RESEARCH RESULTS

This section presents the key findings/results of the analysis of the data (climate, qualitative and survey). The results are divided into four parts following the design of the research objectives. Part A presents the findings of the climate analysis juxtaposed with the men and women farmers' perceptions of climate variability trends over the past forty years. Part B describes the men and women farmers' perceptions of how these climatic changes have affected their livelihoods and food security. Part C focuses on the more recent past and summarizes the coping strategies used by men and women farmers in response to abnormal amounts of rainfall. Finally, part D highlights the institutional context of the situation the farmers describe. These results are further discussed and interpreted in the final section.

A Men's and women's perceptions of climate variability coincide with the climate record

This section juxtaposes a simple analysis of the climate variability of the study districts based on available data with the farmers' perceptions of climate (note that farmers use the term "weather" to mean both "weather" and "climate"). While climatological terms and farmers' descriptions are not always identical, it was possible to compare them. This comparison is important as it created a multi-perspective description of the climate conditions, which can serve as a foundation for designing participatory responses to climate variability and change.

KEY FINDINGS:

- **1. All farmers reported seeing changes in climate variability over the past forty years.**
- **2. Farmers' perceptions and the climate record confirmed that Anantapur and Mahbubnagar districts have a history of drought and tend toward worsening drought conditions.**
- **3. Men and women farmers reported similar or identical observations of temperature and rainfall trends over time.**

Anantapur is one of the most drought-prone districts in Andhra Pradesh. The annual average rainfall is 552 mm, of which more than 60 percent is received between June and September during the summer monsoon season. Mahbubnagar receives an average annual rainfall of 850mm, with monthly rainfall showing a dominant uni-modal monsoon season pattern with a maximum rainfall in July. The co-efficient of variation of mean monthly rainfall of Anantapur and Mahbubnagar shows a high level of variability especially during crucial crop growing months. Note that July rainfall is crucial for agriculture as most of the rainfed crops are sown and rice transplanting also takes place during this month. See Figure 2 (next page).

"Nowadays rains are like a sprinkle on a burning coal." – Female farmer

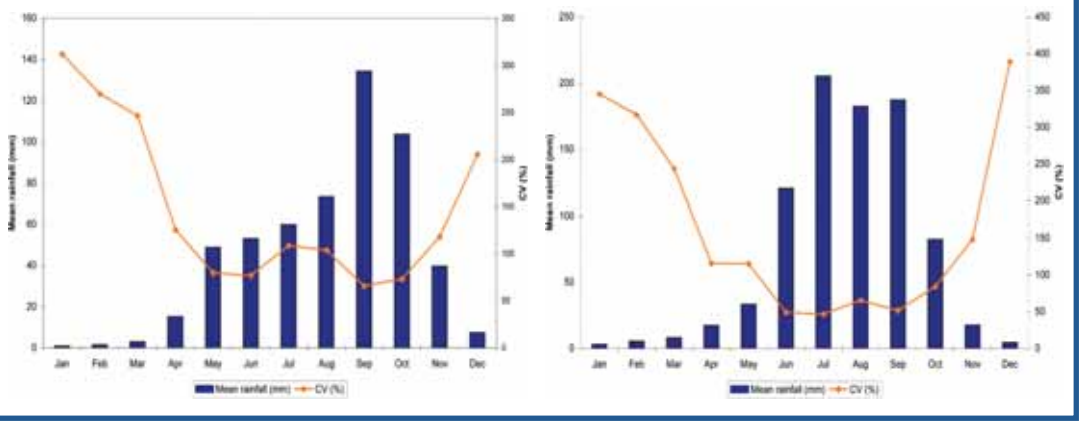
"If it rains during Visaka Karthe* the crop yield will become poisonous, that is what is happening now. We lost the crop!" – Female farmer

*(seasonal calendar representing winters)

"If rain God opens his eye then everyone will prosper." – Male farmer

Figure 2. Left: Monthly mean rainfall (mm) and co-efficient of variation (%) in Anantapur district of Andhra Pradesh, India. Right: Monthly mean rainfall (mm) and coefficient of variation (CV) in Mahbubnagar, Andhra Pradesh, India.

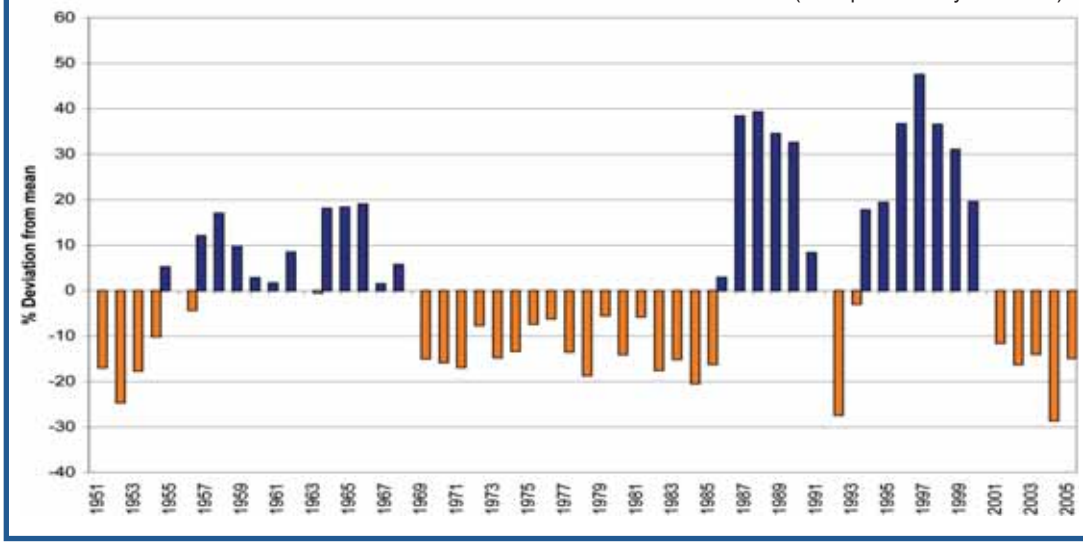
(Data provided by ANGRAU)



An analysis of the monsoon season rainfall over the period 1954 to 2005 for Anantapur[17] indicates a sequence of above and below normal rainfall (Figure 3) with the pattern of distribution within the season varying considerably from year to year. The record shows an extended period of below normal rainfall during the 1970s into the 1980s, followed by years of mostly above normal rainfall.

