

INTRODUCTION

This report discusses the potential of drought mitigation in Medak district of Telangana, one of the three regions of the state of Andhra Pradesh, India. I became motivated to research water management in this district after visiting a village in Kowdipally mandal, Medak (a 'mandal' is an administrative unit consisting a cluster of villages). There I met many curious and excited children who swarmed around to ask for photographs. As we left they chanted 'bye!' and another phrase in Telugu. I was told that they were calling "water problem, water problem!" They were begging us to help them find an alternative source of water to their shrinking pond.

The situation was the same in other villages we visited. One elderly man told us that his village had been struck with five consecutive drought years. While the village had once been blessed with surplus production, its inhabitants were now selling cattle and borrowing money to make ends meet. He told us that nothing could be done – they just had to wait and pray for rain.

Was there really nothing that could be done for those poor children in that village?

When I posed this question to Mr Subhash Chandra, Centre for Action Research and People's Development (CARPED), he introduced me to the concept of drought mitigation. I soon discovered that there were many ways to minimise the impact of a drought. The key words seemed to be 'planning' and 'preparedness'. Armed with a 'drought contingency plan', a region can undertake measures to conserve water both before and during a drought. For instance, structures can be built to harvest rainwater during the monsoon. The filtered result can provide supplementary drinking water during dry periods.

Moreover, farmers can be educated about water conservation and methods of cultivating land that optimise water efficiency. For instance, ridges and trenches can be dug in the fields so that the rain that does come slowly soaks into the soil and recharges the groundwater, rather than running off the field. 'Soak pits' can also be dug for a similar purpose at the edge of fields or where washing is done in the village. Furthermore, the layer of silt can be removed from a tank bed to achieve more effective groundwater recharge. If these methods do not reduce the impact of a drought sufficiently, government schemes can offer subsidies to farmers or alternative work in exchange for food or money.

These measures will be described in more detail later in this report, but first it must be noted that they assume that the drought is a temporary phenomenon – that it refers to a time of water shortage preceded and followed by a period with 'normal' water availability. Under this definition, no region

can have 'annual' droughts. Yet, the Medak villager told me that they had had one for five consecutive years! Through my research I aimed to establish whether these villagers were actually experiencing drought, a change of climate or the reduction in the efficiency of water management. I then intended to identify the problems caused by drought in Medak, how they were presently being addressed and ways in which drought mitigation could be improved.

In order to collect this information I interviewed sixteen people working for non governmental organisations (NGOs) and research institutions. I also visited twelve villages in the districts of Medak, Nalgonda, Nizamabad, Anantapur and read relevant research material, including Season and Crop Reports published by the Directorate of Economics and Statistics. Details of my field work with the names and dates of the villages I visited are furnished in Annex 3.

Of course, this research was severely limited by my inability to speak the local languages. Much information must have been lost through translation. Furthermore, the brief nature of my visits to each village could mean that the information I did obtain is not necessarily reliable, because I did not have time to establish a rapport with the locals and make observations for myself. Moreover, while I attempted to select my interviewees in a random, unbiased manner, in many villages this was not possible because I was guided by a representative of an NGO who took me to certain people that he thought I should talk to. Also, in many cases most of my questions were answered by males, because the women were busy elsewhere. Wherever possible I did try to seek a female, but this was not always possible. Hopefully, these limitations were somewhat balanced by the time I spent talking to NGO staff who have spent a great deal more time in these villages.

I am very grateful to the staff members and all the people who spent time with me and helped seek answers to my questions about drought in Andhra Pradesh. The knowledge I gained from them was not limited to my research. I will always remember the heart of India, which they guided me through.

WHAT IS MEANT BY 'DROUGHT' IN MEDAK?

Drought may come in several forms. The Indian government declares that a *meteorological* drought is taking place when less than 75% of the 'average' rainfall falls in an area over a prolonged period of time.¹ A *hydrological* drought is identified when there is a significant reduction in water bodies such as rivers, ponds, tanks and groundwater.² Finally, an *agricultural* drought is when crops fail because

¹ 'Defining Drought', Available on World Wide Web: www.disasterrelief.org/Library/Dictionary/index_txt.html (Accessed January 30 2004).

² P. Sainath, *Everybody Loves a Good Drought: Stories from India's Poorest Districts* (New Delhi: Penguin, 1996), p.320

there is insufficient moisture in the soil during crucial times in the harvest. In India this occurs when there is a meteorological drought for four consecutive weeks during the period of mid-May to mid-October, or for six consecutive weeks during the rest of the year.³ Of course, these types of drought are connected and its possible for a community to experience all four at the same time.

According to the government millennium study 'State of the Indian Farmer' long periods without a drought are rare in India. The study reports that there have only been four such periods in the last hundred years, with the latest being from 1987-2001. These periods tend to be followed with droughts for several years in succession. Indeed, as shown in the rainfall statistics displayed in Annex 2, 2002-2003 was also a year with less than 75% of the average rainfall in Medak. On the other hand, 2003-2004 was actually a year with the normal quantity of annual rainfall in Medak. However, there was deficient rainfall during the crucial North-East monsoon, indicating that farmers may have experienced an agricultural drought during this time. There were also monsoon failures in 2000, 2001, 1999 and 1997. From this data, gathered from the Season and Crop reports of the Directorate of Economics and Statistics, it seems that Medak farmers have been experiencing agricultural, hydrological and social droughts rather than meteorological droughts when they say that they have had a drought for the last five or ten years.

An analysis of rainfall over the last century suggests that there has not been a significant change in quantity.⁴ However, it seems that there has been some change in rainfall pattern. Researchers at CRIDA (Central Research Institute for Dryland Agriculture) have observed that there is typically normal or surplus rainfall in La Nina years and below average rainfall in El Nino years. They have also noted that the time of peak rainfall has shifted in recent years from September to October.⁵ This may account for the frequency of agricultural droughts in recent years. People in small towns and villagers that I spoke to observed that the monsoon rainfall was more dispersed than in the past, with rain no longer coming for several days at a time.

IMPACT OF DROUGHT

The effects of periods of water shortage is manifold and affects people differently depending on location, occupation, gender, age and type of drought.

³ Bharat Ramaswami, Shamika Ravi, & S.D. Chopra, 'Risk Management', in *State of the Indian Farmer – a Millennium Study*. Vol 22 (Delhi, Ministry of Agriculture, 2004) p.52

⁴ R.N. Athavak, *Water Harvesting and Sustainable Supply in India* (Jaipur \ New Dehli, Ravat Publications, 2003), p.30

⁵ Dr. Y.S. Ramakrishna (Director of CRIDA), *Personal Communication* (Hyderabad: April 21 2005).

DIFFERENTIAL IMPACTS ACCORDING TO LOCATION

The differences according to location can be seen in the contrast between Nizamabad, where tankers supply free water to villages suffering from drought, and Anantapur, where drought sufferers must pay a rupee for each 10 litre can. Furthermore, some communities with a water source nearby may not be able to use it because it is polluted or monopolised by another water user. For instance, careless waste disposal practices of pharmaceutical, pesticide and aluminium industries in Petancheru, Medak, has severely contaminated the local tanks and drains. This has caused the productivity of paddy fields in the area to decrease from 40 bags and acre to only 10.⁶

Similarly, communities living near the Singur reservoir in Pulkal mandal of Medak district have been deprived of water for irrigation after the reservoir was built to supply water to Hyderabad city. While the area once produced crops worth over Rs 500 crores before the project, it is now fallow land. Attaining water from another source would be expensive because the water would have to be lifted 300m. (Public Hearing on Manjira River & Fluorosis, email, news clipping) Thus, a meteorological drought in this area might have more severe consequences than if it happened in Hyderabad.

HEALTH IMPACTS

Likewise, a shortage of rainfall can be particularly hard on a community if they do not have access to safe drinking water. Andhra Pradesh has thirteen districts with villages in which there is more than 1.5mg of fluoride per litre in the water supply. The World Health Organisation has declared that drinking water with more than 1mg of fluoride per litre is unsafe, as higher levels can cause fluorosis. This disease causes tooth decay (dental fluorosis) or the crippling of bones (skeletal fluorosis). Medak has the fifth most villages (212) with water with excessive fluoride in Telangana, and many have no choice but to drink it. In Zilla Parishad High School in Kowdipally, Medak, the only source of drinking water for the students is a nearby borewell with high fluoride levels. Two to three students in every year level suffer from fluorosis.⁷

DEBT

For many farmers, impossibly high debts are another consequence of drought. In Telangana, dependence on costly inputs such as fertilisers and pesticides has grown in recent years, and farmers often borrow money to pay for them. A drought-stricken crop may make it impossible for a farmer to repay these loans. The situation is made particularly difficult for 87% of rural poor who do not have

⁶ R. Doraiswamy, & B. Gujja, *Understanding Water Conflicts: Case Studies from South India* (Bangalore: Pragathi – Farmers' Society for Rural Studies & Development, 2004), p. 37

⁷ Prabhakar, Mr. (Teacher at Zilla Parishad High School, Kowdipally) *Personal Communication* (April 4 2005).

access to institutional sources of credit.⁸ They are forced to attain money from private moneylenders who demand interest rates of up to 35% . These moneylenders may also be the local pesticide dealer, who typically exploit farmers by charging 15-20% extra for the goods obtained on credit.

If a drought causes crop failure farmers may acquire cash to repay debts in several ways. Most typically food consumption is reduced and stored produce is sold. In Vattu Thanda, Medak, I was told that the main difference in a drought year was that the people ate jowar and maize instead of rice. Research has indicated that landless people decrease their food consumption by 35% during a drought year, and large farm households by 37%.⁹ People in drought-affected villages may also receive income from relatives or from taking on additional work or loans. As a last resort, they may liquidate assets or migrate in search of further employment. Selling livestock is avoided if possible because they can provide a vital source of alternative income, and, in any case, livestock do not fetch a good price during hard times.¹⁰

FARMER SUICIDES AND PROSTITUTION

Unfortunately, some farmers do not hold any hope that these coping mechanisms will be effective, and choose to end their life instead. A recent study has revealed that suicides committed in rural areas often follow intensive pressure and humiliation from moneylenders.¹¹ Farmer suicides have been particularly prevalent in Anantapur district of Andhra Pradesh over the last decade. (Refer to data from Dr E Revathi) Resilience to drought has been reduced in the agriculture of this region because of dependence on the groundnut.¹² The cereal crops that were traditionally grown in this region had greater drought resistance and less dependence on inputs than this commercial crop.

