accordingly which was equivalent to prevailing wages for a labourer per day.

In some of the panchayats there used to be an individual entrusted with the work of maintaining a register of absentees, normally the 'Shanubag'. He was also responsible for maintaing accounts of fines levied and collecting fine from those who are punished by the panchayat for absenting from desilting or repairing. This system is prevalent even today in Ghattalagollahalli of Tumkur district, Talaku in Challakere Taluk of Chitradurga district and in parts of Kolar district Such persons who maintained registers were called 'Harikara' (Photo 5).

In the second type, each beneficiary will be asked to desilt the canals and distributories next to their field. Those who failed to do so were punished by denying water or till the entire canal was desilted, water was not let into the canal. Which was to compel all the individuals in turn, to pressurise the individual who has not desilted the canal to desilt the same. Another way of punishing the erring individuals was by getting that portion of the canal desilted through the Nirganti by the Panchayat and water was denied till concerned and owner paid the cost incurred and the fine levied by the panchayat. At present, in the terminal tanks like Parashurampura tank in Chitradurga district and the Agrahara tank of Bangalore district it is practiced. In Hebbalagere of Shimoga district, and in Tangali of Kadur taluk which are middle order tanks in the series, the above system is still in vogue.

This type of institutions meant exclusively for water distribution were superseded by the Public Works Department in the case of terminal tanks during 1966. In such cases, the irrigation committee constituted for the entire taluk decides on the management of water in all these tanks that are maintained by the PWD in the taluk. Unlike the panchayats, these taluk-level irrigation committees does not compel the farmers to desilt the canal or distributories. On the other hand, the department on its own will desilt the canals and distributories, as a part of annual maintenance exercise. Due to low budgetary allocations made available for the works and also due to difficulties faced in the execution such works, the canals and

of who owns the land, each land owner within the command area will be accommodated by a committee, by reducing each one's holding to the proportion in which the command area is halved.

In few tanks of Mulbagal Taluk, the panchayats depending on the water collected in the tank, decides upon the area and crop to be irrigated. Accordingly, farmers within the area to be irrigated will accommodate their friends and relatives. As the demarcated area keeps changing every time every farmer has a chance to accommadete his friend or relative and also reciprocation, such accommodations and reciprocations do help every farmer to harvest a crop of paddy, with available water.

The farmers of Nallur and Kappalamadagu have not failed to take a crop in any year irrespective of rainfall (Table 4.1). Similarly, the farmers of G.G. Halli and Tallaku have also raised crops of one sort or the other, even in drought years (Table 4.2). Therefore, water management in such villages have to be commended as appropriate, since even in drought affected years the available water is rationally utilized.

Compared to the panchayat maintained tanks, the terminal tanks managed by the P.W.D. appears to be in a sorry state. Irrespective of rainfall, area of kunigal doddakere, the tail-enders have not been able to irrigate a single crop of paddy, even during khariff from last ten years. All the farmers owning wet lands in the Billidegula tailend of kunigal tank have converted their wet lands into rainfed lands. This is due to improper water distribution, badly maintained canals and diversion of water to places outside the command area.

In Kunigal doddakere, the taluk irrigation committee decides the cropping pattern and expects the junior engineers and Sowdis* to enforce their decision. As the Sowdis only let water into the canal and does not take the responsibility of distributing water to the fields, the individual farmers overfeed their crops. Further, as in Talaku, the Nirgantis do not take the responsibility of closing the vents in the top reach to transport water to the tailend and as a result, the tail-enders at Billedegula are not in a position to receive water.

*** Sowdis are paid - employees of PWD to distribute water.**

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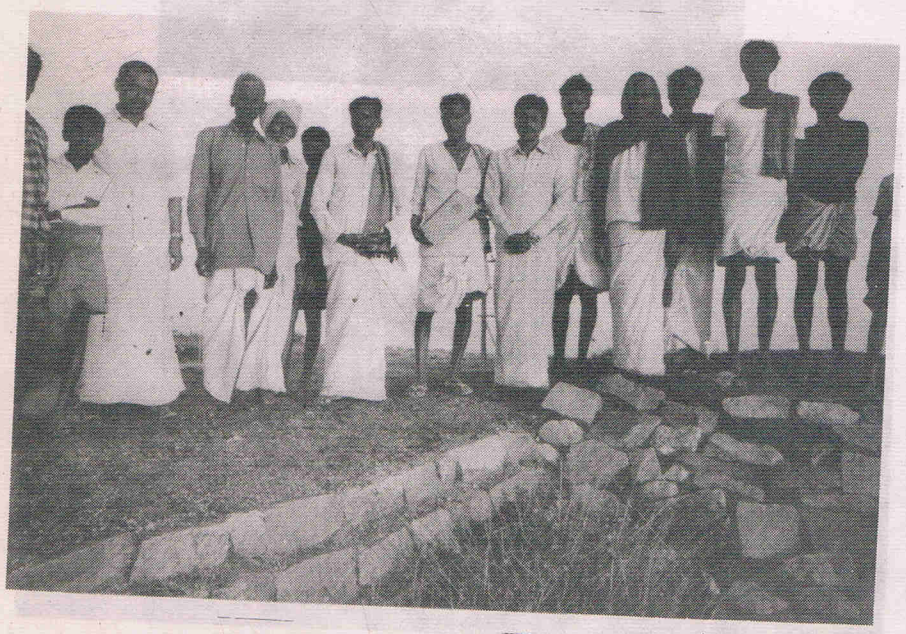

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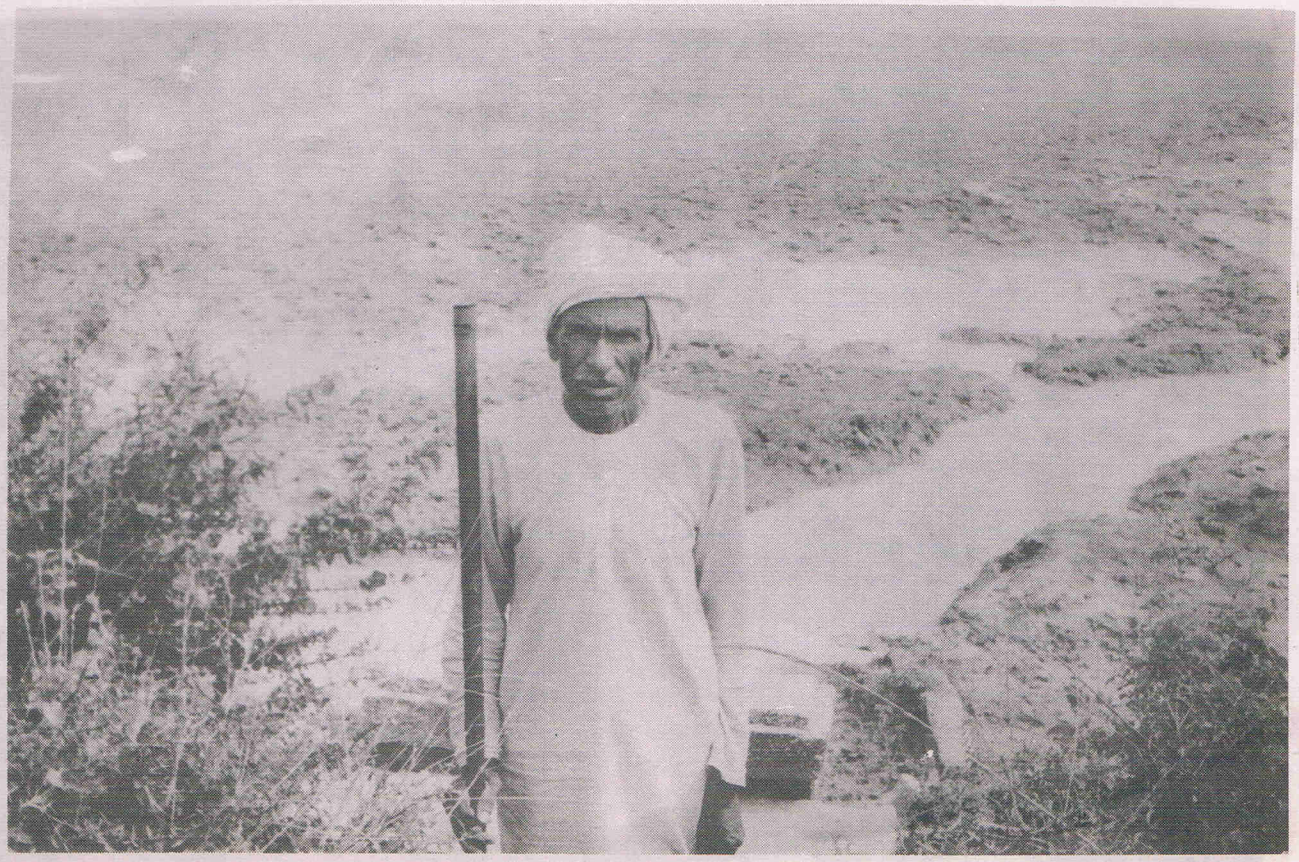

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Even though cropping pattern is decided by the irrigation committee in consultation with the Assistant Director of Agriculture, the cropping pattern is not enforced. As a consequence, those who have the ability to supplement the water received from the tank with wells are growing sugarcane at the tail end and those who do not have a well grow only semi-dry crops during khariff season.At middle reach, those who do grow paddy in khariff leave land fallow in the rabi season. Thus, it is resulting in unequal distribution and wastage of water in the Kunigal doddakere.

The Alam Khan tank of Raichur district has a command area of 240 hectares. It is managed by the PWD from 1966. Though the water-spread area of this tank is 127 hectares, the water is not sufficient even for 12 hectares of paddy in the khariff season. Only during the rabi season few more acres can get some water to irrigate semi-dry crops. The LBC and RBC have not been desilted from a long time. As this tank is located in black- cotton soils area, the distributories and canals were lined. Today due to accumulation of silt and weed, the linning has withered away at many places (Photo 7). In such places, the canals and distributories are broken and a lot of water is wasted. As a consequence, it has not been possible to irrigate more than 12 hectares of paddy in khariff. Thus, the conserved water in a low rainfall and a drought-prone area (Deodurga taluk) is going as waste.

In Hospet taluk of Bellary district, Kamalapura tank is at the terminal of the Basava canal, a diversion from the river. The command area of this tank consists mainly of black soils, and three semi-dry crops were grown in a year. After the tank was linked to the low level canal (LLC), drawn from the Tungabhadra dam, the tank panchayat was superseded by the command area development agency.

With the linking of the tank to LLC, the farmers have changed their cropping pattern from semi-dry crops to paddy and sugarcane. These two new crops are rotated every year. Because of cultivating only paddy and sugarcane, today even if the tank overflows, it is difficult to raise a crop in summer, unless the tank receives water from LLC.

Water Management and Ground Water Levels

Water management will have a bearing on the environment around the tanks.. If water impounded in a tank is conserved throughout the year, it helps in recharging the ground water, which will be helpful in irrigating the area outside the command area and also in meeting the domestic requirements such as drinking and washing.

In the case of tanks where panchayats are still functioning, natural springs are still alive. Even in low rainfall areas such as Tallaku (455 mm), and G.G. Halli (720 mm), they are irrigating fields around them. For example, around the Basava spring canal in Tallaku about 40 acres are irrigated. In G.G. Halli about 30 acres area irrigated by many spring canals. Areas where water management is administered by the Department even in the event of a rainfall of 760mm, ground water is depleted, as in the case of Kunigal tank. Very next to the tank one has to dig a well upto the depth of 150 feet to 200 feet to strike ground water.

The panchayat and Nirganti system are disappearing in the case of many tanks, especially where they are located at the beginning of the series or at the middle. The reasons are physical as well as institutional. Physically, those tanks that are at the beginning of the series are loaded with silt thereby decreasing the capability to withhold water. Insitutional impact can be found to be a cause for the disappearance of the panchayat in such tanks which are situated at the middle of the series.

The changes that have been brought about in the catchment area of those tanks which are at the beginning of the series appear to be the major cause for the disappearance of panchayats. These beginners being located at the foot of the catchment for a series of tanks they were functionally supposed to act as silt traps even under normal conditions such tanks received greater amount of silt once the catchment area was brought under cultivation. The increased silt deposit proportionately reduced the water holding capacity of the beginners. This, in turn, reduced the area to be irrigated in year and consequently, with the reduction in their income, the nirgantis, had to work for alternatives. As a consequence, where the beginners had

a 'Nirganti' system, it has to be disbanded.

In Savanur of Doddaballapur taluk, there were three tanks located at various depths of contour in the catchment. After this catchment was brought under cultivation in 1950s and 1960s, the tank called 'Hosakere or 'new tank, first in the series, silted up totally. Following that the gowdanakere silted up totally. At present the proper savanur tank is in the process of silting. This tank overflows with every rainfall and carries all silt from the catchment to the Hanabe tank lower down in the series. The increased silt deposit in the Hanabe tank has affected crop production from the last ten years. Only those who are able to have wells in the command area are irrigating their fields. Others, who are not in a position to own a well have converted their fields in the command area into rainfed areas. Nearly 3/4th of the tank bed is encroached. With the tank losing its importance as a major source of irrigation, the panchayat and Nirganti system of the Hanabe tank are disbanded. Following this, the Hanabe tank, the Aralumallige tank, the next in the series also has been affected, and from last three years the panchayat system and nirganti system are abandoned in this tank also. Kerebiduru tank was the terminal tank for a series running down almost from Raichur town about 30 kms. This huge catchment area had series of Kattes and Kuntes which were in the past providing water for irrigational purposes. Release of forest areas for cultivation in the catchment and subsequent silting of kattes and kuntes has affected the holding of Kerebudunur tank. Today, upto its waste weir, silt is collected and attempts are being made to get the tank bed to be distributed for cultivation purposes. This has affected the traditional water management systems. Today, none of the traditional water management systems are functional.

If the physical factors are responsible for disbanding the panchayat and the nirganti systems for the tanks at the beginning of the series, the institutional factors such as abolition of hereditary village offices, abolition of land grants; changes brought about in the cropping pattern, etc., are responsible for abandoning the panchayat and nirganti systems in many tanks located at the middle of the series.

It was explained earlier that it was a normal procedure for the

zamindar or the village headman (Patel) and revenue collector (Shanubag) to be the presiding officers of panchayats managing the water in a tank. As these offices were hereditary, they were abolished in Karnataka in 1976 and such offices were succeeded by officials called Village Accountants. The Patel and Shanubag being resident farmers and big land owners had an interest in the rational utilization of water. The socio-economic status of these officials also helped in exercising control over other beneficiaries in the command area. The village accountant is the lowest official in the revenue cadre and often a non-resident and not a farmer. As the panchayats in charge of water management are informal organizations, village accountants being officials, they do not participate in any of the meetings, nor able to excerise any power as that is not prescribed as part of their official work. In those places where the patel or the shanubag could establish themselves politically the panchayats have survived. wherever they could not do so they have been disbanded.

In G.G. Halli the two shanbags who were presiding officers in the traditional panchayats were able to establish themselves politically also. Each one of them could become Chairman of their respective village panchayats. Similarly, in Tallaku also, the presiding officer of the panchayat was able to become chairman of village panchayat. In Sakalavara of Anekal taluk in Bangalore district, the presiding officer could not gain the status of a chairman of village panchayat, and as a consequence, the panchayat could not survive for a long time.

With the abolition of hereditary offices, the position of Nirganti system was also abolished. Further, the Nirganti system also was affected by the abolition of the inamdari system. Though the abolition of inamdari system helped the individual nirgantis to gain ownership rights to the piece of lands that were granted to them for working as Nirganti, the control that panchayats had on Nirgantis through granting that piece of land was lost. The panchayats, earlier to the abolition of inamdari system could withdraw the grant or restrict the usage on such lands of those Nirgantis who do not perform their part of work efficiently. Having lost that power, once the ownership is conferred on Nirgantis, the panchayats could not compel the

Nirgantis to implement the decisions they took. As a result, many panchayats have to be disbanded.

The land grants awarded to Nirgantis, as explained earlier, was for a family at the time of the construction of the tank. Such grants fragmented into small portions with every succeeding generation. In Sakalavara, land was granted at five acres each for three families of Nirgantis. Now the existing families of Nirganti (39) have less than a quarter acre. Such fragmented land being very small in extent and uneconomical, the families depending on such piece of land are forced to look for alternative occupation. As a consequence, Nirgantis refuse to carry out their duties, as that duty will interfere in performing other occupations on which they presently depend upon.

The changes introduced especially in the irrigated crops are also in a way responsible to discourage the Nirgantis in performing their duties. The introduction of HYVs as a package of green revolution, in a way, has affected the annual income of nirgantis. Cultivation of HYVs with costly inputs commercialised every crop that is grown. As a result, when the payment in kind has to be made to the Nirganti every grower felt it as a loss. Such sense of loss strained the relationship between Nirgantis and the farmers to the extent of calling off the system in village like Sakalavara.

With the cultivation of HYVs of short duration, by a few farmers having larger holdings, the calendar of crops in a command area was also affected. Few fields with HYVs used to mature earlier than the local varieties. By the time local varieties mature, the one who had grown HYVs will be demanding water for next crop. As a result, it became difficult to follow uniform pattern to release water and to distribute such released water, as the requirement of each beneficiary was different from one another.

Along with HYVs, commercial crops like cotton, mulberry, sugarcane, etc., gained importance. The water requirement of each of these crops was different from one another. For many panchayats it was not possible to draw different patterns of water distribution for different crops. As a consequence, conflicts developed between the

beneficiaries and the executives of the panchayats as in the case of Hebbalagere in Chennagiri taluk. The conflict resulted in disbanding the panchayat.

When Panchayats are disappearing slowly from the scene, the Department is experimenting to form similar type of organizations for newly constructed tanks with the financial assistance of the World Bank. Such attempts are called "Farmers' participation in water management." The experiment aims at developing an organization of beneficiaries wherein beneficiaries themselves will decide the type of crop to be grown uniformly within the command areas, the time and quantum of water to be released, nature of distribution, desilting of canals, etc.

In all the command areas of a new tank farmers organizations are developed even before water was let out for irrigational purpose. A representative from each canal is elected to an executive body, which is once again presided over by an elected person called 'Chairman'. To this body, the local engineer and agricultural officer are also ex-officio members. The distribution of water is looked after by 'Sowdis' who are paid a salary by the PWD. To assist the farmers, schedule of time of water release to each field is displayed.

