



## Equity in Irrigation – A Study in the Command Area of Nagarjuna Sagar Right Canal, A.P.

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**Abstract:** Creation and development of irrigation potential is an age old practice in India. The scriptures of pre-Vedic and post Vedic periods showed the development of irrigation facilities by different rules. The vast water resources of the country, provided by the number of According to the estimates of the irrigation commission, the available water resources have the potential to irrigate about 81 million hectares of land. On the other hand the National Commission on Agriculture has estimated, by taking all the constraints into account that nearly 110 million hectares of land can be irrigated by tapping the existing water sources.

**Key Words:** Scarcity of water, Human beings, Agricultural output, Water management.

### Introduction

The human existence in most of the tropical countries of Asia and Africa is threatened with the scarcity of water. The recent havoc in some of the African counties caused by severe drought clearly indicate that water is an indispensable requisite for the survival of all living organisms. Thus the importance of water in the human life can be gauged from the irrevocable harm it has been causing to the very survival of human beings.

Agriculture is the prime sector in appropriating the largest proportion of available water resources. Basically, the earth's hydrological cycle, enabling moisture to circulate constantly along land, ocean and atmosphere, causes precipitation which may be absorbed into the soil or run off back to the ocean. But when the hydrological cycle is not punctual, world's vegetative system receives a set back and food production and population suffer. Thus it necessitated the controlled use of water throughout the year by storing it in periods of abundance.

As Colin Clark (1970) aptly pointed out that this application of water by a human agency to the crops through the control of water resources is called irrigation. Several studies have highlighted the role of irrigation in agricultural development. Bhalla (1980) pointed out that high productivity levels in agricultural output are significantly associated with areas of high rainfall and assured

levels of irrigation. The study of Rao, SK (1971) showed that showed that irrigation alone would explain nearly 70 percent of the variations in agricultural output among different states. The study of Oran, et.al.(1990) suggested that investment in irrigation development if the best strategy for all the developing countries in meeting the domestic demand for food grains and employment opportunities.

Creation and development of irrigation potential is an age old practice in India. The scriptures of pre-Vedic and post Vedic periods showed the development of irrigation facilities by different rules. The vast water resources of the country, provided by the number of According to the estimates of the irrigation commission, the available water resources have the potential to irrigate about 81 million hectares of land. On the other hand the National Commission on Agriculture (1976) has estimated, by taking all the constraints into account that nearly 110 million hectares of land can be irrigated by tapping the existing water sources

Despite abundance of water sources, the Indian economy suffered with the continuous occurrence of droughts in one or other part of the country inflicting damage to human and cattle population. A part from this, the more serious problem at present is the recent trends in growth of aggregate agricultural production. The recent budget (vote on

account) pointed out a negative growth rate in agricultural sector. (However, this trend is pointed out as early as in 1983 at a seminar sponsored by Indian Society of Agricultural Economics (1983) The Participants at the seminar are apprehensive about the stagnant, if not decelerating rates of growth in the agricultural output of the country. This phenomenon may imply rising food prices and non availability of food grains to the vulnerable sections of the society. As cautioned by Bansil (1983), this situation of stagnation /deceleration of growth of agricultural output has severe repercussions when it is juxtaposed with the increasing use of fertilizers and high yielding varieties on a massive scale. Thus provision of irrigation to agriculture is a sine qua- non for not only the development of agricultural sector but also the overall development of the economy.

#### **Progress of irrigation in India:**

Even if water resources are plenty, if there is any lapse in exploiting them to irrigate the land it can be ascribed as a reason for the present crisis in the agricultural sector. But an examination of the history and pace of development of irrigation potential in this country does not support this view. Under colonial rule, development of irrigation was treated as a famine relief measure and was accorded with less priority. As a result, the proportion of area irrigated to the total net area sown was only about 20 per cent at the time of independence. Since India has attained its independence, emphasis has been placed on the development and exploitation or irrigation potential by allocating huge amounts in successive Five year Plans for the construction of major, medium and minor irrigation projects.