Of course, it must be noted that debts often accumulate even for farmers who have sufficient water. In Anantapur many farmers do not get the Minimum Support Price (MSP) for their groundnut harvest even in years of sufficient rainfall, because they rely on middlemen who fix low prices.¹³ A study of suicide cases in this district found that 50% of the deceased farmers had taken on loans to improve wells. Another 25% had attained debts for social expenditure, such as for health, education or marriage purposes. (p 82 M.Bharath Bhushan's article). Crop failure was reported to be a factor in 42% of suicides.

⁸ 'A Bold Initiative on Rural Credit', *The Hindu*, 15-03-05, p.16

⁹ A.R. Subbrah, 'Natural Disaster Management', in *State of the Indian Farmer – a Millennium Study*. Vol 21 (Delhi, Ministry of Agriculture, 2004), p.71

¹⁰ *Ibid*, p.59

¹¹ R.M. Vidya Sagar, & Suman Chandra, K., *Debt Trap or Suicide Trap*, Countercurrents.org (20-06-04). Available on the World Wide Web. Accessed 25 February 2005, p.3

¹² *Ibid*, p.2

¹³ *Ibid*

It seems that a significant amount of suicides may occur for psychological reasons that are unrelated to drought and debt. When I visited a village in Anantapur where a farmer suicide had recently taken place, his neighbours commented that the drought could not be described as the 'cause' of the suicide or else they would all have taken their own lives. Individual psychological factors clearly play a significant role. Some sceptics have suggested that the financial compensation offered to victims of agrarian suicides encourages people to make false claims about the nature of deaths.¹⁴ In any case, there is no doubt that drought is putting farmers under a great deal of stress and that the number of suicides committed by farmers is a serious problem in drought-prone areas.

Statistics suggest that the deceased person is often a middle-aged male, with about 10-20% of cases being female.¹⁵ This does not mean that women are less stressed or desperate during droughts. In fact, it is evident that water scarcity is particularly hard on women. They are typically the first to go hungry or thirsty, because they feed their family first before consuming their share. Furthermore, since carrying water is considered to be 'women's work' in Indian society, women are often faced with walking long distances to the nearest water source during a drought. Some women spend up to eight hours a day merely collecting firewood, fodder and water.¹⁶ On top of this they have to manage a stressed household and – especially if their husband has committed suicide – may do agricultural work as well.

If they are left alone after a 'farmer suicide', they may be burdened with threats from the same moneylenders that pressured their husband.¹⁷ Others suffer similar financial problems when their husbands migrate and do not send back sufficient money. In such situations, an increasing number of women in Anantapur district are turning to prostitution. In the ten mandals of Kadiri, Anantapur, over 4000 sex workers have been forced into this profession because they cannot find another way of gaining income in this drought-prone region.¹⁸ About 400 others have been illicitly trafficked to Pune, Mumbai and Delhi in the last few years, where they are sold to brothel houses. In these conditions they are at high risk of being exposed to HIV.¹⁹

MIGRATION

Migrants also are at a high risk of contracting HIV. The spread of AIDS throughout the people of Araku Valley, Vishakapatnam, is believed to be exacerbated by local farmers migrating to

¹⁴ Rao, Sambasiva (Banjara Development Society), *Personal Communication*, March 16 2004

¹⁵ Cheruvu Bhanuja (Rural Environment Development Society), *Personal Communication*, April 5 2005

¹⁶ P. Sainath, *When the better half dies* (India Together, June 2004). Available on World Wide Web: www.indiatogether.org/cgi-bin/tools/pfriend.cgi (Accessed January 25 2004).

¹⁷ *Ibid*

¹⁸ Rural Environment Development Society (REDS) staff, *Personal Communication* (Kadiri, Anantapur: April 20 2005).

¹⁹ *Ibid*, p.15

Vishakapatnam for the dry season when there is no other work.²⁰ This 'temporary' or 'seasonal' migration occurs annually throughout rural areas of Andhra Pradesh, but it tends to intensify when there is a drought. It is particularly common in Mahabubnagar, where ten to fifteen lakhs of people migrate annually from Mahabubnagar, increasing another five lakhs during a drought year.²¹

The consequence of this migration depends largely on the identity and destination of the migrants. While in years of 'normal' rainfall migrants often undertake rural labour works, constructing dams or toiling on more successful farms, during a drought they are more likely to seek jobs in urban areas.²² The only jobs available to many migrants, if they can get one, are unskilled construction or factory work (MAHITA). The employment is often on a casual basis and the migrants suffer poor working and living conditions and meagre wages. They typically lack access to basic amenities, health-care and schooling.²³ A DFID (Department of International Development) survey found that just 5 out of 93 families saved enough from migrant work to attain improved living standards.²⁴

Research has indicated that the majority of seasonal migrants are males between 25-35 years of age. As with widows of suicide victims, the women left behind suffer under an increased workload and financial problems.²⁵ On the other hand, if an entire family migrates it is likely that their children's education will be compromised, for they are typically put to work themselves. It is estimated that less than one third of child migrants attend school (according to Ramesh Shekhar Reddy of MAHITA).

FALLOW LAND

The large number of migrants escaping rural life during a drought leave a vast amount of cultivatable land unutilised. This 'current fallow' land accounts for 9% of land in Andhra Pradesh, whereas it only accounts for 4% of land in the whole of India.²⁶ 'Other fallow land' (which has been fallow for 1-5 years) and 'cultivable waste' (which has been fallow for more than five years, but was once cultivated) take up an additional 15% of Andhra Pradesh's geographical area.²⁷ These lands may suffer desertification if they are not cultivated for a prolonged period of time.

²⁰ A. Ramakrishna (NATURE project coordinator), *Personal Communication* (Araku Valley, Vishakapatnam: April 11 2005).

²¹ Mahabubnagar District Profile, (Hyderabad: CARPED, 2004), p.35

²² S. Laxman Rao, S., & Deshingkar, P., 'Labour on the move,' Available online: <http://www.humanscape.org/Humanscape/2004/March/labourmove.php>, (Accessed March 3 2005).

²³ Laxman Rao & P Deshingkar, 'Labour on the move', op. cit., p.3

²⁴ *Ibid*, p.31

²⁵ *Ibid*, p.41

²⁶ V. Ratna Reddy, 'Ecological Divide: Regional Disparities in Land and Water Resource Management in Andhra Pradesh', in Y.V. Krishna Rao & S. Subrahmanyam (Eds.), *Development of Andhra Pradesh: 1956-2001. A Study of Regional Disparities* (Hyderabad: NRR Research Centre, 2002), pp.108

²⁷ *Ibid*, p.111

There have been only minor changes in this landuse (or rather, neglect) over the last fifty years²⁸ but at the same time the population of the villages have doubled.²⁹ The exploding population of India has placed severe pressure on the available resources, so that food production per capita has decreased – 64.6% in Medak since the early 1980s.³⁰ Thus, the government has initiated projects like the Integrated Land Development Programme (ILDP) in Anantapur to increase the cultivation of fallow lands. Under this programme the government is providing irrigation, seed subsidies, technical advice and financial support for landless farmers to develop fallow land.³¹

DROUGHT MITIGATION EFFORTS

There are numerous other NGO and government programmes being implemented throughout the state to mitigate drought by providing opportunities to access safe drinking water and to earn income from alternative sources. For example, the MYTRY and UNICEF are working with the government to promote domestic defluoridation filter units in Anantapur, which locals can purchase at a subsidised rate. UNICEF have also undertaken campaigns to educate people about the causes of fluorosis through songs, puppet shows, plays and slogans.³²

Another NGO, the Rural Environment Development Society (REDS), has set up a counselling centre in Kadiri, Anantapur to mitigate the suicides, trafficking and prostitution that occur in response to the frequent droughts in this area. The REDS team combats farmer suicides by highlighting the negative consequences of this act on family members. It also provides support to farmers against moneylenders by organising meetings between both parties, REDS staff and the police. Finally, it helps families get the compensation payment that the government offers those who have lost a member to a farmer suicide.³³

REDS does a similar mix of prevention and victim support work for the trafficking of women. For prevention, REDS raises awareness about women being tricked into going to Delhi, Pune or Mumbai, where they are told they will be given a good job in which they will earn lots of money. REDS staff explain that this actually means working in a brothel house under terrible conditions. They also help

²⁸ *Ibid*, p.108

²⁹ Subbrah, 'Natural Disaster Management,' *op. cit.*, p.84

³⁰ K. Purna Chandra Rao, 'Crop Shifts in Andhra Pradesh since its Formation', in Y.V. Krishna Rao & S. Subrahmanyam (Eds.), *Development of Andhra Pradesh: 1956-2001. A Study of Regional Disparities* (Hyderabad: NRR Research Centre, 2002), p.130

³¹ Cheruvu Bhanuja (Rural Environment Development Society), *Personal Communication*, April 21 2005.

³² *Combating fluorosis with household filters*. Available on World Wide Web:

www.whoindia.org/SDE/Sangam/07-vol01-03/Page01.pdf (Accessed May 10 2005).

³³ Rural Environment Development Society (REDS) staff, *Personal Communication* (Kadiri, Anantapur: April 20 2005).

women at risk of trafficking and those who have escaped from it gain alternative employment by training them in crafts such as tailoring, netting or making plastic flowers.