Figure 3. Percent deviation from average seasonal rainfall (June to September) at Anantapur (5 years moving average); Long-term average rainfall is 332 mm

(Data provided by ANGRAU)



While not directly comparable, Anantapur farmers' perceptions of seasonal rainfall in comparison to what they considered normal amounts of rainfall followed a similar trend as the data displayed in Figure 3. As seen in Table 1, farmers described a "good" amount

of rainfall in the 1960s and drought in the 1970s. The farmers' perceptions did not capture the below normal rainfall in the early 1980s. While we cannot be sure why, it could be that because borewells were introduced around this time, there was enough water for farmers to be able to achieve good harvests despite low rainfall levels, and farmers' memories of the good harvests are attributed to good rainfall. Farmers described the 1990s as having less rain, which differs from the record, however farmers' memories of rainfall amounts may be influenced by the pattern of rainfall, which they described as "scattered" and "unseasonal".

Table 1. Summary of men and women farmers' descriptions of average seasonal rainfall amounts from the 1960s until the present in Anantapur.

DECADE	1960s	1970s	1980s	1990s	2000s
Average amount of rainfall during June-September	Good amount of rain	Drought starting early-mid 1970s	Moderate to good amount of rain	Less rain	Insufficient rain 2000-2005; moderate-to-good rainfall 2006-2008

Table 2. Summary of men and women farmers' descriptions of average seasonal rainfall amounts from the 1960s until the present in Mahbubnagar.

DECADE	1960s	1970s	1980s	1990s	2000s
Average amount of rainfall during June-September	Good to very good rain	Good until onset of drought early to mid 1970s	Moderate rain	good	Insufficient rain

A similar analysis as shown in Figure 2 could not be performed for Mahbubnagar due to lack of data, however an analysis in which an earlier period of thirty years (1963 – 1992) was compared with a recent decade (1993 – 2002), showed that there was a decreasing trend in rainfall in the recent decade for the months of June, July and for the entire monsoon season (Singh et al., 2007). This coincides with Mahbubnagar farmers' observations (see Table 2). They described rainfall amounts from the 1960s to 1993 as good or moderate, and the more recent rainfall as less or insufficient.

The number of days with a maximum temperature greater or equal to 35 °C has increased. Oppsite page: women with seeds

The record shows that inter-annual variability has been increasing in recent years in both Anantapur and Mahbubnagar and thus increasing uncertainty of effective rainfall events to support crop growth. Farmer observations supported this; nearly half of the farmers surveyed noted an increase in "unexpected rains", which can be taken to mean "uncertainty". In focus group discussions, farmers also agreed that in the last couple of years they had seen unseasonal rains and higher temperatures resulting in changes in all the seasons; summer was longer, winter was warmer. However, only a very small percentage of farmers noted observing an increase in unpredictable weather, which suggests that the changes farmers perceive are within the range of variability with which they are familiar.

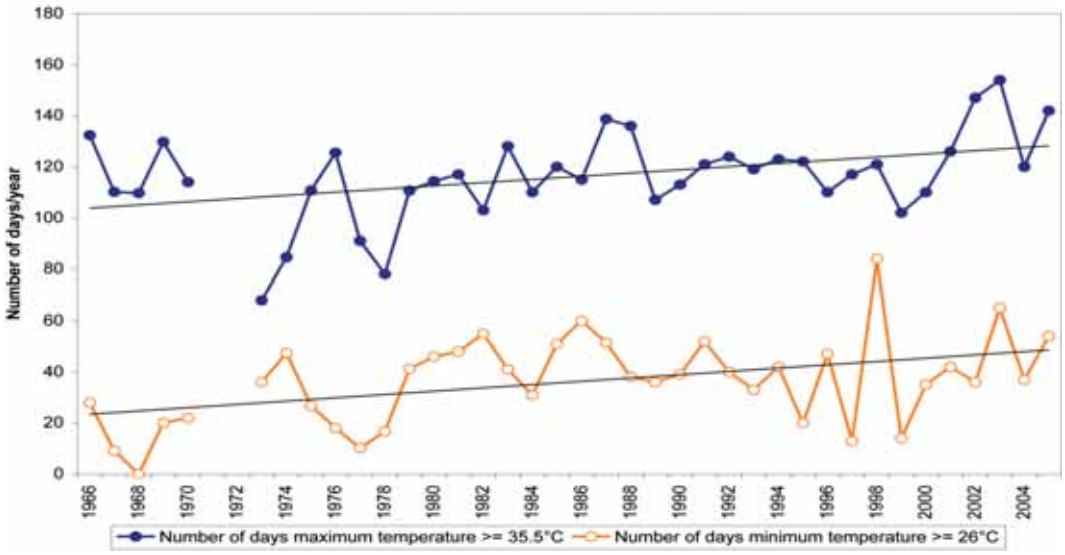
Extreme temperature events could have major impacts on the subsistence farming in drought-prone areas such as Anantapur. In focus group discussions, farmers reported a reduction in the number of cold days and an increase in number of extreme hot days. They described an increase in the minimum temperature as 'intensity of cold decreasing' and perceived higher temperatures in summer and winter.

The record shows that the maximum number of consecutive dry days at Anantapur increased over the period from 1965 to 2007. The magnitude of this change was approximately from 80 days in 1960 to around 120 days in 2007. In qualitative focus group discussions farmers reported observing "longer winters" which they described as a lengthening of the period without rainfall. The Anantapur region was particularly vulnerable to changes in climate extremes as a result of its exposure to climate variability, shallow soils and low value crops.

