# 6 CONTINGENCY CROP PLANNING

Climatic variability is a predominant feature of Indian agriculture and, therefore, crop production is greatly conditioned by climatic risks. Often due to the late onset of the monsoon, prolonged dry-spells during the cropping season or total failure of monsoon leads to partial or complete failure of crops. The management of the drought primarily involves development of crop management strategies for minimising the severity of the impact caused by the weather aberrations.

1.2 Even though the area under irrigation in India has gone up considerably over the years, most of the irrigation systems are based on the availability of surface water, which in turn depends on the rainfall. During unfavourable monsoon period, reservoir levels go down, shallow wells dry up and tank irrigation systems have low capacity to support crops.

1.3 When a major drought is preceded by a series of 3-4 years of unfavourable monsoon the problem gets accentuated and it is all the more difficult to support crop systems with groundwater sources which are already exhausted due to poor replenishments over the consecutive drought years. The consecutive droughts lead to destruction of biomass in varying degrees creating hardship to millions of farm families.

1.4 South-west monsoon (June to September) is the main season in which about 80 per cent of the precipitation is received. Out of net sown area of about 141 million hectare in the country, 70 per cent of the area is unirrigated and follows cropping patterns as determined by the erratic and unpredictable rainfall, soil type and traditions of the farming community. In the post-Independence era the country has faced major droughts in 1965-66, 1972-73, 1979-80 and 1987-88. Over the years a number of strategies have been evolved to mitigate the impact of drought.

**Contingency Crop Planning**

2.1 In India approximately one - third each of the arable area receives 500-750mm, 750-1125mm and 1125mm and above, rainfall. As the rainfall increases the co-efficient of variability decreases. With low rainfall the variation of rainfall from the mean is much higher than with high rainfall. Axiomatically the likelihood of breaks in rainfall, leading to drought are more in low rainfall areas.

**Table 14: Magnitude of Drought in Selected Years, 1965-1987**

| S.No. | Year | Number of Sub-Divisions Affected | Geographical Area with Deficient / Scanty Rains as Percentage of the Total Area | Percentage of Normal Food-grains Production Accounted for by Affected Sub-Divisions |
|---|---|---|---|---|
| 1. | 1965 | 19 | 66 | 53.23 |
| 2. | 1966 | 13 | 48 | 43.21 |
| 3. | 1972 | 19 | 57 | 45.55 |
| 4. | 1974 | 17 | 55 | 47.99 |
| 5. | 1979 | 18 | 52 | 53.50 |
| 6. | 1982 | 10 | 36 | 21.45 |
| 7. | 1986 | 14 | 34 | 26.88 |
| 8. | 1987 | 21 | 63 | 53.66 |

For instance in Bellary in Karnataka with an annual rainfall of 508mm, 5 years out of 10 years are sub-normal leading to drought. On the other hand in the sub-mountaneous region of Dehra Dun in Uttar Pradesh with an annual rainfall of over 2000 mm, a drought is likely to occur once in six years.

2.2 Besides the cumulative rainfall of an area, the other variables which are important while considering the moisture availability to crops are: (a) Distribution of the rainfall; and (b) Intensity of the rainfall. The distribution has a significant impact on the moisture availability at different phenological stages of crop growth. Even though the total rainfall is adequate, if its distribution is such that in critical stages (flowering and grain formation) there is no moisture availability, the crop yields would be seriously affected. Similarly, if the intensity is very high i.e., more than 25 mm per hour much of the rain water runs off the farm fields. Thus an understanding of rainfall and its characteristics becomes important for effective planning for increased moisture availability to crops and for better crop planning through choice of crop varieties and cropping systems. Well defined cropping patterns exist in the country which have emerged on the basis of long-term traditional experience. The latest crop production technology applies only to normal monsoon years and, if for any reason, monsoon fails, they need to be modified to fit into the changed situation.

2.3 During 1987 as many as 21 meteorological sub-divisions out of 35 recorded deficient / scanty rains leading to drought. These sub-divisions account for about 54 per cent of the total foodgrains production in the country. A comparison of the magnitude of the problem during selected drought years is shown in Table 14.

It may be seen that India faced eight agricultural drought years in the past 25 years and the drought of 1987 was one of the severest and widespread in terms of its impact and sweep. The drought of 1987 threatened significant loss in crop production in respect of rice, wheat, coarse cereals, groundnut, cotton and jute. Another striking aspect was that drought of 1987 was preceded by 3 unfavourable seasons of 1984-85, 1985-86 and 1986-87. No other previous major drought was preceded by consecutive unfavourable seasons extending to 2-3 years.

2.4 The India Meteorological Department(IMD) had established Agromet Advisory Centres in 9 States and from each of these centres agromet advisory bulletins were issued in coordination with the State Agricultural Departments which took into account the state and stage of growth of crops. The bulletins were passed on to the farming community for planning various agricultural operations starting from sowing to harvesting stages. In addition, the climatic conditions and the rainfall predictions as received from IMD were critically examined in the DAC every week and necessary measures were suggested to the States for follow up action. The IMD alerted the DAC in June end/ early July 1987 regarding the likelihood of a 'weak' monsoon during the season.Immediate steps were taken and on 3rd July, 1987 States were advised about the contingency crop plans, the details of which may be seen at Annexure-XIII.

2.5 Based on research recommendations, regionwise, alternate crop strategies were suggested to various States to meet the drought situation of 1987. These contingency crop production plans contained alternate crop / varieties depending on commencement of rains and availability of soil moisture. This greatly helped States in formulating their strategies to meet the challenge of drought of 1987.

2.6 With the deficient / scanty rains in the beginning of the monsoon, the growing season of the crop was reduced. The normal crop varieties may not remain suitable for the later periods of the season. Under such a situation, alternate crops / varieties have to be chosen and sufficient quantities of seeds of these crops / varieties have to be made available to the farmers. During drought of 1987, the DAC suggested some changes in the crops and cropping systems. It recommended adoption of alternative varieties / crops particularly in the case of pearl millet, paddy, sorghum and maize. Similarly, some alternate fodder crops and short duration pulses were recommended to be cultivated in place of pearl millet and groundnut in the States of Gujarat and Rajasthan. Alternate systems of sowing, particularly in regard to increased seed rate, was recommended in the case of delayed planting under moisture stress conditions.

2.7 In some States, drought situation developed after the crop had already been sown. Under such situation, some corrective measures were taken which included (a) re-sowing of shorter duration crops, (b) under-taking mulching operations if mild stress occurred, and (c) removal of weed from the fields so that there was minimal competition for moisture and nutrients to the standing crops. These measures proved quite helpful in minimising crop losses.

***Rabi* 1987-88**

3.1 During 1987-88 when drought situation developed in *kharif* 1987, emphasis was laid for more increased production during the following *rabi* season. Crop production programmes were reviewed and it was felt that with the reasonably good rains in the subsequent months, it might be possible to have an adequate stored soil moisture for raising good crops even under rainfed conditions. Emphasis was also laid for more rational use of irrigation water and a cropping system was suggested which included low water duty crops in place of rice, wheat and sugarcane which are high water duty crops. Emphasis was also laid to increase the efficiency of irrigation management systems so that irrigation water could be saved and maximum area could be irrigated from the limited water resources. In order to implement the compensatory programme, it was considered essential to develop the seed programmes which could provide sufficient quantity of required varieties of seed in such a drought situation. About 4 lakh quintal of wheat seed for covering additional area was arranged during 1987-88 and a scheme for distribution of 1.37 lakh minikits in drought affected area for growing vegetables at an outlay of Rs. 2.06 crore was sanctioned.

3.2 In order to make good the *kharif* losses due to drought a *rabi* production strategy was formulated to take maximum advantage of available water in the reservoirs / wells by following strict water budgeting for various crops. Details of the strategy may be seen at Table 15. The drought situation of 1987 posed a number of problems. The most important one was proper coordination amongst Ministries of Agriculture, Water Resources, Power and Energy and Rural Development. The reservoir position was not satisfactory and it needed concerted efforts on the parts of Ministry of Agriculture and Ministry of Water Resources for strict water budgeting. The arrangement worked to a large extent but it could have been much better had the releases of water been made at critical crop stages.

3.3 The efforts made by the Ministries of Water Resources, Petroleum and Chemicals and Power had greatly helped in containing the crop losses. Vital inputs like irrigation water, uninterrupted power supply for a minimum 8 to 10 hours a day on priority basis to agriculture sector and provision of high speed diesel (HSD) and other petroleum products ensured the success of *rabi* strategy in the drought affected area.

