

**WATER AND POVERTY:  
A CASE OF WATERSHED DEVELOPMENT IN  
ANDHRA PRADESH, INDIA<sup>1</sup>**

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## I Background

The future of agriculture development and food security is critically dependent on the development of rain fed agriculture. This is not only due to the fact that these regions account for more than half of the total cropped area but also due to the reason that the productivity levels of the irrigated and green revolution belts has saturated. As a result, returns to investment in agriculture are found to be substantially higher in the rain-fed regions when compared to irrigated regions (Fan and Hazell, 2000). Incidentally, majority of the poor lives in these regions. Therefore, development of these regions helps in solving the twin problems of poverty and agricultural production. Besides, it would help in reducing the regional inequalities as well.

While providing productive irrigation facilities to these regions is an effective solution it would be a time consuming (long run) and costly proposition given their geographical disadvantages. On the other hand, watershed development is proved to be the most suited technology for improving the conditions of these regions at least in the short and medium runs. Watershed development helps in improving agriculture productivity of rain fed areas through *in situ* moisture conservation, vegetative cover, increased availability of water, etc. It can also lead to sustainable irrigated agriculture in moderate rainfall (above 750 mm) conditions<sup>1</sup>.

This case study is an attempt to understand the potential of watershed development in addressing the issues of poverty alleviation. The important issues in this regard include: a) assessing the linkages between watershed development and rural livelihoods & poverty, b) type and nature of benefit flows accruing to various sections of the community, and c) challenges in making the watershed programme pro-poor and sustaining it in the long run. The study stems out from the authors' longstanding experience in the region<sup>2</sup> and some intensive field visits and discussions with various sections of society and also other stakeholders in the programme such as NGOs, administrators, policy makers, etc. The case study is located in one of the most drought prone districts of Andhra Pradesh i.e., Anantapur district of the Rayalaseema region. The main focus here is on the watersheds that are implemented by the Rural Development Trust / Accion Fertarna (RDT / AF), a local NGO<sup>3</sup>. This case study is organised in five parts. A brief description of the case study region is presented in the following section. The linkages between watershed development, water and poverty are explored in section three. While the impact of the watershed development and other supportive programmes on poor is examined in section four, the last section makes some concluding remarks and recommendations.

## II Description of the Case Study Area

### **Choice of study area**

The Government of Andhra Pradesh (GoAP) implements the central government watershed related policies and programmes enthusiastically on a wide scale. The state administration has identified watershed development as a key to promote sustainable livelihoods for the poor. AP is the forerunner and exemplifies of what can be achieved in poverty alleviation through better watershed and water management through state initiatives. Its' approach is unique in the sense that programmes are implemented 'top-down' with 'bottom-up' approach. The state has so far initiated about 7000 watersheds covering about 3 million hectares. This accounts for roughly a

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<sup>1</sup> However, this is not to suggest that watershed development is a substitute for irrigation development.

<sup>2</sup> In fact, one of the authors Mr. Y. V. Malla Reddy has been involved in the development activities of the region for past 30 years.

<sup>3</sup> The focused villages for the study include Kadiridevarapalle, Mallapuram, Marrimakulapalle and Guddella.

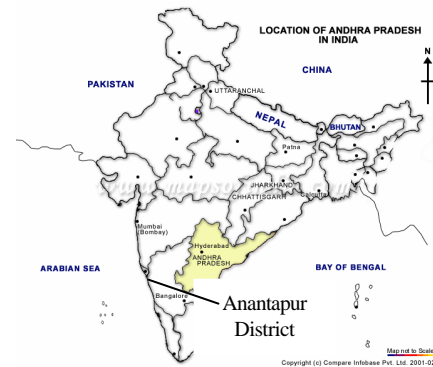
third of the land that needs treatment and a fifth of the total rain-fed area in the state. Therefore, AP is a natural choice for understanding the links between poverty and watershed / water management initiatives.

The specific case study area, the district of Anantapur situated in the Rayalaseema region of the state, has been chosen for two reasons. First of all, as a semi-arid, low resource and high-risk environment with a high incidence of poverty, it typifies the conditions under which much of the future agricultural growth and poverty alleviation in India will have to take place. Such areas with rain fed-agriculture cover about 60 per cent of the gross cropped area in India. Secondly, Anantapur represents some of the best-implemented watersheds in the state and hence provide the opportunity to assess their true potential for poverty alleviation.

### **Physical and Socio-economic setting**

While India is considered to be rich in terms of annual rainfall and total water resources, water is spatially and temporally unevenly distributed. AP is one of the states with less than average rainfall within the state; Anantapur is the district with the least rainfall. The area is one of an undulating topography, poor soils and a generally low resource base.

Over the years population pressure has added to the woes of this region characterised with high fragility and low carrying capacity. Moreover, of late rainfall has become more erratic with its distribution becoming unfavourable for crop calendars. Though average rainfall over the last hundred years appears to be stable or increasing rainfall in the crucial months like July has declined (Hill, 2002). Its geographical disadvantage provides little scope for surface irrigation facilities. As a result, Anantapur has the lowest proportion of area under irrigation (17 per cent) in the State. Anantapur district accounts for 4.79 per cent of the state's population and 6.97 per cent of the geographical area. It has only 10 per cent of its area under forests as against 22 per cent at the state level. Anantapur district has higher percentage of small (26.3 per cent) and semi-medium (25.9 per cent) size farmers when compared to other Rayalaseema districts.



About 19 per cent of its population belongs to Scheduled Castes and Tribes (SC/ST), which is lower than the State's average (22 per cent). Its sex ratio (972/1000) is same as that of the state average. However, sex ratio has declined during the last decade. The incidence of gender discrimination is expected to be relatively more acute here because of its low level of development. Similarly, the district has a literacy rate (56.7 per cent) below the state average (61 per cent) as per 2001 census. The figures are much lower in the case of female literacy (43.9 per cent as against the state average of 51.2 per cent). Health of the population reflects its poverty. A UNDP pilot study in the neighbouring Kurnool district found half of a village's 473 people suffering from body ache, general weakness, anaemia and cough. Most of the illnesses amongst the SC population stemmed from malnutrition and chronic anaemia. Diseases associated with poverty, e.g. tuberculosis, are on the rise. On most indicators the people of Anantapur are worse off than the average of AP.

As far as basic services are concerned, e.g, access to drinking water, 97.29 per cent of the villages in Anantapur have access. However, access is not in terms of potable, reliable and safe drinking water supply with easy access. In fact, most of the habitations are reported to be having poor quality water. Sixty four per cent of the villages in the district have access to post

and telegraph facilities. Transport worthy roads or all weather roads connect 70.15 per cent of the villages in the district. All the villages are having access to electricity.