An annual time series of temperature index was computed, without removing the seasonal cycle. This means that changes in a hot day index will tend to be representative of changes in hottest seasons. As seen in Figure 4, the number of days with a maximum temperature greater than or equal to 35 °C[18] has increased and may have an impact on crops in terms of enhanced water requirements and sensitivity to temperature maximum thresholds. Also seen in Figure 4, the number of days with a minimum temperature of greater than or equal to 26 °C is increasing[19].

Figure 4. Number of days with maximum temperature greater than or equal to 35.5 °C and minimum temperature greater than or equal to 26 °C at Anantapur.

(Data provided by ANGRAU)



The recorded data suggests a shift in average climate conditions. Furthermore, all farmers participating in the quantitative survey agreed that the weather had changed over the past thirty years. Seventy eight percent of respondents (81 percent of men and 75 percent of women) agreed that the temperature had increased while 97 percent of respondents (97 percent of men and 97 percent of women) agreed that the amount of rain was less. When asked why these changes were happening, most respondents said they do not know or "only God knows". While it might not be clear to the farmers why the changes were happening, it is clear from the recorded data and farmers' perceptions that the conditions with which farmers are familiar were changing and, as the subsequent sections will show, their livelihoods and well-being appeared to be under stress.

Men and women experience changes in climate variability differently

The farmers in the study area perceived[20] that the climate conditions appeared to be changing toward warmer conditions on average and the recorded data supports this. This section discusses what the effects of the changing climate conditions have been and who has been affected according to the farmers. Note that a timeframe of thirty years ago to present (about 1978-2008) was imposed so that all of the respondents could contribute, as opposed to the discussion on general climate trends presented in the previous section.

KEY FINDINGS:

1. Men and women farmers stated clearly that the changes in key aspects of their farming activities over the past thirty years were linked to changes in climate variability.

2. Men and women farmers described that the changes had led to increased workloads, but in different areas of work according to gender.

FARMING ACTIVITIES ARE AFFECTED BY CHANGES IN WEATHER[21]

Based on the changes in weather they had observed the participants were asked to describe what those changes meant for their lives. Men and women speaking in separate focus group discussions recognised the centrality of rainfall for their livelihoods and said that "no rains" or "no timely and sufficient rains" were the primary risks facing agricultural production. The survey results also revealed that men and women had similar perceptions of the impacts of the changes in the weather. Ninety percent of men and women surveyed reported that weather changes had led to poorer harvest or reduced crop yields.

Other changes mentioned included bore-wells or ponds dried up (55 percent), decreases in the number of livestock (34 percent), less fodder (38 percent), shortage of drinking water (30 percent) and health affected (23 percent). Men were significantly more likely than women to report there was less fodder and that bore-wells and ponds had dried up. Women were significantly more likely than men to report that health was affected.

These are significant gender findings and indicated that women were more focused on the health of the family while men were more focused on the farming production issues. See Table 3.

Table 3. Perceived impact of changes in weather over the past thirty years on key components of farming activities, by gender

IMPACT OF CHANGES	Percent of male respondents reporting change	Percent of female respondents reporting change	Percent of all respondents reporting change	χ 2
Less fodder	45.3	28.3	38.3	6.23**
Use different crops	15.8	15.1	15.4	.019
Borewells/ ponds dry up	53.2	46.8	55.2	3.45*
Decreased livestock	42.1	36.8	39.3	.593
Shortage of drinking water	32.6	26.4	29.4	.934
Poorer harvest/yield	**87.4**	**88.7**	88.1	.082
Reduced forest	16.8	18.9	17.9	.140
Health affected	17.9	28.3	23.4	3.02*

* X^2 significant at 0.10 ** X^2 significant at 0.01

MEN AND WOMEN ARE AFFECTED BY CHANGES IN WEATHER

Significant gender differences existed in who was perceived as most adversely affected by changes in the weather. Both men and women agreed in similar numbers that the entire family was most affected by the changes. However, women were much more likely than men to report that women were most affected. At the same time, men were more likely to report that men were most affected. See Table 4.

Table 4. Perception of who in the family is most affected by changes in the weather in the past thirty years, by gender

WHO IS AFFECTED	Percent of male respondents	Percent of female respondents	Percent of all respondents
Men	**23.2**	21.7	22.4
Women	7.4	26.4	17.4
Children	1.1	0.9	1.0
Elderly	0	0.9	0.5
Entire family	67.4	49.1	55.7

Going into more detail about the nature of the effects of changes in climate on their lives, it is clear that men and women's lives were affected in both similar and different ways. The four most popular responses to the question "how are men's lives today different than 30 years ago because of the changes in the weather?" were:

1. **Increase in pressure to mobilize loans (reported by 61% of all respondents)**
2. **Increase in pressure to provide food (reported by 51% of all respondents)**
3. **Increase in emotional stress/anxiety (reported by 33% of all respondents)**
4. **Increase in fights/arguments among the family (reported by 22% of all respondents)**

Conversely, the four most popular responses to the question "how are women's lives today different than 30 years ago because of the changes in the weather?" were:

1. **Increase in pressure to provide food (reported by 61% of all respondents)**
2. **Increase in workload at home (reported by 55% of all respondents)**
3. **Increase in health problems (reported by 36% of all respondents)**
4. **Increase in fights/arguments among the family (reported by 28% of all respondents)**

These results show that changes in climate over time have different impacts on men and women and these differences are linked to their gender roles[22]. The result that an increase

in emotional stress/anxiety was a highly-ranked issue for men more so than women is somewhat surprising as women are typically considered to be the nurturers and caregivers and would thus be expected to be more likely than men to report an increase in emotional stress. The increase in emotional stress among men was likely due to the pressure to mobilize loans, which the respondents report as the top pressure and which has been documented elsewhere as a serious issue, sometimes leading male farmers to commit suicide (Sainath, 2004).