Women's entrepreneurial activities are widely being supported by NGOs and the government throughout Andhra Pradesh to alleviate financial hardship in times of drought. For example, Dangoria Charitable Trust trains groups of thirty girls in sewing and embroidery and helps them sell their products through personal contacts.³⁴ Indeed, support for marketing is crucial in such programmes, as women living in isolated villages find it difficult to get customers on their own. Ms Nausheen from MAHITA comments that these women are disadvantaged in comparison to city women when it comes to marketing such crafts, as they have limited cash to purchase materials and nowhere to sell their products. Thus, Nausheen recommends that an NGO identifies products that are special to a particular place, such as the blankets of the Rolwaka community, or unique bangles, pots or leather items made in rural areas. The NGO can help village women 'polish up' these items to sell in government handicraft stores in cities.

On the other hand, Dangoria Charitable Trust and CARPED are both helping women earn profits closer to home by training them to make vermicompost (a bio fertiliser) and vermishash (a bio pesticide). These are simple, low cost activities that are useful for their own agricultural purposes (the products improve soil nutrition and reduce pesticide and fertiliser requirement by 50 percent) and as a good that can be sold in the local market.³⁵

Mahita is giving both vocational and marketing training to women who have migrated from drought-stricken villages to the overcrowded slums of Hyderabad city. Computer skills are taught as well as sewing to provide them with more employment opportunities. To further mitigate the negative consequences of migration, the NGO motivates parents to send their children to the local school and helps them gain access to health care and legal facilities.

The above NGO efforts are commendable, and certainly make a difference in the lives of individual women. However, because NGOs have limited resources, they are necessarily small-scale. Therefore, widespread improvements at drought mitigation must come from improved implementation of government programmes and policies.

³⁴ *Annual Report 2003-2004* (Hyderabad, Dangoria Charitable Trust, 2004). *Annual Report 2003-2004* (Hyderabad, Dangoria Charitable Trust, 2004), p.6

³⁵ Bamji, Mahtab (Dangoria Charitable Trust), *Personal Communication*, March 3 2005 & Santhi Kumar (CARPED), *Personal Communication* (Telan Nagar, Kowdipally, Medak: January 19 2005).

GOVERNMENT POLICIES

The government has various policies to assist communities affected by drought, at both the state and central level. In order to ensure a prompt response to droughts, the Relief Department of the AP government monitors the rainfall of 1008 different mandals on a weekly basis, and the water levels of major reservoirs are recorded daily.³⁶ This is important because, as R. Nagarajan notes, an early warning system is a necessary ingredient for drought mitigation.³⁷ If a drought is identified early in the season it is possible for farmers to change crops to those that are better suited to dry conditions and produce fodder for cattle.³⁸ Furthermore, if a drought situation is declared the government can intervene with programmes to alleviate problems that arise from dry conditions.

While the Andhra Pradesh government does not have a permanent drought contingency plan, village panchayats may possess such plans. In Kamareddy, Nizamabad, government officials and panchayat members have jointly prepared action plans for such events. Such a plan will include the aforementioned switch to dryland crops, if it is early enough in the season. As a preventative measure the government is offering 50% seed subsidies, a minimum supporting price and marketing assistance for dry crops like maize and soyabean to encourage more farmers to grow them on a regular basis.³⁹ What is more, the government is employing an Agricultural Extension Officer to give cropping advice to farmers in each mandal. However, at present there is a considerable number of vacancies for these positions, leaving many villages without this opportunity for consistent agricultural support.⁴⁰

In villages with a large number of cattle, the action plan will outline where farmers can get an extra supply of fodder – whether it is from a fodder bank, from grazing the cattle on the tank bed or through purchasing government cattle feed at a 75% subsidy.⁴¹ A fodder bank is when a community jointly stores fodder so that it can be used in a time of drought. Seed banks may also be built up for the same purpose, to mitigate the steep price increases during a drought.⁴² They can also be used to give relief to a single family that is under financial pressure. In Sisalunda village in Kondida, Vizag, such a family repaid the community by putting extra seed in the bank the next year.

³⁶ *Report of the FAO-CRIDA expert group consultation on farming systems and best practices for drought-prone areas of Asia and the Pacific region* (Hyderabad: CRIDA 2002), p.31

³⁷ R. Nagarajan, *Drought; Assessment, Monitoring, Management & Resources Conservation* (New Delhi: Capital Publishing Company, 2003), p.246

³⁸ Dr. Y.S. Ramakrishna (Director of CRIDA), *Personal Communication* (Hyderabad: April 21 2005).

³⁹ Mr Jaganmohan Reddy (Assistant Director of Agriculture), *Personal Communication* (Kamareddy, Nalgonda: April 24 2005).

⁴⁰ Mr Shivanand, *Personal Communication*, (Kamareddy, Nizamabad: Mandal Agricultural Officer, April 24 2005)

⁴¹ *Ibid*

⁴² *Report of the FAO-CRIDA expert group consultation on farming systems and best practices for drought-prone areas of Asia and the Pacific region, op.cit.*, p.11

Other drought mitigation initiatives are being promoted in the state's Neeru-Meeru Programme. As part of this programme, a 42-member panel of scientists, NGOs and people with a special knowledge and interest in this issue, known as the 'Water Conservation Mission', was created to focus on improved water management throughout Andhra Pradesh. It has a wider focus than simply drought mitigation, because it acknowledges that the state's vast areas of fallow land have been caused by inadequate utilisation of the water available, rather than from insufficient water (Refer to WCM). The goals of the mission include:

- Mitigating natural hazard impacts (such as giving priority to water resource allocation in drought prone areas)
- Developing clean, healthy aquatic systems
- Promoting water re-use and recycling
- The development of river water systems and improved efficiency of irrigation projects
- The promotion of rainwater harvesting
- Ensuring sustainable groundwater development
- Ensuring wide adoption of improved agricultural practices, including crop diversification
- Improved interdepartmental cooperation between government departments, communities and non-governmental organisations (NGOs).

The last goal is important because at present many government departments have separate roles in water management. This has led to weak coordination and implementation of water initiatives – especially in some areas like dryland agriculture, for which no department has overall responsibility. It also diffuses the funds that go towards water resource management. It is highly recommended that such responsibility be granted to one department. Yet, since the Water Conservation Mission is only an advisory body and does not have implementation powers, this change will only come if there is a great public demand for it.⁴³

One product of the Neeru Meeru programme is the Food Assurance Programme (FAP). This was initiated in 2004 as a revised version of the Food For Work scheme that was implemented by the former government. In the FAP participants receive 40 kg of rice and Rs 100 each month for a predefined quantity of work, often on a structure that will contribute to the community.⁴⁴ This facilitates community development as well as providing an alternative to migration.

⁴³ Vinod Goud (WWF), *Personal Communication*, (Patancheru, Hyderabad: April 13 2005).

⁴⁴ *Food Assurance Programme: Building on the Pilot in Andhra Pradesh* (Hyderabad: Society for Elimination of Rural Poverty & Centre for Environment Concerns, 2004), p.5

As part of this programme the people of N Vijay Kumar village, Medak, were asked to remove a unit of silt (5 X 2 X ½ m) from the village tank to earn the monthly allotment and increase its storage capacity. However, the salary was not enough to motivate the villages to do the work – especially since the scheme did not allow families to earn more rice if they undertook extra labour. It was necessary for CARPED to re-strategise and motivate the members of the village Self-Help Group comprising women to do the desiltation task under the FAP. This strategy was successful in a nearby village, where silt has now been transferred onto the fields according to [Mr Arjun Prasad of TNRMG](#).

The above difficulty in implementing the FAP was not unique to these villages. Dr Revathi has noted from her research in Mahabubnagar that many farmers prefer to migrate in search of work, rather than participating in FAP, because they believe that they can make more money through migration.⁴⁵ Other needy villages are not participating in FAP because they are unaware that such schemes exist or because they suspect that the government offer is not genuine.⁴⁶ Indeed, staff of REDS in Kadiri (Anantapur) observed that a local FAS was not accessible to the poorest. ([Ref to Bhushan's net article on FAS –reforms and scams...](#)) reported that the contractor, dealers and government officials involved in the FAP conspired together and sold the rice delegated for the project to rice mill owners, who polished it and sold it to the Food Corporation of India.

On the other hand, the farmers of Burgumalla village in Warangal district successfully completed the desiltation of their community tank, partly out of their own expense. Here a group of 80 farmers contributed Rs 32 000 between them for the desiltation and application of silt onto their lands. For this task they also acquired a loan of Rs 50,000 from MARI (Modern Architects for Rural India) and a sum of Rs 18 000 that had been granted to the local Water Users Associations (WUAs) from the government. Silt was applied to 82 acres of land and the area for water storage was substantially increased for the next monsoon season. Moreover, the fertilising qualities of silt enabled farmers who applied it to their lands to reduce chemical fertiliser use by 60%.⁴⁷ Indeed, the Swiss Agency for Development Cooperation (SDC) Inter-cooperation (IC) has found that applying silt to land increases productivity by 20-40% as well as substantially decreasing fertiliser requirement.⁴⁸ Perhaps if desiltation produces such positive results in N Vijay Kumar this community will also be willing to shoulder some of the costs of this activity.

⁴⁵ Dr. E. Revathi (Centre of Economic and Development Studies) *Personal Communication* (Hyderabad: March 14, 2005).

⁴⁶ P.V.V.S. Murty (Dangoria Charitable Trust), *Personal Communication*, (Narsapur, Medak: February 28 2005)

⁴⁷ *Capitalising on experience: Tank Restoration Interventions* (Hyderabad; SDC-IC NGO Programme, 2004), p.10

⁴⁸ *Ibid*, p.24

The contrasting response to a tank desiltation scheme in Burgumalla and N Vijay Kumar exemplifies the importance of community ownership over development initiatives. Experience shows that if a village develops a water harvesting system with minimal external assistance, they are more likely to maintain it in the long-term.⁴⁹ According to a study conducted by MARI and the District Water Management Agency (DWMA), many of the tanks selected for the Neeru Meeru programme were chosen on the will of political leaders, rather on a community's request or need.⁵⁰ Consequently, the planning and execution of these works tended to be apathetic and not responsive to the community's needs. Although migration was common in the communities concerned, the tank desiltation was typically done with machines, and thus did not even provide employment for the local people.⁵¹

This implementation of Neeru Meeru activities is at odds with the participatory ideology behind the Andhra Pradesh Farmer's Management of Irrigation Systems Act of 1997. This act was created to make irrigation systems more efficient by giving the primary users (united in a 'Water User Association') more control over the management of their water resources. A total of 10, 292 Water User Associations (WUAs) were created under this act, with 80 percent of them governing minor irrigation systems.⁵² The WUAs were given responsibility for the maintenance of these systems and were also a point of redress for farmers with water-related disputes.⁵³ However, since they are not financially autonomous, they are dependent on external funding for these functions. In many cases the funds attained are inadequate for the extensive repairs currently required, and continued maintenance is unsustainable.