3.4 With the approval of the CCD, an amount of Rs. 15.92 crore was sanctioned to NSC for the procurement of good quality wheat grain from Food Corporation of India to meet the requirement of wheat seed of the State of Bihar and Jammu and Kashmir during *rabi* 1987-88. The uncertified wheat seed was supplied to both these States in time after germination test for the sowing during *rabi* 1987-88.

**Table 15: Compensatory Crop Production Programme, 1987-88.**

## STRATEGY FOR CROP PRODUCTION 1987-88

### WHEAT PRODUCTION

The State of Uttar Pradesh, Punjab, Madhya Pradesh, Haryana, Bihar and Rajasthan account for 88 per cent of Wheat area in the country.

**Punjab and Haryana**

— Treat the seed with Vitavax/bavistin to control loose smut.
— Since water availability is not sufficient, apply irrigations at critical growth stages and according to water availability. Crown root initiation and boot stages are most important.
— Balanced use of fertilizers including micronutrients wherever deficient.
— Top dress N, if winter rains are received.
— Control weeds by applying Isoproturon or Dosanex.

**Uttar Pradesh and Rajasthan**

— Adopt timely sowing of the crop.
— Divert part of the wheat area to oilseeds and pulses where irrigation water is a serious constraint e.g. in the tail end area of the command.
— Increase fertilizer use particularly of N and P.
— Top dress N, if winter rains are received.
— Regulate canal water supplies to provide irrigation at critical growth stages.

**Bihar**

— Ensure availability of quality seed of varieties suitable for late planting.
— Use higher seed rate to ensure optimum plant population.
— Increase area under wheat by late planting in the flood affected districts.
— Ensure moderate application of fertilizers (40 Kg N, and 20 Kg $P_2 O_5$ per hectare).
— Increase water availability by exploiting under ground water.

**Madhya Pradesh**

— Popularise use of seed drill.
— Use fertilizers under rainfed conditions.
— Irrigate the crop at crown root initiation stage.
— Divert part of the area to oilseeds and pulses, below Vindhyan belt.

### RICE PRODUCTION

**Minimizing loss in current Kharif**

— The rainfed upland crop may now be protected from diseases, insect pests, and post-harvest losses.
— The rainfed lowland crop should be topdressed with N @ 15-25 kg per hectare soon after the withdrawal of water, if it has not reached grain filling stage. This be followed by appropriate plant and weed protection measures.
— The irrigated crop fertilized adequately and irrigation schedule and plant protection measures should be followed to maximize production.

**Rice crop during *rabi* 1987-88 in the areas with sufficient water**

— Apply adequate quantity of compost and 50kg each of N and $P_2 O_5$ per hectare to the nursery bed to raise vigorous seedlings.
— Select high yielding varieties of 90-110 days duration.
— Raise healthy seedling from 15th January to 15th February and transplant after 20 days.
— A fertilizer dose of 80-100Kg N and 40-50Kg $P_2 O_5$ per hectare should be applied. Out of total nitrogen, 75 per cent should be applied as basal and remaining 25 per cent at panicle initiation stage.

— The crop should be protected from insects, pests and diseases by following recommended plant protection schedule.

**Rice under restricted water supply**

At least four irrigations are required for raising a moderate rice crop, preferably at transplanting, pre-tillering, flowering and grain filling stages.

Following alternate crops are suggested in the order of reduced availability of water:

| | | |
|---|---|---|
| —Andhra Pradesh | : | Groundnut, Maize, Sunflower, *Mung, Urd,* Chickpea. |
| —Karnataka | : | Groundnut, Maize, Soybean (paddy fallows), *Ragi, Bajra* (Seed crop), Cowpea, *Mung, Urd.* |
| —Tamil Nadu | : | Groundnut, Soybean, *Ragi, Bajra, Mung, Urd.* |
| —Maharashtra | : | Groundnut, *Bajra, Mung, Urd.* |
| —Orissa | : | Groundnut, Maize, Small Millets, *Mung, Urd.* |
| —Assam | : | Maize, Lentil, *Mung, Urd.* |
| —West Bengal | : | Maize, Soybean, Lentil, *Mung, Urd.* |
| —Bihar | : | Maize, Wheat, Lentil, Linseed. |

## BARLEY PRODUCTION

— Barley can be cultivated in saline area and diaraland which could be planted as late as mid-December.
— This year barley has better scope in Uttar Pradesh, Rajasthan and Haryana where rains have been scanty and soil moisture is limited and cannot support high moisture requiring crops.
— For higher yield, grow varieties, *Azad, Amber, Vijay, Jyoti and Kedar* in Uttar Pradesh and Madhya Pradesh; RDB 1, RD 31, RD 103, RD 57, *Rajkiran,* and RS 6 in Rajasthan and BG 25, BG 105, and BH 75 in Haryana.
— Grow linseed, gram and mustard as intercrops.

## PULSES PRODUCTION

— Pulse crops grown: during *rabi* are: gram, lentil, pea, horsegram, lathyrus, *rajmash, mung, urd* and cowpea.
— Gram should be preferred over wheat in situation of limited water supply. In area like Bundelkhand, Bikaner, and Ganganagar divisions of Rajasthan, Marathawada in Maharashtra, parts of Madhya Pradesh, Punjab and Haryana where supplemental irrigation is possible, area under gram should be increased.
— Area under lentil should be increased in the states of Bihar, Assam, West Bengal, and Eastern U.P., as this crop can be planted late (upto December) after the flood waters recede.
— In the coastal areas of Orissa, Andhra Pradesh and Tamil Nadu, and in the States of Uttar Pradesh and Bihar *mung* or *urd* may be planted in the rice fallows upto the end of December.
— A good crop of early maturing horsegram can be raised in the moisture deficient area of the four southern states.

**Increasing Productivity**

— Seeds treatment with appropriate rhizobium culture.
— Apply Di-Ammonium Phosphate (DAP) @ one quintal per hectare.
— Spray against pod borer with 0.07 per cent Endosulfan at the pod initiation stage. Repeat the spray after 10-15 days, if necessary.

— Keep the fields free of weeds upto 40 days by removing either mechanically or by pre-emergence application of tasso/Basalin, untertake inter-cropping of *mung* and *urd* with *rabi* sorghum in Karnataka and Maharashtra and with spring planted sugarcane in Uttar Pradesh.

## OILSEEDS PRODUCTION

### *Toria* Catch Crop

— Taking advantage of recent rains, intensify *toria* sowing as a 'catch crop' preceding wheat under assured irrigation (Punjab, Haryana, Himachal Pradesh, Rajasthan and Uttar Pradesh).
— After *kharif* harvest under residual soil moisture condition (Eastern Uttar Pradesh, Bihar, West Bengal, Orissa and Assam).
— After the cessation of flood (Eastern Uttar Pradesh, Bihar, West Bengal and Assam).

## CROP SUBSTITUTION

For better exploitation of limited water, replace 5-10 per cent wheat area by mustard (Punjab, Haryana, Rajasthan and Uttar Pradesh) and rice by sunflower/groundnut in southern states including Maharashtra and Gujarat.

## INTRODUCTION IN NEW AREA

Introduce/popularise spring/summer sunflower, groundnut/sesame in non-traditional area and intensify efforts to bring more area under these crops during *rabi*/summer in traditional area under assured irrigation.

## INTERCROPPING

Under rainfed situation, to minimise risk and to fetch higher net monetary return per unit area, time and input, inter-crop rapeseed-mustard with sugarcane, wheat, potato and chick-pea; linseed with chick-pea; lentil with dryland wheat and potato, and safflower with dryland wheat, coriander, *rabi* sorghum and chickpea.

### Rainfed

— Paira/Utera crop in all linseed growing area where nothing is grown after the harvest of paddy.
— In Malwa region of Madhya Pradesh, plateau region of Chotanagpur, Deccan plateau and its adjoining area, go for safflower, if adequate moisture after *kharif* harvest is available.
— Plant *taramira* where soil moisture is inadequate and planting of mustard is delayed (Rajasthan, Haryana, Punjab and Delhi).
— Go for high yielding, disease and pest resistant and early maturing varieties.

