

REPORT  
OF  
THE KRISHNA GODAVARI COMMISSION

99



X5 (D26) 1.2 RK. NGE  
K2  
87582



JULY 1962

For Official Use Only

**MINISTRY OF IRRIGATION AND POWER**



**REPORT**  
**OF**  
**THE KRISHNA GODAVARI COMMISSION**

**JULY 1962**

**PRINTED IN INDIA BY THE GENERAL MANAGER,  
GOVERNMENT OF INDIA PRESS, NEW DELHI, 1962**

No. 1-61-KGC.

Government of India  
MINISTRY OF IRRIGATION AND POWER.

New Delhi, the 21st August, 1962.

To

The Secretary to the Government of India,  
Ministry of Irrigation and Power,  
New Delhi.

Sir,

We have pleasure in forwarding the report of the Commission appointed by the Government of India *vide* Resolution No. F. (17)/61-Adm. II dated the 1st May, 1961.

2. In dealing with our terms of reference, we felt that it was necessary also to study some other important aspects connected with the water resources development of the Krishna and Godavari basins. The report includes the result of this study.

3. The report is accompanied by 37 Plates and 18 Annexures.

4. The report is unanimous.

Yours faithfully,

N. D. Gulhati  
D. D. Jaini  
R. C. Hoon

## THE KRISHNA GODAVARI COMMISSION

1st May 1961 to 31st July 1962

<b>Chairman</b>	.	.	.	.	.	.	.	.	.	N. D. Gulhati
<b>Members</b>	.	.	.	.	.	.	.	.	.	D. D. Jaini
										R. C. Hoon
<b>Secretary</b>	.	.	.	.	.	.	.	.	.	Bhim Sen

### Officers of the Commission:

<b>A. N. Malhotra (Consultant)</b>	.	.	.	.	.	.	.	.	.	(7th July to 6th October 1961)
<b>B. S. Johri (Superintending Engineer)</b>	.	.	.	.	.	.	.	.	.	(4th August to 30th December 1961)
<b>U. C. Arora (Executive Engineer)</b>	.	.	.	.	.	.	.	.	.	(3rd July to 30th December 1961)
<b>K. S. S. Murthy (Deputy Director)</b>	.	.	.	.	.	.	.	.	.	(13th September 1961 to 31st July 1962)
<b>S. R. Bhala (Executive Engineer)</b>	.	.	.	.	.	.	.	.	.	(15th July 1961 to 31st July 1962)
<b>A. K. Sengupta (Assistant Director)</b>	.	.	.	.	.	.	.	.	.	(15th May 1961 to 31st July 1962)
<b>A. S. Ramamoorthy (Assistant Director)</b>	.	.	.	.	.	.	.	.	.	(10th May 1961 to 31st July 1962)
<b>K. D. Thite (Extra Assistant Director)</b>	.	.	.	.	.	.	.	.	.	(15th July 1961 to 31st July 1962)
<b>T. S. Sohal (Senior Draftsman)</b>	.	.	.	.	.	.	.	.	.	(12th May 1961 to 31st July 1962)