It is clearly evident that irrigation development has been attained prominent place in successive Five Year Plans and the Governments investment on irrigation development has increased from Rs.441.8 crores in first plan to Rs.100105.9 Crores in the tenth plan. Thus the area irrigated is increased by almost four times since independence. Thus on one hand we have witnessed and impressive development of irrigation potential coupled with the massive use of fertilizers and other new technological inputs. On the other hand, the economy is facing decelerating/ stagnating rates of growth in agricultural output.

The Governmental agencies try to conceal the real extent of underutilization in the irrigation projects of their jurisdiction and their estimation is very much suppressed one and some unofficial estimates put the figure at least double than the stated levels. Thus underutilization of irrigation potential is a major problem in each and every major irrigation project. It implies the wastage of not only precious water resources but also the attending benefits. Moreover, even the stated level of utilisation of irrigation potential is being done in a haphazard manner there by affecting both the productivity and equity of the irrigation system.

The committees appointed by central and state governments, have studied this aspect to identify the reasons for the inefficient and underutilization of the irrigation potential in the major and medium irrigation projects. The important factors identified by these committees for this phenomenon are:

- i. Canals are not maintained properly and there by ineffective in carrying the designed discharges.
- ii. Conveyance losses are heavy in some of the reaches necessitating lining.
- iii. Water courses and field channels are not constructed even years after the canals are ready.
- iv. The cropping patterns envisaged in the design are never realized in Practice. Even if irrigated dry crops are stipulated at the head reaches of irrigation channels, wet crops are grown by the farmers.
- v. There is widespread unauthorized irrigation and it may not be possible to prevent it in the existing socio-political setup.
- vi. The tail enders do not get their due share while, the farmers at the head – reaches of the canals and distributaries use more than their share of water, and.
- vii. In general, irrigation discipline is almost absent.

All these factors are the culmination of inefficient management of water resources in the command areas of irrigation projects. To remedy this situation, it has been suggested that scientific management of water resources is the need of the hour. If implemented properly the water management on scientific lines can successfully remove these maladies of water use. As aptly

pointed out by Leaster Brown(1975), “as population presses more and more on the available supply of water in the poor countries, the efficiency of water use will ultimately determine to a large degree, the supply per person. Incresignly, the lack of water, rather than of land, is limiting food production, we must, therefore, begin to concern ourselves more with man water ratios and less with man landratios”.

### Meaning and Goals of water Management:

Bromley, et.al.(1986) have stated that the term scientific water management connotes at least five things.

- i. Rehabilitation of existing Projects in terms of modifying the distribution network.
- ii. More intensive operation and maintenance of their infrastructure;
- iii. More careful planning of cropping pattern and schedules.
- iv. Greater care in the allocation and scheduling of water both among and within the systems, and .
- v. Greater enforcement of or changes in the rules and regulations governing access to irrigation water by individual farmers.

Next regarding the goals of water management, the perceptions differ among individuals, groups, disciplines, professional and departments according to their own narrow preoccupations. However, as a comprehensive and practical frame work Chambers (1987) has proposed five focal objectives of water management, They are

- i. ‘Productivity’ especially of water,
- ii. ‘equity’ regarding the distribution of water system,
- iii. ‘stability’ of both the environment and the system,
- iv. ‘Carrying capacity’ (livehood intensity) indicating the size of population supported at a decent and secure level, and
- v. ‘wellbeing’ which denotes health, amenity, nutrition and psychic factors of the supporting population.

### The Problem

Though all the measures suggested above are important for efficient water management, the present study addresses itself to highlight the equity

in the distribution of irrigation water in relation to the location of the farm on the irrigation channel and the resultant effects on cost structure and productivity. It impels that the emphasis of the study is to highlight the advantages or disadvantages of farms located at different reaches on the irrigation channel.

