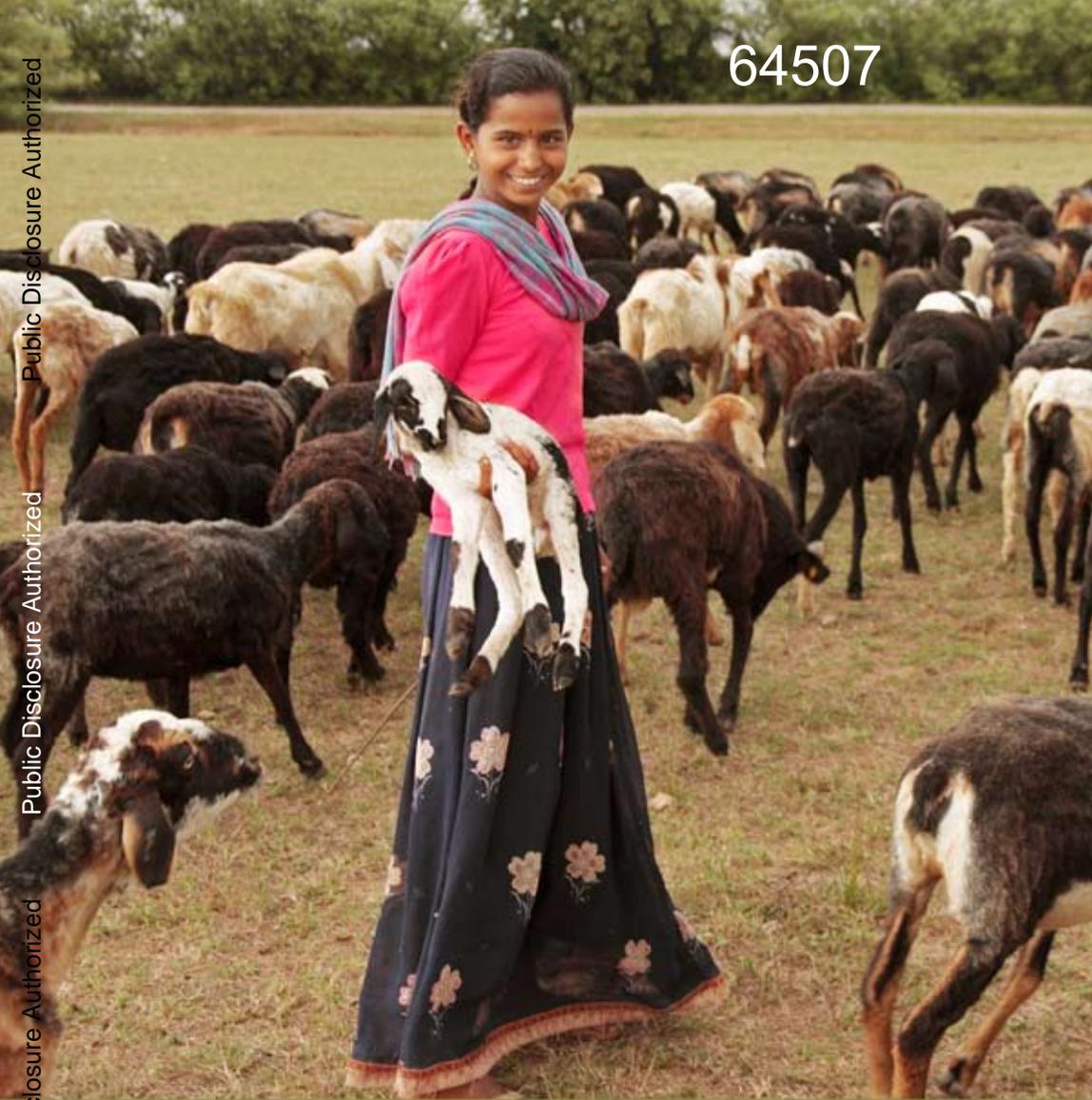


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India: Andhra Pradesh Drought Adaptation Initiative

Lessons from Community-based Adaptation
Approaches to Strengthen Climate Resilience



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India: Andhra Pradesh Drought Adaptation Initiative

*Lessons from Community-based Adaptation
Approaches to Strengthen Climate Resilience*

Final Report

April, 2011

South Asia Region

India Country Management Unit

Sustainable Development Department

Environment, Water Resources and Climate Change Unit



THE WORLD BANK

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Abbreviations and Acronyms

APDAI	Andhra Pradesh Drought Adaptation Initiative
APRPRP	Andhra Pradesh Rural Poverty Reduction Program
APREGS	Andhra Pradesh Rural Employment Guarantee Scheme
CCIG	Climate Change Initiative Grant
CIG	Common Interest Group
CPR	Common Property Resource
CRC	Chick Rearing Centers
CRD	Commissioner, Rural Development
CSS	Centrally Sponsored Scheme
DFS	Diversified Farming System
FFW	Food for Work
GS	Gram Saba
GVA	Gross Value Added
IKP	Indira Kranthi Patham
IWMP	Integrated Watershed Management Program
LTA	Lead Technical Agency
ME&L	Monitoring, Evaluation and Learning
MMS	Mandal Mahila Samakhya
MPs	Mandal Parishads
NABARD-RIDF	National Bank for Agriculture and Rural Development— Rural Infrastructure Development Fund
NREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
NRM	Natural Resource Management

PDS	Public Distribution System
RLDP	Rainfed Land Development Program
SAPAP	South Asia Poverty Alleviation Programme
SERP	Society for Elimination of Rural Poverty
SHGs	Self-help Groups
SRI	System of Rice Intensification
VO	Village Organization
WASSAN	Watershed Support Services and Activities Network
ZPs	Zilla Parishads

Conversions

Units of measurement	
1 lakh	100,000
1 crore (100 lakh)	10 million
1 hectare (ha)	2.47 acres or 10,000 m ²
1 km ²	0.4 sq. mile
1 cumec	1 m ³ /second
°C to °F or °F to °C	$(F-32)/9 = C/5$
Effective exchange rate (May 20, 2007)	
US\$ 1	Rs (rupees) 40.76
Re (rupee) 1	US\$ 0.0245

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Executive Summary

The government of the southern Indian state of Andhra Pradesh has for several years been seeking ways to overcome the consequences of frequent droughts in its eight drought-prone districts. In 2005, it invited the World Bank to undertake a study to address the drought problem. The study entitled *Overcoming Drought, Adaptation Strategies for Andhra Pradesh, India* recommended a strategy that focused on the local level. The recommendation was accepted by the government and resulted in the Andhra Pradesh Drought Adaptation Initiative (APDAI), a pilot launched in 2006 for a three year period. The APDAI is South Asia and India's first operational initiative on climate resilience supported by the World Bank.

The APDAI started in June 2006 and was implemented in two phases. Phase I of the pilot program (June 2006–April 2007) was financed by a World Bank-executed trust fund. The GoAP launched Phase II (May 2007–June 2009) as a two-year pilot program in collaboration with the World Bank. It was financed by the recipient-executed Japan PHRD Climate Change Initiative Grant (CCIG) of US\$961977. The activity closed in December 2009 after a six month extension requested by the Department of Economic Affairs and the GoAP.

The APDAI was set up as a stand-alone pilot initiative in the Department of Rural Development and institutionally linked to the World Bank supported Andhra Pradesh Rural Poverty Reduction Program (APRPRP). The latter was done to benefit from APRPRP's project management structure, but more significantly, from the mobilization of the rural population under the concept of self-help groups (SHGs) and their federate structures at the village and Mandal levels that

the APRPRP had developed. The Watershed Support Services and Activities Network (WASSAN), a respected non-governmental organization (NGO) was selected as the lead technical agency (LTA), to guide the work in the field.

Two of the most drought-prone districts in the state, Anantapur and Mahbubnagar, were selected for the initiative. They rank lowest among the districts in terms of per capita income, and are more dependent on the primary sector (crops, livestock and forestry) both with regard to the contribution of the agricultural sector to the gross domestic product (GDP) as well as the percentage of the workforce employed in this sector. The heavy dependence of these districts on groundwater combined with their comparatively low productivity in crops other than rice and high grazing intensity reflect that their production systems have basic dryland characteristics (high grazing intensity) but are ill adapted to dryland conditions.

It is well recognized that drought adaptation measures must include a wide array of options including creation of alternative livelihoods. The APDAI, however, has been limited to four areas of interventions in natural resource-based economic activities: (i) production systems; (ii) institutional support and capacity building; (iii) management of common natural resources; and (iv) economic instruments and marketing. A dual focus strategy, based on natural resource conservation and socio-economic improvement was developed around these areas of interventions with the aim of improving livelihoods through development of natural resource-based economic opportunities. The socio-economic focus of the strategy has motivated the APDAI to seek innovative solutions, —targeting the poor and the landless,—that would turn their natural resource base into a source of income for all. The strategy further focused on internalizing these innovations at an institutional and societal level to help make them sustainable.

The technical challenges were defined as: (i) securing access to water, in particular groundwater for all households for their livelihood needs as well as for critical irrigation of rain-fed crops; (ii) diversifying cropping and farming systems for better drought resilience; (iii) diversifying the portfolio of income opportunities, for the poor in particular, through the livestock and fisheries sectors; and (iv) creating buffers of resources, in particular of water, fodder and seeds, through localized storage facilities and quick institutional response mechanisms.

To respond to the government's initial concern of reducing the negative consequences of frequent drought, an important element of the strategy from

the APDAI's inception was to integrate innovative solutions into government departments and programs as an important condition for scaling up and sustainability.

Following a wide-ranging participatory analysis of the drought-related problem, which included village assemblies and village institutions, specific stakeholder groups in villages such as farmers, herders and landless people and representatives from government departments, an “impact and response matrix” was developed. This matrix systematically identified the expected negative and positive impacts of climate variability and change, the response strategy that would be required to manage the impact, and specific pilot initiatives that translated that strategy into actionable interventions. A total of 19 pilot initiatives were identified and subsequently tested under the project. Almost all intervention measures were related to water management as water is a limiting factor in dryland natural resource management systems. The focus was on capturing and using water more efficiently. Moreover, as the livestock sector is less sensitive to droughts and an important capital asset for many marginal farmers, it assumed an important role in the comprehensive drought adaptation strategy.

With regard to groundwater management, the focus of the APDAI has been on reinstating groundwater as a common property, making it available to all, not just to those with access to privately owned borewells. This was done by pooling a group of borewells around the fields of borewell owners and non-borewell owners alike. The attraction for borewell owners was that they could access all their fields with groundwater and that non-borewell owners would commit to not drilling any new wells within a ten year period. The result has been positive with productivity increases in the range of 20 percent.

Of the total 19 pilot initiatives, nine were included in existing or emerging structures for scaling up; six validated their relevance and ‘do-ability’ in the context of drought adaptation; the remaining four either could not be tested and fully developed or were considered not viable. With the APDAI coming to an end, it is now up to the Government of Andhra Pradesh to decide how to pursue the six validated schemes and determine the final fate for the four that still require some work. The most institutionalized approach to scaling up is through the government’s launch of the Rainfed Land Development Program (RLDP) and through the Government of India’s Mahatma Gandhi National Rural Employment Guarantee Scheme (NREGS) implemented at the state level. Three of the pilot initiatives are included under the RLDP, i.e.

Diversified Farming System (DFS), Groundwater Sharing and Seed Banks. The combination of these initiatives demonstrates that drought adaptation cannot have a silver bullet solution but requires a combination of interventions, internally supportive of each other. Other pilot initiatives that are being scaled up through government departments include some that are of particular interest to marginal farmers and the landless. These include breed improvements in sheep for better drought resistance and productivity, as well as poultry-based and tank-based fishery initiatives.

The main lessons learned from the APDAI are:

- ◆ *Strong leadership is required to change the paradigm for natural resource management towards climate resilience.* APDAI was initiated upon the request of the most senior leadership in the government of Andhra Pradesh. Previous attempts to modify government programs and departments did not result in the required change. It was clear that definite changes were needed to address the slow pace of development in the state's drylands, and overcome the drought related emergency situations in these areas that had become all too frequent. Accordingly, the state government with the Principal Secretary, Rural Development in the lead, conveyed the message to all those involved to cooperate closely with the lead technical agency that had been carefully selected to head the effort. To secure continuous involvement of the government, a dedicated APDAI Cell (Unit), which would have a key role to play in any scaling up of successful pilot initiatives, was set up in the Department of Rural Development under day-to-day supervision of the Special Commissioner, Rural Development. This gave APDAI the required visibility in the state and was an important factor in obtaining results in a relatively short period.
- ◆ *Strong civil society organizations are necessary for successful adaptation.* The crucial role that the village and Mandal level organizations played in all aspects of defining, planning, implementing and monitoring the pilot initiatives can hardly be overemphasized. It is through these organizations that financial and technical support were channeled and organized. Through the experience in building the self-help groups, they developed a capacity to represent villagers and to support their activities. It is through the village organizations that the poorest people were selected for inclusion in pilot initiatives.
- ◆ *Adaptation requires well functioning government structures, and a willingness by those running them to innovate and change.* Adaptation means change—not only must

the villagers be prepared to accept that new ways and solutions are required but so too must government departments and programs. Strong leadership within these structures is required to change routines and do things differently, or to do new things.

- ◆ *Intensive and inclusive dialogue with all stakeholders is a prerequisite for “new thinking” about adaptation to climate change.* Considerable time and effort is required to trigger a new way of thinking about droughts, climate variability and how to build climate resilience. The challenge is not in recognizing the problem but on how to respond—how to diversify incomes, how to establish resource buffers to overcome periods of stress and shortages, and how to better manage the most critical resource ‘water’ in particular ‘groundwater’ to serve these objectives. To find answers to these questions it was necessary to understand the shortcomings in the current methods of managing natural resources, i.e. what was wrong in the farming system—the crop and livestock management systems—and what could be done about the common resources, common land and groundwater.
- ◆ *A strong synergy between natural resource management and livelihood development with a focus on diversification, conservation, regeneration and creation of resource buffers is a no-regrets approach to developing climate resilience in drylands.* The APDAI has resulted in the understanding that in the long term drought adaptation innovations should enable (i) reversing a negative trend in terms of natural resource productivity, (ii) building adaptive capacity through diversifying the portfolio of income (especially for the poor), creating local buffers and improving allocation of resources, (iii) correcting maladapted practices and policies, and (iv) taking account of the new challenges, positive and negative that climate variability has created and in this way do adaptation leap-frogging (i.e. skipping a number of interim steps).
- ◆ *Technical solutions are often simple, but the challenge lies in the enabling environment.* The most striking lessons learned from the development and implementation of technical options and approaches are that, in technical terms, most of them are relatively simple. The real challenge lies instead in the institutional and administrative framework, as well as the enabling environment that must be in place to allow for technical solutions to be widely accepted and implemented.
- ◆ *For any activity to stand the test of time it must be economically viable for the individual or group of individuals who undertake the activity.* The

sustainability of all initiatives is dependent on them being economically viable for individuals whose livelihood depends on them. Reaching that stage often requires subsidies but also experimenting with the best technical and institutional approach, which in many cases, will require investments that cannot always be recuperated. The role of APDAI as a pilot project has been to bear the costs of experimentation and learning and in setting up systems that could sustain the activities beyond the closure of the pilot. The financial support for the APDAI was through revolving funds set up in cooperation with Mandal Mahila Samakhya (MMSs) and village organizations (VOs). If the activity could repay the loan, a new cycle could be initiated. In the event of total or partial loss, the cost was met by the pilot and the revolving fund replenished for a new cycle of experimentation revised on the basis of the previous experience. Several of the revolving funds were self-sustained at the closure of the initiative and several initiatives had become commercially viable as they had taken root in their respective stakeholder groups.

- ◆ *NREGS is a powerful tool to support drought adaptation.* The omnipresence of the NREGS is the government's best vehicle for supporting farmers and villagers to achieve climate resilience at scale. State governments, such as GoAP are also generously endowed with resources under the NREGS to make a scalable impact through the program. It can be a vehicle for improving the sustainability of dryland farming, going beyond its basic social security dimension by contributing to restoring the productivity in natural resource-based production systems. —it does this by supporting investments that would otherwise be non-economical for both the individual farmer or communities. Part of the reason farmers cannot afford some labor intensive investments is that the cost for farm labor has gone up considerably. Through NREGS the government can support the poor by offering better wages at the same time as it supports farmers in undertaking drought adaptation measures they cannot afford on their own.
- ◆ *Supporting drought adaptation is good government policy.* Agriculture is one of the most subsidized economic activities in many countries. However, drylands and other marginal areas have been neglected in this respect. The experience from APDAI is that if counterproductive subsidies are discontinued and well targeted ones are introduced, and combined with well-functioning institutional

support structures, these subsidies can be as justified in drylands as in high potential areas. Thus in a dryland context, discontinuing subsidies relating to price support on electricity and rice (that leads to excessive withdrawal of groundwater) and introducing price support for millet, a natural dryland crop, could prove beneficial. Scaling up climate resilience in dryland areas thus requires policy interventions that support drought adaptation measures that are ecologically sustainable and as cost efficient as possible, i.e. support interventions and behaviors that contribute to drought adaptation.

**1**

Introduction

This report presents the impact and lessons learned from the Andhra Pradesh Drought Adaptation Initiative (APDAI). The APDAI was implemented as a package of pilot activities in two dryland districts in Andhra Pradesh (Anantapur and Mahbubnagar) with the aim of developing and testing approaches for natural resource-based economic activities to better respond to current climate variability and long-term consequences of climate change (also see Box 1.1). The report discusses how innovations are being scaled up through integration into regular government programs for greater outreach.

1.1 Droughts in Semi-arid India, Prevalence and Impact

A ‘prolonged period of abnormally low rainfall’ and the consequent ‘shortage of water’ is termed a drought.¹ Drought is among the more serious problems faced by rain-fed areas in India and is intricately related to the livelihoods of

¹ The definition of drought is from www.askoxford.com. Drought is considered an imprecise term and today the term ‘conditions akin to water scarcity’ is used to denote that a failure of rain causes a scarcity of water for drinking and other domestic uses as well as for irrigation.

the people.² If monsoon rains ‘fail to appear’ when expected, are scanty, delayed or are interspersed by unusually long dry spells, rain-dependent farming suffers severe setbacks and surface water bodies and groundwater aquifers are not replenished in the normal manner. Hence, failure of monsoons not only affects rain-fed agriculture in the monsoon (*kbharif*) season, but also reduces food, fodder and fuel wood production in the dry (*rabi*) season. Droughts can lead to famines, which is ‘extreme scarcity of food’ (ibid.).

The impacts of drought vary significantly even across small geographical areas due to variations in weather patterns, differences in soil types, water availability, access to markets and the way the local economy is organized. The ability to cope with drought varies across individuals and communities depending on their access to and control over resources, knowledge and support systems. The immediate impact of a drought is a reduction in agricultural production but there are also losses in livelihood in the predominantly agrarian economies of semi-arid India.

1.2 Drought and Drought Relief in Andhra Pradesh

The state of Andhra Pradesh is situated in the south-eastern part of India and has a population of 76 million of which approximately 35 million live in its eight drought-prone districts. Employment in public works has been the mainstay of drought relief provided through Food for Work (FFW) programs and, recently through the Mahatma Gandhi National Rural Employment Guarantee Scheme (NREGS). In addition to public works, relief measures include digging wells and providing protective irrigation for standing crops, paying crop insurance, transporting water through tankers and trains, setting up relief camps, providing fodder for livestock, and setting up livestock camps. Typically, several government departments are mobilized to provide a coordinated response. However, such large-scale drought relief has a high cost in terms of government resources. The cost³ of the 2009 drought to the state of Andhra Pradesh amounted to nearly half

2 This section draws on the APDAI Baseline Report and James (2009), ‘De-mystifying climate change Policy implications for agricultural and rural development for drought adaptation in semi-arid India’, Paper presented at the International Conference on Climate Change, Livelihoods and Food Security, Jaipur, India, 9–10 June 2009.