## RABI SORGHUM PRODUCTION

### Adequate Soil Moisture

— Apply pre-sowing irrigation where possible.
— Planting should be completed between September and early October.
— Grow only CHS 9, CSV 8R, and M35-1 in Andhra Pradesh; CSH 8R, M35-1, and CSV 8R in Karnataka; CSH 8R, CSV 8R, M35-1 and *Swati* in Maharashtra.
— Apply entire fertilizer dose of 50 kg N and 25 Kg $P_2O_5$ per hectare at planting.
— Control weeds by pre-emergence application @ 0.5 kg atrazine per hectare.
— Minimize the incidence of midge and ear-head bug by growing the varieties/hybrids of similar maturity duration in the same region.

### Limited Soil Moisture

Where moisture is limited, in place of *rabi* sorghum, the following crops should be raised:

| | |
|---|---|
| Andhra Pradesh: | Chickpea, *Urd, Mung, Safflower,* Coriander. |
| Maharashtra: | Chickpea, *Urd, Mung,* Safflower, Coriander. |
| Karnataka: | *Ragi, Urd, Mung,* Cowpea, Safflower, Coriander. |

## RABI/SUMMER MAIZE PRODUCTION

— The major *rabi* maize growing states are Bihar (0.4 million hectare), Andhra Pradesh (0.07 million hectare) and Karnataka (0.33 million hectare).

— The average productivity of maize is 1450 kg per hectare, whereas that of *rabi* maize is 3500-4000 kg per hectare; Yields as high as 6000-7000 kg per hectare are not uncommon.

— The high productivity of *rabi* maize is due to better management of water, favourable temperature, abundant sunshine, better response to nutrients, better plant population and better weed and pest control.

**Increase Area**

During this year more area under *rabi* maize may be brought:

— In Bihar, Assam, West Bengal and Eastern Uttar Pradesh where rice and other *kharif* crops have been damaged, the fields of these crops will be available for *rabi* maize.

— In Andhra Pradesh, Orissa, Tamil Nadu, Assam and West Bengal, in place of rice, maize may be grown as 2-3 times more area under maize can be planted with the same quantity of irrigation water.

— At the sowing time of wheat the average temperature should be 22°C. In case the present drought spell continues, the average temperature will be higher than 22°C. even during middle of November, the peak period of sowing of wheat. Under such situation maize cultivation may be beneficial.

**Crop Management**

— Plant only improved hybrids and composites. The recommended hybrids are Hi-starch, *Ganga 2, Ganga 5, Ganga 9, Deccan 101* and *Deccan* 103 and composites are *Pratap Manjiri* and *Hunius.*

— Use 20 Kg per hectare seed rate and spacing of 60×20 cm.

— Apply NPK @ 120, 60 and 40 kg per hectare respectively.

— Apply atrazine @ 1 kg per hectare before seedling emergence for the control of weeds.

— In general 4 to 6 irrigations are required. If limited irrigation is available, irrigation at vegetative stage may be avoided.

— For controlling seedling diseases, treat the seed with Thiram @ 2.5 g per kg of seed.

— Short duration pulses like *rajmash, urd, mung,* linseed, soyabean and coriander may be intercropped with maize.

## SEED PRODUCTION

There will be a shortage of quality seed for planting during *kharif* 1988. To overcome the shortage in *kharif* 1988 the following steps are proposed.

**Seed Assessment**

— Requirement of seed of different *kharif* crops for planting during *kharif* 1988.

— Likely production of seed from current *kharif* crops.

— Deficit in respect of each of the crops for which production during *rabi* 1987-88 to be organized.

Areas for seed production during *rabi* 1987-88 and spring/summer, 1988

| | |
|---|---|
| — Rice: | Assam, West Bengal, Andhra Pradesh, Tamil Nadu and Kerala. |
| — *Bajra:* | Tamil Nadu, Andhra Pradesh, Gujarat and Maharashtra. |
| — Sorghum: | Tamil Nadu, Andhra Pradesh, Gujarat, Maharashtra and Karnataka. |
| — Maize: | Bihar, Andhra Pradesh and Karnataka. |
| — Groundnut: | Gujarat, Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu. |
| — Sunflower: | Gujarat, Maharashtra, Karnataka and Tamil Nadu. |
| — *Urd, Mung* and Cowpea: | Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu and Orissa. |
| — Sesamum: | Tamil Nadu, Kerala, Maharashtra, Andhra Pradesh and Madhya Pradesl |
| — *Soyabean:* | Tamil Nadu, Andhra Pradesh and Karnataka. |
| — *Rabi* Summer | *Urd, Mung* in the northern states and after the harvest of cowpea *rabi* crops. |

**Production Management**

— Select fields having good fertility, accessibility, adequate irrigation, or assured growing conditions.

— Planting crops with recommended seed rate, spacing, time of planting and other requisites to satisfy seed certification standards.

— Keep crop free from weeds, insects, pests and diseases.

— Adopt recommended water management/irrigation schedule.

— Harvest at appropriate time for processing, packing and storing.

3.5 A proposal for the approval of CCD was initiated to provide a short-term loan of Rs. 48.62 crore to the Government of Gujarat to procure 44,400 tonne of groundnut which after processing was to be used as seed for sowing during *kharif* 1988. In response MOF released Rs. 40.00 crore to Gujarat as additional short-term loan. With the help of this loan, the Government of Gujarat was able to procure the requisite amount of groundnut to be used as seed from outside the State.

**Achievements**

4.1 A severe situation arose in Thanjavur district which is the rice bowl of Tamil Nadu where the normal area under paddy is 6 lakh hectare. During 1987 due to poor storage in Mettur Dam water was released only in November instead of in June. The *Kuruvai* cultivation (the summer crop) could be taken up using filter point tubewells in an area of 25,000 hectare in comparison to the normal area of 1.68 lakh hectare. The delay in the release of water made even raising a single crop *samba* paddy (rabi season) doubtful. A novel plan of 'direct' sowing was adopted for the first time in Thanjavur district. The strategy was to raise the crop in the rains and then as and when Mettur storage improved and it became possible to release water, it could be utilised to supplement the rainfall. This required constant monitoring and co-ordination at all levels. The farmers in the first instance had to be convinced of the necessity for this strategy. But, once it was realised that at least on some portion paddy could be raised, a large number of farmers came forward to adopt this strategy. But for this strategy, the entire *samba* paddy crop would have been lost whereas by this direct sowing method 2.09 lakh hectare (49 per cent of the normal area) was brought under paddy. The paddy variety used was the high yielding ADT 36 of 107 days duration. The average yield from the direct sowing crop was 3.9 tonne per hectare and a total production of 8.25 lakh tonne of paddy was obtained. Due to this strategy the production level in 1987-88 was maintained inspite of the drought situation.

4.2 The State Government of Uttar Pradesh took up the sowing of potato as an early crop in an area of 40,000 hectare to compensate shortfall in foodgrain production to the extent possible. An assistance of Rs. 400 for fertilisers and Rs. 200 for plant protection measures per hectare as incentive to the farmers who completed the potato sowing by 10th October, 1987 was provided. As a result of implementation of this scheme, an additional quantity of 2.48 lakh tonne of potatoes was produced. During 1987 record production of potatoes was obtained.

4.3 The successful implementation of the Contingency Crop Planning even though the area under various crops shrunk from 1986-87 level, which itself was a bad monsoon year, helped to minimise crop loss. The details of area and production during 1986-87 and 1987-88 are given in Table 16.

4.4 During *kharif* 1987, the production of rice fell from 53.6 million tonne in *kharif* 1986, to 48.8 million tonne. During *rabi* 1987-88 season, however, the rice output increased to 7.7 million tonne from the 1986-87 level of 7.0 million tonne. Thus the fall in *kharif* rice production was partly off-set by an increase in *rabi* production of rice. Except for Andhra Pradesh and West Bengal all other major rice growing States recorded decline in rice production in 1987-88. It was significantly lower in Bihar (2 million tonne), Uttar Pradesh (1.9 million tonne), Punjab (0.8 million tonne), Haryana (0.7 million tonne) and Karnataka (0.6 million tonne).

