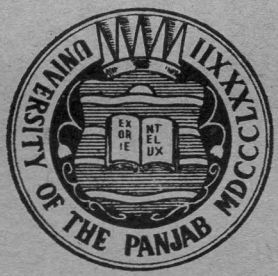
PAKISTAN GEOGRAPHICAL REVIEW



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THE PETROGRAPHY OF THE ISWARDI SOIL

BY
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INTRODUCTION

ISWARDI, the site of this research, is a railway junction in the district of Pabna, and forms a part of an alluvial, terrace of the present channel of the Ganges, three miles away. An increase of load contributed by the headwaters caused the Ganges to deposit much alluvium and thus to build up its channel until the proper gradient was established to permit transportation of the increased load. When this was followed by a reversal of conditions, erosion was resumed and terraces were formed.

In the Pleiostocene period the most dominant features of the geography of Indo-Pakistan subcontinent had come into existence and the country had then acquired almost its present form and its leading features of topography except that the lands in front of the newly-upheaved mountains formed a depression which was rapidly being filled up by the waste of the highlands brought down by the Ganges, the Brahmaputra and the Indus. Only a part of the deposits of the former forms the subject-matter of this research.

The alluvium consists of gray clay with shades of brown, black and yellow, and contains a fair percentage of calcium carbonate. The total thickness of the alluvial deposits has not been ascertained but from the few borings that have been made it appears that the thickness is in the order of a few thousand feet. Considering the above, it is needless to mention that the Iswardi soil has no bearing whatsoever with the underlying solid rock formation and that for its source only the upper reaches of the valley of the Ganges have to be explored.

The primary object of this investigation has been to make a petrographical study of the Iswardi soil with the hope that it might throw some light on the probable source of the soil. This is the first time that such investigation has been undertaken in these areas.

MINERAL CONSTITUTION

It will appear from the following list that the soil in question has peculiarly rich and characteristic mineral assemblage. Of the light crop, of density

less than 2.8, quartz and white mica are the most abundant constituents, while orthoclase and plagioclase felspars are comparatively uncommon. Chlorite and biotite are also conspicuous.

The typical heavy minerals are zircon, kyanite, tourmaline, sillimanite, garnet, hornblende, epidote with less importantly rutile and staurolite. Of the iron-ores, hematite and magnatite are most common while ilmenite, limonite and lencoxene are infrequent.

QUARTZ is the most abundant constituent of the clay, the large* grains being moderately rounded, while the smaller angular. It is usually clear and colourless and free from inclusions. Undulose extinction, characteristic of quartz from crystalline rocks, which have undergone dynamic metamorphism, has been observed in most of the grains.

ORTHOCLASE, though more common than plagioclase, is almost insignificant compared to the abundance of quartz. The crystal fragments are generally small and are often roughly rectangular, and are generally much kaolinised.

PLAGIOCLASE exhibits remarkable lamellar twining and from its mean refractive index appears mostly to be oligoclase-andesine but some grains occur of refractine index greater than 1.560 which are possibly labradorite. The size varies from medium to small.

It is curious to find such a low proportion of the felspars when the materials were transported and deposited not long time ago. Even granting the possible long distance the grains had to travel before settling down, the life of the felspars was amazingly short. Tropical climate seems to have been hard enough to decompose the felspars quickly to form mica which is very prominent in the soil.

MUSCOVITE is the most plentiful mineral after quartz, and is present as large and minute flakes. Most of the grains are allogenic, though many have formed secondarily. Undulose extinction is prominent in some of the transported grains.

BIOTITE occurs mostly as brown or yellow medium-sized cleavage flakes with jagged edges. Striations, though obliterated to a considerable extent, can still be recognised. Partial and almost complete alterations to chloritic matter is commonly observed.

*.05	—	·08	m.m.	... small or minute
.08	—	.12	,,	... medium
.12	—	.2	,,	... large
Greater than		.2	,,	... very large

CHLORITES, better designated as chloritic matter while referred to its occurrence in sediments, have mostly originated from the alteration of biotite. It is green or greenish yellow in colour and gives faint pleochroism.

ZIRCON, as usual in sediments, is the most abundant of the heavy minerals and is generally of medium size. The prevalent type is colourless, sub-angular or rounded, less frequently showing good crystalline form. Prismatic grains with pyramidal terminations are quite common and often exhibit zoning. The presence of inclusions sometimes arranged parallel to the length of the crystal, at other times irregularly distributed, is a common feature. Occasionally, the grains have a dusky appearance due to the crowding of the inclusions.

TOURMALINE is fairly plentiful varying in size from small to large occurring principally in three forms, prismatic with varied terminations, basal or quasi-basal (usually rounded) and irregular fractured grains. Some prismatic grains are terminated by rhombohedra. The colours are yellow brown, pink and green. Prismatic grains often show striations parallel to the principal axis. Pleochroism is remarkably strong.

KYANITE is usually conspicuous and the grains are of large size and a few of the largest are bent in a remarkable manner. Most of the grains are tabular, lying upon the perfect cleavage faces parallel to (100). The (010) cleavage produces long grains and the basal parting results in approximate rectangularity and cross cracks. Pleochroism in the ultra-blue is very rare but examples have been seen with a beautiful colour. A few grains resting upon (010) face have been observed, and these give straight extinction and no figure in convergent light.

SILLIMANITE is generally uncommon in heavy residues of sedimentary rocks of older age and its occurrence, therefore, is interesting and needs careful consideration. It is quite common, though not as abundant as kyanite, and is usually found as slender prisms or fibres of medium size, sometimes flattened, with fractured or irregular terminations. Grains with regular striations are few in number.

GARNET is comparatively rare, though it forms one of the chief constituents of resistant minerals. Most of the grains are very irregular and of all shapes, showing sub-conchirdal fracture

and re-entrant angles but a few occur as platy fragments due to the imperfect (110) cleavage. Rounded grains are rare and all appear to be entirely isotropic. Only the colourless variety has been identified. The grains are variable in size and habit.

EPIDOTE is fairly common occurring mainly in plae, yellowish-green sub-angular small and medium size grains, like small chips of broken bottle glass. Many of the grains are pleochroic in yellow green tints, and show in convergent light, the emergence of an optic axis.

HORNBLENDE, green and pleochric, with a low extinction angle, occurs quite frequently in the form of large elongated platy cleavage flakes determined by (110) and with frayed ends. The most striking is the abundance of this mineral which is not considered a resistant mineral. Its presence is yet to be justified.

RUTILE is unexpectedly rare and is of medium size. The roundness of the grains indicates that they are detrital.

STAUROLITE is more common than rutile and occurs as medium-sized irregular grains. The pleochroism, in tints of golden yellow, is very marked.

HEMATITE is the most abundant of the iron-ores. It has commonly been found as irregular or rounded earthy grains of reddish brown colour by reflected light.

MAGNETITE is also common, either as angular fragments or in well-rounded grains. A few crystals with octahedron faces have been noted. Limonite, leucoxene and ilmenite are comparatively uncommon.

THE PROBABLE SOURCE OF THE ISWARDI SOIL

The mineral assemblage detailed above indicates quite clearly that the source of the Iswardi soil is to be looked for in a massif of crystalline rocks which have undergone regional metamorphism, and bear quartz with strain shadow, felspars and such minerals of metamorphic origin as tourmaline, kyanite, sillimanite, staurolite, epodite, garnet and muscovite. The nearest area which would yield most of the detrital minerals described is probably the Archaean complex of West Bengal, Bihar, parts of U. P. and Rajputana.

The Metamorphic series of Bihar and U.P., consisting of a group of metamorphic rocks including hornblende schists, quartzites, quartz-schists,

micaceous and chloritic schists, is found as a series of small exposures isolated by granites. The schists contain garnet, staurolite and kyanite, the last forming large deposits in many areas. The Iron-ore series is intruded by dolerite, gabbro, picrite and anorthosite which are often seen altered to epidiorites, talcschists, talc-chlorite schists, tremolite schists etc., and contain lenses of titaniferous magnetite. Other intrusives into the Iron-ore series include ultra-basic rocks, granites and newer dolerite. The granites are composed of quartz, orthoclase, microcline, biotite, apatite and tourmaline.