3 Cost includes damage to crops as well as the cost of drought relief.

Box 1.1: The Background for Emergence of APDAI

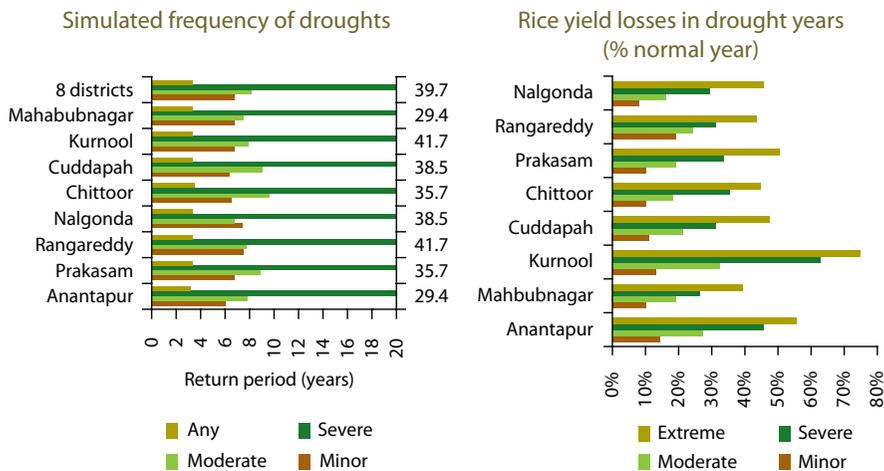
In 2005, the World Bank undertook a study entitled, *Drought in Andhra Pradesh: Long-term Impacts and Adaptation Strategies* which aimed to: (a) develop a robust analytical framework for simulating the long-term impacts of drought at the micro (drought prone areas) and macro (state) levels, (b) conduct a quantitative probabilistic risk assessment of the impacts under different scenarios; and (c) assist the Government of Andhra Pradesh in the development of a forward-looking and anticipatory strategy for adapting to frequent drought events and conditions of water deficit. The study focused on the eight drought-prone districts in Andhra Pradesh. The report reached the following major conclusions:

- ◆ A probabilistic simulation of droughts shows that the eight rainshadow districts face a 40 percent chance of droughts (once in two to three years). The long-term overall assessment for this region is “chronic water scarcity and drought conditions”.
- ◆ The impact of droughts on the state level economy is limited and an additional reduction in the share of the agricultural sector to the total economy would further reduce the impact of drought.
- ◆ In the eight rainshadow districts, a larger proportion of the workforce is dependent on the primary sector, per capita incomes are lower than the state average, the agricultural sector is more vulnerable to drought and groundwater is a more limited resource. Thus the primary sector is still important to the economy of the rainshadow districts and is more vulnerable to drought.
- ◆ The impacts of drought vary significantly at small geographic scales due to the natural variability in weather patterns, differences in soil types and water availability, access to markets and social circumstances. For instance, rice yields are projected to decrease by 29 percent in Nalgonda district and up to 62 percent in Kurnool district, as a percent of normal year production.

Responses to drought therefore require intensified efforts at the micro scale (i.e., at the level of villages or watersheds). Interventions need to be planned at this level with local, district and state governments facilitating the planning and implementation process and taking into account both short-term and long-term effects of climate change and of drought management strategies.

The conclusions of the study were widely supported at a workshop of stakeholders in Hyderabad in July 2005, and there was strong support from the Government of Andhra Pradesh for a follow-on initiative to design a framework for, and to pilot, integrated community scale plans and approaches to climate change adaptation, building on, complementing and consolidating existing activities. This materialized in the APDAI,

which is South Asia's and India's first operational initiative on climate resilience supported by the World Bank.⁴

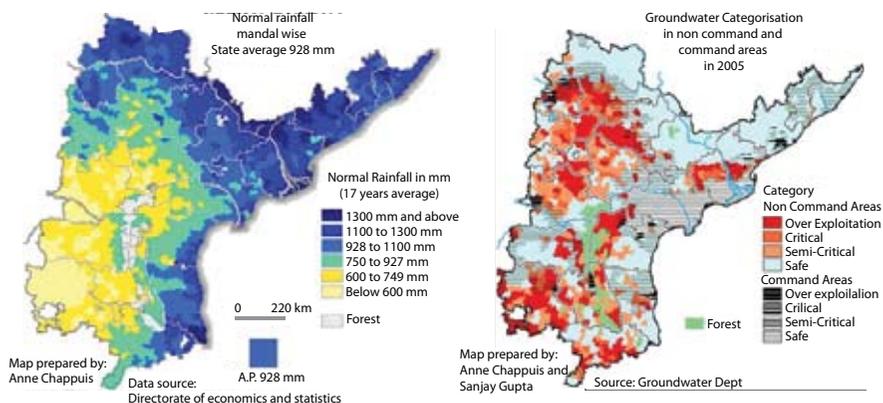


the state's expenditure on agriculture, rural development and flood control over the preceding five year plan period (2002–2007). Further, there are considerable costs to the rural community in the form of forced labor migration, losses due to distress sales of cattle and ornaments, and the social costs of indebtedness and distress.

Given the high economical costs to the government and individuals affected by drought, reducing the impacts of drought has been a cornerstone in the programs of the GoAP for several years. A large variety of centrally-sponsored and state-financed schemes target drought-affected communities. Even then, the failure of the monsoons continues to have a significant effect on the agricultural sector, and the population dependent on it. The impact is particularly felt in the eight districts of the state that have below average rainfall and no access to large-scale surface irrigation (Figure 1.1). The same districts score lower on socio-economic indicators than the state average. The climate change and enhanced climate variability that would come with it could aggravate the situation further.

4 It is also worthwhile to note here that as AP DAI was emerging another 2007 study, Climate Change Impacts in Droughts and Flood Affected Areas: Case Studies in India, estimated that arid regions in Andhra Pradesh will have substantially higher temperatures (2.3°C–3.4°C) and a modest increase in rainfall generating deteriorating agro-climatic conditions with declining yields for all major crops (rice, jowar and groundnut).

Figure 1.1: Rainfall and groundwater levels and most drought prone districts in AP⁵



The historical rainfall pattern for the dryland region of Andhra Pradesh is shown in Figure 1.2a. The monsoon season (the *khariif* season) is clearly marked to occur during the months of June to September (starting in May and finishing off in October). An analysis of future trends up to 2050, as shown in Figure 1.2b⁶, is based on an ensemble of available global circulation models and shows that the total yearly precipitation may not decrease but instead remain unchanged or even increase somewhat during the *khariif* season (estimated change of about 30 millimeters (mm)). Future projections also suggest an increased variability and higher uncertainty of precipitation in the months leading up to the monsoon period, November to May, i.e. the *rabi* and summer seasons (some models project an increase of around 150 mm, others project a decrease of less than 100 mm). This implies that precipitation may occur during the dry season, which is a new phenomenon. In addition, a higher variability can occur during the monsoon season itself, with more extreme precipitation and longer periods of drought in-between. These two projected changes are in line with experiences of current climate variability as presented later in this report.⁷

5 Source: I & CAD Department and Center for Good Governance, Government of Andhra Pradesh. <http://www.apwaterreforms.in>

6 Figure 1.2b shows the projections in rainfall variation from 15 different IPCC Global Circulation Models (GCMs) with around two and three degrees resolution, which translates into an estimated grid size of 100 – 300 km²).

7 Source: <http://sdwebx.worldbank.org/climateportal/>

Figure 1.2 a: Historical monthly average precipitation during 1925–2002

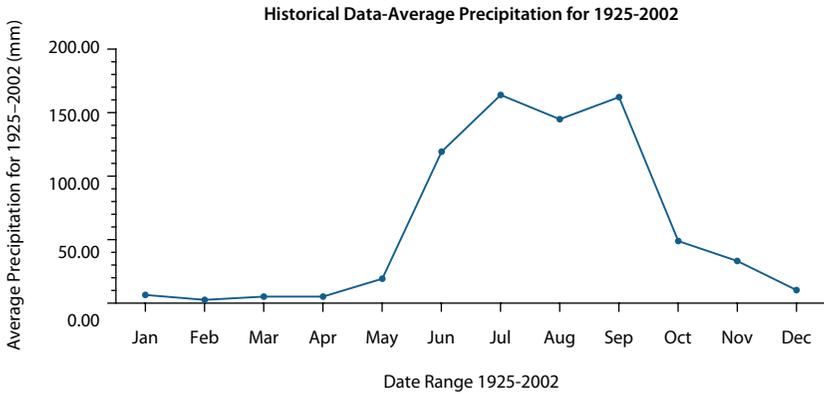
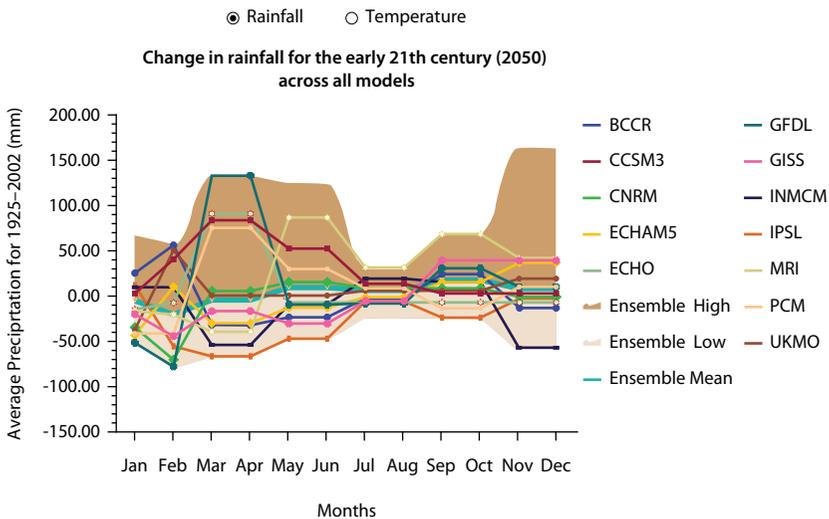


Figure 1.2 b: Change in rainfall for the early 21st century (2050) all models



1.3 Mitigation and Adaptation

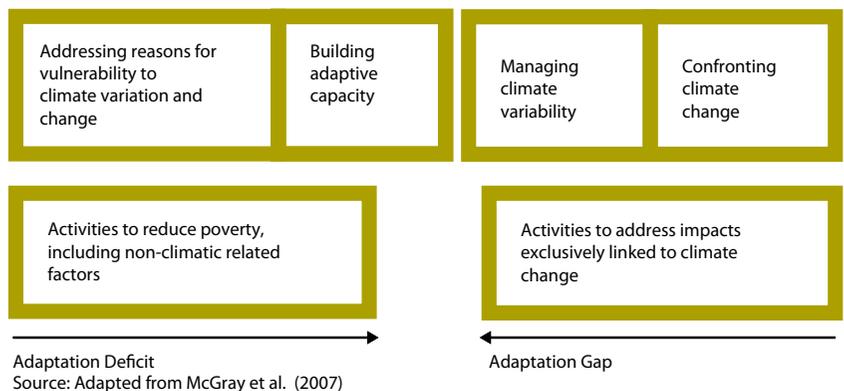
It is now recognized that an effective response to climate change must combine both mitigation and adaptation to avoid the unmanageable (mitigation) and manage the unavoidable (adaptation). Mitigation is chiefly a question of either reducing emissions of greenhouse gases into the atmosphere or absorbing

them from the atmosphere, whereas adaptation is a more multifaceted process. This is reflected in the definition of adaptation: “Adaptation is an activity that reduces the vulnerability of human or natural systems to the impact of climate change and climate-related risks (variability) by maintaining or increasing their resilience.” Adaptation is a continuum as described in Figure 1.3.

There are essentially two complementary approaches in adaptation to climate change and variability. The first relates to building up and improving the response capacity. This includes strengthening and diversifying local economies to reduce their vulnerability to climate change. These approaches reduce exposure to highly climate-dependent activities as well as poverty reduction in general. This approach aims at closing the ‘adaptation deficit’ or building adaptive capacity and is often about catching up with past neglect and underdevelopment. The other approach refers to addressing the so-called ‘adaptation gap’. It relates to special interventions required to address issues that have arisen as a consequence of climate variability and change, for example being better equipped to deal with extreme weather events, having buffers against droughts, and dealing with changes in cropping patterns resulting from temperature rise.

The two approaches are complementary. There is no implication that one effort has to precede the next. Indeed, some interventions that are undertaken to address the adaptation deficit can, if climate change impacts are taken into account, at the same time address the adaptation gap. In this way it is possible to do “adaptation leap-frogging”.

Figure 1.3: Adaptation as a continuum



1.4 Adaptation in Dryland Agriculture

Agricultural development in drylands and other marginal areas has been neglected for a long time. The need for addressing development in drylands has gained extra recognition as it has become clear that the livelihoods in these areas are lagging behind in development. Moreover, climate change is making the situation in these already underprivileged areas even worse. Serious droughts and famines in drylands with the added issue of the rural poor in developing countries often living in such areas have put the focus on the need for special efforts. However, the efforts and investments made to develop agriculture in drylands have often been based on the approach developed for higher potential areas. Such policies may be counterproductive, leading to so-called maladaptation. What is needed is a policy environment supportive of a sustainable dryland management system.

Literature on adaptation and livelihood resilience in drylands is on the increase.⁸ Further, to situate APDAI in an international context and compare the approaches that are being pursued in other countries by their governments and civil societies with regard to building resilience to drought, climate variability and change, an annex has been included (Annex 4). It presents cases from Brazil, Kenya and Yemen—three countries that have sizeable populations living in drylands and are facing many of the same challenges as those in the drylands of Andhra Pradesh.

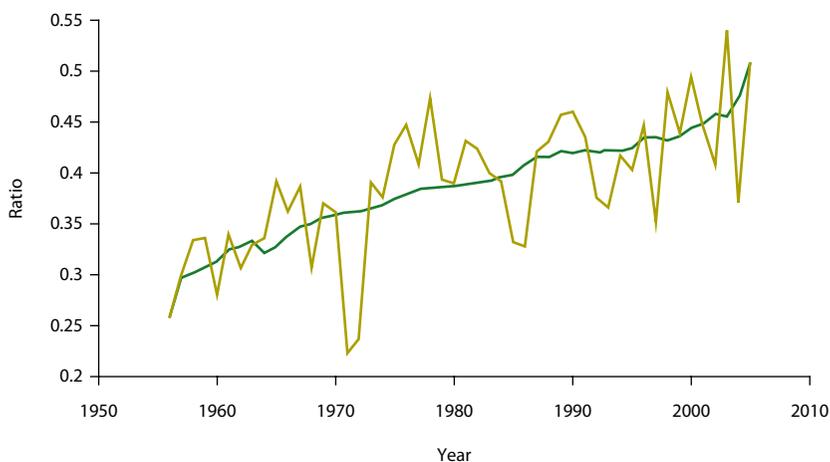
1.5 The Adaptation Context of APDAI

In the past 30 years one of the major changes in the drylands in Andhra Pradesh has been the spectacular increase in groundwater-based irrigation that has transformed dryland agriculture. Figure 1.4 shows that the proportion of rice grown in the dryland areas of Andhra Pradesh over the period 1960 to 2008 has been increasing and now accounts for about 50 percent of the total rice production in the state.

This development was driven by farmers' investments stimulated by government policies of free or subsidized electricity for irrigation pump-sets, subsidies for borewell digging and higher guaranteed prices for irrigated crops, such as rice. This

8 A reference that may interest the reader: Anderson S., Morton J., Toulmin C., *Climate Change for Agrarian Societies in Drylands: Implications and Future Pathways*, in *Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*, Mearns R. and Norton A., eds; Washington DC: The World Bank, 2010.

Figure 1.4: Proportion of state rice production in dryland areas



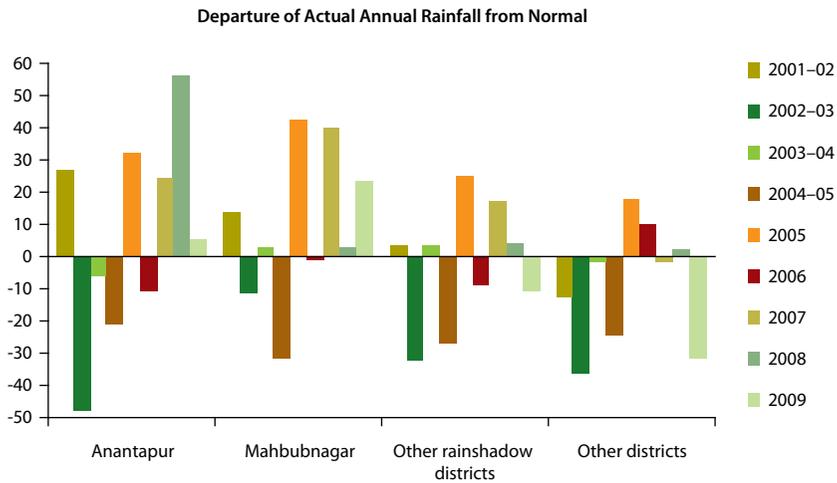
Source: University of Colombia Water Resource Study Group, 2008.

intense groundwater-based development in the dryland districts did bring welfare for those with access to groundwater. However, in many areas groundwater extraction is now outstripping replenishment, resulting in dug wells and shallow tubewells falling dry. In 2001, Anantapur and Mahabubnagar districts accounted for a quarter of the shallow tubewells that dried up in the state, and together with the other rainshadow districts accounted for a little over half of the state's dried up tubewells.

The APDAI responded to this context of maladaptation through a strategy that combined addressing the adaptation deficit and the adaptation gap. It addressed the adaptation deficit through a focus on developing farming and other natural resource based economic activities specifically based on dryland conditions. It addressed the adaptation gap through interventions that propose alternatives to the current maladaptation practices and policies.

In consultation with the Government of Andhra Pradesh, it was decided to focus APDAI on the two most drought-prone districts of Andhra Pradesh—Anantapur and Mahbubnagar. Anantapur district has an average rainfall of 544 mm per annum, which is the lowest in the state. Mahbubnagar district has the second lowest average annual rainfall in the state. However, the concern is not with the amount of rainfall alone (Figure 1.5), but that the departure of the actual annual rainfall from the normal (both excess and deficit) is the highest in these two districts compared to the other districts in the state.

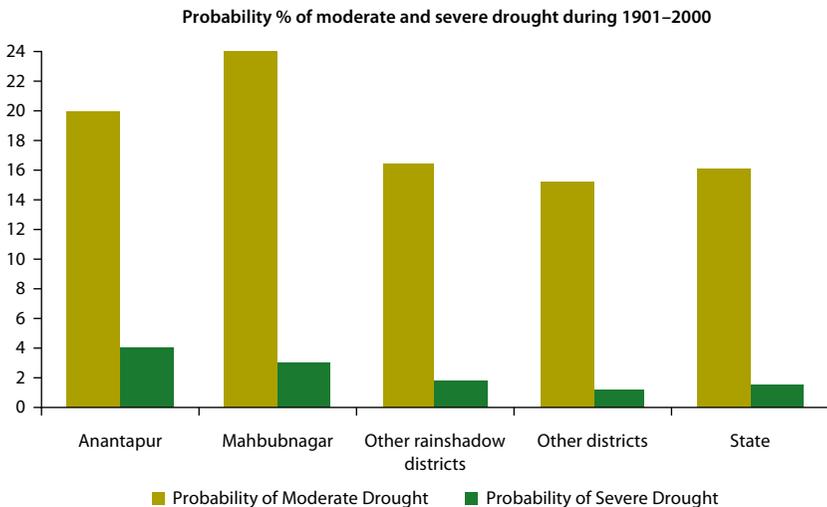
Figure 1.5: Anantapur and Mahbubnagar have a higher variation in rainfall than other districts



1.6 Selection of Pilot Area

Figure 1.6 shows that these two districts had a higher probability of both moderate and severe droughts over the last century (1901–2000) compared to the other rainshadow districts of the state.

Figure 1.6: Anantapur and Mahbubnagar have had a higher probability of drought than other districts over the past century



Over the 12-year period, 1995–96 to 2006–07, all the Mandals in Anantapur and Mahbubnagar were drought-affected in five years. Of the other Mandals in the other rainshadow districts, 90 percent were affected in four years, while in the remaining districts this happened only in one year (2002–03).

As seen in Figure 1.7, the dependence on groundwater for agriculture in the two districts is very high compared to the other districts in the state. As a result, the majority of the Mandals in these two districts are classified as having semi-critical, critical, or over-exploited status with respect to the groundwater resource (Figure 1.8).

The critical status of groundwater notwithstanding, the dependence on this resource is increasing as seen in Figures 1.9a and 1.9b. At the same time, reliance on traditional and replenishable water sources, such as tanks and open wells, is decreasing.