According to the 1991 census 48 per cent of the state's population is classified as 'non-workers' while 54 per cent of Anantapur's population is 'non-workers'. Anantapur has 17 per cent of its population as agricultural labourers when compared with over 20 per cent for the state as a whole. Incidence of poverty is the highest among the ST population (56.7 per cent) followed by SC (50.2 per cent), BC (45.5 per cent) and OC (33.3 per cent). The situation of SC / ST and BC are much worse in the district than the general situation in the state. In fact, 35.59 per cent of the villages in Anantapur fall in the high deprivation category (income of less than Rs. 120.03 per capita per month). In the 1991 GoAP survey on indebtedness, it was revealed that 45 per cent of the rural families are in debt as against the State average of 18 per cent. Drought is a major reason for this indebtedness.

### ***Water Resources: Status and Linkages***

In the study area water resources, surface as well as ground, are limited. Rainfall is between 255-650 mm per year, and falls mainly during the monsoon (July-September). Rainfall data confirm what local people say, that rainfall patterns have become more unpredictable. The result is crop failure with only the 2000-2001 season giving a reasonable crop in the last five years. Even then late rains damaged the groundnut crop in certain areas. Some localities have ephemeral streams or rivers. Villagers have, from time immemorial, had common access to tanks and open wells, some of which are still in use. There is a clear link between surface and ground water resources. Rainwater is traditionally harvested by diverting surface water flows into tanks, open wells and into the ground water through specific infiltration areas. Most people in Anantapur district have access to drinking water from hand tube wells.

Untimely rainfall is the biggest water related vulnerability. Crops require water, however limited, at certain stages of their growth. Uncertainty over rainfall characterises agriculture and life in these areas. One farmer stated it clearly: "Agriculture is now like gambling". The main source of irrigation is ground water through open and bore wells. Though surface irrigation systems such as tanks used to be the main source of irrigation earlier, most of these systems have degenerated over the years in the absence of policy support. Unfortunately, this has rendered the local institutions that were managing these systems as things of past, though there are traces of these institutions in some villages. In the process water resources have transformed from a community resource to a private resource. Due to its capital intensive and lumpy nature ground water extraction has become privy to large farmers. The advent of deep bore wells and submersible (deep) bore pumps has further aggravated the problem. Expansion of bore wells in the absence of any initiatives to strengthen the ground water replenishing mechanisms has led to depletion of ground water table and drying up of open wells. This has adversely affected the resource poor farmers. Even some common access (drinking) hand tube wells have gone dry as a result of private ground water use for irrigation. Conversion of a common good into a private property is complete thus denying the genuine rights of majority of the people in a common pool resource.

In certain areas ground water has high levels of fluoride, which is detrimental to the health of particularly the young and the old and those otherwise not completely healthy. As a result there is a high incidence of dental and, in some places, skeletal fluorosis. Poor diet and the consumption of foods contaminated with fluorine add to the problem of drinking water with a fluoride content exceeding the 1.5 ppm limit. Water quality, particularly of open sources and at the end of the dry season, is often poor. Poor water quality leads to gastro-intestinal and other diseases, adversely affecting both people and livestock.

People are aware of the links between ground and surface water bodies. But due to the magnitude of the investment and collective efforts required communities shy away from reviving the surface water bodies. They expect the state to take up such activities. They seem to be comfortable with the private exploitation of ground water though they are aware of the externalities arising out of over exploitation of ground water. Degradation of the resource and the widening inequalities are a common sight. This has not reached a conflict point due to the low awareness of the people regarding resource endowments and entitlements. But, the impact of dwindling water tables (well failure) coupled with adverse climatic conditions, adverse input-output prices and poor quality of inputs (especially seeds) has brought agriculture sector to a flash point in these regions. There are reports of farmer suicides and widespread migration even among the large farmers.

### **III Watershed Development, Water, Livelihoods and Poverty**

The preceding section clearly brings out the fragility of the resource base and the prevailing socio-economic conditions in the study region. This is a general phenomenon even in our study villages prior to the interventions of RDT / AF through watershed development programme. Under such adverse conditions, the introduction of watershed development is expected to improve the living conditions of the local communities in varied ways. These improvements can range from dramatic to moderate changes. Before going in to the details of impact in the next section, here we attempt to establish the linkages between watershed development, water and poverty and the institutional imperatives underlying the implementation of the programme.

Watershed development is a land-based technology consisting of various components aiming at land, water and tree conservation. Basically, every piece of land is a part of a micro watershed, which is a sub-set of a macro watershed. When a micro or macro watershed is treated land quality will improve due to checking of soil erosion caused by wind and water. Activities like contour bunding, pebble bunding, trenching, nala bunding, gulli plugging, plantations, etc are expected to check soil erosion, enhance *in situ* moisture, improve the vegetative cover, etc. As a result of improved quality of soil and availability of moisture productivity of land would increase. Besides, these measures also improve ground water recharge due to the reduced run off. At the macro level when all the watersheds, micro as well as macro, are treated availability of water resources will improve. For, rainwater harvested per unit of land would rise. This could be in terms of ground water recharge or increased capacity of reservoirs due to low siltation. Besides, watershed development can also create small-scale local reservoirs with the help of check dams, which have multiple uses including ground water recharge (see Box 1).

**Box 1: Check Dams: beneficial or not?**

The impact of check dams is a debated part of watershed activities. Check dams are small, capital intensive structures, retaining the stream flows of a small catchment area. They help water storage for 3-6 months resulting in ground water recharge, availability of water for livestock and plantations during the water stress periods. They may even support fish farming. The most important ecological impact is ground water recharge and revival of open wells.

Of late check dams have become controversial, for both ecological and economic reasons, as they may obstruct down stream flows. Evidence from the case study area and elsewhere does not support the criticism.

In Kadiridevarapalle, a hundred year old open well that has dried up during 80s was revived in the 90s when two check dams were made nearby. In the 50s the owner of the well, Mr. B. Venganna (80 years old) got the well widened and deepened and added another well. These 40 feet deep wells used to irrigate 2.67 hectares of land, growing paddy, millet and bajra. In 1983-84, when the water table went down due to severe drought, he installed four in-well bores. Three of them failed shortly thereafter and supply from the remaining one was barely sufficient to irrigate half his land.

After the construction of check dams in 92 and 95, both open wells were revived with plenty of water. One more bore well also was installed. Despite the drought conditions of the last 5 years, the wells can supply water round the clock. These wells support 5.33 hectares growing paddy, papaya, sunflower, vegetables, millet, etc. The main constraint is power supply, which is available for 7-9 hours in a day.