The Son-valley, a tributary of the Ganges, exposes chloritic schists, schistose-quartzites, thin limestones and basic igneous rocks. In parts of the Gaya and Hazaribagh districts there are various types of schistose rocks, *viz.*, biotite-schists, sillimanite gneiss, cale-granulites and epidiorites.

It is noteworthy that quartz is the most plentiful of all minerals in the rocks described above and it seems highly probable that most of the quartz grains of the Iswardi soil were derived from these metamorphic rocks. It cannot be denied, however, that numerous grains, showing normal extinction, owe their origin from granites and other associated igneous rocks. The overwhelming preponderance of quartz in all argillaceous and arenaceous sedimentary deposit is mostly due to its much greater resistance to denuding agencies. Smaller grains may have been transported from the Ganges Himalayas, while the more rounded grains, indicating more than one cycle of deposition, may have come from the older sedimentary formations such as the Gondwanas and the Cretaceous of Bihar and other western provinces. The decomposition of felspars have also made further additions.

Such a great abundance of muscosite in the soil may be attributed to its predominance in the schists, gneisses and granites of the west. It has also formed from the decomposition of felspars.

Though chlorite and biotite are quite prominent, much greater number of grains was expected considering its widespread occurrence in the chlorite and biotite schists. Of these two minerals, greater abundance of biotite indicates that there was not much scope for its alteration to chlorite. Felspars, on the other hand, have mostly been decomposed to form mica and silica and appear to have originated from the acid and basic igneous rocks.

The extraordinary profusion of colourless zircon in the heavy mineral suite is remarkable but it is difficult to postulate the source of the minerals since it is practically uncommon in the rocks of Bengal, Bihar and Rajputana. To conceive of its extraction and transportation from the Ganges Himalayas may apparently seem reasonable but the derivation of the bulk of the grains from such a distant source looks hardly justifiable. There is popular suggestion that the river Teesta was once flowing due south through Pabna into

the Ganges. In that case, some zircon could have been yielded by acid felspathic rocks of the Darjeeling Himalayas. It is not to be overlooked, however, that the older sedimentary rocks, *viz.*, the Gondwanas and the cretaceous of Bihar, Bengal and U.P. might have made a considerable addition.

To search for the source of epidote, which is fairly common in the soil, is a difficult problem as it has not been reported from anywhere except from the granulite-like rocks of C.P. and gneisses of Bengal though the rocks which are likely to contain epidote are widespread in the Archaean complex. Probably the study of the detailed literature in the petrology of the metamorphic rocks may throw some light on the solution of the problem but unfortunately they are not available at the moment. Kyanite, being rather more widespread than sillimanite, being found in gneisses and in kyanite-quartz rocks, is more plentiful in the soil than the latter. It is really surprising not to meet with more garnet particularly as this mineral is of wide distribution in many of the garnetiferous schists of Dharwarian age and almost every Archaean tract is capable of yielding some quantity of this mineral. Comparative rarity of staurolite seems, however, quite reasonabe due to its limited occurrence in the schists. Tourmaline is frequently seen in the granites but is especially abundant in the pegmatite phase as in parts of Bihar and may, therefore, account for its richness in the heavy mineral suite of the soil. Rutile is rather uncommon in the Archaean complex and hence its rarity is easily accountable.

The most striking feature is the occurrence in the soil of numerous grains of hornblende which is generally treated as a non-resistant mineral. The only plausible explanation which seems attributable, is its derivation from granite and grano-diorite of Bihar which is quite close to Pabna ; some grains may also arise from the decomposition of the pyroxenes which are common in the basic rocks of the same locality.

Summing up the foregoing discussion it is tempting to suggest that most of the minerals of Iswardi soil were derived from the Archaean rocks of Bengal, Bihar, U.P. and Rajputana while some may have come from the Gondwanas and other sedimentary rocks and the rest from the Ganges Himalayas. It should not also be overlooked, however, that the weathered products of igneous and metamorphic rocks of Darjeeling may have made some contribution.

THE SOURCE OF THE CARBONATES

The prevalence of calcareous matter in the alluvial clays of the Ganges round about West Pabna and other adjoining districts affords an interesting

study as the latter is easily distinguishable from the mainly non-calcareous sediments of the Brahmaputra and the Meghna.

Calcium carbonate does not occur as nodules or concretion but forms an inherent constituent of the clays, and its uniformity, both laterally and vertically, is more or less maintained in all the horizons of the sediments. There may be evidence that percolation played a part in the distribution of the carbonates but it will be well not to exaggerate the role of percolation.

Besides, the region is devoid of any local concentrations of calcareous materials which generally form pockets, lenses or veins, in any definite horizon of the superficial sequence. Barring a few shells of fresh-water gastropods and lamellibranches, fossils are extremely rare in the alluvial series.

Moreover, the uniform, widespread distribution of calcareous soil throughout West Pabna, West Rajshahi, Jessore and 24-Paraganas leads one to believe that chemical precipitation is most unlikely to account for such a vast deposit when the occurrence of lime-bearing minerals is so limited. Had this process been operative, one should encounter such extensive calcareous deposits in the flood plains of the Brahamaputra and the Meghna, which are also bringing down lime-bearing minerals from the Himalayas and the Garo hills.

It is reasonable, therefore, to look upon the lime content of the soil as an original constituent, and further to think that it was supplied mostly as carbonate. Moreover, gradual increase in the content of carbonates in the soils towards the west, where lie vast deposits of Vindhyan and Guddapah limestones, is indicative of their derivation from these rocks. The mineralogical study also conforms with this view.

REFERENCES

1. Auden, J. B., Vindhyans of the Son Valley, *Memoir Geological Survey of India*, Vol. LXII, 1933.

2. Heron, A. M., Geology of Rajputana, *Memoir Geological Survey of India*, Vol. XLV, 1917 & 1922.

3. Krishnan, M. S., *Geology of India.*

4. Milner, H. B., *Sedimentary Petrography.*

5. Oldham, R. D., Geology of Son Valley, *Memoir Geological Survey of India*, Vol. XXXI, 1900.

6. Wadia, D. N., *Geology of India.*

SWAT : SOME ASPECTS OF ITS GEOGRAPHY

BY
M. M. MENON

NATURAL SETTING

THE State of Swat lies in the midst of the offshoots of the mightiest of mountains of the world, in the extreme north of West Pakistan. On its north are Chitral State and Gilgit Agency, south-south west Mardan district, east Hazara district and Indus Kohistan, and on the west, Dir State and Malakand Agency. It lies between 34° 10′ and 35° 50′ N. and 72° 5′ and 73° E. From north to south it is about 125 miles and east to west about 50 miles, with an area of 2,934 sq. miles and a population of more than half a million (518,596) in 1951.

From the point of view of physiography the whole region is divisible into three distinct units : (1) the Swat Kohistan, or mountain country on the upper reaches of Swat river and its affluents as far south as Ain. (2) Swat proper, which is divided into "Upper" and "Lower" Swat Valley ; and (3) the Buner region, a circular basin east and south-east of Mt. Illam, drained by Barandu river and its tributaries.

In Swat Kohistan many peaks are snow covered and the gradient is steep almost to the extent of being inaccessible. Below the snow-line are woods of fir, pine and deodar. People lead a pastoral mode of life and practise transhumance. Land available for agriculture is patchy, and human settlements scanty and widely scattered. The Lower Swat valley extends from Mingora to Landakai within the State border and to Kalangai, a few miles above the junction of Swat and Panjkora rivers outside it. The entire vale of Swat does not exceed 130 miles in length with an average width of about 12 miles. It is closed on either side by mountain ranges varying in elevation from 20,000 to 4,000 feet diminishing gradually as they run southward. The valley widens down stream, and more cultivated areas could be seen along both the banks and in the lateral glens. It is this region which is agriculturally rich and most important. Rice and fruits are the chief products. Human settlements are numerous, and closer to each other. The average elevation of Buner region is 2,500 feets. It is roughly 600 sq. miles in area. surrounded by high mountain,

accessible through difficult passes, or up the still more difficult defile of Barandu river, which after collecting all the drainage of the valley, empties itself in the Indus, 8 miles above Amb, opposite the Black Mountains. This area abounds in bird life and provides an excellent shooting ground. A greater portion of this region has an arid aspect and most of the cultivated land is irrigated. Maize, barley, honey and hides are the chief products. The entire area is studded with permanent hutments.