The PWD through its representative who is a Junior Engineer will help the executive body of the farmers organization in getting the type of works they require to and also exercise his official position to check any misutilisation of water, etc. The agricultural officer suggests the type of crops to be grown with the available water in the tank. Further, the agricultural officer raises demonstration plots of the crops that are recommended.

This experimentation in a way is relevant in understanding the relative merits of officials and farmers organizations in managing water efficiently, in checking the illegal utilisation of water, etc. In one of the tanks (Yadarahalli) under experimentation, at the first outlet, unauthorised utilisation of water by tampering the outlet was noticed during rabi season of 1986-87. The beneficiaries in other outlets informed the unauthorised utilisation to the engineer concerned. The engineer made an oral request and also broadcast on the radio

to desist farmers from drawing water unauthorisedly. The problem was not solved by such efforts. On the other hand, it got aggravated into a conflict when the gate to the first outlet was broken, among the beneficiaries who grow crops of four monts duration and those who grow crops of six months duration. A few at the first outlet had grown paddy and sugarcane much against the recommendations of the agricultural officer. These differences has encouraged unauthorised utilisation of water. Similar situation arose during khariff season of 1987-88.

The methodology chosen by the officials to control unauthorised water use and violation of cropping pattern was to make requests orally and through radio. When such requests did not materialise, the officials had to resort to lodging police complaints against such people in 1987-88. But the situation was brought under control both the times by the farmers organization, who could persuade the beneficiaries through their representatives not only to stop unauthorised utilisation but also to repair the damage they have caused to the outlet at their own cost. The methodology the farmers adopted was not the use of force like police, but social pressure that an united social organization can provide. Therefore, it is essential to understand that more than the power of the state exercised through its official machinery, it is the social pressure which emanates from the united social organizations, that can compel an individual to obey the decisions of the collective for the conservation and utilisation of water.

Chapter 5

AGRO-CLIMATIC ZONES, RAINFALL, DROUGHTS AND TANKS IN KARNATAKA

The geographical area of Karnataka (1.92 Lakh sq. kms.) is divided into four climatic regions: coastal regions, western ghats or Malnad region; Northern maidan region and the Southern maidan region. Each climatic zone varies widely from each other due to differences in topographical conditions and quantum of rainfall. The coastal region is characterised by very heavy rainfall during the monsoon season, ranging upto 8,000 mm. This area comprises of Dakshina Kannada and the South-western parts of Uttara Kannada. The western ghats or malnad is the region that includes the mountaneous terrain and forest areas lying to the western edge of the ghats. The south-western part of Belgaum district, the northern and eastern parts of Uttara Kannada district, the extreme western parts of Shimoga and Chikkamagalur districts; the south-western parts of Hassan district, most of the Kodagu and the extreme south-western parts of Mysore district are identified as western ghat or malnad region. This climatic zone is called "Climatic Divide", as it forms the main watershed due to very heavy rainfall it receives. The rainfall on the western ghats ranges from 4,000 mm to 8,000 mm. This high rainfall keeps decreasing towards the east and at the fringe of the area the rainfall will be about 2000 mm.

The northern maidan region comprises of Bidar, Gulbarga, Bijapur, Raichur, Bellary, Dharwar and north-eastern parts of Belgaum district. This climatic zone is an extensive undulating plateau with elevation ranging from 1050 feet to 1950 feet. The highest rainfall of 1500 mm is received on western parts of the zone and it keeps decreasing eastwards upto 500 mm of rainfall.

The southern maidan is an undulating plateau having an elevation ranging from 1000 to 3000 feet. Almost half of the southern part of the state falls within this region. The annual rainfall in this region ranges from 460 mm in the eastern fringe to 2000 mm in the western fringe. The districts that form this region are Chitradurga, Tumkur,

distributories are neglected. The panchayat of Madura tank was superseded and today the LBC canal is in a dilapidated condition. The stone revetment given to it at the beginning of the canal is collapsing. The canal is silted up here and there. The RBC of the same tank has silted up to a height greater than the sluice outlet. As a result, the beneficiaries of RBC are not in a position to draw water.

Compared to the Madura tank, the State of the Kunigal Doddakere is much more deplorable. Traditionally Kunigal doddakere tank had a Panchayat of six people headed by the zamindar of kunigal town. The members were selected on distributory basis. This committee was superseded in 1957. Today, the Department is not in a position to desilt all the canals. The consequence is that tail-enders at Biledegula are not in a position to receive water. Out of the 148 acres to be irrigated at Biledegula, paddy crop is grown not even in a single acre. Many farmers have converted their wet-lands into dry, rainfed crops.

The only exception is the Parashurampura tank the farmers have continued their traditional system of water management. In this system, even though the executive body is disbanded each canal has a committee to distribute water. These committees have an understanding with government appointed Chowdis, who were earlier Nirganties. As a consequence of this understanding the panchayat is able to continue its rational system of water management. Even though the panchayat is superseded by the PWD, the Nirgantis do compel the farmers to desilt the canal and distributories before water is let out. If a canal or distributory is not desilted, water is not let into such canals. In those years when every farmer will be busy in harvesting the groundnut crop, each beneficiary will contribute at the rate of Rs.10 per acre and request the Nirgantis to engage labourers to get the canal desilted.

In such tanks, where Panchayats are still functioning, the desilting of canals activity is carried out regularly till the silt in the canal is entirely removed. As a result, the flow of water in the canals is not obstructed and in such tanks no major changes are found in the cropping pattern or loss of crops in any year (details elsewhere).

Kolar, Bangalore, Mandya, north-eastern parts of Mysore and Hassan districts and eastern parts of Chikkamagalur and Shimoga districts.

To identify a homogenity, the maidan regions are further divided into 'Agro-climatic zones' on the basis of rainfall pattern, soil types, elevation, topography, vegetation and cropping pattern. Such division will help in appreciating the role of climatic factors in the development of irrigation. The three agro-climatic zones of northern maidan regions are: north-eastern transition (NET) zone, north-eastern dry (NED) and northern dry zone (NDZ).

The southern maidan is categorized into four agro-climatic zones, central dry zone (CDZ), Eastern Dry Zone (EDZ), southern Dry Zone (SDZ) and Southern Transition Zone (STZ).

The North-Eastern Transition Zone (NET) has a rainfall ranging from 829 mm to 919 mm characterized by an elevation of 800-900 metres and possess shallow to medium black clay soils. There are totally seven taluks in this region. Out of such taluks, five are from Bidar district and two are of Gulbarga district.

The North Eastern Dry Zone comprises of eleven taluks in the State. Eight taluks of Gulbarga district and three taluks of Raichur district form this region. The annual rainfall in this zone ranges from 633 mm to 806 mm and the elevation ranges from 300 to 450 metres. The soils are black cotton or vertisols with deep to very deep clay and it is shallow in a few small pockets .

The Northern Dry Zone (NDZ) is thebiggest agro-climatic zone in the state, encompassing 35 taluks or almost three-fourth of the geographical area of northern maidan. This zone with an elevation ranging from 450-800 metres, receives an annual rainfall ranging from 464-785 mm. The soils found in the region range from medium to deep black clay in most places of the area. In small pockets sandy loams are also found.

The Central Dry Zone (CDZ) encompasses nine taluks of Chitradurga district and six taluks of Tumkur district as also four taluks of the Malnad region. The average annual rainfall in this zone ranges from

455 mm on the eastern fringe i.e., Challakere taluk of Chitradurga district to 717 mm on the western fringe (Shikaripura taluk of Shimoga district). This zone has an elevation ranging from 2100 to 2700 feet. Certain places of the area have an elevation ranging from 2700 feet to 4500 feet. Major soils are red-sandy loams, but in few places shallow to deep black soils are also found.

The entire Bangalore and Kolar districts form the Eastern Dry Zone (EDZ) along with two taluks of Tumkur adjoining Bangalore and Kolar districts. The total number of taluks in the zone are 24, forming the biggest block in the southern maidan. The normal elevation range from 2400 feet to 2700 feet, and in some areas, the elevation ranges from 2700 to 4500 feet. This EDZ has a rainfall ranging from 680 mm to 890 mm. The type of soils that are dominant in this region are red-loamy. A few pockets have clay lateritic soil.

The Southern Dry Zone (SDZ) is constituted by entire Mandya district and eight taluks of Mysore district and two taluks of Tumkur district. In this zone, the elevation ranges from 2400 feet to 2700 feet and the average annual rainfall ranges from 670 mm to 840 mm. The dominant soils are red-sandy loams but black soils are also found in isolated pockets.

The Southern Transition Zone (STZ) consists of three taluks of southern maidan belonging to Mysore district, the rest of the taluks (10) are from Malnad region. Five taluks of Shimoga, four taluks of Hassan and one taluk of Chikkamagalur district form this region. The annual rainfall ranges from 611 mm to 1054 mm. the major soils are red-sandy loams and red-loamy soils.

The other agro-climatic zones of the State are the Hilly Zone (HZ), the Northern Transition Zone (NTZ) and the Coastal Zone (CZ), of these, the significant one from the point of view of rainfall is the CZ where rainfall ranges from 3010 mm to 4694 mm. In NTZ rainfall varies from 620 mm to 13,003 mm. Ten taluks of Dharwar district and four taluks of Belgaum district constitute this zone.

Depending on the quantum of rainfall in various regions, the agro-climatic zones of Karnataka are grouped into "Arid-areas" and

"Semi-arid areas". Those agro-climatic zones like NDZ, CDZ and SDZ where the annual rainfall is less than 750 mm are grouped as "arid areas" and such of those regions, NDZ, EDZ, STZ and NTZ where annual rainfall is between 750 mm and 1150 mm are grouped "semi-arid areas". Above threefourths of the area of the State (153.22 lakh hectares) or 80 percent falls within these two areas. 92 percent of the net area sown is classified into these two groups. Which means that the state has to meet its food resources within these areas (80 percent) having a low rainfall ranging from 750 mm to 1150 mm to 1150 mm (GOK, BES 23, 1984). Aridity and semi-aridity result from the evaporation (including transpiration) being larger than the rainfall. The arid and semi-arid regions being located at the rainfall shadow regions of Western Ghats they suffer both from low rainfall and high evaporation. Even though the rainfall ranges from 750 mm to 1150 mm, these regions especially arid regions receive only 600 mm of rainfall with a coefficient variation in NEDZ (36 percent) followed by NTZ (34 percent). The number of rainy days in these regions is less than 50, compared to a cropping season of about 115 days or more (Ramaprasad and Kirthi Malhotra). Added to the limited rainy days is the high evaporation which affects the water balance. A study conducted at Mangalore, Belgaum, Bangalore, Mysore and Bellary reveals that when evaporation reaches its peak around April-May, shortage of water is experienced at the stations especially in the arid areas like Bellary, which has water shortage throughout the year. Whereas in semi-arid areas like Bangalore and yosre, the water shortage is partial (Ramaprasad and Kirthi Malhotra, 1984).

The difficulties that arise from shortage of water or low water balance is due to the total dependence f arid and semi-arid regions on the south-west monsoon (SWM) which arrives around June and lasts till September. In the arid and semi-arid areas the contribution of south-west monsoon ranges between 75 percent and 25 percent and the coefficient variation ranges between 30 and 40 percent. Whereas annual participation in semi-arid region is 62 percent and 57 percent in arid region, 60 percent of the geographical area of the State is totally dependent on SWM. Hence, the SWM is very crucial in the calendar of crop production in Karnataka. The peculiar

characteristics of climatic conditions have made these arid and semi-arid regions susceptible to drought with any or little variation in SWM. To counter such susceptibilities, irrigation is essential. To develop such irrigational facilities rain water is impounded for irrigational purposes in the form of tanks in the arid and semi-arid regions.

Understanding the complimentary role of irrigation in crop production and the relative freedom i provides from the vagaries of monsoon, tanks have been constructed for irrigational purposes taking into consideration the geographical, and topographical factors and the nature of soils in each region. In the arid and semi-arid regions of Karnataka tanks irrigated an area of 12,04,321 acres (Table 5.1). The highest area irrigated by tanks is in Shimoga district (2,16,596 acres) followed by Dharwar (1,49,370 acres) and then Hassan district (1,43,833 acres). Tanks play a predominant role in agro-climatic zones where redloamy soils are predominant. In regions where black soils predominate, tanks do not play a significant role as black soils are not suitable for irrigational purposes. The black cotton soils have a high water retentive capacity and a poor capacity to drain. As a consequence, irrigation in such areas affect the soil and develop salinity, alkalinity and water logging.

Rainfall in Karnataka, apart from creating arid and semi-arid conditions, brings about drought at frequent intervals. It is estimated that drought like condition will occur once in four years, in the southern maidan region and once in two years in the northern maidan region. As a consequence, it is estimated that about half of Karnataka is drought prone comprising of almost the entire area of the state to the east of the line joining Mandya and Shedbal. This region is characterised by rainfall of less than 600 mm and a coefficient variation of more than 25 percent. (Ramaprasad and Kirthi Malhotra, 1984). An examination of the number of tanks in Karnataka, shows clearly that it is in the districts falling within drought affected regions that tanks are found in large numbers. Especially, tanks that have a capability to irrigate above 500 acres are more in number in this region. Tanks in this region were to impound the rain water for irrigational purposes and also to recharge the ground water,

which is, once again, used for irrigational purposes through wells.

A study by the Bureau of Economics and Statistics report that an analysis of rainfall over 80 years for 19 districts indicate 20 years of drought. From 1953 to 1964, the State was free from droughts, whereas from 1971-1982, the state experienced four droughts. The highest number of droughts (32 in a 75 year period) suffered was by Mandya, Mysore, Kolar, Tumkur and Chitradurga districts in the semi-arid region. The largest continous period of drought for eight years was experienced by Athani taluk of Belgaum district, Chincholi taluk of Gulbarga district, Naragund taluk of Dharwar district, which are in the arid areas. In the semi-arid area Gubbi taluk of Tumkur district is the only one that has suffered from drought consecutively for eight years.

The normal reasons held out for the occurrence of drought are high deviation in the rainfall and low quantum of rainfall. Once again, an analysis of 20 years of rainfall from 1961-1981 by Bureau of Economics and Statistics shows that the deviation in the average annual rainfall shows a high variation (-41) only during cold weather period. Whereas in other seasons where rainfall is important for the crops, south-west monsoon and south-east monsoon do not show much variation. In fact, it is reported that the south-west monsoon which contributes about 75 percent of the rainfall required for crop production in Karnataka show a variation of only one (-1) percent, which can be treated as insignificant. The South-East monsoon (SEM) which is crucial for the agricultural economy of the state in the form of rabi crop the average deviation of SEM in two decades (1962 to 1981) is reported to be more or less normal (GOK, BES 23, 1984).

An analysis of the intensity of rainfall shows that the pattern of South-West Monsoon between 1962 and 1981 was normal for eight years, for seven years it was above normal (Table 5.2). The north-east monsoon followed absolute similarity with the annual year wise rainfall in that, for as many as nine years, it was normal for the rest six years.

Independent of the results that the analysis of rainfall can show the state was supposed to have experienced dry years almost

continuously from 1952-53 (Tabel 5.3), according to a government publication. Supporting the Statement, ground water level has receded by 5 metres in the state from 1980-86. As a result, shortage of water for drinking and irrigational purposes has been experienced from 1984. Such shortages are termed as ground water drought and surface water drought respectively (J. Bandyopadhyay, 1987).

An examination of the areas irrigated by tanks and the number of crops raised per year in the command areas irrigated by tanks, shows that from 1975 onwards, even though there is no drastic reduction in the quantum of rainfall, the net area irrigated by tanks is declining. In Kolar district the net area irrigated has been reduced from 44,324 hectares to 33,279 hectares by 1983-84. Similarly, districts in EDZ also show a decline in the net area irrigated by tanks.

In NDZ, Raichur district of NDZ during 1964-65, 5834 hectares were irrigated by tanks, but by 1983-84, it was reduced to 2369 hectares. In the same period, other districts like Belgaum, Bijapur and Gulbarga of the same agro-climatic zone have gained due to the construction of tanks.

The reduction in the net area irrigated by tanks apprears to be common even in those agro-climatic zones called transitional zones, unless new tanks have been added to that zone. Even in those districts which are in the southern transitional zone (STZ), the reduction is apparent inspite of this area being located in Malnad region where rainfall is as high as 2000 mm. In Shimoga district the net area irrigated by tanks has decreased from 65,628 hectares in 1965-66 to 61,586 hectares by 1983-84. Similarly, in Hassan district also the reduction for the same period is from 36,758 hectares to 30,908hectares.

In the North Transitional Zone (NTZ), there i a decline in one district (Dharwar), whereas an increase in another district (Belgaum). The net areas irrigated by tanks in Dharwar district has continuously declined from 4,84,464 hectares in 1965-66 to 32,720 hectares by 1983-84. In Belgaum district there is an increase from 5759 hectares in 1965-66 to 9705 hectares by 1977- 78. But later on, there is a decline, and by 1983-84 only 8108 hectares were irrigated by tanks

in Belgaum district.

In the Central Dry Zone (CDZ), Chitradurga is the largest district. In this district, where tanks have played a great economic role in the past, they are losing their significance due to the reduction in the net area irrigated by them (Table 5.4). In 1965-66, in Chitradurga, 16,657 hectares were irrigated by tanks. In 1970-71 it was 17,380 hectares but by 1983-84 only 10,687 hectares were irrigated by the tanks in Chitradurga district.

Bellary and Bijapur districts are entirely in the Northern Dry Zone (NDZ). These districts present a totally different picture with regard to net area irrigated by tanks. In Bellary it decreased from 6629 hectares in 1965-66 to 5672 hectares in 1970-71. Then on, it declined by 1983-84 to 4850 hectares.

The decline in the net area irrigated by the tanks in almost all the zones prompts a conclusion, that not only the ratio of area irrigated by tanks to that of total irrigated area has decreased, but in the net area irrigated by the tanks also there is a decline. Which means that though the potentiality of tanks to irrigate is high, it is not fully utilized. This reduction in the capability to irrigate the potential area as understood earlier, is not due to shortage of rainfall. South-west monsoon is the major contributory and as established earlier, there is no significant deviation in SWM. Therefore, for the reduction in the net area irrigated by the tanks in all the zones, rainfall does not appear to be the factor responsible.