"In earlier days we had a pattern of regular intervals to visit our fields and sometimes we would visit to collect fodder, but nowadays everyday we have to tend our crops. It's like bringing up an infant. Our workload has increased."

– Female farmer

MEN AND WOMEN HAVE DIFFERENT PERSPECTIVES ON HOW WEATHER HAS CHANGED EACH OTHER'S LIVES

When a distinction is made between how men and women view the effect of weather changes on men's lives, it became clear that there was a gap between men's and women's perceptions about men's lives (Figure 5a). This difference in men's and women's perspectives was also true when considering changes in women's lives (Figure 5b).

These results demonstrate the importance of documenting men's and women's views of their own lives so that the degree to which certain issues matter more to men or women is clear. In addition, it is important to collect data from men and women separately so that their responses are not biased by the presence of members of the opposite sex (e.g. men may be less likely to report on emotional issues in front of women if cultural definitions of masculinity prohibit displays of emotion).

While the farmers were asked to list changes in their lives due to changes in the weather over thirty years, it appears that some of their responses were not changes due only to weather. The additional household work of women linked to limited water availability as reported by both men and women appears to reflect socio-cultural changes, rather than resulting solely from reduced water resources caused by changes in climate variability. The qualitative exercises revealed that members of the caste traditionally responsible for washing clothes no longer fulfil that function, and it may be the upward mobility among the oppressed castes, among other social changes, that have led to an increase in household work among the respondents. Thus, while farmers reported these changes in their lives were due to "weather changes", follow up research is needed to clarify if the result documented here is further evidence of climate change increasing the workload of women (see for example Leduc, et al., 2008; Brody, et al., 2008).

Figure 5a. The four most important changes in men's lives because of weather changes over the last thirty years, perceived by men and women

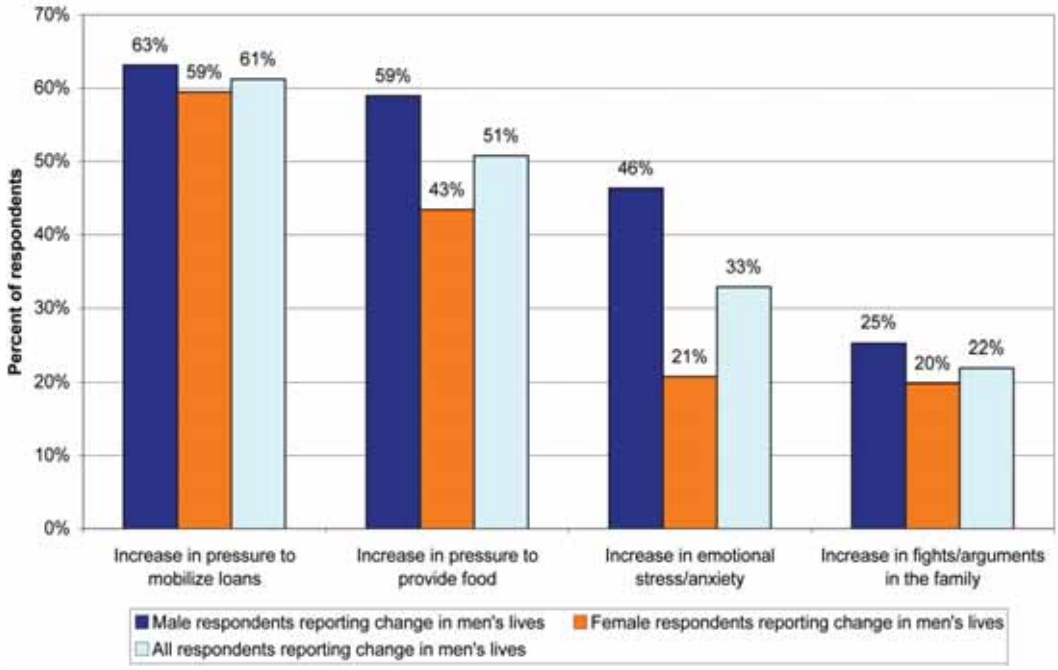
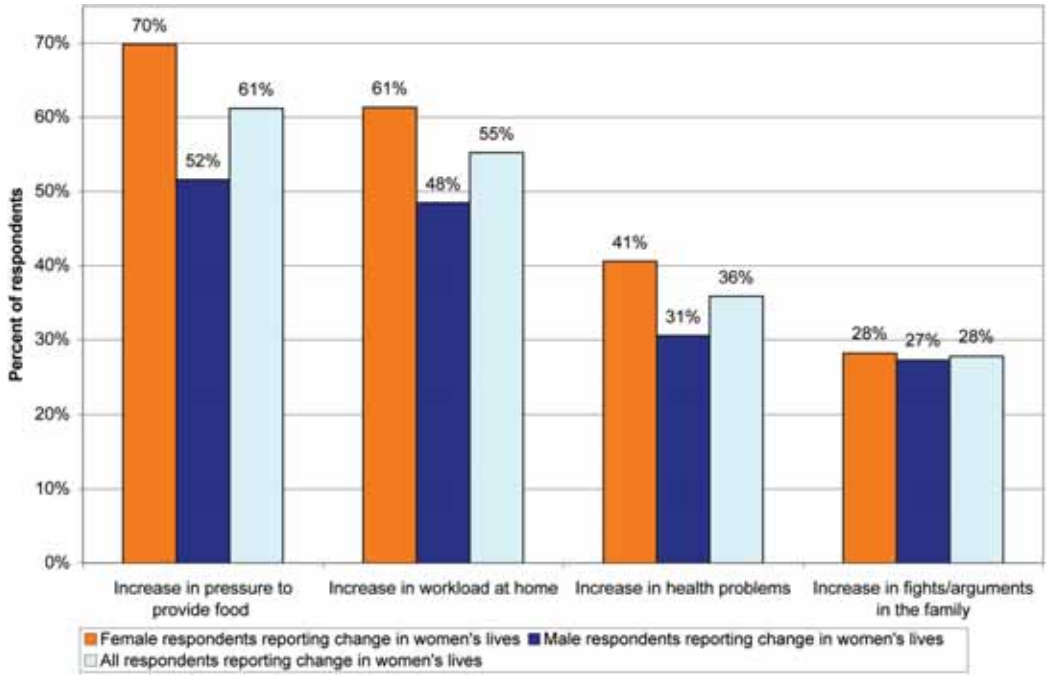