The climate of Swat may be classed as warm-temperate. Summers are moderate with cold and snowy winters in some places. Summer temperature at some places often rises to 102°F, and in winter goes down below the freezing point. Rain is received by both the currents, westerly as well as easterly. Total annual rainfall amounts to 30". Two-thirds of the total rainfall takes place between December and April due to the Mediterranean depressions and the remaining one-third between July and September due to monsoons. Snow falls once or twice in a year, and slight fog is common during winters.

Conditions of climate and topography go a long way in shaping the characteristic vegetation of this region. Forests of the type of monsoon lands are found on mountain slopes. In these forests oaks are generally succeeded at higher levels by conifers. On the lower slopes chirpine (Pinus longifolia) abounds, while upwards it is replaced by deodar (cedrus deodara) and blue pine (pinus excelsa), whilst silver fir, beech and spruce are found at about 8,000 ft.

PEOPLES

The 1951 census shows Swat as comprising of 5,18,596 persons, out of whom 2,74,103 are males and 2,44,493 females. Thus there is an excess of males over females by 29,610. The density of population per square mile is 177. No population figures are available prior to 1941, when the population was listed as 4,46,014 ; the rise in population during the decade 1941-1951 works out to 16 per cent. This rise may be attributed, in the first place, to natural excess of births over deaths, secondly, to better medical facilities, and thirdly, to an increase in the economic standards of people resulting from large sums of money being spent on development projects and public works of utility.

The population is predominantly Muslim, of the Sunni sect. Of a total population of 5,18,596, only 471 are caste Hindus, most of whom are engaged in business ; there are also a few Sikhs who command most of the trade of the Buner region. People of minorities are afforded every protection by the ruler. It is noteworthy that during the great holocaust of 1947 not a single member of the minority communities was touched. The inhabitants of this state deem it as their national honour to give protection to those who need it.

The language of the people like that of other Pathans is Pashto. In Swat Kohistan non-Pathan tribes speak Torwali, and Gujars a kind of Hindi, quite

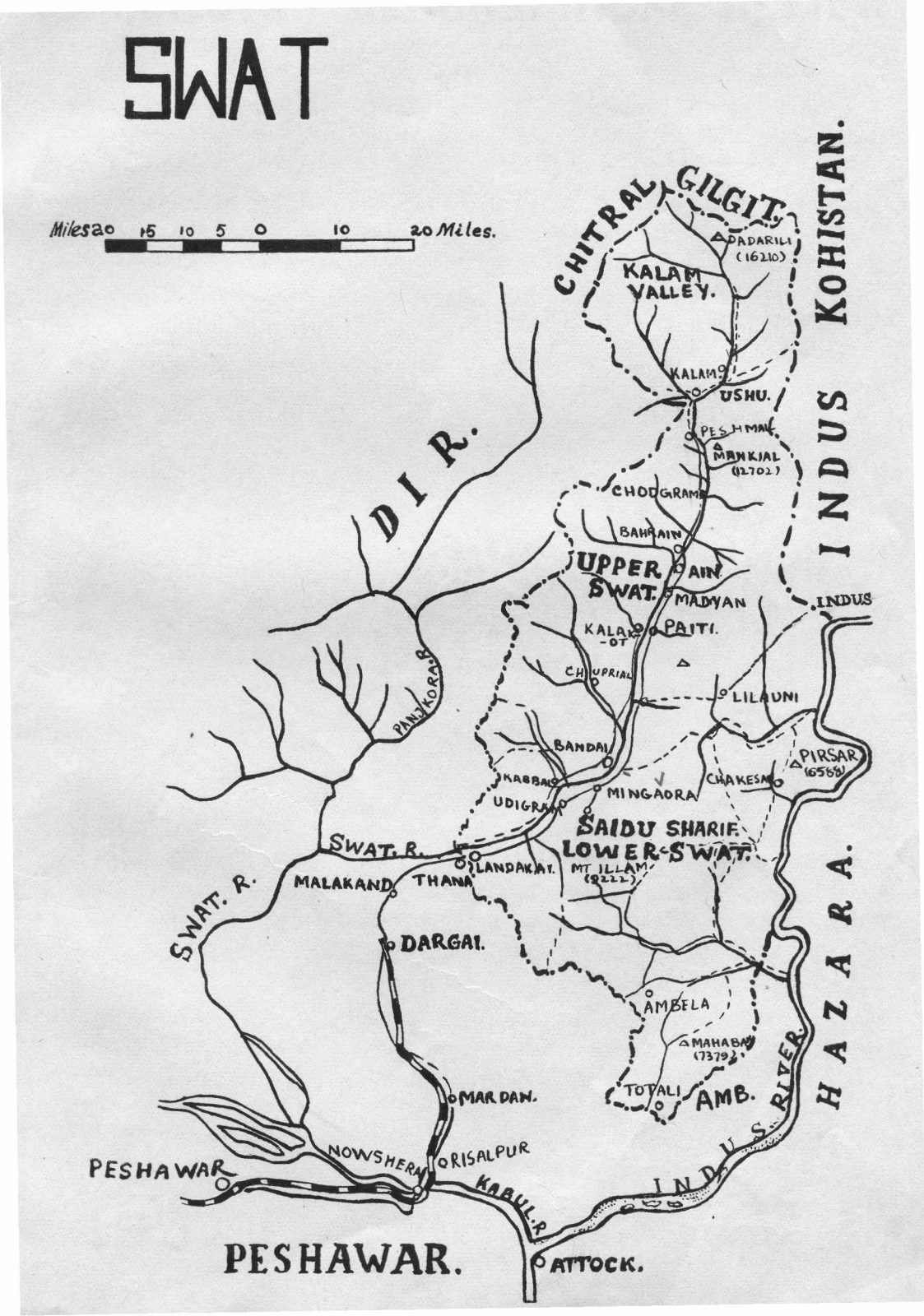
distinct from Punjabi or Pashto. At present Pashto is the leading language and is spoken by 5,00,603 people ; Kohistani is spoken by 64,298 and Urdu by 12,126. Urdu, the national language of Pakistan, is fast gaining ground due to the progress in trade and business with other parts of Pakistan. Other languages spoken are Persian, Kashmiri, Punjabi and Hindi. Only 568 persons speak English. It is rather astonishing to find that the Census Report of 1951 has listed about 15 persons as Marathi-speaking in the State.

Education is spreading rapidly in the State on account of the personal interest of the ruler, and a substantial amount of its income is being spent on this item. "Jahanzeb College," a structure worth the name, is a landmark in the educational progress of the State.

Swat is the centre of Yusufzai Pathans and its different offshoots. The Yusufzais, a branch of the great Sarbani family of Afghans (to which Durranies belong) invaded and occupied Lower Swat in the 16th century. In Humayun's reign Upper Swat was also annexed as far as Ain, beyond which they have scarcely advanced to this day. They gave the valley the name of Yusufzai and this is why Swat is often called as Yusufzai State. Prior to this invasion by the Pathans, Buddhism was the prevailing religion and it was after its occupation by the Pathans that the light of Islam spread over this region.

In physiognomy a Yusufzai is not much different from other Pathans. He is fairly stalwart, above the average of the other peoples of Asia. His features are well-formed with a regularity sometimes distinctly Grecian. His traditional dress consists of a loose gown (*khalqa*) or shirt, long, loose trousers and a turban or cap covering the head. He also puts on a *chaddar* or sheet, which is either thrown over the shoulder or wrapped round the body. In cold it serves as a blanket and in summer as an umbrella, and as a bed to lie under the shade of a wayside tree when tired. His footwear consists of *chapplies* or sandles, more or less of Grecian type or typical Pathan shoes. Educated people have begun to adopt Western dress. Jinnah cap (the Pakistani national headwear) is becoming increasingly popular, and with well-to-do people expensive Karakuli cap. Women are fond of ornaments and gay dress ; they put on long shirts, baggy pyjamas and *dopatta*, while pardah-observing ladies put on *burqa* as well.