As indicated earlier, the intended objective of all the irrigation projects, whether major or minor is the equitable distribution of the resultant benefits to all the people. But in practice, equitable distribution besets with so many problems and these are very acute in case of water distribution. This leads to several forms of inequity in the distribution of water among different farmers. For instance, in the absence of effective irrigation policy and law, the farms located at the upper reaches may appropriate more water than what they have to get, while the farms located at the tail end may not get their due share of water. Though equity may be interpreted in several ways, the researcher adopted the definition of this concept from the study of Murray et. al (1938). According to them with regard to a situation of agricultural production, equity means all producers have something approaching equal access to productive resources, mainly water even if not all are able to get the same results. In this simplified sense, according to Arthur Mass and Anderson (1979), “Implementation of equity is to govern the exercise of any discretion that canal officers have when they enforce orders and regulations for water distribution and to govern the legislator’ discretion when they fashion these rules form formal concepts”. However, in practice, the rules and regulations framed by the legislatures and their implementation by the irrigation officials gave rise to several imperfections in the distribution of water. Among them the most important problem is the prevalence of the doctrine of ‘prior appropriation’, which denotes that whoever first used the resource has a right to continue to do so. Due to this attitude, the farmers at the head reaches of the channels who are permitted to draw the water at their will in the beginning, when the excavation of channels was yet to be completed after the completion of dam, are behaving in the same manner by withdrawing more than their due share of water though the ayacut area is extended by finishing the excavation of channels.

As a result the frequent and almost a common feature of all the irrigation projects is the

inequitable access of the channels draw the water in relation to their location at different reaches of the irrigation channel.

Top enders of the channels draw the water unlimitedly, which has been regarded as their right, thus leaving less or no water to the farms located at the lower reaches or tail enders of the channels. Next, the farmer at the head reaches let the water flow to the tail end only after their fields are completely irrigated and when it is dangerous to their crops to hold water in their fields. This results in a situation that the tail end farmers are denied water when it is necessary but flooded with water when it is not required. In addition, at times of water scarcity the top enders resort to all sort of means to utilize the available resources thus dissipating the hope of the tail enders. Thus the three basic requirements of a good irrigation system, viz., quantity, timing and assurity of water are completely denied to the tail enders which is mainly due to the complecent view of the irrigation administration.

The inequitable distribution of water, in turn may reflects in the differences in farming practices and socio-economic status of the farm households located at different reaches of the channel. As pointed out by Gustafson and Reidinger (1910) and Wade (1911) uncertainty of water may force the farmers to adopt a drought resistant cropping pattern and lower level of inputs as a hedge against risk.

Keeping the above discussion in view, the present study aims at an examination of the relative advantages of the farm located at different reaches of the irrigation channel. In other words, it is proposed to examine the effects of inequitable distribution of water on the costs and returns of farming.

### **Objectives of the Study:**

The Specific Objectives of the Study are :

1. To examine the differences in socio-economic and agricultural characteristics of the farm households located at different reaches of the irrigation channel.
2. To Analyse the economics of farm business of farms located at different reaches of the irrigation channel in order

to point out the differences in the input use, yields and returns.

3. To examine the economics of production of principal crops of farms located at different reaches of the irrigation channel, and
4. To suggest policy measures to achieve efficiency in the distribution of water.

### **Methodology:**

#### **Setting of the study:**

The Study is carried out in the Right Canal Command Area of Nagarjuna Sagar Project, Andhra Pradesh. Though this canal is providing irrigation facilities to farms in Guntur and Prakasam Districts, only Guntur district is selected as around 70 percent of the localized ayacut falls in this district. At the instance of the Union Ministry of Agriculture, the Andhra Pradesh Government has created the Command Area Development Authority (CADA) to the NSP Right canal Command area with its headquarters at Guntur. The main objective of the CADA is to attain efficiency in the distribution of water by adopting better water management practices. To this end, the CADA of NSP right canal, has adopted 'warabandhi programme' on an experimental basis and 'systematic anal operation' on a regular basis to ensure equitable supply of water. However, due to the deficiencies in the design of outlets at the level of distributories and field channels, warabandhi programme could not make a success. Thus the only water management practice being adopted and in the implementation by CADA is systematic canal operation by which the water supply in the minors/direct pipes is rotated to deliver designed/ eliable discharge at each outlet.