Figure 1.7: Anantapur and Mahbubnagar are overtaxing their groundwater resources

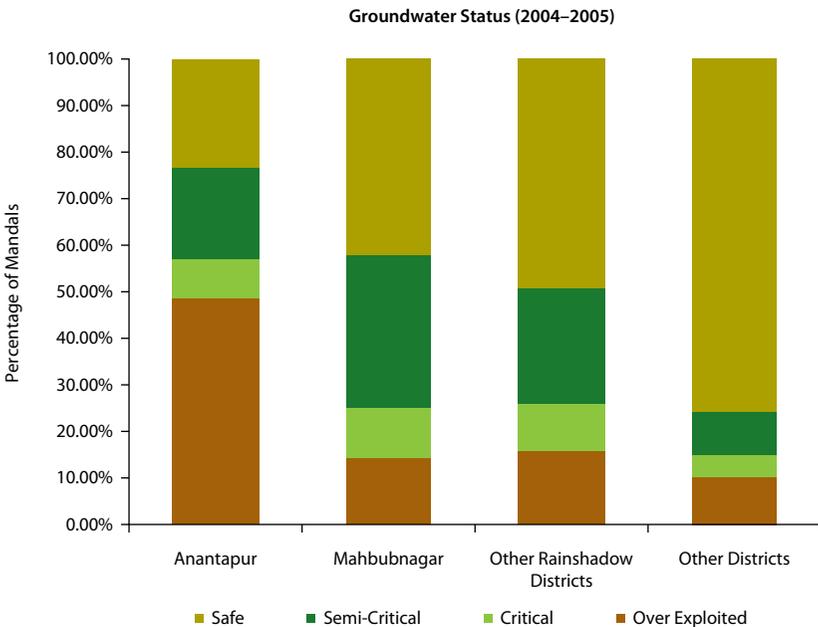
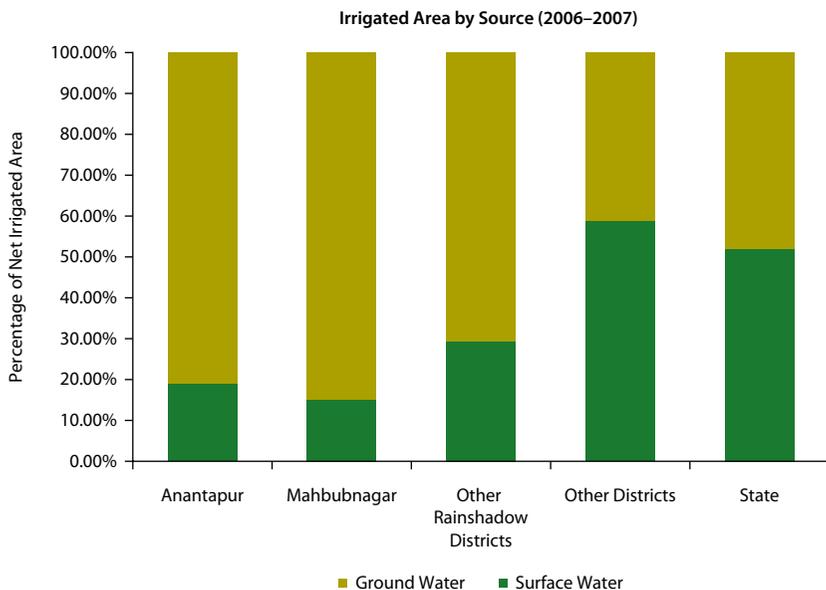
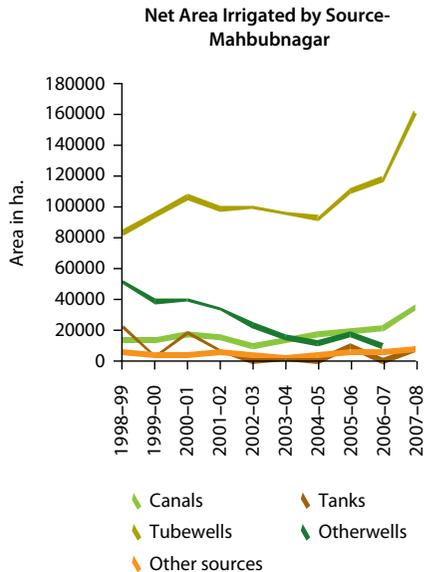
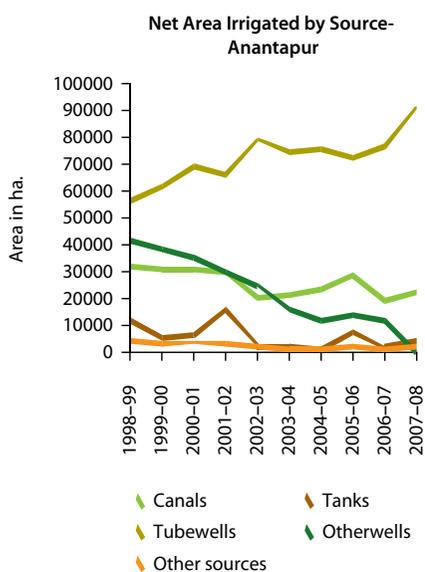


Figure 1.8: Dependence on groundwater for agriculture is higher in Anantapur and Mahbubnagar than in other districts



Figures 1.9a and 1.9b: Anantapur and Mahbubnagar are increasingly dependent on groundwater



The pressure on common resources is not limited to groundwater alone. As seen in Figure 1.10, the grazing intensity in Anantapur and Mahbubnagar is higher than it is in the other districts.

Crop productivity for several non-rice crops also remains lower in comparison to the other districts as shown in Figure 1.11.

Figure 1.10: Anantapur and Mahbubnagar have higher grazing pressures than other districts in the state

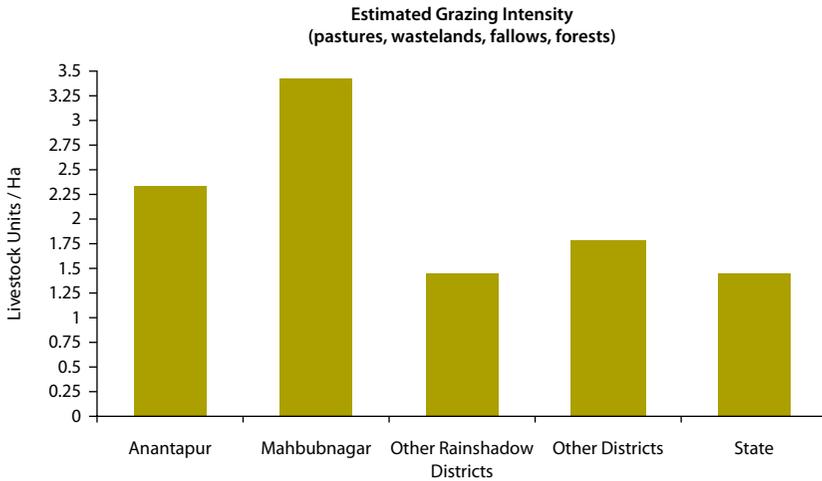


Figure 1.11: Anantapur and Mahbubnagar have lower crop productivity

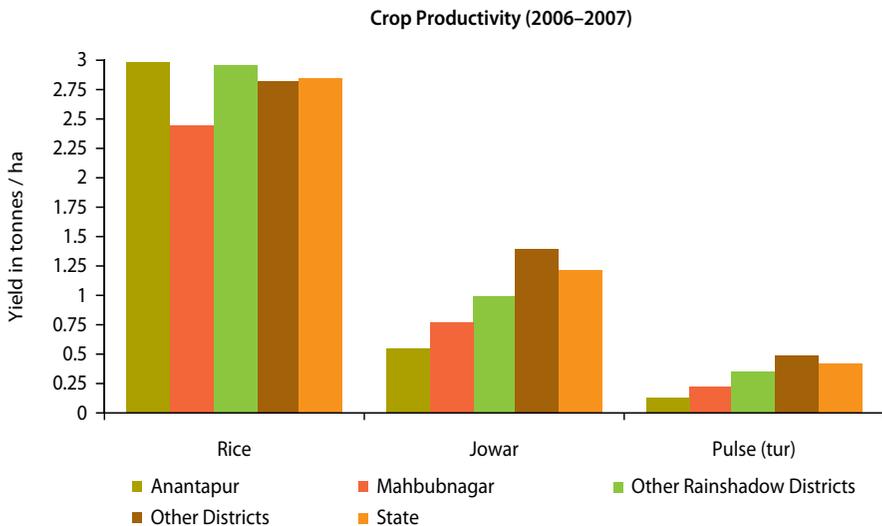


Figure 1.12, Tables 1.1 and 1.2 summarize the rationale for focusing on the two districts of Anantapur and Mahbubnagar in APDAI. The role of the primary sector, especially of agriculture in the economy, in the two pilot districts is more prominent compared to the state in totality as well as with other rainshadow districts, both in terms of the contribution of agriculture to the GDP as well as the percentage of workforce employed in this sector. In addition, the per capita income in these districts is lower than that of the other rainshadow districts of the state. The heavy dependence on groundwater over the past several years in the two districts combined with the comparatively low productivity in crops other than rice and the high grazing intensity in the districts reveal that while their production systems have basic dryland characteristics (high grazing intensity), they are ill-adapted to drylands conditions. Thus a case for a drought adaptation initiative in the districts is well founded.

Figure 1.12: Anantapur and Mahbubnagar are more dependent on the primary sector and lag behind the rest of the state in per capita income

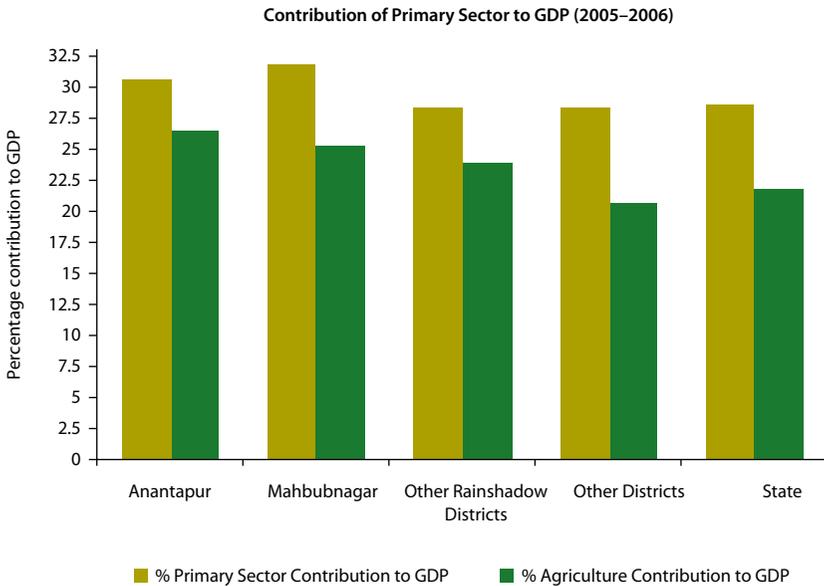


Table 1.1: Anantapur and Mahbubnagar are more dependent on the primary sector and lag behind the rest of the state in per capita income

	Anantapur	Mahbub-nagar	6 other rainshadow districts	15 non-rainshadow districts	State
Irrigated area (net irrigated area as % of total cropped area) (2006)	11%	20%	32%	40%	35%
Area irrigated by groundwater (as % of net irrigated area) (2006)	81%	82%	68%	40%	47%
Crop productivity (2006) (tonnes/ha)					
Rice	2.99	2.44	2.95	2.83	2.86
Jowar	0.54	0.78	1	1.39	1.22
Pulse (tur)	0.14	0.21	0.35	0.49	0.42
Grazing intensity (livestock units/ha ⁹) (Livestock 2003, Land Use 2006)	2.34	3.44	1.46	1.78	1.45

Table 1.2: Anantapur and Mahbubnagar are more dependent on the primary sector and lag behind the rest of the state in per capita income

	Anantapur	Mahbubnagar	6 other rainshadow districts	15 non-rainshadow districts	State
Contribution of agriculture to GDP (%)	27%	25%	24%	21%	22%
Percentage of the workforce occupied in the agriculture sector (cultivators and labor) (2001)	68%	73%	63%	61%	62%
Average per capita income as percentage of average state per capita income	80%	80%	96%	105%	100%

9 One livestock unit = one cow/steer or four sheep/goats. Available grazing land has been computed as land in forests; barren, uncultivable land; pastures, grazing land; wasteland; fallow lands.



Andhra Pradesh Drought Adaptation Initiative

2.1 Pilot Design

The APDAI started in June 2006 and was implemented in two phases¹⁰. Phase I of the pilot program (June 2006–April 2007) was financed by a World Bank-executed trust fund. The GoAP launched Phase II (May 2007–June 2009) as a two-year pilot program in collaboration with the World Bank, which was financed by the recipient-executed Japan PHRD Climate Change Initiative Grant (CCIG) of US\$ 961,977. The activity closed in December 2009 after a request for a six month extension from the Department of Economic Affairs and GoAP.

Although it is recognized that drought adaptation measures must include a wide array of options including the creation of alternative livelihoods, the APDAI

¹⁰ Phase I initiated activities in six villages in three Mandals of Mahbubnagar District, while Phase II expanded the project into an additional nine villages in Mahbubnagar and 10 new villages in the Anantapur District. In addition, it provided for the option of pursuing pilot initiatives outside of the 10 selected villages in Anantapur.

has been limited to interventions on “natural resource base” related activities as it was assumed that non-natural resource management (NRM) based income diversification would be supported by other on-going and proposed initiatives in the selected pilot sites, and in particular through the World Bank supported Andhra Pradesh Rural Poverty Reduction Project (APRPRP). The APDAI was planned and implemented as a standalone initiative but was institutionally linked to the APRPRP.

APDAI focused on four areas of interventions: (1) *production systems* emphasizing diversification and intensification in agriculture, livestock and horticulture through the application of technological innovations; (2) *institutional support and capacity building* focusing on institutional strengthening of community-based organizations at the village level, including self-help groups (SHGs), farmers’ associations, among others; (3) *management of common natural resources*, in particular groundwater and common lands; and (4) *economic instruments and marketing* with a focus on improved access to credit, insurance and markets for innovative activities specifically designed for drought adaptation.

In line with these areas of intervention, APDAI aimed specifically to: increase awareness of the consequences of climate variability and climate change in particular with regard to the drought-prone areas of Andhra Pradesh; develop and test options and approaches with regard to the natural resource base of the local economies in these areas to cope with the effects of climate variability and change; adapt on-going government programs and activities to better respond to long-term consequences of climate variability and change; and develop institutional mechanisms for delivering assistance to adapt to climate variability and change at local, district and state government levels¹¹.

2.2 Institutional Set-up

The Society for Elimination of Rural Poverty (SERP) was the implementing agency of APDAI.¹² The NGO Watershed Support Services and Activities Network (WASSAN) was engaged as the lead technical agency (LTA) to facilitate

11 Details of Outputs of the Technical Assistance Program as agreed in the Grant Agreement are included in Annex 1.

12 Society for Elimination of Rural Poverty (SERP), an independent autonomous Society registered under Public Societies Act, is implementing the APRPRP also called the Indira Kranthi Patham (IKP) in all the 22 rural districts of Andhra Pradesh.

implementation of the APDAI¹³. The pilot was implemented under supervision of the Principal Secretary, Rural Development. Within the Department of Rural Development, an APDAI Cell was set up in the office of the Commissioner, Rural Development (CRD) for day-to-day interaction with the LTA and SERP and for overseeing the implementation process. The CRD also has the responsibility for coordinating the scaling up of successful initiatives emerging from APDAI, throughout the state.

Andhra Pradesh has been actively involved in building SHGs of rural women since 1993¹⁴. Women are organized into SHGs (each consisting of 10–15 women) to make them partners in the development process, with a focus on saving and lending activities. SHGs are now operating in every village of the state and are federated at the village and Mandal levels. Thus, representatives from all SHGs in a village form a Village Organization (VO), while representatives from all VOs in a Mandal constitute a Mandal Mahila Samakhya (MMS), and representatives from all MMSs in a district comprise the Zilla Mahila Samakya. This SHG institutional structure operates alongside the formal local government structure of Zilla Parishads (ZPs), Mandal Parishads (MPs) and Gram Panchayats (GPs), supported by a Gram Sabha¹⁵. At present there are 10,660,968 members in 933,585 SHGs and 36,391 VOs, 1099 MMSs and 22 Zilla Mahila Samakhya¹⁶. SHGs have built up considerable human, social and financial capital, and currently MMSs operate a number of government programs. The total savings of SHG members are Rs. 2660.96 crores (US\$ 651.93 million) and Rs. 4508.92 crores (US\$ 1104.69 million) respectively¹⁷. Considering the strength of the existing SHG institutional structure (outreach, inclusiveness, sustainability), the APDAI pilot utilized the same institutions (VOs and MMSs) for implementation. However, as APDAI focused on specific production systems (such as agriculture, livestock), it was felt necessary that a new entity—the Common Interest Group (CIG)—also be

13 WASSAN was selected on the basis of being an NGO with longstanding experience of working at village level with rural development and natural resource based economic activities.

14 Viewed on 31 March 2010.

15 The Gram Sabha approves the village development plan, Gram Panchayat budgets and audit reports, the list of beneficiaries selected for various development programs and reviews the progress of all schemes.

16 Source: http://www.rd.ap.gov.in/IKP/IKP_Progress_Feb_2010.pdf viewed on 31 March 2010.

17 Source: http://www.rd.ap.gov.in/IKP/IKP_Progress_Feb_2010.pdf viewed on 31 March 2010.

created where required. The CIGs are groups of men or women organized on the basis of a common livelihood activity.

The SHGs and CIGs thus became the vehicles for implementation of all the pilot initiatives. The members of these groups took part in the final design of the initiatives and had to agree to pursue them in practice as they provided the labor and in several cases also part of the capital through loans.

While APDAI capitalized on the institutional strength of the SHG structure, it also created additional capacity to enable these community institutions to anchor the pilot. Each MMS was provided with a support team consisting of a Mandal coordinator, a technical assistant, a village assistant and a Mandal resource person for pilot project implementation. The pilot implementation was carried out with the involvement of line departments, such as the departments of Agriculture, Forestry, Animal Husbandry and Fisheries, and with the cooperation of the District Collector at the district level. To interact with SHGs, CIGs, line departments and their para-workers,¹⁸ a team including a project manager, subject matter-specific anchor persons and resource persons was established. The institutional linkages of the pilot are shown in Table 2.1.

2.3 Pilot Area

To obtain results from a pilot project with very limited time at its disposal, the criteria for selection of Mandals and villages focused on two aspects:

- i. The capacity of community institutions, in particular the VOs and MMSs, to handle new initiatives; and
- ii. the physical circumstances in the Mandals and villages and the technical challenges these would present.

The social capital represented by the SHGs and their federations was recognized as important for the success of the pilot interventions (and has proven to be so, during implementation). With regard to technical challenges, a number of criteria were established for selecting the Mandals and then, the villages within these. The selection of villages was made with the involvement of the MMSs. The two boxes (2.1 and 2.2) below list the criteria applied at the Mandal and village levels respectively.

¹⁸ Para-workers are local youth who are selected and provided some basic training by Line Departments (LDs) to provide community-level support to departmental activities. They are not LD staff and are not paid by the LDs, but are allowed to collect charges for village-level livestock services such as vaccination and artificial insemination.

Table 2.1: Stakeholder groups and institutional linkages at different levels

Stakeholder Group Level	Political Structure	Administrative Structure	SHG Structure (Civil Society Organization)	APDAI Structure
State	Legislative Assembly	Secretary (Rural Development)		Society for Elimination of Rural Poverty (SERP)
		Commissioner (Rural Development)		Lead Technical Agency (WASSAN)
District	Zilla Parishad (ZP)	District Collector Line Departments and District-level agencies (e.g., DWMA, DRDA)	Zilla Mahila Samakhya	APDAI Advisory and Lesson Learning Committee
Mandal (Sub-district)	Mandal Parishad (MP)	Mandal Development Officer (MDO)	Mandal Mahila Samakhya (MMS)	WASSAN Support Team
Village	Gram Panchayat (GP) (Local Government at village level)	Departmental village-level workers	Village Organization (VO)	Village Assistant (VA)
	Gram Sabha (GS) (Village Assembly)		Self Help Groups (SHGs) Common Interest Groups (CIGs)	

Box 2.1: Criteria for Selection of Mandals

- ◆ Maturity of the MMS.
- ◆ Experience of the MMS in Natural Resource Management (NRM) programs.
- ◆ Willingness or level of motivation of the MMS to work on drought adaptation related aspects.
- ◆ High drought-proneness and adverse impacts as indicated by severe distress factors like migration.
- ◆ Low potential for irrigation development.

Box 2.2: Criteria for Selection of Villages

- ◆ Availability of active and well organized community institutions, such as SHGs and farmers' associations.
- ◆ Presence of relevant on-going development programs such as APRLP.
- ◆ Intensity of groundwater use.
- ◆ Variation in farming systems.
- ◆ Diversity of soil types.
- ◆ Dependence on common property resources.

While these criteria were used to select the first nine Phase I villages in Mahbubnagar, the experience gained from this process led to extra emphasis on the maturity of village civil organizations for the selection of the subsequent set of villages for Phase II. This was a deciding factor for making progress with the implementation of the initiative. Accordingly, of the 15 villages chosen in Mahbubnagar for Phase I, two villages were subsequently dropped by the MMSs due to the unsatisfactory performance of their VOs. The final selection of Mandals and villages in the two districts is shown in Table 2.2.

Table 2.2: Distribution of pilot villages

	Pilot Villages ¹⁹	Gram Panchayats of Project Villages	Number of VOs in Pilot Villages	Number of SHGs in Pilot Villages
Anantapur				
1. Nallacheruvu Mandal	9	4	4	64
2. Gandlapenta Mandal	20	7	5	88
Total Anantapur	29	11	9	152
Mahbubnagar				
1. Kosigi Mandal	5	5	5	43
2. Doultabad Mandal	4	4	4	156
3. Bommaraspet Mandal	4	4	4	104
Total Mahbubnagar	13	13	13	303
Overall Total	42	24	22	455

19 Villages refer to hamlets. Each Gram Panchayat in Anantapur district covers more hamlet villages than have been selected for the APDAI pilots and the 29 hamlet villages covered by APDAI fall under 11 Gram Panchayats.

