



GOVERNMENT OF MAHARASHTRA

**WESTWARD DIVERSION OF WATERS
OF KRISHNA FOR GENERATION OF
HYDRO-POWER AND IRRIGATION
IN THE RATNAGIRI DISTRICT IN
MAHARASHTRA**

FOREWORD

A NUMBER of misleading notions against the proposed use of waters from Krishna by westward diversion for generation of power and irrigation are in vogue. This brochure aims at clearing those faulty notions in circulation and giving a true picture of the overwhelming benefits which the Nation stands to get by way of additional production of foodgrains, additional production of rice and generation of hydro-power in a power famine area located over 700 miles from collieries, by westward diversion of waters from Krishna for use on multi-purpose projects in Maharashtra. It also answers specifically some common questions asked by those who object to westward diversion of waters of Krishna such as :

(i) The average annual rainfall in the coastal district of Ratnagiri in Maharashtra is about 110". Why not use the waters of west-flowing streams in this district for generation of power and irrigation ?

OR

(ii) Whether you drop waters in a single drop to the west or in a series of drops along the course of the river the total drop available being the same, identical quantum of power can be generated from the same waters. Then why westward diversion ?

The fallacy of these arguments in case of Krishna waters is clearly brought out in this brochure.

**WESTWARD DIVERSION OF WATERS OF KRISHNA FOR GENERATION
OF HYDRO-POWER AND IRRIGATION IN RATNAGIRI DISTRICT
IN MAHARASHTRA**

I

The Necessity of Hydro-Power Generation

1.1. The western districts of Maharashtra in the Krishna and Godavari valleys including the Osmanabad district in the Krishna and the districts of Aurangabad and Bhir of Marathwada Region of Maharashtra in the Godavari valley have neither the mineral nor the forest resources available for the economic development of the region. The land resource of this region is also not productive for want of adequate and timely rainfall. The statistical data in respect of low productivity (scarcity) lands in the districts in Krishna Valley are given in the sub-joined Table No. 1.1. Similar statistical data for the States of Mysore and Andhra in the Krishna Valley are also given in the table.

TABLE NO. 1.1

Name of State	No. of tahukas with assessment less than one Rupee per acre in Krishna valley	Population affected in thousands	Culturable area in thousand acres	Percentage of total population affected in Krishna valley
1	2	3	4	5
Andhra	5	911·62	1,933·3	11·7
Mysore	18	2,642·26	5,511·5	34·1
Maharashtra	29	4,196·06	7,679·6	54·2

SOURCE.—(i) For column 2 see Table XVIII, pages 104 to 107 of the Krishna-Godavari Commission's Report.

(ii) For column 3 see Annexure 1.1.

The Maharashtra State Irrigation Commission has observed that inspite of developing every possible source including the underground water resource available for irrigating lands in these districts, hardly 24 per cent of the culturable area of these districts can be provided with irrigation facilities. The population settled in the remaining 76 per cent area which has no other natural resources available to it for its economic development will, therefore, have to resort to industries for betterment of its standard of life. Accordingly, the only course left for the economic development of people settled in this area would be to provide industries which would essentially need cheap power. The necessity of providing industries to these areas has been accepted by the Union Minister for Irrigation and Power in paragraph 19 of his statement placed by him on the table of the Lok Sabha on the 23rd March 1963. The coastal districts of Ratnagiri and Kolaba have also no Natural Resources available for their economic development and cannot be provided with irrigation facility *as no irrigation and power schemes based on west-flowing streams are economically possible.* This entire region lies far beyond the economic transmission range of possible power generating stations located at collieries. A haulage of over 700 miles is involved in carrying coal to these western districts of Maharashtra for

generation of thermal power which as a result, becomes very costly. Accordingly, the only source of cheap power which can be made available to this region would be the hydro-electric resource based on westward diversion of waters from Krishna. The Union Ministry has, however, placed a ban on any new projects based on diversion of Krishna waters for generation of power [vide paragraph 14 (i) of Union Minister for Irrigation and Power's Statement of 23rd March 1963].

Hydro-power needs of areas in Maharashtra located beyond economic transmission range of thermal stations located at pit heads

1.2. For the purposes of supply of power the Maharashtra State has been divided into two service areas, viz. :—

- (i) Tata-Central Railway—Koyna Service area ; and
- (ii) Khaperkheda-Paras-Bhusaval grid system service area.

Of these two service areas, the second service area lies generally within economic transmission range of thermal stations located at or near collieries themselves. Naturally, therefore, the best source of power supply to this area would be the thermal power supplemented by such hydro-power as could be had locally and accordingly Maharashtra does not intend supplying hydro-power from western Maharashtra to this area. The other system, viz. Tata-Central Railway-Koyna service area covers the entire western Maharashtra Region which is located over 700 miles away from the collieries. The peak load forecast for the year 1975-76 given in the detailed load survey for this service area made by the Central Water and Power Commission is of the order of 2680 MWs. It is this area which is required to be supplied with hydro-power. The thermal capacity already installed in this area is of the order of 284 MWs. To this capacity another 615 MWs. are proposed to be added by installing 125 MWs. at Trombay, 300 MWs. at Nasik and by obtaining 190 MWs. from the Tarapur Atomic Station as Maharashtra's share. The installed thermal capacity within the next few years would, therefore, be of the order of 900 MWs. The balance capacity needed by 1975-76 will, therefore, be 1780 MWs. of which about 800 MWs. will be needed as base load capacity and the balance as peaking capacity. The total 95 per cent. dependable hydro-power potential of all existing and proposed hydro-electric projects in Maharashtra in this service area inclusive of all projects based on westward diversion of Krishna waters amounts to about 1130 MWs. at 100 per cent. L.F. (for details see Statement I in Appendix) or 1870 MWs. at 60 per cent. L.F. The entire load up to 1975-76 can therefore, be served from the thermal capacity already being installed, supplemented by the hydro-power which can be developed in western Maharashtra. There would, therefore, be no necessity whatsoever to go in for any new thermal stations in the Tata-Central Railway-Koyna service area if the hydro potential as available, is completely developed. The Central Water and Power Commission's load survey has forecasted a peak load for 1980-81 for this service area at 4000 MWs. An additional capacity of about 4000-2700=1300 MWs. will have to be installed in this service area. The hydro-power stations are ideally suited to take peaks and accordingly, the new hydro-power stations may have a larger installed capacity to enable their running at a load factor of 25 per cent. or even less, as and when additional load develops and supplementary power generation from other fuels beyond 1976 becomes necessary. A statement is sometimes made by some, that the power needs of Maharashtra after 15 years would be of the order of

five million KWs. of which hardly two million KWs. would be made available from the existing thermal and hydro stations supplemented by another one million KWs. of hydro-power potential in the Western Ghats available to Maharashtra. Assuming that this entire hydro-power potential is developed, Maharashtra would still run short by two million KWs. which would necessarily have to be generated as thermal power by burning coal or by burning atomic fuel. It is further said that this being the case Maharashtra should not insist on developing hydro-power potential which represents hardly 20 per cent. of the total power requirements of the State but should make Krishna waters available for growing foodgrains by allowing them to flow along the natural course of the river. The discussion in the earlier part of this paragraph clearly brings out the fact that of the two service areas, the Khaparkheda-Paras-Bhusawal area which is nearer the collieries will have to be and should be fed by power based on coal supplemented by such hydro-power as can be generated in that service area and in the second i.e. in the Tata-Central Railway-Koyna service area with generation of hydro power by westward diversion of Krishna waters as proposed there should be no need to instal any more thermal power plant to meet the load demand up to about 1979-80, whereafter when the load rises further these hydro stations may run as purely peaking stations with low load factors.

Maharashtra's hydro-electric projects in the Tata-Central Railway-Koyna Service area

1.3. The Krishna-Godavari Commission demanded information in the prescribed *pro forma* in respect of all proposed irrigation and hydro projects in the State based on Krishna and Godavari waters and gave the States about two months in which they had to collect, compile and submit the information to the Commission. Maharashtra being in the head reaches of both the Krishna and Godavari rivers has a very large number of proposed projects some of which were investigated partly and in case of some others the investigations were in a preliminary stage. In case of hydro-electric projects based on westward diversion of Krishna waters detailed studies regarding use of tail race waters for irrigation were not made and accordingly very sketchy information regarding the use of tail race waters for irrigation was given. From the information given, an impression is generally created that the tail race waters from these hydro projects would mostly go waste into the Arabian Sea. This impression is mostly responsible for a very strong objection to the power projects based on westward diversion of Krishna waters. A considerable study regarding the possible use of tail race waters for irrigation in the Ratnagiri district has since been made and as a result the proposed hydro projects as presented to the Krishna-Godavari Commission are now classified into two categories, viz., (i) purely hydro electric projects, and (ii) multi-purpose projects. The Koyna will now be the only purely hydro-electric project. All other projects have now become multipurpose projects wherein about 80 per cent of the tail race waters are proposed to be used for irrigation.