Basically watershed development is expected to improve the conditions of the farmers and the poor through greater availability of water. While overall impact of watershed development on water resources at the macro level is clear, it is not so in the local context. At the local level improvement in water availability depends on local rainfall pattern, soil type, slope, gradient, etc. These aspects may vary from village to village and hence the availability of water due to watershed development. In the case study region, which is characterised with low rainfall, water gains from watershed development range from improved *in situ* moisture content to moderate improvements in ground water availability (see Box 1).

Given the socio-economic context of the study region the key beneficiaries from the programme would be the landed households who are in the majority. Large farmers are generally better off, but in AP in general and the case study area in particular, their indebtedness is high. The main reasons are drought induced crop failure and unsuccessful bore well drilling. Indebtedness is one of the main reasons behind the relatively high number of suicides in the area. Marginal and small farm households are another interest groups. Though AP is the only State in the country in which the land inequality has shown a downward trend over time, land continues to be concentrated in the hands of a few while small and marginal farmers dominate in numbers. Relatively, the study region has low incidence of landless ness. Inequalities are more in the case of access to water than to land.

Scheduled Castes and Scheduled Tribes are also key interest groups when it comes to poverty alleviation. Traditionally they have been at the margin of society, owning few resources, such as land and also having less social and other forms of capital. Similarly, women make up the majority of the poor and suffer the most from poverty. Census data show that women are predominantly engaged in agricultural labour. In general women are involved in activities that are less remunerative or unpaid because it is work within the household for subsistence. Only about two percent of women in the case study area own land.

Different interest groups in the case study area have diverse ways of making a living. Their livelihood patterns are largely determined by their access to six forms of "capital" namely human capital (health, education, skills, etc.), physical capital (infrastructure, land, buildings, etc.), natural capital (water, fodder, fuel wood, etc.), financial capital (cash flows, savings, etc.), social capital (institutional strengths, cooperative behaviour, etc.) and finally political capital (active political participation, policy influence). While livelihoods vary considerably, two general trends are clear. First of all most households invest in the future of their children by sending them to school. Secondly, most households strive to diversify their income earning sources to spread the risk.

In times of extreme hardship, such as during the drought that occurred in 4 of the 5 most recent years, the poor start by skipping a meal a day or shift to low nutritional value foods. This has aggravated their health problems leading to greater medical expenditure. Often huge, and unexpected health expenditure pushes households into the debt-trap. Furthermore, some poor households have taken one or more of their children, usually daughters, out of school. This reduces expenditure and adds a partial income-earning member.

Marginal and small farmers diversify by working part time as labourers or by getting into non-agricultural income earning activities. Labourers cope with setbacks by temporarily migrating out of the area to places of work, in the worst cases selling themselves as bonded labourers. Even large farmers adjust by reducing social expenditure such as for education, religious festivals and marriages. Of late even medium and large farmers are migrating due to well failure consequent to severe drought. For households that have always maintained them-selves from their land honourably, the process of pauperisation is a social and psychological trauma.

### **Context of Watershed Implementation**

Collective action institutions are a prerequisite for watershed implementation and management. This aspect is well recognised in the new watershed guidelines formulated in 1994-95 by government of India. These guidelines prioritise participatory approaches to watershed management, and the Ministry of Rural Development implements these guidelines from 1995-96 onwards<sup>4</sup>. Watershed work in the districts is managed by specially appointed Project Directors who work as a part of the DPAPs, DDPs and DRDAs. Watershed Development Teams (WDTs) constituted by the project implementing agencies (PIAs) implement the work. Multi-Disciplinary Teams (MDTs) from project director's office supervise the field operations through. Members of MDTs, WDTs and PIAs are drawn from the relevant line departments and NGOs. Villages with watershed development programmes have a watershed association (WA) and watershed committee (WC). Representatives from the *Panchayati Raj* bodies are represented in the WC and where NGOs are involved they usually insist on representation from the existing informal groups as well. Where watershed development is done by GoAP agencies the WCs are usually rather inactive, while in the cases where NGOs have done awareness raising and group formation the WCs are more active. AP is in the forefront of implementing these guidelines with

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<sup>4</sup> The 1994-95 guidelines are updated in August 2001, though the basic principles of the former remain the same.

adequate flexibility for local level adaptations. In Anantapur this has resulted in a move away from check dams to the revival of traditional water bodies such as ponds and tanks, horticulture plantations and dairy development.

To ensure that watershed development has the intended positive impact on the rural poor, the GoAP is experimenting with a “watershed plus” approach. Among others this is done through the Andhra Pradesh Rural Livelihoods Programme (APRLP). APRLP has watershed development at its core, but at the same time it has additional activities not directly related to water, such as dairy farming, savings and credit programmes and horticultural activities that allow the poorer sections of the community to benefit from the security provided by better water management. To ensure maximum and lasting impact the APRLP has the following seven components: i) capacity building for primary and secondary stakeholders, ii) innovation to enhance the impact of watershed works, iii) lesson learning and policy influence, iv) convergence of top-down and bottom up activities, v) gender and equity, vi) watershed and watershed plus SRL initiatives, and vii) participatory technology development (GoAP, 1999). Implementation is done through NGOs, such as the Rural Development Trust (RDT) and line agencies in 6 districts.

The 73<sup>rd</sup> Constitutional Amendment Act (CAA) greatly strengthened the position and role of the *Panchayati Raj* Institutions (PRIs) in planning and managing rural development. Andhra Pradesh passed a conformity legislation to acknowledge the acceptance of the principles laid down in the CAA and conducted elections for the PRIs. However, AP has been slow with devolving powers and functions to PRIs. Generally, rural development activities are managed by the line departments and the District Rural Development Agencies (DRDAs). PRIs with little training and orientation, no experience of managing watershed programmes and with allegations of widespread corruption are seen by many government officials as unfit for playing a major watershed role at this stage. In AP Panchayats are therefore not normally involved in implementing watershed programmes.

### **Local initiatives**

Community based rain water harvesting has traditionally been practised. Under the leadership of kings temple committees or local lords, tanks were built and maintained. Furthermore common pool resources, including rivers, streams, forest and grazing areas were maintained and any income from these was used to pay for their maintenance in particular and village development in general. For various reasons the maintenance of these common property resources has suffered. Land owners have also traditionally tried to retain rainwater on their land by building water harvesting structures, such as ponds, bunds, open wells, cross dams and infiltration areas. This increased the moisture content of the soil and increased crop production. These measures are extended through the soil conservation programme of the Central and State Governments from time to time. During the 80s land conservation activities have culminated into an integrated watershed development programme.