The focus of APDAI was thus on arriving at recommendations with regard to drought adaptation. A larger project with more time and resources at its disposal could have included villages with less social capital at its disposal (like the ones in Mahbubnagar that were dropped) at the start of the process; and this would have provided good insights on how to deal with the situation (the counterfactual). However, a statistically rigorous monitoring and evaluation exercise was not intended for APDAI due to limited budget and time for implementation.

2.4 Characteristics of Pilot Area

A baseline assessment²⁰ of the conditions in the pilot villages underscored their vulnerability to drought both in terms of the natural resource base status and socio-economic conditions:

- ◆ A large proportion of the local population is socially disadvantaged: 80 percent of the population consists of small and marginal farmers (only three percent are large farmers), while women head 13 percent of the households.
- ◆ Groundwater resources are over-exploited and yet irrigation pump-sets represent a large proportion of the agricultural infrastructure (see Chapter 1).
- ◆ There is a shift from the traditional, locally-adapted and less water-intensive crops to more remunerative but water-intensive crops.
- ◆ There is a general decline in land and water resources (see Table 2.3).
- ◆ Most villages are not near towns and access to government programs is generally low with the exception of the NREGS. Most programs do not reach more than 20 percent of the population. NGOs, although operating in the area, have limited outreach.

Figure 2.1 below shows the stress (manifested in the form of scarcity, shortage or distress) faced by different livelihood groups in the two pilot districts.

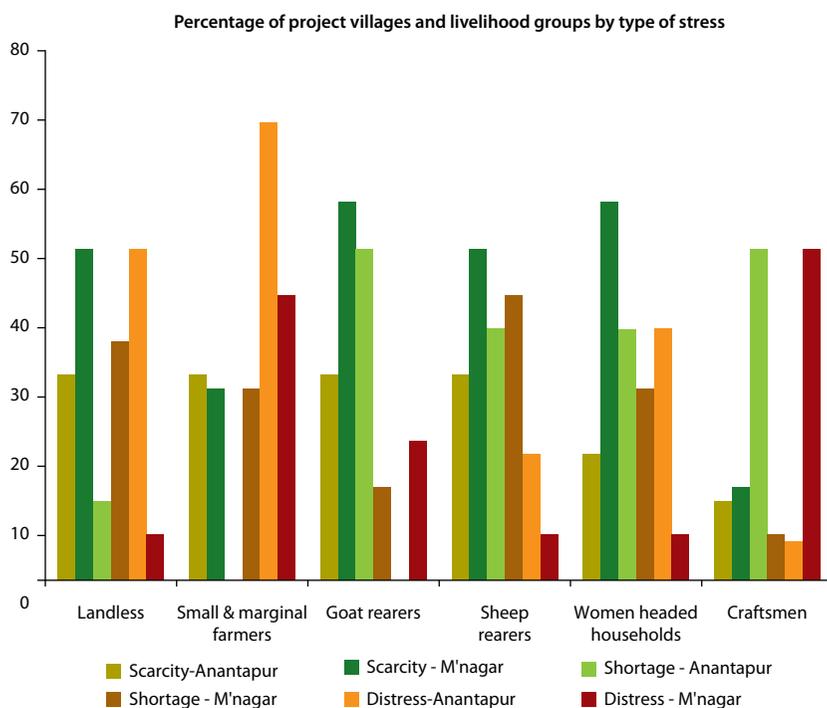
Different livelihood groups adopt a variety of coping strategies to help overcome distress, including migration, reduced consumption and borrowing (Table 2.4).

20 Poverty Learning Foundation, 2008, APDAI Baseline Report: Mahbubnagar and Anantapur Districts, 2008.

Table 2.3: Trends in resource use in pilot villages

Resource	Trend ²¹
Land cultivated by large farmers	-- for Mahbubnagar ++ for Anantapur
Land cultivated by small and marginal farmers	+
Forest land	-
Waste land	--
Open wells	--
Community tanks	-
Borewells	+++
Ground water level	----

Figure 2.1: Stress faced by different livelihood groups



Note: Figures are percentages.

21 The trend denotes change from 20 years ago and 10 years ago to the current level. This table presents an aggregated picture for the study area including Mahbubnagar and Anantapur districts. Marks of (+) or (-) in 'Trend' column in the Table indicate the intensity of change, negative (-) or positive (+). A single mark signifies low intensity, a double mark indicates moderate intensity and a triple mark indicates high intensity.

Table 2.4: Coping strategies adopted by different livelihood groups

Livelihood groups	Anantapur		Mahbubnagar	
	Past	Present	Past	Present
Landless	Reducing quantity of meals Migration Working as attached labor	NREGS Borrowing	Reducing quantity of meals Working as attached labor Borrowing Migration	NREGS Migration Borrowing
Small and marginal farmers	Borrowing Sale of assets Reducing quantity of meals	NREGS Migration Borrowing	Sale of assets Borrowing Reducing quantity of meals	Borrowing from others NREGS Sale of assets
Goat rearers	Sale of assets	Sale of assets Borrowing Migration	Sale of assets Borrowing	Sale of assets Borrowing
Shepherds	Sale of assets Migration	Migration Sale of assets	Sale of assets Migration	Migration Sale of assets Borrowing
Women in women-headed households	Reducing quantity of meals Borrowing	NREGS Borrowing Attached labor Sale of assets	Reducing quantity of meals	Borrowing NREGS Sale of assets Reduce quantity of meals
Craftsmen	Borrowing Reducing quantity of meals	Borrowing Migration	Borrowing Reducing quantity of meals Migration Sale of assets	Borrowing Migration

Note: Borrowing refers to borrowing from others; in most cases from money lenders.

These coping strategies have changed over time with distress responses, such as reduced food intake, sale of assets and migration, partly being things of the past. Guaranteed local employment through the NREGS²², the improved availability of credit through women's SHGs and rural banks are helping people cope. In a single fiscal year, state expenditures under NREGS are in the ballpark of US\$ 350 million. However, the deteriorating natural resource base, which increases vulnerability to drought, remains to be addressed.

²² Mahatma Gandhi National Rural Employment Guarantee Scheme.

2.5 Pilot Strategy and Approach

It is known that a successful drought adaptation strategy must go beyond a focus on natural resource-based economic activities and should include the creation of employment opportunities outside of the agricultural sectors to release the pressure on the natural resource base. Issues such as migration policy and remittances would be important factors in this more inclusive strategy. However, the strategy for APDAI emerged out of the recommendations of the initial 2005 study, which stressed that drought response requires intensive efforts at the micro-level and in the four areas of intervention presented in Chapter 2.

The strategy and approach evolved as a result of participatory analysis and experience sharing with the stakeholders involved. The following three considerations were instrumental in the formulation of the strategy.

- i. Natural resources are an important source of livelihood for rural communities and thus the strategy has a dual focus on natural resource management and economic opportunities. This places APDAI in a particular niche, distinguishing it from projects with a livelihood agenda and those that concentrate solely on the natural resource base. The former group includes a broader set of activities, such as pursuing alternative livelihoods and micro lending. The latter focuses on the sustainability of the resource base and its optimal use within these limits. The socio-economic focus of the strategy has motivated APDAI to seek innovative solutions—particularly targeting the landless or near landless population—that could become a source of economic growth for all through the natural resource base. The dual (natural resource conservation and socio-economic improvement) focus of the strategy must be complemented by a set of institutional and policy conditions for the innovations to take root, be scaled up and sustained. While this enabling environment was provided by the project during its implementation, it needs to be internalized into the government and other institutions. The innovations can be considered internalized into society and institutions when they function without the support of the pilot structure.
- ii. The new conditions resulting from accentuated climatic variability have guided the strategy in two important ways. One, the strategy reflects the negative as well as positive implications of the new conditions. These include unseasonal rainfall, long dry spells, more intense precipitation,

unpredictability of the monsoon and temperature variations. Two, there is an acknowledgment that the response capacity—the capacity to act quickly when risks and opportunities arise—must be tailor-made to the new conditions.

Based on these strategic considerations the challenges of the pilot strategy were defined as follows:

- ◆ Broaden access to water for all households for their livelihood needs—in particular to groundwater, to allow for critical irrigation of rain-fed crops.
- ◆ Better manage soil moisture by increasing organic matter in the soils.
- ◆ Improve irrigation agronomy, in particular by promoting SRI (System of Rice Intensification).
- ◆ Diversify cropping systems, in particular rain-fed systems, by introducing a mix of short and long duration crops, annual and perennial horticultural crops and by integrating food and fodder crops into the systems.
- ◆ Diversify the portfolio of income opportunities—for the poor in particular—especially in the livestock and fisheries sectors. This can be done by establishing a livestock health care system able to respond quickly to unseasonal outbreaks of diseases (due to unseasonal rains), increasing fodder production to support an enhanced role of livestock in farming systems, and developing new livelihood opportunities through backyard poultry, small ruminants, tank fisheries, improved management of common land, etc.
- ◆ Create buffers of resources, in particular of water, fodder and seeds, through localized storage capacities and/or through quick institutional response mechanisms.
- ◆ Introduce weather and other forms of insurance schemes to hedge against risks and losses incurred despite the implementation of successful drought adaptation measures.

The pilot strategy was not limited to field-level interventions; instead the focus was also on mainstreaming these into the policy context through: integration of the innovations into mainstream government programs; integration of new routines into government operations through changes in operational procedures and budget allocations (for example community-managed livestock vaccination

service); and the introduction of price mechanisms and subsidies in favor of drought-adapted behavior and practices (such as price support for a drought-adapted crop like millet) while at the same time engendering negative policy signals for non-drought aligned practices and behavior.

2.6 Climate Change Impact Analysis and Response Measures

The process of development of the specific pilot interventions was based on a participatory analysis (of both negative impacts and opportunities arising from a changing climate, and, identification of response measures) that was undertaken in the pilot villages. This was done through community-level meetings, orientation workshops for government officials in the district line departments and mandal/village community-based organizations, village theatres and field tours.

On the basis of the threats and opportunities identified, strategic response options were defined that were translated into specific pilot initiatives. A total of 19 pilot initiatives were developed, each defined in terms of its technical, institutional and policy requirements. The initiatives were developed over time, and in some cases one initiative led to the identification of another (Box 2.3).

Box 2.3: Example of Intervention Planning: Soil Fertility Management

To increase the availability of both fodder and biomass for composting, tree planting was promoted, particularly species suitable for fodder and green manure. To meet this need, nurseries were established providing seedlings to private farmers as well as for planting on common land. These nurseries were established on land nominally under the control of local government and but given to destitute women to manage.

The presence of the organic material was not sufficient to get the compost pits introduced. A bottleneck was the labor required to cut the biomass and put it in compost pits. This issue was addressed by including labor related to composting into the Mahatma Gandhi National Rural Employment Guarantee Scheme (NREGS). The argument was that as chemical fertilizer are subsidized, organic fertilizers with a large propensity to retain moisture should be as well.

The inclusion of compost pits in NREGS in turn required that the labor input was estimated in such a way that it could be included in the computerized system for registering laborers for their work under NREGS.

Thus, the process that was followed is best likened to filling a barrel full of holes with water. The water will only reach up to the lowest hole and gush out. It will only be possible to fully fill the barrel once all holes are plugged, starting at the bottom.

Table 2.5 summarizes the analysis. As an initiative can respond to more than one identified threat or opportunity, some of the pilots are listed more than once.

Almost all the intervention measures are related to water management as water is the critical factor in dryland farming systems and has to be captured where it falls and used efficiently and effectively for the benefit of the natural resource-based production systems. Water storage is understood in a broad sense and includes efficient infiltration into the soil, better water-holding capacity of soils (through increasing organic matter in soil) and ensuring that run-off is captured to replenish groundwater aquifers.

The livestock sector is less sensitive to drought than the agricultural sector. Livestock is also the most important capital asset for many marginal farmers and should therefore play a major role in a comprehensive drought-adaptation strategy. Adaptation measures include breed selection, management practices and year-round fodder security. Unseasonal rainfall offers opportunities and challenges

Table 2.5: Impact and response matrix

Expected Impact — Negative and Positive	Response	Pilots
Reduced or erratic rainfall will increase rain-fed production risks, while heavy unseasonal rainfall can increase the potential for top soil erosion. Also, increased temperature, reduced soil moisture or shorter growing periods could affect crop yields.	Better management of soil moisture through increase in, and conservation of organic matter. Timely supply of agricultural inputs to take advantage of available moisture and rainfall.	Development of diversified farming system
		Introduction of plough bullocks in support of small farmers
		Establishment of village level seed banks
		Establishment of tree nurseries
Increased quantities of groundwater withdrawal as reduced rainfall will reduce the availability of surface water and groundwater	More efficient use of groundwater by using it for critical irrigation and ensuring access to all by treating it as a common property	Development of system for groundwater management
		Introduction of system of rice intensification (SRI)
		Introduction of millet into the Government Public Distribution system (PDS) as incentive to encourage its production

Expected Impact — Negative and Positive	Response	Pilots
Erratic rainfall pattern could disturb employment opportunities for those dependent on seasonal agricultural labor for their livelihood, triggering out-migration	Enhanced livelihood opportunities for marginal groups through goat and sheep rearing, backyard poultry and fish farming in tanks	Development of backyard poultry
		Establishment of chick rearing centers
		Development of inland fisheries cooperatives
		Establishment of common interest groups (CIG) for goat rearers
		Establishment of goat crèche (goat kids rearing center)
		Farming on leased land
		Common property resource development
Reduced fodder production due to crop failure in rain-fed agriculture will have negative impact on the productivity of dairy cattle. Also, unseasonal rainfall might result in outbreaks of diseases normally linked to the rainy season	Integration of crops and livestock in a mixed farming system for fodder production combined with better animal health service delivery	Development of diversified farming system
		Introduction of village-level fodder banks
		Development of community-managed livestock vaccination service
		Development of livestock insurance system
		Establishment of tree nurseries
Erratic or unseasonal rainfall could have a positive impact on sheep and goat rearing as grazing becomes possible during seasons that normally would not offer this possibility. But disease outbreaks due to unseasonal rainfall could be a negative impact	Common land restoration for grazing and for rainwater infiltration, combined with better animal health service delivery	Development of system for common property resource management
		Establishment of common interest groups (CIG) for goat herders
		Establishment of Goat crèche (goat kids rearing center)
		Development of community-managed livestock vaccination service

in this regard which is reflected in the response options as are the challenges in terms of unseasonal outbreaks of diseases. With regard to common property resource, better management of tanks results in opportunities for fish farming

while improved management of common land, in the context of unseasonal rains, is important not only for grazing livestock but also for environmental services, such as reducing run-off, and for improved infiltration of rainwater into groundwater aquifers.

It was understood from the outset that a specific set of activities, or a combination of innovations, would have to be applied in tailor-made combinations to meet the specific local needs and to fill gaps or complement on-going public programs. The adaption process is very context-specific. It is a question of harmonizing the use of the natural- resource base with agricultural and livestock production systems and combining this with a set of economic and institutional instruments so that maximum and sustainable livelihood gains can be obtained from the resources used across surplus and deficit rainfall years. It also includes providing an economic and food “safety net” to sustain people even when a well-adapted production system fails in the most extreme of external conditions.

The 19 pilot initiatives are presented in more detail in Annex 2. For each pilot a number of parameters are given so as to position it in the drought adaptation context, from the technical as well as socio-economic perspective. The description of the pilots includes: (i) issues being addressed, (ii) actions required to address the identified issues, (iii) expected outcome and impact of the initiative, and (iv) relevance of the initiative to the drought adaptation agenda.

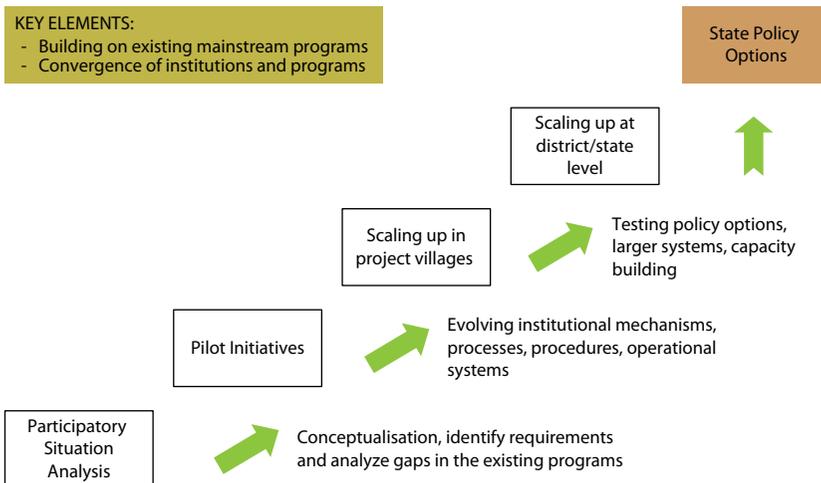


APDAI Outcomes, Results and Lessons Learned

An important objective of the APDAI was to prepare for the scaling up of successful initiatives through government institutions and programs. The strategy followed is shown in Figure 3.1 below.

Figure 3.1: Operational strategy of APDAI

Operational strategy:



At the completion of the APDAI a number of pilot initiatives were ready for scaling up. Each one of these initiatives is discussed separately, following the results achieved with the remaining pilot initiatives and their status with regard to potential for wider scaling up. The last section of this chapter discusses the lessons learned from the initiative.

3.1 APDAI Results and Outcomes

3.1.1 Results

Of the 19 pilot initiatives, 10 have been incorporated into existing or emerging structures for further scaling up and are thus considered as outcomes of APDAI. Of the remaining nine initiatives, five are considered to have validated their relevance and ‘do-ability’ in the context of drought adaptation. The remaining four initiatives could not be tested and fully developed due to lack of time, or were considered not viable in themselves.

The fact that 10 out of 19 pilot initiatives already have been included in various government programs is a testimony to the Andhra Pradesh Government’s seriousness in addressing the drought problem and the linked issue of rural poverty. Even those initiatives that have not yet been included in a particular government program have been recognized as valid components of a holistic drought adaptation strategy and thus have a good chance of being pursued under a suitable government program in due course. The plough bullock initiative is one of those recognized as being of particular interest to small and marginal farmers. In addition to the specifically designed Rainfed Land Development Program (RLDP) (see below), the Government will mainstream APDAI initiatives into all the watershed areas under its management as well as into the forthcoming Integrated Watershed Management Program (IWMP). New groundwater legislation that will recognize the rights of the community over groundwater is being proposed. And in line with this, a programmatic framework, based on the lessons learned under APDAI is under preparation for introducing the concept in all the 21 threatened groundwater basins in the state.

Further, recognizing that farming is the main source of livelihood in the drylands of Andhra Pradesh, the state government intends to pursue agricultural development based on the concept of organic agriculture in these areas. The focus will be on soil moisture conservation, with a diversified farming system

approach with low water intensive cropping patterns including the SRI technique for rice cultivation. Non-pesticide Management (NPM) developed under SERP and tree-based farming will be supported through large-scale nurseries with funding from NREGS for increased biomass production.

A Comprehensive Land Development Project (CLDP), focused on bringing degraded uncultivated land under cultivation, will be established with funding support from NREGS and NABARD-RIDF and be based on the concepts developed for RLDP. This initiative goes a long way in scaling up the Common Land pilot initiative which could have been marked as “scaling up secured”. On this basis, it would bring the number of initiatives in this category to 11.

By any standard, the above reflects a very positive outcome of the project. However, some of the pilot initiatives still need some work as described in the following paragraphs.

The insurance schemes, which were expected to become an important component of a drought adaptation strategy, proved to be more complex in reality than expected; there was not enough time to fully develop that scheme. The basic principle of an insurance product is that it should cover a risk with low likelihood of occurring; otherwise the premium would be prohibitively expensive and negate the real meaning of insurance. The scheme must also be designed so that claims can be verified for their eligibility at a minimal cost. The livestock insurance scheme introduced under the APDAI as explained below is expected to meet these criteria. Although it is not considered to have fully proven its validity for scaling up yet, negotiations are underway. A logical next step to pursuing insurance schemes would be to link such an initiative to RLDP and the crop production systems that are included under that scheme (see below).

The livestock vaccination initiative, would require sustained technical and institutional support from their respective departments and institutions (in most cases the MMS structure) to take root and become sustainable.

The inclusion of millet in the public distribution system is among the three initiatives that have not been tested yet. It is however clear that such an initiative should be included to address a serious policy failure to help move towards a drought-adapted natural resource management system.