4.5 Wheat is the most important *rabi* crop in the country. It occupies 50 per cent of the area under *rabi* foodgrains crops and contributes to 70 to 72 per cent of the total foodgrains production in the *rabi* season. An area of 23 million hectare is covered under this crop out of which 12 million hectare is under dependable irrigation, 6 million hectare under limited irrigation and 5 million hectare under rainfed conditions. Despite the fall in soil moisture content and also adverse effect of the 1987

**Table 16: Area and Production of Foodgrains and Oilseeds in 1986-87 and 1987-88.**

| S. No. | Category | Area (million hectare) | | | Production (million tonne) | | |
|---|---|---|---|---|---|---|---|
| | | 1986-87 | 1987-88 | Percentage Difference | 1986-87 | 1987-88 | Percentage Difference |
| 1. | Total *kharif* Foodgrains | 81.46 | 74.45 | (−) 8.6 | 80.20 | 73.89 | (−) 7 |
| 2. | Total *rabi* Foodgrains | 45.74 | 44.26 | (−) 3.2 | 63.22 | 64.52 | (+) 2 |
| 3. | Total Foodgrains | 127.20 | 118.71 | (−) 6.7 | 143.42 | 138.41 | (−) 3 |
| 4. | *Kharif* Oilseeds | 11.51 | 11.47 | (−) 0.3 | 6.38 | 6.28 | (−) 1 |
| 5. | *Rabi* Oilseeds | 7.12 | 8.53 | (+) 19.9 | 4.89 | 6.10 | (+) 24 |
| 6. | Total Oilseeds | 18.63 | 20.00 | (+) 7.4 | 11.27 | 12.38 | (+) 10 |

drought on the subsequent *rabi* season, wheat production was maintained at the previous years' level. This was largely on account of the contigency measures taken to protect and augment *rabi* production. Among the wheat growing States, while Uttar Pradesh, Punjab, Madhya Pradesh and Maharashtra recorded increase in output, Bihar, Gujarat and Rajasthan registered decline in production in 1987-88 as compared to production in 1986-87.

4.6 The important coarse cereals are *jowar, bajra,* maize and barley. Maharashtra is the largest *jowar* growing State in the country accounting for 42 per cent of the area and 50 per cent of production of *jowar* in 1987-88. Rajasthan, Gujarat and Haryana are the major *bajra* producing States. Maize is an important crop in the States of Uttar Pradesh, Rajasthan and Bihar. Barely is mainly grown in the States of Uttar Pradesh, Rajasthan and Haryana. The majority of the area under coarse grains is under unirrigated conditions — *bajra* (94 per cent), maize (79 per cent), *jowar* (96 per cent) and barley (54 per cent).

4.7 Despite severe drought conditions the production of *jowar* increased substantially from 9.19 million tonne in 1986-87 to 11.85 million tonne in 1987-88. This was, however, offset by the decline in production of other coarse grains like *bajra,* maize and barley. *Bajra* output declined from 4.51 million tonne in 1986-87 to 3.28 million tonne in 1987-88 while maize declined from 7.59 million tonne to 5.63 million tonne during the same period. The fall in other coarse cereals was marginal.

4.8 The production of pulses in 1987-88 was 11.04 million tonne as against 11.71 million tonne in 1986-87. The slight increase in output of *kharif* pulses (*arhar, mung, urad,* etc.) was, offset by a decline in the production of *rabi* pulses (gram, peas, lentils, *rabi urad* and *mung,* etc.) from 7.51 million tonne in 1986-87,to 6.7 million tonne in 1987-88. *Kharif* pulses are grown in an area of 11 million hectare. *Mung, urad* and *arhar* are the main pulses grown during *kharif* season while gram is the major *rabi* pulse crop. The production of *arhar,* which accounts for more than 50 per cent of *kharif* pulses and which is mainly grown in Uttar Pradesh. Maharashtra, Madhya Pradesh, Karnataka, Gujarat and Tamil Nadu amounted to 2.23 million tonne in 1987-88 as against 2.27 million tonne in 1986-87 and 2.44 million tonne in 1985-86. However, the decline in the output of *arhar* was more than offset by an increase in the production of other *kharif* pulses. In the *rabi* season, the production of gram, which is mainly grown in the States of Madhya Pradesh, Uttar Pradesh, Rajasthan, Haryana, Maharashtra and Bihar suffered a set back due to drought conditions. Production declined from 4.53 million tonne in 1986-87 to 3.62 million tonne in 1987-88.

4.9 The production of nine oilseeds increased from 112.7 lakh tonne in 1986-87 to 123.8 lakh tonne in 1987-88. This was largely on account of a substantial increase in the acreage and output of *rabi* oilseeds, especially rapeseed and mustard which increased from 26 lakh tonne in 1986-87 to a record level of 33.7 lakh tonne in 1987-88. *Rabi* oilseeds production totalled 61.0 lakh tonne in 1987-88 as against 48.9 lakh tonne in 1986-87. On the other hand, without any perceptible decline in acreage, *kharif* oilseeds output declined by only one lakh tonne to 62.8 lakh tonne in 1987-88. This was mainly on account of fall in the production of groundnut in the worst drought affected State of Gujarat where production declined from 12.92 lakh tonne in 1986-87 to 1.40 lakh tonne in 1987-88. But Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu recorded

**Table 17: Production of Oilseeds, 1985-86 to 1987-88**

(lakh tonne)

| S.No. | Oilseed | | 1985-86 | 1986-87 | 1987-88 |
|---|---|---|---|---|---|
| 1. | Groundnut | | | | |
| | | *Kharif* | 37.6 | 44.3 | 40.1 |
| | | *Rabi* | 13.6 | 14.5 | 16.4 |
| | | Sub-Total | 51.2 | 58.8 | 56.5 |
| 2. | Castorseed | | 3.1 | 2.3 | 1.8 |
| 3. | Sesamum | | 5.0 | 4.5 | 5.6 |
| 4. | Rapeseed and Mustard | | 26.8 | 26.0 | 33.7 |
| 5. | Linsed | | 3.8 | 3.2 | 3.7 |
| 6. | Nigerseed | | 1.9 | 1.3 | 1.8 |
| 7. | Safflower | | 3.5 | 3.5 | 4.5 |
| 8. | Sunflower | | | | |
| | | *Kharif* | 1.7 | 2.5 | 2.7 |
| | | *Rabi* | 1.1 | 1.7 | 2.4 |
| | | Sub-Total | 2.8 | 4.2 | 5.1 |
| 9. | Soyabean | | 10.2 | 8.9 | 11.1 |
| | | Total *Kharif* | 59.5 | 63.8 | 62.8 |
| | | Total *rabi* | 48.8 | 48.9 | 61.0 |
| | | Grand Total | 108.3 | 112.7 | 123.8 |

substantial increases in groundnut production. The *kharif* crop in Gujarat suffered widespread damage due to drought conditions since it is grown under rainfed conditions. Reduced soil moisture content and other effect of drought also affected the *rabi* crop in the State. The production of different oilseeds during 1985-86 to 1987-88 may be seen in Table 17

**Table 18: *Kharif* and *Rabi* Foodgrains Production for Selected Years, 1966-67 to 1987-88.**

**(million tonne)**

| S.No. | Year | Favourable (F)/ Unfavourable (UF) Season | *Kharif* Foodgrains Production | *Rabi* Foodgrains production | Total Foodgrains Production |
|---|---|---|---|---|---|
| 1. | 1966-67 | UF | 48.49 | 25.34 | 74.23 |
| 2. | 1970-71 | F | 68.92 | 39.50 | 108.42 |
| 3. | 1971-72 | UF | 62.99 | 42.18 | 105.17 |
| 4. | 1972-73 | UF | 58.64 | 38.39 | 97.03 |
| 5. | 1973-74 | F | 67.84 | 36.83 | 104.67 |
| 6. | 1974-75 | UF | 59.10 | 40.73 | 99.83 |
| 7. | 1978-79 | F | 78.08 | 53.82 | 131.90 |
| 8. | 1979-80 | UF | 63.25 | 46.45 | 109.70 |
| 9. | 1982-83 | UF | 69.90 | 59.62 | 129.52 |
| 10. | 1983-84 | F | 89.23 | 63.14 | 152.37 |
| 11. | 1984-85 | UF | 84.52 | 61.02 | 145.54 |
| 12. | 1985-86 | UF | 85.99 | 64.48 | 150.47 |
| 13. | 1986-87 | UF | 80.20 | 63.21 | 143.41 |
| 14. | 1987-88 | UF | 73.88 | 64.53 | 138.41 |