Rural Development Trust / Accion Fertarna (RDT / AF) is one of the largest and leading NGOs in the state with more than 30 years of standing in Anantapur District. It works on a multitude of activities focusing on poor specifically with the weaker sections of society. Besides, RDT / AF is involved in awareness building as well as group formation. RDT / AF has been involved in Environmental Development and Drought Mitigation Activities for the past 11 years. These previous activities created a good basis for the formation of Watershed Committees and for the additional activities. RDT / AF has its own model of participatory watershed development, which is close to the ‘watershed plus’ approach. Its main focus has been soil and moisture conservation, rainwater harvesting, vegetation development, horticultural development and dry

land agriculture. RDT / AF works closely with government at district and state levels. At present, RDT / AF is working in 50 micro watersheds with the objective integrated watershed development. In addition to these 50 watersheds, government under new guidelines funds 22. Salient features of RDT / AF model include:

1. Emphasis is laid on selecting potential villages (for collective action).
2. RDT / AF watersheds cover the entire village rather than restricting to 500 hectares. This ensures widespread benefits and participation.
3. Two members from each household (at least from 90 per cent of the total households) should become members of the watershed association by paying a membership fee of Rs. 11 each.
4. Cooperation from the *Gram Panchayat* president and other members is mandatory.
5. Firm on user contribution in order to ensure demand driven approach. In some instances the user contribution is as high as 30 per cent.
6. The organisational structure of watershed management is somewhat different from that of the guidelines. There is no watershed secretary, who is usually a paid employee.
7. Watershed committee is supported by watershed advisory committee consisting of village elders (influential people).
8. RDT / AF has broad based barefoot technical and non-technical specialists on a permanent (more or less) basis.

RDT / AF emphasises gender perspective. A separate women staff (watershed women organiser) is employed for every 10-12 watershed villages. The organiser lives in the village and interacts regularly with women about their role and responsibility.

RDT / AF has a two-pronged approach to watershed development and poverty alleviation. It follows: i) land based watershed development targeting the whole village population and the natural resource base, private as well as common and ii) poor-based socio-economic development targeting only the poorest among the village i.e. the dalits and tribals (See Table 1). The approach is designed in such a way that the poorest communities also improve their 'six forms of capital' and enhance their proximity to access the benefits of watershed development and poverty alleviation. Thereby strengthen the equity and sustainability aspects.

Even within the watershed development programmes poor farmers and the dalits and tribals are positively discriminated in terms of cost sharing / peoples contribution. For instance, in soil and moisture conservation programmes the dalit and tribal farmers as well as small and marginal farmers share only 5 to 10 per cent of the cost while the other farmers share between 15 to 30 per cent of the cost. Similarly, incentives are higher for dalit and tribal farmers in the case of horticulture, as their investment capacity is very low. Such discrimination enables the poor to make best use of the watershed programme and creates some equity.

**Table 1: RDT / AFs Approach to Watershed Development and Poverty Alleviation**

<b>Watershed Development</b>	<b>Poverty Alleviation</b>
Target Group: Entire population & Natural system	Target Group: Dalits and Tribals (poorest)
1. Soil and Moisture conservation 2. Restoration of traditional water bodies and construction of small <i>in situ</i> rainwater harvesting structures. 3. Development of vegetation and biomass.	1. Organising the poorest communities. 2. Universal education with special focus on girls. 3. Women's development. 4. Special programmes to develop marginal

<p>4. Water saving technologies.  5. Rain fed agriculture practices and technologies.  6. Rain fed horticulture  7. Dairy and livestock development  8. Bio-gas plants  9. Development of human capital, institutions and infrastructure</p>	<p>lands owned by the poor.  5. Credit support for off-farm / non-farm income generation activities for women.  6. Health programmes, integrating promotional, preventive and curative aspects of health.  7. Housing.  8. Drinking water and sanitation.  9. Awareness building, institutional and leadership development of the poor.</p>
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#### IV Impacts

The impacts of watershed development can be termed as short run and long run or / and direct and indirect impacts. Being a land based programme watershed development mainly helped the landed households. All the soil conservation activities are beneficial to landed in the medium to long run. However, landless and landed poor have benefited from increased employment and wages in the short run. All watershed works are done on a legal unit rate basis by local labourers. As there are no middlemen the labour earnings result in daily wages 2-5 times the normal rate. Because of the volume of work labour households, as well as small and marginal farms households with extra labour capacity have benefited considerably from the interventions.

For the poor, the watershed development provided some benefits in the long run while the short-term benefit of earnings from labour have been substantial during the implementation stage. In a recent study of RDT / AF it was established that many of the labour, who have worked continuously for 5-7 years in the watershed programme have improved their living conditions. They have also repaid their old debts, bought assets like land, gold, livestock, etc. Moreover, no fresh borrowings were reported despite the continuous drought. It was heartening to note that the women were the happiest among the labourers, as they had earned and made assets like gold for themselves or for their daughters, bought household articles and kitchen equipment symbolising improved social status of the family and women.

Another impact of watershed development on the poor is the decline in migration. For instance, in Kadiridevarapalle about 5 families used to be on permanent migration and about 20 families on seasonal migration before the advent of watershed development. But after the watershed development none of the families migrate even on seasonal basis due to increased area under irrigation and diversified cropping pattern consequent to assured ground water availability. However, the impact of higher wages is normally short run i.e., during the period of watershed works.

Landed households benefit in the medium and long run, as the yield rates tend to improve by 20 per cent (Reddy, et. al, 2001). Cropping pattern changes are noticed even in the rain fed agriculture, though on a smaller scale. In irrigated areas cropping pattern has shifted from paddy and ragi to sunflower, horticultural crops like papaya, floriculture and vegetable crops (Box 2). But, given the uncertainty in rainfall and its distribution these benefits are not stable. Unless these instabilities are addressed the benefits from watershed development remain uncertain even to the landed. On the other hand, farmers with access to groundwater are reaping stable benefits from the watershed activities. For, watershed activities have improved and stabilised the groundwater yields. However, access to groundwater is limited to large and medium farmers in most of the cases (Table 2). Often marginal farmers do not have access to groundwater. Therefore, while in short run agriculture labour (landed as well as landless) benefit

from the activities, farmers, especially with access to water, benefit in the medium and long runs.