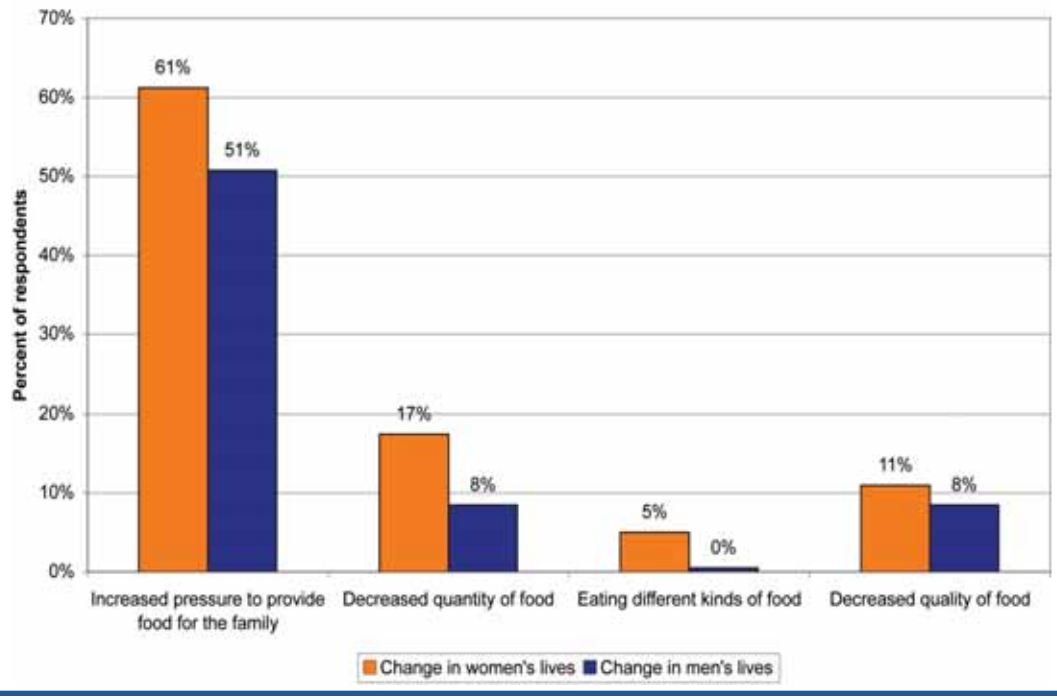
Figure 5b. The four most important changes in women's lives because of weather changes over the last thirty years, perceived by men and women



CHANGES IN FOOD SECURITY DUE TO CHANGES IN WEATHER

Men and women farmers both reported an increase in pressure to provide food to the family as one of the primary changes in their lives due to changes in the weather. Other areas related to food security, however, did not rank as highly. Figure 6 demonstrates that "decreased quantity of food", "eating different kinds of food", and "decreased quality of food" were changes for only small percentages of the respondents (results similar for men and women answering separately; not shown here).

Figure 6. Changes in men's and women's lives related to food security due to changes in weather



In contrast, during qualitative discussions, most farmers did mention a decrease in quality of food over the past thirty years. Based on their responses to the quantitative survey, it appears that farmers may not have associated the decrease in quality with changes in the weather. Instead, they may have perceived the decreasing quality of food as resulting from the shift toward purchasing food (even though this shift is partly related to climatic changes affecting the viability of farming). The issues of availability and sources of food are key components of food security in relation to a changing climate and are discussed in subsequent sections of the report.

Over the course of the last thirty years, many changes have taken place in farming practices, infrastructure and government support which have intersected with changes in climate variability. It is not possible at this level of analysis to attribute changes in farmers' lives

directly to or solely to changes in climate variability over time. The important outcome here is that men and women farmers perceived changes in their well-being linked to a changing climate and these changes differed for men and women. The following section examines how farmers responded to weather conditions in a given year in the context of climate variability; on this time scale, causal linkages are more clearly defined.

"Earlier when it used to rain, by the time we picked up our sack to protect us, it would get wet and we too would be full of water. Now, most of the time there is hardly a drizzle."

– Male farmer

"Now we are washer women, sanitary workers, wage labourers and house keepers."

– Female farmers

Men and women's coping strategies are complementary but different

Examining farmer coping strategies for dealing with different climate conditions over the past thirty years was complicated by the fact that multiple socio-economic changes were also taking place. Thus, instead of looking at average climate conditions over time and responses to them, this section focuses on coping strategies during the growing seasons of the most recent past and hypothetical future scenarios. The discussion focuses on coping strategies for responding to variations in rainfall, as "no rainfall", "unseasonal rains" and "no rainfall during agricultural season" were ranked as the greatest risks to farming production by men and women in all but one of the study villages[23].

KEY FINDINGS:

- **1. Men and women reported similar coping strategies to ensure farm productivity in a dry year or wet year.**
- **2. When farm income was not sufficient, women and men had different available options for coping strategies to earn income.**
- **3. Traditional coping strategies for coping with food scarcity had a strong gender component and became exacerbated during dry years.**

COPING STRATEGIES IN RESPONSE TO ABNORMAL RAINFALL IN 2008

As shown in Figures 7 and 8, during 2008[24] (January-December), Mahbubnagar experienced below normal rainfall during the growing season, while Anantapur experienced above normal rainfall during that time. Farmers' perceptions confirmed these patterns.