**Table 19: Changes in Rainfall and Foodgrains Output for Selected Years, 1964-65 to 1987-88.**

| S.No. | Year | Percentage Change in Cumulative Rainfall Index (CRI) from Normal | Percentage Fall in Output Over the Previous Year. | | | Total Foodgrains Output (million tonne) |
|---|---|---|---|---|---|---|
| | | | *Kharif* | *Rabi* | *Total* | |
| 1. | 1964-65 | (+) 6.0 | | | | 89.9 |
| 2. | 1965-66 | (−) 18.7 | (−) 18.7 | (−) 17.7 | (−) 18.4 | 72.3 |
| 3. | 1978-79 | (+) 10.0 | | | | 131.9 |
| 4. | 1979-80 | (−) 20.0 | (−) 19.0 | (−) 13.7 | (−) 17.0 | 109.7 |
| 5. | 1981-82 | (+) 0.2 | | | | 133.3 |
| 6. | 1982-83 | (−) 13.2 | (−) 12 5 | (+) 9.2 | (−) 2.9 | 129.5 |
| 7. | 1985-86 | (−) 4.0 | | | | 150.5 |
| 8. | 1986-87 | (−) 13.8 | (−) 4.3 | (−) 4.0 | (−) 4.3 | 143.4 |
| 9. | 1987-88 | (−) 27.5 | (−) 7.9 | (+) 2.1 | (−) 3.5 | 138.4 |

4.10 For crops in watershed, sowing within the watershed was done in nearly 50 per cent to 100 per cent (average 70 per cent) of the area normally sown in the *kharif*, while outside the watershed area, only 15 per cent to 60 per cent (average 40 per cent) area was sown. In the watersheds experiencing severe drought conditions observation in the first week of September, 1987 showed that an average loss of 45 per cent was expected within the watershed (range 20 per cent to 70 per cent) while the loss outside was around 75 per cent from the cropped area (range 60 per cent to 100 per cent). Other benefits like source of supplemented irrigation created through surface storage, complete prevention of run off and increased groundwater recharge were prominent in the watershed area.

5.1 The trend in production in *kharif* and *rabi* season was as follows. The drop in unfavourable season of 1987-88 was very steep as in the case of earlier droughts of 1965-66, 1972-73 and 1979-80. In the case of pulses, oilseeds, rice and maize, there was some compensatory effect in the *rabi* season and in the case of wheat which is grown in the *rabi* season, the fluctuation in the production was not as sharp as in the case of *kharif* crops. The trend of *kharif* and *rabi* production of foodgrains are given in table 18

5.2 Table 19 indicates changes in rainfall and foodgrains output. The table shows that in terms of rainfall deficiency 1987-88 was one of the worst but in terms of production the fall was much higher in earlier droughts. The impact of rainfall deficiency on *rabi* foodgrains was clearly much less after 1980.

5.3 Net import of foodgrains between 1966-67 and 1976-77 was 47.7 million tonne. However, no foodgrains were imported since 1980 to tackle the drought situation in the country. A comparative position of the impact of drought in selected drought years may be seen in Table 20.

**Table 20: Impact of Drought in Selected Years, 1918-19 to 1987-88.**

(million tonne).

| S.No. | Drought Year | Percentage of the Area Affected | Percentage Reduction in Foodgrain Production over the Previous Peak Year | Total Foodgrains Production | Import of Foodgrains |
|---|---|---|---|---|---|
| 1. | 1918-19 | 73 | 32.2 | NA | NA |
| 2. | 1965-66 | 66 | 18.8 | 72.4 | 10.6 |
| 3. | 1972-73 | 57 | 7.7 | 97.0 | 3.6 |
| 4. | 1979-80 | 52 | 17.0 | 109.0 | 0.0 |
| 5. | 1987-88 | 63 | 9.3 | 138.1 | 0.0 |

Note: NA = Not Available.

**Lessons Learnt**

6.1 Contingency crop planning in conjunction with appropriate administrative support goes a long way in tackling difficult drought situation on an emergent footing. Monitoring is a basicrequirement for obtaining requisite data from the field for making appropriate mid-course policy correction and its implementation. The DAC arranged to receive regular weekly information of the various steps being taken in the States through its Area Officers. The jnformation included the coverage and the crop situation, reservoir position and availability of critical farming inputs. Such a systematic monitoring also helped not only in providing timely financial assistance to the States but also assistance in physical terms particularly in making timely arrangements for seed, irrigation and power.

6.2 The drought of 1987 saw introduction of many precedent-breaking innovations. During drought management it was realised that systematic production of seed to meet the requirement of the next season's crops will go a long way in helping the farmers in offsetting their loss of drought affected crops. The State of Gujarat, where the groundnut crop almost failed, particularly in Saurashtra, leaving the farmers without any seed, took a bold step in requesting Andhra Pradesh farmers to grow groundnut seed and for this purpose it even advanced a loan of Rs. 40 crore in 1987-88 to the farmers of Andhra Pradesh. The loan amount was channelised through cooperatives of Andhra Pradesh. This innovation paid a rich dividend to Gujarat as it was able to meet the seed reqirement of its farmers to a large extent.

6.3 An agronomic manipulation also helped a great deal. The direct seeding of germinated seed of paddy in Thanjavur district of Tamil Nadu and Chhattisgarh area of Madhya Pradesh proved very beneficial. This strategy helped in increasing the area under rice cultivation despite late and inadequate rains. Further *toria* in the State of Bihar and eastern Uttar Pradesh was raised in the fields where *kharif* crops could not be sown or had failed due to inadequate or no rain.

6.4 For drought proofing what is more important is gathering detailed information on rainfall and temperature in determining the cropping system in a particular zone after identifying the assured moisture availability periods. The on-farm rain water management is the next important consideration for improved and extended availability of moisture to the crop grown in the dryland.This is achieved through the contour/graded bunds and inter-bund land treatment. Due to the high cost of engineering structures cheaper methods of soil and moisture conservation will have to be adopted to enable replicability of a higher order. The rain water has to enter the soil through the surface of the land. Therefore, the surface has to be kept receptive by different land configurations. Further, the rain water can be harvested into the farm ponds, percolation tanks and also through *nala* bunding and check dams. Diversion drains and the strengthening the waterways would be needed so as to see that the rainwater from non-arable land does not encroach upon arable land and creates erosion problems. The data generated shows that with these conservation measures there is an increased groundwater availability in different regions, the intensity depending on the rainfall and the soil type.

Most of the water resources of India are contributed by the precipitation received during the monsoon months. All over the country substantial flows are received in rivers, tanks and reservoirs. Ingress into the ground raises ground water levels. The storage and acquifers are generally used for providing irrigation for *rabi.*

1.2 There are more than 200 major and 900 medium irrigation projects in operation in the country. Excluding irrigation projects based on diversion of river waters, projects having storages account for roughly half of the surface water utilisation for irrigation. For having a broad idea of water availability situation, the Central Water and Power Commission (CWPC) in the Ministry of Water Resources (MWR) monitored weekly position of 47 reservoirs. The review on 20th July, 1987 indicated that live storage in 44 reservoirs was 26.486 thousand million cubic metre (TMCum) against the designed live storage capacity of 101.133 TMCum (Data for 3 reservoirs were not available). A study made for 15 important reservoirs indicated that on 10th August, 1987 the water availability had further reduced. Water availability as on 10th August, 1986, 20th July 1987, and 10th August 1987 vis-a-vis the designed capacity for the fifteen reservoirs has been tabulated in Table 21. Ramganga (Uttar Pradesh), Jayakwadi (Maharashtra), Balmela (Orissa) and Mettur (Tamil Nadu) had storages even less than 10 per cent of the designed capacity. In the case of others also the position was far from encouraging. It was therefore clear that if releases are not controlled during *kharif,* there may not be any water left for *rabi* irrigation. Sound judgement was therefore necessary for regulating the outflows to derive optimum benefit from the available water.