### **Box 2: Shift to Horticulture**

In 1996-97, a year after the RDT / AF started a watershed programme in Mallapuram village, Mr Timmappa started horticulture cultivation on RDT's advice. He planted mango saplings on five acres of his land on which he earlier cultivated groundnuts. RDT / AF paid the cost of digging pits, fertilizers and saplings. While the 200 saplings grew Mr Timmappa grew groundnuts as an intercrop. To supply the necessary water to the mango trees, Mr Timmappa has dug a hand bore, spending Rs.10000. The guaranteed water supply has enhanced the plant survival and growth rate.

During the summer 2001 the first mangos were harvested. Mr Timmappa did not sell all the mangos in the market, but distributed some of the fruits among relatives and retaining some for his own consumption. What he did sell gave him a net income of Rs. 5000/-. Marketing is no problem as contractors come and buy the mangos directly from farmers.

Mr Timmappa is reasonably happy with the returns from the mango crop. As a result of his success about 80 ha of land in the village is now under mango cultivation as against 6 hectares at beginning of the watershed. With water supply guaranteed, and with some initial external support there is huge potential for the horticulture in the area. Now that horticulture is being taken up in big way in district, there is a need for strengthening facilities such as transportation, marketing, storage and processing. The lack of such facilities is already being felt in the case of papaya.

**Table 2: Distribution of Well Owners by Farm Size in Kadiridevarapalle.**

Farm Size (acres)	No. of Households having open wells	No. of Households having bore wells
00 – 03	00	00
3.01 – 5.00	01	04
5.01 – 10.00	02	03
Above 10.00	22	28

Watershed development has many positive and potentially long-term impacts. For instance water retention works on agricultural lands result in better yields due to residual moisture. Removing of pebbles and rocks from the fields increases the suitability of the soil to grow crops. Cleaning and deepening of tanks and open wells increase common access for washing, bathing, feeding of livestock and in some cases irrigation of nearby fields. Check dams have a number of benefits such as storage of water for fisheries and/or irrigation, infiltration of water into the ground and therefore recharge of open wells and boreholes (see Box 1). It is observed that on an average each check dam supports three wells in Kadiridevarapalle.

### ***Making the Watershed Benefits Pro-poor***

The GoAP's stress on poverty eradication calls for an all-out effort to ensure a more equitable distribution of watershed development benefits. At present the major benefits of watershed development go to the richer households as 70 per cent of the expenditure goes to interventions that benefit them. At the same time only 7.5 per cent of the input is used to support the livelihoods of poor and landless families (Gol, 2001). The watershed plus approach of the APRLP is a step in this direction, but more innovation and experimentation is needed. Here we discuss some of the pro-poor initiatives of RDT in particular.

Most of the infrastructure built and or repaired under the watershed development interventions is done on private land. These benefits mainly accrue to landed. There is a clear bias against the land less and landed poor as far as receiving sustained benefits are concerned. One way of addressing their needs is strengthening the common pool resources. There is however concern over the maintenance of common property resources as in many places there is no effective institutional arrangements to maintain them. At the heart of this is lack of participation, which, though at the heart of the programme, remains largely unrealised. Further, the people have not been effectively motivated or organised and involved in preparing action plans. The PIAs and WDTs generally see their role as implementers, as indeed the name 'Project Implementing Agency' suggests. The transfer of management and technical capacities to communities and Watershed Committees is neglected. However, the effectiveness of community involvement in CPR management is clearly demonstrated in the RDT / AF villages (see Box 3).

#### ***Box 3: Getting Watershed Benefits to the Poor***

A major way to target long-term watershed benefits to landless and other poor households is to strengthen the common pool resources (CPRs), making them accessible to the poor. An example is the arrangements concerning palm trees in the CPRs of Guddella village. Palm leaves are used in basket and mat making activities, while *toddy* (local liquor) is extracted from mature palm trees. Two economically and socially poor communities depend on these activities for their livelihoods.

Guddella village has 1000 palm trees under the 30 ha of temple lands (CPR). Before the watershed committee was started, these palm trees were treated as open access. Even neighbouring villagers would cut their branches for various purposes. The households from within the village often faced shortage of leaves and were forced to travel far to procure palm leaves.

The watershed committee and the Village Development Committee (VDC) have now taken charge of these trees. Two guards are employed by the VDC at Rs 600 per month to protect the trees year round. Yearly the households depending on the palm trees pay some money to the VDC to get use rights. The amount is decided on a consensus basis, rather than on an actual cost basis. This arrangement has ensured that the village poor have better access to the resource and led to a more productive use of their time.

There are similarly instances of giving exclusive fishing rights in tanks and behind check dams to the local fishing community. Furthermore, in some villages Scheduled Castes are given the exclusive use rights of roadside plantations.

Unlike the general approach RDT / AF begins its intervention in village with poverty alleviation stream of activities. Watershed activities are added after a few years. Thus the poor are strengthened socially and economically to a degree before watershed programme begins. The idea is that Dalits and tribals need longer-term intervention with poverty focus due to their socio-economic backwardness. Such an approach seems to be more effective (see Box 4).

**Box 4: Impact on Dalits and Tribals in Watershed Villages**

- ❖ Literacy levels have gone up from 5 to 70 per cent. In case of girls from 0 to 60 per cent.
- ❖ Households depending entirely on wage labour have now become part cultivators.
- ❖ Their land values have gone up by 100 to 300 per cent due to land improvement activities.
- ❖ Self-confidence and leadership among men and women (social and political capital) has improved substantially.
- ❖ Non-farm employment of educated youth has increased manifold.
- ❖ Health and nutrition status has improved.
- ❖ Participation in village development activities has increased along with their bargaining capacity for better wages, better facilities and services.

Another important activity, which has potential for improving rural livelihoods, is dairy activity (Box 5). Dairy activity is closely linked with the improvement of CPRs like water and grazing lands. Renovating water bodies, horticulture and dairy activities are eagerly pursued by the district administration in the study region. While dairy development has lot of potential, it needs to be tuned to the local constraints. At present the programme is not favourable to the poor households. Dairy could be an effective pro-poor programme under the watershed development if the policy support is tuned to the needs of the poor.

### Box 5: Dairy Development and the Poor.

Dairy development along with horticulture development programme is expected to complement and enhance the benefit flows from watershed development, especially to the poor communities. Both these activities are dependent on water and other common pool resources like wastelands or common grazing lands. While these two programmes are being launched in a big way their impact on poor communities is rather ambiguous. This is mainly due to the reason that the prevailing policy environment is not conducive for such benefit flows towards poor.