Sir Henry MacMahon remarks : "The Pathans of Swat differ little from the other Pathans except in that they possess the spirit of discipline. It has doubtless been inculcated by their long-standing system of communal Government and the periodical redistribution of tribal lands....." Sir Denzil Ibbetson remarks : "The Yusufzais are of lively, merry, sociable disposition, fond of music and poetry and jealous of the honour of their women. Their tribal constitution is distinctly democratic."


SWAT
Miles 20 15 10 5 0 10 20 Miles.
CHITRAL
GILGIT
INDUS KOHISTAN.
DADARILI (16210)
KALAM VALLEY.
KALAM
USHU.
PESHMAL
MANKIAL (12702)
CHODGRAM
BAHRAIN
UPPER SWAT.
AIN
MADYAN
INDUS
KALAM-OT
PAITI.
CHUPRIAL
LILAUNI
DIR.
PANJKORA R.
BANDAI
PIRSAR (6568)
KABBAL
CHAKESAR
MINGORA
UDIGRAM
SAIDU SHARIF.
LOWER SWAT.
SWAT. R.
LANDAKAY
MT ILLAM (9222)
MALAKAND
THANA
SWAT. R.
DARGAI.
AMBELA
MAHABAN (7379)
HAZARA.
TOTALI
AMB.
RIVER.
MARDAN.
NOWSHERA
RISALPUR
PESHAWAR
KABUL R.
INDUS
PESHAWAR.
ATTOCK.

The non-Pathan tribes, Gujars, Torwals and Garhwis occupied both Lower and Upper Swat prior to the invasion of this territory by the Yusufzai Pathans in the 16th century, they are now confined to Swat Kohistan. People inhabiting Swat Kohistan stand somewhat apart from the rest. They are purely pastoral and almost a nomadic people practising transhumance. Here nomadism is a special and dynamic response to the environment by which the frontier of human occupation is pushed farther within a region of increasing difficulty ; it represents the only possible utilisation of limited geographical opportunities, and not an unsatisfactory alternative to agriculture.

Major Wace describes Gujars as "a simple, all-enduring race, thrifty and industrious, with no ambition but to be left alone with their cattle and fields" ; and "many of them are fine men in every way."

The Gujars are a fine, manly race with peculiar handsome features. They are mild and inoffensive in manners. Their women are tall and it is among these hill women that one comes across real beauty in rags.

The tribal system of the Pathans of the area is not different from that of other Pathans of West Pakistan. Each section of a tribe, however small, has its leading men, who is known as Malik, a specially Pathan title. The tribe is split up into numerous clans, and these again into sects. Swat people have a distinct corporate existence, each tribe, and within the tribe each clan possesses a clearly defined tract of country. The Yusufzai organization like that of most other Pathan tribes is based on the theory that all members of the tribe have equal rights. Generally speakiug, only a member of the tribe can own land, and any person who ceases to own land loses his tribal rights.

History tells us that no people are more tenacious for their liberty and individual rights than the people of Swat and that they have always been famed for resistance to submit to any form of Government. In an hour of trial personal feuds and jealousies do not come in their way, and the entire community acts together as one man against an invader.

In the earlier part of the 20th century Swat was a constant battle-ground of 24 separate tribes who inhabited this region and who relied for their livelihood on what they could loot from their neighbours. Mian Gul-Shahzada Abdul Wadood (Badshah Sahib), grandson of Akhund Sahib, put an end to this pillage and plunder and brought all the 24 tribes of the area under his subjugation by 1917. He also abolished the system of "Wesh" which was prevalent from the days when the country was first occupied. Under "Wesh" all land was redistributed by lots every four years, so that everybody could get a chance to obtain the more fertile plots. However, this practice proved harmful as no one took the slightest interest in improving the land, developing irrigation or building permanent houses.

The Swat people generally dwell in mud huts, some walled and protected by towers. In towns and villages pacca buildings are springing up rapidly ; and with the installation of electricity, radio-sets at prominent places are seen attracting crowds in this remote hill country.

Many interesting ceremonies are observed on marriage occasion. Some parents exact large sums for their daughters and the money is paid at the time of nikah. Dowry system is also in practice ; and presents like ornaments, clothes, utensils, and beds come from parents, near relations and friends.

In some of the hill tribes like Torwals, a bride price is paid, and the bridegroom's party is accompanied at the wedding by men dressed as women who dance and jest. In this community daughters inherit the father's land in equal shares with sons.

Notwithstanding the absence of cinemas and clubs, the public have a strong taste and fondness for amusements. Males and females enjoy ceremonies by singing tappas, folklore in Swati and Pashto, in accompaniment with country-made musical instruments and unique and piquant dances. During Eid holidays males and females enjoy themselves by holding separate fairs beside river Swat. In Swat every Thursday has been decreed a holiday, the logic being that Friday, the usual day of rest, should be spent in praying at the mosque.

Intoxicants and immoral practices are strictly forbidden in the State. All crimes except murder are punishable by fines, which make up a sizable portion of state's income. The only offenders who are kept in prison are those who are unable to pay and must work their fines off. Murderers are handed over to victim's family to be disposed of as the aggrieved ones see fit. This may be one reason why Swat's murder rate is the lowest in the Indo-Pakistan sub-continent, within an annual average of less than 10.

GENERAL ECONOMIC LIFE

Agriculture is by far the most important economic activity in Swat. Of the 1,69,715 self-supporting persons in the State 1,39,728 are engaged in agriculture. Thus more than 82 per cent of the people derive their sustenance from it directly, and a further proportion is dependent upon the products of agriculture, either as a supplement to the livelihood of pastoral nomadism, or as a source of raw materials for minor cottage industries.

Although agriculture plays an important part in the life of the region, the land under plough is too small when compared with the area of the state. Cultivated land can best be viewed as a mosaic, in which intensively cultivated patches alternate with vast tracts of unexploited mountainous terrain. It is only in the valleys, on the sides of streams, and along the banks of river Swat, the life-blood of the state, that one finds tossing fields laiden with grain. Topo-

graphy affects agriculture to an enormous degree ; as flat land is scarce suitable, mountain slopes have been carved out in a step-like manner to be made available for agriculture.

The physical environment of this region challenges its inhabitants to bold action, and they are braving obstacles, with great courage and fortitude, by terracing hill-sides, digging channels through hard rocks, constructing roads clinging to ridges and planting bridges over the streams. In short, they are endlessly striving to raise their lot and prove worthy of the land they inhabit.

Agriculture is primitive in character and is still in an early stage of development ; subsistence is the overriding consideration with the aim of feeding the local population upon local produce. Under such a system, food-stuffs tend to be the main crop regardless of their suitability to the geographical conditions in the area, and thus specialization in a few other products that might succeed better is generally avoided.

The age-old plough is still employed and shall continue to remain so, driven by small and hardy bullocks. Mechanized agriculture does not find any place here on account of the hilly nature of the country and small land-holdings. Prior to the present regime, a system of rotation of land amongst the influential tribesmen, was practised but the progressive ruler has now done away with this unscientific method and has enforced permanent settlement.

Although average rainfall is 30", much of the precious water is drained off, hence the problem of irrigation assumes paramount importance. Roughly three-fourths of the total arable land is irrigated. The people have made use of the natural facilities available for irrigation, in the form of springs, hill torrents, and river Swat with its tributaries. Channels have been diverted from these natural sources to reach every patch of cultivable ground which could possibly be irrigated.

Fed by snow and glaciers, river Swat has a considerable volume of water in the summer months, but shrinks after the middle of September till in mid winter it is fordable almost everywhere. It not only irrigates the valleys of Swat but also enriches the area it drains outside the state borders. The sugar-cane plantations of Mardan district and the hydel stations of Malakand and Dargai entirely owe their existence to this river.