Furthermore, the coordination of such activities has been poor, because of inadequate communication within the WUA membership and with the irrigation department staff. In one study only 30% of farmers surveyed knew the name of their local WUA president, and others did not even know of the committee's existence.⁵⁴ Attendance at WUA general meetings tends to be low because of poor

⁴⁹ A. Agrawal, & Narain, S., 'Making water management everybody's business: water harvesting and rural development in India', *Gatekeeper Series*, No. 87 (International Institute for Environment and Development, 1999). Available on the World Wide Web: <http://www.iied.org/docs/gatekeep/GK87.pdf> (Accessed February 12 2005).

⁵⁰ Vinod Goud, 'Revival of Tank System in Mid Godavari Basin: a Sustainable Alternative for Development,' in Uma Maheshwari, R., *Perspectives...The Godavari Lift Irrigation Scheme* (Hyderabad: Prajasakti Daily Printing Press, 2005), p.98

⁵¹ *Ibid*

⁵² Vinod Goud, 'Revival of Tank System in Mid Godavari Basin: a Sustainable Alternative for Development,' in Uma Maheshwari, R., *Perspectives...The Godavari Lift Irrigation Scheme*, (Hyderabad: Prajasakti Daily Printing Press, 2005), p.96

⁵³ Jasveen Jairath, 'Participatory Irrigation Management in Andhra Pradesh: Contradictions of a Supply Side Approach'. Paper presented at *South Asia Regional Poverty Monitoring and Evaluation Workshop* (New Delhi: June 8-10 2000). Available on the World Wide Web: <http://files.inpim.org/Documents/Jairath2> (Accessed February 1 2005), p.5

⁵⁴ *Ibid*, p.21

communication and a lack of incentive to attend.⁵⁵ Indeed, for many farmers there is little incentive to participate in the WUA because the execution powers for the distribution of water remain with the government department.⁵⁶ Farmers at the tail-end of an irrigation system have even less reason to participate because water often does not reach them after it has been irrigated by the farmers at the head reaches.⁵⁷ Thus, tenant farmers are unlikely to sacrifice their daily wage to attend a WUA meeting in such a situation.⁵⁸ Finally, the majority of 'water users' who do not use water for irrigation are excluded from this committee. This should not be the case, as they also require the water supply to be maintained for washing and drinking purposes.

WHAT CAN BE DONE TO REPLENISH A DEPLETED WATER SUPPLY?

The dilapidated state of Andhra Pradesh's tank water harvesting system has been implicated in the rising incidence of hydrological drought in recent years. From 1960 to 1998 the proportion of irrigated area under tank irrigation in Telangana decreased from 48% to 11%.⁵⁹ During the same period the proportion of private well irrigation increased from 13% to 45% in response to government support. This has meant an average of 56,000 new wells are sunk each year in this region.⁶⁰ In contrast, little change has occurred with regard to Telangana extent of canal irrigation. While this type of irrigation fed 14% of irrigated area in 1960, it feeds around 11% of irrigated area today.⁶¹

Farmers eagerly adopted direct groundwater extraction in the place of tanks as their primary irrigation source because it was seen as more reliable in the face of recurring metrological droughts. However, this steep rise in groundwater extraction from borewells in a region with recurring droughts is thought to be a major reason for the depleting water table. In recent years, farmers have had to dig lower and lower to locate water, so that most borewells are at least 10-20m deep.⁶² Often they do not find it at all and try again in a different location with money they have taken on loan, perpetuating the debt traps

⁵⁵ Nikku, Bala Raju. "Water Users Associations in Irrigation Management: Case of Andhra Pradesh, South India." Presented at "*The Commons in an Age of Globalisation, the Ninth Conference of the International Association for the Study of Common Property* (Victoria Falls, Zimbabwe: June 17-21, 2002). Available on the World Wide Web: <http://dlc.dlib.indiana.edu/archive/00000892/00/nikkub010402.pdf> (Accessed February 1 2005), p.8

⁵⁶ *Ibid*, p.2

⁵⁷ Jairath, 'Participatory Irrigation Management in Andhra Pradesh: Contradictions of a Supply Side Approach' *op.cit*, p.11

⁵⁸ Nikku, "Water Users Associations in Irrigation Management: Case of Andhra Pradesh, South India.", *op. cit.*, p.10

⁵⁹ Ratna Reddy, 'Ecological Divide: Regional Disparities in Land and Water Resource Management in Andhra Pradesh', *op.cit*, p.117

⁶⁰ *Ibid*, p.120

⁶¹ *Ibid*, p.117

⁶² Ratna Reddy, *op. cit*, 'Ecological Divide: Regional Disparities in Land and Water Resource Management in Andhra Pradesh' p.120

discussed earlier in this report. Musampally village in Nalgonda has two borewells for every human being – with 85% of them being dry.⁶³ Telangana farmers have spent over Rs 20,000 crores pursuing this type of irrigation, while in other regions farmers can access canal irrigation for just Rs 200 per annum.⁶⁴ It is evident that the unsustainable rate of groundwater extraction is hindering the development of the Telangana region and that alternative sources of water must be considered to alleviate hydrological droughts.

IRRIGATION SCHEMES

To address the chronic water shortages that some regions experience, a government task force is currently investigating the viability of a proposal to link 37 Indian rivers into two parts. Under this scheme water from areas with a surplus supply would be transferred to dry regions, for an estimated cost of Rs 560,000 crore.⁶⁵ A major concern is that there has been no informed public debate on the legal, social, technical and environmental issues associated with the project.

The legal issues refer to disputes between states over the water that will be transferred between them. Social issues include the large-scale displacement that is inevitable in such a grand scheme. Technical issues refer to whether there is enough energy, finance and water available to fulfil the projects requirements. Finally, environmental issues will come with the products significant disruption to the ecosystem and its impact on the people, organisms and plants within it. While the scheme may balance the spread of water through out India, it may also spread pollution and environmental degradation.⁶⁶ Biksham Gujja and Hajara Shaik note that India needs to learn from the disastrous consequences of other large water infrastructure projects, such as the diversion of the Amu Darya and Syr Darya (rivers) away from the Aral Sea. The people of coastal India may suffer if there continues to be the misconception that water that goes out to sea is ‘wasted’ and that all cultivable land must be irrigated.⁶⁷

The Andhra Pradesh government is currently pursuing the Godavari Lift Irrigation Scheme (GLIS) as its own solution to the water shortages in Telangana. Under this project, water from the Godavari river

⁶³ Sainath, P. *Sinking borewells, rising debt* (India Together, June 2004). Available on World Wide Web: www.indiatogether.org/cgi-bin/tools/pfriend.cgi (Accessed January 25 2004).

⁶⁴ K. Jayashankar, ‘Telangana: the Irrigation Scenario’, in Biksham Gujja (Ed.), *Dialogue Bulletin* (WWF, Special Edition Issue No. 12 February 2005), p.39

⁶⁵ R Doraiswamy & Gujja, B., *Understanding Water Conflicts: Case Studies from South India* (Bangalore: Pragathi – Farmers’ Society for Rural Studies & Development, 2004), p.44

⁶⁶ Dr. Ashok Khosla, ‘National Level / Policy Dialogues’, in Biksham Gujja (Ed.), *Dialogue Bulletin* (WWF, Special Edition Issue No. 12 February 2005), p.22

⁶⁷ Biksham Gujja & Shaik, Hajara, ‘Interlinking of Rivers: Lessons from the Past’ in Medha Patkar, *River Linking – A Millennium Folly?* (Mumbai: National Alliance of People’s Movements / Alliance, 2004), p.95

will be lifted a height of 350m and transported a total of 170.43 km through 12 irrigation canals.⁶⁸ It is expected to irrigate 647,000 acres in 33 mandals of Medak, Nalgonda, Warangal and Karimnagar.⁶⁹ It will be supported with a grant of Rs 3000 crore from the Austrian government, which will also go towards the construction of a 350 MW hydro project to help power the scheme.⁷⁰

This project will give at least some of the residents of Telangana (including those in Medak) their rightful access to the Godavari River water. The 70 lakh acres of area under irrigation that was promised to the Telangana people when they merged to become part of the Andhra Pradesh state never materialised. In fact, the area of land under surface irrigation has almost halved in that time, decreasing from 20 lakh acres in 1956 to 12 lakh acres in the present day.⁷¹ The Sriramsagar is the sole project on the Godavari river in this district and it remains incomplete. It only irrigates 6 lakh acres of the 120 lakhs that were proposed forty years ago. 90% of Telangana's rightful portion of the Godavari river waters continue to flow into Coastal Andhra district.⁷²

However, the feasibility of the GLIS must be questioned. It will cost a tremendous amount of money to lift so much water such a height. The electricity for well irrigation requires Rs 739 per acre, whereas lifting water under the GLIS could cost as much as Rs 7953 per acre at some points.⁷³ And this does not account for the cost of maintenance and operation. What is more, it does not account for the power and money needed to irrigate the fields with drip and sprinkler irrigation once the water gets to its destination. It costs over Rs 50,000 to set up these methods of irrigation on one acre of land. Although most farmers in the GLIS project area will be eligible to get this installed at a 50% subsidy, for many even that price will be too much.⁷⁴