Figure 7. Average seasonal rainfall at Mahbubnagar (average of district stations) in 2008 compared to long-term average of seasonal rainfall

(Data from IMD 2010 a; ANGRAU)

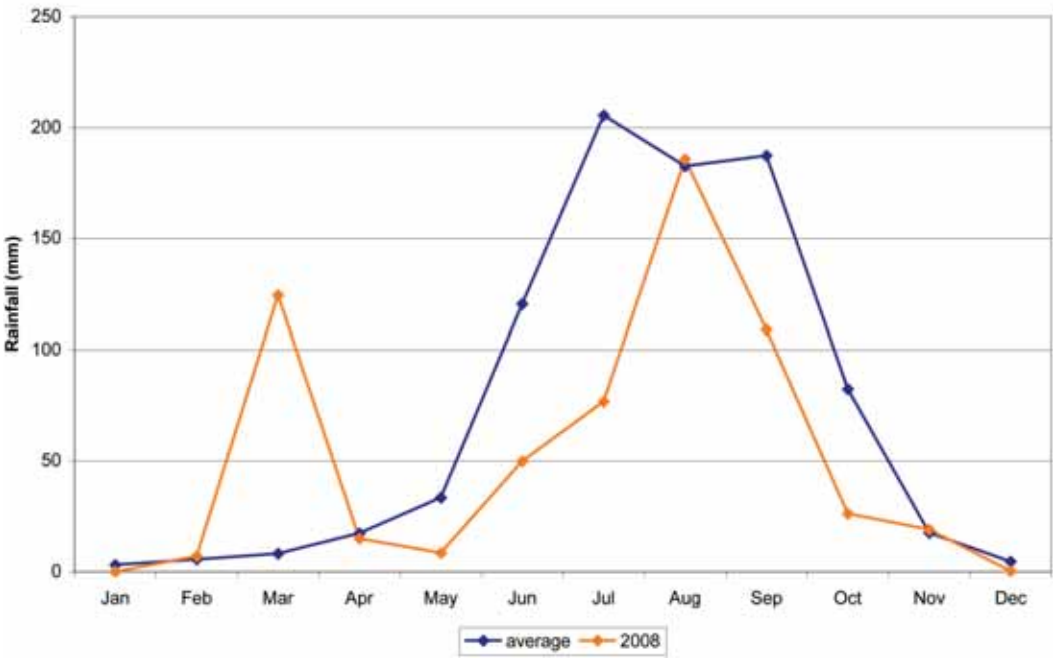
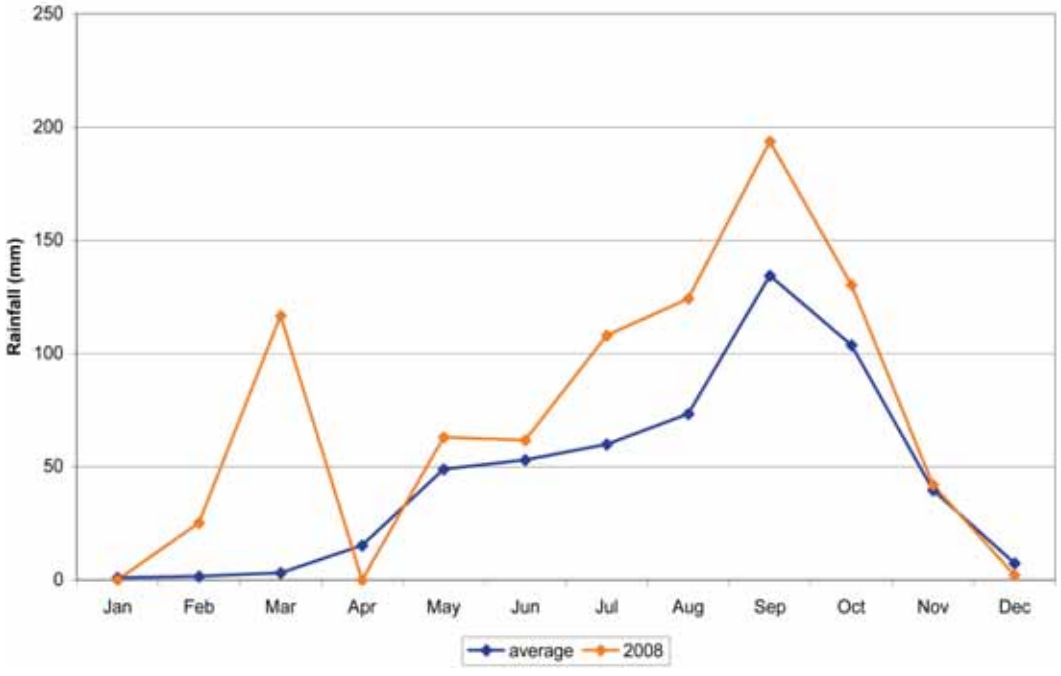


Figure 8. Average seasonal rainfall at Anantapur (average of district stations) in 2008 compared to long-term average of seasonal rainfall

(Data from IMD 2010 b; ANGRAU)



In response to the low and late-arriving rainfall of 2008, the majority of the Mahbubnagar respondents made some sort of change or a combination of changes to their cropping and livestock practices, the most frequent being cultivating crops that used less water (50 percent) and changing to more edible crops (37 percent). Indeed, rainfall was the primary factor among almost all respondents (96 percent) in influencing changes in cropping patterns. In a year in which there was more rain than 2008 (i.e. normal rainfall), farmers in Mahbubnagar would change their cropping pattern (48 percent) and grow more kinds of crops (39 percent). Similar percentages of men and women responded with this preference.

Meanwhile, in Anantapur, in response to an above-normal amount of rainfall, 63 percent of farmers made no change to their cropping and livestock practices while 25

"We will decide as we are the owners and we bear the input costs."