II

Objections to westward diversion of Krishna waters

2.1. In general, everyone seems to agree that in the peculiar conditions obtained in Western Maharashtra industrialisation, requiring cheap power, is a necessity. However, the westward diversion of Krishna waters for generation of power, is objected to very vehemently particularly by Andhra Pradesh and Mysore on the

grounds that the waters from the tail race of the power houses would go physically to waste into the Arabian Sea whereas if allowed to flow along the course of the river they could be used for irrigation of food crops, particularly rice, in addition to generation of almost equal amount of power with benefits of power to more distributed area along the course of the river. It is further added, that as we are at present importing both foodgrains and rice, with the point of view of becoming self-sufficient in the matter of food supplies we must use the available water resource primarily for irrigated agriculture in the most appropriate areas and thus increase our food production even to the exclusion of generation of cheap hydro-power because power can be generated by burning coal and other fuels as an alternative. The protagonists of this view go to the extent of saying that water must not be put to any other more productive uses even if such uses add many times more to the Nation's wealth than the addition on account of its use for irrigation of foodcrops and such incidental power as such use can generate. Ostensibly this water use for irrigated agriculture in Andhra Pradesh and in Mysore also aims at :—

(i) More production of foodgrains
and

(ii) More production of rice.

Since this is a controversial issue having a very wide circulation it will be worthwhile examining this contention specifically and critically.

Projects in Andhra and Mysore for the alternative use of Krishna waters proposed to be diverted to the west for multipurpose projects in Maharashtra

2.2. The proposed irrigation works in Andhra Pradesh and Mysore which can use the waters of Krishna proposed to be diverted to the west for power generation on new multipurpose projects in Maharashtra as presented by the respective Governments to the Krishna-Godavari Commission are listed in the sub-joined Table No. 2.1.

TABLE No. 2.1

Name of Project	Name of district in which irrigation is proposed	Area proposed to be irrigated (Ayacut) in thousand acres	Percentage of paddy proposed	Annual withdrawal proposed in T. M. C.
1	2	3	4	5
<i>Andhra State</i>				
(1) Sangameshwaram—				
Canals Stage I	Kurnool ..	287.9	33	160.9
Canals Stage II	Cuddaph ..	70.6		
(2) Nagarjunsagar Project Stage II and Sri Sailam Project (Irrigation Part).	Nellore ..	888.0	44 to 100	144.9 + 41.3
	Krishna ..	228.0		186.2
	West Godavari ..	210.0		
(3) Pulichintala	Guntur ..	391.0	100	73.0
(4) Nagarjunsagar Stage III	No additional ayacut but only change over to 100 per cent. paddy.		100	595.17
(5) Okachettuvagu	Mahaboobnagar ..	5.5		1.9

TABLE NO. 2.1—contd.

Name of Project	Name of district in which irrigation is proposed	Area proposed to be irrigated (Ayacut) in thousand acres	Percentage of paddy proposed	Annual withdrawal proposed in T.M.C.
1	2	3	4	5
<i>Mysore State</i>				
(1) Bijapur Lift Irrigation Scheme	Belgaum ..	114·0	22·0	120·2
	Bijapur ..	736·0		
(2) Upper Krishna Project Stage II	Gulberga ..	162·0	18·0	115·0
	Bijapur ..	107·0		
	Raichur ..	98·0		
(3) Ghataprabha Project Stage III	Belgaum ..	129·0	5·0	34·8
	Bijapur ..	169·0		

SOURCE.—Report of the Krishna-Godavari Commission—Annexures X and XI.

NOTE.—(i) Projects in sub-basins lying entirely in Andhra are not listed as they would not be able to use the waters proposed for use on multipurpose projects based on westward diversion of waters from Krishna.

(ii) Projects in which extension of canals from Mysore Projects are proposed are also not listed.

On page 18 of the brochure on "Krishna-Godavari Waters—Optimum Economic Utilisation, Part I" published by Andhra Pradesh (1961) it was claimed that Andhra soils were more fertile and better producers of paddy than those of Mysore and Maharashtra and in support of this statement the figures of average yield of clean rice per acre for the three States as given in "Rice in India" was quoted. The table given therein is reproduced below. Three more columns are added to this table for proper appraisal of the figures of average yield of clean rice per acre in Andhra, and the then Bombay and Mysore.

TABLE NO. 2.2

Name of State	Acreage in Thousand Acres			Production in M. tons	Average yield per acre in pounds
	Irrigated	Unirrigated	Total		
1	2	3	4	5	6
1. Bombay	710	3,229	3,939	1·278	727
2. Mysore	1,180	924	3,104	0·919	978
3. Andhra Pradesh ..	5,620	353	5,973	2·679	1,005

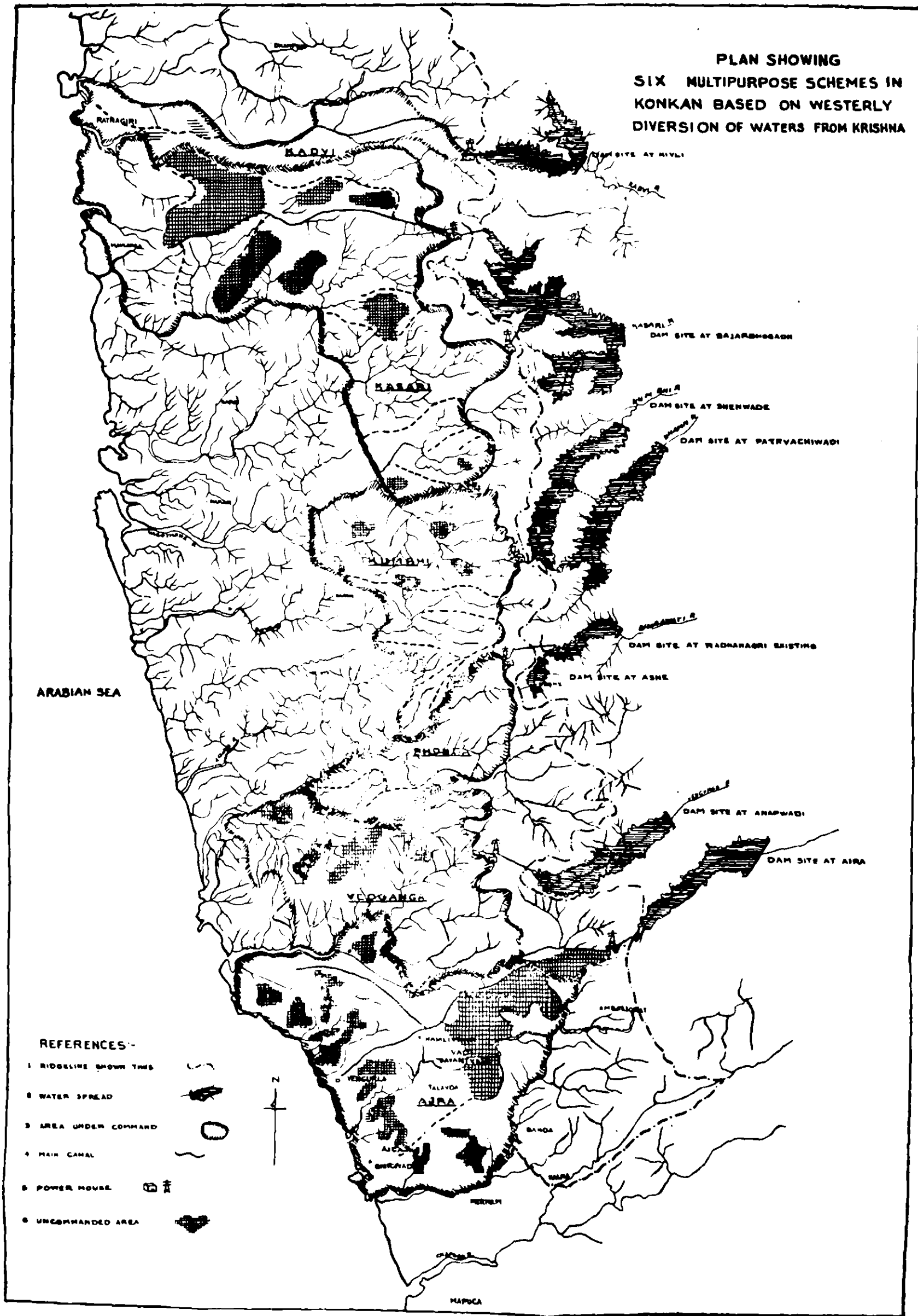
This comparison is not fair since the yield of predominantly irrigated rice in Andhra is compared with the yield of rainfed paddy in Bombay and that too outside the Krishna valley. In the Krishna valley proper, some progressive irrigators have grown even "Basmati" variety in black cotton soil area and have obtained an average yield of paddy of the order of 3,600 lb. per acre corresponding to 2,400 lb. of clean rice per acre. The average yield of other strains of irrigated paddy, where

grown, is of the order of 3,000 lb. per acre giving a yield of clean rice of about 1,800 lb. per acre against a low figure of 727 lb. of clean rice per acre quoted for Bombay in "Rice in India". As a matter of fact the productivity of Maharashtra soils under irrigation is much higher than Andhra and due to the peculiar soil-climate complex obtained in Maharashtra the water need of irrigated crops is much less compared to that for the same crops in Andhra (*see* para. 18-61 of the Report of the Krishna-Godavari Commission). The average yield of clean rice per acre of irrigated paddy where grown in Konkan is of the order of 1,600 lb. for the first crop and 2,200 lb. for the second crop (*see* Annexure 1.2). Accordingly, Andhra's claim that she is a better producer of irrigated rice is not borne out by facts. On the contrary it may be said that Maharashtra can produce more clean rice per acre under irrigated conditions than Andhra both in the Krishna valley and in Konkan districts. However, for the purposes of direct comparison it is necessary to specifically compare the estimated production of clean rice in the Ratnagiri District (Konkan) under irrigation from the tail races of the proposed multi-purpose projects with the corresponding production of clean rice in Andhra and Mysore States if the same quantum of waters received in the ghats were used by allowing them to flow down the river.

