduct of soil studies over compact blocks of agricultural lands. These blocks are found to range from about 3000 to 10,000 hectares and larger and the areas taken up for surveys are either Collective farms or State Farms. There appears to be little need for a programme of continuous or progressive detailed survey of lands excepting in cases where they are brought under investigation where extensive and continuous areas are brought under intensive agriculture. The object is to give a complete picture of the soils over the areas surveyed followed by detailed procedures for management of the different soil units mapped in the area. The management practices recommended relate to the properties of the different soils distinguished and mapped or the limitations and hazards these are subject to. The interpretation of soils information are made not only to classify the lands into different classes based upon their fitness for cropping, but also for taking them down to the level of management units. Of course the classification system adopted in Russia does not follow the land use classes adopted in the U.S.A. and the West, but there is a general similarity in the division of the lands upon suitability for different systems of cultivation. The soil survey and the interpretation of the soil analytical data are strictly objective and carried out to furnish information leading to crop planning and management of the lands under intensive use.

Thus acidity in soils is a very common problem in the soils of the northern latitudes and the management practices recommended take account of the different doses of liming required to be applied on the basis of the soil groupings. Associated with these remedial measures are the ones of applying phosphatic and potassic fertilizers to provide for any inadequacies in the soils where acidity has developed due to podsolization or intensive leaching processes. Soils with different concentrations of soluble and alkali salts are similarly dealt with and remedial measures suggested. Where depth of soil requires to be taken account of and particularly where irrigation practices require to be adopted, suitable methods of tillage, and levels, intensity and periodicity of irrigation to be adopted are all recommended as a part of the management measures needed for the particular lands.

There, however, appears to be little stress in Russian work on soil survey for anti-erosion measures, because of the minor importance given to this problem. The farmed areas are usually on deep soils, the soil resources are considered to be sufficiently large to ignore the superficial soil losses. Since mechanised farming is extensively practiced, any structures or obstacles built up in the cultivated areas in the form of bunds or terraces are looked upon as undesirable and obstructive to the easy operation of the machines. Fertilizer applications being heavy and adequate to produce the required results in yield of crops, the marginal benefits resulted from anti-erosion measures and which cannot show benefits in a short period of time, are not considered important to be given serious consideration. While it is not desired to generalise on this aspect as being applicable to the whole country, the above is true of the extensive steppe lands and the semi-desert lands under cultivation in Uzbekistan and similar areas. Terracing and anti-erosion and soil conservation measures are of course adopted in areas with steep slopes as in Moldavia and Georgia, but these are on lands for specified crops and not on lands under large scale cultivation for annual

crops.

Thus it will be seen that there is little resemblance between the type of detailed surveys carried out by us over continuous stretches of land in the Catchment areas of River Valley Projects to aid in conservation measures, and the type of detailed surveys over limited and confined areas carried out by the Russians for recommendations and of intensive management measures over farm and other intensively cultivated lands. If it is required to adopt the Russian methods it will become necessary to work intensively over well defined compact areas and on the basis of detailed soils information, work out plans for crop planning and intensive management measures as suited to each specified soil unit. Such work would involve, besides mapping the soil, the following chemical and physico-chemical analyses carried out on each of the mapped soil units so that these characteristics are also mapped on separate maps.

- (1) pH
- (2) Nitrogen content
- (3) P205 content - (a) Total (b) Available
- (4) K20 content - (a) Total (b) Available
- (5) Soluble salt content.

Where water table is a factors influencing the cropping, a map is prepared showing the hydrographic features during the cropping season.

From each of the separate maps thus prepared after intensive soil sampling and analysis, a map showing the general pattern of pH, the availability of different nutrients etc. which can be associated with closely related soil units is prepared. Such a map becomes the basis for recommendations of such of the following measures as may be indicated or needed.

- (a) amelioration measures (involving acidity, salinity etc.)
- (b) application of different kinds and levels of fertilizers.
- (c) measures for drainage
- (d) tillage operations considered optimum for the different soil conditions.
- (e) levels and frequency of irrigation suited to soil conditions.

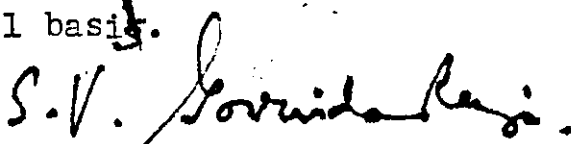
4. Training of Indian Soil Scientists in field survey work.

Every year some scholarships are available under the Cultural Exchange programme between India and the U.S.S.R. It will be very useful if the experienced senior and junior officers are sent to U.S.S.R. for a period of 4-6 months to receive field training in Soil Survey according to Russian methods. Since the language is a big barrier and it is not always possible to have an Interpreter to translate into English and vice versa adequately advance instruction may be given to the candidates to receive some training in the study of the Russian Language in India itself as otherwise they have to spend a considerable time in Russia in learning the language and become proficient in this.