– Male farmer

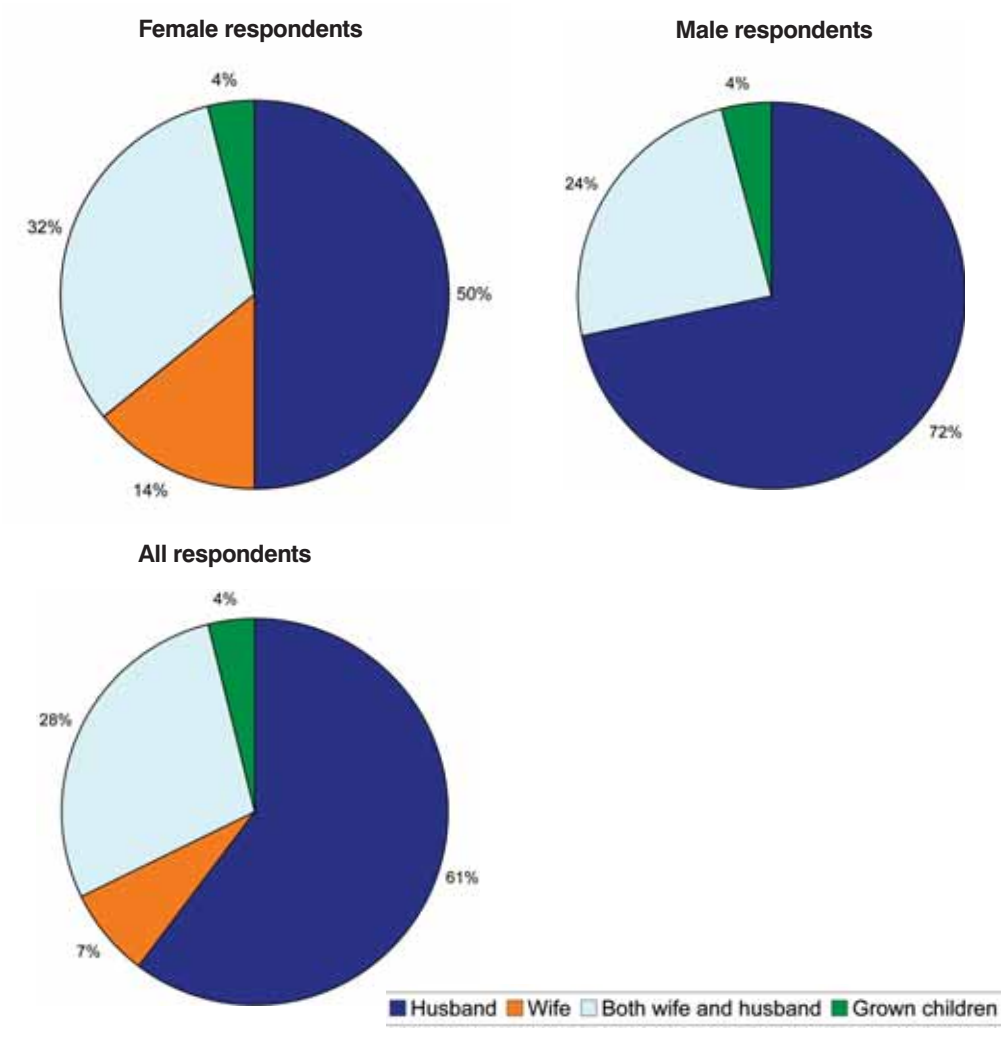
"Earlier except for red cotton we used to grow all food crops, but now we are only growing crops which we sell."

– Women farmers

percent did change their cropping pattern. This could be indicative of the respondents not having the resources to make changes, not having the information to anticipate the above-normal rainfall or not believing changes were necessary (institutional support for coping with rainfall fluctuations is discussed in section D). Farmers did seem to feel that they could implement changes if necessary; most farmers in Anantapur said that in a year in which there was less rainfall than 2008, they would cultivate crops that required less water.

There was no discernible difference between men and women with regard to what they reported as changes made in response to abnormal rainfall in Mahbubnagar and Anantapur. However, men and women did have distinct roles in deciding to implement changes and they also had different perspectives on their roles (Figure 9).

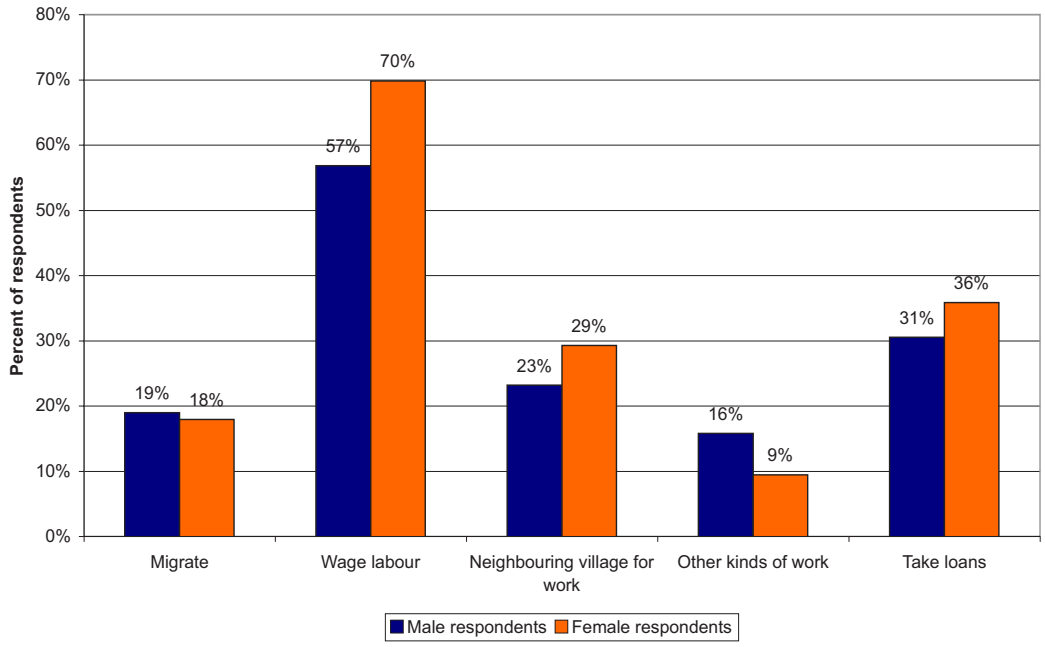
Figure 9. Who decides to grow different crops or to change cropping patterns? Comparison of responses by men and women.