#### **Approach of the study:**

In the above scenario, the approach of the study is to compare the economy of farm households located at different reaches of the irrigation channel, viz., upper end, middle end and tail end. In addition, the economy of these three categories of farms are compared with farms located outside the command area where water management practices are absent and are with assured water supply when once water is released for crop production. This group of farms located outside the command area are treated as controlled group.

### Data base:

Date is collected through canvassing a pre-designed well structure schedule among the selected sample households. The reference year of the study is 2012-13.

### Selection of the sample:

The selection of the sample households is based on multi stage stratified random sampling technique. At the first stage with the help of the CADA officials, the list of the villages located at the upper end, middle end and tail end of the irrigation channel are prepared. At the second stage six villages form each of the categories, i.e., upper end, middle end and tail end are selected randomly. Similarly, five villages form the controlled group i.e., upper end, middle end and tail end are selected randomly. Similarly, five villages form the controlled group i.e., outside the command area are selected randomly from the list of villages obtained from the Executive Engineer's office (Irrigation) Guntur District. In the third stage, a census schedule is canvassed among the household of each of the villages to elicit information on structure of land holdings, tenancy, live - stock, assets, etc. From among this list, the cultivator households are separated and they are arranged in an ascending order of the operational holding. In the next stage, these households are stratified into four groups, viz., marginal (1:00 hectare and below), small (1.01-2.00 hectares), large (2.01-5.00hectares) and big (above 5.01 hectares). Finally 10 , farm households from each of the villages are selected according to the probability proportional principle. Thus the total sample consists of 290 farm households.

### Technique of Analysis

Tabular analysis with simple average and percentages are widely used. In addition different concepts of costs and returns as used in the Farm management studies are adopted. Production Function analysis is used to examine the efficiency in resource use.

The major findings of the study are summarized as here under.

1. There are glaring inequalities in the distribution of land in all the four categories, viz., upper-end, middle-end

and tail – end of the command area and the controlled group. Tenancy practices are almost non-existent. However, there is a possibility of concealed tenancy in both leasing-in and leasing-out operations.

2. The differences in demographic characteristics, viz, literacy and age of the heads of the households, average family size, composition of farm family etc, among different categories are minute. A direct/inverse relationship is observed between farm size and average family size/number of earners per family.
3. The cropping pattern reflects the modernization of agriculture in the study area. The two principal crops paddy and cotton together accounted for around 60 percent of the gross cropped area. In the controlled category area. In the command area as one move form upper- end to tail – end, the proportion of area as expected, paddy is the principal crop and shared about 50% of the copped area. In the command area as one move form upper – end to tail – end, the proportion of area under paddy to gross cropped area shows a declining trend, while the same with respect to cotton shows and increasing trend. This may imply that farmers at lower reaches are adjusting their cropping pattern towards irrigated dry cash crops. This is a notable feature of the study which could be explained subsequently.
4. The differences in the composition of farm assets milch cattle, drought cattle, possession of major and minor implements are not worth mentioning.
5. It is unfortunate to note that, even after 63 years of independence and 42 years of nationalization of commercial banks, above 65 percent of the farm credit is being provided by non-institutional agencies alone in the study area. Still the economically weaker and marginal and small farmers are in a disadvantageous position with regard to the access to institutional finance. This inference is based on the observed inverse relationship between farm size and proportion of non – institutional credit to total credit.
6. The study also indicates that the differences in average annual consumption



expenditure among different categories in the command area are negligible. In the controlled category it is higher by about 16-22 percent than that in different categories of command area. The study also reveals that none of the selected sample farmers is living below the poverty line.