**Action Plan**

2.1 Recognising the acute shortage of water caused by drought conditions in most parts of the country, Secretary Ministry of Water Resources in August, 1987 held a meeting with Secretaries of State Irrigation Departments and Command Area Development (CAD) authorities. In this meeting review of the storages available in the reservoirs and tanks, impact of reduced storage on *kharif* and *rabi* irrigation, measure for optimum utilisation of storages and maximising ground water utilisation were discussed. Based upon the discussions, an action plan was recommended. Main features of this plan were as under:

(i) The available water resources shall be put to maximum use. For this purpose full inter-departmental cooperation at project/State level will be ensured particularly among the Departments of Irrigation, Agriculture, Public Health Engineering, State Electricity Board (SEB) and the Ground Water Department;

(ii) The State Governments will make a weekly compilation of live storage capacities of major and medium works in their States under operation and taking into consideration the normal levels that prevail during the corresponding periods, review the water availability position for various uses and draw up a water plan for judicious use of available water resources, giving first priority to drinking water supply, fodder and low water consumptive crops;

(iii) Reservoir operation plans will give highest priority for reserving water for drinking water supply in scarcity areas;

(iv) A Statewise fortnightly summary of live storage capacities available in 1987-88 along with information of corresponding storages in normal years will be made available to the Central

Water Commission (CWC) to enable periodical review to be taken up at the Central level;

(v) Effective coordination must be ensured between the Agriculture Department, Irrigation Department and CAD authorities to achieve the twin objectives of rational distribution of water and satisfactory implementation of crop strategy. A detailed action plan shall be worked out for conserving and for optimum use of water, and sent to MWR as quickly as possible;

(vi) In view of the deficient/scarce monsoon rainfall in 1987-88, the residual moisture in the soils will be low in the post-monsoon season and consequently *rabi* crops will have to be supported by irrigation to a greater degree. For this purpose, a trade-off will have to be made between the benefits accruing from the alternatives of *kharif* and *rabi* Irrigation. There should not be undue concern to save damaged *kharif* crops, and water may be released for standing *kharif* crops only for very compelling reasons and without compromising the drinking water supply for the months to come;

(vii) The endeavour should be to resort to longer rotation periods and to supply a minimum number of waterings to sustain crops so that the benefits of irrigation can be extended to as large an area as possible. High water-consumptive crops will be discouraged and alternate crops, including growing of fodder crops, will be encouraged. The farmers will be made aware of the situation by wide publicity;

(viii) Mulching will be popularised to minimise evaporation from fields. Compartmentalisation to reduce the surface area of stored water should be undertaken to reduce evaporation loss. These works could be done under NREP, RLEGP and drought relief works programme;

(ix) Irrigation Departments will initiate action to procure chemical retardants to be able to use them right from November, 1987 to reduce evaporation losses from stored water;

(x) Starting from September, 1987 bunds will be constructed across streams, where feasible, to create temporary storages consistent with the needs downstream. This should be accorded a very high priority under NREP and RLEGP;

(xi) If the monsoon improves, a review will be undertaken around mid-September to identify medium and minor storages likely to suffer spillover of water and action taken to temporarily raise the storage level by use of earth-filled gunny bags;

(xii) Water budget will be prepared for every reservoir covering drinking water, *kharif*/*rabi* requirement and evaporation losses;

(xiii) Ground water has a vital role to play in combating drought. Every effort will be made to maximise ground water utilisation by pressing into service all the created potential and creating additional irrigation potential by mobilising the resources as stated below:

(a) The irrigation pumpsets already energised be put to maximum use;

(b) A drive will be a launched for releasing service connections to all consumers who had submitted their applications with the concerned State Electricity Boards (SEBs). (The GOI wrote to State Governments on 13th August 1987);

(c) SEBs will be prevailed upon to assure 8—10 hours of power supply to all irrigation pumpsets;

(d) Availability of diesel supply will be ensured to all irrigation diesel pumpsets;

(e) Public tubewells will be pressed into immediate service and those remaining unused will be repaired and commissioned on top priority so that they are all in good working order during *rabi* season;

(f) All drilling capacity available will be mobilised including CGWB and the programme of drilling reoriented from exploration to development at the request of State Governments, who will also examine the need for entering into long-term arrangements with private companies for development of new wells;

(g) The concerned authorities will take over exploratory tubewells constructed by the

CGWB (Secretary, Ministry of Water Resources wrote to Chief Secretaries in this regard);

(h) While taking the above measures, the need for drinking water supply will be kept in view. In the area prone to drinking water scarcity as well as in area where the ground water table has been decreasing, caution and restraint shall be exercised to conserve ground water at optimum levels. Availability of power will be regulated where ground water is inadequate to prevent overdrawal of water; and

(xiv) To ensure better availability of water for drinking and agriculture sectors, water supply for industrial use will be regulated and the State Governments should take necessary steps in this direction, paticularly asking industrial units, large industrial and/or commercial establishments to increase storage capacity or to take water through pipes instead of open water courses.

2.2 The CWC in the Ministry of Water Resources monitored the weekly reservoir position of 47 reservoirs, and fortnightly Statewise position of water availability in the reservoirs of major and medium irrigation projects of various States. The data collected from the States was sent to the DAC for considering the periodic availability of water and to review their contingency action plan for agriculture production.

2.3 The data on 47 reservoirs for 1987-88 were compared with the data of water year 1986-87 (from 1st June 1986 to 31st May 1987). A graph showing the total live storage available in the two years starting from 1st June 1986 to 27th May 1988 has been plotted which may be seen in Figure 6. A perusal of the graph shows that live storage in the monsoon months of 1987 was much less than the corresponding storage in 1986. In 1986 maximum storage was 79.218 TMCum on 2nd September, 1986 whereas the maximum storage available in 1987 was only 48.258 TMCum on 9th September 1987 which is about 61 per cent of 1986. Compared to the designed live storage of these projects, the percentage availability in 1987 was only 46 per cent which showed that it may not be possible to supply water for *kharif*. It would be seen from the graph that there are rapid withdrawals for irrigation from September onwards in 1986 resulting into significant utilisation for *kharif*. But in 1987 there has been insignificant withdrawal and the water availability on 15th January 1988 was 47.063 TMCum compared

**Table 21 : Position of Live Storage in Important Reservoirs as on 10th August, 1987**

(thousand million cubic metre)

| Sl. No | Reservoir | Live Capacity at Full Reservoir Level (FRL) | Live Storage as on | | | Percentage of Live Storage as on | | |
|---|---|---|---|---|---|---|---|---|
| | | | 10th August 1986 | 20th July 1987 | 10th August 1987 | 10th August 1986 | 20th July 1987 | 10th August 1987 |
| 1. | Ukai (Gujarat) | 7.100 | 2.3921 | 2.135 | 1.962 | 33.69 | 30.07 | 27.63 |
| 2. | Gobind Sagar (Himachal Pradesh) | 7.172 | 5.295 | 3.555 | 4.603 | 73.83 | 49.57 | 64.18 |
| 3. | Pong Dam (Himachal Pradesh) | 7.119 | 4.705 | 1.339 | 1.546 | 66.09 | 18 81 | 21.71 |
| 4. | Gandhi Sagar (Madhya Pradesh) | 6.827 | 0.489 | 1.423 | 1.167 | 7.16 | 20.84 | 17.09 |
| 5. | Ramganga (Uttar Pradesh) | 2.053 | 0.631 | 0.117 | 0.156 | 30.73 | 5.70 | 7.60 |
| 6. | Rihand (Uttar Pradesh) | 8.967 | 6.421 | 3.881 | 4.272 | 71.61 | 43.28 | 47.64 |
| 7. | Nagarjunasagar (Andhra Pradesh) | 6.841 | 1.48 | 1.34 | 1.247 | 21.63 | 19.59 | 18.23 |
| 8. | Srisailam (Andhra Pradesh) | 8.288 | 3.098 | 1.626 | 3.043 | 37 38 | 19.62 | 36.72 |
| 9. | Linganamakki (Karnataka) | 4.294 | 1.526 | 1.013 | 1.012 | 35.54 | 23.59 | 23.86 |
| 10. | Tungabhandra (Karnataka) | 3.276 | 1.908 | 0.882 | 0.781 | 58.24 | 26.92 | 23.84 |
| 11. | Jayakwadi (Maharashtra) | 2.171 | 0.094 | 0.099 | 0.144 | 4.32 | 4.56 | 6.60 |
| 12. | Koyna (Maharashtra) | 2.677 | 1.915 | 0.965 | 1.096 | 71.54 | 36.05 | 40.94 |
| 13. | Hirakud (Orissa) | 5.822 | 3.110 | 1.492 | 2.338 | 53.42 | 25.63 | 40.15 |
| 14. | Balmela (Orissa) | 2.676 | 0.100 | 0.102 | 0.165 | 3.74 | 3.81 | 6.17 |
| 15. | Mettur (Tamil Nadu) | 2.647 | 0.383 | 0.229 | 0.196 | 14.47 | 8.65 | 7.40 |

**Table 22 : Statewise Additional Irrigation Potential and Additional Outlay for Irrigation Projects, 1987**

| S. No. | State | Additional Irrigation Potential to be created (thousand hectare) | Amount of Additional Outlay Sanctioned (Rs. in crore) |
|---|---|---|---|
| 1. | Andhra Pradesh | 12.50 | 22.00 |
| 2. | Gujarat | 29.37 | 30.00 |
| 3. | Haryana | 2.00 | 2.00 |
| 4. | Himachal Pradesh | 1.00 | 1.10 |
| 5. | Jammu and Kashmir | 3.40 | 6.40 |
| 6. | Karnataka | 11.00 | 25.00 |
| 7. | Kerala | 2.50 | 5.50 |
| 8. | Madhya Pradesh | 23.71 | 27.00 |
| 9. | Maharashtra | 14.50 | 26.00 |
| 10. | Nagaland | 0.50 | 0.50 |
| 11. | Orissa | 13.01 | 22.00 |
| 12. | Rajasthan | 25.31 | 37.50 |
| 13. | Tamil Nadu | 1.30 | 3.00 |
| 14. | Uttar Pradesh | 24.04 | 28.00 |
| | Total | 164.14 | 236.00 |

to 48.258 on 9th September 1987 and 58.488 on 30th December 1987. This achievement was possible by adopting the various steps suggested by the GOI. Around 29th January, 1988 the storage position mostly coincided with that of 1987. On 8th April 1988 the storage position was same as 1987. This shows that by monitoring of resevoir positions and persuading the State Governments it was possible to achieve conservation of water storage.

