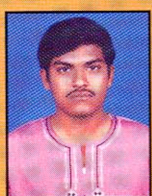
Case study of Addakal Mandal, AP

This case study describes the use of GIS-derived tools for water budgeting and participatory approaches to rural learning in improving drought awareness in a cluster of 21 villages

G Sreedhar[1,2]



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Introduction

Drought is more than a physical phenomenon or natural event. Drought occurs in virtually all climatic zones, and its characteristics vary significantly among regions. It is related to a deficiency of precipitation over an extended period of time, usually for a season or more. This deficiency results in water shortage for some activity, group or environmental sector, and it is often exacerbated by human activities. Drought is a critical phenomenon of climate change whose occurrence, duration, intensity, spatial variation and context is difficult to quantify.

The prediction of drought is difficult as its development is very slow. International experience, especially that deriving from work in the sub-Saharan Africa, considers that preparedness is often more effective than relief. Information is the backbone of drought preparedness. While there is a need to foster drought preparedness at various scales, its effectiveness is particularly enhanced if there is preparedness at the level of vulnerable communities. A number of OECD (Organisation for Economic Co-operation and Development) countries such as the USA, Australia, Spain and France, have well-established systems and procedures to prepare whole regions and States to face drought and to mitigate its impact. India has for over three decades managed some well-structured action such as the Drought-Prone Areas Programme. Over the last two decades, the National Remote Sensing Centre (NRSC) of India has built a large programme to monitor the vegetation index to develop forecasts for drought onset over large regions. However, in most of the developing world, there is no established practice to foster drought-preparedness at the level of vulnerable rural areas. Realising this, the Science and Technology Commission of the United Nations Convention to Combat Desertification (UNCCD) has recommended the adoption of a communication system that combines top-down approaches and community mobilisation, to enhance preparedness (UNSO, 2000). In this case study, we present an approach to micro-level drought vulnerability assessment and its dissemination among the potentially vulnerable families using village information centres, and briefly discuss the results related to its utility.

We constructed GIS-derived drought vulnerability maps at a micro-level (less than 20000 ha) as a tool to improve drought awareness and preparedness. This study was conducted in partnership with the Adarsha Mahila Samaikhya, a rural micro-credit federation in Addakal Mandal[1] of Mahabubnagar district in Andhra Pradesh.

Adarsha Mahila Samaikhya (AMS)

Adarsha Mahila Samaikhya is a federation of all-women self-help groups with a membership of 6300 from 21 villages in Addakal Mandal, Mahbubnagar district of Andhra Pradesh, India. The AMS has been active as a community-based organization since 1994 and has developed a campus of its own. ICRISAT's Virtual Academy for Semi-Arid Tropics (VASAT) project is involved in knowledge creation and also imparting non-formal education to rural families. ICRISAT with the help of the Government of Andhra Pradesh and ISRO-NRSC has setup an Internet connected hub with two way video conferencing facility in the AMS premises and has worked with the AMS to strengthen the capacity of the AMS volunteers in info-mediation (*http://www.icrisat.org/vasat/pilothub/index.html*). ICRISAT and AMS have set up Village

Information Centres with PCs and Internet access. Recently, the partners have extended their activities to reach all the 21 villages of Addakal Mandal.

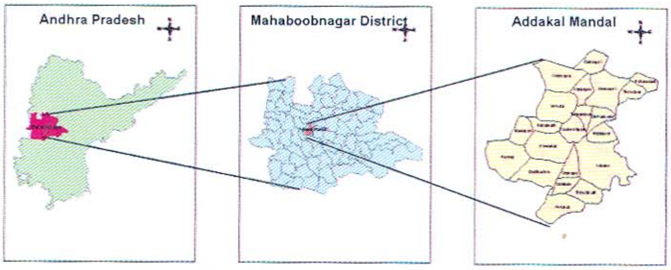


Figure1: *Study Area: Addakal Mandal, Andhra Pradesh, South Central India*

Study area

Addakal Mandal (Figure 1) covers an area of 196 km^2 and consists of 21 revenue villages with 13 hamlets. It is situated within the latitudes 16° 28' 28.3" to 16° 41' 1.98" N and longitudes from 77° 2' 47.34" to 78° 2' 46" E with an elevation ranging from 380 – 647 m above Mean Sea Level (MSL). Annual precipitation in this Mandal ranges from 391.0 to 542.6 mm and is categorized under the Southern Telangana agro-climatic zone. Around 15% of this area is under irrigation, 60% is rain-fed and remaining 25% is considered as waste land.