Soil is sufficiently fertile and yield per acre of the different crops is fairly good according to our standards. Cattle dung is used as manure and rotation of crops is practised to regain the lost fertility. There are two crops, Rabi and Kharif. The State is self-sufficient in respect of food-grains and during favourable years there is also a little surplus of about 300,000 maunds annually for purposes of export to the adjoining deficit areas.

Maize is the leading crop of Swat from the point of view of production. Average annual yield is 27,00,000 maunds. It is one of the finest qualities and greatly relished for its sweetness. Wheat ranks second and is of fairly good quality, its annual yield is 9,50,000 maunds. Rice follows wheat with a production of 6,00,000 maunds. It is one of the finest varieties and is very much liked for its flavour and taste. Barley comes last with a production of 4,00,000 maunds. Various other crops like tobacco, lentils, mustard, sugar-cane and potatoes are also grown but are not of any great significance in view of their small production.

The climate of Swat being warm temperate is favourable for a wide variety of fruits. The value of fruit cultivation to this region is great, because fruits can be planted on slopes of hills, and thus rugged lands, which otherwise have no agricultural use, can most profitably be utilized. Another advantage to this region is that late frosts which nip the blossom, and early autumn frosts which injure the fruit while riping, do not occur so late in the spring or so early in autumn as on the plains. Citrus fruits like oranges which thrive well in tropical and sub-tropical areas have a bright future in this region, while some of the hardy deciduous fruits like apple, which otherwise belong to cool-temperate regions, can also be grown successfully on account of their adaptability to a wide range of climatic conditions.

In Swat there is a large variety of fruits grown including grapes, pears, apples, date-palms, oranges, red-blood maltas, persimmons, almonds and walnuts. If one visits Swat he is likely to see orchards hither and thither on both sides of the roads. Although people have now begun to realise the opportunities that fruit-farming offers for the economic uplift of the state, scientific fruit-farming is still a long way off.

Both dry and fresh fruits form an important item of export trade. Export of fruits can further be stepped up if proper grading and packing is done, and if facilities for their cold-storage and speedy transport to markets of consumption are made available. Disposal of fruits offers no problem, for there is a ready market for them in the whole of West Pakistan. There are also good chances for the introduction of fruit canning and processing industries, provided their importance is realised and sufficient capital is invested.

WATER BALANCE AND MAGNITUDE OF WATER DEFICIENCY IN THE ARID ZONE OF WEST PAKISTAN

BY

MUBASHIR LALL KHAN

IN a country like PAKISTAN where drought and floods are both great problems, where conservation of moisture is very urgent and the necessity of irrigation ubiquitous, the water balance method of Thornthwaite offers a sound basis for the appraisal of our water problem.

Properly speaking, this article should begin with the definitions of the terms "arid" and "semi-arid" region. However, notwithstanding the world-wide usage of these terms, it is not an easy matter to give them concise and at the same time exact definitions. Aridity, in fact is a relative term and no single geological or meteorological factor can explain its evolution and prevalence. It is actually a combined product of very complex and multifarious phenomena of nature such as low rainfall, extreme temperatures, continentality, soil conditions and nature of the terrain. Aridity signifies a deficiency of moisture and is created when the meteoric supply of water is unable to meet the requirements of evaporation from the soil and transpiration from the plants (evapo-transpiration). Not only is the phenomena of evapo-transpiration independent of rainfall so far as the factors responsible for its operation are concerned, it represents a process reverse to that of precipitation in the hydrological cycle since the latter is responsible for bringing water from atmosphere to the earth, the former transports it from the earth back to the atmosphere.

The actual evapo-transpiration varies widely, depending upon climatological factors, the nature and properties of the evaporating surface and the amount of moisture available in the soil. For instance,in arid climates with poor vegetation evapo-transpiration is limited by the amount of soil moisture ; if more water were available, more vegetation would grow and this would naturally increase the evapo-transpiration. Considerations of this sort led Thornthwaite[2] to realize that to obtain a moisture index precipitation must be compared with potential evapo-transpiration rather than with the actual evapo-transpiration. The potential evapo-transpiration is defined as the amount

of water that would evaporate and transpire if it were available in sufficient amount for an optimum use. Thornthwaite himself designed an instrument for the direct measurement of potential evapo-transpiration but since it is comparatively very recent, there are only very few places in the world where these measurements are being conducted.[3]

By correlating mean temperature with water use at numerous places Thornthwaite has arrived at a complex exponential formula for evaluating monthly potential evapo-transpiration from the more generally available data of temperature and length of the day. The whole computational procedure is done by the help of certain tablets and nomograms. The values of potential evapo-transpiration obtained by this formula.* are taken for water need and compared with the corresponding values of rainfall for each month. Water budgets are prepared to define the amount of water deficiency and water surplus. THORNTHWAITE allows ten centimeters for storage in the soil and this is utilized before any deficiency occurs.

The following table gives the actual water balance computations for certain stations situated in the arid zone of WEST PAKISTAN. The various operations indicated in the table are relatively straightforward although appropriate tables need be used to obtain the soil moisture storage change. Such a manual is under preparation by THORNTHWAITE which will deal with full instructions for conducting the various operations in working out the water balance.

Although only the data of temperature and precipitation are needed, the THORNTHWAITE's Water balance method results in quantitative estimates of water deficiency and water surplus, the two critical aspects of the water problem in PAKISTAN and the neighbourhood. Water balances have been computed for about 25 climatological stations in the arid and semi-arid zones of WEST PAKISTAN so that the map of average annual water deficiency could be drawn after the interpolation methods of CARTER[4] (see the map).

The region with the greatest water deficiency as shown in the map is in the Middle and Lower INDUS plain including the KACHHI re-entrant and the detached HAMUNI-MUSHKHEL area on PAK-IRANIAN border. While

*The formula states thus : —

$$e\,t = 1.6\ (10t/I)a$$

where 'e' is monthly potential evapo-transpiration, 't' is mean monthly temperature, 'I' is heat index (calculated from the equation $i = (t/5)\ (1.514)$ and the value of the constant 'a' being $0.0000006751^3 - 0.0000771^2 + 0.017921 + 0.49239$. The formula gives unadjusted values of potential evapo-transpiration for months of 30 days of 12 hrs. each which are to be adjusted by the help of a correction factor.

TABLE

Station	January	February	March	April	May	June	July	August	September	October	November	December	Year
*I ...	00.0	1.2	3.0	7.3	14.1	18.1	20.7	18.1	12.3	6.8	2.2	1.3	105.1
II ...	5.5	5.2	3.6	1.9	0.8	0.0	1.5	0.0	0.0	0.2	2.3	4.1	25.1
III ...	5.5	1.6	0.0	−5.4	−4.6	0.0	0.0	0.0	0.0	0.0	0.1	.8	...
IV ...	8.4	10.0	10.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	2.9	...
V ...	0.0	0.0	0.0	0.0	8.7	18.1	19.2	18.1	12.3	6.6	0.0	0.0	83.2
DROSH													
*I ...	0.0	0.6	2.0	4.7	11.3	16.7	19.7	17.8	11.8	6.5	2.7	0.2	94.0
II ...	3.4	3.9	9.3	10.3	4.8	1.6	1.5	1.6	1.7	3.2	0.9	3.0	45.2
III ...	3.3	3.3	0.5	0.0	−6.5	−3.5	0.0	0.0	0.0	0.0	0.0	2.8	...
IV ...	6.2	9.5	10.0	10.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	2.8	...
V ...	0.0	0.0	0.0	0.0	0.0	11.6	18.2	16.2	10.1	3.3	11.8	0.0	61.2
LAHORE													
*I ...	0.8	1.5	5.3	14.0	19.8	21.1	20.7	19.8	10.3	9.7	3.5	1.3	127.8
II ...	2.6	2.4	1.9	1.4	1.4	4.1	13.6	12.8	5.5	0.8	0.2	1.1	47.8
III ...	1.8	0.9	−2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...
IV ...	1.8	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...
V ...	0.0	0.0	0.7	12.6	18.4	17.0	7.1	7.0	4.8	8.9	3.3	0.2	80.0
NOKKUNDI													
*I ...	0.9	1.9	3.8	11.7	19.9	21.3	21.7	20.4	17.3	10.5	3.2	1.4	134.0
II ...	2.2	1.0	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	4.7
III ...	1.3	−0.9	−0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...
IV ...	1.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...
V ...	0.0	0.0	3.1	10.9	19.9	21.3	21.7	20.4	17.3	10.5	3.1	1,1	129.2
SUKKUR													
*I ...	1.2	2.9	8.2	16.2	20.9	20.6	21.3	19.8	17.6	14.4	6.0	2.1	151.1
II ...	0.5	0.7	0.6	0.3	0.4	0.4	3.6	2.8	0.0	0.0	0.0	0.1	9 4
III ...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...
IV ...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...
V ...	0.7	2.2	7.6	15.9	20.5	20.2	17.7	17.0	17.6	14.4	6.0	2.0	141.8