Table 3.1 lists all the 19 initiatives under the three categories of “scaling up secured”, “viable for scaling up”, and “not yet ready for scaling up”. It should be

Table 3.1: Results of APDAI pilot initiatives — Summary table

Scaling Up secured: US		Viable for Scaling Up: V		Not yet ready for Scaling Up: NR	
Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
<i>Agricultural Production System Related Initiatives</i>					
DFS	DFS is developed by packaging three pilots (i) Crop diversification including tree crops and fodder crops, intercropping, (ii) soil improvement through application of compost, green manure, mulching, application of tank silt, (iii) application of NPM technique.	80 CIGs formed, 53 in Mahbubnagar and 20 in Anantapur for a total of about 1200 farmers.		Included under RLDP and NREGS	US
Seed Banks	Each seed bank stores 10–15 varieties of seeds and serves five villages. Operational cost is RS. 100,000 per year and seed bank. Farmers repay in kind with 25 percent interest. The original stock of seed is obtained from farmers and research institutions.	Three banks set up in Mahbubnagar and two in Anantapur to serve 25 villages. An additional three banks set up by WASSAN.		Included under RLDP and NREGS	US
Nurseries	Set up to provide a wide selection of seedlings to farmers; fodder timber, fruit and biomass species. Operated by poor people selected from SHGs through VOs and paid wages through NREGS.	Eight nurseries established; four raised and sold additional plants to farmers for a profit (one sold 7000 plants at Rs. 7-10 per plant). Remaining four provided plants only to NREGS.	Benefit-Cost Ratio = 1.4	Condition for successful scaling up dependent on initiative being included under RLDP. Not yet the case.	US

Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
SRI	<p>Technique to grow paddy with 35 percent reduced water consumption and a potential of 25 percent increased yield requires precision sowing and intensive weed control undertaken with a hand operated weeder. Tank based SRI depends on all farmers sharing the tank water agreeing to apply the new technique. The NREGS provides support for channel clearing and tank de-silting. Technical support is provided by Department of Agriculture and the Agricultural Technology Management Agency.</p>	<p>Farmers in six villages had taken up SRI on the basis of irrigation from tanks on 400 acres, and 350 acres were taken up by farmers with access to bore wells in 10 villages. After APDAI closure, farmers in two villages are sustaining SRI under tank-based conditions on their own. Further, CIGs have been formed in four villages to pursue SRI on 1,000 acres in the Kharif 2010.</p>	<p><i>Non SRI (Kharif 2007):</i> Benefit-Cost Ratio = 1.4 <i>SRI (Kharif 2009):</i> Benefit-Cost Ratio = 2.4 <i>Non DFS (Kharif 2006/2007):</i> Benefit-Cost Ratio = 1.3 <i>DFS (Kharif 2009):</i> Benefit-Cost Ratio = 1.9</p>	<p>Sustained technical support and subsidies provided through NREGS are required for sustained Scaling Up.</p>	US
Plough Bullocks	<p>In order to ensure timely access for small farmers to draft power for soil preparation, pairs of plough bullocks are provided on lease basis by MMS to a select number of small farmers for them to rent out their services to "colleagues".</p>	<p>One pair of bullocks can service about 15 small farmers or about 30 acres. Concept has proven its validity as a profitable economic activity. 21 bullock pairs and 17 carts were established at the end of APDAI.</p>	<p>Benefit-Cost Ratio = 1.5</p>	<p>Currently ongoing operations likely to continue but expanding the concept depends on funds made available to MMSs/VOs to set up revolving fund for purchase of bullocks.</p>	V

Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
Leased Land Framing	CIG of the poorest people (selected from SHGs by VOs) were supported in leasing a piece of land on which to start farming. APDAI and MMSs provided loan for a ten year lease. NREGS supported compost production, earthworks and bund plantation; tanks silt application and plants from nurseries just as for other farmers.	Out of four CIGs, one was successful, two were able to repay their loans while one failed.	Benefit-Cost Ratio = 1.3 For successful group	Limited scope for scaling up as substantial funds are required as well as sustained support from MMSs.	NR
<i>Livestock Production System Related Initiatives</i>					
Goat Rearing/Goat kid Rearing	- CIGs are formed by MMSs and provided with a flock of 10 goats. After a year they return 10 animals plus two female kids. - Kid rearing centers established to secure to good conditions during young age and reduced mortality.	- CIGs have been successful in M. with 10 flocks in 2008 and 13 in 2010. - Kid rearing centers did not work due to low salary of caretakers. Discontinued as no time available to work out different model.	Benefit-Cost Ratio = 3 This id for goat rearing	Scaling up dependent on funds made available to MMSs. No such follow-up foreseen at closure of APDAI.	V/NR

Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
Breed improvement in sheep/Ram lamb rearing	<ul style="list-style-type: none"> - Replace entire stock of rams in a village with improved Deccani breed and replace stock every two years. Rams provided on 50 percent subsidy by Department of Animal Husbandry (DoAH) and APDAI through VOs to herders organized in CIGs. - CIGs formed for Ram lamb Rearing as income generating activity. Lambs reared from 3-4 months age to one year and then sold. CIG members pay 50 percent of cost up front and 50 percent through a loan from VO. 	<ul style="list-style-type: none"> - 80 CIGs formed in Mahbubnagar and Anantapur for ram replacement for breed improvement. Nine CIGs with 223 members formed in Mahbubnagar for ram lamb rearing while six individuals took up this activity in Anantapur. State Federation of Sheep and Goat Rearers (part of DoAH) plans to expand the program across the state. Regular training provided to rearers by DoAH. 	<p>Benefit-Cost Ratio = 1.8</p> <p>This is for Ram lamb rearing</p>	<p>Both initiatives have proven validity and profitability for members. Rearers' federation in the process of organizing marketing and insurance.</p> <p>Lamb rearers in process of replacing revolving fund with bank loans. DoAH and local NGO provide backstopping</p>	US
Chick Rearing Centers (CRC)/ Backyard Poultry (BYP)	<p>Two days old chicks are reared in CRCs for 4–6 weeks and sold for direct consumption or backyard egg and meat production. CRCs are operated on commercial basis. Birds for BYP subsidized by DoAH to 50 percent. DoAH supports vaccination.</p>	<p>11 CRCs set up in Mahbubnagar and four in Anantapur. four individuals set up CRCs on their own. After initial trial period CRCs are now commercially viable. 15,000 birds distributed through DoAH in Mahbubnagar in 2009.</p>	<p>Benefit-Cost Ratio = 1.3 for CRCs and 1.75 for BYP.</p> <p>In the latter case self-consumption of eggs and meat not accounted for.</p>	<p>CRCs being scaled up through DoRD and DWMA with a plan to cover 200 watersheds. DoAH, WASSAN and local NGO Continue to provide backstopping.</p>	US

Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
Fodder banks	Aims at providing fodder security through dry season for, primarily livestock that do not migrate. Fodder Bank set up on the basis of revolving fund provided through MMS/VO and repaid in kind by farmers organized in CIGs at interest rate fixed by them. DoAH provided fodder seed on subsidy.	Four fodder bank CIGs in four villages in A. While functions well. While four in M. functions less well. Livestock more important part of the economy in A. can be one explanation for this. Need for fodder bank less acute in M.		Facilitation and support still required through MMSs and VOs for CIGs to sustain the initiative.	V
Livestock Insurance	Insurance for ram lambs organized through private insurance company. Insurance paid out upon death of animal with amount dependent on age. Payment made in kind and balance in cash if applicable. Certification of legitimacy made on behalf of company by MMS for a fee.	Of the 586 animals insured, there were 57 deaths, of which 53 were deemed legitimate and compensated during the pilot period.		Sheep and Goat Herders' State Federation (linked to DoAH) is in the process of negotiating comprehensive proposal.	NR
Livestock Vaccination	Due to off season rainfall, moisture related diseases, normally linked to the monsoon period starts to appear during the dry season. This initiative aims at creating a rapid response vaccination system that includes all animals. MMSs, in cooperation with other village organizations such CIGs of goat and sheep herders	Both institutionally and financially the concept has proven its validity. Over two years the program achieved almost full coverage in the pilot villages.		Sustainability and scaling up requires continued support from MMSs and DoAH.	V

Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
	prepares for vaccination of all animals at agreed time and location and communicate this to DoAH. Vaccination undertaken by animal health workers. The cost of vaccines is subsidized through DoAH.				
Fisheries Cooperatives	Fisheries cooperatives have existed for many years but captured by the elite. With the support of department of fisheries (DoF), the National Fisheries Board (NFDB) and an agriculture extension institution of the Government (Krishi Vigyan Kendra), this pattern has been broken to re-instate valid cooperatives. NREGS is supporting their work through financing bush clearing, the strengthening of the earth works around tanks and the digging of ponds for seed rearing. Fish vendor women from villages, previously cut out by middlemen, are selling fish locally.	11 cooperatives and four CIGs are operational in 17 villages of Mahbubnagar and Anantapur. The operation covers 23 tanks. Key to success has been support by DoF, NFDB and local NGO.	Benefit-Cost Ratio = 2	DoF in cooperation with NFDB and with support through NREGS, plan to scale up in 200 villages. The Government agriculture extension institution will provide technical backstopping support.	US
<i>Common Property Related Initiatives</i>					
Groundwater Sharing	Borewells are pooled through a network of pipes to provide access to groundwater for all farmers in an area (owners and non-owners of	Three pilots operating in Mahbubnagar and two in Anantapur on a total of 460 acres.	Benefit-Cost Ratio = 1.3	Included under RLDP and NREGS. Subsidies provided by APMIP	US

Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
	<p>borewells). Water is used for critical irrigation of all fields, securing a harvest for all. Investment of approximately Rs. 10,000/acre financed through subsidies and loans to farmers.</p>		<p>Cost of pipeline, trenching, sprinklers not accounted for.</p>		
Common Land	<p>Common land is often heavily overgrazed and degraded. To restore its functionality a CIG was formed of a group of women from the poorest segment of the community selected from SHGs by the VO. Interventions included tree planting with seedlings provided by nurseries, spreading of seeds provided by research organizations to restore grazing, earthworks to control erosion and facilitate water infiltration, the digging of farm ponds and feeder channels to create a source of water for animals, fire lines were created as well as cattle proof trenches around the areas to prevent unauthorized entry. CIGs of goat and sheep herders were included in a common land protection committee to control grazing.</p>	<p>Following an initial failure in M., eight new initiatives were initiated in Anantapur on a total of 40 acres and an investment of Rs. 650,000. These are operating well with backstopping from three local NGOs. The key to success in Anantapur as compared to Mahbubnagar are due to better preparations and backstopping, the inclusion of the goat and sheep herders' CIGs in Anantapur and because livestock management</p>		<p>Provided continued backstopping is secured and work subsidized by NREGS, the initiative has good potential for scaling up.</p>	V

Group of Pilots	Summary Description	Status at conclusion of APDAI	Benefit Cost-Ratio	Potential for Upscaling	US V NR
		<p>plays a more important role in the economy in Anantapur. All work components are included under NREGS.</p>			
<i>Policy Related Initiative</i>					
Inclusion of Millet in Public Distribution System	Millet is a traditional dryland crop that has been replaced by rice due to the policy of subsidizing irrigation and having a guarantee price on rice. As a policy incentive to encourage the re-introduction of millet in the cropping system, the same guarantee offered to rice was introduced for millet.	On an experimental basis millet has been introduced into five shops of the Public Distribution System in A. This will reach 2,500 households.		Scaling up will depend on government policy decision to offer subsidies for millet similar to those now provided for rice. No such decision is yet taken.	NR

noted that many of the initiatives marked as viable for scaling up, would require very limited support to move forward. The plough-bullocks initiative for example, is economically viable and would be sustainable and as mentioned above is recognized by the government as an important component in a drought adaptation strategy. Scaling up would require a capital infusion to set up revolving funds with MMSs to allow for more bullock pairs to be purchased and leased to farmers on a revolving fund basis.

The cost-benefit details that are provided for some of the initiatives are based on best available numbers at the close of the initiative. They are partly drawn from the monitoring and evaluation report and from publications of the LTA. It is emphasized that these numbers should be considered as indicative only as they are based on very small samples and very short time periods. However, they are included to provide an indication of the economic feasibility of some of the initiatives. It should be noted, as explicitly pointed out in the groundwater initiative that costs are exclusive of subsidies.

3.1.2 Outcomes

Ten pilot initiatives (of the 19) have been sufficiently developed and tested as well as incorporated into existing or emerging structures for further scaling up (i.e. ‘secured’) They are considered as outcomes of APDAI as they would have an impact as predicted in the initiative’s strategy. The initiatives and the mechanisms that have been established for their scaling up are presented below.

Scaling up of Diversified Farming System, Seed Banks and Groundwater Sharing through a Rainfed Land Development Program and NREGS.

The Rainfed Land Development Program (RLDP) was specially designed to secure the consolidation and scaling up of a select number of pilot initiatives. RLDP was designed to merge the strategies of APDAI with those of the Mahatma Gandhi National Rural Employment Guarantee Scheme. The aim is for it to become an important vehicle for implementation of three of the agricultural focused pilot initiatives—DFS, seed banks and groundwater sharing. In the start-up phase, RLDP is designed as a pilot program, fully financed by the GoAP covering an area of 24,700 acres in all of the Mandals in which APDAI has been operating. As in the APDAI, the RLDP will cooperate closely with MMSs, VOs and other village organizations, and WASSAN will continue to

provide technical backstopping. The RLDP would establish a RLDP Committee in each village, and be set up as a sub-committee of the VO with representation from the Gram Panchayat, farmers, and laborers. The Committee's role would be to facilitate area-based planning, organization of farmers, training programs and coordination of work. The planning process is elaborate and includes 14 steps—from the identification of the area in the village to be included under the RLDP initiative to the preparation of annual work plans, translation into NREGS-supported bulk work orders, and their monitoring. The RLDP will be implemented as an extended pilot program of the government until the agreed upon elements are included under NREGS throughout the state. The overall objective of the RLDP, which builds on the objectives set for APDAI, is to improve the drought and climate variable adaptive capacity of farming by increasing the productivity of rain-fed farms. This can be done by facilitating better crop choice and crop diversification (link to seed bank pilot), by better management of soil nutrition and moisture content. This can be done by applying techniques and approaches developed under DFS (such as compost production, green manuring, bund plantation), and other soil quality enhancing interventions which were taken up by 1200 farmers at the conclusion of the APDAI. The specific objectives set for RLDP are completely in tune with the objectives set for the DFS pilot and are as follows:

- ◆ Improvement of soil health by arresting land degradation and increasing soil moisture-holding capacity through the use of organic matter.
- ◆ Development of biomass for soil fertility improvement and production of fodder, fuel, small timber and fruit production in farm land.
- ◆ Diversification of crop and farming systems by encouraging cultivation of fodder and green manure crops, the introduction of mixed and inter-cropping and thereby the strengthening of links between livestock and crop husbandry.
- ◆ Generation of substantial wage employment opportunities for marginal farmers and the landless.

RLDP is thus an example of applying a package approach to drought adaptation. It includes a few essential and inter-related elements that can, over time be expanded to incorporate other components. Ideally it should be initiatives that have been included under the NREGS but not yet under the RLDP. Through the efforts of APDAI, 17 different interventions (such as digging of diversion drains,

multi-purpose plantation of bunds for biomass development, raising of perennial fodder crops and compost preparation), generating a total of 84 work schedules and 41 related investments (such as supply and transport of seeds, seedlings and fertilizer), are included under the NREGS (Table 3.2).²³

Table 3.2: Additional work included in NREGS as developed by APDAI		
Examples of activities and related works	Number of labor-related specific tasks	Related material investments
Pebble bunding	1	
Diversion drain	6	
Green manuring for improvement of problem soils	6	1; Supply of seed
Application of gypsum for improvement of problem soils	4	1; Supply of gypsum
Sand application for improvement of problem soils	3	
Grass seed sowing	1	1; Supply of seed
Earthen gully plug	10	2; Cost and transport of stone
Dryland horticultural plants	11	8; Supply of seeds and seedlings, transport of plants, manure and fertilizer including micro-nutrients, brush wood fencing and other plant protection material, technical guidance by para-worker
Multi-purpose plantation of bunds for biomass development	4	5; Cost and transportation of plants, compensation for survival
Raising perennial fodder crops	18	7; Cost and transportation of farmyard manure and fertilizer

23 Table 3.2 presents the type of activities and related works that have been included under NREGS and the total number of specific labour and material components for compensation by NREGS that are related to each activity.

Examples of activities and related works	Number of labor-related specific tasks	Related material investments
Silvipasture	16	11; Cost and transportation of plants, fertilizers, brush wood fencing
Compost pit with biomass plantation	8	2; Purchase and transportation of biomass plants
Compost preparation	5	0
Green manuring (rainfed crops)	3	1; Purchasing of green manure seed
Mulching	2	0
Intercrops promotion	1	1; Purchase of intercrop seed
Trenching for pipeline	5	0

Through the RLDP, the NREGS is established as a vehicle for improving the sustainability of dryland farming, going beyond its basic social security dimension to contribute to restoring the productivity in natural resource-based production systems. These production systems, largely involving the poor, are neglected in public policy. The interventions that would be directly supported through NREGS and RLDP would also have indirect benefits. For example, they contribute to sustainability of livestock management through fodder crops that can become part of the farming system, and fodder trees that can be supplied through the nurseries. A diversification of the farming system does lower risk and in this way contributes to livelihood security, which in turn adds directly to drought adaptation and resilience.

The example in Box 3.1 demonstrates what can be achieved by pursuing a crop husbandry approach more in tune with dryland conditions; this is the DFS approach.

Inclusion of the groundwater initiative for scaling up through RLDP addresses the other fundamental issue in dryland farming in Andhra Pradesh, i.e. to secure equal and efficient use of a scarce resource for the benefit of all farmers. The groundwater pilot initiative is discussed in Box 3.2 (also see Annex 3), including progress made during the course of APDAI implementation. In short it aims

at making groundwater available to all farmers for critical irrigation, thereby securing a harvest for all rather than restricting groundwater use to borewell owners only. To achieve this objective, cropping patterns have been changed to reduce paddy production and replaced it with less water-demanding crops. As shown in Box 3.2, encouraging results have been obtained with reduced water consumption combined with a 20 percent increase in productivity.

Box 3.1: Results Obtained by a Farmer Applying the DFS Approach

Hanumaiah, a marginal farmer in Mahbubnagar district has two patches of land — 1.75 acres and 1.25 acres. He shifted to mono-cropping of redgram (tuar dhal) about 10 years ago in both fields and took up soil conservation works in both of his fields. With the support of the APDAI, he diversified his cropping system and undertook further soil fertility improvement measures in the 1.25 acre patch while he continued with mono-cropping in the 1.75 acre patch. A comparison between the two patches showed that the additional 0.8 tons per acre of compost added to the soil, combined with the cultivation of eight crops rather than one, resulted in a net revenue increase per acre of 342 percent.

It is against this background—and the possibility of achieving these types of results—that the mobilization of NREGS as an important financing mechanism for the implementation of RLDP was carried out. The additional investment for compost production and spreading has been included under NREGS. The seed banks from which Hanumaiah obtained his seeds is included under RLDP. The inclusion of the expenses with regard to nurseries from where he obtained his tree seedlings is still being debated.

Box 3.2: Experiences with Community-Based Groundwater Management in APDAI

APDAI has addressed the problem of groundwater management from a different perspective. Instead of regulating consumption among those already having access to groundwater, the approach has focused on re-instating groundwater as a common property thereby rendering this resource available to all under agreed-access rules. This was achieved by connecting all boreholes through a common pipeline to which sprinklers were then connected. Convincing evidence was required to prove to borewell owners that there were advantages to sharing “their” water with non-borewell farmers. Two factors at the core of the approach were crucial in this discussion. Non-borewell farmers had to commit to not open up any new wells for at least a 10-year period. They also had to make it possible, through the installation of pipelines and sprinklers, for borewell-owning farmers to irrigate a larger share of their farmland, as farmers’ fields are rarely contiguous but spread over a number of different locations. This approach allowed a number of non-contiguous fields to be irrigated.

This socio-technical solution was combined with a shift from dry *rabi* season full-irrigation to complementary irrigation during the rainy *kharif* season. This move helped to compensate for delayed rains or lack of rain during critical crop stages. This whole approach was designed to counteract climate change and variability as observed in the drylands in Andhra Pradesh, i.e. an unreliable monsoon.

The collectivization pilots showed the following encouraging results:

- ◆ Overall water consumption from the boreholes decreased or stabilized while productivity gains of 20 percent were observed.
- ◆ Access to groundwater became far more equitable.
- ◆ No new boreholes were dug.

The APDAI approach is challenging because it demands a lot from the borewell-owning farmers and requires time to “negotiate” a system that includes a larger area and several borewell as well as non-borewell owners. The potential benefits are however, considerable for both categories of farmers and there are strong indications that once the system has proven its benefits for a couple of seasons, it would generate interest in villages and scaling up should become easier. It must however be recognized that scaling up this initiative would require considerable resources from extension agents and supporting NGOs. This would be required not only during the initial negotiation process but also afterwards to assist farmers and communities in crop-water budgeting and to help keep the community spirit alive. Other groundwater initiatives with less ambitious targets have taken 10-15 years to mature and reach scale.