The population of this region is 46,380 (male: 50.57% and female: 49.43%) and the literacy rate is 35 %(male: 66 % and female: 34 %) (Census of India, 2001). The main occupation of the people in this region is agriculture, dairy farming and allied activities. The chief crops grown in the region are castor, groundnut, maize, chickpea, sorghum, pearl millet, paddy and orchard crops.

This region is prone to frequent droughts and exodus has been noticed and reported in the last 10 years. The water resources in this region are dwindling and groundwaters being semi-critical in availability (Rafiuddin et al., 2007), the farmers depend mainly on rainfall or rainfall runoff that is stored in surface water tanks for irrigation. These tanks act as insulators when drought or flood events occur. A field survey was undertaken with the help of Global Positioning System (GPS) in May 2008 to assess the status of water tanks in this Mandal. It was observed that many of these tanks were dry, accumulated with 1.82 to 3.0 meters of silt and also were infested with weed.

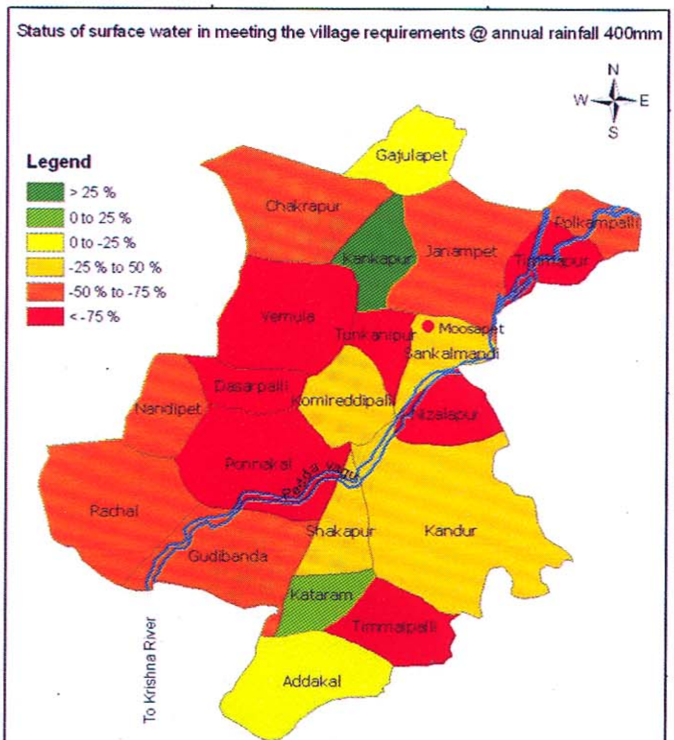


Figure 2a: *Drought vulnerable villages at 400mm rainfall*

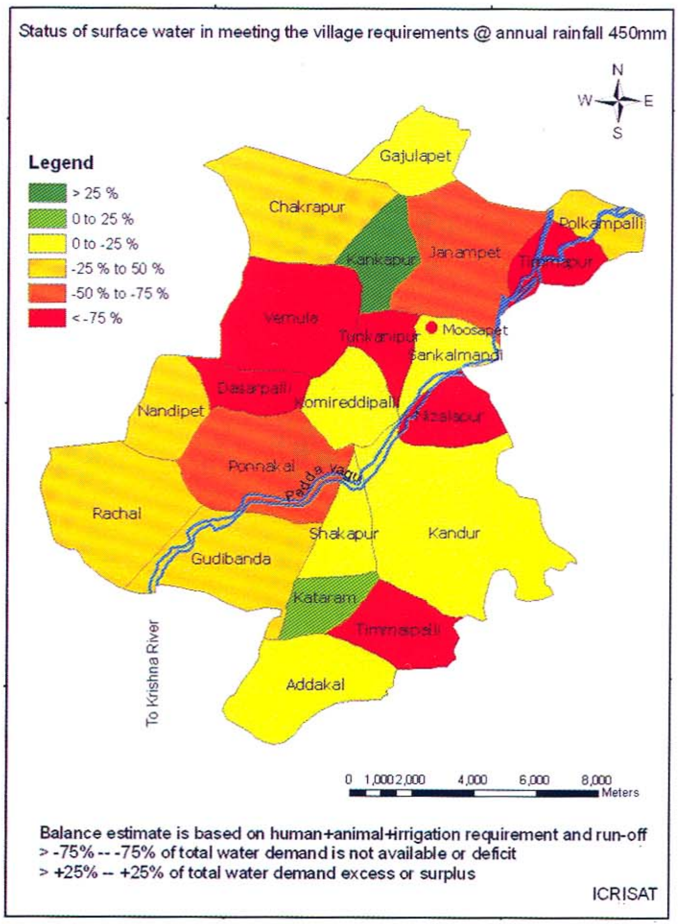


Figure2b: *Drought vulnerable villages at 450mm rainfall*

Drought vulnerability estimation and generation of colour-coded maps

A GIS-based framework developed by Indian Institute of Technology, Mumbai (*http://www.csre.iitb.ac.in*) which is based on water budget calculations was adopted in developing the Micro-level drought vulnerability maps. This had been earlier tested on a pilot basis in parts of Addakal Mandal and the results were in agreement with actual conditions (Dileep Kumar, 2007).

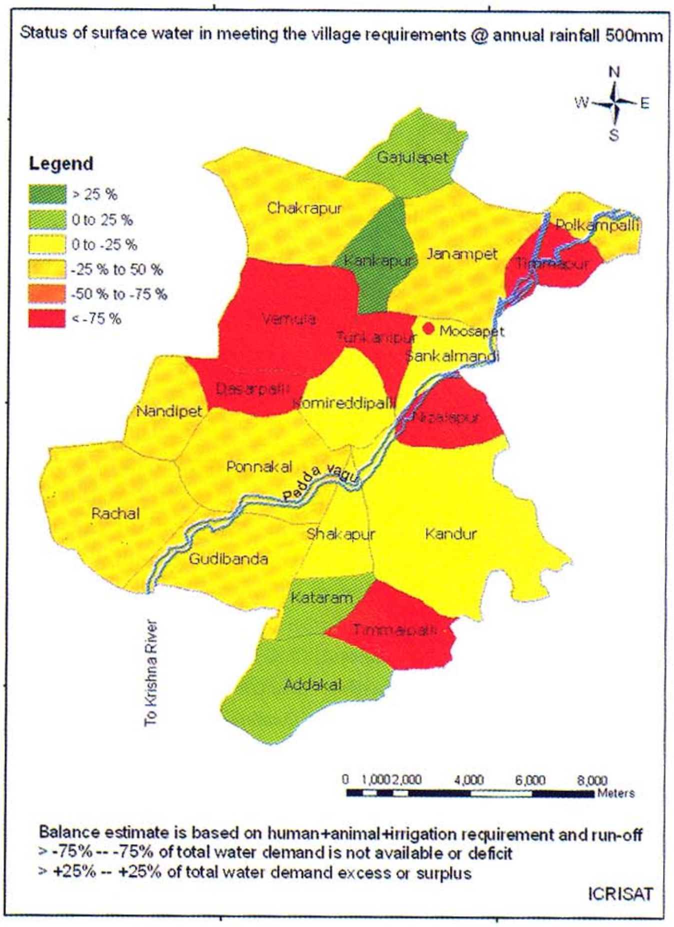


Figure2c: *Drought vulnerable villages at 500mm rainfall*