TABLE

Station	January	February	March	April	May	June	July	August	September	October	November	December	Year
PESHAWAR													
*I ...	0.9	1.6	4.4	9.5	18.5	21.1	21.6	19.6	15.6	9.5	3.4	1.3	127.0
II ...	3.6	3.8	6.1	4.4	2.1	0.8	3.1	5.1	2.0	0.5	0.8	1.6	33.8
III ...	2.7	2.2	1.7	−5.1	−1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.3	...
IV ...	3.0	5.2	6.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	...
V ...	0.0	0.0	0.0	0.0	14.7	20.3	18.5	14.5	13.5	9.0	2.6	0.0	93,2

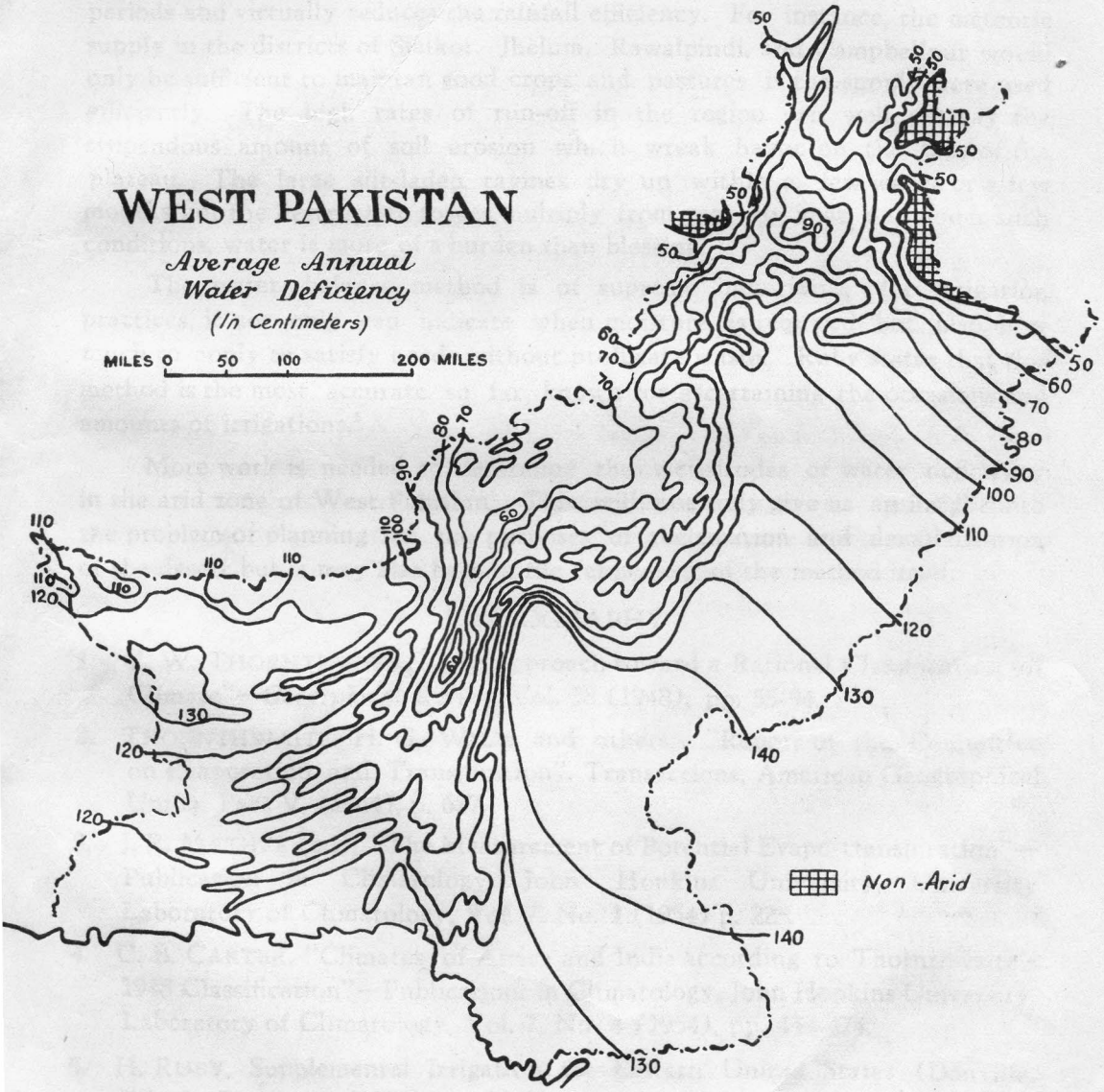
*I = Potential Evapo-transpiration. II = Precipitation. III = Storage Change.
IV = Storage. V = Water Deficiency.

N.B.—All figures in centimeters.

the country around SIBI and JACOBABAD, with a maximum deficiency of about 143 cms. forms the heart of the deficit region, there are also large deficiencies extending as far north as GILGIT (80 cms.) and DROSH (62 cms.) in the HIMALAYAN-KARAKORAM region. Nowhere in the upper INDUS plain, is there a water deficiency of less than 80 cms. in a year. In the more elevated, dry sub-humid parts of the western mountains around Kalat, Quetta, Ziarat, Shinghar, Manikhaw, Shaghalu, Kiryan, Shalozan and Chitral the annual deficiency varies from nearly 50 to 70 cms.

Over most parts of the arid zone, there is water deficiency in all the twelve months of the year but in some parts particularly in the elevated (situated in the spring and winter regimes of rainfall), there is no deficiency during one or two winter months. For instance, at Sukkur the annual water deficiency is 142 cms and there is deficiency in all months though in varying magnitude whereas at Nokkundi which receives nearly half of the annual amount of rainfall at Sukkur has no deficiency during January and February. Sibi, Bannu, D. I. Khan, Gilgit, Khushab, Lahore, Las Bela, Lyallpur, Montgomery, Pasni and Panjgur are other stations of the arid zone having no deficiency during the two winter months.

A study of the march of deficiency through the year shows that throughout the arid zone the peak of deficiency is reached in the month of May or June preceding the monsoons. This is so because the hot weather season in West Pakistan lasts from March to June. The Monsoons begin at


WEST PAKISTAN
Average Annual
Water Deficiency
(In Centimeters)
MILES 0 50 100 200 MILES
Non -Arid

the end of the hot season with the northward displacement of Inter-Tropical Front, and this generally results in slight fall in temperatures but the temperatures are still high even in the rainy season. Therefore the water deficiency remains high from April up to the month of October though during the rainy season, it may but very slightly fall.

In the elevated parts of the arid country, the water deficiency is comparatively greater than the actual water deficiency figures indicate. This is chiefly due to the run-off which occurs at very high rates for very short periods and virtually reduces the rainfall efficiency. For instance, the meteoric supply in the districts of Sialkot, Jhelum, Rawalpindi, and Campbellpur would only be sufficient to maintan good crops and pastures if the supply were used efficiently. The high rates of run-off in the region can well portray the stupendous amount of soil erosion which wreak havoc on the face of the plateau. The large silt-laden ravines dry up within a few weeks or a few months but the destructive forces multiply from year to year and under such conditions, water is more of a burden than blessing.