Furthermore, stakeholders have accused the government of using the scheme to win votes and benefit constituents in other districts, rather than to improve the lives of the people living in the Godavari basin area. They are critical that none of the daily wage labourers working on pipeline construction in Warangal are from Telangana. A handful are from Coastal Andhra but most, including the contractors, come from outside Andhra Pradesh.⁷⁵ The government has leased 900 acres of land from local people

⁶⁸ Doraiswamy & Gujja, *Understanding Water Conflicts*, op.cit., p.39

⁶⁹ Biksham Gujja, 'The Water Needs for Mid-Godavari Basin Farmers: Role of Water Tanks,' in Biksham Gujja (Ed.), *Dialogue Bulletin* (WWF, Special Edition Issue No. 12 February 2005), p.13

⁷⁰ Gujja, Biksham, 'Changing, but uncertain times' in Biksham Gujja (Ed.), *Dialogue Bulletin* (WWF, Issue No. 6 July 2004), p.8

⁷¹ Jayashankar, 'Telangana: the Irrigation Scenario', *op.cit.*, p.37

⁷² *Ibid.*, p. 38

⁷³ Reddy, M. Thimma, A White Elephant in Making: Power Needs for the GLIS, in in Uma Maheshwari, R., *Perspectives...The Godavari Lift Irrigation Scheme* (Hyderabad: Prajasakti Daily Printing Press, 2005), p.13

⁷⁴ M. Thimma Reddy, A White Elephant in Making: Power Needs for the GLIS, in in Uma Maheshwari, R., *Perspectives...The Godavari Lift Irrigation Scheme* (Hyderabad: Prajasakti Daily Printing Press, 2005), p.15

⁷⁵ Maheshwari, Uma, 'GLIS and its Implications for People and Environment in Warangal District', in Uma Maheshwari, R., *Perspectives...The Godavari Lift Irrigation Scheme* (Hyderabad: Prajasakti Daily Printing Press, 2005), pp.68

for this work and will also take an additional 344 acres of forest land. The lease may expire after three years, but there is no guarantee that the land will give the same level of productivity after being exposed to the cement from the pipes.⁷⁶ Moreover, the farmers in this area are not being compensated for approximately 100 borewells that are situated within the land the government has acquired. What is more, only two of the five pipelines being constructed will be supplying irrigation to them – the rest of the water is being diverted for industries.⁷⁷

Ironically, it appears that the poorest people of Warangal will gain the least from this project. The government is actually acquiring 56 acres of the land from the tribal people of Guttala Gangaram illegally, for the sale of tribal land is in violation of the Scheduled Area (1970) provisions. Furthermore, the loss of the 344 acres of government forest land will deprive scheduled tribes of a precious source of non-timber forest products. While the government has identified 1056 acres of wasteland in Anantapur as possible compensation land, the clearance for this has not come through, and the people concerned are unwilling to be moved such a great distance from their homes.⁷⁸ The acquisition of forest lands in Warangal has also not yet gained approval from the Ministry of Environment and Forests. The works will disturb 250 species of birds and animals such as the Giant and Rock squirrel, Elugubanti (Sloth Bear), Bonnet and Rhesus monkeys, Panthers, Indian Bison, Cheetal and Black Buck.⁷⁹ Furthermore, the manipulation of the Godavari River will disturb the fish life and put the livelihood of local fishermen in jeopardy.

The running of the four pipe fabrication units will also strain local resources. For instance, the Hasanaparthi unit will be powered by a generator that will consume 180L of diesel a day and emit toxic fumes into the atmosphere. The same unit will require 3-20 tonnes of water per day – collected from tankers, two borewells and the river.⁸⁰ This is in an area where people have to walk long distances to collect drinking water. This is also true for those living right next to the Godavari river, for they do not have a kaluva (small channel) needed to harness the water. For these people such a construction will be far more useful than this major project which they believe will benefit people in other regions rather than their own.⁸¹ Therefore, while major projects have merits, it is important that minor irrigations systems are not neglected.

⁷⁶ *Ibid*

⁷⁷ *Ibid*, p.70

⁷⁸ *Ibid*, p.71

⁷⁹ *Ibid*, p.72

⁸⁰ *Ibid*, p.69

⁸¹ *Ibid*, p.70

TANKS

Unfortunately the tank system of water harvesting has been neglected over the last few decades. Biksham Gujja, the policy advisor of WWF, has calculated that if tanks in Medak are restored from their current state of disrepair they could store around 1,687 MCM. This is about 27% of rainfall during an acute drought years and 13% of rainfall during a 'normal' year, although it does not take evaporation and seepage into account.⁸² For centuries south Indian tanks were a critical way of storing monsoon rain. They were often so big that they could be mistaken for lakes, and were typically linked to a neighbouring tank through a canal and sluice system. This allowed the overflow from one tank to be transferred to another after a heavy monsoon rain.⁸³

Historically, the tanks in this region made a valuable contribution to the local ecosystem and economy. In and around their waters one could find birds (such as pelicans, cranes and storks), fish and animals like deer and wild boar. Tanks supported the local economy by providing employment for fishermen and quality clay for pot and brick-makers on the tank bed. What is more, the silt that accumulated on the tank bed over time was an effective natural fertilizer that was periodically removed and applied to fields.⁸⁴

Nevertheless, life during the reign of tanks was far from idyllic. The water from the tanks was only enough for sporadic irrigation. Crop productivity was extremely low, averaging only 500 kg per hectare. With this poor output, there were twenty seven food scarcities and famines from 1770 to 1880 – when the population was only 170-250 million.⁸⁵ Thus, the government attempted to establish a more reliable water supply post-independence by promoting the construction of more dams and private well irrigation. At the same time, tanks were markedly devalued, with a considerable number being deliberately damaged to provide more space for urbanisation.⁸⁶ The maintenance of many others was neglected so that they have now fallen into disuse, with breaches, closed sluices and the accumulation of weeds and silt over the tank bed. The silt layer blocks rain from seeping into the soil, thus exacerbating the problem of the declining water table. It can also reduce the tank's storage capacity by over 50%.⁸⁷

⁸² Gujja, Biksham, 'The Water Needs for Mid-Godavari Basin Farmers: Role of Water Tanks,' in Biksham Gujja (Ed.), *Dialogue Bulletin* (WWF, Special Edition Issue No. 12 February 2005), pp.13-15

⁸³ Holland, Richard, 'Tanks for Everything' (Netherlands: WWF, 2004). Available on World Wide Web: www.panda.org (Accessed 15 April 2005), p.12

⁸⁴ *Ibid*, p.13

⁸⁵ Dr. C.D. Thatte, Patel, V. B., Menon, M. S., & Pandit, C., 'WWF Glorifies Bullock Carts', in B. Gujja (Ed.), *Dialogue Bulletin*, WWF, Issue 13, April 2005, p.16

⁸⁶ K. Jayashankar 'Telangana: the Irrigation Scenario', in Biksham Gujja (Ed.), *Dialogue Bulletin* (WWF, Special Edition Issue No. 12 February 2005), p.38

⁸⁷ K.V. Raju, *Participatory Irrigation Management in Andhra Pradesh, India*. Available on World Wide Web: http://www.cised.org/FAO_CSAndhraPradesh.pdf. (Accessed February 1 2005)

Another problem is that the usefulness of tanks in the present day is reduced in areas with high groundwater extraction (such as from tube or borewells). This is because water seeps into the ground more quickly in these conditions and therefore is not available as a source of drinking water for people or animals.⁸⁸ For instance, Uma Shankari observed that her village tank in Chittoor district of Andhra Pradesh was empty just a few days after a heavy rainfall of 140mm.⁸⁹ In the villages I visited on my personal research in Medak, Anantapur and Nizambad I was frequently told that the local tank was dry because it never rained for sufficient time to full the tank. Of course, there may have been breaches in the tank that I was not told about. Yet, it did seem that the rainfall pattern had changed, for on several occasions I was told that these days monsoon rain came in smaller doses, rather than for several days at a time. Whatever the case, tanks are undoubtedly beneficial for the facilitation of groundwater recharge and providing employment and free organic fertiliser (through desiltation). If the government is to increase the availability of irrigation to the average farmer they need to increase funding to tank restoration as well as major irrigation projects.

THE IMPORTANCE OF WATER HARVESTING

If rapid seepage is persistently rendering a tank bed dry, the installation of water harvesting structures such as soak pits, check dams and household tanks could improve the situation. Soak pits are drainage pits constructed to allow water to slowly seep through layers of stone and sand and recharge the groundwater.⁹⁰ It is particularly useful to position these pits adjacent to borewells or in locations where a lot of water flows – such as the place where people do their washing.

A series of check dams can also replenish groundwater levels in areas that are fortunate enough to be in close proximity to monsoon streams. Check dams harvest the surface run-off that comes from streams during the monsoon and spread it over the streambed. The recharge of groundwater aquifers increased from 5.2 to 38% in Pali district of Rajasthan after a series of checkdams was installed.⁹¹

In addition, it is particularly beneficial to have rooftop water harvesting structures in locations where safe drinking water is scarce. These structures collect rainwater from a roof, filter it and store it in a covered tank for use in time of water scarcity. Since the construction of this structure can be costly, Mr M.M. Sharma of ICRISAT has designed a similar low cost water harvesting tank of 8m diameter that is positioned inside a brick wall (with filter holes) in the centre of a shallow 30m pit in the ground. In

⁸⁸ Thatte, Patel, Menon & Padit, 'WWF Glorifies Bullock Carts', *op. cit.*, p.25

⁸⁹ Uma Shankari, 'Tank You', in B. Gujja (Ed.), *Dialogue Bulletin*, WWF, Issue 13, April 2005, p.22

⁹⁰ 'Activities' (Hyderabad: Water Conservation Mission, 2004). Available on World Wide Web: www.wcmap.org/home (Accessed February 5 2005).