The reduction in the capability of tanks to impound water has many deleterious effects on the environment. Firstly, it causes dry conditions as there will be a reduction in the atmospheric water vapour. Once the atmoshpereic water vapour is reduced inspite of normal rainfall, less quantum of water will be available for evaporation and precipitation. In such a situation, the roots of crops search for the sources that will be available within the sub-soil as moisture. At that point, through capillary action plants try to get water if the ground water levels are at a lesser depth. When tanks fail to withhold water successively, the ground water level may also reach greater depths, as the rechargeability is limited to a few months in a year. Such

depleting levels will not help capillary action and as a result even sub-soil moisture is denied to plants. As a consequence, there will be, on the one hand, surface soil-moisture shortage and on the other, there will be ground water shortage (J. Bandyopadhyay, 1987). In such conditions, the time for any crop to wilt is high due to shortage of sub-soil moisture and ground water. Hence, the crops whither quickly creating a drought like condition especially in the arid and semi-arid regions. (Khushalini and Khushalini 1971, Dhakshina Murthy).

Another effect of the reduction in the capacity of tanks is the immediate shortage of water to crops. To supplement such shortage, wells may be preferred. But wells having link with the level of water in the tank, will drain off the impounded water in te tanks within a short time. As a consequence, physically even though the quantum of impounded water would have been similar to the previous years it may not last long enough, due to draining by wells. Within short time, the chain relationship between the sub-soil zone where capillary action is possible and the ground water is broken. Such a break, will speed up the process of wiltage of crops Khaushalani and Khushalini, 1971).

Thr prevalence of prolonged dry condtions will affect the texture of soils. Such an impact will reduce the capability of soils to have a continuous chain relationship with ground water. As a consequence, there will be higher dependency on ground water for irrigation. With which gradual depletion occurs and in proportion to such a depletion dry conditions prevail. As a consequence, even normal rainfall will appear to be in shortage. Such shortages are regarded as 'droughts'.

Table 5.1: Area Irrigated by Tanks in EDZ, SDZ AND NDZ of Karnataka

	AREAIRRIGATEDBYTANKS					
	With Atchakat 10 to 50 acres	Atchakat 50-100	Atchakat 100 to 500	Above 500 acres	Less than 10 acres	Total
Bangalore	23,947	16,366	38,492	17,714	26,502	96,519
Kolar	45,999	24,681	47,580	19,407	33,279	1,37,667
Tumkur	19,338	21,969	63,973	43,989	32,609	1,41,573
Chitradurga	2,902	6,427	34,779	27,826	10,687	82,621
Chikkamagalur	22,864	6,591	13,833	14,666	2,171	60,125
Hassan	59,339	25,539	22,971	5,076	30,908	1,43,833
Shimoga	71,864	43,369	69,811	9,458	22,094	2,16,596
D.Kannada	3,678	1,578	1,940	-----	-	7,196
Kodagu	15,583	4,711	1,904	-	-	20,294

Contd. in page 85

Table 5.1 (Contd.)

	AREAIRRIGATEDBYTANKS					
	With Atchakat 10 to 50 acres	Atchakat 50-100	Atchakat 100 to 500	Above 500 acres	Less than 10 acres	Total
Mysore	13,069	7,700	26,168	38,774	7,028	92,739
Mandya	10,751	6,623	20,219	66,102	26,369	61,128
Dharwar	35,982	20,917	66,102	26,369	11,559	1,49,370
U.Kannada	26,642	9,658	13,401	1,856	-	51,557
Belgaum	8,563	9,254	29,310	22,314	1,567	71,008
Bijapur	291	404	10,584	23,053	5,676	34,332
Bellary	1,889	4,207	10,584	6,956	4,858	28,494
Gulbarga	5,116	4,207	12,108	13,986	5,542	43,079
Raichur	5,086	4,103	10,389	10,124	2,369	32,071
Bidar	495	881	8,021	8,705	-	18,102

Source: Extracted from records in Directorate of Economics and Statisicts, Bangalore.

Apart from the desilting activity, the panchayats were also responsible to prevent misutilisation, abuse and diversion of water from command areas. In Gottalagollahalli, of late, 40 acres of dry land has been added to the existing command area by converting them into wet lands. The panchayat has not allowed the owners of these lands to draw water from the tank. Only when there is surplus water they are allowed to draw water.

In Talaku village, unlike other places, the panchayats do not allow those who have wells in the command areas to draw water from the tank for the reason that the well owners have a resource which should be used first. Secondly, the panchayat is of the opinion that as the wells do draw water in the tank in the form of ground water, one should not be allowed to have access twice to the same sources.

Compared to the above two cases, in the Kunigal tank, where the panchayat is superseded, there are sixteen points on the RBC (Ramabana Canal) diverting the water flow from the main canal to their wells situated outside the command area and pumping the same to the lands lying outside the command area. Further, on the right side foreshore area of Kunigal doddakere, canals are dug from the tank bed to the small wells on fringes of the tank to feed the lands situated at a higher altitude than the tank. All the wells are energised by the State Electricity Board. In actuality, the PWD should have penalised such people who indulge in pilfering water, but so far only a few cases have been registered and no legal action is initiated by the PWD or by the taluk level irrigation committee.

The arrangement for equitable distribution of water to every piece of land and for the implementation of decisions taken by the panchayat, was with an another institution called 'Nirganti'. Nirganti literally means 'Knotting the water', but functionally, it is the harnessing of water by checking its tendency to flow freely. The one who controlled the water in the command areas of all types of tanks was called 'Nirganti'. The only difference was that the command areas of tanks at the beginning of the series had only one Nirganti, whereas those that are at the middle of the series had two or four; the terminal tanks has several of them, depending on the size at the command area a

Table No. 5.2: Distribution of rainfall according to its intensity in the two decades (1962 to 1981) in the State.

Sl. No.	Classification	S.W. Monsoon (No. of years)	N.W Monsoon (No .of years)	Annual (No. of years)
1.	Above normal	5	5	5
2.	Normal	8	9	9
3.	Below Normal	7	6	6

Source: Extracted from records in Directorate of Economics and Statisicts, Bangalore.

Table 5.3: Development of Drought in Karnataka 1957-75

District	Drought year	Duration
Bangalore (9 taluks)	58-59, 64-65, 65-66, 66-67 67-68, 68-69, 71-72, 72-73	Once in two years
Belgaum (8 taluks)	58-59, 59-60, 60-61, 62-62, 63-64, 64-65, 66-67, 68-69, 71-72.	Generally once in every year
Bellary (8 taluks)	60-61, 61-62, 62-63, 63-64, 64-65, 65-66, 66-67, 68-69 71-72.	Generally once in every year
Bidar (4 taluks)	63-64, 64-65, 65-66, 66-67, 67-68, 68-69, 71-72, 72-73.	Once in two years
Bijapur (10 taluks)	58-59, 59-60, 60-61, 61-62, 62-63, 63-64, 66-67, 68-69, 71-72, 72-73.	Every year
Chikkamagalur (3 taluks)	62-63, 64-65, 65-66, 66-67, 67-68,68-69.	Once in two years
Chitradurga (9 taluks)	58-59, 60-61, 61-62, 62-63, 63-64, 64-65, 65-66, 66-67, 67-68, 68,69, 71-72, 72-73.	Every year

(*Contd. in page 88*)

District	Drought year				Duration
Dharwad (10 taluks)	58-59,	59-60,	60-61,	61-62,	Generally every year
	64-65,	65-66,	67-68,	68-69,	
	71-72,	72-73.			
Gulbarga (10 taluks)	58-59,	59-60,	60-61	61-62,	Generally every year
	64-65,	65-66,	67-68,	68-69,	
	71-72,	72-73.			
Hassan (7 taluks)	60-61,	64-65,	65-66,	66-67,	Once in two years
	67-68,	68-69,	71-72,	72-73.	
Kolar (11 taluks)	57-58,	58-59,	60-61,	61-62,	Generally every year.
	63-64,	65-66,	66-67,	67-68,	
	68-69,	71-72,	72-73.		
Mandya (7 taluks)	57-58,	61-62,	63-64,	65-66,	Once in two years.
	66-67,	67-68,	68-69,	71-73.	
Mysore (9 taluks)	63-64,	64-65,	65-66,	66-67,	Once in two years.
	67-68,	68-69,	71-72,	72-73.	
Raichur (9 taluks)	58-59,	59-60,	60-61,	61-62,	Generally once in
	62-63,	64-65,	65-66,	67-68,	every year.
Shimoga (4 taluks)	60-61,	63-64,	64-65,	65-66,	Once in two years.
	67-68,	68-69,	71-72,	72-73.	
Tumkur (10 taluks)	58-59,	59-60,	60-61,	61-62,	Every year.
	62-63,	63-64,	64-65,	65-66,	
	66-67,	67-68,	68-69,	71-71	
	72-73.				

Source: Extracted from records in Directorate of Economics and Statisicts, Bangalore.

Table 5.4: Net area irrigated by tanks in various districts of Karnataka (area in hectares)

District	1965-66	1968-69	1970-71	1977-78	1983-84
Bangalore	31486	29754	38434	34296	26502
Belgaum	5759	6424	8845	9705	8708
Bellary	6629	8438	5762	4839	4850
Bidar	2090	916	1012	1226	1735
Bijapur	2315	4762	5511	7766	5776
Chikkamagalur	27361	18586	10529	14766	14734
Chitradurga	16657	13106	17380	14788	10687
Coorg	2422	2431	2471	8057	1464
Dharwar	48464	47031	46809	29718	32720
Gulbarga	5772	5216	6090	8441	5574
Hassan	36758	35479	24171	32978	30908
Kolar	44324	31240	36275	32748	33279
Mandya	13241	13380	13541	9729	9630
Mysore	9149	12146	16627	16099	7028
North Kanara	10834	7141	11541	11086	9453
Raichur	5849	4521	3721	4296	2369
South Kanaran	9437	6221	10082	5937	3795
Tumkur	46715	38081	31835	41008	32609

Source: Extracted from records in Directorate of Economics and Statisicts, Bangalore.

Table 5.4: Net area irrigated by tanks in various districts of Karnataka (area in hectares)

District	1965-66	1970-71	1977-78	1985-86
Bangalore	36764	34845	34606	26502
Belgaum	9425	8845	9705	8708
Bellary	8529	8538	5762	4859
Bidar	2080	916	1012	1721
Bijapur	2315	4762	7756	5776
Chikkamagalur	27367	19888	14795	11774
Chikkaballapur	17280	19710	17259	10687
Chitradurga	4232	1431	8057	7467
Coorg	4700	5080	3578	3270
Dharwar	19784	4700	8444	5574
Gulbarga	5775	8125	5775	3909
Hassan	38758	36479	35478	32272
Kolar	43534	37540	37548	9220
Mandya	13241	16908	13841	5520
Mysore	9149	12749	16227	7028
North Kanara	10834	11744	11086	6453
Raichur	3227	4824	4229	2289
South Kanara	5949	6827	10082	3795
Tumkur	45725	47805	31855	32809

Source: Statistical Abstract of Karnataka

Chapter 6

SOILS, CROPS, CROPPING PATTERN AND TANKS IN KARNATAKA

The agro-climatic zones of Karnataka determine the nature and type of crops and cropping pattern on the basis of climate, topography, soils and rainfall. The classification can be summarized as follows:

Sl. No.	Agro-climatic zone	%age of Geographical Area	Crops grown
1.	North-Eastern Transition Zone	5	Khariff; Sorghum, Maize, Cotton and Chillies, Rabi: Pulses, Maize and oil seeds.
2.	North-Eastern Dry Zone	13	Sorghum, Millet, Oil seeds pulses and cotton
3.	Northern Dry Zone	34	Sorghum, Millet, Pulses and oil seeds.
4.	Central Dry Zone	10	Sorghum, Millet, Pulses. Chillies, oil seeds & Cotton to little extent.
5.	Eastern-Dry Zone	8	Millet, Paddy, Pulses Maize & oil seeds.
6.	Southern Dry Zone	7	Paddy, Sorghum, Millet, Pulses and oil seeds/
7.	Southern Transition Zone	7	Paddy, Sorghum, Millet, Pulses and Sugarcane.
8.	Northern Transition Zone	8	Paddy, Sorghum, Pulses, Oil seeds, Cotton and Sugarcane.
9.	Hilly Zone	6	Paddy, Condiments, Spices, Coffee.
10.	Coastal Zone	2	Paddy, Coconut, Arecanut, Cashew, Fruits & Perennials.

The above summarization brings out clearly the cropping pattern in each region of the State. To a great extent, all the agro-climatic regions of the northern maidan and, to some extent, the central region can be identified as the Sorghum region. The southern maidan can be termed as the ragi dominant region and the Hilly Zone and the Coastal region can be grouped together as the paddy zone. These agro-climatic zones based on the type of soils they have can

be further differentiated into two zones. Zones dominated by black soils, and those dominated by red loamy. The red loamy can be further differentiated as red laterite, red sandy loamy, red clay loamy and coastal alluvial.

Black soils can be differentiated into shallow, medium and deep regions (Table 6.1). Depending upon the locally-available soils, variation in the crop pattern can be found. In the CDZ and NDZs, as the percentage of both type of soils dominate various pockets, both sorghum and ragi are grown in the same agro-climatic zone. In the EDZ and SDZ, ragi is prevalent compared to Jowar (Sorghum).

The agro-climatic zones can be further differentiated into regions where crops can be irrigated and where crops do not require irrigation under normal conditions. Paddy cultivation in the Coastal Zone, Hilly zone and in transitional zones are grown under normal rainfall conditions as the rainfall in these zones vary from 900 mm to 5000 mm. Whereas the same crop when grown in SDZ, EDZ and CDZ has to be irrigated since the average rainfall ranges between 750 mm to 900 mm. The same crop does not find favour either in the NED or in NDZ not only due to low rainfall, but also due to unfavourable soils to irrigation. In the agro-climatic zones of Northern Maidan i.e., NETZ, NDZ, and in NED no crop is normally irrigated even when rainfall is low ranging from 464.5 mm to 900 mm. The reason being, the unfavourable black-cotton soils, which has high water retentive capacity. This is very well reflected in the pattern of irrigation found in the state during 1956-57 (Table 6.2). The percentage of net irrigated area in 1956-57 was highest (28) in Malnad region, followed by coastal (21) and southern maidan (12). Whereas it was very low (3) in the northern maidan. The reason being that NETZ, NED, NDZ and to some extent, CDZ are dominated by the black soils.

The black soils are derived from or formed of a variety of rocks which include basalt of Deccan and Rajamahal traps and schists and gniss occurring in Karnataka. The black colour of these soils has been variously attributed to a black mineral; Titanic Magnetite. This magnetite is found associated as a compound particle of hydrated aluminium oxide or as a complex organic compound of iron and

aluminium to the association of organic matter which has high base status and alkaline conditions of the soil.

The black soils can be classified as: deep, medium and shallow. The deep black soils, confined to the Northern maidan are 90 cm deep and are usually dark brown in colour. Percentage of silty clay in these deep black soils range from 40-65 per cent. These deep black soils have a high water holding capacity ranging from 60 to 75 per cent. The permeability of water through these soils is very low ranging from 0.1 to 100 mm per hour. It has a tendency to shrink and swell as the percentage of moisture fluctuates. They are fertile and produce good yield when soil moisture is adequate.

The medium deep soils are found mostly in the north central part of the state (NDZ). These soils are moderately deep (30-90 cm) and are dark in colour. They contain a high percentage of clay (30 to 40 percent). These medium deep black soils have a moderate water holding capacity ranging from 30 to 40 per cent. The permeability rate of water is higher (0.2 to 2.5 cm per hour) when compared to deep black soils.

The shallow black soils are those less than 30 cm deep and are found in minor pockets in NED and in CDZ. The texture of these soils range from gravelly clay loam to clay loam and clay. The water holding capacity of these soils range from 30 to 40 per cent. Compared to other types of black soils, these soils have a higher permeable rate and have a comparatively high draining capability. Therefore, these shallow black soils are best suited for irrigation, when compared to other types of black soils. Due to this reason irrigation plays an important role where shallow black soils are predominant.

The topography of these zones where black soils are predominant, is an extensive and monotonous plateau with an average elevation of about 610 metres. This part of the country has a rolling topography with numerous small and big streams which carry a copious flow for short duration only during rainy days and are dry for the rest of the year. However, in few districts like Raichur, Gulbarga and Bidar tanks are quite frequent and play a dominate role in irrigation. As a result, the flat terrain and low rainfall has not facilitated construction to tanks

on a large scale as in the case of southern maidan.

Inspite of adverse conditions, the northern maidan region has a few tanks. Even then the percentage of net area irrigated (NAI) to net area sown (NAS) is low. But the productivity does not suffer in any way. In fact, exploiting the high water retentive capacity of deep and medium black soils, two to three crops are grown in a single agricultural calendar year. As a result, the intensity of land use is very high in the northern maidan, when compared to the southern maidan (table 6.3).

Even though the dominant soil in agro-climatic zones of northern maidan are black-soils, the prevalence of red laterites and red loamy soils in patches had encouraged construction of tanks for irrigation purposes. Of the three agro-climatic zones in the northern maidan (NET, NED and NDS), the Northern Dry Zone (NDZ) has a larger number of tanks (1003), than any other region. In this NDZ, even though Dharwar district has a large number of tanks, majority of them are in the North Transitional Zone (NTZ). A similar situation can be found in the case of Belgaum district. Therefore, they cannot be included in the Northern Dry Zone. But within this NDZ region, Gulbarga has the highest number of tanks (372), followed by Raichur (361) and Bellary (185). Majority of these tanks are small and are able to irrigate between 10 to 50 hectares, confined to such pockets where red loamy soils are found in that region or in the shallow black soils which have high permeability. The bigger tanks are constructed across a stream or gorge only where shallow black soils predominate. Prevalence of these soils has helped Raichur district to have large number of tanks.

I all the agro-climatic zones of northern maidan, paddy was the main crop during khariff season in the command area of tanks. In Bijapur, Belgaum and Dharwar districts sugarcane was grown. The varieties of paddy that were grown were local, which have higher adaptability to rainfed conditions. These local varieties varied from place to place. In Raichur taluk of Raichur district, Dindiaga variety was grown in Deodurga. Similarly, in Bijapur district the varieties grown are varied.

These local varieties had long time span ranging from 120 to 160 days. This long duration enabled the paddy crop to be transplanted in the month of August-September to utilise the cold season to mature. Further, after transplanting till the plant gained to 10 to 12 inches of height, no water was fed. Even later on, in many parts, where shallow black soils predominated, water was never impounded to prevent the soil becoming alkaline or waterlogged. Water was impounded only in such soils which have proven ability to drain off excess water.