2.4 Due to some late rains storage position improved to some extent and reached the maximum of 58.478 TMCum on 30th October 1987 which was still much less than the corresponding storage total of 71.546 TMCum in 1986. Therefore it was necessary to exercise some control on releases for *rabi* also. A review meeting taken by Secretary, Ministry of Water Resources with the State Secretaries on 11th November 1987 showed that States had set up requisite co-ordination mechanism for scientific water management to optimise utilisation by according suitable priorities for various uses of water.

2.5 The CGWB offered the services of technical manpower and machinery to assist the State Governments. Drilling rigs numbering 25, deployed in the indicated area of various States completed 168 tubewells during 1987-88 and further added 76 tubewells by the end of June, 1988. The CGWB also monitored the efforts made by the State Governments in energisation of pump sets, operationalisation of inoperative tubewells, construction of new tubewells and taking over of exploratory tubewells constructed by the CGWB. The information in this connection was being collected on fortnightly basis through the nodal officers designated for the purpose in the States by the State Governments. Efforts were made to hand over the completed tubewells to State Governments. It was possible to hand over 51 tubewells to Madhya Pradesh, 27 to Maharashtra, 28 to Rajasthan, 13 to Haryana, and 6 to Delhi during 1987-88.

**Special Assistance for Irrigation Projects**

3.1 In pursuance of the long term objective of drought proofing, the Planning Commission approved an additional outlay of Rs. 236 crore for expediting identified irrigation projects under execution in the drought prone area as shown in Table 22. For this purpose, 94 major and medium irrigation porjects and 19 minor irrigation programmes were identified in 14 States in accordance with the details given in Annexure XIV. It was expected that with the additional assistance these projects and programmes will be completed within a period of 2 years creating an additional irrigation potential of 1.64 lakh hectare. The additional assistance was provided subject to the State Governments utilising the plan outlays for the identified projects in full.

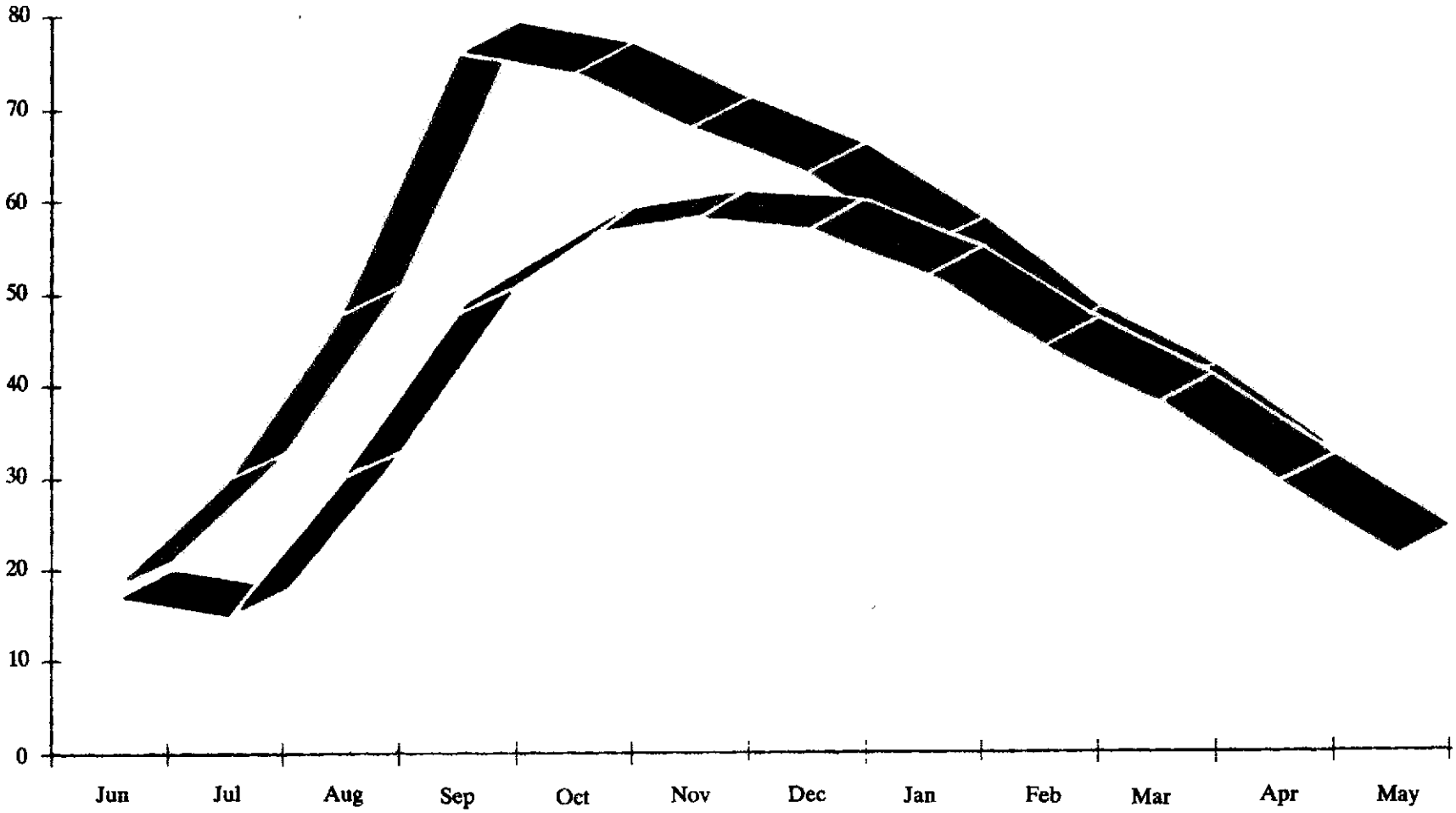


**Figure 6: Storage of 47 Important Reservoirs** (Statorage in Thousand Million Cubic Metres)

3.2 The additional outlay provided, to complete the projects within a period of 2 years, was funded as follows:—

(a) 50 per cent of the additional outlay required was found from the funds allocated for the employment-generation programmes under the drought relief assistance, as approved by the GOI on the recommendations of the HLCR; and

(b) The remaining 50 per cent was made available as net additionality under drought over and above the amount sanctioned as drought relief assistance to the States. This amount was spent on material components as well, as was agreed in the individual cases by the Planning Commission.

3.3 Out of the 14 States selected for this programme, 2 States viz. Tamil Nadu and Himachal Pradesh with outlay totalling Rs. 4.10 crore for creation of addition potential of 2300 hectare, did not implement this programme, whereas all the other States took it up.

3.4 Progress of works on the projects/schemes implemented under the above programmes was monitored by Planning Commission on quarterly basis. Though the State Governments were expected to utilise the additional assistance under the programme during 1987-88 itself, yet most of them sought extension of time. Planning Commission also took the decision that while formulating Annual Plans from 1988-89 onwards the following aspects would be emphasised:—

(a) Priority and stepping up of expenditure on and completion schedule of such irrigation projects as are likely to benefit chronically drought-prone areas;

(b) Promote use of water-saving devices like the sprinkler system and drip-irrigation;

(c) Take the help of scientific organisations like the Department of Space for identifying water rechargeable locations, digging of tubewells, etc. (A complete mapping exercise needs to be carried out);

(d) Much greater research and push on dryland farming: and

(e) Stress on year-round propagation of water management conservation methods.