7. The economics of farm business reveals that: (A) the total cost of production per hectare of cultivated area is relatively higher in different categories of command area as compared to controlled group and in the command area, it shows an increasing trend as one moves from upper end to tail end. This phenomenon is perhaps due to the relatively higher proportion of area under cotton in the command area. Apart from the overhead and imputed costs, fertilizers, pesticides, hired human labour, bullock labour, seed and machine labour appear to be the predominant components of total cost. In all the four categories, a direct relationship is observed between farm size and the proportion of expenditure on hired human labour to total cost. (b) the gross returns per hectare of cultivated area is the highest on tail-end farms (Rs.19738) followed by controlled farms (RS.19729), upper-end farms (Rs.17293) and middle – end farms (Rs.17085). On the other hand, net returns, viz, farm business income, family labour income, farm investment income and net income are found to be higher on controlled farms followed by tail-end , upper – end and middle-end farms. Within the command area this phenomenon of higher gross and net returns on the tail-end farms is quite unexpected. The possible factors causing this phenomenon could be explained subsequently. Thus, the analysis of farm business reveals that, controlled farms have achieved a relatively higher efficiency in the use of resources than the different categories of command area. In the command area, the efficiency in the use of resources is found to be relatively higher in tail end category and is followed by upper end middle end categories.

8. The economics of production of paddy indicates that a) the total cost per hectare

of cropped area is higher in controlled category than that in the command area. In the command area this is found to be higher in upper end and the difference in middle end and tail end categories is almost negligible. Expenditure incurred on fertilizers, hired human labour, pesticides, machine labour, bullock labour and seed are found to be important components of total cost. (b) the gross income per hectare of paddy is the highest in upper – end and it is followed by controlled group tail – end and middle and categories. Net returns are also found to be higher in upper end and in the command area, net returns show a declining trend as one moves from upper – end to tail-end . This is as expected due to the fact that paddy is a water intensive crop and timely and adequate supply of water is essential for achieving efficiency in the use of resources. The upper – end farms as compared to the other two categories in the command area are in an advantageous position with regard to access to irrigation, as such they would have achieved a higher efficiency in the use of resources and there by higher gross and net returns.

9. The economics of production of cotton reveals the following: (a) the total cost of production per hectare of cropped area is the highest in the controlled category followed by middle –end, tail –end categories. Pesticides alone appear to be a predominant component of total cost and the expenditure on pesticides accounted for a quarter of the total cost and together with fertilizers, it accounted for 38 percent. The relatively higher expenditure on fertilizers and pesticides in the controlled category than the other categories in the command area would have caused the higher cost of production. Among different categories, it is observed that the expenditure on pesticides, absolute as well as relative, is relatively higher on small farms compared to larger farms indicating the economies of large scale production.
10. The gross return per hectare of cotton is the highest in controlled category and the lowest in upper-end category (Rs.18,383).

In command area, as one moves down from upper end to tail – end, the gross income per hectare shows an increasing trend Net returns per hectare on the basis of farm business income, family labour income, etc., are also found to be highest in the controlled category and in the command area net returns show an increasing trend as one moves down from upper end to tail end.

11. The economics of production of chillies indicates the following.
  - a. The total cost of production per hectare of chillies is the highest in middle – end followed by upper – end , tail – end and, lowest in the controlled category. Fertilisers and pesticides are the two important components of total cost and accounts for one half of the total cost. The results also suggest that wherever the expenditure on human labour is higher / lower, the expenditure on pesticides is lower/ higher. This may be due to the substitution of pesticides to labour in some of the farm operations specifically prevention and clearing of weeds.
  - b. Gross income per hectare of chillies is Rs. 36848, Rs.26,268, Rs.30,433 and Rs.32,496 respectively in upper end, middle end, tail end and controlled categories. Net returns on the basis of farm business income, family labour income, etc., are found to be higher in the controlled category than the other three categories of command area. In the command area, these net returns are found to be higher in upper-end and lower in middle –end category. The relatively higher net returns in the controlled category, though with a relatively lower gross income some of the categories of command area is mainly due to the relatively lower cost of production in this category.