In such soils, where the tendency to turn alkaline on irrigation is great, only vegetables were grown. To upkeep soil moisture irrigation was rarely provided. Normally, vegetables like Brinjal, Chillies and Onion were grown. These vegetables were grown after harvesting the paddy crop, utilising soil moisture available or occasionally by drawing water.

In the past, in many of these districts Jowar, bajra and groundnut was not at all irrigated on a large scale. In 1957-58 the crops irrigated in few districts of this region is given below to provide an idea of the nature of crops irrigated. With the changes brought about in the crops and cropping pattern, the need for irrigation is felt. Today even crops like Jowar finds a place in the list of irrigated crops today (Table 6.4). But the area under jowar, to a large extent and also under food grains in general is decreasing, whereas the area under commercial crops is increasing, especially new crops like sunflower. With the introduction of HYV cotton, the irrigated area under cotton is increasing. Such an increase in the crops and the new cropping pattern requiring irrigational facilities is finding favour with the government. A large number of new tanks and major and medium projects are being taken up in the northern maidan region, under a programme financed by World Bank. Of these nearly 23 tanks were constructed in the agro-climatic regions of Northern maidan (Table 6.5).

The ND zone got a major share (10) in the tanks constructed with the finance from World Bank. Unlike the traditional tanks these are not small tanks irrigating a small command area or confined to red loamy soils or shallow black soils. The new tanks irrigate on an

tank has. When the number of Nirgantis exceeded more than two, there used to be Chief of Nirgantis (Photo 6). This chief may be one among the Nirgantis, usually the elder one was regarded as the Chief or one of the beneficiary my be appointed by the Panchayat to supervise the Nirgantis. In that case, the post will be an honorary post.

The position of Nirganti was hereditary, normally assigned to Scheduled Castes residing in the villages. There are cases wherein member of other castes being appointed as 'Nirgantis'. Every family of Scheduled Caste had a privilege of becoming Nirganti. Even when family was fragmented between brothers, each one of them had a right to become a Nirganti. Every family in case of command areas requiring several Nirgantis were given a chance on an annual rotation basis or on the basis of seasons depending on the number of families eligible to become Nirgantis. The normal method was to have a rotation system to provide equal chance to every family. If a family is fragmented, then the brothers in turn were asked to take up the assignment on a rotation basis. If a village is served by more than one tank, then rotation system was followed separately for each one of them.

The duties of each Nirganti was to summon the beneficiaries for the maintenance of canals and distributories; to let out water into each field according to the crop and its growth level or as advised by the panchayat; to guard crops from stray cattle and to report to the panchayat about individual beneficiaries who have violated the panchayat's decision or has tampered with the water distribution and neglected the annual repairs that have to be attended too. In certain command areas where desilting of canals and distributories is not carried out individually, Nirgantis had to desilt the part of the canal that does not feed any field in the immediate proximity. Further, it was also the duty of nirganti to prevent stealing of green fodder from the bunds in between paddy fields.

The payment for the Nirgantis was made in two ways; Firstly, a portion of the land within the command area was allotted to each Nirganti and secondly, a fixed proportion of the crop that is grown

average more than 300 hectares. Because of this it is difficult to confine the command areas only to red loamy or shallow black soil. As a result, new tanks will have a command area dominated by black soils. The two tanks constructed in Khustagi taluk of Raichur district have medium to deep black soils. Similarly, the Chikkalingadahalli tank in Chincholi taluk has a command area dominated by black soils. The Hassirugnudi tank also in chincholi taluk has black soils in the command area.

In most of the command areas of the new tanks, the cropping intensity even before water for irrigation was provided was high due to prevalence of black soils. With irrigation the intensity will be raised only marginally. This rise when compared to the southern Dry Zone or transition zone is very low, because in ST, NT and SD zones the red loamy soils are highly responsive to irrigation (Table 6.6) (V.M. Rao and Chandrakant)

Only semi-irrigated crops have to be encouraged in the command area of the new tanks in the northern maidan region to prevent the destruction of soils and development of water logging. The crops that are usually recommended are HYVs of jowar, cotton, groundnut and sunflower. The market prices being in favour of oil seeds, farmers prefer to grow sunflower and cotton than jowar or other foodgrains.

The southern maidan is constituted mainly by five districts, Bangalore, Kolar, Mandya, Tumkur and Mysore districts. These are once again classifed into three agro-climatic zones; Eastern Dry Zone,Southern Dry Zone and Southern Transition Zone. Only three taluks of Mysore district fall within the Southern Transition Zone.

This Southern maidan region in general receives a rainfall of 750 mm spread over six months from May to October. The highest intensity is in the months of September and October. Nearly 40 percent of the annual rainfall is received during these two months. Another peak is in the month of May. An examination of rainfall over 50 years shows no marked deviation from the normal rainfall (N.V.Ratnam, 1979).

The average annual rainfall in the State for 20 years (1962-1981) has

been examined by the Bureau of Economics and Statistics. According to their findings, in the cold period i.e, between January and February. There is a deviation of 4 in the case of North-East monsoon, but with regard to South-West monsoon the variation is insignificant (Table 6.7). None of the taluks in the Southern maidan have received rainfall below normal between 1962 and 1981. On the other hand, of the several taluks in Kolar district which normally receive a rainfall below 750 mm, two taluks have received higher rainfall than the normal (Table 6.8). There are three such taluks in Tumkur district two each in Mysore and Bangalore districts. This amply proves that the average rainfall in twenty years (1962-1981) was normal, and for ten taluks in the arid region it was above normal.

The soils in various agro-climatic zones of southern maidan are red sandy, red loamy and laterite soils. Laterite soils are predominant in Bangalore and Kolar districts. The red loamy soils are found partly in Bangalore, Madya and Tumkur districts. Red sandy soils are predominantly found in Kolar, Mysore and partly in Mandya and Tumkur districts. The red loamy has low fertility and low water holding capacity. They are considered as well drained soils. These soils have permeability and the infiltration capacity ranges from 1.5 to 2.5 cms per hour.

Due to the existence of considerably well-drained soils, which have low water holding capacity, irrigation has become indispensable in the Southern maidan to raise more than one crop. Of the total irrigated area in the state nearly 57 percent of the irrigated area is in this southern maidan. Above 20 percent of the net area of southern maidan is irrigated when compared to ten percent in the northern maidan region. Of the districts in this region, Mandya has the highest percentage of its geographical area under irrigation (17.4) due to the extension of water facilities from the Krishnaraja Sagar Dam. Even in the absence of major and medium projects, Kolar and Bangalore districts have 11.3 and 10.4 respectively of their geographical area under irrigation. This has become possible due to the prevalence of a greater number of tanks in Bangalore (2040) and in Kolar district (3947), when compared to Mysore (1370) Mandya (817) and Tumkur (1777) districts.

Over the years, the proportion of irrigated area to tanks is decreasing in a few districts due to the development of wells in Bangalore, Tumkur and Kolar districts and by major and medium projects in Mysore and Mandya districts. The area irrigated by tanks constitute above 20 percent in Bangalore, Kolar and Tumkur districts (Table 6.9)

In Kolar district, during 1956-57 the area irrigated by tanks was 28,800 acres and by wells was 12,400 acres. Even during 1964-65 the area irrigated by tanks (34,938 hectares) was higher than that of wells (16,106 hectares). But by 1968-69, the area irrigated by well was higher (46,969 hectares) than that of tanks (31,240 hectares). It reached a peak during 1970-71, where the area irrigated by wells (67,391 hectares) was almost double than the area irrigated by tanks (36,275). From then on, the difference between the area irrigated by tanks and wells narrowed down, not due to increase in the area irrigated by tanks but due to decrease in the yield of wells. With an increase in the number and density of wells in the district. The yield has declined, along with area irrigated by each well.

In the agro-climatic zone of Eastern Dry Zone, (EDZ) the number of crops grown in a year in the command area of tanks is normally two: one in khariff and one in summer, usually termed 'rabi'. In the Southern Dry Zone (SDZ) the number of crops grown in a year is three:Kar (early monsoon), Mungaru (monsoon) and Hingaru (late monsoon). The timings of these crops more or less coincide with the distribution of rainfall in that particular zone. In the SDZ and EDZ and rainy season is supposed to commence from mid-March or the beginning of April. The number of rainy days in each month varies from zone to zone in various seasons of the year. Since Mandya and Mysore districts receive 26 percent and 25 percent respectively of their normal annual rainfall in between March and May, it will be helpful in growing early monsoon crops (kar). Following the kar crop, the khariff or Mungaru or monsoon crop is grown in the command area of tanks in SDZ. After harvesting the mungaru, an hingaru or rabi crop is grown. This cropping pattern is followed in the transitional zone also. Whereas in EDZ the khariff crop commences in June or July and on the availability of water at the end of khariff, rabi crops will be sown.

In the early monsoon season kar, a mixture of sunhemp, horsegram, cowpea, green gram and black gram are sown. These are sown for the purpose of meeting the household requirement of pulses and also to provide nitrogen to the soil as most of those crops have nitrogen fixing ability. These crops do not normally require irrigation. Following this crop paddy is transplanted in the month of July. While puddling the fields, if the pulse crop is not harvested, it will be ploughed in. After 4 to 5 months the paddy will be harvested and a crop of ragi or jowar will be sown after an interval of one and a half months. This crop is called hingaru. This crop ragi or jola may be interspread with lot of pulses. A few may grow even vegetables.

In the EDZ, due to insufficient rains in the months of March to May, normally no crop is raised. But in the command areas of big tanks, a crop of sunhemp mixed with horse gram will be grown in these months of April or May. This system is resorted to in a few taluks of Bangalore districts. Whereas in Kolar and Tumkur districts, this is not normally resorted to, due to insufficient rainfall. In such places only two crops are irrigated; khariff and summer. Even in these, in the taluks closer to Central Dry Zone, the khariff crop is normally catch crop. Where in farmers closer to CDZ grow a crop, firstly to estimate the water that can be collected in the tank during the monsoon season and secondly, in that a short term ragi crop is grown. Only when the water collected in the tank by end of October is sufficient to grow a crop of paddy, then it will be grown otherwise, either groundnut or ragi will be grown even in summer. In few parts of Chitradurga district vegetables like onion will be grown in summer months.

In few tanks of CDZ in monsoon only ragi crop of 3 to 4 months duration is grown in the command area. This is resorted due to uncertain rainfall in the months June to August. Ragi is grown as a catch crop so that the entire quantum of water that is collected in the tank can be used to grow a paddy crop in rabi season. Normally these people have nursery beds of paddy under rainfed conditions and transplant immediately after harvesting ragi crop.

One of the possibilities that tanks have provided to low rainfall areas

like Chitradurga district, within CDZ especially in taluks such as Hollakere and Hosadurga where annual rain fall is below 500 man, is to grow coconut plantations. In these taluks, the water collected in the tanks is not used for irrigating a paddy crop, but by storing the water in the tank throughout the year. They wish to recharge levels of ground water in the wells. By using wells in the command area coconut plantations are fed. Similar situations prevail in Channagiri taluk of Shimoga district. Coconut Research Centre has attributed the possibility of coconut plantations in such low rainfall areas to high levels of moisture in the soils. In a few taluks of Kolar district, mulberry is grown as a perennial crop in the command areas. In a few other places of Kolar district, vegetables are grown in the summer months.

In both (EDZ & SDZ) zones, sugarcane is a crop that goes as a rotational crop along with paddy. It is usually planted in the months of March-April as an annual crop, to be harvested after 12-13 months. In the early months, in between the crop, vegetables are also grown. In several parts of Kolar and Bangalore district, sugarcane crop is grown in the command area of a tank only if there is a well to supplement water.

Apart from the above major crops that are grown in the command area, it was a practice to grow betelnut and betel leaf garden in the EDZ, SDZ and CDZ and in Transitional zones, exploiting the seepage from the tank bund and also drains at the toe of the bund. This was a perennial crop. In between the trees of betelnut, fruit crops like banana were grown. All along the bunds or at the boundary of the garden many useful trees like pongamia, papaya, tamarind, bamboo, etc. were grown. In between the betelnut trees, coconut trees were also grown. These crops were grown in such an interpersed manner, that it was difficult for sunlight to reach the ground. This type of gardening at the foot of the bund helped to conserve the soil moisture. The extent of these gardens in a command area helped in a way to conserve water for others who are at the middle or at the tailend of the command area. No arecanut garden was provided water from tank for irrigational urposes.

The cropping pattern followed in the irrigated parts of southern maidan has been affected due to the inability of tanks, to withhold water. As explained earlier, the tanks at the beginning of the series and at the middle of the series are losing their capability to withhold water to irrigate more than one crop. As a consequence of depleted ability of the tanks the cropping patterns followed in the command areas of tanks is changing. Such change can be categorized into two: total shift to rainfed crops and change to perennial crops. In a way both these categories signify the continuity in the change that is taking place.

The changes in the cropping pattern under tanks fed irrigated areas have become imminent due to the decrease in the ability of tanks to hold sufficient water. The change will be initially in the form of reduced number of crops, which will be confined to khariff season. At present most of the tanks in the Southern maidan are able to provide water only for one crop. Even under big tanks like Kunigal doddakere, or Parashurampura it is becoming difficult to raise more than one crop, even when there is normal rainfall. In Parashurampura tank, with a very low rainfall of 102.8 mm against a normal rainfall of 455 mm, a crop of paddy was raised in 200 acres in 1976-77. In the following year (1977-78) with a rainfall of 560 mm paddy crop was raised in 254 acres. But in the year 1980 to 1983, even with a rainfall above 400 mm no crop of paddy was grown, despite rainfall ealier to july was more than normal (Table 6.10) and in 1981 the rainfall after July was more or less higher than normal monthly rainfall. Whereas in 1983, when rainfall was higher in months of May, August and September, a paddy crop was raised. In 1983, during khariff season the entire command area was sown with paddy (647 acres) in the rabi season, paddy was grown in 267 acres. Later on, once again, from 1983 onwards paddy crops were not grown in more than one hundred acres in any single year. The cause for not growing paddy during 1983-84 was that the rainfall was not sufficient enough for paddy crop. Therefore, two crops of groundnut is grown in that year. Paddy was grown in a insignificant area .

Similar to the Parashurampura tank, even in the terminal tanks of Madhura in Doddaballapur taluk in 1974-75 at a rainfall of 997.5 mm

against the normal 741 mm, two crops of paddy were grown. In the following year 1975-76 with an annual rainfall of 1232.9 mm once again two crops of paddy were grown. Afterwards the rainfall was 984 mm in the year 1977-78 yet only one crop of paddy was raised in an area of 210 acres. Then on, even with good rainfall which was above normal, no double crop of paddy is grown (Table 6.11). On the other hand, perennial plantation crops like casurina have come to occupy a dominant place in the atchkat belonging to Madhura village. This crop does not require any irrigation at all. Along with casurina, betelnut and coconut gardens are being established with independent wells within the command area of the tank. The causes for such a change to perennial crops is insufficient availability of water from the tank. This condition prevailes despite the deviation not being beyond 75 per cent of annual normal rainfall

In tanks which are at the middle of the series, like Hanabe tank of Doddaballapur taluk, the conditions appear to be a total shift from irrigated crops to that of rainfed crops. In Hanabe, during 1967-68 in a command area of 222 acres, paddy was grown in 109 acres and sugarcane in 82 acres. Later on, the area under sugarcane increased upto a maximum of 180 acres in 1968-69. In that year, paddy was grown in 10 acres. At that time, no rotational system was followed. A monoculture of sugarcane prevailed due to the establishment of a sugarcane factory in nearby Gowribidanur. Later on, the area under sugarcane decreased due to shortage of water and the area under paddy increased till 1972. Then on, only those who could afford independent wells to irrigate sugarcane grew it and those who could not withdrew from irrigating any crop. By 1984-85 paddy was irrigated only in 14 acres and about three acres of sugarcane was also maintained.

Similarly, in Tangali tank, paddy crop was irrigated in 129 acres (52 per cent) in a command area of 250 acres during 1968-69. By 1980 paddy crop was irrigated only in ten acres paddy crop was irrigated but in 1968 groundnut was grown in an area of 17.26 acres. By 1970, it increased to 35.25 acres and in 1971 it was grown in an area of 131 acres. Later on, it declined and by 1980 the crop was grown only in eight acres. Sugarcane was also grown upto 1971, and later on it

Table 6.4: Crops and area irrigated in various districts of Northern Maidan (000 acres)

District	Khariff				Total	Rabi				Total
	Paddy	Jowar	Bajra	Others		Paddy	Jowar	Wheat	Others	
Bidar	-	-	-	-	-	2	1	-	-	3
Bijapur	4	1	-	8	13	-	24	2	14	40
Gulbarga	21	1	-	11	33	3	1	4	2	10
Raichur	20	1	-	2	23	1	-	-	-	1

SOURCE: Report of Krishna-Godavari Commission, 1962, Government of India

was totally discarded. The crop that gained importance was coconut. By about 1975, coconut was grown in 215 acres (86.18 per cent) of the command area.

In Kolar district, the Kanithalli tank of Siddlaghatta taluk has a command area of 72 acres. In 1965, paddy was grown in 43 acres during khariff season. In 1975-76 during khariff paddy was grown in 62 acres and during rabi season in 30 acres. By 1980-81, the area sown with paddy was reduced to 11.03 acres. By 1985-86, no paddy crop was grown in the command area of Kanithalli tank. In between 1980-81 and 1985-86, paddy crop was grown in 23 acres during rabi season only in one year (1984-85).

The Kanithalli tank feeds the tank at Muthur village. This tank has a command area of about 60 acres. From 1981-82 to 1985-86, paddy crop was grown in the command area of this tank only twice. In 1981-82, paddy crop was grown in an area of 30 acres as rabi crop. Another time during 1984-85, paddy crop was grown in an area of 25.10 acres as khariff.

The changes in the crops and cropping pattern in the irrigated area of southern maidan, are no doubt an indication of a decrease in the capability of tanks to withhold water. The factors responsible for such a decrease can be the presence of wells surrounding the tank (refer Chapter on Restoration for details). But above all,the major cause is the breakdown or superseeding of farmers' organizations for distribution of water. If the collected water could have been equally distributed as in the case of Kappalamadagu tank, or Nallur tank or Bodampalli tank it would have been possible to raise a crop (refer Chapter on Water Management for more details) of paddy. Therefore, it is not the quantum of rainfall or the quantum of water collected that is responsible for the tanks to lose their ability to irrigate, but the failure to develop a methodology to distribute the available water and changes in crops and cropping pattern.