Benefits from use of 152 T.M.C. of Krishna waters in western ghats by westward diversion for generation of Power and Irrigation in Maharashtra

2.3. There are eight new multi-purpose projects based on westward diversion of Krishna waters in Maharashtra utilising about 161.5 T.M.C. of 95 per cent. dependable flow (*see* Statement II in appendix and map). Of the 161.5 T.M.C., 9.4 T.M.C. are proposed to be used for irrigation in Krishna valley itself and the balance 152.1 say 152 T.M.C. is proposed to be diverted to the west. The tail race waters from all these schemes are proposed to be utilised fully during the non-monsoon period (nine months) in the Ratnagiri District (Konkan) for irrigation of food crops. At present rice is being grown in the command of tail races of the proposed multi-purpose projects in small narrow low-lying strips. The statistical data of land use of the culturable commands of the tail race canals shows [*see* Statement III in appendix] that hardly 18 per cent. of the culturable area under the proposed canals is at present cultivated under rainfed paddy. In 32 per cent. of the remaining area inferior millets such as "Nachni", "Val", "Vari", "Kulith", etc., are grown, and the balance area remains uncultivated, the distribution of rainfall and soil characteristics being unsuitable for growing any crops economically. As the rainfall in this area is concentrated in about three months period (from 15th June to 15th September), the cultivator is obliged to grow only such strains of paddy under rainfed conditions which can mature with available rains obtained over a period of about three months. As a result, the average yield per acre of rainfed clean rice in the Ratnagiri District is as low as about 975 lb. If assured water is made available to this area it is possible to grow better varieties of paddy giving substantially high yields such as Kolamba, Zinya and *Japonica Indica* hybrids—all of which have been tried at the Karjat Agricultural Farm and have been found to give an average yield varying from 2,400 lb. to 3,000 lb. per acre when grown in low-lying areas which have adequate water supply after the cessation of the monsoons. Already there is a practice to grow Kolamba in such low-lying areas with retentive soils in the districts of Kolaba and Thana (Konkan) where the

**PLAN SHOWING
SIX MULTIPURPOSE SCHEMES IN
KONKAN BASED ON WESTERLY
DIVERSION OF WATERS FROM KRISHNA**



ARABIAN SEA

REFERENCES:-

- 1 RIDGELINE SHOWN THIS
- 2 WATER SPREAD
- 3 AREA UNDER COMMAND
- 4 MAIN CANAL
- 5 POWER HOUSE
- 6 UNCOMMANDED AREA



MARUCA

cultivators are getting an average yield of about 2,400 lb. per acre. The agricultural experts are of the opinion (*see* Annexure 1.2) that if irrigation waters are provided for growing of irrigated paddy of the long term strains mentioned above in the monsoon period, *i.e.*, as first crop, an average yield of 2,400 lb. per acre could be obtained with certainty. This means that that merely providing supplementary irrigation in the non-rainy period in Ratnagiri District the produce of clean rice could easily be expected to rise from the present figure of 975 lb. per acre to 1,600 lb. per acre. There is only one medium irrigation work in operation in the Konkan at present, *viz.* the Raja Nalla Scheme in the Kolaba District which gets its supply from the tail race of Tata's Bhivpuri Power House. This work has been commissioned in 1959. Irrigators on this scheme are getting an average yield of 3,300 lb. (40 maunds) of paddy per acre from the second crop of paddy which is transplanted by the middle of December and harvested by the middle of April. The agricultural experts also confirm that a yield of 3,300 lb. per acre could be safely expected as an average yield although higher yields are possible. In the Ratnagiri District hardly any second crop of paddy is being grown at present for want of adequate water supply in the postmonsoon period. The second crop of irrigated paddy under the tail races of the proposed multipurpose project would, therefore, be completely an additional produce and, therefore, an additional asset to the Nation's rice production. These areas were jointly inspected by the Chief Engineer and Joint Secretary to Government and the Additional Director of Agriculture. A copy of their inspection note is appended in Annexure 1.3. If all the new eight multi-purpose projects involving westward diversion of Krishna waters were implemented the net quantitative benefits which would accrue to the Nation in the matter of availability of power and foodgrains are summarised in Table No. 2.3 below :—

TABLE No. 2.3

(1) Addition to the Nation's foodgrains	..	..	4,12,800 Tons.
(2) Addition to the Nation's clean rice production (The average production of clean rice per acre of rainfed crop in Ratnagiri District is taken as 975 lb. and not 727 lb. as stated by Andhra and referred to in Table No. 1.3.)			3,90,200 Tons.
(3) Power in MWs. at 100 per cent. L. F.	..	..	445 MWs.
(4) Water Supply to villages	..	..	129 Numbers.

(For full details please *see* Statement IV in Appendix.)

Generation of Hydro-Power and Irrigation from Water Resource of West Flowing Rivers in Maharashtra

2.4. It is sometimes said that the average annual rainfall on the western slopes of western ghats being of the order of about 110 inches it should be possible to develop large block of hydro-power from the waters falling on the western slopes

and also use them for irrigation in the Konkan districts and accordingly it should not be necessary to use the diverted waters of Krishna for irrigation in the Ratnagiri District. Unfortunately the entire western slopes of western ghats in Maharashtra are very steep and reach a level of about 250 feet above mean sea level within two-three miles of the ridge and there are no reasonably economic sites for construction of storages for power generation on the western slopes of the ghats except in two cases viz. (i) the Vaitarna and (ii) Tillarinalla. The hydro-power potential of these two streams is, however, very small being of the order of 41.1 MWs. at 100 per cent. load factor and is already proposed to be developed fully. At present there is hardly any irrigation work in existence in the Ratnagiri District. The possibility of irrigation projects based on west flowing streams has been studied and it has been found that generally no reasonably economic storage sites for storing water are available at about R. L. 400 and above. The possible storages at lower levels submerge the very lands proposed to be irrigated and command a very small area under them with uneconomic lengths of canals. The Ratnagiri District has a predominantly lateretic formation and as such it is doubtful whether the storages constructed in this area would at all hold water. Studies have since been carried out for harnessing the waters of the west flowing streams in the commands of the five southernmost multi-purpose projects based on westward diversion of Krishna waters. The sub-joined Table No. 2.4 shows the possible sites, the extent of irrigation possible from them and the rough cost per acre irrigated from these sources.

TABLE No. 2.4

Name of Multi-purpose project	Alternative source of west flowing stream	Based on west flowing stream		Multi-purpose scheme					
		Annual irrigation in T. acres possible	Rough cost per acre of irrigated cropped area in Rs.	Annual irrigation proposed in T. acres	Rough cost per acre of irrigated cropped area in Rs.				
1	2	3	4	5	6				
1. Hiranyakeshi ..	Karli near Talamba	54.2	4,040	140.0	250				
2. Vedganga ..	Peedhaval near Avlegaon.	21.4	10,200	88.0	832				
3. Kumbhi ..	Shuk near Karul .. Aruna near Bhom Jamda near Kolamb	49.5	4,750	160.8	930				
4. Kasari ..	Kajavi near Bavda Machkandi near Bankharwadi.					26.6	5,120	207.0	532
5. Kadvi ..	No scheme possible									61.0	390

NOTE.—T. acres = Thousand acres.

It will be observed from the details given above that the cost per acre of irrigated cropped area for use of west flowing waters is prohibitive rendering the project economically infeasible. The fact that although three Five-Year Plans are almost over and it has not been possible to provide a single irrigation project in this district, is also indicative of the lack of economically feasible irrigation projects based on west-flowing streams.