## CONTENTS

	<i>Page</i>
Definitions and abbreviations . . . . .	(vii)
Units . . . . .	(xi)
<b>CHAPTER I—INTRODUCTORY</b>	
Appointment and terms of reference; collection of data and procedure; other sources of data; acknowledgements; accuracy of data; basin-wide survey . . . . .	1
<b>CHAPTER II—THE KRISHNA AND GODAVARI BASINS</b>	
The basin boundaries; political sub-divisions; political changes since Independence; topo-graphy; geology . . . . .	9
<b>CHAPTER III—THE KRISHNA RIVER SYSTEM</b>	
The Krishna; the Ghataprabha; the Malaprabha; the Bhima; the Tungabhadra; the Musi; sub-basins . . . . .	20
<b>CHAPTER IV—THE GODAVARI RIVER SYSTEM</b>	
The Godavari; the Pravara; the Purna; the Manjra; the Pranhita; the Indravati; the Sabari; sub-basins; Krishna and Godavari rivers compared. . . . .	25
<b>CHAPTER V—CLIMATE</b>	
Mean temperature; rainfall; rainfall variations; evaporation; evapotranspiration . . . . .	31
<b>CHAPTER VI—SOILS</b>	
General; principal soil types; drainage characteristics of soils; effect of rainfall on soil formation; behaviour of different soil types under irrigated agriculture; crops grown in relation to soil types; predominant soil types by districts; need for comprehensive scientific soil surveys . . . . .	48
<b>CHAPTER VII—LAND USE AND AGRICULTURAL PRACTICES</b>	
Introductory; land use; crop pattern in Krishna basin; crop pattern in Godavari basin; crop pattern in Krishna and Godavari basins compared; crop pattern under tanks, canals and wells; recent trends in crop pattern in irrigated areas; crop seasons; preparation of land for irrigation; soil conservation; contour bunding; afforestation; land use statistics required by basins and projects . . . . .	63✓
<b>CHAPTER VIII—REGIONAL ECONOMY</b>	
General; population; forests and agriculture; power; mineral wealth; industries; scarcity areas; dependence on rainfall and water resources . . . . .	99✓
<b>CHAPTER IX—RIVER FLOW</b>	
Available flow data; reliability of available data; uneven distribution of discharge sites; general features of river flow; lack of flow data at project sites; estimating river flow for project purposes; proposals for comprehensive system of discharge observations; need for a special organisation; appraisal of the present position; quality of river waters . . . . .	109

	<i>Page</i>
<b>CHAPTER X—GROUND WATER RESOURCES</b>	
Nature of sub-soil strata; tubewells; surface wells; possibility of further development;	145 <sup>v</sup>
<b>CHAPTER XI—HYDROLOGIC CHARACTERISTICS</b>	
General; rainfall zones; disposal of rain waters; losses by direct evaporation; direct use for sustaining plant life; contribution to ground waters; contribution to stream flow; effect of small tanks on stream flow; transit losses; river gains; valley storage; water balance . . . . .	153
<b>CHAPTER XII—WATER RESOURCES DEVELOPMENTS UP TO 1951</b>	
Wells; tanks; diversions; minor schemes; operational statistics of small tanks and diversions and minor schemes; delta canals; other irrigation works; power development; navigation; reservoir losses; drainage . . . . .	159 <sup>v</sup>
<b>CHAPTER XIII—DEVELOPMENTS SINCE 1951</b>	
General; works in operation in 1951; works which have come into operation since 1951; works under construction; overall magnitude of new developments; reservoir losses; drainage; other uses; change in scope of projects during construction; exclusive developments; main aim of irrigation projects; high costs of projects; full development many years hence	171 <sup>v</sup>
<b>CHAPTER XIV—FURTHER DEVELOPMENTS—PROPOSED AND CONTEMPLATED</b>	
General; new projects on the Krishna; new projects on the Godavari; reservoir losses; proposed annual diversions; other uses; regeneration; optimum use of varying river supply; relative merits of various projects; further developments on pre-1951 projects; nature of the proposals for new works; joint projects; assistance needed by one State from another; need for inter-State co-operation and adjustments; need for an integrated basin-wide plan	194 <sup>v</sup>
<b>CHAPTER XV—AVAILABILITY OF WATER SUPPLIES IN RELATION TO EXISTING AND CONTEMPLATED USES</b>	
Examination by sub-basins necessary; sub-basin K. 1 to K. 12; sub-basins G. 1 to G. 12; comments on sub-basin studies; hydrologic characteristics of different sub-basins; limitations on estimates of sub-basin flow; need for caution; some general conclusions; integrated project for lower Godavari; Pochampad project . . . . .	222 <sup>v</sup>
<b>CHAPTER XVI—DIVERSION OF GODAVARI WATERS TO THE KRISHNA</b>	
Physical possibilities; Pochampad-Nagarjumasagar Link; Polavarem-Vijayawada Link; Godavari-Pulichintala link; the Penganga-Pochampad link; consequential changes in various projects; overall effect of the proposed diversions . . . . .	290 <sup>v</sup>
<b>CHAPTER XVII—IRRIGATION PRACTICES, POLICY AND ADMINISTRATION</b>	
Important for optimum development; existing legislation; multiplicity of departments dealing with irrigation development; regulation and distribution of water; Government control on crops to be irrigated ; water rates; economic use of water; drainage; method of paddy cultivation . . . . .	295
<b>CHAPTER XVIII—SUMMARY AND RECOMMENDATIONS</b>	
General; rainfall; evaporation; river flow; ground waters; developments upto 1951; working statistics of canals and distributaries; developments since 1951; new projects and adequacy of river supplies therefor; administration and management; need for a new policy; need for co-operative approach; irrigation extension service . . . . .	306