Dairy development is actively pursued in some of the villages. Nationalised banks provide loans to the households up to 90 per cent of the cost. The banks finance on unit basis (two buffaloes). The total loan amount ranges between Rs. 20, 000 to Rs. 28, 000 per unit. Some of the conditions for getting the loan include: a) a deposit of Rs. 2000 per animal as guarantee, b) ownership of land, irrigated is preferred and c) a guarantor. Besides, most of the loans are given to hybrid (murra) buffaloes. The borrower is expected to repay the loan with 50 per cent of the earnings from milk on a monthly basis.

These conditions exclude the poor from participating in the programme. While it is rational that land ownership is necessary to maintain the high feed intensive murra buffaloes, their suitability to local environment is questionable. For, our discussions with the beneficiaries revealed that murra breed is a failure due to the water and fodder stress in the region. On the other hand, the local varieties may be more profitable. Provision of loans to local varieties will not only be low cost but also accessible to poor. For, even the landless households can maintain local varieties, as their fodder requirement is much lower. Now the efforts, especially by the RDT, are on to convince the bankers to finance the local varieties and also to improve the local breeds through cross insemination. Only then landless poor households can benefit from the programme.

More over, there is a need for inculcating the dairy culture, i.e., dairy as an economic activity, in these areas. This could be done only through strengthening the infrastructure like collecting centres, cooling stations and markets. These facilities coupled with some demonstration of the viability and profitability of the dairy would go a long way. The latter needs some efforts of selecting the right breeds that suit the local conditions. In fact, RDT has initiated the *Gopal Mitra* programme under which a local person is trained to perform Artificial Insemination (AI) of local cows and buffaloes with improved breeds and help the households with the dairy related problems.

RDTs AI programme is at almost no cost though it takes about 2-3 years for improved animals to start giving income to the farmers. The AI programme more pro-poor as it is not capital intensive. Besides, local cattle upgraded through AI survive under low fodder, hot climatic conditions and water stress conditions apart from being high disease resistant.

One more activity under the watershed programme, which has greater potential for poverty alleviation, is the formation of self-help groups. Forming and strengthening institutions at the village level is an innovative feature of the watershed development guidelines. Small (10-15 members) groups are organized to generate money through savings. During watershed development wage rates go up 3-5 times and employment opportunities also increase. During that time it is relatively easy for even the poor to start savings. The savings are circulated amongst the group members who use it for investment or consumption, paying a pre decided interest rate (usually 24 per cent per year).

Once these self-help groups are established a revolving funding of RS 50,000 per watershed is available to support them through matching grants. The watershed in Mallapuram, under RDT / AF implementation, demonstrates the potential of such programmes in poverty alleviation (Box 6).

***Box 6: Self Help Groups and the Poor.***

Under the watershed programme in Mallapuram there are 8 self-help groups. These groups are organized around occupations and there are two tailoring groups (women), two groups of cane workers (women), two groups of masons (men), one group of carpenters (men) and one group of cobblers (men). Membership ranges between 5-10.

Most of the groups are very active and have generated substantial savings. They not only lend for their own vocational activities, but also lend towards new activities such as petty business, etc. One of the women groups has about Rs. 150,000 in savings, and they have lent out money for purchase of two auto-rickshaws. The main reason for the success of these groups is that they concentrated on individual based lending rather than community based activities. While collective activities can be very profitable, most of the times they are dogged by the classic collective action dilemmas. The real strength of self-help groups lies in identifying activities that match local resources, skills and needs and are economically profitable.

***Institutional Integration***

As it is clear from our discussion that institutional innovation and sustenance is the key for the success of the watershed development as well as making it a pro-poor activity. Participatory watershed development emphasises evolution of institutions and strengthening the existing ones. While number of institutional arrangements such as watershed association, user groups, self-help groups, etc are evolved in order to utilise the benefits of the programme, their sustenance in the long run is questionable. For, these institutional arrangements are imposed from outside rather than socially embedded. Socially embedded or informal institutions are more sustainable than formal institutional arrangements, because they evolve out of a genuine requirement. Evolution of such institutions is a time consuming and costly (transaction costs) affair and hence their impact is rather limited. On the other hand, the impact of formal institutions could be widespread and effective at the macro level. Though it is too much to expect the evolution or replication of socially embedded institutions in every village, formal institutions should draw lessons from such institutions in order to sustain in the long run. Often, the success of socially embedded institutions is critically linked with their financial sustainability and socio-economic equity in the distribution of costs and benefits. There is need for integrating

market principles with the institutional approaches. Marrimakulapalle is an example of such institutional sustainability and provides some useful insights for institutional strengthening and sustenance (Box 7).

**Box 7: Socially Embedded Institutions and the Poor**

While the formal watershed committee was established only during 1998, Marrimakulapalle had 20 years of experience in maintaining traditional institutions. About 20 years back the village elders, with the help of RDT / AF, initiated three institutions, the *Anjaneya Swamy Committee* (ASC), *Peerla Swamy Committee* (PSC) and *Vidya Committee* (VC). All the committees have proportional representation from all the caste groups in the village.

The ASC has eleven members and looks after the law and order issues in the village. In the village meetings the committee discusses all minor and major offences. Those declared guilty are fined depending the seriousness of the offence. Members of the committee itself are not spared from the procedure.

The PSC also has eleven members and works as a community bank. The PSC generates money from various common resources such as income from temple lands, sale of dung in the streets, fines from punishments by ASC, etc. The PSC has constructed quarters for schoolteachers and rents them out to teachers. Money thus generated is distributed among community heads, proportionately to their population. This is given as loans to the needy within the community at a 24 per cent per annum interest rate, and the loan is collected with interest on a particular day in the year for redistribution. The PSC has accumulated savings to the tune of Rs. 300,000.

The VC has 30 members representing all the caste groups and collects funds from the members on a voluntary basis. Donated money is used for extension of the school building, employing assistant teachers, etc. Since the construction of quarters most of the teachers stay in the village.

The needs of the landless are taken care of in a unique fashion. The village council has acquired 10 hectares of land with the help of RDT / AF, on which a bore well is drilled for irrigation. This land is auctioned to groups of landless households on yearly, rotational basis. Usually a group of 4-5 households take the land for cultivation purposes. In this manner, the equity issues are resolved to some extent as far as land is concerned. However, inequity in water distribution is yet to be resolved. Some of the economic and equity principles of these informal institutions could be useful for strengthening the formal institutions.