Benefits from use of 152 T.M.C. of Krishna waters in western ghats for Irrigation in Andhra Pradesh and power generation along the course of the river

2.5. The irrigation demands of the Sangameshwaram Canals or the Nagarjunsagar Stage II (excluding the irrigation proposed under the Sri Sailam Project) exceed the net availability from the 152 T.M.C. of waters received in western ghats proposed to be diverted to the west for power generation in Maharashtra after undergoing losses *en route* to Sri Sailam and Nagarjunsagar. A reference to column 2 of Table No. 2.1 (pages 4&5) will show that the aim of most of the proposed development of irrigation in Andhra Pradesh is the conversion of rain-fed cultivation of cereals such as Bajra or Jowar to irrigated paddy. At present hardly any use of underground waters is made for irrigation in the area proposed to be irrigated under the projects listed in column 1 of the table. The present average yield of cereals like Jowar per acre in this area, under rain-fed conditions, varies from 440 lb. in Guntur to 767 lb. in West Godavari district (Season and Crop Report of Andhra Pradesh for 1958-59). An average produce of 600 lb. per acre can therefore be assumed as the present production. The agricultural experts state (*see* Annexure 1.2) that with a normal Kharif rainfall of more than 20" the yields of Kharif Jowar can easily go up to over 1,200 lb. per acre by mere practising of better agronomic practices. In Maharashtra where such adequate assured Kharif rains of over 20" are received an average yield of over 1,200 lb. per acre has been obtained by leading agriculturists under rain-fed conditions. The areas commanded by all these projects in Andhra have an assured Kharif rainfall of 20" and above. If underground waters (which are invariably available in the Kharif and Rabi seasons in almost all irrigation wells) are used to give one or two waterings at the appropriate time the average yield per acre of cereals like Jowar so irrigated should normally go up to 1,600 lb. If, therefore, rain-fed cultivation of cereals like Jowar is converted to cultivation of irrigated rice, the Nation stands to lose a potential production of 1,600 lb. per acre of foodgrains with almost equal quantity of fodder and would hope to get in return about 1,005 lb. of clean rice per acre (which is the average yield of clean rice per acre (predominantly irrigated) in Andhra Pradesh *vide* Table No. 2.2 (page 5) with a small quantity of poor fodder-paddy straw. In other words in spite of using a very large quantum of water at a considerable cost, the Nation would stand to produce less of foodgrains, which are already in short supply. The only difference such irrigated agriculture, in such tracts, would make is to reduce the import of rice. It is, therefore, obvious that with the point of view of increased foodgrain production and reduction of import of foodgrains, conversion of rain-fed cultivation of Jowar and similar other cereals to irrigated rice as proposed in projects of Andhra Pradesh would not help the Nation. Since the principle aim of use of waters in the main valley is the production of foodgrains, only such power generation can be considered as can be done without any appreciable loss of water. Although provision of storages in western ghats for hydro-power generation along the course of the river would add to the power potential it involves very heavy loss of water by way of heavy transit and other losses along the course of the river. Accordingly the power which one could generate by providing storages in the western ghats and *en route* up to Sri Sailam or Nagarjunsagar will have to be foregone. The most appropriate course would, therefore, be to provide a storage either at Sri Sailam or at Nagarjunsagar itself for use of such of the waters from the 152 T.M.C. proposed for westward diversion as would reach Sri Sailam

or Nagarjunsagar after undergoing transit losses from the ghats to Sri Sailam or Nagarjunsagar. Since 90 per cent. of the flow is received in the monsoon period extending over only four months these waters would be received at Sri Sailam/ Nagarjunsagar in the monsoon period only. Assuming the transit losses from western ghats to Sri Sailam to be of the order of say 10 per cent. (The Krishna Godavari Commission has estimated the transit losses from source to Vijayawada at 20 per cent.) the quantum of water reaching Sri Sailam by non-use of 152 T.M.C. of waters received in the western ghats in Maharashtra would be of the order of say $152 - 15 = 137$ T.M.C. The estimated annual reservoir losses at the Sri Sailam reservoir account for about 33 T.M.C. The net quantity available at canal heads on Nagarjunsagar canals would, therefore, be $137 - 33 = 104$ T.M.C. Irrigation under the Nagarjunsagar Canal Stage I is already proposed to be developed fully by the two canals as provided in Nagarjunsagar Stage I project. The irrigation in Stage II of the project starts beyond mile 127 of the Nagarjunsagar Right Canal. The Nagarjunsagar Right Canal being an unlined canal, the transit losses in a length of 127 miles may be safely considered to be of the order of 33 per cent. This virtually means that the quantum of water which would be available at the virtual canal head of the command of the Nagarjunsagar Stage II in mile 127 of Nagarjunsagar Right Canal would be of the order of only two-thirds of 104 T.M.C., *i.e.*, say 70 T.M.C. In other words, the use of 152 T.M.C. of Krishna waters received in western ghats along the course of the river would be capable of generating power at the Sri Sailam reservoir by letting down 104 T.M.C. of waters annually with a head of 320 feet generating 70.4 MWs. of power at 100 per cent. load factor and delivering 70 T.M.C. of Krishna waters for irrigation on the Nagarjunsagar Right Canal in Stage II of the project. Alternatively, if Sri Sailam storage is dropped, no power could be generated but instead 137 T.M.C. would become available at Nagarjunsagar delivering 92 T.M.C. at the commencement of the command of Nagarjunsagar Project Stage II. Table No. 2.5 below gives the benefits in terms of extra production of foodcrops, clean rice and power, both under present conditions and under improved conditions of rain-fed agriculture, which could be had as a result of use of Krishna waters in Andhra Pradesh for irrigation on the Nagarjunsagar Right Canal by the two alternative uses possible. As the releases from Sri Sailam will be controlled releases, two crops of rice are considered treating Nagarjunsagar storage as a balancing reservoir and the extra reservoir losses at Nagarjunsagar are neglected.

TABLE No. 2.5

(For full details please see Annexure 1.4)

(The average yield per acre of clean rice in Andhra Pradesh is assumed as 1,200 lb. instead of 1,005 lb. given by Andhra Pradesh *vide* Table 2.2, page 5).

	<i>Alternative No. 1</i>	<i>Alternative No. 2</i>
(a) Net increase in production of foodgrains in thousand tons—		
(i) under present conditions of rain-fed agriculture.	119.5	145.5
(ii) under improved conditions of rain-fed agriculture.	40.0	<i>Nil.</i>
(b) Net increase in production of clean rice in thousand tons.	199.0	291.0
(c) Power in MWs. at 100 per cent. load factor	.. 70.4	<i>Nil</i>

ALTERNATIVE No. 1 —

Generation of hydro power at Sri Sailam by use of 104 T.M.C. annually and use of 70 T.M.C. delivered in mile 127 of Nagarjunsagar Right Canal.

ALTERNATIVE No. 2—

No Sri Sailam Storage and use of entire 137 T.M.C. at Nagarjunsagar lake, i.e. 92 T.M.C. in mile 127 of Nagarjunsagar Right Canal for irrigation on Nagarjunsagar Right Canal beyond mile 127 for Abi rice.

If instead of using the waters ex-Nagarjunsagar, they were proposed to be utilised for irrigation on the Sangameshwaram Canals no power benefits could be had and the actual water delivered at canal head ex-Somasila and ex-Vempenta together would be less than that obtainable at the beginning of the Nagarjunsagar Stage II i.e. mile 127 of Nagarjunsagar Right Canal due to excessive transit loss through long natural streams, etc. The additional foodgrain production in this case would naturally be less than that obtained by use on the Nagarjunsagar Right Canal and hence is not considered and tabulated in this study.

Can almost equal quantum of power be generated along the course of the Krishna river in Andhra and Mysore by use of waters proposed to be diverted to the west for generation of power and irrigation in Maharashtra ?