5. Exchange of scientific information on published literature on Soil Studies.

Prof. S.V. Zern, Soil Scientist of the Geographical Institute indicated that a large amount of work on soils is being done at in the U.S.S.R. and the results published in Russian Journals. He made an offer that they could arrange to supply us copies of these papers duly translated into English, if we at our end could undertake to supply copies of these to various soil workers in India.

This offer should be availed of by the I.C.A.R., with possibly some arrangements for supply to the U.S.S.R. of Indian publications on a reciprocal basis.


(S.V. Govinda Rajan)
Chief Soil Survey Officer.

Parminder

A P P E N D I X - 1.

Itinerary of tour to the U.S.S.R. of
Dr. S.V. Goindra Rajan.

- 23.10.1964 Leave New Delhi and arrive in Moscow. Meet representatives from the Ministry of Agriculture, U.S.S.R. and discuss immediate programmes.
- 24.10.1964 X MOSCOW: Visit the Indian Embassy and discussions
to X with the Charge d' Affairs and others.
27.10.1964 X Visit the U.S.S.R. Ministry of Agriculture, the Dokuchaiev Institute of Soils, the Lomonossov Moscow University, the Exhibition of Economic Achievements of the U.S.S.R.
- 28.10.1964 Leave Moscow and arrive Tashkent, Uzbekistan.
- 29.10.1964 X TASHKENT: Visit to the Ministry of Agriculture,
to X Uzbekistan; Meet First Deputy Minister
31.10.1964 X for Agriculture; Visit the All Union Institute for Cotton Research, Akkovic, the Central Asian Institute, Tashkent, the "Polito-Del" Collective Farm.
- 1.11.1964 SAMARKAND: Visit to the Karakul Sheep Breeding Institute, and the Schrader Horticultural Research Centre, Samarkand.
- 2.11.1964 Leave Tashkent and arrive Moscow.
- 3.11.1964 X MOSCOW: Visit the Indian Embassy, the Dokuchaiev
to X Institute of Soils, the Geographical Institute and the Timiriazev Academy of
7.11.1964 X Agricultural Sciences, the Central Ministry of Agriculture.
- 7.11.1964 Leave Moscow.
- 8.11.1964 Arrive New Delhi.

Parminder

A P P E N D I X - 2

List of Soviet Scientists & Officials met during
the tour of Dr.S.V.Govinda Rajan to
the U.S.S.R. in Nov., '64.

1. Mr. I.F.Karnoukhov Councillor for Agriculture,
Embassy of U.S.S.R. in India.
2. Mr.A.F.Charchenko Chief, Section of Scientific &
Technical Cooperation, Ministry
of Agriculture, Moscow.
3. Mr.M.G.Shamonin Deputy Chief, Section of Scientific
& Technical Cooperation, Ministry
of Agriculture, Moscow.
4. Mr.S. Nikolai Assistant Chief, Section of Scien-
tific & Technical Cooperation,
Ministry of Agriculture, Moscow.
5. Prof. S.S.Sobolev Director, Dokuchaiev Institute of
Soils.
6. Prof. Pak Deputy Director, Dokuchaiev Institute
of Soils.
7. Dr. Triotsky Soil Scientist, Department of Large
Scale Soil Survey, Dokuchaiev Insti-
tute of Soils.
8. Dr.Simakova Cartographer, " " " "
9. Dr. Karmanov Soil Scientist, Department of Large
Scale Soil Survey, Dokuchaiev Insti-
tute of Soils.
10. Mme(Dr.)Ivanova Head, Small Scale Soil Survey, " "
11. Mme(Dr.)Lobova Head, Medium Scale Soil Mapping, " "
12. Academeician I.P.
Gerassimov Geographical Institute.
13. Prof. S.V.Zonn " " "
14. Mr.P.M.Timofeyev First Deputy Minister for Agricul-
ture, Uzbekistan.
15. Mr. Manenov Director, All-Union Institute for
Cotton Research, Tashkent.
16. Mr. Zakirov Deputy Director & Specialist on
defoliation, Tashkent.
17. Mr. Saiduviliev Chief Public Relations Officer,
Uzbek Ministry of Agriculture.
18. Mr. Gildiv Chief, Irrigation Department,
Akkovac.
19. Mr. Kandatürk Chief, Agro-Technique Deptt., Akkovac.

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| 20. Mr. Madrayemo | Chief of Laboratory, Akkovic. |
| 21. Mr. Pak | Deputy Chairman, Collective Farm,
'Polito Del'. |
| 22. Prof. Umarov | Director, Middle East, Asian
Institute for Soils, Tashkent. |
| 23. Prof. B. B. Goussak | Prof. of Erosion Studies, Middle
East Asian Institute for Soils,
Tashkent. |
| 24. Mr. Garbonoff | Incharge, Cartography, Middle
East Asia Institute for Soils,
Tashkent. |
| 25. Prof. Smirroff Keryl | Schrader Institute, Samarkand. |
| 26. Dr. A. K. Kuznetzov | Pro-Rector, Timiriazev Academy
of Agriculture. |

PARMINDER