**Drinking Water**

4.1 During 1987-88, as many as 263 districts in 15 states and 6 Union Territories involving 54,310 villages were affected by drinking water scarcity. The worst hit States were Gujarat, Rajasthan and tribal area of Orissa. Anticipating the drinking water scarcity in these States, the GOI acted quickly. The CCD decided that the Department of Rural Development (DRD) shall co-ordinate all the arrangements regarding provision of drinking water both for rural and urban area.

4.2 On the basis of quick reconnaissance survey the GOI released Rs. 73.40 crore to the worst hit States in addition to the release of Rs. 14.58 crore for purchase of rigs and other equipments. The DRD drew up a contingency plan to combat scarcity of drinking water under which all the States were asked to reprioritise their plan programmes and divert funds to the worst-affected area.

4.3 Various measures were suggested to the State Governments to optimise the utilisation of water and to conserve surface water which they were having by using various methods by compartmentalisation, use of cetyl alcohol, control of use of water in rural and urban area and detection of over-use of water in irrigation and optimisation of water for *rabi* crop. Instructions were issued to State Governments as early as July, 1987. Various instructions had also been issued on health aspects so that water-borne epidemics did not spread. Emphasis was laid on the source finding activities and dovetailing plan programmes with the drought master plan.

4.4 The normal approach to drought was to provide the State Goverrnment funds for development of additional sources. Since 1985-86 the emphasis was on the development of sources through scientific source finding methodology that is with the use of satellite imageries, linear maps, ground truth surveys, geophysical surveys and proper drilling techniques. It is the scientific source finding and application of correct drilling techniques which can increase the life of a bore hole and provide sustained source of water—an aspect which was so far neglected in the Public Health Engineering Department.

**Table 23 : Ceilings of Expenditure Approved for States for Drinking Water Supply, 1987-88.**

(Rs. in crore)

| Sl. No. | State | Approved Ceilings | | | |
|---|---|---|---|---|---|
| | | July 1987 to March 1988 | | April 1988 to June 1988 | |
| | | Rural | Urban | Rural | Urban |
| 1. | Andhra Pradesh | 8.710 | 3.390 | | |
| 2. | Gujarat | 17.622 | 23.356 | 9.450 | 3.344 |
| 3. | Haryana | 3.900 | 1.250 | | |
| 4. | Himachal Pradesh | 1.190 | 0.500 | | |
| 5. | Jammu and Kashmir | 1.405 | 0.600 | | |
| 6. | Karnataka | 4.430 | 2.905 | | |
| 7. | Kerala | 7.640 | 3.300 | | |
| 8. | Madhya Pradesh | 7.540 | 3.660 | 3.140 | 1.320 |
| 9. | Maharashtra | 9.435 | 0.373 | | |
| 10. | Nagaland | 1.000 | | | |
| 11. | Orissa | 3.000 | 0.850 | | |
| 12. | Punjab | 4.500 | 1.000 | | |
| 13. | Rajasthan | 18.436 | 38.344 | 18.598 | 19.750 |
| 14. | Tamil Nadu | 5.600 | 7.110 | | |
| 15. | Uttar Pradesh | 8.700 | 4.840 | | |
| | Total | 103.108 | 91.478 | 31.188 | 24.414 |

4.5 Under the Technology Mission on Drinking Water, emphasis was given on training of personnel for geohydrological and geophysical surveys and drilling technology. Hardware were also provided for appropriate drilling technology. UNICEF was helpful in providing combination rigs which were very useful in Rajasthan and Gujarat. The India Mark II handpump developed can even draw water from depth of 150 meter and that proved to be a boon. The GOI provided a large number of new drilling machines to the State Governments. To improve drilling efficiency a computerised rig monitoring system was introduced.

4.6 The State Governments submitted memoranda for seeking drought assistance. Various central teams visited the drought affected States in order to assess the situation. Based on the recommendations of the central teams, the GOI approved ceilings of expenditure of Rs. 103.208 crore for rural and Rs. 91.478 crore for urban water supply during 1987-88 and Rs. 31.188 crore for rural and Rs. 24.414 crore for urban water supply during 1988-89. Details may be seen in Table 23. In addition an amount of Rs. 17.928 crore was also sanctioned to the drought affected States for purchase of rigs etc. Additional rigs numbering 61 were approved for the States to take up the water supply programme in addition to approval of 15 hydrofracturing units with 11 terrameters and 9 well loggers.

4.7 During 1987-88, DRD released Rs. 288.29 crore for Accelerated Rural Water Supply Programme (ARWSP) for 15 drought affected States. Additional allocation under ARWSP amounting to Rs. 15.58 crore was also released for the area identified under the Desert Development Programme (DDP). The CCD also decided to extend the ARWSP to cover all the affected small towns and *nagar panchayats* of population of 20,000 according to 1981 census.

4.8 As regards physical progress under the normal plan programme of centrally sponsored ARWSP including special additional assistance given in the context of drought, 40,088 problem villages were provided with safe drinking water facilities in 15 drought affected States. Apart from this, 67,298 villages were covered for potable drinking water under the drought relief assistance. More than 1.5 lakh bore holes were drilled. With the use of satellite imageries, geophysical and geohydrological surveys, the failure rate of bore wells reduced from 42 per cent to 7 per cent or even less in the worst drought affected States of Gujarat and Rajasthan.

4.9 A group was constituted in the DRD with members from IMD, CGWB, DST, etc. to continuously monitor the water supply information in the country and to develop a model for forecasting the drinking water availaibility linking it to the monsoon rainfall. A computerised monitoring system of rigs based on UNICEF pattern was extended to all rigs owned by the State Governments including those operated by private contractors in the drinking water programme. All these activities had to be coupled with a strong vigil on health and sanitation aspects so that epidemic did not spread. Particularly before the onset of monsoon precautions were taken in rural area for chlorination of the wells as well as filling up of the trenches near the water sources so that seepage of water did not take place and pollution could be avoided.

4.10 Indian Railways in consultation with the State Governments placed tank wagon rakes/flats at the disposal of the State Governments for transportation of water. The details are as under:—

(i) 1.8 broad gauge rakes per day for 56 days and 2.2 metre gauge rakes per day for 46 days for transportation of water were loaded from Dhola, Rajula and Gandhinagar to Rajkot city in Gujarat in 1986-87; and

(ii) With effect from 8th July 1987 to 5th January, 1988 one water special per day was arranged from Peepar to Jodhpur in Rajasthan. This was stepped up to two specials per day from 6th January, 1988. Each special carried 2 lakh gallons of water.

**Lessons Learnt**

5.1 Close coordination between the irrigation engineers and PHEDs is necessary at the State level. Similarly close relationship between irrigation, drinking water schemes as well as water for industry is essential. A large amount of capital cost can be saved through integration of these projects and through management of the resources which are common for all. The solution to a total water management approach would be to adopt basin concept where a total demand and supply situation of basin is calculated and on the basis of availability of water in that basin the developmental plan of that area is taken up. In a number of basins such calculations have been made but mostly on surface water alone. A conjunctive model both for surface and ground water has been attempted under the Technology Mission by National Institute of Hydrology, Roorkee and Indian Institute of Science, Bangalore. Possibly this will mark a new beginning which will clearly indicate the potentiality of development of a particular basin and direction the growth should really take place.

5.2 The other aspect which tends to be missed is the cost of the water supplied. Every drop of water costs certain amount. However, it is never calculated. The time has gone when water was considered free. The time has also gone when it could be thought that entire water supply system could be handled by Government machinery. It requires decentralisation, involvement of non-governmental organisations and massive awareness campaign of community involvement both in development as well as maintenance of systems. Drinking water supply is not a mere hardware solution; it is more a societal problem and societal solution has to be obtained. More than that a consciousness of water and its importance in life and its scarcity should be brought out sharply. In order to make people appreciate the problems related with it, a joint endeavour is to be made to mitigate the crisis.

5.3 The involvement of the non-governmental agencies/organisations to a great extent helped involve the people in fighting this drought through Council of Advancement of People's Action and Rural Technology (CAPART). A large number of voluntary organisations were given funds and technical advice to set-up drinking water systems. The most notable and innovative experiment was conducted in Gujarat by an organisation called *Mahiti* where rain water harvesting was done in large tanks laying with low density ethyl polyfilms and evaporation was reduced by spraying cetyl alcohol. The experiences of voluntary organisations in water management like *Mahiti* in Gujarat, *Pani Panchayat* in Maharashtra, *Pani Chetna Sangh* in Rajasthan, *Kasa* Trust in Almora and National Association of Water Development Agency (NAWADA), Pune in various parts of the country, will help us to face the crises and develop water modules in future.