## V Summary and Conclusions

It is clear from our preceding analysis that watershed development is necessary for strengthening the ecological resource base and improving the carrying capacity of the fragile environments. But watershed development in itself is not sufficient to achieve the broader objective of poverty alleviation or eradication. Being a land based technology it is more beneficial in the mid and long terms to the households with access to land and water. It is highly

beneficial to the labour in the short term. A well-implemented watershed development programme enhances sustainable agricultural employment opportunities in the long term and thus provides indirect benefit to the labour and might reduce seasonal migration as well. Nevertheless, watershed development should be viewed and pursued as a major sectoral policy in these regions, as agriculture development still holds the key to the overall development of the region. Still more than 70 per cent of the population depends on agriculture or agriculture related activities. More importantly, our analysis has also brought out that watershed development can be translated in to a pro-poor strategy with complementary or supportive policies. Here we discuss some of the weaknesses of watershed development in its present form and indicate the complementary policies to make it pro-poor.

In general, watershed development programme in AP is considered successful when compared to other states, especially in terms of spread and magnitude. The main reasons for this relative success include: i) a wide public debate on droughts and political determination to do something about it; ii) relatively good governance and efficient administration translating political intentions into action; iii) a state-level political process that creates an environment for innovation and reform; iv) active support of donors, because of the flexible and effective government approach; v) NGOs interested in watershed development and together with the government; and vi) the realisation that there is no immediate alternative to watershed development in rain fed areas.

Given this policy environment it becomes easier to understand and rectify the weaknesses of the programme. The weaknesses of the programme are identified in the context of the comparative situation between the best-implemented watersheds (our case study watersheds) and the general picture in the region or the state. Detailed studies (see Reddy, et.al; 2001) on the AP watershed development programme have identified the following operational weaknesses: a) strict adherence to a maximum watershed size of 500 ha, irrespective of the reality on the ground; b) number of watersheds that one PIA can cover is too rigidly defined as between 10-12, where some PIAs can do much more, while for others even 10 is too much; and c) there is a need for training and exposure visits by new watershed committees to successful watersheds so that they get a good idea what they are getting into. At a design and policy level five main weaknesses have been identified, namely the need for a more equitable distribution of benefits, the need to improve implementation, the need to exercise caution while scaling-up and speeding-up watershed development, the need to ensure mutually supportive, poverty alleviation oriented policies and the need to de-link land and water rights.

Improved implementation, particularly the participatory aspects, is needed if the interventions and their impact are to be sustainable. Around 85 per cent of watersheds are implemented through the government line agencies. These are normally not well geared towards a participatory and bottom-up approach. Participatory watershed development is found effective (especially when done by NGOs), but the work is slow. This process has become the main bottleneck for scaling up of the programme. Scaling up gets further complicated when poverty alleviation and SL issues are integrated into watershed development approach. At the same time ad-hoc scaling up in a targeted fashion is neither effective nor sustainable. Hence, attempts should be made to achieve effective scaling up through appropriate policy designing, which is tuned to the demands of the community and enhance the capacity of the implementing agencies.

A two-pronged approach is needed for scaling up. Firstly, the capacity of smaller NGOs should be strengthened so that NGOs can implement a large proportion of the watersheds. In order to facilitate the process of selecting good PIAs (NGO) and strengthening the smaller NGOs, DRDA should identify a nodal PIA (NGO) in each district, which will identify the right PIAs. These nodal

PIAs along with state level and district level officials and other stakeholders will form as a network at the state level. This would facilitate exchange of views on policy matters. Secondly, Involving the *panchayati raj* institutions in the whole process need to be looked in to afresh (see Bandhyopadhyay, Yugandhar and Mukherjee, 2002). They could play an important role as PIAs as well as playing a catalytic role to the NGO PIAs. This institution needs to be given a fair trail before discarding.

Equity in the distribution of economic gains among the community members is as important as the equity in coverage. While the former is concerned with the equity in access the later pertains to equity in outcomes. Equity issues pertain to the neutrality of technology in terms of location (different geographic locations of the watershed) and well being (economic status) of the participants. Inequity in the former case is purely technical while the later is structural and institutional. For, no technology has an in-built bias towards a particular class / caste. The bias is always due to the existing institutional structure (agrarian structure, water markets, credit markets, social structure, etc.). In both the cases, inequalities could be minimised through institutional arrangements. In other words, technical inequalities can be corrected though compensating the participants of the disadvantaged locations. And distributional bias needs correcting of distortions in land, labour, water and credit markets. Failure to recognise the problems of inequity is fatal in understanding the process of watershed management. Equity aspects are also important from the collective action point of view. In this context, access to water by the poor can only be guaranteed if the present link between water and landownership is removed. This may seem impossible, but experience with the *Pani Panchayat* (Maharashtra) and in South Africa, show that it is possible (Reddy, 2002).

Furthermore, there is a need to make sure that various government policies, such as agriculture, power, credit, etc. become mutually reinforcing and aimed at poverty alleviation. Without an integrated package of supportive policies, watershed development will yield sub-optimal results and its poverty alleviation impact will be minimal.

In order to have more poverty focused approach watershed development should be complemented and supported by policies and programmes that directly benefit the poorer sections of rural society. Our case study identifies some of the potential areas such as strengthening the common property resources, promotion of horticultural and dairy activities. These activities need to be supported by institutional arrangements for collective action such as self-help groups and thrift societies. Such interventions, in the form of "watershed plus" are being promoted under the APRLP. In order to make these activities economically viable and sustainable policy support is needed in the form of infrastructure such as markets, transport, processing units, etc.

### **Recommendations**

The following recommendations can be drawn from the case study:

1. Continue and expand the process of experimenting with watershed development at grassroots level and ensure that lessons learned (weaknesses) are taken onboard in policy design.
2. Develop and test interventions that particularly benefit poor men and women, both through watershed development as such and complementary development activities.
3. Build up the capacity of the government agencies, NGOs and Panchayati Raj institutions involved in watershed development and management.
4. Develop a package of poverty alleviation focused policies, including the watershed policy that is mutually complementary and reinforcing.
5. Minimise inequities through more egalitarian institutional arrangements and legislation.