2.6. In considering benefits from use of Krishna waters in Andhra Pradesh the power generation aspect was disregarded. There is however a misleading conception in circulation that whether you develop hydro power at a number of places along the course of Krishna or in a single drop by diversion of waters towards the west the total fall available on both side being almost the same apart from generating almost equal quantum of power along the course of the river the tail race waters from the last power house could be used for irrigation of paddy in Andhra Pradesh. As this argument catches the imagination of a common man very readily it is worthwhile examining it specifically in respect of Krishna waters which are capable of being dropped to the west in a single drop. According to those who put forward this argument there are six suitable sites for the development of hydro-electric power along the course of the river in addition to the sites at the foot of the dams in the western ghats as detailed in Table No. 2.6 together with the Nagarjunsagar and the Pulichintala sites. The Bidri site finds place in the hydro power survey made by the Central Water and Power Commission which strangely enough omits to discover and mention all the westward diversion schemes in Maharashtra with a power potential of about a million KWs. at 60 per cent. load factor. The Mysore State has not proposed any power project at Bidri as the site submerges a vast fertile area under the command of the Ghataprabha Project. There is, therefore, no feasible "Bidri Scheme". While dealing with the possibility of diversion of surplus waters of Godavari to Krishna the Krishna Godavari Commission have stated that there are surplus waters in Godavari which can be economically transferred to Krishna by the proposed Polavaram Vijayawada link. After construction of this link the entire irrigation on Krishna delta system and the proposed new Krishna West Canal can be taken over by Godavari waters and *there would then be absolutely no need to drop any Krishna waters below the Nagarjunsagar dam. Any waters dropped below Nagarjunsagar would therefore virtually*

go waste into the Bay of Bengal. The head or fall and the amount of water available are the two factors which determine the hydro power potential. If 152 T.M.C. of Krishna waters were stored in western ghats and were proposed to be used for generation of power along the course of the river the actual amount of water available at each site of generation would be as indicated in Table No. 2.6 below :—

TABLE No. 2.6

Name of site	Average fall in feet utilised for generation of power	Annual loss in T. M. C.		Net water available in T. M. C.	Power potential in MWs. at 100% L. F.	Remarks
		in transit	at reservoir			
1	2	3	4	5	6	7
1. Foot of dams in ghats.	85	..	19.0	133	27.2	
2. Bidri ..	<i>Nil.</i>	..	N.A.			Not feasible
3. Almatti ..	75	7.0	10*	126	20.0	
4. Narayanapur ..	300	..	14.0*	126	80.0	
5. Sri Sailam ..	320	5.0	33.0	88	59.5	
	780	12.0	76.0		186.7	

*As these reservoirs will be necessary for the Upper Krishna Irrigation Project these losses are ignored.

Besides this fall of 780 feet it may be possible to obtain a further fall between the tail race of Narayanapur and Sri Sailam but such lift dams would mean a further submergence of about 1.2 lakhs acres as a minimum resulting in additional reservoir losses below Narayanapur of about 27 T.M.C. reducing the flow available at Sri Sailam to only 61 T.M.C. The additional power at the intermediate stations may be considered to be of the order of about say 58 MWs. The power at Sri Sailam would, however, get reduced from 59.5 MWs. to only 41 MWs. The total power generated would then be of the order of 226 MWs. with only 61 T.M.C. of waters left for irrigation against a westward diversion power potential of 439 MWs. and actual water use for irrigation of 106 T.M.C. What is said in the case of the possible lift dams would equally apply to a dam at Bidri above Almatti. It is thus obvious that the argument that almost equal quantum of power could be generated from the same Krishna waters by diversion to the west or by dropping them in a series of drops along the course of the river is not borne out by facts and may, therefore, be said to be imaginary than real.

Benefits from use of 152 T.M.C. of Krishna waters in western ghats irrigation in Mysore State

2.7. In Table No. 2.1 (pages 4 & 5) three schemes of Mysore are listed in which the waters available in western ghats in Maharashtra could be used. In this list Upper Krishna Project Stage I has not been shown as the project already stands included in the Third Five-Year Plan for all practical purposes. The Stored water needs of Upper Krishna Project Stage I are just met fully by the construction of the Narayanapur and the Almatti storages as indicated by the Mysore State in the details of Stage I of the Project furnished to the Krishna-Godavari Commission. In the Inter-State discussion with the Krishna-Godavari Commission it was stated that it would not be possible to increase the storage at Narayanapur since any further raising of F. R. L. of that storage constituted submergence of a very large area including the proposed dam site at Almatti. It was further stated that it was equally impossible to raise the storage at Almatti since any further raising of F. R. L. beyond that proposed by the Mysore State in the Upper Krishna Project Stage I, would lead to submergence of the important town of Bagalkot. It is, therefore, obvious that the storages at Almatti and Narayanapur cannot be raised any further. Although no details of any storage for the Bijapur Lift Irrigation Scheme and the Upper Krishna Project Stage II are given a mention of a possible storage on Krishna at Bidri is made. Bidri is located above the confluence of Ghataprabha with Krishna. Accordingly, of the 152 T.M.C. proposed for use by westward diversion for generation of power in Maharashtra, only 123 T.M.C. can physically reach the river above Bidri. However, all the water potential, *i.e.* 152 T.M.C. is considered available for use on Upper Krishna Project Stage II. These 123 T.M.C. of waters received in the western ghats would get reduced to say 118 T.M.C. by the time they reach Bidri. A live storage of about 86 T.M.C. would be needed at Bidri for growing of crops planned under the Upper Krishna Project Stage II. The estimated annual reservoir losses at the Bidri storage would be of the order of about 25.6 T.M.C. and the submergence would be of the order of 122 thousand acres of rich cultivated lands on the banks of the river including a large area under the command of the Ghataprabha Project. The net waters available from Krishna at the Bidri site would thus be of the order of $118 - 25.6 = 92.4$ T.M.C. The balance flow of 29 T.M.C. of Hiranyakeshi at Ajra would get reduced say by 5 per cent. to 27.5 T.M.C. by the time it reaches Almatti. The total flow available for use ex-Almatti may therefore be estimated at about $92.4 + 27.5 = 119.9$ T.M.C. The reservoir losses at Almatti and Narayanapur would increase if the Bidri storage is depleted first or in the alternative the reservoir losses at Bidri will go up if the lower storages are depleted first. The extra loss may be estimated at about 3.5 T.M.C. The balance flow available at canal head would thus be of the order of say 120 T.M.C. Since the existing Almatti Left Bank Canal (Lined) is further proposed to be extended for an additional use of $76.3 - 32.5 = 43.8$ T.M.C. the extra canal losses in a length of 141 miles at 12 per cent. may be estimated at 5.3 T.M.C. The net flow available for irrigation in Upper Krishna Project Stage II would, therefore, be of the order of $119.9 - 5.3 = 114.6$ T.M.C. which is almost equal to the additional use of 114.98 T.M.C. proposed for diversion under the Upper Krishna Project Stage II. If the entire supply of 152 T.M.C. of Krishna waters received in Western Ghats in Maharashtra were used for irrigation on Upper Krishna Project-Stage II

as discussed above the benefits which would accrue to the Nation in the matter of availability of power and foodgrains are summarised in Table No. 2.7.

TABLE No. 2.7

(For full details please see Annexure 1.5)

(1) Addition to the Nation's foodgrains	..	..	2,62,000 Tons
(2) Addition to the Nation's clean rice production	..	..	86,140 Tons
(3) Power in MWs.	..	..	Nil.
(4) Water supply to villages	..	..	Nil.

NOTE.—No deductions on account of loss of foodgrains production in area under submergence (1-2 lakhs acres) under the Bidri reservoir is made in arriving at these figures.

Summary of benefits from alternative uses of 152 T.M.C. of Krishna waters in the three riparian States

2.8. The benefits from the alternative uses of 152 T.M.C. of Krishna waters by westward diversion on multipurpose projects and those from uses for irrigation in the Krishna valley on Upper Krishna Project II in the Mysore State and on the Nagarjunsagar and Sangameshwaram Canals in Andhra were discussed in paragraphs 2.3 to 2.7. A comparative statement of benefits is tabulated in Table No. 2.8 below :—

TABLE No. 2.8

Table showing comparative benefits from alternative uses of 152 T.M.C. of Krishna waters received in Western Ghats in Maharashtra, Mysore and Andhra Pradesh

Name of State	Net increase in thousand tons		Power in MWs. at 100 per cent load factor	Remarks
	in food-grains	in clean rice		
1	2	3	4	5
Maharashtra (Table 2.3)	.. 412.8	390.2	445	In addition water supply to 129 villages.
Andhra (Table 2.5)				
<i>Alternative I</i>				
(i) under present conditions	.. 119.5	199.0	70.4	
(ii) under improved conditions	.. 40.0	199.0		
<i>Alternative II</i>				
(i) under present conditions	.. 145.5	291.0	Nil	
(ii) under improved conditions	.. Nil	291.0		
Mysore (Table 2.7)	.. 262.0	86.1	Nil	

It will be seen from these comparative figures that with all points of view of production the best use of the 152 T.M.C. of Krishna waters is indicated in Maharashtra. Therefore it goes without saying that, 152 T.M.C. of Krishna waters must be diverted to the west for irrigation and generation of hydro-power in Maharashtra in the interest of the Nation.

Economic Appraisal of alternative uses

2.9. A proper comparison of alternative uses of a given water resource can only be done by an economic appraisal by the benefit cost technique. The Gokhale Institute of Politics and Economics has been requested to take up this study and their findings are awaited. The appraisal done by the Institute for hydro-electric projects without any use of the tail race had shown that the use in Maharashtra was more paying than the use for irrigation in Mysore and Andhra Pradesh. Since the full use of tail race in fair weather for irrigation would add substantially to the benefits on projects in Maharashtra the picture of economic appraisal now sought for is bound to be much brighter for use of waters in Maharashtra than before.