⁹¹ 'Water Harvesting and Conservation Methods' (International Water Management Institute). Available on the World Wide Web: <http://www.iwmi.cgiar.org/droughtassessment/index.asp> (Accessed 27 January 2005).

the location where he designed it, the cost of construction was Rs 33,200 and the structure conserved 552798 litres of water. Therefore the water harvested by the structure 'costs' just Rs 0.6 per litre. It does not require chemical inputs and should meet the needs of 35 families.⁹²

THE NEED FOR COMMUNITY OWNERSHIP OF WATER HARVESTING STRUCTURES

As aforementioned, it is important that the development of such water harvesting structures is done under the community's direction. However, motivating a community to take charge of their own development can be difficult. Comments made by Radha Singh (Secretary of the Department of Agriculture & Cooperation) at the *International Workshop on Drought Assessment and Mitigation in South - West Asia* could help to explain the lack of motivation of the N Vijay Kumar community to participate in the Food Assurance Programme. She noted that the growing amount of government assistance given to drought-affected rural communities over the last 130 years has increased dependence on this aid. Thus many villagers have an expectation that they should receive government assistance without having to contribute their own money or labour. For instance, in Avancha village, Medak, the community refused to pay ten percent of the cost of a compound wall that would protect the village's water harvesting structures from being damaged by vandals, when the government offered to pay the remaining ninety percent.

This resistance may have occurred, however, because the villagers did not consider the water harvesting structures to be worth the cost of the wall. The structures in question were a rooftop rainwater harvesting tank and a soak pit that was positioned adjacent to a hand pump. Because the hand pump extracted sufficient drinking water from the borewell below, the villagers were not motivated to ensure that the soak pit stayed in use. Thus, it was left filled with stones that vandals had thrown in. Similarly, they had used the drinking water that filtered from the rooftop tank as soon as it came during the monsoon. When I saw the tank at the beginning of March it was dry and without a tap. I was told that the villagers understood that the purpose of the tank was to store drinking water for the summer, when it was in short supply. Yet they did not do so because they did not think it was safe to drink water that had been stagnant for so long.⁹³

A community is much more likely to contribute to the establishment and maintenance of watershed projects if they can clearly see that it is in their interest for them to do so. For example, the women of Avancha were daily cleaning the dual soakage pits that the village had built with their own labour,

⁹² Sharma, M. M. (ICRISAT), *Personal Communication*, (Patancheru, Medak: April 13 2005).

⁹³ M.M. Sharma of ICRISAT assured me that the water will be safe kept for this period of time as long as the tank was kept covered (Patancheru, Medak: *Personal Communication*, 8 March 2005).

some of their own materials and a grant from Dangoria Charitable Trust.⁹⁴ Previously, the only outlet for wastewater in this village was a poorly maintained open canal. This exposed the village to a large volume of stagnant wastewater, which led to a high incidence of diarrhoeal diseases and mosquitoes. Upon the commencement of Dangoria's interaction with the villagers, only 6.8% of the women expressed satisfaction with this system. There was a clear desire for improvement, although they were unsure how this could be done. After a series of community and focus group discussions, the village agreed to try the soak pit model that Dangoria had explained to them. In this model, pits are constructed to allow water to slowly drain through layers of stone and sand and recharge the groundwater.⁹⁵ In Avancha they were dug next to platforms on which the villagers did their washing. This technique significantly reduced the prevalence of mosquitoes and diarrhoeal diseases. By the end of the project 100% of the women were satisfied with the new system.⁹⁶

THE IMPORTANCE OF SMART CROP MANAGEMENT

In order to mitigate drought, there is a need to empower farmers to make wise decisions concerning the selection and management of their crops so that they make efficient use of the water available to them. In Medak over the last forty years the cultivation of crops with a low water requirement, such as Jowar, Bajra and Ragi has declined. In the early 1960s these crops were grown on 31.9% of cropped area, whereas they are now grown on only 17.9% of the area.⁹⁷ At the same time paddy has consistently been cultivated in one fifth of the cropped area. This crop soaks up 59.3% of the total irrigation supply. Sugarcane and chillies, which have substantially increased in cropped area over the last twenty years, account for an additional 11.2% between them.⁹⁸ The pattern of crop shifts throughout Medak and the district in which it is located (Telangana) is illustrated in Annex 1.

These crop changes have put additional stress on the scarce water resources, and yet encouraging farmers in dry regions to return to the crops planted by their forbearers would not necessarily improve their economic situation. People shifted away from dryland crops such as jowar, bajra and ragi because they were not economically feasible – as shown by K.S.Surya Narayana's study during the period of 1975-76 to 1977-78. (p12 bharaths article). The modern market is not favourable for these cereal crops

⁹⁴ P.V.V.S. Murthy, Ramgopal, K., Vishnu Vardhana Rao, M., & Bamji, Mahtab S., *Strategies for Augmenting Rural Sanitation and Drinking Water supply - Impact on environment, health, and women's awareness* (Hyderabad: Dangoria Charitable Trust, 2004)

⁹⁵ 'Activities' (Water Conservation Mission), op.cit.

⁹⁶ Murthy, Vardhana Rao & Bamji, *Strategies for Augmenting Rural Sanitation and Drinking Water supply*, op.cit

⁹⁷ *Season and Crop Report: Andhra Pradesh 1963-1964* (Hyderabad: Bureau of Economics and Statistics, 1964) & *Season and Crop Report: Andhra Pradesh 2002-2003* (Hyderabad: Directorate of Economics and Statistics, 2003).

⁹⁸ *Season and Crop Report: Andhra Pradesh 1982-1983* (Hyderabad: Bureau of Economics and Statistics, 1983) & *Season and Crop Report: Andhra Pradesh 2002-2003*, op.cit.

because rice is the staple food for so many. Furthermore, with joint families becoming increasingly common, farmers have less labour available to them. This has made the cultivation of rice is more attractive to them than crops like pearl millet, which require a lot of weeding.⁹⁹ Similarly, farmers may prefer to grow rice and commercial crops like sugarcane in preference to vegetables, because they receive money for them in one large payment, rather than in small sums at weekly markets. However, the cultivation of vegetables is less risky in a drought prone area, because they require less water and have a relatively short crop duration (ref: farmer in Avancha village). Finally, it has also been observed that farmers may resist changing from paddy or a cash crop because these crops are more suitable for their land holding patterns or the inputs and markets accessible to them.¹⁰⁰

IDENTIFYING SUITABLE CROPS

These points indicate that it is not useful for NGOs or government agricultural extension officers to blindly 'prescribe' crop changes. However, in places where the cultivation of water-intensive crops is unsustainable, the community may take an interest in alternative crops that do not require irrigation. In such cases, NGOs could provide information about dry crops for which there is a good market, such as medicinal and dye-yielding plants including *Withania somnifera*, *Aloe barbadensis*, *Bixa orellana* and *Lawsonia inermis*.¹⁰¹ Mr M.M. Sharma of ICRISAT identified *Withania somnifera* and safed musli as medicinal plants that could be grown at low cost, but warned that cultivators of these crops need to be protected from middlemen who frequently exploit them. He also suggested henna, indigo and American saffron for dye-yielding plants that are easy and inexpensive to grow. There is an established market for the first two, but the cultivation of American saffron would require some support to find an export market.¹⁰²

Another option could be to cultivate aromatic grasses such as lemon grass and vetiver grass that produce essential oils that can be profitable in dryland agriculture.¹⁰³ It would be beneficial for NGOs to actively promote such crops when there is an early-onset drought. This type of drought occurs before the season's seeds are sown, giving farmers an opportunity to switch crops to those that can withstand dry conditions.

Legumes are also suitable for dryland agriculture. Chickpeas and other legumes are particularly good for poor soil because they enhance biological nitrogen fixation. (ref p 98 Pearson). ICRISAT

⁹⁹ Dr Bamji, *Personal Communication*, March 3 2005

¹⁰⁰ Jairath, 'Participatory Irrigation Management in Andhra Pradesh: Contradictions of a Supply Side Approach' *op.cit.*, p.9

¹⁰¹ *Report of the FAO-CRIDA expert group consultation on farming systems and best practices for drought-prone areas of Asia and the Pacific region* (Hyderabad: CRIDA 2002), p.11

¹⁰² M.M. Sharma (ICRISAT), *Personal Communication*, (Patancheru, Medak: April 13 2005).

¹⁰³ Sharma (ICRISAT), *Personal Communication* (Patancheru, Medak: March 8 2005).

(International Crops Research Institutes for the Semi-Arid Tropics) scientists have developed a chickpea variety that is suitable for drought-prone areas because it is harvested in only 90-110 days, rather than 140-150.¹⁰⁴ A member of the Telangana Natural Resource Management Group from Medak reported to me that such varieties were not available in the local market. Indeed, ICRISAT appears to have problems extending the varieties it develops, for it is a research institute, not an NGO, and has limited resources for such work. That said, it has produced some hybrid seeds of Sorghum, Pearl Millet and Pigeon pea that are being used by farmers.¹⁰⁵ It would be of great value if local NGOs could work with ICRISAT to ensure that dryland farmers gain some benefits from the valuable research that this institute is doing on their behalf.

MAKING EFFICIENT USE OF THE WATER AVAILABLE IN HORTICULTURE

If farmers in water-scarce areas insist on cultivating water-intensive crops, it is recommended that they rotate them with plants that require less water, such as legumes. This can optimise both crop production and moisture conservation, as provides root systems that bring nutrients to the surface and facilitate the seepage of water into the soil. (Ref Pearson p89) Intercropping (growing different crops on the same field) can deliver similar benefits, as well as providing extra security in case one crop is hit by a pest, drought or disease. However, it must be noted that the best results from intercropping or crop rotation come in areas in which rainfall is more reliable. (ref vul article p7)

There are many other ways of cultivating crops to make maximum use of the water available and attain a good yield at the same time. For instance, CRIDA (Central Research Institute for Dryland Agriculture) has found that in situ moisture conservation techniques such as mulching and sand application increase production by up to 20%.¹⁰⁶ Research has indicated that the results of such practices on black soil are even better – with vertical mulching increasing yields by 50% in low-rainfall regions.¹⁰⁷ On light red soil off season tillage conserves water and decreases weed growth, enabling sorghum yields to grow by 33% in low-rainfall areas.¹⁰⁸

Another option is to minimise water loss through surface run-off and evaporation. This can be done by digging a drain of 1m depth and width along the top of the field, in which rain can collect and slowly filter into the field.¹⁰⁹ In other fields contour bunds (regular ridges and furrows) may be a sufficient way of delivering the same effect. Furthermore, crops that require a large amount of irrigation, such as

¹⁰⁴ *Ibid.*

¹⁰⁵ Sharma (ICRISAT), *Personal Communication*, (Patancheru, Medak: April 13 2005).