This method involves calculation of water requirement and water available for each village from different rainfall scenarios. Initially, the water required for each village was estimated by considering the water used for human and livestock consumption, and irrigation needs of different crops. The water availability in the surface water tanks was then estimated for each village for different rainfall scenarios. Finally, the water deficit or surplus was estimated for all the 21 villages from the water requirement and availability information.

Cadastral maps[2] were obtained from Central Survey Office, Hyderabad; Topographic maps were obtained from Survey of India, Hyderabad; and information about population, livestock, crops grown and the numbers of acres were obtained from the Addakal Mandal Office, Addakal.

The cadastral and topographic maps were geo-referenced and digitised to create a layer showing the boundaries of 21 villages of Addakal Mandal. The estimated water deficit and surplus information was input into the GIS database using ArcGIS software for generating choropleth maps[3] of drought vulnerability. The maps generated show the different levels of water deficit. The red colour indicates high water deficit whereas green indicates sufficient water for meeting basic needs of the villages. The other colours such as orange and yellow indicate varying levels of water deficit between red and green.

The factor that adds value to such water budget studies and maps is the rainfall prediction. A press release issued by India Meteorological Department on 30th June 2008 stated that "the long range forecast for the 2008 South-west monsoon was that the rainfall for the country as a whole was likely to be near normal and 99% of the long period average with a model error of +5%. The long period average rainfall over the country as a whole for the period 1941-1990 is 890mm and South Peninsula is 725mm (*http://www.imdpune.gov.in/QuickLinks/pressrelease_30_jun08.pdf*)". Addakal Mandal receives a normal rainfall of 550mm and a seasonal rainfall of 440 mm. The maps were prepared for various seasonal rainfall scenarios ranging from 300-600 mm and the ones for 400-550 mm were selected for wider sharing with the communities resident in Addakal Mandal (figures 2a to 2d).