Scaling up of fisheries cooperatives through the Department of Fishery and National Fisheries Board, with the support of local NGOs.

The fisheries cooperatives have proved to be a considerable success. Fisheries cooperatives have been in existence for many years but typically have been captured by the elite and the profits have not been distributed to the members. With the support of the Department of Fisheries, the National Fisheries Board (NFDB) and the government’s agricultural knowledge centers (Krishi Vigyan Kendras) it has been possible to break this pattern and reinstate the cooperatives as true cooperatives. The NREGS is supporting their work through financing bush clearing and strengthening of the earth works around tanks and digging ponds for seed rearing. The key to success however is more due to the support provided by the DoF, NFDB and the NGO than the support of the NREGS, although it did help to set up a viable operation. Based on the experience of 15 cooperatives set up in Mahbubnagar and

Anantapur, the DoF in cooperation with NFDB and the NGO that has been provided backstopping during the start up phase, has decided to establish cooperatives in 200 more villages.

Scaling up breed improvement in sheep through the Rearers Federation, with support from DoAH and local NGOs.

Small ruminants, such as sheep and goats, are important in a diversified dryland farming system. In order to make the maximum contribution to livelihood security, the selected breeds should be able to survive prolonged drought conditions, cover long distances and sustain themselves on coarse fodder. The Deccani breed of sheep fulfills these characteristics. Based on APDAI's approach—with herders organized in CIGs, rams provided on a subsidized basis and support provided by a local NGO—the Rearers' Federation will build on the 80 CIGs formed, to expand the initiative and organize marketing and insurance for its members. Ram lamb rearing, financed on a revolving fund basis through MMSs and VOs, would be financed through bank loans adding an important income source to the poorer villagers organized into CIGs for this purpose.

Scaling up of livestock insurance through the Sheep and Goat Herders State Federation.

The insurance scheme developed by the APDAI, in cooperation with a commercial insurance company and the MMS/VO structure, has proved valuable to the herders. The insurance company has taken up the initiative as part of its obligation to provide 15 percent of its services to rural areas. Although with its present limited coverage this is not a commercially viable product for the company, increasing its coverage would eventually render it profitable or near profitable. Based on the interest of both herders and the company, the herders' federation, in cooperation with the MMS structure is negotiating a comprehensive proposal.

Scaling up chick rearing centers through DoRD and DWMA, with continued support of WASSAN and a local NGO.

Rearing chicks in the backyard is a long-established practice of the rural poor. Backyard poultry is a source of continuous income throughout the year. Incomes and assets in backyard poultry help to survive drought periods, at least for the marginal population, as this activity is relatively less susceptible to climate variation. Backyard poultry, however, suffer from a number of constraints

including irregular and unreliable availability of chicks. To overcome this obstacle VOs were engaged in identifying SHG members as entrepreneurs to operate chick rearing centers (CRCs). MMSs and VOs also provided assistance in setting up CRCs. In cooperation with the poultry service of the district, they placed bulk orders of two-day old vaccinated chicks of higher quality than traditional types. After an initial trial period, CRCs are now commercially viable with 15,000 birds distributed by 13 CRCs in 2010. In addition, four individual entrepreneurs set up their own CRCs at the conclusion of the APDAI. On the basis of this experience DoRD, in cooperation with the DWMA will set up CRCs in 200 watersheds with WASSAN and a local NGO providing technical backstopping. The birds supplied by the CRCs will be sold at subsidized prices for backyard poultry or directly on the open market. Although the same success has not been achieved with the backyard operation (which aimed at improved feeding and protection from predators), the very fact that birds will now be more readily available will help spread and improve the backyard poultry practice. Some backyard operators have been more successful than others in generating an income in addition to providing nutritious food for the family.

3.2 Conclusions and Lesson Learned

3.2.1 Drought adaptation and building climate resilience in drylands require addressing the adaption deficit, the gap and pursuing adaptation leapfrogging, at the same time

The APDAI strategy was developed to engage communities and involve technical departments in the planning, design and implementation of drought adaption measures. It was based on a good understanding of the development process and the practice of sustainable rural development. Many of the technical solutions reflect good natural resource and agricultural management in a dryland context. These two aspects of the strategy add up to “activities to reduce poverty, including non-climatic factors” and thus address the adaptation deficit (see Figure 1.3). In addition, the APDAI addressed the adaption gap as exemplified by the livestock vaccination initiative, which explicitly accounts for the occurrence of non-seasonal rains. The introduction of price support for millet, the system of rice intensification (SRI), and the groundwater initiatives are examples of adaptation leapfrogging as these are based on the recognition that current climate variability and socio-economic conditions can no longer

support the old way of doing things. Although the APDAI did not set out to address the issue of climate mitigation, some of the initiatives could clearly provide mitigation co-benefits if taken to scale. For example, all initiatives that aim at increasing the organic content in the soil sequester carbon dioxide from the atmosphere and are thus mitigation actions.

3.2.1 Strong leadership is required to change the paradigm for natural resource management towards climate resilience

The APDAI was initiated upon the request of the most senior leadership in the GoAP. As previous attempts to modify government programs and departments did not give the desired results, it became clear that definite changes were needed to address the slow pace of development in the state's drylands. These changes were essential for overcoming the emergency situations that were arising from drought all too frequently in these areas. Accordingly, the state government with the Principal Secretary, Rural Development in the lead, conveyed the message to all those involved to cooperate closely with the LTA, that had been carefully selected, to head the effort. To secure continuous involvement of the government, a dedicated APDAI Cell (Unit) was set up in the Department of Rural Development under day-to-day supervision of the Special Commissioner, Rural Development. The Cell (Unit) would have a key role to play in any scaling up of successful pilot initiatives. The district collectors (the lead government officer at the district level) in the two concerned districts were also closely involved with the development of the initiative. Due attention was paid by the concerned departments to its development and the necessary support provided. Linking APDAI organizationally to APRPRP and SERP was another way of incorporating a mechanism for efficient scaling up of results into the design of the initiative.

The strong institutional support for APDAI gained high visibility with the Principal Secretary making frequent field visits and participating in workshops with senior government staff from the state ministry, the districts and the functionaries of the Mandals.

With strong support came strong demands. The pressure on the LTA to demonstrate new ways of approaching natural resource management in drylands was considerable. The result of this two-way interaction has been that within a short period of three years 19 different initiatives were developed and tested, and many already included in an organized structure for scaling up.

3.2.2 Strong civil society organizations are necessary for successful adaptation

The most significant experience gained from the pilot is the crucial role that the village and Mandal-level organizations played in all aspects of defining, planning, implementing and monitoring the pilot initiatives. This had been envisioned in design of the pilot—setting it up under the umbrella of the APRPRP and its implementing organization SERP through which the system of SHGs were developed. SHGs are always made up exclusively of women who come together for the main purpose of saving and providing loans, but also undertake income generating activities together. This experience creates a bond and prepares them for new initiatives.

Under the APDAI, individuals were brought together in groups as CIGs for the purpose of pursuing a specific activity. They were formed by those already engaged in a given activity as for example a group of goat herders or around a new activity initiated as part of the drought adaptation agenda. Other examples of CIGs are those formed around economic opportunities such as nurseries, chick rearing centers and bullock-sharing. To respond to the objective of poverty alleviation, the latter type of CIGs were typically formed by selecting the poorest people from a number of SHGs. The discipline and the spirit of cooperation that membership in an SHG has instilled in the members of such new CIGs have proved to be an important asset in developing a new activity. CIGs formed around groups of non-SHG members typically have taken longer to mature and operate harmoniously.

At the next level, the VOs and the MMSs are the structures representing SHGs at village and Mandal levels, respectively. It is through these organizations that financial and technical support have been channeled and organized. Through their experience in building the SHGs they have developed a capacity to represent villagers and to support their activities. Some of the poorest people have been selected for inclusion in CIGs through the VOs. The SHG structure from the individual, to the village to the Mandal level, has played a major role.

3.2.3 Adaptation requires well functioning government structures, willing to innovate and change

In APDAI, departments and programs were addressed from three angles. The first approach was to leverage technical and financial support from existing programs, such as the Andhra Pradesh Micro Irrigation Program (APMIP) whose

resources were mobilized to support the groundwater initiative with investments in sprinklers. This proved to be relatively straight forward, as it did not require any adjustment in the mandate or operational routine of the program. It was simply an extension of their geographical coverage.

The second approach was to include government technical staff in providing sustained support to the new initiatives not just through their own structures but in cooperation with MMSs, VOs and CIGs that had become the villagers' vehicles for drought adaptation. While this was relatively straight forward in some cases, it was more challenging in others. The deciding factors were the extent to which the new demands on technical staff diverted them from their regular duties and how much of the work could be accomplished within their allocated budgets. Technical staff had to be prepared to modify their ways of working and think and act "outside-the-box". Drought adaptation requires a systems approach in which a number of factors must come together to yield the desired result. The best example of this was perhaps the groundwater initiative that combined technical and social solutions. To successfully carry out such an initiative, technical staff not only had to know their subject matter, they also had to be good extension agents with considerable social and interpersonal skills.

The third approach was to adjust government programs so that they better served the needs of drought adaptation. The most prominent example of this was the inclusion of new work schedules and related capital investments into the NREGS. This was the most challenging task as it was difficult to reach an agreement on including new components under the NREGS. Such a decision had to be followed through with preparation of new guidelines, staff training, and updating the NREGS's software so that the new tasks were included and could be paid for. As NREGS is a decentralized operation, it also meant that a large number of people were involved and this clearly added complexity to the process. The APDAI was successful in including a number of new work schedules, but the process of having them operating smoothly within the NREGS is still ongoing.

3.2.4 Intensive and inclusive dialogue with all stakeholders is a prerequisite for "new thinking" about adaptation to climate change

All stakeholders understood and accepted that climatic conditions were not what they used to be. Thus, there was little need to spend much time on the climate variability and change issue. The discussion became focused on what had to be

done to build more secure livelihoods from the natural resource base, how to diversify incomes, how to establish resource buffers to overcome periods of stress and shortages, and how to better manage the most critical resource ‘water’ and in particular ‘groundwater’ to serve these objectives. To find answers to these questions it was necessary to understand the shortcomings in the current way of managing natural resource, i.e. what was wrong in the farming system—crop and livestock management—and how could common resources—common land and groundwater—be better managed.

These discussions revealed the adaptation deficit and also policies that had resulted in maladaptation. Many of the practices perceived as modern and efficient actually had resulted in adverse conditions rather than in improvements. These included mono-cropping and high reliance on chemical fertilizers and pesticides resulting in poor soil conditions with a steadily decreasing organic content. This in turn has led to poor water holding capacity, a key negative factor in dryland farming. The non-inclusion of fodder in the farming system has negatively affected livestock management which is another key component in dryland farming systems. There was a growing realization that modern farming as it was practiced did not provide answers and a paradigm shift was needed in thinking of new solutions.

The discussions and analyses were held at all levels, at village level through the all inclusive village fora, with focus groups of farmers, herders, marginalized people depending on common property resources, and with functionaries of the MMSs and VOs. To reach the entire population, village theaters were organized through which messages were conveyed. This became an encouragement for all to participate in the discussions. Often, representatives of government departments participated but separate meetings were also held to discuss the implications of the findings. These discussions resulted in the creation of the “impact and response matrix” (Table 2.4). The wide variety of pilot initiatives identified in the matrix reflects the discussions with several stakeholder groups. Many of the initiatives were initially seen as old fashioned and labor intensive and not in tune with modern technology. The challenge in the end was not related to the climate change or drought adaptation issue as such, but in agreeing on the necessary interventions which were often perceived as diverging from the path of modernization. These included several newly proposed pilot initiatives that had in fact been tried earlier but had not worked. In retrospect, it was likely because these had not been seen in a broader context and not backed up with a well-designed institutional enabling environment.

3.2.5 A strong synergy between natural resource management and livelihood development with a focus on diversification, conservation, regeneration and creation of resource buffers is a no-regrets approach to developing climate resilience

The dialogue described above resulted in the understanding that adaptation innovations would have to be able to (i) reverse a negative trend in terms of natural resource productivity, (ii) build adaptive capacity through diversifying the portfolio of income (especially for the poor), create local buffers and improve allocation of resources, (iii) correct maladapted practices and policies, and (iii) take account of the new challenges, positive and negative that climate variability has created.

In the search for options and approaches it was important to take account of the socio-economic conditions in villages. Technical options and approaches had to be low cost and low risk. In addition they had to render a relatively quick return on investment as longer term investments were beyond the economic resources of most of the target group.

An analysis of the options and approaches showed that many of them focused on better water management. They aimed either at reducing water use or increasing the infiltration and retention of water in the ground. These initiatives were logically linked to agricultural production. This in turn focused on reducing risk of crop failure through diversification of annual crops, introduction of more water efficient husbandry and introduction of tree crops. The latter was in turn linked to initiatives that favor the poor as tree nurseries are managed by them, and to reforestation of common land, also an initiative that specifically targets the poor.

A second set of initiatives were livestock focused as a way to diversify incomes within production systems. Many of these were of particular interest to the poor as many of them were goat and sheep herders. The backyard poultry initiative was one of the potential income generating initiatives suitable to the landless and destitute. In these initiatives substantial efforts went into improving care, access to animal health services and fodder and generally into livestock husbandry. Community based vaccination in particular, assumed greater significance as changing disease patterns result from climate change. Part of the livestock-based initiatives had an important agricultural system function. The plough-bullock initiative aimed at securing timely ploughing of

fields belonging to non-bullock owners, allowing for timely sowing and reduced risk of crop failure. That risk has increased due to the unpredictability of the monsoon. In addition, farm manure was an important contribution to better crop husbandry.

A third set of initiatives focused on creating buffers and enhancing the response capacity in the agricultural system. Well functioning seed banks guarantee timely access to seeds as well as to seeds of crops and their varieties that are suited to local conditions. This is a service with increasing importance under current climate variability. Fodder banks are important to carry livestock over periods with limited access to grazing. This is of particular importance to non-migrating livestock like cows and bullocks.

A fourth set of initiatives focused on common property resources. Common land provides grazing for goat and sheep herders but well-managed common land, reforested with useful species can be an asset for the poor, reduces soil erosion, enhances water infiltration and replenishes the groundwater reserve. Groundwater is an important common property that has been “privatized” through the drilling of borewells. Addressing the groundwater issue was an important objective of APDAI from the outset. A fishery project, fish production in tanks, was also included in this group of pilot initiatives. This is a water dependent production system that does not consume the water; it just uses it as a medium of production.

3.2.6 Technical solutions are often simple, but the challenge lies in the enabling environment

The most striking lessons learned from the development and implementation of the technical options and approaches was that, in technical terms, most of them were relatively simple and filled in the most critical gaps. Farmers and others are familiar with composting techniques or learn them very quickly; creating a fodder bank is simple as it is basically just a stack of straw. Tree planting or running a nursery also are technical tasks that can be learned quickly. Some take more time and the learning period is longer but it is often a question of doing the job more efficiently. Examples of this would be the management of chick-rearing centers or the management of leased land, both tasks in which practice makes perfect. Some of the initiatives were technically more demanding, such as the groundwater initiative, the System of Rice Intensification and part of

the vaccination initiative that required trained personnel. All these challenges were overcome without much problem and the real challenge lay instead in the institutional and administrative framework, the enabling environment that had to be in place to allow the technical solutions to be broadly accepted and implemented. And, although the affordability of the innovations was an important criterion in defining the options, some of them turned out to be too costly for farmers to implement without some form of subsidy or support. Part of the reason for that was the introduction of NREGS which had become a competitor for labor but at the same time an important source of government support for drought adaptation.

3.2.7 For any activity to stand the test of time it must be economically viable for the individual or group of individuals who undertake the activity

The sustainability of all initiatives is dependent on them being economically viable for the individuals whose livelihood depends on them. Reaching that stage often requires subsidies and also experimenting with the best technical and institutional approach which, in many cases, will require investments that cannot always be recuperated. The role of APDAI as a pilot project had been to bear the costs of experimentation and learning and in setting up systems that could sustain the activities beyond the closure of the pilot.

The financial support for the APDAI came through revolving funds set up in cooperation with MMSs and VOs. If the activity could repay the loan, a new cycle could be initiated. In the event of total or partial loss, the cost was met by the pilot and the revolving fund replenished for a new cycle of experimentation revised on the basis of the previous experience. Several of the revolving funds were self-sustaining at the closure of the initiative and several initiatives had become commercially viable as they had taken root in their respective stakeholder groups.

There are essentially two ways of rendering an activity profitable for the individual or the group—either it can be developed into pure commercial profitability, or it can be subsidized by government to cover the costs the individual or the group cannot recover from the market. In the former approach, the commercial enterprise can be further secured by introducing an insurance that covers against losses due to extraordinary circumstances. In the latter approach there must be a social rationale for the government to provide the subsidies.

3.2.8 Policy interventions should be in support of drought adaptation measures

Where subsidies are provided, they should be in support of drought adaptation measures that are ecologically sustainable and as cost efficient as possible, i.e. support interventions and behaviors that contribute to drought adaptation. The guarantee price on rice and subsidized electricity both result in excessive use of groundwater and thus is a behavior that jeopardizes long term sustainability of the agricultural system. Introduction of millet in the same system was an effort to address this situation of maladaptation. The groundwater sharing initiative and the way it was subsidized through reduced prices on sprinkler systems, was another way of seeking to not only reduce the consumption of groundwater but also to ensure its more equitable use. The introduction of the Deccani sheep breed was a third way of re-orienting a government subsidy to be in tune with drought adaptation.

3.2.9 NREGS is a powerful tool to support drought adaption

The omnipresence of NREGS is the government's best vehicle for supporting farmers and villagers to achieve climate resilience at scale. It can be a vehicle for improving the sustainability of dryland farming, going beyond its basic social security dimension to contribute to restoring the productivity in natural resource-based production systems. This can be through supporting investments that are non-economical for the individual farmer or through common investments at the community level that are in support of drought adaptation. Part of the reason farmers cannot afford some labor intensive investments is that the cost for farm labor has gone up considerably. Through NREGS the government can support the poor by offering better wages while helping farmers to undertake drought adaptation measures they cannot afford on their own.

3.2.10 Supporting drought adaptation is good government policy

Agriculture is one of the most subsidized economic activities in many countries. However, drylands and other marginal areas have been neglected in this respect. The APDAI experience shows that if subsidies are well targeted and combined with well-functioning institutional support structures, agriculture can be as justified in drylands as in high potential areas.

Details of Outputs of the Technical Assistance Program

The details of the design and outputs of the recipient-executed technical assistance are discussed below.

Grant Objectives

The key development objective of the grant²⁴ was to facilitate the integration of adaptation strategies into rural development and poverty reduction programs. This was expected to reduce the vulnerability of the rural economy and population of Andhra Pradesh to climate variability and long-term changes.

Scope of the Grant

The scope of the grant was defined as follows:

- ◆ Raise awareness on the consequences of climate variability and climate change for the drought-prone areas of Andhra Pradesh. The long-term assessment for this area is that it will suffer from chronic water scarcity and drought conditions.
- ◆ Develop and test options and approaches to better respond to the long-term consequences of climate change through more sustainable natural resource-based activities.

24 As defined in the grant proposal.

- ◆ Adapt on-going drought-related programs and activities to better respond to the long term consequences of climate change with a focus on selected drought prone districts of AP.
- ◆ Develop institutional mechanisms for delivering assistance to cope with the effects of climate change at local, district and state government level.

Main Beneficiaries

The project sought to target village communities, often landless, small and marginal farmers with unique socio-cultural beliefs and traditions, who do not have access to opportunities for productive activities. The other indirect beneficiaries of the project included local grassroots non-governmental organizations (NGOs), community-based organizations and local government bodies through capacity building efforts; and district and state level agencies in charge of rural development through institutional strengthening.

Table: PHRD TA Grant Allocation and Expenditures in USD from 2006-2009

	Category 1 Consultants' Services Training and Operating Costs	Category 2 Goods and Works	Total
Grant Allocation	521720	440257	961977
Expenditure	432,156.98	450,070.22	
Disbursement			92%

Components of the Grant

The technical assistance grant was spread over the following three components:

Component A: Participatory Drought Adaptation Planning and Design

Summary Description

This component involved farmers and communities through activities related to:

1. Raising awareness on drought and climate risks.
2. Analyzing impacts of droughts and current adaptation measures.
3. Assessing gaps in current strategies and shortfalls in providing livelihood security.

4. Defining new options for climate change adaptation with farmers/communities and experts.
5. Preparation of packages of technical interventions, as well as innovative financial instruments for marketing and supporting adaptation via community-based insurance.