( iii )

		<i>Page</i>
APPENDIX A	Particulars of visits by the Commission to various parts of the Krishna and Godavari basins and adjoining areas	327
B	Statistics of scarcity areas— <i>taluk-wise</i>	331
C	Rough estimate of the yields from some of the Godavari sub-basins	334
PLATE I	Physical map of Krishna-Godavari basins and adjoining areas	
II	Map of Krishna-Godavari basins and adjoining areas showing district and places visited by the Commission	
III	Geological map of Krishna-Godavari basins and adjoining areas	
IV	Map of Krishna-Godavari basins and adjoining areas showing annual isohyets	
V	iso-evaporation lines (annual)	
VI	classification of soils	
VII	general distribution of hard and soft rocks	
VIII	sites for which discharge data have been made available	
IX	proposed discharge sites	
X	diversion schemes	
XI to XXII	maps of sub-basins K. 1 to K. 12	
XXIII to XXXIV	maps of sub-basins G. 1 to G. 12	
XXXV	Hydrograph of Krishna River at Vijayawada	
XXXVI	Hydrograph of Godavari River at Dowlaishwaram	
XXXVII	Longitudinal section of Godavari-Pulichintala Link	
Map VI	Map of Krishna Godavari basins and adjoining areas showing existing and proposed projects	(in separate folder)



- ANNEXURE
- I. Rainfall and evaporation data
  - II. Monthly flow data of the Krishna River System
  - III. Ten-daily discharge data of the Krishna River System
  - IV. Withdrawals by canals—Krishna River System
  - V. Monthly flow data of the Godavari River System
  - VI. Ten-daily discharge data of the Godavari River System
  - VII. Withdrawals by canals—Godavari River System
  - VIII. Particulars of irrigation and hydro-electric schemes in operation, as on 31st March 1951—Krishna River System
  - IX. Particulars of irrigation and hydro-electric schemes which came into operation after March 1951—Krishna River System
  - X. Particulars of irrigation and hydro-electric schemes under construction—Krishna River System
  - XI. Particulars of proposed irrigation and hydro-electric schemes—Krishna River System
  - XII. Particulars of irrigation and hydro-electric schemes in operation as on 31st March 1951—Godavari River System
  - XIII. Particulars of irrigation and hydro-electric schemes which came into operation after March 1951—Godavari River System
  - XIV. Particulars of irrigation and hydro-electric schemes under construction—Godavari River System
  - XV. Particulars of proposed irrigation and hydro-electric schemes—Godavari River System
  - XVI. Irrigation practices, policy and administration in Krishna and Godavari basins
  - XVII. Model experiments regarding flow over the Krishna anicut at Vijayawada and the Godavari anicut at Dowlaiswaram
  - XVIII. Maps of Krishna-Godavari basins and adjoining areas showing
    - I. annual isohyets
    - II. seasonal isohyets—Jan. and Feb.
    - III. seasonal isohyets—Mar. to May
    - IV. seasonal isohyets—June to Sep.
    - V. seasonal isohyets—Oct. to Dec.
    - VI. existing and proposed projects