The water balance method is of supreme importance for irrigation practices, it not only can indicate when moisture is required but also, how much to apply to satisfy needs without profligate waste. Ruby states that this method is the most accurate so far known for ascertaining the occasions and amounts of irrigations.[5]

More work is needed to determine the vicissitudes of water deficiency in the arid zone of West Pakistan. This will not only give us an insight into the problem of planning for the purposes of reclamation and demobilization of the desert but it may also help in the refinement of the method itself.

BIBLIOGRAPHY

1. C. W. THORNTHWAITE, "An approach toward a Rational Classification of Climate"—*Geogrphical Review*, Vol. 38 (1948), pp. 55-94.
2. THORNTHWAITE. H. G. WILM and others, "Report of the Committee on Evaporation and Transpiration", Transactions, American Geographical Union, Part V. (1944), p. 687.
3. J. R. MATHER (ed), "The Measurement of Potential Evapo-transpiration"—Publication in Climatology, John Hopkins University, University Laboratory of Climatology, Vol. 7, No. 1 (1954) p. 225.
4. C. B. CARTER, "Climates of Africa and India according to Thornthwaite's 1948 Classification"—Publications in Climatology, John Hopkins University, Laboratory of Climatology, Vol. 7, No. 4 (1954), pp. 453-474.
5. H. RUBY, Supplemental Irrigation for Eastern United States (Danville. Illinois, Interstate (1954), pp. 90-91.

DISTRIBUTION OF WHEAT IN PAKISTAN

BY
KAZI S. AHMAD

WHEAT is the most important food-grain of West Pakistan and the second most important food crop of Pakistan. It requires cool and rainy weather at the time of its germination and early growth, and warm, dry and sunny weather at the time of harvest. The former conditions largely affect both the acreage and the yield, while the latter mainly regulate the quality of the crop. Well-distributed rains from December to March, with intervals of bright and clear weather, are important in affecting the final yield. Low range of temperature and prolonged cloudiness in January and February promote rust and smut. It can adapt itself to a wide range of soils, excepting very light, alkaline and water-logged lands. The best soils are, however, light clay or heavy or medium loams. The ground must be moderately rolling for natural drainage.

In Pakistan, as in other tropical or sub-tropical countries, it is a winter annual. The seed is sown after the monsoon rains, from October to December, mainly mid-October to mid-November. It is harvested before the intense heat of the hot season, generally from March to May. In the North-West Frontier Region, and some parts of Baluchistan, a small quantity of spring wheat is also sown in March-April, and harvested in July-August. C591 is the most widely grown variety in West Pakistan, as it can be grown in comparatively poor soils under irrigated conditions. C518 is best suited for rich lands with copious water-supply.

Out of the yield of 5,617,000 tons of food-grains in West Pakistan in 1954-1955, wheat shared 3,108,000 tons, or 55.3 per cent of the total. For the same year it occupied 10,457,000 acres out of 18,201,000 acres, or 57.4 per cent of the acreage under food-grains in West Pakistan. In Pakistan as a whole, wheat occupied 10,560,000 acres, and had an, yield of 3,134,000 tons. Of this West Pakistan shared above 99 per cent of both acreage and yield. It occupies about 21 per cent of the total cultivated area in Pakistan, which is only second to that of rice (48 per cent). In normal years there is a small surplus. For example, it had a surplus of 82 lakh maunds in 1949, and 36 lakh maunds of wheat were exported in 1950. The production of wheat in 1948-49 was

112,000,000 maunds and in 1950, 109,000,000 maunds. Although the population has been increasing by about 1½ per cent every year there has not been a corresponding increase either in acreage or production. Before 1953-54 both the acreage and production have tended to vary and fluctuate from year to year. After 1953-54 there has been a slight rise.

The acreage rose from 9,856,000 in 1947-48 to 10,686,000 in 1948-49 and fell to 10,432,000 in 1949-50. It rose again to 10,593,000 in 1950-51 to fall again to 10,240,000 in 1951-52. It fell further to 9,529,000 in 1952-53, the lowest since partition. It rose to 10,651,000 in 1953-54, 10,661,000 in 1954-55 and 11,289,000 in 1955-56.

The fluctuations in the acreage may be attributed to a variety of causes : (1) late summer and winter rains on which sowings depend in the rain-fed areas, (2) availability of canal water, (3) prices of competitive cash crops, like oilseeds in the preceding rabi or cotton in kharif, and (4) floods. In the year 1951-52 the fall in the wheat acreage may be explained on the basis of the diversion of some of its area to oilseeds and cotton ; the increase in the acreage of these two crops being almost equal to the decrease in that of wheat. In 1952-53 several of these factors combined to cause a large decrease in wheat acreage on account of which the country was faced with a serious food deficit. In 1952 the failure of autumn rains, low water-level in canals and further diversion of some area to cotton contributed to the reduction in acreage. The acreage rose by more than a million in the following year, 1953-54, on account of grow more food campaign. For the same reasons the increase in the wheat acreage continued up to 1955-56.

PRODUCTION OF WHEAT

Year	*Production (000 tons)*	*Year*	*Production (000 tons)*
1947-48	3,321	1951-52	2,972
1948-49	3,993	1952-53	2,390
1949-50	3,885	1953-54	3,683
1950-51	3,950	1954-55	3,172
		1955-56	3,315

The production has shown greater variation. Besides factors 1, 2 and 4 mentioned under acreage it is further affected by weather condition during the period of growth and at the time of harvest. Some of the other factors influencing production are : (1) pests and diseases, (2) application of fertilizers (3) type of seeds used and some other agricultural operations. The increase or decrease in acreage is not a sure index to production. For example, in 1954-55, although there was 1 per cent increase in acreage, the production fell by 13.9 per cent. This could be attributed to the continued spell of drought in certain parts of West Pakistan after the sowing of the crop, interruption in canal-water supplies from Bharat and the damage caused by