Deliverables/Outputs

1. Improved knowledge and understanding of farmers/communities of approaches on how to address climate variability and the long-term consequences of climate change.
2. Climate change and drought adaptation packages of interventions tailored to different sub-groups of a village/community to be tested in the field.

Component B: Field testing and implementation of climate change and drought adaptation packages of interventions

Summary Description

Field Testing and implementation of adaptation packages with technical backstopping of the NGO identified by GoAP and its consortium of expert organizations. Implementation was the responsibility of village organizations. District organizations would integrate climate change initiatives into regular work. Investment funds would be disbursed by SERP through village organizations as per established procedures with grants provided for innovative risk financing instruments.

Deliverables/Outputs

Field tested packages of interventions that will allow farmers/communities to cope better with prevailing conditions and prepare them for more severe drought conditions expected as a consequence of climate change.

Component C: Institutional Development, Knowledge Sharing, Monitoring and Evaluation and Program Management

Summary Description

The component supported:

1. Capacity and institution building at local, district and state level to guarantee sustainability of approach and innovations and state level scaling-up.

2. Development and delivery of an effective dissemination and knowledge sharing strategy.
3. An elaborated monitoring and evaluation system that focused on socioeconomic and bio-physical indicators in the context of climate change.
4. Auditing, financial management and procurement functions.

Deliverables/Outputs

1. A capacity building plan outlining specific interventions required and communications and other material required for its implementation through various form of media such as workshops, seminars, radio and television adapted for various target groups.
2. Drought/climate change adaptation teams established at district level and a strategy in place for the Program Convergence Secretariat for scaling up the pilot to other districts within the state.
3. A monitoring and evaluation system adapted to ensure that the project's objectives were met and that the project stayed "on course".

Assessment of Outputs and Outcomes

The component-wise achievements of outputs are as follows:

Expected Output	Actual Output
<p><i>Component A: Participatory Drought Adaptation Planning and Design</i></p> <p>Expected/Outputs</p> <ol style="list-style-type: none"> 1. Improved knowledge and understanding of farmers/communities of approaches on how to address climate variability and the long term consequences of climate change. 2. Climate change and drought adaptation packages of interventions tailored to different sub-groups of a village/community to be tested in the field. 	<ul style="list-style-type: none"> ◆ Criteria establishment and mapping analysis for pilot area villages. ◆ Participatory planning exercise in 42 villages and 24 GPs leading to an impact and response matrix that were translated into pilot initiatives. ◆ Exposure visits and field tours of community based groups. ◆ A total of 19 pilot initiatives were developed, each defined in terms of technical, institutional and policy requirements. ◆ Drought Adaptation Framework for AP DAI and list of pilots developed. ◆ Inception, midterm and final reports prepared by the lead technical agency, WASSAN.

Expected Output	Actual Output
<p><i>Component B: Field testing and implementation of climate change and drought adaptation packages of interventions</i></p> <p>Expected/Outputs</p> <p>Field tested packages of interventions that will allow farmers/communities to cope better with prevailing conditions and prepare them for more severe drought conditions expected as a consequence of climate change.</p>	<ul style="list-style-type: none"> ◆ Field testing, implementation and evaluation of 19 pilots in 42 villages (outputs of implementation are documented in the World Bank lessons learned report). ◆ Convergence mechanisms established with NREGS and line departments for scaling up of successful pilots. ◆ Scaling up Strategy of AP DAI pilots developed; RLDP guidelines with NREGS convergence prepared.
<p><i>Component C: Institutional Development, Knowledge Sharing, Monitoring and Evaluation and Program Management</i></p> <p>Expected/Outputs</p> <ol style="list-style-type: none"> 1. A capacity building plan outlining specific interventions required and communications and other material required for its implementation through various form of media such as workshops, seminars, radio and television adapted for various target groups. 2. Drought/climate change adaptation teams established at district level and a strategy in place for the Program Convergence Secretariat for scaling up the pilot to other districts within the state. 3. A monitoring and evaluation system adapted to ensure that the project's objectives are met and that the project stays "on course". 	<ul style="list-style-type: none"> ◆ Project Management Unit established in CRD/SERP and state-district-mandal-village institutional mechanism developed for AP DAI. ◆ Inception, midterm and final reports of the lead technical agency, WASSAN. ◆ Baseline, interim and final assessments by the M&E Agency, Poverty Learning Foundation. ◆ Capacity building plan and modules on Rainfed Land Development Program (RLDP) and other pilots. ◆ Proceedings of four thematic stakeholder workshops organized at state level on groundwater management, fisheries, backyard poultry and livestock. The workshops included government and civil society participation including communities. ◆ Charts and posters on RLDP; Pilot briefs as communication and awareness materials developed. ◆ Training Module and process manuals in native language Telugu on RLDP and other select pilot initiatives. ◆ Documentary film in English on AP DAI. ◆ Shot documentaries in Telugu on specific pilots. ◆ Lessons learned report by the World Bank.

Annex 2

Table A2.1: Pilot Details, Issues Addressed, Expected Outcomes and Impacts and Relevance to Drought, Climate Change and Variability

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
Diversified farming system ²⁵ ◆ Poor moisture holding capacity ◆ Nutrient loss due to slope/undulated soils ◆ Low soil fertility/productivity ◆ Limited addition of organic matter due to shortage of organic manure ◆ Excessive use of chemical fertilizers	◆ One compost pit per acre ◆ Massive afforestation on bunds with multi-purpose species ◆ Intercropping for biomass production ◆ Use of liquid manure ◆ Tank silt application ◆ Soil and moisture conservation ◆ Linkages with NREGS ²⁶	◆ Diversification of crops ◆ Increase in compost and Biomass production ◆ Improving soil fertility and moisture holding capacity ◆ Increase in crop yields	◆ Saves crops during short and long dry-spells ◆ Provides additional fodder, fuel and food ◆ Reduces the risk of total failure of the production system due to prolonged drought and continuous years of drought

²⁵ DFS is developed by packaging the three pilot initiatives on crop diversification, biomass production and soil fertility enhancement.

²⁶ The Government of India passed the National Rural Employment Guarantee Act, 2005. This Act gives legal guarantee of at least 100 days of wage employment in a financial year to a rural household, whose adult members volunteer to do unskilled and manual work. The act calls for the formulation of Rural Employment Guarantee Scheme by the State Governments keeping in view the main features of the act. Accordingly, the Government of Andhra Pradesh has formulated the Scheme called Andhra Pradesh Rural Employment Guarantee Scheme, which is implemented as a Centrally Sponsored Scheme (CSS) on cost sharing basis between the Centre and the State in the ratio of 90:10.

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
<p>System of Rice Intensification (SRI)</p> <ul style="list-style-type: none"> ◆ Farmers with water facilities in rain-fed areas always prefer rice cultivation ◆ Water is already intricate problem in rain-fed areas ◆ Scarcity of water is more common among farmers engaged in conventional water intensive (inundation) method of rice cultivation ◆ Groundwater table has been falling at alarming rate 	<ul style="list-style-type: none"> ◆ Promotion of SRI under borewell conditions and tanks ◆ Managing water resources carefully 	<ul style="list-style-type: none"> ◆ Comprehensive management of resources such as land, seed, water and nutrients ◆ Optimum use of water as compared to conventional rice cultivation ◆ Reduction in seed and other input cost ◆ Increase in net income 	<ul style="list-style-type: none"> ◆ Reduces risk of crop loss due to water scarcity and high input costs
<p>Plough Bullock</p> <ul style="list-style-type: none"> ◆ Plough bullocks is major constraint for poor farmers ◆ Timely ploughing is constraint due to non-availability of bullock labor, leading to delay in sowing, in turn leading to pest attack and low yields 	<ul style="list-style-type: none"> ◆ Purchase and supply of bullock to members on annual basis ◆ Supply of carts in selected cases ◆ Providing vaccination and insurance services by VO ◆ Operating bullocks on commercial basis 	<ul style="list-style-type: none"> ◆ Poor farmers problem of plough bullock constraint ◆ Increase in income from bullock labor 	<ul style="list-style-type: none"> ◆ Timely sowing reduces crop failure due to pest disease attack by 30-50 percent
<p>Seed Bank</p> <ul style="list-style-type: none"> ◆ Non-availability of seed for main/intercrops in time ◆ Higher dependence on external agencies for seed 	<ul style="list-style-type: none"> ◆ Procuring and supply of seed material for farmers through seed bank 	<ul style="list-style-type: none"> ◆ Establish institutional mechanism for a diversified and local seed bank 	<ul style="list-style-type: none"> ◆ Helps in timely sowing and minimizes crop failure due to non-availability of seed

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
<p>Nursery</p> <ul style="list-style-type: none"> ◆ Availability of locally suitable and drought resistant species is a constraint 	<ul style="list-style-type: none"> ◆ Establishing nurseries ◆ Distribution of plant species to members involved in different pilots ◆ Linkages with NREGS 	<ul style="list-style-type: none"> ◆ Created infrastructure and seed storage facilities ◆ Timely availability of seed for farmers ◆ Reduction in dependency on outsiders for seed 	<ul style="list-style-type: none"> ◆ Generates employment ◆ Plants help in protection of soil from wind erosion, assuring income during drought years
<p>Livestock vaccination</p> <ul style="list-style-type: none"> ◆ Lack of awareness on and access to vaccination services ◆ Lack of human resources in the department for timely vaccination ◆ Supply constraints in vaccines ◆ Absence of back-up support from Animal Health Department for community level institutions ◆ Limited role by community based organizations (CBO) in vaccination 	<ul style="list-style-type: none"> ◆ Streamlining vaccination services through MMS ◆ Communication campaign in villages on disease management ◆ Making available trained para-workers ◆ Planning and conducting vaccination camps 	<ul style="list-style-type: none"> ◆ Improved access to drought resistant plant species to farmers and APDAI pilots ◆ Improved community awareness on vaccination ◆ Institutionalized community based vaccination services ◆ More animals vaccinated regularly ◆ Lower disease rate ◆ Lower death rate 	<ul style="list-style-type: none"> ◆ Protection of animals from exposure to contagious diseases (particularly during unseasonal wet conditions)

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
<p>Fodder bank</p> <ul style="list-style-type: none"> ◆ Seasonal fodder scarcity ◆ Reduction in tree based fodder ◆ Lack of community based institutional mechanism for fodder security 	<ul style="list-style-type: none"> ◆ Households with fodder scarcity are organized into CIG ◆ CIG procure and distribute fodder to its members ◆ CIG promotes fodder production in tank-beds, private/common/leased land 	<ul style="list-style-type: none"> ◆ CIGs formed and strengthened ◆ Improved access to fodder among CIOG members during scarcity periods ◆ Increase in area under fodder production ◆ Increase in production by members 	<ul style="list-style-type: none"> ◆ Prevent distress sale of animals due to fodder scarcity ◆ Availability of additional fodder during drought for preserving nutrition
<p>Backyard poultry</p> <ul style="list-style-type: none"> ◆ There is demand for meat and eggs in the market ◆ Laying capacity of birds is low ◆ High incidence of disease ◆ Lack of awareness on, and access to vaccination and health care 	<ul style="list-style-type: none"> ◆ Supply of egg-laying variety (improved <i>Dexi</i> breed) birds ◆ Vaccination services and primary health care for backyard poultry ◆ Insurance activity 	<ul style="list-style-type: none"> ◆ Providing supplementary income source through backyard poultry ◆ Improved household nutritional security ◆ Increase in bird population in program villages ◆ Increase in animal production and marketing of eggs ◆ Improved access to vaccination and health care services 	<ul style="list-style-type: none"> ◆ Provides subsidiary income to cope with lack of agricultural income and employment during drought
<p>Chick rearing center (CRC)</p> <ul style="list-style-type: none"> ◆ Availability of 4–6 weeks old birds is a problem 	<ul style="list-style-type: none"> ◆ Establishing chick rearing center ◆ Rearing one day old chicks for 42 days 	<ul style="list-style-type: none"> ◆ Chick rearing centers established ◆ Local demand for chicks are met in program villages 	<ul style="list-style-type: none"> ◆ Creates livelihood/employment opportunity for the poor

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
<p>Breed improvement in sheep</p> <ul style="list-style-type: none"> ◆ Inbreeding is resulting in high mortality rate ◆ Cross breeding with Nellore breed causes disease prone offspring ◆ Reduction in quality of wool 	<ul style="list-style-type: none"> ◆ Selection and training of SHG for managing CRC ◆ Supply of 42 day old birds to SHG members for backyard rearing ◆ Introducing pure <i>Deccani</i> breed rams into the flock ◆ Ram-lamb rearing by women ◆ Rearing of nucleus flock of pure <i>Deccani</i> breed ◆ Linkages with banks and line departments for credit support and services respectively 	<ul style="list-style-type: none"> ◆ SHG members are using CRC as livelihood ◆ Increase of flocks with pure <i>Deccani</i> breed rams ◆ Increase in weight of sheep ◆ Supplementary income through ram-lamb rearing ◆ Reduce mortality rate of the sheep ◆ Increase in wool production and value added products 	<p>Relevance to Drought</p> <ul style="list-style-type: none"> ◆ Promote breed that can survive on meager vegetation and is resistant to diseases
<p>Ram-lamb rearing</p> <ul style="list-style-type: none"> ◆ Shortage of breeding animals locally ◆ Lack of supplementary income source for women 	<ul style="list-style-type: none"> ◆ Purchase and rearing of four month old ram-lambs ◆ Sale of ram-lambs at 10-12 months age ◆ Provide community insurance service 	<ul style="list-style-type: none"> ◆ Availability of breeding rams ◆ Supplementary income for women ◆ Access to insurance of ram-lambs 	<ul style="list-style-type: none"> ◆ Available of locally suitable breeding rams would lead to propagation of drought resistant progeny and reduced risk among sheep rearers to lose income
<p>Groundwater</p> <ul style="list-style-type: none"> ◆ Withdrawal of groundwater from wells has surpassed natural replenishment 	<ul style="list-style-type: none"> ◆ Organization of CIG for collective use of groundwater 	<ul style="list-style-type: none"> ◆ CIG formed and strengthened 	<ul style="list-style-type: none"> ◆ Promotes water saving ◆ Ensures critical irrigation during drought

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
<ul style="list-style-type: none"> ◆ Many wells have gone dry due to over-exploitation of groundwater ◆ Farmers are indebted as they are forced to sink more wells ◆ Groundwater resources are mostly in individual control 	<ul style="list-style-type: none"> ◆ Installation of distribution pipeline ◆ Evolving and enforcing social regulations for water sharing, regulation for sinking new borewells, etc. 	<ul style="list-style-type: none"> ◆ Additional area brought under cultivation ◆ Increase in number of farmers using sprinklers ◆ No new borewells sunk ◆ Increase in net income 	<ul style="list-style-type: none"> ◆ Prevents over-exploitation of groundwater
<ul style="list-style-type: none"> ◆ Common land development ◆ Decline in availability of Common Property Resources (CPR) ◆ Deterioration of CPRs has accentuated economic stress and risk among the rural poor ◆ Decline in regeneration of CPRs 	<ul style="list-style-type: none"> ◆ Organizing dependent users into CIG ◆ Obtaining leasing rights by VO from GP ◆ Taking up plantation, soil and moisture measures ◆ Facilitation linkages with government programs 	<ul style="list-style-type: none"> ◆ CIG formed and strengthened ◆ Social regulations enforced by community ◆ Linkages with NREGs established ◆ Increase in wage employment ◆ Increase in number of trees (varieties) ◆ Usufruct rights to CIG members secured 	<ul style="list-style-type: none"> ◆ Provide income generating activities ◆ Secure environmental services (water infiltration) ◆ Improves water security during drought years
<ul style="list-style-type: none"> ◆ Leased land farming ◆ Single women are often without any means of livelihood ◆ They own no land, few productive assets and opportunities ◆ They are exposed to higher risks than other groups 	<ul style="list-style-type: none"> ◆ Organize single women households in CIG ◆ Take agricultural land on lease ◆ Provide technical and financial support for development of lease-in land 	<ul style="list-style-type: none"> ◆ Improved livelihood opportunities ◆ Increase in income 	<ul style="list-style-type: none"> ◆ Reduces the risk and vulnerability of poor women, landless and women headed households

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
<p>Goat Rearers' CIG</p> <ul style="list-style-type: none"> ◆ Poor health care services ◆ High rate of kid mortality ◆ No insurance support ◆ No practice of supplementary feeding and low body weight ◆ Lack of proper marketing facilities ◆ Lack of adequate fodder/ depleting grazing areas of trees 	<ul style="list-style-type: none"> ◆ Formation of CIG of goat rearers and their network ◆ Institutionalizing health services ◆ Addressing fodder issues ◆ Setting up kid rearing center 	<ul style="list-style-type: none"> ◆ Improved access to health services ◆ Reduced kid mortality ◆ Increase in fodder availability 	<ul style="list-style-type: none"> ◆ Provides support to sustain goat population which is an important resource to cope with drought
<p>Goat crèche</p> <ul style="list-style-type: none"> ◆ High mortality of kids of less than four months of age ◆ Absence of proper care for goat kids ◆ Lack of hygienic surrounding for kid rearing 	<ul style="list-style-type: none"> ◆ Setting up kid rearing centers ◆ Provide training of care-takers ◆ Provide nutritious and supplementary feed 	<ul style="list-style-type: none"> ◆ Kid centers established 	<ul style="list-style-type: none"> ◆ Sustain goat population by reducing kid mortality and early sale of kids
<p>Inland fishery</p> <ul style="list-style-type: none"> ◆ Fishermen cooperatives are "controlled" by middlemen ◆ Non-availability of seedlings in local market 	<ul style="list-style-type: none"> ◆ Strengthening of fishermen cooperatives ◆ Seed development 	<ul style="list-style-type: none"> ◆ Cooperatives are strengthened ◆ Improved revenue from fish production 	<ul style="list-style-type: none"> ◆ Improved functionality of fishermen cooperatives and control by women CIG of sale increases livelihood security for poor groups

Issues and Background	Action Areas	Outcomes and Impact	Relevance to Drought
<ul style="list-style-type: none"> ◆ Non-availability of institutional credit for fish seed, feed, etc. ◆ No transparency in management of cooperatives ◆ Lack of regular technical support 	<ul style="list-style-type: none"> ◆ Formation of women CIG for marketing ◆ Strengthening of institutions ◆ Credit, technology and infrastructure support to fisherwomen cooperatives 	<ul style="list-style-type: none"> ◆ Greater control by cooperatives over fishing ◆ Increase in income from fishery and subsidiary activities 	

DFS is developed by packing the three pilot initiatives on crop diversification, biomass production and fertility enhancement.

Experiences with Community-based Groundwater Management in Andhra Pradesh

Over the past three decades groundwater has become a major source of water for agriculture in large parts of the world. Andhra Pradesh is no exception. In 1980 the area under groundwater irrigation stood at 2.47 million acres. The share under irrigation increased steadily and reached close to 7.9 million acres in 2010. This equals the area under surface irrigation in the state, which after huge fluctuations has stabilized at the same level from which it started in 1980, i.e. 7.9 million acres. The importance of groundwater is clear—50 percent of the rice in Andhra Pradesh is now produced in the dry regions of the state.

The rapid use of groundwater has come at the price of lowered groundwater tables. The average decline in groundwater level was 1.90 meters between 1998 and 2006. With the relatively wet monsoons from 2006 onwards, the implementation of large watershed programs and the adoption of water saving measures, the groundwater level in the state recovered during 2006–2008, but the 2009 dry monsoon resulted in a decline in water tables. An increase in the number of ‘dark’ Mandals in the state has been noted, i.e. Mandals where the groundwater is severely overused. A further indication of the severity of the problem is that agricultural power consumption has increased faster than the area under groundwater irrigation, suggesting pumping from ever-greater depths—mining a resource that should be sustainable.

Farmers experienced severe distress caused by the hardships of a failed crop and the consequential loss of their investment in borewells. There was not enough water at the end of the season, to yield good crops for harvest. Another important consequence of the unregulated overuse of the groundwater resource is the loss of a buffer that a reserve of water could provide during a bad year or in the

case of delayed rainfall—reducing the capacity to carry the crop to a successful harvest. With regard to the rabi season (dry season) the area sown has varied depending on the level of the water table at the onset of the season so that during the years of low water table the area sown was reduced and vice versa. A further consequence of increased groundwater decline has been an increase in the degree of fluorosis, because more fluoride is mobilized when water is pumped from larger depths.

There is an obvious and urgent need to establish a sustainable groundwater management regime. Community-based groundwater management, which is often suggested as a solution with considerable promise, figures prominently in the policy document on Groundwater Management prepared by the Expert Group of the Planning Commission of India (Planning Commission 2007). A 2010 World Bank report on India's groundwater economy makes the same point. With the over 1.9 million wells officially registered in Andhra Pradesh²⁷, the consensus is that command and control approaches for groundwater will not work. An approach that includes the farmers as part of the solution must be found to control the increasingly severe problem. The critical challenge is to use the state's groundwater resource in a sustainable way for the benefit of all.