	<i>Page</i>
<b>TABLE I</b> Distribution of various districts in the Krishna and Godavari basins . . . . .	10
II Sub-basins of the Krishna river system . . . . .	24
III Sub-basins of the Godavari river system . . . . .	29
IV Seasonal and annual weighted average rainfall . . . . .	34
V Percentage contribution of rainfall in each season . . . . .	36
VI Co-efficient of variability . . . . .	39
VII Normal potential evaporation—seasonal and annual . . . . .	42
VIII Excess of monthly evaporation over monthly rainfall . . . . .	43
IX Monthly evaporation from reservoirs, as assumed in different parts of the Krishna and Godavari basins . . . . .	45
X Effect of rainfall on soil formation . . . . .	55
XI Cropping pattern by soil types . . . . .	56
XII Statistics of land use in Krishna basin and adjoining areas . . . . .	64
XIII Statistics of land use in Godavari basin . . . . .	68
XIV Area under different crops in Krishna basin and adjoining areas . . . . .	74
XV Statistics of irrigated crops in Krishna basin and adjoining areas . . . . .	78
XVI Area under different crops in Godavari basin . . . . .	84
XVII Statistics of irrigated crops in Godavari basin . . . . .	88
XVIII Land Revenue suspensions . . . . .	104
XIX List of sites on the Krishna river system for which discharge data have been made available . . . . .	110
XX List of sites on the Godavari river system for which discharge data have been made available . . . . .	114
XXI Krishna River System—list of sites at which discharge observations should be made daily . . . . .	131
XXII Godavari River System—list of sites at which discharge observations should be made daily . . . . .	133
XXIII Chemical analysis of waters . . . . .	141
XXIV District-wise statistics of wells in the Krishna basin . . . . .	146
XXV District-wise statistics of wells in the Godavari basin . . . . .	148
XXVI Irrigation development from the Krishna river system as of 1951 . . . . .	163
XXVII Irrigation development from the Godavari river system as of 1951 . . . . .	164
XXVIII Particulars of projects which have come into operation since 1951—Krishna River System . . . . .	174

	<i>Page</i>
<b>TABLE XXIX</b> Particulars of projects which have come into operation since 1951—Godavari River System . . . . .	177
XXX Particulars of projects under construction—Krishna River System . . . . .	182
XXXI Particulars of projects under construction—Godavari River System . . . . .	186
XXXII Particulars of proposed projects—Krishna River System . . . . .	196
XXXIII Particulars of proposed projects—Godavari River System . . . . .	202
XXXIV Important hydrologic characteristics . . . . .	284
XXXV Review of estimated yield and project requirements as proposed by State Governments . . . . .	286

## DEFINITIONS

Unless otherwise stated, the following terms, as used in this report, have the following meaning

**Abi :** *Kharif* crop comprising paddy only, term used in Andhra Pradesh.

**Acre-foot :** Volume of water required to cover an area of one acre to a depth of one foot.

**Anicut :** A weir; usually applied to weirs across rivers, sometimes also to tank surplus weirs.

**Area cropped :** This is the area under all crops, that is, net area sown plus area sown more than once.

**Area irrigated :** This represents the actual geographical area under irrigated crops in a year; areas bearing two irrigated crops in a year are counted only once.

**Area not available for cultivation:** This includes all lands occupied by buildings, roads and railways or under water, rivers, canals, *etc.*, and all barren and unculturable lands like mountains and deserts. Land which cannot be brought under cultivation except at a high cost is classed as unculturable whether such land is in isolated blocks or within cultivated holdings.

**Authorised capacity :** Maximum discharge of a canal, as permitted to be run by competent authority.

**Ayacut :** Area eligible for irrigation and which is normally intended to be irrigated at least once a year, authorised irrigable area. This term is equivalent to C.C.A. if the intensity of irrigation during *Kharif* is 100 per cent.

**Bandhara :** A weir across a stream to divert water into a channel for irrigation.

**Basin :** Short for drainage basin, used in its ordinary geographic sense.

**Capacity factor :** The ratio of the mean supply run in a canal to its authorised full supply or capacity.

**Carry-over :** That part of the live storage in a reservoir which is reserved, or is proposed to be left over, for utilisation after the 31st of May following the storage season.

### Category of projects

A: schemes in operation as on 31st March 1951;

B: schemes which came into operation after March 1951;

C. 1: schemes under construction;

C. 2: schemes referred to in III Plan but not yet approved for execution in III Plan;

C. 3: schemes not referred to in III Plan.

**Consumptive use :** Consumptive use represents that volume of water which is used by vegetative growth over an area in transpiration and building of plant tissue and that evaporated from adjacent soil or intercepted precipitation. It is the amount of water that is changed from a liquid to a gaseous state within an area because of evaporation and or transpiration.