## References and resources

### Websites:

[www.andhrapradesh.com](http://www.andhrapradesh.com)

[www.cess.ac.in](http://www.cess.ac.in)

[www.leeds.ac.uk/geography/projects](http://www.leeds.ac.uk/geography/projects)

- Adolph, B. and C. Turton (1998), "Promoting Equity: Communities, Self-Help Groups and Watersheds in AP", London, Rural Policy and Environment Group: ODI.
- Bandhyopadhyay D; B. N. Yugandhar and Amitava Mukharjee (2002); "Convergence of Programmes by Empowering SHGs and PRIs", *Economic and Political Weekly*, Vol. XXXVII, No. 26, June 29.
- Baumann, P. (2001), "Sustainable Livelihoods and Political Capital: Arguments and Evidence from Decentralisation and Natural Resource Management in India", ODI, London.
- Bhatnagar Pradip (1996), "Growth Potential of Rural Employment Programmes- The Watershed Approach", *Journal of Rural Development*, Vol15, No.2, April-June.
- Chandrakant et. al (1989), "Public Choice Analysis of a watershed Programme in India", Paper Presented at the XX International Conference of Agricultural economists, Buenos Aires.
- Chopra K; G. K. Kadekodi and M. N. Murty (1989), *Participatory Development: People and Common Property Resources*, Sage Publications, New Delhi.
- Chopra Kanchan and Gopal K Kadekodi (1993), "Watershed Development: A Contrast with NREP/JRY", *Economic and Political Weekly*, Vol. XXVIII, No. 26, June 26.
- Department of Rural Development, GoAP, (nd). Sustainable Watershed Management - Partners in Progress. Hyderabad, GoAP.
- Department of Rural Development, GoAP, Ministry of Rural Development, et al. (1999). "AP Rural Livelihoods Project - Project Memorandum", Hyderabad, GoAP.
- Deshpande R. S and N. Rajasekhar (1995), *Impact of National Watershed Development Project for Rain fed Areas (NWDPPRA) in Maharashtra*, AERC, Gokhale Institute of Politics and Economics, Pune.
- Deshpande R. S and V. Ratna Reddy (1990), "Social Dynamics and Farmer's Society: A Case Study of Pani-Panchayat," *Indian Journal of Agricultural Economics*, Vol. 45, No. 3, July-September.
- Deshpande R. S and V. Ratna Reddy (1991), "Evaluation Study of the centrally Sponsored Scheme of Assistance to Small and Marginal farmers for Increasing Agricultural Production", Research report, Gokhale Institute of Politics and Economics, Pune.
- Deshpande R. S and V. Ratna Reddy (1991a), "Watershed Development Approach in Fragile Resource Regions: An Analytical Study of Maharashtra", Mimeograph series No. 33, Gokhale Institute of Politics and Economics, Pune.
- Deshpande R. S and V. Ratna Reddy (1991b), "Differential Impact of Watershed Based Technology: Some Analytical Issues", *Indian Journal of Agricultural Economics*, Vol. 46, No. 3, July – September.
- Dixon John A (1992), "Analysis and Management of Watersheds", in Partha Dasgupta and Karl-Goran Maler (ed), *The Environment and Emerging Development Issues*, Vol.2, Clarendon Press, Oxford.
- Fan Shenggen and Peter Hazell (2000), "Should Developing Countries Invest More in Less Favoured Areas? An Empirical Analysis of Rural India", *Economic and Political Weekly*, Vol. XXXV, No. 17, 22-28 April.
- Government of Andhra Pradesh (2000), *Vision 2020*, Hyderabad, GoAP.
- Government of Andhra Pradesh (2001), "Watershed Development Programme", Hyderabad, AP Govt. Website.

- Government of India (1994), *Guidelines for Watershed Development*, Ministry of Rural Development, New Delhi, October.
- Government of India (1995), *Watershed Guidelines*, Delhi, Gol.
- Hill Joe (2002), *Rainfall Pattern and Distribution in Anantapur District: An Analysis of Hundred Years*, MS Thesis, School of Geography, University of Leeds, U. K.
- J. Farrington, C. Turton, et al. (1999), *Participatory Watershed Development*, New Delhi, Oxford University Press.
- Joshi Deep and David Seckler (1981), "Economics and Management of Rain Water Harvesting Project", *Indian Journal of Soil Conservation*, Vol. 9, No. 2, October.
- Kerr, John, et. al (2000), "An Evaluation of Dry land Watershed Development Projects in India" Environment and Production Technology Division, International Food Policy Research Institute, Washington, USA.
- Nalatwadnath S K, M. S. Rama Mohan Rao and Padmaiah (1997), "Joladarasi Model Watershed Development Programme in Bellary District of Karnataka – A Diagnostic Evaluation", *Journal of Rural Development*, Vol. 16.
- National Institute for Rural Development (1998), "Special issues on Watershed Development, Part I & II" *Journal of Rural Development*, NIRD, Hyderabad.
- Ostrom Elinor, R. Gardner and J. Walker (1994), *Rules, Games, & Common-Pool Resources*, The University of Michigan Press.
- Platteau J-ph. (1992), "Formalization and Privatization of Land Rights in Sub-Saharan Africa: A Critique of Current Orthodoxies and Structural Adjustment Programmes," DEP. No. 34, Development Economics Research Programme, Suntory-Toyota International Centre for Economics and Related Disciplines, London school of Economics, London.
- Purandare AP and A. K. Jaiswal (nd), "Operationalisation of Watershed Guidelines" Hyderabad, NIRD.
- Rao V. M (1992), "Change Process in Dry land Communities" *Indian Journal of Agricultural Economics*, Vol. 47, No. 4, October- December.
- Reddy V. Ratna (2000), "Watershed Development for Sustainable Agriculture: Need for an Institutional Approach" *Economic and Political Weekly*, Vol. XXXV, No. 38, September.
- Reddy V. Ratna (2002), Environmental Degradation: Market, Institutional and Policy Failure (A Case Study of Water Resources in Andhra Pradesh), Project Report, Centre for Economic and Social Studies, Hyderabad.
- Reddy V. Ratna (2002), "Water Security and Management: Lessons from South Africa", *Economic and Political Weekly*, Vol. XXXVII, No. 28, 13-20 July 2002.
- Reddy V. Ratna, et. al (2001), Watershed Development and Livelihood Security: An Assessment of Linkages and Impact in Andhra Pradesh, Project Report, Centre for Economic and Social Studies, Hyderabad.
- Sarin R and Ryan J. G (1983), "Economic Assessment Improved Watershed Based Technology Options in On-Farm Experiments", Economics Programme, Progress Report 46, ICRISAT, Patancheru.
- Seeley, J., Meenakashi Batra, et al. (2000), Women's Participation in Watershed Development in India - Gatekeeper Series no. 92. London, IIED.
- Shah Amita (1998), "Watershed Development Programmes in India: Emerging Issues for Environmental-Development Perspective", *Economic and Political Weekly*, Vol. No. June 27.
- Singh Katar (1994), *Managing Common Pool Resources: Principles and Case Studies*, Oxford University Press, New Delhi.
- Soussan John and V. Ratna Reddy (2002), "The Evolution and Future of Watersheds Policy in Andhra Pradesh" (Forth coming).