The maps were made available before the start of the cropping season along with the rainfall predictions. ICRISAT employed the videoconferencing facility to train the AMS volunteers on a map literacy module. This map literacy helped the volunteers in understanding the maps and what each colour indicates. They were then able to use the network of AMS Village Information Centres to conduct awareness sessions specifically for each village.

Validation of micro-level drought vulnerability assessment

To validate the micro-level drought vulnerability maps developed, ICRISAT has established five rain gauges in this study area at a distance of 10 km to each other. The AMS volunteers were

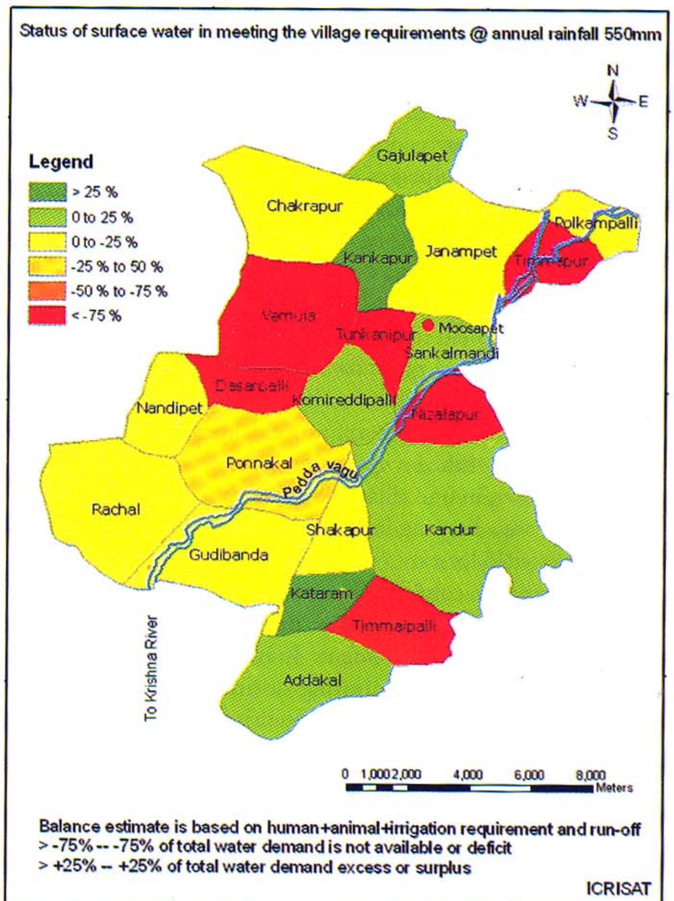
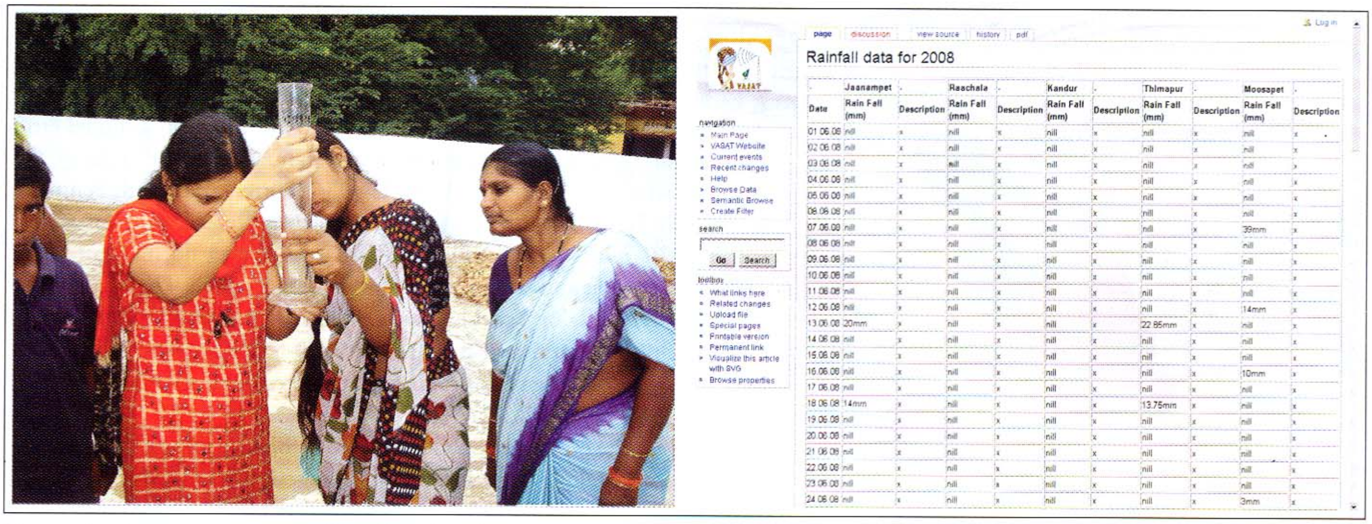