**Crop season :** Period of a year from the beginning of sowing to the harvesting of a crop *e.g.*, *kharif* and *rabi*; or *abi* and *tabi*; or *mungari* and *hingarri*; or *kharif*, *rabi* and hot weather, or two-seasonal and perennial.

**Culturable area:** Gross area as per village papers less the sum total of area under forests and the area not available for cultivation.

**Culturable commanded area:** Gross area commanded less area of unculturable land included in the gross area, such as area under villages, roads, rivers, tanks, etc.

This term, when used for projects in Maharashtra and Madhya Pradesh implies the area for which distributary system is provided; irrigation water is applied annually to the whole or part of this area. When applied to projects in Andhra Pradesh, Madras, Mysore and Orissa, it implies the area available, on the supposition of unlimited waters being available.

**Cusec:** Rate of flow of one cubic foot per second.

**Delta:** Depth of water that would result over the irrigated area from a given water supply *e.g.*, from the supply diverted to grow a particular crop or the supply diverted to grow all the crops in a crop season. Delta may be as at the outlet, or at distributary head or at canal head.

**Overall delta:** Depth of water that would result from the total volume of water delivered to a canal in a year, spread over the total area of crops raised in that year.

**Dry crop:** A crop which does not require large quantities of irrigation water. It is used to distinguish crops like wheat, cotton, *jowar*, etc. from *wet crops* like paddy, sugarcane and gardens.

**Duty:** When applied to a channel it is the area irrigated during a base period divided by the mean supply utilised in cusecs.

Duty may be as at distributary head or as at canal head.

When applied to tank irrigation, it is the number of acres of irrigation per million cubic feet of water.

**First crop:** A term used in Madras and Andhra region of Andhra Pradesh for the first crop grown on a field during the agricultural year commencing 1st July or 1st June, no matter when the crop is sown whether in August or in January.

**Forests:** All actually forested areas or lands classed or administered as forests under any legal enactment dealing with forests whether State-owned or private. If any proportion of such land is not actually wooded but put to some agricultural use, that portion is included under the appropriate heading of cultivated or uncultivated land.

**Gross commanded area:** Area commanded by the whole project; in Andhra Pradesh, Madras, Mysore and Orissa this area is worked out on the supposition that unlimited water is available.

**Hot weather:** Summer crop season in Maharashtra, lasting from middle of February to middle of June.

**Index number of projects:** Indicates the State in which the project is situated, the sub-basin of the river Krishna or Godavari from which water is taken and the category of project.

**Illustration:** 15C. 1-G. 3-M. 10 indicates 15th project in the list of C. 1 category; G. 3 sub-basin *i.e.*, Purna sub-basin of Godavari river and 10th Project in that category in Maharashtra State.

**Irrigated cropped area:** The gross irrigated area under all crops in any year and is the sum total of area irrigated plus area irrigated more than once.

**Kharif:** Summer crops harvested in autumn, extending from 15th June to 14th October in Maharashtra and generally from 1st June to 31st December in Andhra Pradesh, Mysore, Madhya Pradesh and Orissa.

**Major scheme:** One intended for annual irrigation of 50,000 acres or more and all power projects.

**Medium scheme:** One intended for annual irrigation of less than 50,000 acres but having a C.C.A. or Ayacut of not less than 5,000 acres.

**Minor scheme:** One having a C.C.A. or Ayacut of less than 5,000 acres but not less than 500 acres.

( ix )

**Net area sown:** This represents the actual geographical area under the crops, orchards and fodder; areas cropped more than once in a year are counted only once.

**One seasonal:** Applies to a canal which delivers water during only one crop-season.

**Perennial:** Applies to a canal which delivers water all the year round, or most of the year, for crops like sugar-cane, gardens, *etc.*, also applies to such crops.

**Rabi:** Winter crop harvested in spring, extending from 15th October to 14th February in Maharashtra and Madhya Pradesh and generally from 1st January to 31st May in other States.

**Second crop:** A term used in Madras and Andhra region of Andhra Pradesh for the second crop grown on any area in an agricultural year after the first crop has been harvested.

**Small tank or diversion:** A scheme having a C.C.A. or Ayacut of less than 500 acres.

**Tabi:** *Rabi* crop comprising paddy only—term used in Andhra Pradesh.

**Two-seasonal:** Applies to a canal which delivers water for two crop-seasons; also applies to crops which extend from one crop season to the other.