APPENDIX

STATEMENT I

(See para. 1.2)

Maharashtra State

Tata-Central Railway—Koyna Service Area (Hydro)

Name of the Scheme	Power in MWs at 100 per cent L. F.	
(A) Project under operation—		
(1) Tata Hydrel	26·2	
(2) Andhra Valley	34·0	
(3) Tata Power (Mulshi dam)	90·0	
(4) Bhatghar	0·2	
(5) Radhanagari	1·5	
Total ..	151·9	or say 152·0
(B) Under Construction (II, III and IV Plan)—		
(1) Koyna Stage I, II, III and IV	449·6	
(2) Vaitarna Stage I and II	24·4	
(3) Bhatghar and Vir (8·0—0·2)	7·8	(Additional)
(4) Bhira Tailrace	9·0	
(5) Kasari Multipurpose	109·0	
(6) Tillari Nalla	16·7	
(7) Urmodi	1·5	
(8) Bhandardara-Randha	15·0	(Secondary power)
Total to end of IV Plan ..	633·0	633·0
(C) Future Works in V Plan—		
(1) Patharpunj	17·3	
(2) Gothana	12·3	
(3) Phonda	41·7	(Additional)
(4) Kadvi	25·5	
(5) Kumbhi	85·5	
(6) Vedganga	48·0	
(7) Ajra	106·0	
(8) Other minor low head Schemes	6·7	
Total ..	343·0	
Grand total (A)+(B)+(C)=1,128 Mws or say 1,130 MWs		

APPENDIX
STATEMENT II

(See para. 2.3)

Statement showing the water use proposed under new Eight multipurpose projects based on Westward diversion of waters from Krishna in Maharashtra

Serial No.	Name of the Scheme	Water use in T.M.C.		
		By Westward diversion in Konkan	In Krishna Valley	Total
1	2	3	4	5
1	KUMBHI	31.7	2.4	34.10
2	KADVI	12.9	0.9	13.80
3	KASARI	41.0	5.0	46.00
4	VEDGANGA	15.5	1.1	16.60
5	AJRA	29.3	Nil	29.30
6	PHONDA	15.5	....	15.50
7	GOTHANA	2.7	Nil	2.70
8	PATHARPUNJ	3.5	Nil	3.50
Total ..		152.1	9.4	161.50

APPENDIX
STATEMENT III
(See para. 2.3)

Statement showing the Agricultural Statistical Data in the command of the various multipurpose Projects based on westward diversion of waters from Krishna

Serial No.	Name of Project	Taluka	Gross area under command in acres	Culturable area under command in acres	Cultivated area under command in acres	Area under paddy in acres	Population	Remarks
1	2	3	4	5	6	7	8	9
1	Kadvi	.. Ratnagiri	.. 32,281	20,508	11,942	2,232	18,866	
		.. Sangameshwar	.. 25,313	17,612	7,448	1,774	12,718	
		Total	.. 57,594	38,120	19,390	4,006	31,584	
2	Kasari	.. Lanja	.. 84,245	59,593	33,218	6,525	52,338	
		.. Rajapur	.. 43,904	35,388	12,459	2,990	25,078	
		.. Ratnagiri	.. 62,197	31,853	18,370	4,557	37,382	
		Total	.. 1,90,346	1,26,834	64,047	14,072	1,14,798	
3	Kumbhi	.. Rajapur	.. 32,901	23,078	9,888	2,223	14,003	
		.. Deogad	.. 8,804	7,640	2,356	884	4,102	
		.. Kankavali	.. 21,004	12,212	3,625	1,370	9,800	
		.. Total for Ratnagiri District	.. 62,709	42,930	15,869	4,477	27,905	
		.. Gagan Bavada	.. 78,949	58,106	24,153	7,280	27,484	
		.. Total for Kolhapur District	.. 78,949	58,106	24,153	7,280	27,484	

STATEMENT III—contd.

Serial No.	Name of Project	Faluka	Gross area under command in acres.	Culturable area under command in acres	Cultivated area under command in acres	Area under paddy in acres.	Population	Remarks
1	2	3	4	5	6	7	8	9
4	Vedganga	Kankavali	17,371	24,066	10,618	24,008	18,767	
		Malvan	15,145	10,015	5,486	3,396	29,252	
		Kudal	44,417	23,361	11,879	9,923	25,902	
		Total	76,933	57,442	27,983	17,327	73,921	
5	Hiranyakeshi	Savantwadi	40,685	29,295	10,801	8,394	41,224	
		Vengurla	44,699	32,645	20,501	6,896	86,794	
		Kudal	35,219	20,696	12,236	10,214	33,043	
		Total	1,20,603	82,636	43,538	25,504	1,61,061	
		Grand Total for Ratnagiri District.	5,08,188	3,47,962	1,77,827	65,386	4,09,269	
		Grand Total for Kolhapur District.	78,949	58,106	24,153	7,280	27,184	
			5,87,137	4,06,068	2,01,980	72,666	2,36,753	

NOTE.—These figures have been obtained from village records.

APPENDIX

STATEMENT IV

(See para. 2.3—Table 2.3)

Table showing areas under different crops before and after Introduction of Irrigation under Eight Multipurpose Projects in Maharashtra based on Westward diversion of waters from Krishna

(All Areas are in Thousand Acres)

Serial No.	Name of Project	C. C. A.	Cropped area		Area under paddy crops			Area under other food crops		Area under non-food crops		Remarks.	
			Existing rainfed	After introduction of irrigation	Existing rainfed	After introduction of irrigation		Existing rainfed	After introduction of irrigation	Existing rainfed	After introduction of irrigation		
						1st crop short term	1st crop long term						2nd crop
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Kumbhi ..	101.1	47.1	160.1	11.76	25.0	52.5	38.8	35.25	44.5	77.0	Details. under columns 3, 4, 6, 10, and 12 are also given in Statement III.
2	Kadvi ..	38.1	19.40	61.0	4.00	9.0	20.0	14.0	15.40	18.0	....	27.7
3	Kasari ..	126.8	64.00	207.0	14.00	32.0	68.0	50.0	50.00	57.0	....	95.0
4	Vedganga ..	57.4	27.98	88.0	17.34	14.0	26.0	20.0	10.65	28.0	....	40.0
5	Ajra ..	82.6	43.54	140.0	25.50	24.0	50.0	37.0	18.04	29.0	....	74.0
6	Phonda ..	60.0	31.70	95.5	18.60	15.0	30.0	22.5	13.10	28.0	....	45.0
7	Gothana ..	8.2	4.27	12.3	2.50	2.0	4.0	3.8	1.77	2.5	....	6.0
8	Patharpunj ..	11.0	5.80	16.4	3.30	2.6	5.2	4.8	2.40	3.8	....	7.8
Total ..		485.1	243.70	781.0	97.00	123.6	255.7	190.9	146.61	211.8	Nil	373.0	

STATEMENT IV—contd.

(A) Average yield of clean rice per acre —	
(1) 1st crop short period paddy [1st (S)] rainfed	= 975 lbs.
(2) 1st crop short period paddy [1st (S)] irrigated	= 1130 lbs.
(3) 1st crop long period paddy [1st (L)] irrigated	= 1600 lbs.
(4) 2nd crop of paddy, irrigated.	= 2200 lbs.
(B) Yield per acre of Gram, Val, etc. (un-irrigated)	= 520 lbs.
Yield per acre of Gram, Val, etc. (irrigated)	= 600 lbs.

Production before introduction of irrigation :

$$\text{Clean rice } 97 \cdot 0 \times 975 + 2240 = 42 \cdot 1 \text{ Thousand tons.}$$

$$\text{Vari, Gram etc. } 146 \cdot 61 \times 520 + 2240 = 34 \cdot 0 \text{ Thousand tons.}$$

Production after introduction of irrigation :

Clean rice :

$$\text{1st crop (S) } 123 \cdot 6 \times 1130 + 2240 = 62 \cdot 3 \text{ Thousand tons.}$$

$$\text{1st crop (L) } 255 \cdot 7 \times 1600 + 2240 = 182 \cdot 5 \text{ Thousand tons.}$$

$$\text{2nd crop } 190 \cdot 9 \times 2200 + 2240 = 187 \cdot 5 \text{ Thousand tons.}$$

$$\text{Total} = 432 \cdot 3 \text{ Thousand tons.}$$

$$\text{Gram etc. } 211 \cdot 8 \times 600 + 2240 = 56 \cdot 6 \text{ thousand tons.}$$

$$\text{Net increase in food crops} = 432 \cdot 3 + 56 \cdot 6 - 42 \cdot 1 - 34 \cdot 0.$$

$$= 488 \cdot 9 - 76 \cdot 1 = 412 \cdot 8 \text{ Thousand Tons.}$$

$$\text{Net increase in production of clean rice } 432 \cdot 3 - 42 \cdot 1 = 390 \cdot 2 \text{ thousand tons.}$$

ANNEXURE 1.1

(See para. 1)

Statement showing figures regarding population (based on 1961 census) of the scarcity Talukas

Serial No.	District	Taluka	Population (according to 1961 census)
1	2	3	4
<i>Andhra Pradesh</i>			
1	Mehbubnagar	Gadwal	1,18,638
2	Nalgonda	Nalgonda	2,94,846
3	Anantpur	Madakaira	1,35,972
		Anantpur	2,20,888
		Kalyan Durg	1,41,276
		Total ..	9,11,620
<i>Mysore</i>			
1	Belgaum	Athani	2,27,040
2		Parasgad	1,50,783
3		Ram Durg	1,09,311
4		Raibag	1,15,679
5		Gokak	2,14,191
6	Dharwar	Mundargi	67,930
7	Gulbarga	Jewargi	1,11,212
8	Bijapur	Bagewadi	1,64,128
9		Bijapur	2,50,907
10		Indi	1,76,090
11		Muddebihal	1,34,641
12		Sindgi	1,62,810
13	Raichur	Lingsugur	1,35,253
14		Kushtagi	1,05,947
15	Chitradurga	Chitradurga	1,71,225
16		Hiriyur	1,31,384
17		Chellakere	1,52,249
18		Molakalmur	61,478
		Total ..	26,42,258

ANNEXURE, 1.1—contd.