### Conclusions:

From the above summary, it can be concluded that, as expected, the controlled category of farms have achieved a relatively higher efficiency in the use of resources and there by attained higher returns (gross as well as net) compared to the farms in the three categories of the command area. Within the command area the tail end category of farms have registered a higher efficiency in the use of resources and attained returns compared to other categories. This is in contrast to the general belief that the farms in the lower reaches of the irrigation channel are in a disadvantageous position in making use of the resources due to the irregular and inadequate flow of irrigation water. However, from the present study, it cannot be inferred that the farms at the tail end are in an advantageous position with regard to the access to irrigation water and there by achieving higher efficiency in the use of resources. This needs an explanation.

When Nagarjuna Sagar Project water was released for irrigation purposes in 1967-68, as is the case with other major irrigation projects, though construction of the dam was completed, the excavation of the irrigation channels are not completed for the entire command area. For this reason, only 45 percent of the localized ayacut of Nagarjuna Sagar Right canal (NSRC) was irrigated. To reduce the under utilization of created irrigation potential and due to the policy of Government of India to attain self sufficiency in the production of food grains, farmers in the upper reaches of the main channel were permitted to grow irrigated wet crops like paddy in two seasons, for a period of five years i.e., up to 1972-73 on irrigated dry lands. Taking advantage of this and by ignoring the clause relating to the time factor, most of the farmers in the upper reaches have converted the irrigated dry lands into wet lands. After the excavation of canals in the entire ayacut was completed, the officials of the irrigation department are insisting the farmers at the head reaches should confine to the cultivation of ID crops. But these farmers are not paying any attention to this and they are demanding relocation of the ayacut basing on the doctrine of prior appropriation. The farmers at the head reaches argue that they will incur losses if they were to grow ID crops like cotton, chillies, etc., as their land was leveled to suit the cultivation of paddy. They also argue that the yield levels and the returns of ID crops will decline, if at all they grow,

due to the seepage of water from the adjacent wet lands. On the other hand, the tail end farmers argue that they will get abundant quantities of water during monsoon season which stagnates in the fields, for a period of 10 to 15 days due to the absence of drainage net work. This enables a heavy damage to irrigated dry crops if their area was relocalised as irrigated dry.

This problem of relocalisation has been unresolved for the past 20 to 25 years. To cope up with the problem of inadequate irrigation water, the tail-end farmers have resorted to grow irrigated dry crops in most of the area and to avoid the problem of water stagnation at times of heavy monsoonic rains, they are growing wet crops in a limited area adjacent to irrigated dry crops. This resulted in the relatively higher proportion of area under cash crops like cotton in the tail – end area and it is clearly indicated from the study that the proportion of area under cash crops to total cropped area shows an increasing trend as we move from upper – end to tail end on the irrigation channel. It is also evident from the study that the returns from paddy are higher in the upper – end and the farmers at the tail end are at a disadvantageous position. So the relatively higher advantageous position of the tail – enders in the farm business is due to the relatively higher area and returns from the cultivation of cotton. However, this may not happen every year and the farmers in the tail – end areas have expressed that they are used to get good harvests in three out of every five years and whatever the profit they obtain in them is offset by crop failures and low yields in the remaining two years. This may be true if we take into consideration the present plight of cotton farmers in Andhra Pradesh.