Table 6.1: Physiographic particulars of Agro-climatic zones in Karnataka

Sl. No.	Zone	No. of Taluks	AnnualRainfall range (in mms)	Elevation (In metres)	Soil type
1.	North Eastern Transition(NET)	7	829.5-919.0	800-900 in major areas 450-800 Parts of 6 taluks	Shallow to medium black clay soils in major areas. Red lateritic soils in remaining areas
2.	North Easter Dry (NED)		633.2-806.6	300-450 in all taluks	Deep to very deep black clay soils in major areas. Shallow to medium black soils in minor pockets.
3.	North Dry Zone (NDZ)	35	464.5-785.7	450-800 in 26 taluks in remaining taluks 800 to 900	Black clay medium & deep in major areas sandy loams in remaining areas.

(Contd. in page 105)

by a beneficiary in an acre or in one holding is gven if it is less than one acre or a fraction. These payments were made in kind according to the number of crops grown, and it was paid to the individual Nirganti incharge of that particular canal. When the duties of Nirganti were rotated within several families due to fragmentation of a particular family, the payment in kind also fragmented within these families, whereas the land granted to the families was fragmented equally among all the families. As a result, at every succeeding generation, the land got fragmented and the duties to be assigned also become rare.

Apart from payments and honorarium, the Nirgantis had a few privileges which were helpful in accumulating grains or the yield of crops. Such privileges are: the fallen grains at the point of loading the cart and the bottom layer of grains when it is stacked in the threshing yard. Further, if any animal sacrifice is given to ward off the evil forces, the head of the sacrificial animal was supposed to be given to the Nirganti. Nirganti had a right to prevent people from entering the command area. Nirgantis also had a right to stop, any individual of whatever stature by laying down 'lathi' in front of the individual as a symbol to express the complaint about the negligence shown by that particular person in the management of the tank. There is a story that the Nirganti of Sakalavara villageof Bangalore district had stopped the then ruler of the province Sri Jayachamaraja Wodeyar by placing a lathi on his way to a temple, to complain about the negligence shown by the authorities.

The payments in kind varied from place to place, but underlying such payments is the recognition of the need for bth grains and fodder, in equal proportion. Further, whenever commercial crops like sugarcane were grown, the grower was supposed to have paid one block of jaggery for every batch of jaggery prepared. Further, when the vessel for solidifying jaggery was emptied for every batch, the layer sticking to the bottom was reserved for the Nirganti.

Wherever Nirganti system was in prevalence, the beneficiaries had no right to open any vent to let water to the field. It was considered an offense and such a beneficiary was fined by the panchayat. Only

Sl. No.	Zone	No. of Taluks	Annual Rainfall range (in mms)	Elevation (In metres)	Soil type
4.	Central Dry Zone (CDZ)	17	455.5-717.4	800-900 in major areas in remaining areas450-800	Red sandy loams in major areas, shallow to deep black soil in remaining areas
5.	Eastern Dry Zone (EDZ)	24	679.1-888.9	800-900 in major areas, in remaining areas900-1500	Red loamy soils in major areas, clay lateritic soils in remaining areas.
6.	Southern Dry Zone (SDZ)	19	670.6-888.6	800-900 in major areas and 450-800 in remaining areas	Red sandy loams in major areas and in in remaining areas pockets of black soils
7.	Southern Transtion Zone (STZ)	13	611.7-1053.9	800-900 in major areas, partly 900-1500 and partly 450-800	Red sandy loams in major and in remaining areas, red loamy soils.

(Contd. in page 106)

Sl. No.	Zone	No. of Taluks	AnnualRainfall range (in mms)	Elevation (In metres)	Soil type
8.	Northern Transiton Zone (NTZ)	14	619.4-1303.2	800-900 in major areas 450-800 in remaining areas	Shallow in medium black clay and red red sandy loamy soils in equal proportion.
9.	Hilly Zone (HZ)	22	904.4-3695.1	800-900 in major areas 4 taluks 900-1500 in 6 taluks 450-800.	Redy clay loamy soils in major areas
10.	Costal Zone	13	3010.9-4694.4	Less than 300 in major areas in re-maining areas 450-800	Red lateritic and coastal alluvial

Source: Bureau of Economic & Statistics Govt of Karnataka (Extracted)

Table 6.2: Status of Irrigation in Karnataka

Sl. No.	Source of Irrigation	1901 Area (lakh hect.)	1901 Percentage to total	1956-57 Area (lakh hect.)	1956-57 Percentage to total	1981-82 Area (lakh hect.)	1981-82 Percentage to total
1.	Canals	0.56	11	1.65	22	5.80	40
2.	Tanks	2.60	52	3.28	44	3.21	22
3.	Wells	0.60	12	1.29	18	4.01	27
4.	Other sources	1.28	25	1.18	16	1.68	11
	Total of all	**5.04**	**100**	**7.40**	**100**	**14.70**	**100**

Source: Bureau of Economic & Statistics Govt of Karnataka (Extracted)

Table 6.3: Pattern of irrigation according to topographic regions of Karnataka (000 ha)

Sl. No.	Region	1956-57 NAS	1956-57 NAI	1956-57 Percentage of NAI to NAS	1981-82 NAS	1981-82 NAI	1981-82 Percentage of NAI to NAS
1	Coastal	300	64	21	308	96	31
2	Malnad	757	212	28	1020	216	21
3	Southern	2274	278	12	2526	493	20
4	Nothern	6745	186	3	6537	666	10
5	State	10076	740	7	10391	1471	14

Note: NAS - Net Area Sown, NAI - Net Area Irrigated
Source: Bureau of Economics and Statistics 1984

Table 6.5: Number of new tanks constructed with World Bank Assistance in various Agro-climatic zones of Karnataka

Zone	Tank Irrigation No. of	CCA Per tank (hect.)	Projects in various Agro-climatic Zones No. of beneficiaries	Construction cost per tank (million Rs.)
NET	7	517	162	11.5
NED	6	392	182	11.1
ND	10	360	150	10.6
CD	1	48	30	2.4
ED	8	180	145	4.5
SD	9	203	153	6.7
ST	4	464	294	15.0
NT	4	363	193	8.6
HZ	1	150	71	6.1
All tanks	**50**	**327**	**166**	**9.0**

SOURCE: Net Area Irrigated to Net Area Sown has increased from three to ten percent in the northern maidan. The NAI has increased from 186 thousand hectares to 666 thousand hectares by 1981-82, (GOK, BES 23 of 1984). V.M. Rao & Chandrakanth, 1984.

Table 6.6: Indicators of Impact of New Tanks Assisted by World Bank.

Zone	CCA per Beneficiary (in hectares)	Cropping Intensity (%)	
		Existing	Proposed
North Eastern transition	3	-----	-----
North Eastern Dry	2.2	127	125
Northern Dry	2.4	109	120
Eastern Dry	1.2	102	109
Southern Dry	1.3	97	123
Southern Transition	1.6	104	140
Northern Transition	1.9	96	130
All tanks	2.0	105	124

Source: V.M. Rao & Chandrakanth 1984

Table No. 6.7: Pattern of average annual rainfall according to seasons in the two decades 1962 to 1981 in the state

Sl. No.	Seasons	Months covered	Normal Rainfall (in mms)	Average Rainfall (in mms.)	Percentage departure from normal
1.	Cold Weather period	January & February	8.3	4.9	(-)41
2.	Hot Weather period	March to May	142.3	147.7	(+)4
3.	South west Monsoon	June to September	991.7	979.3	(-)1
4.	North East Monsoon	October to December	212.4	204.7	(-)4
All seasons		January to December	1354.7	1336.6	(-)4

Source: BES 1984

Table 6.8: Number of taluks according to normal rainfall and average rainfall (1962-81) in Southern maidan

Districts	Normal Rainfall			Average Rainfall		
	750 mm (Arid)	750 1150 mm (Semi-arid)	1150 mm	750 mm	750- 1150 mm	1150 mm
Bangalore	2	9	-	-	11	-
Chitradurga	9	-	-	9	-	-
Kolar	7	4	-	5	6	-
Mandya	7	-	-	6	1	-
Mysore	5	6	-	3	8	-
Tumkur	7	3	-	4	6	-
Total	**37**	**22**	**-**	**27**	**32**	**-**

Source: BES 1984

Table 6.9: Sourcewise irrigated area in southern maidan region of Karnataka (1983-84)

District	Tanks Total(%)	Wells Total(%)	Canals Total(%)	Other Total(%)	Grand Total	Percentage
Bangalore	26502 (38.24)	37074 (53.49)	37074 (53.49)	2098 (2.93)	69311	-
Kolar	24623 (33.15)	49671 (66.95)	-	33 (0.04)	74327	-
Mandya	9630 (9.54)	7995 (7.92)	81510 (80.75)	800 (1.78)	100935	-
Mysore	7028 (8	- -	- -	- -	-	-
Tumkur	32609 (52.95)	28319 (45.99)	338 (0.55)	314 (0.51)	61580	-

Source: BES 1984

Table 6.10: Rainfall, Paddy and Groundnut Crop in Parashurampura Tank Command Area

Year	Annual Rainfall (mm)	Crops Grown (acres)	
		Paddy	Groundnut
1980	488.9	1.2	215.10
1981	501.0	-	234.39
1982	257.6	-	-
1983	324.5	647	-
1984	169.3	-	324
1985	379.8	24.30	623.10
1986	426.9	16.00	631.00

Nirgantis had the right to open and close the vents. In some tanks, like Tallaku, where it is a problem to provide water to the tailenders, the Nirgantis used to place a seal on the wet soil pack closing the vent in the fields of top reach. If any breach in the seal was found, it was reported to the panchayat. Who used to hear the case and punish the guilty accordingly.

If a beneficiary has a complaint to make about shortage of water, he can do so to the Nirganti and if his request is not honoured, he had the right to complaint to panchayat. Farmers could also complain, if their crops are grazed in khariff season and if green grass on the bunds is stolen. As such times, an explanation was called for and, if found guilt, that particular Nirganti was punished accordingly.

EFFICIENCY OF WATER MANAGEMENT

The merit of any system of water distribution depends upon the extent to which the impounded water is distributed equally among all the beneficiaries for raising the crops. The merit of a system needs to be commended for its efficiency in distribution of impounded water, in a year of low rainfall or drought. The capabilities of a system is put to test in such a situation of scarcity.

From the the point of the efficiency of water distribution, the amount of water collected, the number of crops grown, the technique adopted to distribute water are all important. But for many tanks in Karnataka there is no official system to record the quantum of water stored in each tank. This is equally applicable to tanks managed by the PWD. Traditionally, a stone pillar towards waste weir or in front of sluice was an indicator, but these have become disfunctional due to accumulation of silt. As there is no system to estimate the quantum of silt accumulated, it is difficult to update this measurement stone. In the absence of any measurement, each system has to go by eye view estimation than precise measurement. In cases of eye view estimation, it is the local people who have greater knowledge due to their acquaintance with the tank than the officials who are transferred frequently.

In the Parashurampura tank, of Challakere taluk a unique system of

Table 6.11: Cropping pattern in the command area of Madura tank (1974-75 to 1983-84).

Year	Rainfall	Khariff	Rabi	Casurina	Beatelnut	Coconut	Banana
1974-75	997.5	480.11	156.28	8.24	1.12	0.15	0.8
1975-76	1232.9	468.24	288.24	8.27	1.12	0.15	0.8
1976-77	669.2	250.0	-	3.24	10.12	0.15	0.8
1977-78	984.2	210.25	-	35.15	12.05	3.06	2.3
1978-79	-	130.25	-	126.5	12.05	2.10	2.10
1979-80	-	110.25	-	130.15	12.5	8.06	2.3
1980-81	665.4	35.25	-	183.06	12.5	9.06	2.3
1981-82	-	20.25	-	193.06	12.5	14.05	5.2
1982-83	-	10.25	-	205.15	12.5	17.06	8.2
1983-84	672.3	23.37	-	220.29	12.5	21.15	8.6

Chapter 7

REHABILITATION OF TANKS

With major and medium dams proving to be a big financial loss and impossibility of constructing any major dams due to protests throughout the country, there is a re-thinking on tanks as alternative sources of irrigation. In this light, the possibility of constructing new tanks having been exhausted by our predecessors the only option available is to restore the tank systems in Karnataka. Eventhough rehabilitation of tanks sounds to be available proposition, for many it helps few land holding sections. For many others it is an act which can displace those who are able to own few pieces of land in the catchment or in the fore shore area of a tank. Such doubts though valid have to take into consideration firstly restoration as an act to withhold or to set right those activities which are hindering the tank to perform its potential activities and secondly restoration does not mean enhancing the quantum of water available for irrigation, it is an act which has to make the catchment to yield more. Where in one need not necessarily displace the cultivator. In order to understand how this restoration can be possible, this chapter approaches the issue, firstly listing out all such activities which are affecting the potentiality of a tank, secondly economics of desiltation and to state the possibilities. Rehabilitation of a tank can be defined in two ways - firstly, as an activity wherein the ability of a tank to withhold water to its potential capacity is brought back and secondly, as an activity wherein the efficiency of the tank to irrigate the total potential area is enhanced.

The tank may lose its potential capability to impound water under three conditions; when the bund breaches, when it silts up and when there is leakage in the sluice or seepage from bund. Whenever the tank is affected by any one of the above factors or cumulatively, its potential capability to impound water is affected. Depending on the nature of the impact of each of them, they can be classified as 'instantaneous' and 'cumulative'. The breach in the bund caused by heavy rainfall or any physical changes that can happen within the

bund can be classified as instantaneous, since it will be difficult to forecast such an occurence. The impact will immediately affect the capability of tanks to irrigate. The 'cumulative' effects are those that are dormant, and their incidence and impact could be understood only over the years. The impact of siltation is not immediately perceived, till the dead storage capacity is effected or there is a shortage of water to irrigate the entire command area.

The instantaneous damages to the tanks are a are occurrence. The cumulative effects occur in almost all the tanks.Tanks being impounders of rain water that goes as surface run-off, they are bound to receive the silt from the catchment. Similarly, leakage in the sluices, seepages from the bund etc., are all processes that will be going on at all times. But when such processes threaten the capability of tanks to impound water to its full potential, the process is perceived as an incident, from which tanks have to be restored. But tanks can also be restored before they are totally incapacitated.Therefore, restoration of a tank from cumulative incidents can be classified as 'curative' and 'preventive' restorations.

The curative restorations are such which will be taken up after an incident has taken place. These works include raising the height of waste weir and desilting on a major scale, restoring the holding capability, etc. Preventive restorations prevent certain process before it can totally incapacitate the tank.

To prevent total siltation of a tank, regular annual desiltation was carried out traditionally. For preventing the flow of silt from the catchment into the tanks, the catchments were maintained under vegetative cover.

Historically, silting up of tank has been an issue that was addressed in several ways. An inscription of 1937 AD mentions about the method adopted to desilt the tank in Arasikere taluk "A buffalo-man with his cart was permanently appointed for such work and it was ordered that for oil, wheel, grease, crowbar, pickaxe, etc., every cart-load of the original tenants had to pay two taras and likewise every load of arecanut, betel and oranges had to pay at the same rate." There were endowments made by rich people and members

of royal family for desilting continuously. (GOI,1954). The lands of those people who expire with no heirs were taken over by the village committee for the maintenance of tank.

Another measure envisaged historically to prevent flow of silt in a large quantity, was to maintain the catchment, especially the areas which are in deep contours, as pastures or as deciduous forest areas. In the catchment area of kunigal taluk, the maximum height of contour is 1066 feet. Between 1066 feet and 1053 feet, which forms a deep contour, the area was under dense scrub forest. Similarly, in Siddlaghatta taluk, catchment area of Mallur tank has a contour with a maximum height of 984 feet and a minimum of 915 feet. The area between these and between 984 feet and 926 feet was maintained under deciduous vegetative cover. Whereas the area between 924 feet and 915 feet was cultivated. The major portion of the catchment area of Mallur tank measuring about 204 feet acres lying next to Thimmasandra was maintained as pastures. These types of lands use were helpful in preventing the flow of silt to the tank.

In low rainfall regions like Chitradurga where soil erosion ranges from 359 tons per sq. kms to 11,250 tons per sq.km. the catchments of tanks were maintained under special pasture lands called 'Amruth Mahal Kavals'. Where only a special breed of bullocks were grazed in summer months. This way, Kavals were not only helpful in preventing the soil erosion but also flow of silt into tanks.

Most of the catchment areas that were under pastures and scrub jungle were considered as lands which can produce less than one-forth of normal produce expected in that region. As a result, they were classified as fallow lands, barren uncultivable lands. They were graded accordingly as 'C' and 'D' lands by the revenue department. These 'C' and 'D' lands were officially owned by the Revenue Department but usufructory rights were awarded to the entire community and such lands were regarded as common property resources managed by the community. Infact, the catchment areas of tanks provided most the resources required for the community for agricultural activity. Such resources ranged from fodder to that of timber for agricultural implements and green manure for wet lands.

The poor could collect fuel wood, fruits, fiber and cowdung from the catchment.

Catchments for cultivation

Any preventive measure for the restoration of a tank has to take into consideration the nature and status of the catchment. Since changes in the catchment may effect a proportional increase or decrease not only in the flow of water into the tank but also in the silt content in such a flow. Therefore, any preventive act of restoration has a great role to play on the catchment than on the tank bed. Such an act necessitates an appraisal of the types of uses to which catchment areas have been put to and the relative merit of each use in affecting the capability of a tank to impound water and irrigate.

In general, the catchment areas of tanks in Karnataka were released for cultivation in the earlier phases of 40's, 50's and 60's to enhance production of foodgrains. But later on, under the policy of land to landless much of the land in the catchment areas were distributed to the landless for agricultural purpose. The quantum of land to the landless can be estimated by examining the decrease in the area classified as permanent pastures and other grazing land, fallow land and cultivable waste (Table 7.1).

The consequence of releasing land in the catchment is that almost all the catchments are totally encroached for cultivation. Yet the catchments are defined as good catchments in the tank registers maintained at various taluk offices. A good catchment is explained as hilly with steep slopes, large areas covered by rocky outcrops and non-absorbant soil and generally barren or without cultivation. But in reality the catchments of all the tank are encroached under programmes of "extensive cultivation" and "land to the landless".

Releasing catchments to cultivation has increased the flow of silt due to loss of vegetative cover, ploughing, the digging up of the soil to erect bunds to separate each holdings. As a consequence of increased flow of silt, nearly 50 per cent of tanks in Karnataka have silted up (GOK, 1976).