Serial No.	District	Taluka	Population (according to 1961 census)
1	2	3	4
<i>Maharashtra</i>			
1	Satara	Man	99,448
2		Khataav	1,55,715
		Khandala	63,156
		Phaltan	1,40,014
	Sangli	Jath	1,38,861
6	Sholapur	Pandharpur	1,53,978
7		Barsi	2,20,876
8		Karmala	1,28,688
9		Madha	1,56,081
10		Mangalwedha	89,071
11		North Sholapur	4,05,735
12		Sangola	1,28,036
13		South Sholapur	1,12,525
14		Akalkot	1,74,680
15		Mohol	1,22,963
16	Poona	Ambegaon	1,18,844
17		Baramati	1,73,883
18		Haveli	2,48,618
19		Indapur	1,53,814
20		Purandar	1,26,532
21		Sirur	1,32,381
22	Ahmednagar	Ahmednagar	2,44,717
23		Parner	1,30,969
24		Karjat	98,883
25		Shrigonda	1,17,719
26		Jamkhed	73,036
27	Osmanabad	Parenda	88,266
28	Bhir	Ashti	1,07,739
29		Patoda	90,835
Total			41,96,063

ANNEXURE 1.2

(See para 2.3)

Dr. V. G. Vaidya,
Additional Director of Agriculture.

D. O. No. IRG 1264/15655/1/121,
DEPARTMENT OF AGRICULTURE, M. S.,
Poona 1, 1st April 1964.

My dear Shri Apte,

Reference your D. O. letter dated 20th March 1964.

I have to say that the average yield of rice in Ratnagiri district is 975 lb. per acre (average of 5 years—1955-56 to 1959-60). This average yield is from good, medium and marginal soils. Though the district lies in high rainfall zone of 100 to 150 inches, the monsoon is characterised by uneven distribution and uncertainty, and cultivators feel hesitant to put in more expensive inputs like, fertilizers, intensive measures of plant protection etc. When irrigation is assured, this risk will go away and intensive cultivation methods can be followed as a rule in all the command areas. The average yield will then certainly go up to 1600 lb. rice or 2400 lb. paddy in the command areas. This is by no means a high estimate as some cultivators whose holdings are favourably situated, do harvest high yields of 2000 lb. rice or 3000 lb. paddy or even more.

As regards second crop of rice, it is entirely dependent upon irrigation and as such is grown under controlled conditions. The weather being clear, the crop enjoys better sunshine and physiological processes go on at a favourable rate. The crop is generally free from diseases and cultivators apply fertilizers etc. more confidently. The average yield of second crop of rice should, therefore, be 2200 lb. clean rice or 3300 lb. paddy. The figures of Kharif and second of rice communicated as 1600 lb. and 2200 lb. of clean rice (in Chapter 111) are therefore confirmed.

The average yield of kharif and rabi jowar in the districts of Poona Division is 802 lb. and 351 lb. per acre respectively (average of 5 years—1955-56 to 1959-60). The potential production of kharif jowar with assured kharif rainfall of 20 inches or more with proper agronomic practices can certainly be assumed at 1200 lb. to 1600 lb. per acre. The yield of unirrigated rabi, jowar is low because of less moisture content in soil. If irrigation becomes available it can also give an yield of 1200 lb. per acre or more.

I hope this will meet all your queries.

With best wishes,

Yours sincerely,

(Signed) V. G. VAIDYA.

Shri B. S. Apte,
Officer on Special Duty,
Irrigation and Power Department,
Sachivalaya, Bombay 32.

ANNEXURE 1.3

(See para. 2.3)

Inspection note by Chief Engineer (IP) I and Jt. Secy., I. & P. Department (March 1964)

Scope for irrigation in Ratnagiri District from the proposed westward diversion of the flows of certain tributaries of the Krishna

1. There is a proposal for the diversion of the waters of certain tributaries of the Krishna river towards West for generation of power and utilising the tail waters for irrigation in the Konkan. These tributaries, commencing from the south and going north, are, Hiranyakeshi, Vedaganga, Bhogavati, Kumbhi, Kasari, Kadvi and two minor tributaries of Warna.
2. There is a substantial drop available to generate substantial blocks of dependable and cheap power and topographical studies indicated the feasibility of using all the tail race discharges, except during the monsoon months, for irrigation in the Ratnagiri District.
3. Topographical maps of the Ratnagiri District show that a large part of the district is hilly with some fairly level plateaux and strips of level lands at low levels adjacent to the streams. Officers of the Water Resources Investigation Circle who had studied the irrigation possibilities in the districts, reported after personal inspection that the hill slopes have been terraced extensively and hence irrigating these terraced fields would be no problem, provided the canals are aligned along sufficiently high levels.
4. As the feasibility of the westward diversion projects depends to a considerable extent on whether irrigation from the tail waters would be a practical and economically sound proposition, I decided to inspect these areas personally. Accordingly I motored down to Savantwadi and from Savantwadi I travelled through the district along Mangaon, Kudal, Katta, Kasal, Phonda, Tarsada, Lanja, Rajapur and Pali. Dr. Vaidya, Additional Director of Agriculture and Shri Gokhale, Superintending Agricultural Officer, were kind enough to accompany me on this tour and give me their independent opinion.
5. The inspection revealed that proposal of the Water Resources Investigation Circle is perfectly feasible. The hill slopes are, indeed, terraced almost everywhere and the effort and expenditure on land development prior to the introduction of irrigation would be relatively modest. The earlier proposals of the Department for projects involving westward diversions aimed at maximum generation of power and consequently the tail race levels were kept as low as possible. At these levels the areas of the lands commanded were small. It is now proposed to locate the power houses at higher levels so that tail races would emerge at levels as high as at R. L. 550. Though this will result in some reduction in power, the loss will be far more offset by the substantial irrigation benefits. The cost of power generation would still remain sufficiently low as to be attractive while the cost of canals will vary according to topography but always within economic limits.
6. Another important point that had to be verified was whether sufficient soil depths were available to permit irrigated cultivation. This point was also cleared beyond doubt. In the extensive areas that were visited a generous soil cover was noticed invariably.
7. As regards the irrigated crop pattern, it was clear that two crops of paddy could be taken successively in the same plots. At present paddy cultivation is largely confined to fields at lower where water accumulates while inferior millets are grown at higher levels because at these levels water drains off quickly. If irrigated water becomes available the lands at higher levels could also grow paddy replacing the inferior millets. There are a few perennial streams where a second crop of rice is grown. Elsewhere, for want of water a second crop, is impossible. With irrigation facility there is no reason why a second crop of rice could not be grown. The second crop of rice is a heavy yielder and according to Dr. Vaidya, minimum average yields of 2000 lbs. and over of clean rice could be expected. Dr. Vaidya believes that with assured water supply the yields of even the first (monsoon) rice crops will improve materially. Dr. Vaidya thinks that green

ANNEXURE 1.3—*contd.*

manure crops should be taken in the hot weather period after the second crop of rice is harvested and ploughed in before the monsoon paddy is transplanted. This will help in maintaining the fertility of the soils.

8. Konkan has tropical, humid climate and crops which grow elsewhere in such climate could grow in Konkan too. Thus, there is a good scope for raising sugarcane, coconut, aricanut, pepper, banana, pineapple, fruit trees like mango and chikoo etc. The crops will have to be grown in separate blocks, depending upon their water requirements. As water let down from the canal on the uppermost terrace will flow down to the lowest levels along successive terraces, crops having the same water requirements and growing seasons will have to be sown on one block of terraces from top to bottom.

9. A part from terraced lands on hill slopes there are extensive plateaux at low levels which can be commanded by canals. The most prominent plateaux are those near Phonda and Lanja. The total area which could be irrigated from the westward diversion schemes, including the doubled cropped area is expected to be of the order of 3 1/2 lakhs acres.