¹⁰⁶ Ramakrishna, Dr. Y.S. (Director of CRIDA), *Personal Communication* (Hyderabad: April 21 2005).

¹⁰⁷ Sivenappan, Dr. R.K., 'Water Harvesting and Conservation for Increased Production in Drylands on Watershed Basis', *Financing agriculture*, Vol.36(4), Oct-Dec 2004, p.38

¹⁰⁸ *Ibid*

¹⁰⁹ Emmanuel Koro, 'Zimbabwean Farmers Bag the Clouds', (August 12 2003). Available on the World Wide Web: <http://www.islamonline.net/English/Science/2003/08/article07.shtml> (Accessed February 12 2005)

paddy, should be surrounded with pits to harvest the excess water.¹¹⁰ Finally, evaporation loss can be reduced by irrigating fields during the night. Of course, if the irrigation is powered by electricity, a farmer's capacity to do this might be restricted, depending on the hours that electricity is supplied.

There are also small-scale irrigation methods available to poor farmers that use minimal water and can be installed at low cost. One such example is the 'bucket and drip' irrigation method. All that is required for this method is a drum of water and a rubber or plastic hose with small holes in it. The drum is positioned on a post 1m above the ground, so that water can flow down the hose and onto the crops. (research update July 03)

In some dry areas farmers conserve water by applying wastewater to their crops. This can be a useful way of allowing the poorest to grow crops they usually could not. What is more, the application of wastewater may feed additional nutrients into the soil, decreasing the fertiliser requirement. However, it also may feed harmful viruses, bacteria and parasitic worms into the soil, contaminating the crop or groundwater below.¹¹¹ Farmers in an area of Pakistan where wastewater cultivation is practiced have been found to have a particularly high rate of infection for diarrhoeal diseases and hookworm. It is therefore advised that farmers cultivating with wastewater plant non-food crops and wear protective clothing and footwear. Furthermore, they should have anti-parasitic drugs and health education made available to them.¹¹² A study in Pakistan has found that vegetables grown with the 'bed and furrow' method of cultivation were free of parasitic-worm eggs, even though the eggs were present in the water applied to them. Therefore, it could be that this agricultural technique reduces the negative health consequences of wastewater irrigation.¹¹³

REDUCING WATER USE IN PADDY CULTIVATION

New methods of rice cultivation also have positive implications for drought-prone areas. Paddy is chronically over watered, as farmers needlessly keep it constantly submerged in the hope that this will give added security. This amounts to a great deal of water wastage, as paddy accounts for 59.3% of the area under irrigation in Medak.¹¹⁴ Fortunately, the System of Rice Intensification (SRI) has been developed, which reduces water usage by 30-50%¹¹⁵ and requires only 2kg of seed per acre.¹¹⁶

¹¹⁰ Jairath, 'Participatory Irrigation Management in Andhra Pradesh', op.cit.

¹¹¹ *Confronting the realities of wastewater guse in agriculture* (IWMI Research Update, vol 1, 2004), p.2

¹¹² *Ibid*

¹¹³ *Ibid*

¹¹⁴ *Season and Crop Report: Andhra Pradesh 2002-2003*, op.cit.

¹¹⁵ Vinod Goud, 'SRI Method of Paddy Cultivation: an Untapped Potential for Mid Godavari Basin Development,' in Uma Maheshwari, R., *Perspectives...The Godavari Lift Irrigation Scheme* (Hyderabad: Prajasakti Daily Printing Press, 2005), p.102

Incredibly, with these reduced inputs SRI crops produce an 80-100% greater yield. The main feature of SRI, developed by Fr. Henri de Laulanie in Madagascar, is that the seeds are transplanted when they are six to fifteen days old and planted 25cm apart. This allows large roots to develop that can produce healthy, bountiful tillers.¹¹⁷

I was shown SRI and normal paddy grown by two tenant farmers in separate locations in Nalgonda district, under the support of Acharya N.G.Ranga Agricultural University (ANGRAU). The first farmer, Vekat Reddy, was growing Kavya paddy on one acre of light black soil, with half being cultivated in the conventional way and half being cultivated with the SRI method. A sample paddy plant in the SRI plot had 38 tillers with rice seeds, whereas there were only 17 tillers on the sample paddy plant in the conventional plot. On both plots one bag of urea and one bag of growmore was applied. However, because there was more space between the paddy plants, a rotary could be used to apply the fertiliser in the SRI plot, which may have allowed it to mix more thoroughly into the soil. Similarly, the extra space allowed a machine (costing Rs 800) to be used for weeding the SRI plot. It took five hours to weed the half acre with this machine on six occasions during the harvest. The conventional paddy plot was weeded twice with the manual labour of ten persons, costing Rs 600. Thus, cost of the weeding machine would be paid for through savings on manual labour after only two years of use.

Most significant for the present research is that the SRI plot was watered once in every ten days, whereas the conventional plot was watered daily. Vekat Reddy told us that he could irrigate six acres of SRI paddy with the same amount of water applied to one acre of conventional paddy. One drawback of not keeping the paddy continuously submerged in water was that it was now more vulnerable to pests such as rats. However, this was rectified in Vekat Reddy's plot by the application of one bag of rat poison, costing him Rs 25.

I was also shown SRI paddy in a field with poor red soil. Because the soil had low levels of nutrients, the tenant farmer watered the SRI paddy once every two days. Of course, this is still less than conventional paddy, which is watered daily. In order to observe the effect of soil nutrition on SRI paddy, the farmer cultivated part with fertiliser and part without. In the area where the fertiliser was most concentrated a sample plant had 35 tillers, whereas there were only 15 tillers on the SRI paddy growing in the unfertilised soil. This shows that adequate soil nutrition is required to get the best results from SRI paddy. However, I was informed that the yield from this SRI plot was still better than paddy grown with the conventional method in such poor soil. It must be noted that saline soil is

¹¹⁶ 30 kg of rice is required per acre in conventional paddy crops. Personal communication [Vinod Goud](#) nd was....

¹¹⁷ Goud, 'SRI Method of Paddy Cultivation: an Untapped Potential for Mid Godavari Basin Development,' op.cit, p.102

another case. It seems that paddy planted with the SRI method in this type of soil does not grow well, and therefore this should be avoided.¹¹⁸

REHABILITATING FALLOW LAND

Intercropping and agro forestry systems have been identified as an effective way of rehabilitating land that has been left uncultivated because of consecutive droughts or migration. Trees have the ability to grow deep roots that can seek water from great depths and bring it to the surface to sustain their growth.¹¹⁹ They can also provide a wide variety of non-wood products that are increasingly important for tribal people who have become dependent on land with low productivity. One hectare of trees yielding non-wood products can sustain one family for one year. It has been estimated that employment from the cultivation of these products throughout India is two million person days, and that this figure could potentially reach 4.5 million person days.¹²⁰

Yet, Urmila Pingle warns that it is important to select tree species that are appropriate for the local soil to attain satisfactory results. This point was taken care of in a wasteland development programme that was executed in 1971 to grow mango saplings in an area of northern Andhra Pradesh. The farmer who instigated this programme had already grown these trees on similar sandy lands and had attained a profit higher than that usually received from growing paddy in this area.¹²¹ A collective farming society was formed for this project, which was sponsored by the Tribal Welfare Department and agricultural banks. The funds obtained allowed them to purchase the required saplings, tools, bullocks and carts. The bullocks and carts enabled the farmers to earn income through timber transportation during the five year period before the trees grew fruit. The trees were planted during the monsoon to reduce irrigation requirement. It has been suggested that in vivo grafting could reduce the water requirement further if such a project was replicated in an area with less rainfall.¹²² To date, the mango orchards have benefited 20,000 families. The farmers have paid off their loans and their land value has risen from zero to Rs 50,000.¹²³ Moreover, their children have a reduced incidence of vitamin A deficiency and anaemia after more mangoes were included in their diet.¹²⁴

¹¹⁸ Sharma (ICRISAT), *Personal Communication*, (Patancheru, Medak: May 28 2005).

¹¹⁹ Urmila Pingle, 'Greening of Central Indian Wastelands', in C.M. Hladik, A. Hladik, O.F. Linares, H. Pagezy, A. Semple & M. Hadley (Eds.), *Tropical Forests, People and Food: Bio cultural Interactions and Applications to Development*, Man and the Biosphere Series, Vol. 13, UNESCO Paris & The Parthenon Publishing Group, p.726.

¹²⁰ *Ibid*, p.727

¹²¹ *Ibid*

¹²² Pingle, Urmila (Independent Development Analyst), *Personal Communication*, (Hyderabad: March 23 2005).

¹²³ Pingle, 'Greening of the Central Indian Wastelands', p.728

¹²⁴ Pingle, Urmila, 'Impact of Horticulture on Nutrition of the Rural Poor'.

Of course, mango trees will not be as productive in other regions with fallow land where the soil is not so conducive for them. CRIDA has found that neem tree works well with green gram in some areas, whereas the Telangana Natural Resource Management Group (TNRMG) recommends maize with red gram or horse gram to farmers in Kowdipally mandal, Medak. The maize yield in this district is higher than the state average yield.¹²⁵ Thus it has been identified as a good rain-fed crop to grow in this area, and has been steadily expanding across the district.¹²⁶ Additionally, authors of a book on sustainable dryland cropping note that legumes can attain maximal seed production and self-generation on fallow land. (-p89 Pearson sustainable dryland cropping)

RECOMMENDATIONS

In the final analysis it seems that the key requirement for drought mitigation is the cooperation of communities, NGOs and the government to prepare village drought contingency plans that counter impacts of drought such as health problems, debts, suicides, prostitution and migration. It must be made clear who is responsible for the maintenance of water harvesting structures, and how this will be paid for. While drought contingency plans may already exist in some localities on paper, they are worthless unless the relevant community has ownership of it and is serious about implementing it. To do this they need access to funds and expert advice on the most suitable water harvesting structures and dryland crops for their location. This is the responsibility of the government.