In the absence of any systematic recording of either inflow of water or the silt that is deposited in any tank, it is difficult to have any authoritative information on any tank. This situation appears to be the consequence of the absence of updating of any kind of information on the status of catchments. Whatever assessment available is from the studies made at the beginning of this century. Therefore, to assess the quantum of silt deposited in any tank, the reports from the villagers has to be obtained. According to such reports depth of silt in the Kunigal tank is about ten feet. Similarly, the amount of silt deposit in Parashurampura tank is about five feet. In Hebbalagere tank the silt deposit is also upto five feet. Due to lack of information direct correlation cannot be drawn between the amount of land released for agriculture and the quantum of silt deposited.

Irrigation in the Catchment

The cultivation of crops and the cropping pattern in the catchment area of tanks is affecting the flow of water into the tanks. In an examination of the crops and cropping patterns in the catchments, it was noticed that there is a shift from crops that require little water and are highly drought resistant, to crops that require greater quantum of water and are less resistant to drought. For example, in the catchment of Muthur tank in Siddlaghatta taluk, the dominant crops in the earlier stages of cultivation was ragi which was grown in 120 acres during 1965 under rainfed conditions. This was reduced to 108 acres by 1975-76. By 1984-85 ragi was grown only in 66.34 acres. On the other hand, upto 1980-81, the area under mulberry increased in lands irrigated by wells in the catchment area. Due to scarcity of ground water, the area under mulberry decreased from 1975-76 and onwards. By 1984-85, mulberry was grown only in 13.39 acres. In the place of mulberry, irrigated grape orchards came to be established. By 1982-83 about ten acres of irrigated area was planted with grapes. In 1983-84, it increased to 16.19 acres and by 1984-85 it was grown in 32 acres.

The consequences of these changes in the cropping pattern is the increased demand for water in the catchment areas. Crops such as

mulberry and grapes demanding high soil moisture have exhausted available moisture levels in the sub-surface of the soil. The net impact of such exhaustion of moisture at various levels in the subsurface soil is the wilting of crops at every slight deviation in rainfall or low yield from wells. Frequent wiltings and loss of crops on one hand and total depletion of ground water resources in the catchment areas on the other hand has compelled many farmers to go-in for crops which, tap moisture levels at greater depths. Eucalyptus and Casurina have been favoured in this regard. More than 25 percent of the catchment area of the Muthur tank is planted with eucalyptus. In the catchments of Hanabe, Savanur and Chikkanahalli tanks, eucalyptus and casurina crops are also grown on large scale. In the catchment of Kappalamadagu tank of Mulabagal taluk, eucalyptus was grown in 25.10 acres in 1981-82. It increased to 56.24 by 1982-83 and in the next year (1983-84) it was planted in 61.25 acres. Similarly, in the catchment area of Nallur tank in the same taluk, eucalyptus was grown in 30.27 acres in 1984-86, and casurina in 23.16 acres. By 1987-88 the area under eucalyptus increased to 36.14 acres, whereas casurina decreased to 14.12 acres.

In the catchment of Muthur tank of Siddlaghatta taluk, 135 acres are irrigated by 32 wells. Almost all the wells are fitted with deep bore-wells and own energised pumpsets. The crops that are irrigated as mentioned earlier, range from grapes to vegetables.

In the catchments of Hanabe tank, nearly 35 wells are dug to irrigate arecanut gardens and to grow vegetables. Similarly, around Savanur tank there were 23 wells. Many of these wells have borewells within them running to a depth of about 150 to 200 feet. These wells are fitted with energised pumpset ranging from 3 HP to 10 HP. The average area irrigated by these pumpsets ranges from two acres to five acres. Wells in the catchment siphon off the impounded water in the tank. As tanks play an important role "... to maintain the water levels in the well in their immediate neighbourhood." (Royal Commission on Agriculture, 1926, p.33), the drawal of water by an individual from his well amounts to drawing water from the tank also. This will result in exhaustion of the impounded water in a short time. In Doddaballapur taluk, the annual

normal rainfall is 741.2 mm. An examination of the rainfall shows that even in the year 1986 the rainfall was 823.5 mm., which is above the normal rainfall. Yet, in that year, none of the tanks in the catchment of Hanabe tank had water beyond the months of November and December. The examination of rainfall for ten years showed that for 1971, 1972, 1973, 1976 and 1977 the annual rainfall was above normal, even then the tank has not overflowed from last 20 years and the yield of water from the wells around this tank has declined. The ground water has receded from a depth of 15 feet in 1970 to 150 feet in 1987.

In Hanabe, the area irrigated by wells has increased from 97 acres in 1970 to 423 acres by 1984. The crops that were grown are arecanut and sugarcane. The area under sugarcane increased under well irrigation from 0.16 acre in the year 1966-67 to 120 acres by the year 1979-81 and by 1981-82 it was grown in 140.7 acres. Later on it declined due to insufficient yield from the wells and in 1986-87, in 29.25 acres sugarcane was irrigated through wells. Sugarcane being a high water consuming crop, it has to depend upon water extracted from greater depths with powerful pumpsets. As there is a linkage between water in the wells and tanks when water was drawn from the wells, through underground linkages water in the tank is also extracted. As a result of excessive extraction, an artificial scarcity of water is created. Tanks are no more useful. Farmers are not in a position to draw water from the tank even for one or two waterings, as the impounded water gets exhausted within a few weeks. There the tank is no more useful, as a consequence three-fourth of the bed is encroached.

The Muthur tank of Siddlaghatta taluk has also been affected by the excessive withdrawals through the wells. The village Gangenahalli and lands around it formed the catchment area of the Muthur tank. In this village the area irrigated by wells increased from 25.15 acres in 1965-66 to 84.23 acres by 1975-76. The area irrigated by rains decreased from 150 acres to 90 acres in the same period. Due to this increase in the area irrigated by wells, the yield from the wells decreased and as a result the area under wells also decreased to 67.36 acres by 1985-86. The consequence of these activities in

the catchment can be observed in the area irrigated by the Muthur tank. The Muthur tank has a command area of 68 acres, whereas the water spread area of the tank is 102 acres. Before 1975-76, farmers used to grow two crops with one filling. But later on, it became difficult to grow even one crop. By 1981-82, the area irrigated by the tank in monsoon was ten acres. In that year, as there were good rains during December, a summer crop was grown in 30 acres. Later on in 1982-83 only 13 acres were irrigated by the tank and there was no summer crop. In subsequent years even with good rainfall, no irrigation was possible.

Muthur tank has a smaller tank in the catchment called the 'Kanithalli tank', irrigating about 43 acres. In the command area of this tank from 1980-81 no crop has been irrigated. Now the command areas in both the tanks have been either irrigated by wells or left fallow. In the year 1984-85, the fallow land in the command area of Muthur tank was 37.22 acres and in 1985-86 it increased to 52 acres. Of late, fallow lands are converted to grow rainfed crops especially ragi. Thus, the role of tanks as sources for irrigation has been totally lost due to bad management of the catchment area.

Too many Owners

Destruction of catchment is caused not only by the cropping pattern and wells but also due to administrative lapses. The flaw in the administration lies in regarding the tank only as a physical structure to impound water. The administrators, especially in independent India, never considered the catchment, the tank bed and the command areas as integral parts of a system. Each part of the physical structure of the tank was regarded as a ingle disjointed unit without any organic linkages. The organic linkages such as the flow of water from catchment into the tank and later on into the command area, the conditions of the catchment and how these two aspects determine the capability of a tank as a source of irrigation and ho the capability of a tank determines the economics of a command area, are not taken into consideration.

The failure to recognise organic linkages between each physical

part of the tank has resulted in administration of each physical part of tank by different departments of government. Sometimes, even different activities in each part of the physical structure is managed by different departments and their programmes often run contrary to each other. A good example is that of Kunigal tank. Even though it is a well-known fact that running a channel from the bed of a tank to the well on the foreshore is illegal, the electricity department of the Government of Karnataka has energised the pumpsets for all such wells (Photo 8). On the left hand foreshore of the tank, there are nearly 30 such energised pumpsets drawing water from the tank bed. The consequence is not only that the farmers in the tail-end are not receiving water but also the impounded water is not even sufficient for one crop.

In the catchment of Kunigal tank, construction is going on now for housing units to house officials belonging to various departments. Close to the housing units an industrial area is planned. If both these units let affluents into the Kunigal tank, the tank being the source for drinking water to Kunigal, the people of the town will be affected.

The catchment areas of many tanks were traditionally considered as 'Gomals' or 'community grazing lands'. Every family in the village had a right to graze their cattle and collect fuelwood for the family from the existing vegetation. But this was only a right honoured by the government. The rights of administration in such cases were always vested in the revenue department. If the catchment was forest area, as in several tanks in Malnad districts, the administrative rights were vested with the Forest Department. These departments have nothing to do with the tank, which itself is managed by the PWD. The consequence is that the revenue department being interested in revenue, has legalized all the encroachments in the catchment without ever worrying about its consequences for tanks. In Chikkanahalli the distribution of the catchment is made by the Forest Department. In the case of Gattalagollahalli tanks, the Forest Department has deforested the area for revenue purposes and has planted eucalyptus which affects the flow of water and rechargability of ground water (V. Shiva and J. Bandyopadhyay, 1984).

water measurement is adopted which is in relation to the requirement of the command area. On the two supporting pillars of the sluice, there are various types of symbols like two lines, three lines, a wheel and a conch. Each one of these symbols indicate the quantum of water collected and the timings to be followed for letting out water.

For example, if the water is upto the level of two lines, water should be released once in fifteen days. Similarly, three lines indicate three feet of water and the release of water was once in ten days. The conch at the top indicated the full level and water could be released every day to the full capacity of the sluice. These readings were taken at the beginning of each season by the panchayat and accordingly crops to be grown were planned.

Even in the tanks newly constructed through World Bank assistance, the system of measurement is not given due regard. Whatever system may be it is a rough estimation of a scale painted on the supporting pillars of the sluice, which will indicate the height of standing water. But to estimate the area that can be irrigated various calculations are necessary. To facilitate this a table is developed for each newly constructed tank. This table also does not help an illiterate Nirganti to make estimations as easily as that of the scale in the Parashurampura tank.

Wherever the measuring instruments are absent, the panchayats used to decide the timings of water release through eye-view estimation. For example, in Gattalagollahalli, the panchayat assembles every week-end and takes a reading by eye-view estimation of how much water is available and decides the timings to be followed for releasing water based on the growth levels of crops. If the water is above one foot over and above the top hole in the sluice and the paddy crop in khariff has developed earhead then for a command area of 175 acres, the decision will be to release water once a week. Similarly, if the impounded water is not beyond half the length of the supporting pillars of the sluice in the month of June or at the end of Rohini rain, which will be approximately in the month of the farmers will not be allowed to go for paddy nursery. The farmers will be directed to go in for irrigated ragi crop.

In Chikkanahalli of Doddaballapur Taluk the distribution of catchment for cultivation purposes has affected even the silt catching ponds like kuntes and kattes. As a result, the old Chikkanahalli tank is being silted up. In the neighbouring village Savanur also, the catchment of three tanks have been distributed for cultivation purposes. The consequence is heavy erosion forming huge gulleys, and two out of three tanks are totally silted up. In some parts of this catchment farmers have planted eucalyptus under Social Forestry Programmes, to make available sufficient soil moisture when the saplings of eucalyptus are very young, smaller bunds are layed to prevent flow of water. These bunds over the years will be eroded and contribute to further siltation of the tank.

Ground Water Regulation

The regulation of ground water utilization in any area of the state belongs to the Department of Mines & Geology. Even though these departments have laid down certain regulations such as the location of well, distance between each well, etc., it is honoured rarely. Regulations such as the location of well, distance between each well etc., are not generally observed. Whether the rules laid by the Department of Mines & Geology are honoured or not, the agencies of the State such as Land Development Banks, Commercial Banks etc., do fund individuals to go in for wells. It appears from the way sinking wells is financed in Savanur, Hanabe and Chikkanahalli, that the funding agencies do not consider the consequence of concentration of wells in the catchment areas of a tank. Wells with pumpsets of large horse power siphon off the water from tanks. None of the financing agencies has taken note of the relative merit of a functional tank. On the other hand, when the wells failed to yield sufficiently due to curtailment of the recharging process of ground water, the agencies finance deepening wells, even beyond 100 to 200 feet. This once again, creates a shortage of surface water and also ground water (J. Bandyopadhaya, 1987).

Lack of Studies

The Department of Mines & Geology and the Geologists attached to

the PWD are responsible for measuring the flow of water from the catchment and the yield from catchment. Even though studies have to be conducted for each catchment area once in ten years, the available information in the Department does not provide any clue to any studies done of late. The information about assessment of many catchments is of the 19th century. None of the tank registers show any change over the years. In the absence of these studies, the Department is not in a position to know the latest yield from the catchment or the condition of the catchment.

The siltation has to be taken up in an integrated manner, so that every step taken will help in preventing the flow of silt to the tank.

Which type of tank has silted most

As mentioned earlier, nearly 50 per cent of the tanks have silted up due to utilization of catchment areas for cultivation purposes. In that context, it is pertinent to examine the type of tanks that have silted up and those that are in the process of silting. As the siltation depends upon the area of the tank bed, and the location of the tank, it is easily discernible that a tank with few acres of tank bed is the one that silts fast. The reason is that the area of the tank bed being small whatever silt that is received has to pile up and then spread over a vast area. Therefore, it is always the small tanks that silt up fast.

As most of the tanks in Karnataka are located in a series in the increasing order of capacity, the tanks at the foot of the catchment or at the beginning of the series like Gowdanakere, Hosakere of Hanabe series will be the first one to silt up totally. The Savanur tank is silted to threefourth of its capacity. As present, the Hanabe tank is receiving the silt from all the tanks above it.

Similarly, in the series of Sakalavara tank, the Vaderahallikere, Sudugunteplyakere and Hullahalli kere have silted up. Sakalavara tank, like Hanabe tank being at the middle of the series is receiving silt at present. Whereas the terminal tanks though not totally free from silt, also receive silt from their own catchment and a few middle order tanks. In the case of the Madhure tank, a terminal tank of the series, the siltation is high. It is reported by the farmers that about

six to eight feet of silt has accumulated, especially towards the northern foreshore area. This accumulation of silt is due to the destruction of the scrub jungle in the catchment and absence of tanks in that part of the catchment. The Tangali tank at Kadur taluk, a terminal tank is being silted up due to its linkage to the canal from Varuna project. Heavy silt deposit can be found only towards that side where canal is linked to the tank.

Maintainence

Leakage from the sluice is an another aspect which affects the water holding capacity of a tank. The leakage occur when the plug or the shutter used in the sluice is worn out or when the construction around the orifice in the sluice had developed cracks. But, to a large extent, the leakage will be due to wearing out of the plug and the shutter.

The Department has installed shutter systems in many terminal tanks to prevent leakage. This shutter system installed at Kunigal tank, Alamkhan tank, Yamalapura tank and Madhure tank have also developed leakage. The leakage in such shutter system is not confined to old tanks. Even new tanks like Yadarahalli has leakage and about 30 acres are irrigated by using the leaking water and a paddy crop was grown in the khariff season of 1987- 88.

In the kunigal tank due to the leakage in the sluice of Ramabana the water flow in the canal leading from the sluice is about two feet depth. In the Madhura tank, the leak in the sluice of LBC gives out a feet of water. These leakages are affecting the holding capacity of these tanks. Generally, in the shutter system leakages cannot be plugged as in the case of plug and pole system. The sluice of the Parashurampura tank continue to be operated through plug and pole system, yet the leakage from it is prevented by adding fresh soil or bunches of turf around the orifice. Such a method of prevention is not possible in the case of the shutter system.

In most of the middle tanks and the beginners sluices continue to be operated by plug and pole system. The Department is responsible for the maintenance of the sluice, waste weir and bund of these tanks. Yet the Department has not shown sufficient interest in restoring

these tanks if there is leakage in the sluices. As a consequence in most of the tanks, even if there is a leakage as in the case of Hebbalagere, the leakage is stopped by farmers by putting in extra soil or bunches of turf. In most of these tanks, like Arakere tank of Kunigal taluk, Hebbalagere of Channagiri taluk, the sluice do not have the plug and pole system to release water. Due to wear and tear the system has been totally damaged, yet the Department which has to maintain the physical conditions of these tanks has not replaced the worn out plug and pole. Even then the panchayats managing water have been able to control the flow of water by using a wooden log. In some tanks of the middle order, which have lost the capacity to withhold water due to siltation, it is not the plug and pole system alone that has been replaced, but the sluice also is newly constructed as in the case of Hanabe tank and Doddanayakanahalli tank in Malur taluk. As these new constructions are constructed properly they continue to leak over theyears wasting lot of water. Due to these lopsided priorities the tanks that still have the capability to withhold water and where water is efficiently managed, the panchayat has to exercise its power to summon its beneficiaries now and then for restoring the sluice through their own method.

Due to the absence of restoration efforts, even in many terminal tanks managed by the Department, sluices have been totally closed. Parashurampura had two sluices, at present only one sluice is in operation. In the tank of kadur taluk, there were three sluices and only one is in operation at present. In Madhure tank the sluice on RBC is not functioning at all.

Role of Local Bodies

Commenting on the negligence shown by the Department towards restoration works in the middle and beginner tanks, the Public Accounts Committee (PAC) of Karnataka Legislature holds the Government responsible for improper allocations. The tanks that are affected most due to such improper allocations are those managed by the Taluk Development Boards (TDBs). All tanks which irrigate less than ten acres are managed by the TDB, as they irrigate less than 10 acres. Being located mostly at the foot-hill of a catchment,

these tanks act more as silt catching tanks than being useful for irrigation. Due to such a function, the chances of these small tanks losing their capability is very high. Preventive activity for such tanks involve the entire catchment. As such the tanks involved are too many and require a big financial commitment. TDB being the organization responsible for implementation than planning, was not in a position to plan for any preventive measures to restore the tanks. TDB with its limited technical manpower specialized in extension activities was once again incapable of planning anything to prevent the siltation of beginners. Furthe, TDB could not prevent cultivation of catchment, as the catchment is regulated by the revenue department. Therefore, most of the beginners which are essential for the survival of other tanks in the series are neglected. Presently, the mandals are invested with the responsibility of managing the small tanks. As theses mandals are in a way scaled versions of the TDB, they suffer from the same drawbacks.