10. The Kasari Project is an attractive project from the point of view of power generation as well as irrigation which would be cheap and extensive (over one lakh acres). Investigations have been taken up for this project and I have already inspected the dam site near Bajar-Bhogao and issued an inspection note separately. I hope to be able to submit the project report by end of August 1964.

(Signed) G. N. PANDIT,
Chief Engineer (IP) I,
Irrigation and Power Department.

2nd April 1964.

ANNEXURE 1A

(See para. 2.5—Table 2.5)

Alternative No. 1—

(a) Power aspect—

- (i) Water leaving turbine of Srisaïlam power house 104 T.M.C.
or 3,300 Cusecs.
- (ii) Average head available at Srisaïlam storage 320 feet.
- (iii) Therefore power generated at 100 per cent L. F. will be

$$\frac{3300 \times 320}{15} = 70.4 \text{ M.Ws.}$$

(b) Irrigation aspect—

- (i) Water available at Nagarjunsagar reservoir 104 T.M.C.
- (ii) Transit losses in unlined Nagarjunsagar Right Canal between M/0 to 127 at 33 per cent of water released at head regulator. 34.0 T.M.C.
- (iii) Water available for irrigation beyond M/127 of Nagarjunsagar Right Canal. 70.0 T.M.C.

Since this supply will be received as a regulated supply from the tail race of Srisaïlam turbines two crops of paddy will have to be grown namely, Abi and Tabi Paddy, treating Nagarjunsagar Storage as a balancing reservoir.

Assuming 50 per cent of the water thus available as used for irrigation in 'Abi' Paddy and the balance 50 per cent for irrigating 'Tabi' Paddy—

Water use in Abi.....	35 T.M.C.
Water use in Tabi	35 T.M.C.

hence possible area under irrigated Paddy with a delta of 3.9 feet for Abi Paddy and 4.8 feet for 2nd crop (Tabi) would be :—

Abi Paddy ..	=	207.0	Thousand acres.
Tabi Paddy ..	=	168.0	Thousand acres.
Total ..		<u>375.0</u>	<u>Thousand acres.</u>

II. Production—

(a) Andhra Pradesh has given a figure of 1005 lb. of clean rice production per acre of irrigated paddy vide table 3.2. However, a production of 1200 lb. of clean rice per acre may be assumed.

Thousand Tons.

- (i) Production of clean rice from Abi and Tabi crops would therefore be

$$\frac{1200 \times 375}{2240} = 201.1$$

ANNEXURE 1.4—*contd.*

	Thousand Tons
(ii) Deduct loss of production of clean rice from the existing irrigated acres which are coming under sub-mergence of Sri Sailam reservoir, i.e., four thousand acres ..	$\frac{1200 \times 4}{2240} = 2.1$
(iii) Net additional production of clean rice	199.0
(a) Loss of potential production of cereals in Abi period under present rainfed conditions from 297 thousand acres (207 thousand acres converted to Abi paddy under Nagarjunsagar Right Bank Canal and 90 thousand acres submerged under Sri Sailam reservoir) at 600 lb. per acre ..	79.5
(b) Loss of potential production under improved agricultural practices under rainfed conditions at 1200 lb. per acre. ..	159.0
∴ Net additional foodgrain production—	
(a) Under present rainfed conditions	= 199 — 79.5 = 119.5
(b) Under improved agricultural practices	= 199 — 159 = 40.0

Alternative No. 2—

(a) *Power aspect—*

Without Sri Sailam storage there will be no power generation.

(b) *Irrigation aspect—*

(i) Water available at Nagarjunsagar reservoir T.M.C. 137.0

(ii) Transit losses in unlined Nagarjunsagar Right Canal between head to mile at 33 per cent. of water released at head regulator 45.0

(iii) Net water available for irrigation beyond mile 127 of Nagarjunsagar Right Canal. 92.0

Since the entire water potential available beyond mile 127 of Nagarjunsagar Right Canal is considered for irrigating only Abi paddy, possible area under irrigated Abi paddy with delta of 3.9 feet at head (i.e., in mile 127) will be 543 thousand acres.

	Thousand Tons
Production of clean rice of irrigated Abi paddy at 1200 lb. per acre	$\frac{1200 \times 543}{2240} = 291.0$
(a) Loss of potential production of cereals in Abi period under present rainfed conditions at 600 lb. per acre ..	$\frac{600 \times 543}{2240} = 145.5$
(b) Loss of potential production under improved agricultural practices under rainfed conditions at 1200 lb. per acre ..	$\frac{1200 \times 543}{2240} = 291.0$
∴ Net additional foodgrain production—	
(a) Under present rainfed conditions	= 291.0 — 145.5 = 145.5
(b) Under improved agricultural practices and rainfed conditions	= 291.0 — 291.0 = NIL

ANNEXURE 1.5

(Para. 2.7 Table 2.7)

Benefits from alternative use of 152 T. M. C. of Krishna waters on Upper Krishna Project Stage I in Mysore

The statistical data in respect of the existing cropping pattern obtained in the commanded areas in the Upper Krishna Project Stage II were worked out from available Season and Crop Reports of the defunct Bombay and the Hyderabad States. As a result it was observed that the existing cropping pattern indicated by the Mysore State in the details of the project submitted to the Krishna-Godavari Commission was not correct. In this study, however, the figures given by the State Government to the Krishna-Godavari Commission are treated as valid.

For the purposes of assessment of the existing yield per acre of the principle foodcrops in the command of the project, statistical data of yields as given in the Season and Crop Report have been considered. The average yields per acre in lbs. of the various rainfed crops obtained in the concerned three districts are tabulated below. Groundnut is considered as a foodcrop.

Name of District	Name of Principal Foodcrop		
	Kharif Jowar	Rabi Jowar	Kharif Groundnut
1	2	3	4
1. Bijapur	230	280	880
2. Gulberga	300	300	430
3. Raichur	280	280	500

The yields of irrigated paddy and irrigated wheat for these three districts given in the Season and Crop Report vary from 336 lbs. per acre to 670 lbs. per acre and 150 lbs. per acre to 240 lbs. per acre respectively. In assessing the produce of these irrigated crops, these low figures given in the Season and Crop Report are ignored. Instead the yields under irrigated conditions expected in Maharashtra in similar soils climate regions in Maharashtra State have been adopted.

They are :—

- (i) Irrigated clean rice 1,600 lbs. per acre.
- (ii) Irrigated wheat 1,200 lbs. per acre.
- (iii) Irrigated Kharif and Rabi Jowar 1,600 lbs. per acre.

The cropping Pattern under irrigated conditions aims at conversion of—

From	To	Percentage
(i) Rainfed Jowar	Irrigated Jowar	25
(ii) Rainfed Groundnut	Irrigated Paddy	18
(iii) Rainfed Groundnut	Non-foodcrops	12
(iv) Rainfed Rabi Jowar	Irrigated Rabi Jowar	20
(v) Rainfed Rabi Cotton	Irrigated Rabi Wheat	10
(vi) Rainfed Cotton	Irrigated Rabi Jowar	5
(vii) Rainfed Cotton	Irrigated Rabi Cotton	10

ANNEXURE 1.5—contd.

The following acreage is proposed to be brought under irrigated foodcrops under the Upper Krishna Project Stage II :—

(All figures are in thousand acres)

Name of district	Acreage under foodcrop				Total
	Kharif	Rabi	Rabi	Paddy	
	Jowar	Jowar	Wheat		
1	2	3	4	5	6
1. Bijapur	25·0	25·0	10·0	18·0	78·0
2. Gulberga	41·8	41·8	16·7	30·0	130·3
3. Raichur	100·0	100·0	40·0	72·6	312·6
Grand Total ..	166·8	166·8	66·7	120·6	520·9

The extra yield per acre in the three districts as a result of conversion of rainfed crop to irrigated foodcrop is tabulated below against each crop in the three districts :—

Irrigated Crop	Acreage thousand	Yield per acre in lbs.	Production in thousand tons
1. Clean rice	120·6	1,600	86·14
2. Kharif Jowar	166·8	1,600	238·29
3. Rabi Jowar	166·8		
4. Rabi Wheat	66·7	1,200	35·71
Total foodgrain ..			360·14

Deduct existing foodgrain production under rainfed conditions—

(a) *Bijapur district*—

(i) Kharif Jowar	25·0	230	2·56
(ii) Groundnut	35·0	880	13·80
(iii) Rabi Jowar	25·0	280	3·12
Total ..			19·48

(b) *Gulberga district*—

(i) Kharif Jowar	41·8	300	5·60
(ii) Groundnut	58·5	430	11·23
(iii) Rabi Jowar	41·8	300	5·60
Total ..			22·43

(c) *Raichur district*—

(i) Kharif Jowar	100·0	280	12·51
(ii) Groundnut	140·0	500	31·21
(iii) Rabi Jowar	100·0	280	12·51
Total ..			56·23

Grand total of production under rainfed conditions (a)+(b)+(c) 98·14

Increased foodgrain production (i.e. 360·14—98·14) = 262·00 Thousand Tons