**Wet crop:** Crops like paddy, sugarcane and gardens, requiring large supplies of irrigation water.

## ABBREVIATIONS

### *In the Index Number*

A.	.	.	stands for Andhra Pradesh
Ma.	.	.	stands for Madhya Pradesh
Md.	.	.	stands for Madras
M.	.	.	stands for Maharashtra
My.	.	.	stands for Mysore
O.	.	.	stands for Orissa
C.C.A.	.	.	Culturable commanded area
G.C.A.	.	.	Gross commanded area
G. 1 to G. 12	.	.	sub-basins of the Godavari basin
K. 1 to K. 12	.	.	sub-basins of the Krishna basin
kW.	.	.	kiloWatt
L.S. Cotton	.	.	Long staple cotton
M.A.F.	.	.	Million acre feet
M. Cft.	.	.	Million cubic feet
N.A.	.	.	Not available
pH.	.	.	A measure of the hydrogen ion concentration in water or soil (acidity or alkalinity)
R.L.	.	.	Reduced level, referred to mean sea level
T.M.C.	.	.	Thousand million cubic feet

UNITS

(All figures are correct to two places of decimals)

1. Linear

1 inch	=25.4 millimetres	100 millimetres	=3.94 inches
1 foot	=12 inches =304.8 millimetres	1 metre	=3.28 feet =1.09 yards
1 mile	=5,280 feet =1,609.34 metres =1.61 kilometres	1 kilometre	=0.62 mile

2. Area

1 acre	=4,840 square yards =0.40 hectare	1 hectare	=2.47 acres
		100 hectares	=247.1 acres =0.39 square mile
1 square mile	=640 acres =259 hectares		

3. Volume

1 cubic feet	=0.03 cubic metre =6.23 gallons	1 cubic metre	=35.32 cubic feet =219.97 gallons
1 million cubic feet	=11.57 cusec-days =22.96 acre-feet =28,316.8 cubic metres =6.23 million gallons	1 million cubic metres	=35.31 million cubic feet =810.71 acre-feet
One thousand million cubic feet.	=28.32 million cubic metres =22,957 acre-feet =385.8 cusec per month (30 days) =6,228.8 million gallons	1 milliard cubic metres	=0.81 M.A.F.
1 million acre-feet	=43.56 T.M.C. =1.23 milliard cubic metres		
1 cusec-day	=0.09 million cubic feet =1.98 acre-feet =2,446.57 cubic metres =0.54 million gallons	1 cubic metre per second for 1 day.	=0.09 million cubic metre =70.05 acre-feet =3.05 M.Cft.



3. Volume (continued)

1 cusec-month (30 days)  
=59.50 acre-feet  
=2.59 M.Cft.

1 cubic metre per second for one month (30 days)  
=2.59 million cubic metres  
=2,101.36 acre-feet  
=91.54 M. Cft.

1 cusec-year (365 days)  
=723.97 acre-feet  
=31.54 M.Cft.

1 cubic metre per second for one year (365 days)  
=31.54 million cubic metres  
=25,569.79 acre feet  
=1.11 T.M.C.

1 million gallons  
=160,544 cubic feet  
=4,546.09 cubic metres

4. Rates of Flow

1 cubic feet per second  
=1.98 acre-feet per day  
=0.03 cubic metre per second  
=28.32 litres per second  
=6.23 gallons per second  
=22.424 gallons per hour  
=0.54 million gallons per day

1 cubic metre per second  
=35.31 cusecs  
=70.05 acre-feet per day  
=219.97 gallons per second

1 milliard cubic metres per day  
=0.41 million cusecs  
=0.81 million acre-feet per day

1 acre-foot per day  
=0.50 cusecs  
=0.015 cubic metre per second  
=14.16 litres per second

1 litre per second  
=0.04 cusecs  
=791.91 gallons per hour

10,000 gallons per hour  
=0.45 cusecs  
=0.88 acre-feet per day

1 million gallons per day  
=1.86 cusecs  
=3.69 acre-feet per day

Gallon is imperial gallon=1.20 U.S. gallons  
Milliard=1,000 million=1,000,000,000.