Role of Public Works Department

The minor irrigation wing of the PWD is actually the body that is incharge of maintenance and restoration of tanks. The PAC alleges that the allocations to this wing for restoration is not only insufficient but is also instructed to exercise restraint in its expenditure on restoration. But the same Department has shown enthusiasm to raise an investment loan from World Bank to construct new tanks, to the tune of Rs 65 crores. Similarly, it has been able to construct new tanks out of planned expenditure. A few of such new tanks constructed at Koratagere in Channagiri taluk, Chowdlapura tank in Kadur taluk, Mookanapalya in H.D. Kote taluk and Pangarga in Chincholi taluk are not an at serving any irrigational purposes. Even when tanks at Chowdlapura and Koratagere receive a good flow, farmers are not interested in taking water for irrigational purposes. The water impounded in Chowdlapura being saline, no water is drawn. At Koratagere, as the fields in the command area contains deep black soils, farmers find it difficult to draw water from the tank, as the command area and the main canals are at a higher plane than the tank. As a consequence, the investment of nearly ten

lakhs rupees on both these tanks has gone waste. Through proper planning, this could have been foreseen and the same money could have been made available for restoration.

Tanks at Mookanapalya and Pangarga were constructed with a loan from the World Bank. Even two or three years after completion, these tanks have not received good flow even during years of normal rainfall. As a consequence, the investment of Rs. 48 lakhs on these projects is a waste. In Chincholi taluk, the Hasirugundi tank was constructed with an investment of Rs. 8 lakhs, today as the canals are not constructed in the command area, the whole investment is going as waste. Probably, these wastages could have been prevented and the same amount could have been made available for restoration activities.

Table 7.1
Area Under Permanent Pastures, Other Fallows And Cultivable Wase In Karnataka

Year	Permanent Pastures	Other Fallows	Cultivable Waste
1970-71	1619	672	615
1974-76	1515	618	585
1979-80	1365	554	506
1981-82	1314	519	495

Chapter 8

IRRIGATING DROUGHT PRONE REGIONS

In Karnataka, the frequency of drought is increasing both in terms of area and also in terms of duration. Drought has become an annual phenomenon and a few districts of the State like Kolar, Gulburga, Bijapur, etc., have reeled continuously under drought from 1983-84. In order to check the increased frequency of droughts, the state is developing its present potentiality to irrigate from the present 15 per cent of gross irrigated area to 26.6 per cent, which is the national average. By the end of Sixth Five Year Plan, the target is to achieve a cumulative potential of 28.46 lakh hectares or slightly more than half of the ultimate potential. Neither the achieved potentiality of 13,87,000 hectares or 15 per cent of the gross irrigated area of the State will be in a position to save a few parts of the state from recurrence of drought. Districts like Kolar, Bijapur and taluks such as Mundargi of Dharwar, Deodurga of Raichur district, etc., are so situated that it is difficult to develop any major or medium irrigation projects (Ramaprasad and Malhotra, 1984). As a consequence, of the 97,410 M cum of surface water available from major rivers, only 36.07 M cum of water can be tapped through major and medium projects. Out of 40,000 cubic meters of surface run off in the state,only 5,000 M m3 water can be actually utilized.

In Karnataka, among the major rivers it has, Krishna drains 59 per cent of the geographical area. Next to Krishna, it is Cauvery which drains nearly 20 per cent of the geographical area. Among other rivers, which are important are the west flowing rivers that yield highest (56,634 M cum) when compared to Krishna (27,467 M cum) or Cauvery (10,987 M cum). As the west flowing rivers flow for a small distance, they are of little consequence to irrigate drought-prone regions.

From the point of view of irrigating drought prone regions, it is rivers like Pennar, Palar and Krishna which are of importance. But much of river Krishna drains an area which is dominated by black soils. Wherever attempts are made to irrigate these black soils through the

construction of major and medium projects, waterlogging has developed on a large scale (2.4 lakh ha), whereas in the same regions dominated by black soils, the tanks, even if few in number, are free from waterlogging, even after several centuries of irrigation. Therefore, possibility to irrigate through tanks appears to be useful in this region.

The Palar and Pennar rivers, unlike Krishna, are totally seasonal rivers. Much of the basin of these rivers is already interspersed by tanks. In the Tumkur, Kolar and Chitradurga districts which fall within the basins of Palar and Pennar, tanks are the ones that meet the irrigational requirements. These tanks in the Pennar and Palar basins have proved successfully, especially in drought years, that with the given social organization, they can efficiently irrigate two crops in a year, irrespective of rainfall (Chapter on Water Management for details). Such an ability to grow crops even with low rainfall, actually helps in controlling the impact of drought in any region. Therefore, from the point of view of fighting the drought, tanks and a social organization to control water are essential. But an examination of the irrigated area by tanks both in Krishna basin and Pennar and Palar basins show that over the years, the area irrigated by tanks is decreasing in both the basins (Table 8.1)

The reduction in the area irrigated by tanks is highly evident in the district like Chitradurga, Kolar, Raichur and Bellary, where there is only a limited provision for any more major or medium projects. Even though the only apparent alternative for such districts is to plan for tanks in the catchments of rivers, except in Raichur district, in other districts the tanks are already well developed into a series. Therefore, it will be difficult to find a new site which will not effect a tank in the downstream. Therefore, there is a greater need to decide either in favour of rehabilitating existing tanks or to go on constructing new tanks irrespective of the size of command area they irrigate and ignoring the economics at the same time.

To check the recurring drought in Krishna, Palar and Pennar basins, the State Government has constructed few new tanks which shows that there is a least scope to develop tanks with bigger command

areas. Since the land that will submerge in the northern maidan will be 1:2 which means to irrigate two acres of land, one acre of land has to be submerged. This is regarded as uneconomical. Whereas in ETZ and NTZ, there appears to be a greater scope for new tanks as they can command a bigger area. The ratio of submergence of land to that of irrigation is 1:3 but such places rarely suffer from drought. Hence, the districts that suffer from drought will be benefited by the construction of new tanks in SDZ or in NDZ.

As the scope to construct new tanks is limited in those regions which are highly drought prone, there is a need to think of utilising existing tanks in an efficient manner. The task of utilization of the existing tanks has to include plans for catchment area rotection, desiltation of tanks and canal and distributories. Further, it has to remodel the present system of water distribution in the command areas of tanks.

An analysis of tanks registers show that in Bangalore district 540 tanks have been abandoned due to siltation. In Tumkur due to siltation nearly 400 tanks have been abandoned for the same reason. Taluk-wise listing of tanks show that the abandonment is high in Bagepalli and Srinivasapura taluks of Kolar district which are the highly drought-prone taluks in Kolar district. Similarly, in Tumkur district Sira and Gubbi taluks have lost the highest number of tanks due to siltation and they are the taluks that are highly drought prone.

As the changes in the cropping pattern of the northern maidan suggests, in future, there will be an increased demand for water to irrigate. To meet such demand in the light of locational and ecological limitations on major and medium projects, it appears that only tanks have a capability to meet such an increase in demand. Even to expand tanks in terms of new construction, especially in SDZ and in EDZ there is a constraint in the form of proper sites. Therefore, the only possibility in the present situation is to rehabilitate the existing tanks that are threatened with siltation both in the northern maidan and southern maidan.

Economics of Rehabilitation

The programme of rehabilitation of tanks has to take into considera-

In Parashurampura, at the beginning of Rohini, if water level is not upto the wheel, then it is decided that the crops to be grown will be semi-dry crops and not paddy. Similarly, for the summer crops, if the water is upto the eight line mark, jowar or groundnut is grown and water will be let out only once in eight days. If by chance water depletes faster and if it reaches the three lines mark, water will be let out once in ten days. This signifies that the instrument of measurements or the units used should be in relation to the crops and the mode of water- release to be followed. The units or symbols used should be in a position to motivate the individual beneficiary to understand the need to exercise restraint in water utilization.

Another aspect of distributing water is to do it equitably among all the beneficiaries.The crops to be grown, the optimal water requirement of each crop, soils, location of the field etc.,have to be taken into account. Once again, the methodology followed differs from one system to another. In the PWD managed tanks the irrigation committee decides the crop and the acreage to be irrigated. For example, in Madura tank only 130 acres out of 980 acres in the command area were declared eligible for drawing water in 1985, for semi-dry crops. Secondly, for the Kothagere tank of Kunigal district, it was decided by the Taluk level irrigation committee that as there was sugarcane in 100 acres and paddy in 50 acres at the end of khariff season, water will be supplied to them in the rabi season in the normal way and for the remaining 360 acres where paddy crop is harvested water will be supplied only for semi-dry crops. A system of regular supply of water to sugarcane cultivation was, in a way, encouraging crops that consume too much of water and on the other hand, it amounts to denial of water to others who have not grown sugarcane.

In the panchayat operated tanks, at the beginning of every agricultural season the panchayat decides the nature of crop to be grown in the entire command area by every farmer irrespective of social status or political standing. It takes care to see that everyone grows the same crop or only such crops that have equal requirement of water. In G.G. Halli of Tumkur district, at the beginning of the khariff season in 1987, as the water impounded was below the foot of

tion the economics and the time factor involved. As argued by the Department "the scheme will be prohibitively costly (and) manual labour cannot be engaged since work will be very slow and there by uneconomical." Committee on Plan projects, irrigation and Power has opined that "while desilting may be unavoidable, it is nevertheless a very expensive operation costing Rs. 1500/acre per foot depth. Obviously, at this rate even if half the number of tanks are to be desilted to the depth of only six inches, the cost would be about a quarter of a million of rupees...". So to avoid the huge investment, the short-cut method suggested by PWD is to raise the waster weir. But, as discussed elsewhere, raising the height of waste weir amounts to postponement of the issue than solving it. Therefore, to solve the issue the economics of desiltating has to be examined.

The economics of desilting as an investment should be examined in comparison with (a) construction of a new tanks; (b) the investment of manpower and finance to develop a new command area under a new tank; and (c) other adjunct benefits that may be accrued or problems it may develop.

The recently intensified activity of tank construction in Karnataka, after obtaining a massive loan of Rs. 65 crores from World Bank provides us the cost of construction of a tank in each region, in terms of cost per hectare of command area. The table below shows that the average cost of construction of new tank per one hectare (Table 8.2) has Rs. 25,650, which is varying from one agro-climatic zone to the other. The highest cost, Rs. 33,341 per hectare is at STZ and followed by SDZ (Rs. 33,245) and NDZ (Rs. 29,262). Compared to this cost under a new tank, the cost of desilting per acre/foot has been estimated as Rs. 1500 at 1964. Even if the cost is multiplied eight times to wear out inflation, it will be Rs. 18,000 per acre/ft. It will roughly work out to be Rs. 30,000 per hectare. As one hectare of live storage can irrigate one and half hectare, the cost per hectare of CCA will work out to Rs. 20,000 which will be less than the cost of new construction, in any of the agro-climatic zone.

This investment on desiltation, unlike the new constructions, does not have a gestation period at all, as the command area is already

developed. Hence no new loans need to be paid for the development of land in the command areas. The investment need not go as interest free, as in the case of new tanks, interest rate of three to four per cent can be levied as desiltation can enable the beneficiaries to raise two crops in an agricultural year.

At present, the government is incurring a loss of Rs. 325 per hectare of irrigated area under minor irrigation projects and Rs. 977 per ha under major and medium irrigation projects. But by an investment of Rs. 20,000 for desilting one acre and enabling the farmer t raise two crops, this loss can be maintained by enhancing water rate and by levying interest on investment.

There is a debate as to whether the desiltation process should be carried out manually or by machines. It is argued that the number of mandays required to desilt is high as the entire process has to be completed in summer months before the beginning of the rainy season. Such an argument appears to have an inherent apprehension that whatever work is executed, if not completed before rainy season, will get back to original status during the rainy season. Such an apprehension is also indicative that the work carried out in summer months will be limited to only desiltation and does not cover any preventive measures in the catchment. Unless the preventive measures are carried out simultaneously in the catchment there is room for the fear that tank will get back to the previous status with the onset of rainy season. If this activity is carried out, innumerable poor farmers who are awarded with erodable land do get a chance to develop structures which can not only prevent soil erosion but also to enhance moisture levels within their fields.

Whether desiltation should be carried out mechanically or manually is linked to the question of generation of employment opportunities in the rural areas during the lean season and creation of employment opportunities in the drought-affected, to check migration.

An examination of the labour forces affected during the drought of 1986, shows that the worst affected areas were those that have tanks in a large number (Table 8.3), especially in NDZ and SDZ zones. In such affected areas the largest section affected by drought is te

agricultural labourers. Therefore, if the rehabilitation of tank is carried out the decision to desilt tanks has to be from the point of view of either providing employment to the large section of local population so as to help them in tiding over the natural calamity or denial of such an ability by employing mechanics to desilt. Rehabilitation of tanks is presently considered by the PWD to be restoration of tanks to their original water holding capacity, either by desilting or by raising waste weir or both at a time. But what is not realized is that, if siltation has to be checked protection of catchment area is a must. Along with it the requirement of an organization to maintain canals and distributories and proper allocation of water on equitable terms. Unless these aspects are recognized as essential aspects of rehabilitation, whatever is invested in rehabilitation will be lost. Therefore, there is a need to consider the above two aspects in the entire programme.

The tanks at Tallaku village in Challakere taluk and Naralur in Mulabagal taluk have silted to an extent of five feet and eight feet respectively. But in these tanks, farmers have never failed to grow food crops in spite of low rainfall. Table 8.4 depicts the low rainfall years and the crops grown in the command areas of above two tanks. Both the tanks differ in their approach to face the low rainfall. If in Nalluru the area under paddy has increased inspite of low rainfall, in Tallaku village it has decreased. This is due to the particular variety of paddy that Nalluru farmers have grown called 'Baira Nellu' which is highly drought resistant (Table 8.4). Whereas Talluku farmers have shifted to onion crop on a large scale to meet the contingency arising out of low rainfall. The crops are complimented by the well maintained canals and distributories. There is a panchayat in each of these village which are controlling the use of water and every year the panchayat gets the canals and distributories desilted. As a result, even the low quantum of water that was collected even in low rainfall year is utilised productively. Thus, it is essential to have properly maintained canals and distributories with an efficient system of water management, if tanks have to play a meaningful role during drought years.

Certain questions need to be examined pertaining to source of

finance, organizational capability and the methodology to be followed for rehabilitation. The committee on plan projects consider that a quarter of a million rupees is required to desilt all the silted up tanks. This estimation was made around 1964. Few experiments initiated in the state from 1989, have also shown that the cost of total rehabilitation including catchment area protection does not work out to be Rs 2843 per acre of irrigated area. Considering the huge investment of Rs. 700 million on new projects, the sum required at this rate to desilt is not high. If the required sum is raised as a loan from international organizations, the repayment can start immediately due to the total absence of gestation period. Further, unlike the present policy of treating investment on minor irrigation as non-capital expenditure the total expenditure can be treated as capital expenditure and interest can be levied. By spreading out evenly the entire investment on the number of crops over several years, the investment along with interest can be realised.

The financial requirements to desilt tanks does not appear as a heavy investment when compared to what is planned to be spent as a drought relief in a region. The Karnataka Government had spent Rs. 5036 lakhs by the end of December 1985 to provide relief during the drought year 1985-86. The district-wise expenditure shows the highest amount to be spent on Dharwar, followed by Tumkur, Belgaum, Gulburga, Kolar and Bangalore districts (Table 8.5). Almost all these districts have tanks which are spread out evenly in the entire district. In such districts, desiltation was carried out in 1605 tanks at a cost of Rs. 4009 lakhs. The desiltation programme carried out under drought relief programmes fell short of total desiltation of tanks, as the work was limited in its approach. It was a programme to utilize desiltation as a means to provide employment, as a result, it was not a planned programme of desiltation. Therefore, desiltation was carried out only at certain points. From the point of view of rehabilitation of tanks such programmes were not properly supported by preventive measures in the catchment, as a result, even the little work carried out under drought relief programme has to be treated as ineffective. If the Department had developed a systematic programme of desiltation and preventive measures for each tank at

least in such districts where recurrence of drought is high, the entire amount available for drought relief could have been utilized, as the finance available for rehabilitation of tanks.

Co-ordination of Programmes

Apart from utilising funds made available for drought relief there are various Departments which, in one way or the other, have programmes which, if properly coordinated, can help in rehabilitating the tank system. These programmes are independently executed by each department according to their own plans to realize their own targets. From the point of view of tanks, each of these programmes should be integrated to focus on tanks in order to prevent the flow of silt.

Presently, the Forest Department of Government of Karanataka is carrying out tree planting on the off-shore area of tanks and is encouraging tree planting on the catchment of the tanks by distributing saplings free of cost. These two activities are carried out under a programme called 'Social Forestry'. For this programme, the Department has taken a loan of Rs. 600 million. In an area of 8,000 hectares of tank beds and fore-shore areas of tanks and 40,000 hectares of waste lands and gomal lands are identified as the areas for tree planting. The financial outlay on both these programmes was Rs. 123 million. The number of seedlings supposed to have been planted was 168 million which means about 3000 saplings in each hectare at a cost of Rs. 2.5 thousands per hectare, which, if read with the production target of the forest department, proves that it is eucalyptus which will be dominantly planted in the foreshore areas and gomal lands. This, according to the critics of the programme, will affect the yield from the catchment and the trees in the foreshore areas will exhaust the water in the tanks (Bandyopadhyay, 1984). If there were to be coordination between the departments it would have helped in a foresting the catchment with beneficial trees and in preventing the flow of silt into the tanks.

Need for an Social Organisation

The existing tanks such as Naralur, Kappalamadagu, Bodampalli and

Tallaku show that the efficiency of a tank depends on the organization of the beneficiaries. This has been recently recognized by the Department. But such organizations are required for each and every tank, especially for rehabilitation, as there is a need to mobilize people to participate especially in the preventive measures. PWD being a bureacratic body is not in a position to motivate people. Even the Forest Department has failed to mobilize people to participate in their social forestry programme even though it was an avowed objective of the programme. Therefore, there is a requirement for an organisation to motivate people into organizations similar to that of the panchayat.