Figure2d: *Drought vulnerable villages at 550mm rainfall*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Rainfall data for 2008

-	Jaanampet	-	Raachala	-	Kandur	-	Thimapur	-	Moosapet	-
Date	Rain Fall (mm)	Description	Rain Fall (mm)	Description	Rain Fall (mm)	Description	Rain Fall (mm)	Description	Rain Fall (mm)	Description
01 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
02 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
03 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
04 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
05 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
06 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
07 06 08	nill	x	nill	x	nill	x	nill	x	39mm	x
08 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
09 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
10 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
11 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
12 06 08	nill	x	nill	x	nill	x	nill	x	14mm	x
13 06 08	20mm	x	nill	x	nill	x	22.85mm	x	nill	x
14 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
15 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
16 06 08	nill	x	nill	x	nill	x	nill	x	10mm	x
17 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
18 06 08	14mm	x	nill	x	nill	x	13.75mm	x	nill	x
19 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
20 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
21 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
22 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
23 06 08	nill	x	nill	x	nill	x	nill	x	nill	x
24 06 08	nill	x	nill	x	nill	x	nill	x	3mm	x

Figure3: *Rural women measuring rainfall and the wiki website with rainfall data (http://vasatwiki.icrisat.org/index.php/Rainfall_data_for_2008)*

trained in maintaining the rain gauges, measuring techniques and uploading data onto the website. The rainfall data measured is uploaded onto the Wiki-based website (*http://vasatwiki.icrisat.org/index.php/Rainfall_data_for_2008*) everyday (Figure 3).

Initial results and observations

From the pilot experiment in 2007 that covered 12 villages, we observed that the maps were indeed found useful for the rural families in drought-related decision making (Dileep Kumar, 2007). In the pilot study, the outcome mapping method was used to assess the usefulness or otherwise of this information support.

In 2008, the study covered all the 21 villages of Addakal Mandal. A field survey conducted in September-October 2008 for evaluating the usefulness of the maps. Our assessment was that 18 out of 21 villages faced vulnerability in terms of significant surface water shortages. As of November 2008, it emerged that all the 18 villages did indeed face serious scarcity of water for agricultural production and livestock requirement. In villages marked red, crop yield losses to an extent of 60% was reported while the depletion of groundwater forced most pumps there to go dry. Specific advisories to shift to cultivation of dryland crops such as castor or pigeonpea or chickpea were not heeded generally because of the low prices such crops would fetch in the market. However, in one village, farmers cultivated only 60% of the cropping area, keeping in view the advisory and were able to avoid serious yield losses.

It is clear that in combination with a rural learning program, simple techniques can be useful in improving community-level drought vulnerability assessment. It is important to give the community a stake in monitoring critical data such as daily rainfall and their ability to manage this process greatly adds to value of the overall project for vulnerability assessment and preparedness. There is also a strong need to foster capacity of local agencies and institutions to convert such vulnerability predictions into production and marketing-related advisory. The village information centres organised in a hub-and-spokes pattern do make a contribution to improving micro-level drought preparedness. ■

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Footnotes:

1 *Mandal is an administrative division in some countries of South Asia.*

2 *Cadastral map is a comprehensive register of the metes-and-bounds real property of a country. A cadastre commonly includes details of the ownership, the tenure, the precise location (some include GPS coordinates), the dimensions (and area), the cultivations if rural and the value of individual parcels of land.*

3 *A Choropleth map is a thematic map in which areas are shaded or patterned in proportion to the measurement of the statistical variable being displayed on the map, such as population density or per-capita income. It provides an easy way to visualize how a measurement varies across a geographic area or it shows the level of variable within a region.*