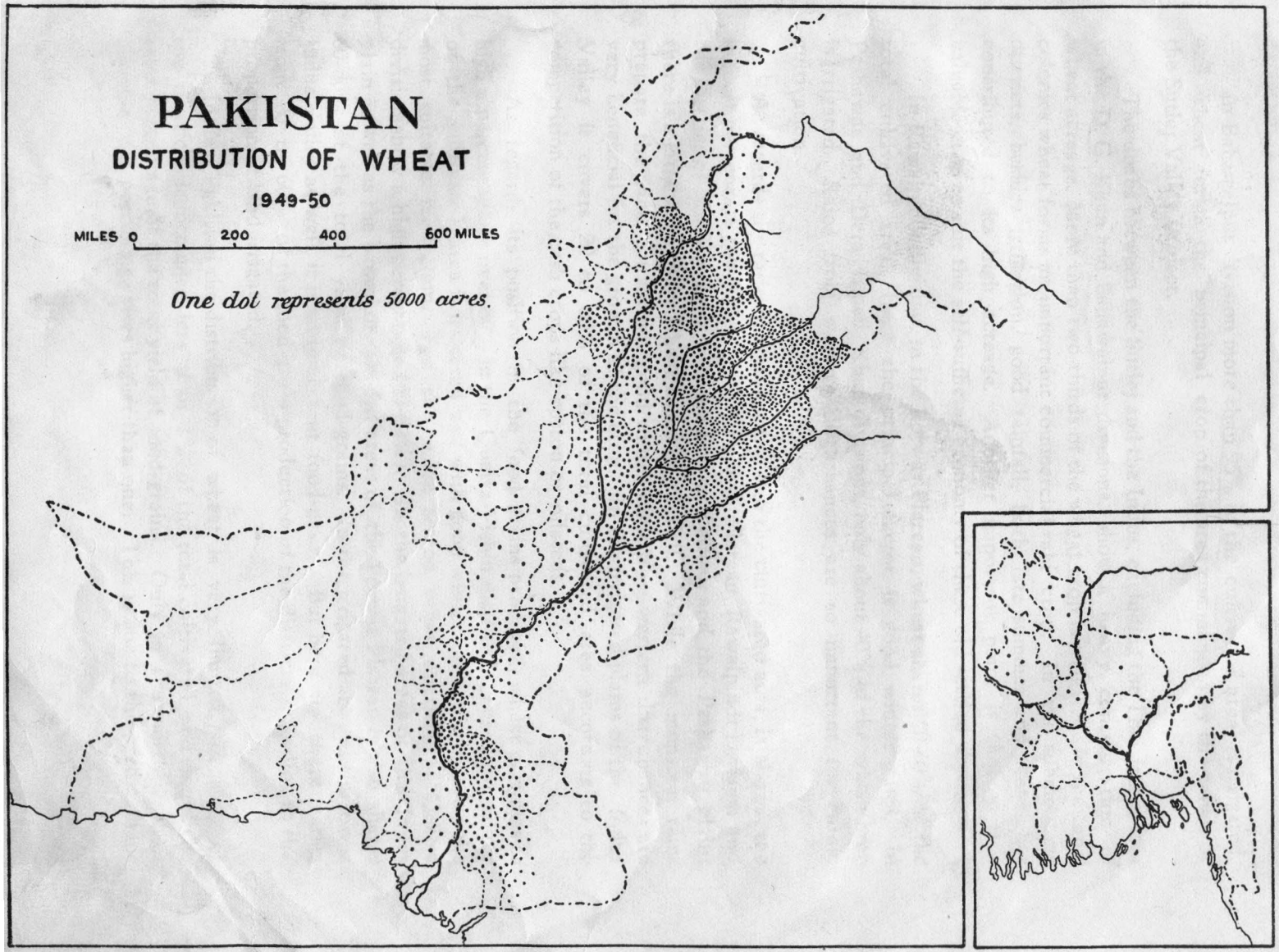
hailstorms. Like acreage, the production of wheat reached the rock bottom in 1952-53, resulting in serious deficit in food, estimated at nearly 12.5 lakh tons. The U.S. gift of 7 lakh tons of wheat and the Canadian and Australian aid of 11,600 tons and 42,950 tons of wheat respectively, under the Colombo Plan, helped to tide over the food shortage. Under the "grow-more-food" campaign, launched in 1953, amongst other things attention is being paid to : (*i*) high yield through the use of fertilizers, (*ii*) plant protection schemes and (*iii*) adequate supply of good seeds.

It may be pointed out that since the establishment of Pakistan the demand for wheat is much more than the natural increase in the number of population may indicate. The percentage of wheat-consuming population in West Pakistan has increased since partition. Great increase in the prices of agricultural products during the last war brought prosperity to the agricultural population. There was improvement in their standard of living, and many of them turned over to wheat. Besides, over one million more Muslims crossed into West Punjab from East Punjab than the non-Muslims who left it. About 460,000 refugees came from U.P., and 200,000 from Kashmir. Most of these immigrants were wheat-eating.

Considering the acreage, the total production is low. Our yield of wheat per acre is about the lowest in the wheat-producing countries of the world. It had an average of 9.6 maunds per acre during the quinquennium 1947-51 and 8.1 during the four years 1951-55. During 1947-51 the yield of wheat in Egypt was 20.1, in Japan 18.4, Italy 15.6 and U.S.A. 12.3 maunds per acre. Turkey having practically no irrigation, with the help of winter rainfall, had an yield of 10.3 maunds per arce. It is only Bharat, with 6.8 maunds per acre, which falls below the level of Pakistan.

Water being the basic need, the distribution of wheat in West Pakistan closely corresponds with the extent of the irrigated land in the dry areas, or regions of good and reliable autumn or late summer rains. An extensive system of canal or well-irrigation gives it security against failure of rains. Good, evenly distributed and reliable rains on the other hand ensure a fair crop. The competition of other crops becomes stronger as the risk of the failure of rains increases.

In the lower Indus Valley, in the Hyderabad and Khairpur divisions as well as in the Quetta and Kalat divisions where the rainfall does not exceed 10 inches, 100% of the crop is irrigated, in the former mainly from canals and in the latter from other sources. Tharparkar, Hyderabad, Nawabshah and Khairpur are, therefore, the chief wheat-producing districts in the lower Indus Valley which are commanded by the Sukkur Barrage. The small amount of wheat that is produced in Quetta and Kalat divisions is almost confined to Quetta-


PAKISTAN
DISTRIBUTION OF WHEAT
1949-50
MILES 0 200 400 600 MILES
One dot represents 5000 acres.

Pishin, Sibi and Loralai districts, with a good winter rainfall to supplement irrigation.

In Bahawalpur division more than 95% of the cultivated area is irrigated, and wheat forms the principal crop of the area commanded by the canals of the Sutlej Valley Project.

The doabs between the Sutlej and the Indus, excluding the Thal desert area in the D. G. Khan and Bahawalpur divisions, show a heavy concentration of wheat acreage. More than two-thirds of the wheat crop is irrigated. In the canal colonies wheat forms an important commercial rabi crop. In the submontane districts, besides irrigation, good rainfall, both late summer and winter, has contributed to its high acreage. Another important point is that it is a valuable crop to suit the self-sufficing economy of these old settled districts.

In Rawalpindi division, in the Potwar Plateau, wheat shares 50-60% of the total cultivated area. Here the principal factor is good winter rains. In Peshawar and Dera Ismail Khan divisions, only about 40% of the wheat crop is irrigated. Rains from western disturbances are so important for *barani* cultivation.

As regards the ratio of wheat acreage to the cultivated area, it shows the highest percentage (60-80%) in the Potwar Plateau, Rawalpindi Division and the district of Muzaffargarh. In the Potwar Plateau and the Peshawar plains there is a large area under wheat based on rainfall. While the monsoon rains prepare the land for sowing, good winter rains from western distrubances are very beneficial for the growth of the crop. In the irrigated plains of the Indus Valley it covers 20 to 60% of the total cultivated area according to the competition of the cash crops like cotton or oilseeds.

As regards its position in the food grains produced, wheat occupies as high a percentage as over 80% in the Quetta-Pishin district because the whole of the cultivated area is irrigated and with good winter rains wheat forms the most suitable food-grain. For the same season other districts of Quetta division show a high percentage (60-80%). In the irrigated areas of the Indus plain as well as the barani or rain-fed areas of the Potwar Plateau it also shares 60-80% of the total yield of food-grains. In the irrigated area of the lower Indus Valley as well, it is an important food-grain. But here its share varies from 20 to 60% of the food-grain production of the districts according to the proportion of land irrigated.

In East Pakistan the distribution of wheat is very limited. In most of the districts it occupies less than 1% of the total cultivated, and shares the same percentage of the total yield of food-grains. Only in the north-western districts the percentage rises higher than one. This is due to the predominant

position of rice as a food crop and unsuitability of the climate which is too humid, moist and warm for wheat. The winter months are dry and there are no means of irrigation during these months.

Considering the importance of wheat in the diet of the people of this country and the influence of its price in determining the general price level of general commodities, it is obviously so necessary to increase its production, not only by increasing the yield per acre but also by bringing more land under it. About 23 million acres of culturable land lies uncultivated in West Pakistan which no country with such a great pressure on land can afford. We should not leave the farmer to indiscriminate cultivation ; it is high time that we should regulate our wheat acreage in the light of our experience during the past decade and concentrate on research to increase the yield per acre by adopting methods suitable to various areas. Attempts may be made to introduce high yielding varieties from similar regions of the world. The development of varieties with a short growing-season and resistible to diseases under humid conditions may help in the extension of its cultivation in East Pakistan where as a rabi crop it would not much interfere with rice cultivation and may easily be rotated with the aus or autumn crops of rice. The consumption of wheat in East Pakistan is gradually increasing. During food shortages, as in 1956, many people who could not get rations in rice took wheat and *ata* which has helped them to acquire a taste for wheat flour. This change in the diet should be encouraged as, during food shortage, the import of wheat is easier and cheaper with consequently less pressure on foreign exchange.