Yet, because the nature of drought and its impact can be so varied, there is no simple plan that will 'save' a community from its negative consequences. Therefore, diversification of risk must be particularly emphasised. When a family has multiple sources of income, from different crops, entrepreneurial activities and livestock, they are at much less risk of suffering economically. Additionally, If they have diverse sources of water, such as a rooftop tank, village tank and a borewell beside a soak pit (or, if they are lucky, a kaluva or check dam from a nearby river or stream) the affect of a drought on drinking water supply will be additionally reduced. If the above measures fail then it is necessary to have safety net procedures in available such as seed banks, fodder banks and government programmes like the FAS.

Many NGOs are working to help villages develop such strategies, but these efforts are constrained by limited resources, and therefore are typically on a small-scale. What is needed is a comprehensive

¹²⁵ Sivamohan, 'GLIS and Impact on Cropping Patterns', in Uma Maheshwari, R., *Perspectives...The Godavari Lift Irrigation Scheme* (Hyderabad: Prajasakti Daily Printing Press, 2005), pp.24-63

¹²⁶ *Season and Crop Report: Andhra Pradesh 1963-64*, op.cit.; *Season and Crop Report: Andhra Pradesh 1982-1983 & Season and Crop Report: Andhra Pradesh 2002-2003*, op.cit.

drought mitigation programme implemented through the cooperation of the relevant government departments (united in a body like the Water Conservation Mission). It should help dry farming communities access minor and major irrigation systems and educate them about options for drought prevention and alleviation. This should include giving information about alternative dryland crops and SRI paddy, dependent on location suitability. Mandal agricultural officers are currently responsible for this, but as aforementioned, many mandals have not employed these officers.

In addition, it is important to address practices that exacerbate droughts, such as water wastage and the tendency for villagers to have large families. Curbing these practices involves changing the mindset of traditional communities. Therefore, it will require a sustained, long-term effort by government officials and NGOs. It would be particularly useful to raise awareness about these issues among the representatives of a community's future – its children. Moreover, it would be valuable to encourage respected persons to lead by example. The village panchayat must not sit idle while a tap is missing from a village tank.

It is difficult to write a concluding paragraph for this report on drought mitigation because the issue is such a complex one, involving numerous issues, agencies and stakeholders. During the five months that I have been researching it I have frequently been told one way of alleviating a water shortage only to be told “but...” by the next person I speak to. There are many fantastic ideas and policies being advocated by the government and NGOs but implementation is often weak. Implementation problems may come from a lack of stakeholder participation, lack of a post-project evaluation or lack of sustained funding. However, I feel I could now tell those village children I met at the start of my study that the situation is not hopeless. I have been inspired by mango orchards, SRI paddy and successful soak pits, check dams and water harvesting tanks. Most of all I have been inspired by hardworking individuals who are doing all they can to spread their knowledge and help struggling communities access the government funds and projects that have been created for them.

Without them my research would not have been possible. I thank them.

ANNEX 1 : CROP CHANGES

Average principle crops sown in Medak during the periods 1959-64, 1978-83 and 1998-03.¹²⁷

Crop	Percentage of area under principle crop to the total area sown		
	1959-64	1978-83	1998-03
Rice	22.8	20.6	20.6
Jowar	28.6	32.0	17.6
Bajra	0.9	1.3	0.3
Ragi	2.4	1.8	0.0
Total millets and cereals	66.9	71.2	55.6
Total pulses	17.7	15.4	21.4
Castor	1.8	1.1	0.3
Cotton	0.1	0.1	2.9
Groundnut	0.8	0.6	1.5

¹²⁷ Information from *Season and Crop Report: Andhra Pradesh 1963-1964, 1982-1983 & 2002-2003* (Hyderabad: Directorate of Economics and Statistics, 1964, 1983 & 2003).

Crop Shifts in Telangana Between 1979-82 and 1998-01¹²⁸

Crop	Area (ha)			Productivity		
	1979-82	1998-01	% Change	1979-82	1998-01	% Change
Rice	1086.3	1488.7	37.0	1857.7	2660.2	43.2
Jowar	1452.0	567.0	-61.0	617.2	694.7	12.6
Bajra	189.1	43.4	-77.1	489.7	523.0	6.8
Ragi	54.7	21.3	-61.1	665.4	953.1	43.2
Maize	296.7	398.7	34.4	1645.8	3141.5	90.9
Major millets	1993.7	1031.0	-48.3	755.6	1638.5	90.9
Minor millets	70.0	20.3	-71.0	485.7	280.8	-42.2
Bengal gram	-32.2	34.3	6.5	313.7	524.8	67.3
Red gram	143.6	243.7	69.7	201.9	357.4	77.0
Green gram	399.2	281.0	-29.6	271.3	426.7	57.3
Black gram	493.4	80.4	85.3	177.4	424.1	139.1
Horse gram	132.0	24.4	-81.5	186.4	344.3	84.7
Cow gram	2.3	9.7	321.7	120.4	412.4	216.3
Groundnut	218.6	292.4	33.8	1073.2	954.5	-11.1
Sunflower	2.3	50.5	2095.7	N.A.	586.1	N.A.
Chillies	82.0	113.1	37.9	840.2	2033.6	142.0

¹²⁸ K. Purna Chandra Rao, 'Crop Shifts in Andhra Pradesh since its Formation', in Y.V. Krishna Rao & S. Subrahmanyam (Eds.), *Development of Andhra Pradesh: 1956-2001. A Study of Regional Disparities* (Hyderabad: NRR Research Centre, 2002), p.144

ANNEX 2: SEASONAL RAINFALL DATA

Below are seasonal rainfall statistics for Medak from 1994-2004, obtained from Andhra Pradesh Season and Crop Reports. The rainfall data could not be found from this source for the periods of 1998-1999 and 2001-2002. Thus, for these years I have retrieved the rainfall measurements taken at ICRISAT, which is located in Patancheru, Medak. The figures taken from this source are written in brackets. Bold figures indicate that the rainfall is at least 25% less than the average rainfall for that season.

Rainfall in Medak (mm) 1994-1995

	1994-1995	Normal	% Deviation from Normal
South-West Monsoon	495	810	-39
North-East Monsoon	212	89	138
Winter	70	8	775
Hot weather period	84	52	62
Total rainfall	861	959	-10

Rainfall in Medak (mm) 1995-1996

	1995-1996	Normal	% Deviation from Normal
South-West Monsoon	631	810	-22
North-East Monsoon	329	89	270
Winter	1	8	-87
Hot weather period	35	52	-33
Total rainfall	496	959	4

Rainfall in Medak (mm) 1996-1997

	1996-1997	Normal	% Deviation from Normal
South-West Monsoon	746	810	-8
North-East Monsoon	164	89	84
Winter	8	8	0
Hot weather period	94	52	81
Total rainfall	1012	959	6

Rainfall in Medak (mm) 1997-1998

	1997-1998	Normal	% Deviation from Normal
South-West Monsoon	440	810	-46
North-East Monsoon	191	89	115
Winter	7	8	-13
Hot weather period	20	52	-62
Total rainfall	658	959	-31

Rainfall in Medak (mm) 1998-1999

	1998-1999	Normal	% Deviation from Normal
South-West Monsoon	(887)	810	(9)
North-East Monsoon	(180)	89	(204)
Winter	(31)	8	(436)
Hot weather period	(114)	52	(119)
Total rainfall	(1212)	959	(26)

Rainfall in Medak (mm) 1999-2000

	1999-2000	Normal	% Deviation from Normal
South-West Monsoon	574	810	-29
North-East Monsoon	20	89	-76
Winter	15	8	488
Hot weather period	73	52	-40
Total rainfall	662	959	-29

Rainfall in Medak (mm) 2000-2001

	2000-2001	Normal	% Deviation from Normal
South-West Monsoon	763	680	12
North-East Monsoon	17	133	-87
Winter	7	10	-30
Hot weather period	34	51	53
Total rainfall	821	874	-6

Rainfall in Medak (mm) 2001-2002

	2001-2002	Normal	% Deviation from Normal
South-West Monsoon	(524)	680	-23
North-East Monsoon	(131)	133	-2
Winter	(27)	10	170
Hot weather period	(28)	51	-45
Total rainfall	(710)	874	-19

Rainfall in Medak (mm) 2002-2003

	2002-2003	Normal	% Deviation from Normal
South-West Monsoon	431	680	-37
North-East Monsoon	88	133	-34
Winter	2	10	-80
Hot weather period	19	51	-62
Total rainfall	540	874	-38

Rainfall in Medak (mm) 2003-2004

	2003-2004	Normal	% Deviation from Normal
South-West Monsoon	665	680	-2
North-East Monsoon	73	133	-45
Winter	21	10	110
Hot weather period	60	51	18
Total rainfall	819	874	-6

ANNEX 3

List of Villages visited during the Field work for the study

Village	Mandal	District	Date
Telan Nagar	Kowdipally	Medak	19-01-05
Kannaram	Kowdipally	Medak	21-01-05
Mohammed Nagar	Kowdipally	Medak	21-01-05
Kotha Cheruvu Thanda	Kowdipally	Medak	21-01-05
Devulapalli Thanda	Kowdipally	Medak	23-01-05
Avancha	Narsapur	Medak	28-01-05
Bhattu Thanda	Kowdipally	Medak	02-04-05
Sisalunda	Kondida	Vishakapatnam	11-04-05
Valasi	Kondida	Vishakapatnam	12-04-05
Paddy farm	xxxxxxx	Nalgonda	14-04-05
Kummarivandlapally	Kadiri	Anantapur	21-04-05
Kyasampally	Kamareddy	Nizamabad	24-04-05