Andhra Pradesh has a number of interesting experiences in community-based groundwater management to offer that should be drawn upon in designing an approach for broad scaling up. The geology of Andhra Pradesh lends itself well to local groundwater management as it is made up of a patchwork of small hard rock pockets that form aquifer basins. According to the State Level Groundwater Estimation Technical Committee there are 1195 groundwater basins of 100 to 300 square kilometres in size. The effect of overuse of groundwater in Andhra Pradesh is not irreversible as these aquifer basins are replenished during each monsoon season. Farmers gamble annually, playing roulette on whether they will run out of water in their wells before the season has successfully yielded a good harvest.

Coordinated crop planning as an approach to controlling groundwater consumption

The first project that aimed to promote local ground water management was the Andhra Pradesh Well Development Project (APWELL). APWELL started off in

²⁷ As in several areas there are many unauthorized connections (see above), the figure may even be higher.

the 1980s as a classic groundwater development project aiming at installing group tubewells for marginal farmers. In the latter part of the project community-based groundwater management was introduced. The methodology was based on participatory hydrological monitoring, i.e. teaching farmers to measure the groundwater table and the withdrawal rate combined with promoting alternative cropping patterns. In several project sites farmers successfully applied this approach.

The successor project to APWELL was the APFAMGS (Andhra Pradesh Farmer Management Groundwater Systems Project). APFAMGS operated in 62 hydrological units (sub-aquifer basins) from 2003 to 2009. Its main objective was to promote community-based groundwater management. The emphasis was on increasing the collective understanding of the groundwater resource by and through farmers. This was done by measurement of groundwater levels and rainfall by farmer volunteers in each habitation in the hydrological unit. The data was fed into an annual Crop Water Budgeting exercise, undertaken prior to the dry *rabi* season, in which all groundwater users participated. The purpose of the planning exercise was to calculate the expected water demand for the *rabi* season based on the combined cropping plans of all farmers of all habitations in the hydrological unit. This was then compared to the estimated recharge calculated on the basis of the groundwater levels and rainfall data. To further improve groundwater management, farmer water schools introduced water-saving techniques and alternatives for reducing water demands and adjusting cropping patterns. An analysis of the results after three years showed the following positive impact:

- ◆ In 63–71 percent of the hydrological units—with a predicted negative water balance prior to the crop water budgeting exercise (prior to the *rabi* season)—cropping patterns were adjusted.
- ◆ All water-stressed hydrological units systematically reduced the proportion of high water consumption crops. In half of the cases water-intensive paddy was removed from the *rabi* cropping pattern. This resulted in rising water tables.
- ◆ To add to the adjustment in cropping patterns, the area under more water efficient management, including micro-irrigation and moisture conservation techniques, went up from 14.7 to 33.7 percent from 2005 to 2008.
- ◆ The net value of output (NVO) from cultivation of different crops was estimated using the data collected from sampled farms in all the hydrological units. The data showed an increase compared to the base period whereas in control units NVOs showed a decreasing trend.

Sharing access to groundwater

The objectives of the APFAMGS was to bring about a shared understanding of the groundwater situation among farmers and a balance in the use of groundwater among borewell owners in relation to water availability in the aquifer. The Community-Based Groundwater Management (CBGWM) pilots of Centre for World Solidarity (CWS) and APDAI addressed the problem from another perspective. Instead of regulating consumption among those already having access to groundwater, the approach focused on the ‘collectivization’ of groundwater or re-establishing groundwater as a common property. This concept was lost with the introduction of private borewells through which the farmer owning the well also controlled all the water that could be pumped from that well. The starting point for the APDAI was to develop a system that would allow borewell and non-borewell owners access to groundwater—by connecting individual boreholes to a common pipeline to which sprinklers were connected. This was a more challenging approach—for it to be of interest to borewell owners it must be advantageous to them as the approach obliges them to share “their” water with non borewell owners. The trade-off lay in non borewell owners committing themselves to not opening up new wells for at least a 10-year period and the borewell owners being able to irrigate a larger share of their farmland with the installation of the pipes and sprinkler systems. As a farmer’s fields are rarely situated all together but spread over a number of different locations, it became possible to connect them with a pipe system shared with those farmers whose fields the pipes would have to cross. The cultivation of paddy was also discouraged to save water.

This socio-technical solution was combined with shifting from a dry *rabi* season full irrigation to complementary irrigation during the rainy *kharif* season. Irrigation in the *kharif* can be life-saving and highly productive as it compensates for delayed rains or lack of rain during critical crop stages. This approach was designed to counteract climate change and variability. Late onset of the monsoon and long dry spells during the monsoon had long been observed in the drylands in Andhra Pradesh, i.e. the collectivization pilots have shown encouraging results:

- ◆ Overall water consumption from the boreholes has decreased or stabilized while productivity gains of 20 percent have been observed.
- ◆ Access to groundwater has become far more equitable.
- ◆ No new boreholes have been developed.

The approach developed by APDAI is challenging. It asks a lot of borewell owners and it takes time to “negotiate” a system that includes a larger area including several owners and non-owners. The potential benefits are however, considerable for both categories of farmers and there are strong indications that once the system has proven its benefits for a couple of seasons, it will generate interest among farmers in villages and scaling up should become easier. In addition, a reduced discharge of groundwater during *kharif*, combined with the water-budgeting technique developed under APFAMGS should allow for a more secure *rabi* season. This means aligning the cropping system much more closely with the conditions prevailing in the drylands of Andhra Pradesh—bringing the human endeavour closer to the realities of nature.

Conclusion

These Andhra Pradesh cases show the promise of community-based groundwater management combined with reduced discharge. The result is increased agricultural production and productivity. This is an important conclusion in the context of adaptation to climate change. In the context of Andhra Pradesh, it is possible to adjust farming systems to better cope with irregular drier and wetter cycles that are a consequence of climate change, while still making progress in terms of overall agricultural productivity. Faced with groundwater overuse, the objective should be to encourage and facilitate optimized, balanced and equitable use of groundwater, not to simply discourage it.

International Experience

The international experience in adaptation to climate change in dryland areas is limited, although it is expanding quickly either by including a dedicated climate change adaptation component in conventional development projects or through new initiatives designed to address the climate change challenge from the outset, as was the case with APDAI. In order to position APDAI in an international context, following are three examples of development and adaptation to climate change in drylands. The three selected projects represent three different approaches to tackle the development and adaptation challenge in drylands but, as will be seen, they have also much in common.

Brazil

Brazil is a middle-income country with a rate of economic growth of about six percent per year. Poverty is however still prevalent in the dryland area states in north eastern Brazil, which comprises only 28 percent of the country's population and 17 percent of its land area but almost 50 percent of the country's poor and an even larger share of its rural poor.

The World Bank-supported PCPR (*Projeto de Combate à Pobreza Rural*) is a large-scale program operating in north-east Brazil since 1993. The project has had an important impact on creating social capital, empowering communities and creating governance structures at the local level. Investments are demand-driven, with communities taking the lead in prioritizing needs. Most important, they remain in the drivers' seat through completion and operation.

A key part of the strategy developed under the PCPR focused on playing a catalytic role in guiding the PCPR towards a more productive, income-generating focus based on linking clusters of organized rural producer to markets as follows.

- ◆ Meeting the market to better understand product demands/requirements. The demand for products originating in the small farm sector in developing countries has been growing at a rate of 25 percent per year in the European Union over the last 10 years. At the same time, there has been a growing tendency in Brazil for exporting firms and supermarket chains to be interested in products coming from family agriculture, including organic produce and products with favorable impact on the environment. The most important niche is known as 'Fair Trade', developed by an international network of stores specialized in selling products that come from small farmers in low-income countries or poorer regions in middle income countries (like NE Brazil) The project has been actively inviting such organizations to visit the PCPR, explore the kinds of products in which they have an interest, define volumes they would potentially acquire, and determine the type of investments needed in terms of production, processing and packaging, to reach the level of quality required by the market.
- ◆ Strengthening partnerships with public technical assistance organizations as well as with national and international NGOs. The PCPR addresses three sets of capacity-building needs of community associations in the process of linking to markets or already having established linkages: (i) on technical matters; in consultation with the buyers, professionals are identified who can provide technical support to communities on design issues and in reaching quality standards required by the markets. (ii) on various aspects of small business management. (iii) on helping communities understand and navigate exporting procedures from Brazil and importing procedures into Europe and elsewhere.
- ◆ Developing links with micro-financing entities. Linkages have been established with national banks working at the local level.

As a dryland area the Brazilian Northeast experiences critical problems related to water scarcity with periodic, long and severe droughts. One of the key ingredients in the alleviation of the adverse impacts of these cyclical droughts is the provision of a safe and reliable supply of water for multiple uses by the population, industry and agriculture. Considerable progress has been made over the last 20 years through, for

example introduction of water-pricing schemes and construction of dams for long term storage. This has been combined with awareness-raising (including at schools), capacity building, village-level organization, technical interventions for sustainable water management and income generating activities. Extensive investments have been made by the villagers with the assistance of the project in water retention structures such as dams and tanks; construction of terraces and bounds as earth works and/or with stones; and planting of trees and other vegetation to protect waterways and to recuperate degraded lands. The results have been seen in terms of reduced erosion, increased production and productivity of farms, introduction of new income-generating activities such as honey production, elevation of the water table and re-appearance of some animal species.

The PCPR is a poverty reduction project without a specific focus on natural resources although the natural-resource base has been an important component for economic development. Impact evaluation studies indicate a remarkable improvement in families' wellbeing and quality of life with significantly improved access to education and basic health services.

Kenya

The Kenyan economy grew at 6.1 percent in 2006, up from 5.8 percent in 2005, mainly due to improved macroeconomic management and structural reform, while national poverty declined in absolute terms from 52 percent in 1997 to 47 percent in 2006. Despite the impressive recent gains in economic growth and poverty reduction, Kenya continues to face significant development challenges. In particular the arid and semi-arid lands (ASAL) face the challenge of chronic underdevelopment. This is due to a number of reasons, including climatic and agro-ecological factors and socio-economic conditions, such as low levels of access to markets and services. Most districts in the ASALs have very high poverty rates (more than 70 percent), well above the national average and have long been disadvantaged in public service and infrastructure provision, due to its relatively isolated location and dispersed population.

The World Bank-supported Arid Lands Resource Management Project (ALRMP) was started in 1994 as an emergency drought-recovery project but was expanded into the larger ALRMP project in 1996. It was realized that a longer-term program aimed at building a drought-management system as well as community capacity to cope with drought was needed. Climate change introduced an additional

uncertainty into managing natural resources and promoting sustainable land-use management. An increased variability between extremely dry and wet conditions, shifts in seasonal climate characteristics as well as associated effects on extreme events and vector borne diseases placed an additional strain on human health and food security. All of this threatened water resources particularly through rising risks of droughts and floods, and the viability of rural livelihoods in already marginal lands with implications for the broad strategies for poverty alleviation and economic development.

It was concluded that the best way to address these risks was to include climate risk-management into ongoing programs with a focus on Arid and Semi-Arid Lands (ASALs) as the most vulnerable areas to climate-related risk.

In line with the above strategy and in order to maximize the return on investing in adaptation measures the government decided to implement a second phase of ALRMP starting in 2003. Through this initiative, a sound decentralized institutional structure, and effective coordination mechanisms at the national, district and community level have been developed for an effective multi-sectoral approach to development. This baseline project is, on the one hand clearly affected by the rising risks of climate change, and on the other hand provides a very effective delivery mechanism for adaptation enhancements. This will not only help better achieve the baseline project's objectives under a changing climate, but also have a positive impact well beyond the baseline project.

In order to further strengthen the adaptive response capacity of ALRMP, the *Kenya Adaptation to Climate Change in the Arid and Semi-arid Land (KACCAL)* project was developed (2009). The additional capacity provided through this project will further strengthen the adaptive response capacity of ALRMP with regard to risks associated with climate variability and change. It will help strengthening the systems put in place by ALRMP by developing a forward-looking, multi-hazard risk response capacity through adaptive investments particularly in land and water management. The project will take the following approach:

- ◆ **Reducing adaptation deficit:** At the local level, emphasis is placed on reducing the existing adaptation deficit revealed by current climate hazards that frequently translate into disasters. This is to be achieved by strengthening efforts to make early warning and seasonal climate forecasts accessible to vulnerable stakeholders, while also strengthening their capacity to act on information through improvement of agricultural extension services and training in natural resource management.

- ◆ **Introducing economic and financial measures to support and protect rural livelihoods:** Recognizing that the additional burden of climate change will make some livelihoods unsustainable, the project aims to build long-term sustainability by including the private sector in efforts to provide alternative livelihoods.
- ◆ **Improve climate data infrastructure:** In a region for which the impact of climate change is very complex, with expected dryer and wetter conditions in close proximity to each other, it is important to have as good an understanding as possible of the conditions that will affect the arid and semi-arid regions of the country.
- ◆ **Strengthening links between disaster risk management and climate change:** At the governance and institutional level, the project will focus on strengthening the link between disaster risk management and climate change to ensure that development and operational planning, policy processes, and incentive systems address existing vulnerabilities at the same time as they account for climatic changes. This is important to avoid processes which will reflect maladaptation in the medium to long-term.

The project is still in its early stages of implementation but a thorough investigation has been undertaken with regard to how people in the targeted districts understand risks to their livelihoods. The conventional wisdom in the development community has been that unfavorable agro-ecological conditions and market infrastructure offer little hope for development in drylands. However, study shows that in spite of the unfavorable agro ecology and market infrastructure in the ASALs, there is lots of evidence of a wide variety of viable socioeconomic activities.

Yemen

The project in Yemen, entitled the Agro-Biodiversity and Adaptation Project, which is in its early stages of implementation, had been developed as an adaptation project from the outset. However, like APDAI it will coordinate its work with the ongoing World Bank-supported project Rainfed Agriculture and Livestock Project (RALP). Synergies will also be explored with another ongoing World Bank supported project entitled Groundwater and Soil Conservation. A number of studies are feeding into the adaptation project such as one which will estimate the costs and benefits of climate change, another one which will develop climate change scenarios and yet another one that will focus on climate impacts on water

resource management in agriculture. Two economic studies will focus on costing adaptation through local institutions and on rural community resilience to climate change. These studies will provide valuable knowledge for the benefit of the adaptation and agro-biodiversity agenda in Yemen.

The agro-biodiversity and adaptation project, like RALP is focused on the rain-fed agricultural sector of Yemen's economy, the poorest among the Arabian Peninsula countries. Yemen relies mostly on agriculture which contributes more than 15 percent to gross domestic product and employs, directly or indirectly 74 percent of the population. Poverty has declined in the country but Yemen is still one of the poorest countries in the world with over 40 percent of the population living in poverty. Rural poverty has declined only marginally from 42.8 percent in 1998 to 40.1 percent in 2005-06.

Agricultural development in the past was largely focused on irrigated areas although more than half of the country's cultivated area is under rainfed and subsistence agriculture. For the nearly 84 percent of the poor in the highlands of the rural areas that depend on rainfed agriculture, it is the primary source of livelihood and food security.

Climate change is a real concern for Yemen as climate change will exacerbate the general uncertainty in Yemeni agriculture. Yemen lies in a latitudinal band where global circulation models differ in projected precipitation trends. However, there is observational evidence of increased variability of rainfall in recent years leading to greater frequency of droughts and flash floods. Rain-fed agricultural areas are the most vulnerable to the impact of climate variability and change with both an immediate and a long-term detrimental impact on rainfed crop production. One study estimates that climate change could lead to a 50 percent reduction of crop yields for rainfed crops by 2020.

The agricultural system in the highlands is, to a large extent based on communities retaining important agro-biodiversity and traditional knowledge related to the utilization of their agro-biodiversity resources. A large number of indigenous varieties of different crops are still used within the prevailing and diverse farming systems to meet the food needs of these communities and those of their livestock. Most of these landraces have accumulated adaptive attributes for coping with the adverse environmental and climate conditions and the needs of the local communities. In addition many wild relatives of these crops and many other plant species that have forage and medicinal value are still found at

the edge of fields and in remnant natural habitats. This local agro-biodiversity is however threatened by the consequences of land degradation, including erosions of terraces, a gradual loss of traditional knowledge and a policy environment that favors new varieties as opposed to the traditional land races.

Against this background, the project has identified four components for its interventions:

- ◆ **Agro-biodiversity and Traditional Knowledge Assessment:** The first component of the project focuses on harnessing the traditional knowledge and, together with the communities select varieties of the crops that have proven to perform better under the increasingly variable climatic conditions. The aim is to collect and systemize the existing knowledge base of farmers with regard to characteristics of local land races and their wild relatives.
- ◆ A shortlist of land races of particular importance for food and fodder production will be developed in cooperation with farmers. Their performance under climatic stress conditions such as droughts, floods, frost and high temperature will be tested.
- ◆ **Climate Modeling:** This component will employ various techniques to assess future climatic conditions. The aim is to minimize the uncertainty associated with climate change in Yemen, and to improve the Yemeni capacity in data management and modeling to assess climate change.
- ◆ **Development and Piloting of Coping Mechanisms:** The third component aims at improving traditional coping mechanisms defined as information, technology or techniques that enable farmers to be better prepared to continue farming under changed climatic conditions and to sustain a livelihood base. There are several sub-components included. i) Development of a directory of coping mechanisms for farming in the rainfed highlands. The directory will include an inventory of traditional knowledge and a list of land races, cropping patterns, crop-management techniques and agro-biodiversity conservation techniques that will prove successful under low, medium and high climatic variability; ii) Development of agro-biodiversity-based small scale income-generating activities. The purpose of this sub-component is to help poor farmers and in particular women to use agro-biodiversity as a basis for economic activities;

iii) A further sub-component will focus on raising community awareness on climate change and sustainable natural-resource management. It will deal with six priority areas: water conservation, nutrition, natural-resource conservation and traditional knowledge, livestock management, building of natural reserves (seeds, etc.), and options for additional sources of revenue.

Concluding Remarks

It is evident from the three examples above as indeed from the description of the situation in India's drylands that drylands are lagging behind in the development process. The Millennium Ecosystem Assessment (MEA)²⁸ provides some facts about drylands and the development deficit they are suffering from. Drylands occupy 41 percent of the Earth's land area and some two billion people, or a third of the human population lives there. Ninety percent of dryland people live in developing countries and 55 percent of them or approximately one billion people live in rural areas and are dependent on the natural resource base for their livelihood. Ten to 20 percent of the dryland areas are degraded with about 70 percent of all used land in Africa affected by desertification. The socio-economic conditions lag significantly behind those in other areas. The implication is that drylands and their populations have been left behind in the development process for too long. Addressing desertification and the needs of dryland people is therefore critical for meeting the Millennium Development Goals (MDG) and yet progress towards the MDGs is slower in drylands than in more favored environments. Based on their needs dryland people deserve more attention and based on their right to participate fully in the human development process, they have a strong claim to more assistance.

One of the reasons often cited for the neglect of drylands and indeed other marginal areas such as mountainous regions is that their very distance from urban centers, make them less viable from the commercial point of view. Providing inputs as well as transporting produce out of such remote areas is costly and therefore un-economical. The Brazilian example points to a way out of this dilemma. The focus has been on developing high-value produce for a very select market. This has turned out to be a commercial success and generated substantial income for farmers in drylands. The investment period has been long

28 Millennium Ecosystem Assessment, *Global Assessment of Desertification: A Millennium Ecosystem Assessment Synthesis Report*, 1 March 2005.

and required considerable inputs, not least connecting the dryland areas and their farmers with credit institutions and market representatives. Such opportunities should be possible to exploit also in other dryland areas and maybe particularly appropriate in India where the commercial sector is comparatively well developed, the distances to urban centers often shorter and the population density, even in drylands higher than in many other dryland areas, notably in Africa.

The Yemeni project has as one of its foci to select land races that are better able to cope with the new climatic characteristics as compared to commercial varieties that have been introduced over the past several years. In order to prepare for a future economical viability of the drylands in Yemen, it might be that an additional selection criterion should be the market value of land races and in particular the value they might have in a more select market. Given the project's focus on high value crops, this aspect seems important.

The above discussion and the conclusions drawn from primarily the Brazilian and the Kenya projects mainly highlight the considerable adaptation deficit that drylands in general are subject to. The adaptation aspect has entered into these projects as an additional objective following the recognition of the devastating affect that climate change will have in drylands in terms of disruption of an already precarious production system and linked to this, the impact climate change will have on the populations living in these areas. The Yemeni project responds to the same neglect of dryland farming in that country.

If there is a silver lining on the climate change cloud hanging over the world's drylands it would be that they are now recognized as a priority concern in the scientific, the humanitarian, the political and development communities. It is now important to recognize that much of the response to overcoming the long neglect is a question of addressing the adaptation deficit, correct mal-adaptations and seek to leapfrog the innovations that will be required to meet the new challenges generated specifically by climate change.



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