#### **Policy Implications:**

The study indicates that the tail end farmers are not getting their due share of water though a higher proportion of the cultivated area is localized as irrigated wet by the authorities. However, to cope up with the problem of inadequate and irregular water supply, the farmers at the lower reaches of the irrigation channel have adjusted their cropping pattern towards irrigated dry crops, mainly cotton. This fetched them good returns during the study year which, may be due to favorable conditions from all the fronts. But if we take into account of the current plight of cotton growing farmers in Andhra Pradesh, stern measures may be required to

be taken by the authorities to safeguard the interests of the farming community in the study area in general and that of the farmers at the lower reaches of the irrigation channel in particular. Hence, the following policy measures are suggested.

1. The major problem in the command area of NSP is to relocalise the ayacut. The farmers at the head reaches are demanding for relocalisation of their ayacut as irrigated wet, though most of the ayacut was originally localized as irrigated dry. On the other hand, farmers at the lower reaches are demanding for their original status i.e., irrigated wet. As this process involves political considerations, the matter of relocalisation is dragging on so long as it may not be possible to relocalise the ayacut. In this regard, the only and best alternative is to implement warabandi in the entire command area at the pipe level. Way back in 1983, the command area development Authority of N.S.P. Right Canal, has adopted 'warabandi' Scheme at the pipe level on an experimental basis in a limited area and they achieved good results. But to extend this scheme to the entire command, the existing design of the distributary does not work in inadequate and it should be completely changed. Thus though in the initial stage it may involve considerable amount, in the long run interest of the farming community implementation of warabandi is a must.

2. In addition to the implementation of warabandi the long pending action of lining the water courses must be finished at the earliest so as to curtail the water losses due to seepage and leakages.

3. At present the water rates are based on area basis. On the other hand if warabandi is implemented, the water rates can be charged on the quantity of water used. If so, this will force the farmers, specifically at the upper reaches, to use the water more economically.

4. One of the important objectives of CADA is to evolve suitable cropping patterns from time to time taking into consideration the agro climatic conditions of different zones and the possible supply of irrigation water. In practice this is not adhered to so far. Thus efforts should be made to evolve cropping patterns to suit different agro climatic zones on scientific basis and the farmers must be made to adhere to this cropping pattern.



5. Extension education to farmers in the form of better utilization of water resources and scientific water management should be given. This may enable them to use water to the required levels and thus save precious water resources.

Wade, R.A. (1975), Administration and distribution of Irrigation Benefits, Economic and Political Weekly, November 1975.

### References

Clark, K. Colin (1970), The Economics of Irrigation Pergamon Press, Oxford.

Bhalla, G.S. (1980), Growth of Agriculture: A District wise Study, Sterling Publishers, New Delhi.

Rao, S.K. (1971), "Inter Regional Variations in Agricultural Growth, 1952-53 to 1964-65, alternative Analysis in relation to Irrigation" Economic and Political Weekly, Vol, VI, No.27.

Bansil, P.C. (1983), The Crisis in Agriculture, Economic Report, No.2.

Lester Brown R, ('1972) Seeds of Change – the Green Revolution and Development in the 1970s, prager publications, New York.

Bromley, W.D., Taylor D.C. and Parker, D.E. (1981), Water Reform and Economic Development: Institutional Aspects of Water Management in the Developing Countries, Economic Development and Cultural Change, Vol.XVI, No.2.

Chambers, Robert (1983), Irrigation Management Ends, Means and Opportunities, Productivity and Equity in Irrigation Systems", Institute of Development Studies, Lucknow.

Hammend Murray, Rust et.al. (1983), Productivity and Equity in Gal Bya Left Bank – A Sri Lanka Irrigation System, paper Presented to work shop on Productivity and Equity in Irrigation Systems, Institute of Development Studies, Lucknow.

Arthur Mass and Anderson R.L. (1978), The Desert Shall Rejoice – conflict, Growth and Justice in Arid environment, M.I.T. Press, Cambridge.

Gustafson, W.E. and Reidinger, R.L. (1971), Delivery of Canal Water in North India and West Pakistan, Economic & Political Weekly, December, 6.