There is a need for an an organization to develop panchayats not only for water management but also for carrying out preventive measures in the catchment area. Such measures like tree planting, soil conservation and contour bunding require the cooperation of people who are not directly benefited by the tank. To elicit cooperation from such people, Voluntary Organizations are the best alternative to bureaucratic involvement. The voluntary organizations working in each agro-climatic zone should be encouraged to take up the activity of developing panchayats to manage the catchment as well as the tank. This appears to be a need as the experiement that to rehabilitate a tank was planned, in Kaira village of Devanahalli taluk by Zilla parishad of Bangalore rural district planned to rehabilitate a tank prone. Even though the Zilla Parishad was ready to engage labourers and also pay hire charges for the tractors, villagers did not show greater enthusiasm in the rehabilitation of a tank. This was due to lack of enthusiasm among the villagers who regarded the work executed by ZP, as entirely an act of ZP and nothing do with them. Villagers were neither organised nor educated about the need for their participation, they considered the act of rehabilitation of tank as an another work to be executed by the govt through the help of a contractor.

When compared to the experience of ZP, few voluntary organisations in Kolar and Bangalore districts are able to make villagers to contribute part of the cost. In Mulabagal taluk an voluntary organisation called Grama Vikas was able to desilt a tank and was successful

in carrying out catchment area protection in the village Kunibande where except one family, all other are marginal farmers. Similarly an other organization, Prayog in Malur taluk is carrying out desiltation in a phased manner, after completing the protection of catchment areas for two tanks. In Bangalore district an organisation Institute for Youth and Development has been able to organise villagers not only for desiltation and protection of catchment area but also for innovative measures in water management.

Table 8.1: Area Irrigated by Tanks in the Districts within Krishna Basin and Pennar Basin

Districts	1970-71	1977-78	1983-84
KRISHNABASIN			
Bijapur	5,511	7,766	5,676
Bellary	5,762	4,839	4,858
Raichur	3,721	4,292	2,369
PENNARBASIN			
Tumkur	34,835	41,008	32,609
Chitradurga	17,380	14,788	10,687
Kolar	36,275	32,748	33,279

Source: Report of Krishna Godavari Commission, 1962, GOI

Table 8.2: Construction Costs of New Tanks(In Rs)

Zone	Per Hectare CCA	Per Beneficiary Family
NET	22,234	71,029
NED	28,226	60,607
ND	29,262	70,447
SD	33,245	43,933
ST	33,341	51,026
NT	23,642	44,521
All Tanks	**25,650**	**54,349**

Source: V.M.Rao and Chandrakant, EPW, 30 June, 1984

Table 8.3: Number and categories of Rural population affected by drought during 1986

District	Total Small Farmers	Total Marginal Farmers	Total Agricultural Labourers	Number Affected		
				Small Farmers	Marginal Farmers	Agricultural Labourers
Bangalore	69597	113530	122236	50277	86369	9278
Chitradurga	53966	47068	240666	42556	37117	19928
Kolar	58764	11511	161270	58764	111511	16127
Shimoga	26480	29647	88377	13854	15973	3164
Tumkur	88244	154029	114143	71840	118587	10075
Belgaum	86521	105139	279867	47028	43863	12086
Bijapur	56388	25717	337862	24096	12118	13990
Dharwar	41009	79869	429339	41009	79869	42933

(Contd. in page 144)

District	Total Small Farmers	Total Marginal Farmers	Total Agricultural Labourers	Number Affected		
				Small Farmers	Marginal Farmers	Agricultural Labourers
North Kanara	28250	45526	63183	5771	3281	2863
Bellary	46434	51557	442746	26212	32306	25387
Bidar	30801	22996	116409	8216	7665	4569
Gulburga	52798	38927	326248	49471	35997	31259
Raichur	79782	54884	280527	37298	28615	11322
Chikkamagalore	23050	22281	44094	17916	21307	36907
Coorg	9630	11388	33024	2640	1200	5350
Hassan	57691	97825	49792	48407	80109	40749
Mandya	66154	193483	115823	45815	137079	77681
Mysore	103352	159544	2023362	65576	95760	143894

SOURCE: GOK: Bargala Parasththiya Zillavaru Vivaragalu Mathu Karnataka Rajyadalli Kaikondiruva Parihara Kramagalu - 1985-86.

Table 8.4: Talaku Tank (Atchkat area 187 acres)

Year	Rainfall (mm) Normal	Actual	Paddy	Cocunut & Betel Leaf	Groundnut	Onion
1976	455.5	833	36.33	9.31	81.05	10.20
1978	455.5	360	9.31	11.17	6.15	82.15
1980	455.5	282	10.50	13.17	15.00	91.00
NALLUR TANK: (Inclusive of crops in Summer season) Atchkat area 197 acres						
1970	762.9	671	190.30	8.20	37.10	
1973	762.9	677	206.18	8.20	30.00	
1983	762.9	615	204.37	5.25	13.30	
1984	762.9	495	204.32	5.25	9.0	
1987	762.9	496	209.19	5.25	2.12	

supporting walls of the sluice but covering the slope of the sluice, it was decided that semi-dry crops will be grown and water will be le out at the rate of half an hour's flow to one acre once in a week. Those who had mulberry gardens and arecanut gardens were also told that water will be supplied at the same rate to them. The particular crop that was chosen was ragi, but an exemption was provided to such lands which are low lying, and water will be supplied at the same rate, as low laying lands do collect seepage.

In the Nallur and Kappalamadagu of Mulabagal taluk, it is not only the crop that is decided but also what sort of seeds to be grown. The Nallur tank has a command area of 179 acres, but the capacity of the tank being less (88 mcft), and the rainfall being low (762 mm), the panchayat is more particular in using the available water for at least one crop of paddy. Therefore, the panchayat has decided that only paddy of particular variety called 'Baira nellu' of five months duration should be grown. This variety being highly drought resistant can withstand droughts of two to three months. Further, it requires few waterings, ranging from three to five.

Apart from the seed and crop to be selected, the method of sowing the seeds also is decided by many panchayats. In G.G. Halli, Nallur and Kappalamadagu even if paddy is allowed to be grown, puddling is not allowed. Dry sowing is insisted. By this method a lot of water will be saved and the crop can be grown as rainfed for at least 2 1/2 months to three months. For such a method, HYV paddy is not suitable, therefore, it has not been encouraged.

In Talaku, as the tank is not receiving its normal supply, due to the construction of kattes or small tanks in the catchment, the tank has not overflowed since last ten years. The panchayat of that village has insisted upon jowar and groundnut in the kharrif and pulses as the rabi crop. They are able to manage the water impounded for both the crops. One of the unique systems of water management called 'Domoosi' is prevalent in Bodampalli village of Chintamani taluk. In this system, normally followed for a crop of paddy in summer the command area is halved in propotionate to the water available in the tank. In the demarcated command area, irrespective

Table 8.5: District-wise expenditure on drought relief (Rs. in lakhs)

District	Amount	District	Amount
Bangalore	340.37	Bidar	117.60
Kolar	344.09	Raichur	297.65
Tumkur	444.60	Bellary	273.89
Chitradurga	272.20	Belgaum	380.97
Shimoga	245.94	Bijapur	346.89
Mysore	288.05	Dharwar	481.82
Mandya	143.26	UttaraKannada	77.89
Chikkamagalur	173.26	Coorg	7.22
Hassan	273.89	DakshinaKannada	102.15

Source GOK 1985-86

Chapter 9

ADMINISTRATION OF TANKS: NEED FOR A COORDINATED BODY

Irrigation in India is taken as a criterion to evaluate the economic development of a region. The factors taken into consideration are the enhanced capability to produce a higher quantum of foodgrains and the extent of the region's independence from the vagaries of rainfall during the monsoon. Where 80 per cent of the cultivated land is dependent on rainfall, the extension of water for irrigating crops, especially when rainfall is low, is a significant infrastructure for the development of agriculture. Recognizing irrigation as an infrastructure, the Constitution of India has made States responsible for development of irrigational facilities within its geographical area (Union List, provision No.17 and No.56). Therefore, the administration of tanks may be considered as "the administration of development" (Bhargava). Administration of development generally involves setting up development goals and objectives and evolvement of strategies. Therefore, administration of development involves mobilization of existing and new resources and cultivation of appropriate skills to achieve the development goals" (Bhargava).

In Karnataka, the irrigated area increased from 85,800 hectares in 1960-61 to 1,38,700 hectares by 1977-78. The investment is of the order of Rs. 1825 crores. Of this, Rs. 1552 crores is spent on major and medium projects to develop an irrigation potentiality of 5,61,000 hectares and Rs. 272 crores on minor irrigation to deveop an irrigaitonal potentiality of 7,44,000 hectares Karnataka's achievement is only 15% of the gross cropped area. Therefore, the goal of administration is to develop potentiality to achieve the target i.e, the national average.

To reach the national average, the State has to exploit the major rivers draining 80 percent of the geographical area and the available ground water. The total surface water available in the State is 97,300 cubic meters. Only half of the available surface water can be utilized as most of the tributories of major rivers are seasonal. Even the major

rivers have 90% of their annual flow only for three to four months that is from June to September, but peak flow will be always for August and September. Such flow cannot be utilised as almost all major rivers that flow in the State have part of their catchment in the neighbouring states. The State requires Rs. 300 crores to utilise 200 TMC of water in Krishna, its share as awarded by the Bachawat tribunal. In such a situation, the only possibility to reach national average in irrigation is either by exploting ground water or through tanks.

Groundwater resource of the State is estimated to be 12,000 cubic meters which can irrigate about 1.8 million hectares. At present only 0.4 million hectares is irrigated by utilising ground water. But this resource is exploited by private individuals with assistance from financial organizations of the State. Of late, in the plateau areas of the State with crystalline underneath, the yield has decreased between 5 to 10 metres, as a consequence, ground water shortage is experienced, Consequently, exploitation of ground water becoming expensive and is beyond the reach of small farmers. As a result, the only viable method to develop irrigation is through tanks which help not only in storing surface water, but also in recharging groundwater. At present, tanks are irrigating only 3,47,000 hectares. There is a plea to develop another 25,000 hectares through the tank system, as one of the steps to reach national average.

The objective of the Karnataka Government to reach the national average is in a way guiding the administration of developmental projects like tanks. The major objective of the administration to expand the area irrigated by tanks is reflected in the structure of administration of tanks. The entire structure is geared to investigate, plan and implement. No part of the structure is addressed to maintenance at any point. There is much importance attached to Minor Irrigation Investigation Divisions (MIID) and sub-divisions . The task of MIIDs is to investigate and plan for new tanks. The areas where more tanks are planned is in ETZ, EDZ, CDZ and SDZ. As a result, in the EDZ there are five MIIDs, four in STZ, two in NTZ and one in ETZ. Corresponding to such a division, there is no division formed either for restoration or for maintenance. Whatever divisions or sub

divisions exist are a part of the central structure. It is well-known that Shimoga, Hassan and Kolar district have the highest acerage area irrgated by tanks. Yet to meet the pressure of work in such areas no special sub-divisions are organized. This, in a way, shows the attitude of the Department towards managing existing tanks.

To achieve the goal of reaching the national average in terms of area irrigated, there is a special division to develop various designs to construct new tanks. Even when 12,000 existing tanks have silted up and 50 percent of the tanks are threatened with siltation, there is no major attempt to establish a cell or a subdivision to rehabilitate the silted ones or for the prevention of siltation. Somehow on the pretext that desiltation is an expensive affair, innumerable old tanks are allowed to face destruction. What is not realized is that by allowing the old tanks to silt up, the administration is not moving towards the goal. They want to be perpetual builders. But such a process of building is already nearing dead-end. Few tanks which were built recently like Mookanapalya and Pangarga are not receving any water as they are constructed in an unsuitable area or as in Yadarahalli the downstream flow is being affected. Therefore, there is a need to establish a technical division to prevent siltation of tanks and to rehabilitate the silted ones.

In the heirachical structure of the administration, the ability for restoration appears to be totally absent as the financial powers even for normal maintenance is concentrated in the ranks above the executive engineer cadre.

The junior engineers who are at the taluk level does not have any authority to approve any financial commitment. Assistant Engineers also do not have any financial powers. As a result, certain negligible financial commitments like replacing the plug and pole in a sluice has to wait for the approval of E.E. (Bhargava). In such a situations, delay in obtaining approval costs a lot in terms of water available for crops. The failure of the Deartment to install plug and pole at Arakere in Kunigal taluk and at Hebbalgere in Channagiri taluk reflects the attitude of centralised financial administration. The sluices in Parashurampura, Kunigal and Deodurga are in need of repairs since

a long time.

In maintenance, the highest priority is accored only to breaches. The siltation or seepage etc. are not regarded as important works. Only when the bund develops leakage immediate attention is paid. Desilting of canals, or prevention of leakages in the sluices have not been attended due to centralised financial management.

Whenever the finance department of the State Government orders a limitation on spending, the centralised financial system preferred to place a limit on the expenditure on maintenance as it feels that exercising a limit on the going construction projects will lead to increased costs.

The entire administrative system of the PWD is restraining itself in exercising certain options in carrying out maintenance activities, as the officials concerned in collecting water rate are not efficient. The Revenue Department which is responsible for the collection of water rate is not in a position to collect it efficiently. This arises due to the lack of coordination between the two departments. This lack of coordination has developed gaps between the area, on which water rates are levied and the actual area are irrigated. Usually, the revenue department identify a higher area than what is actually irrigated by the department. In these tanks where PWD does not manage water, the gap between the revenue department and the irrigation department is wider. A study of Directorate of Economical Statistics of 1980 reports such variations upto 60 percent. Such variations are regarded as a result of lapses on the part of the PWD, who always go by approximation than investigating the actual position. The result of such a lapse is lower revenue to PWD. As a result of these differences, the department is facing a loss of Rs. 127 per acre of irrigated area under minor irrigation (DES). Even though this is less than the loss due to major and medium irrigation projects (Rs. 352), this loss can be prevented if there is a coordinated body.

As in the case of the collection of water rate, the charges collected for utilization of silt, sand, clay, etc., available in the tank bed is regulated by the Department of Mines & Geology. This department issues licenses to industries and individuals to make use of the tank

bed for their requirements on a fee called 'royalty' payable every year. This royalty is on a slab basis and not on the quantum of resources collected. As a result wherever the tank bed is used for extraction of raw materials, there is a financial loss to the government. This arises mainly due to the inability of the Department, to keep account of such extraction at all such tanks. Therefore, the PWD should either manage it through sowdis, if appointed or in their absence, to develop farmers organisations to collect such revenue on quantum basis for the maintenance of their own tank. But once again such system will affect those tanks where extraction is not taking place. Therefore, there is a need for a coordinated body to administer all such aspects.

The PWD has assumed the responsibility of water distribution only in such tanks where above 500 acres can be irrigated. In such tanks, it has also assumed the responsibility to desilt the canals. Due to financial restraints these canals are not desilted. Therefore, less acreage is irrigated as lot of water is wasted resulting in lower revenue. In such places, it is better to enforce the system practised at Parashurampura tank.

At present, the Department is thinking of impounding water only and not in terms of efficiency or conservation of stored water. The cases of Kunigal, Choodlapura, Koratagere, etc., speak for such a thinking. Unless the impounded water is efficiently distributed in equal quantum to every farmer, the purpose of impounding will not be on a sound financial footing. To achieve that, there is a need to encourage farmers participation as found in the case of middle order tanks. To develop such organisations there is a need in the case of World Bank aided projects to have an outside agency. This agency should be in a position to motivate farmers not only in water distribution but also in the physical maintenance. At present, in the World Bank aided projects the physical maintenance part has not been addressed to a large extent. Therefore, an institution specially committed to this aspect is necessary.

The inability of PWD to prevent siltation, as discussed earlier, arises due to the inability to manage catchments. Catchments are under

the control of the revenue department if it is cultivated or the forest department if it is a forest area. Lack of coordination between these departments has made each one of them pursue their departmental objective, even if it is in conflict with the activities of the other department. Therefore, if siltation has to be prevented to save the life of 50 percent of the tanks, there is a need to establish a coordinated body to rehabilate tanks.

The present administrative set up in the PWD does not have a specialized branch to monitor the changes in the catchment area and its impact on the tanks. No reliable data is available on the quantum of silt accumulated, silt flowing in, yield and flow from the catchment, etc. As a consequence, the tank registers have not been updated. In such a situation, it has become impossible to plan or to develop a policy for the rehabilitation of existing tanks and above all working expenses have affected the tank system to a great extent.

The most important impact is that the proportion of area under tanks has been continuously declining from the domonant position of 46.8 percent in 1954-56 to 34.8 percent in 1964-66 and then to 29.8 percent in 1973-75. In 1979-80 it was 19.71 percent. This reduction in the proportion is explained as a consequence of increase in area irrigated by major and medium irrigation projects. But the medium and major projects do not have an effect to upset the proportional area irrigated area by tanks in all districts. There are districts such as Kolar, Bangalore and Tumkur where no major and medium irrigation projects are carried out. In these districts also the proportion of the area irrigated by tanks is decreasing which proves that the proportional area under tanks is decreasing.

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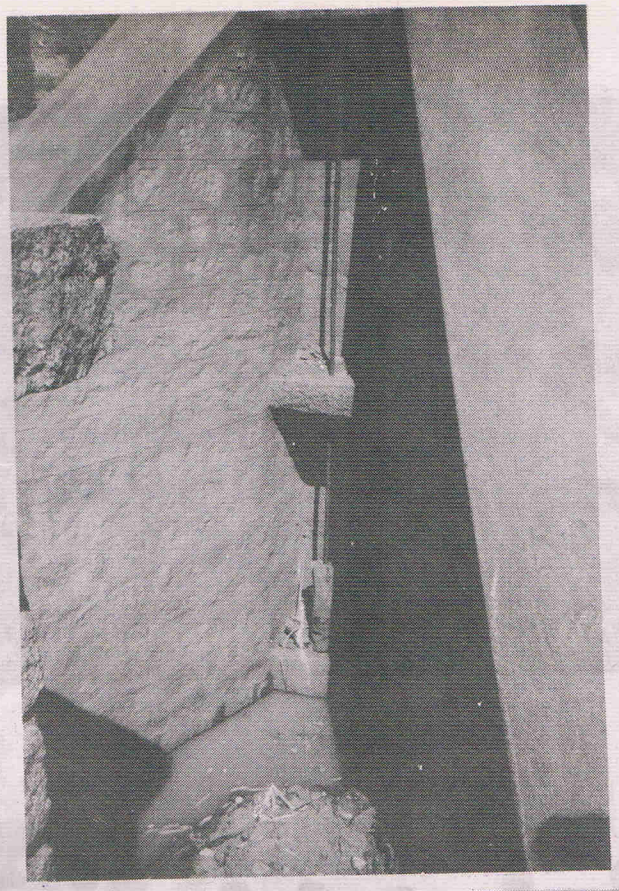

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2. Plug and Pole Sluice