COPING STRATEGIES IN RESPONSE TO LOW FARM INCOME DUE TO LOW RAINFALL AND DROUGHT[25]

In general, when rainfall led to low yields and insufficient income, as it did in 2008 in Mahbubnagar and in other years in Anantapur, farmers employed various coping strategies to supplement their farm income. As shown in Figure 10, the majority of farmers turned to wage labour for income, for example, in construction. More women (70 percent) than men (57 percent) reported that they undertook wage labour as a coping strategy in response to crop loss, which could be indicative of women's roles as "farmers" being less socially determined in terms of roles and expectations than men's. In addition, women of lower castes took on wage labour more readily than men of the same castes; women of lower castes supplementing family income through wage labour has also been shown elsewhere (Deb et al., 2002). Taking loans followed by taking work in neighbouring villages were also mentioned by about one third of participants, in both cases, by a higher percentage of women than men.

Figure 10. Men's and women's coping strategies to earn income when there is a crop loss due to low rainfall



In response to the more severe conditions of drought, the majority of respondents, both men and women, cite migration for income (as opposed to migration for survival, see Deshingkar and Start, 2003 and Rao GB, 2001) as the main coping strategy in response to drought. In response to drought, local wage labour and taking loans were also employed as coping strategies. The question of who migrates seemed to be related to the severity of the drought.

Migration in search of wage labour is a major coping strategy of households affected by drought

In focus group discussions, farmers spoke of large numbers of whole families migrating in response to severe droughts in the 1970s and many remaining away permanently, whereas today families migrated to cities for construction work during the non-agricultural season but it was not a permanent migration. In some cases the husband migrated and the rest of the family stayed behind. In the study villages, farmers reported in qualitative exercises that the decision whether to migrate and who migrates were taken jointly by men and women, however the specific decision of where to migrate was taken by men.

Other studies in Andhra Pradesh have shown that migration in search of wage labour is a major coping strategy of households affected by drought (World Bank, 2006; Laxmaiah and Vijayaraghavan in Rao, et al., 2005). Some studies have documented the hazardous conditions that migrants may encounter, including exploitation of labourers from Mahbubnagar district by labour contractors (Olsen and Ramana Murthy, 2000) and the employment of women and children from Anantapur in waste collection in Hyderabad whose living conditions are without basic amenities (CARPED, 2003). This demonstrates that farmers in this region no longer relied only on farming in drought years, and both men and women were likely to seek employment elsewhere.

It has been suggested elsewhere that migration can adversely affect family stability and that the change in demography can lead to the deterioration of natural resources through neglect (Deb et al., 2002). There is anecdotal evidence from the study area that attempts were made to maintain family stability by using new modes of communication; it was reported that men who migrated purchased mobile phones for their wives so that they could call them to check in and to continue to provide inputs to on-farm decision making when they were away from the family. How accessibility to new technology might mitigate the effects of migration on those that remain at home, particularly in light of the expected future agricultural and long term economic pressures of climate change remains to be seen.

COPING STRATEGIES IN RESPONSE TO FOOD INSECURITY

Ninety-eight percent of respondents reported that the amount of income from farm produce, which was their primary source of income, followed by wage labour, varied from year to year and was linked to climate variability. Income from farm produce was impacted in order of importance by the weather, yield, prices, availability of power supply and labour availability. This suggests that farmers' food security varies from year to year along with income.

Income is critical to the food security of the farming households, as food is sourced primarily through purchases rather than only through their own production. In a year with below normal rainfall, farmers obtained their food from multiple sources, including the Public Distribution System (PDS)[26] (94 percent), the open market (75 percent), stored produce (53 percent), through earnings of wage labour (48 percent) and wife's original home (3 percent). Less than a third of respondents noted they could not buy sufficient food for the entire family, suggesting that for the majority of respondents, sufficient amounts of food were available, despite the unfavourable climate conditions. While there was availability of food, the utilization component of food security did not appear to be sufficient in a dry year. One quarter of respondents reported that their households had sufficient food but not the types of food they wanted to eat. Most respondents found the food to be somewhat nutritious and a third did not think it was at all nutritious.

For those families that did not have sufficient food during a low rainfall year, the coping strategy for dealing with this shortfall was for all family members to eat less. However, more women than men noted that they themselves would eat less. In fact, men were more likely than women to say that the whole family had sufficient food (56 percent of men vs. 34 percent of women). Also, women were much more likely to say that their husband got sufficient food (24 percent) than men would say their wives got sufficient food (1 percent). As men were not involved in food preparation, they were more likely to be unaware of the actual food distribution. In the qualitative focus group discussions, women described eating two instead of three meals: they distributed food first to men, then to children (boys and girls) and finally to themselves. This gender-based distribution of food is a traditional coping strategy for dealing with food scarcity and takes place usually even without low rainfall (and is based on the 'value' and 'worth' culturally assigned to men and women); however, it appeared to be exacerbated during a dry year. In-household access to food must be considered when examining how climate variability impacts food security.

Finally, the stability of the farmers' food security appeared to vary over the course of the year and was tied to climate variability. The men and women of Malkapur village (Mahbubnagar district) described how during the June to October season of 2008 they relied on the Public Distribution System (PDS) for mostly white rice and stored food from

their own crops. According to the women, the amount of food available largely depended on the men's decision on how much to store and how much to sell. Women also noted that while it was the men's responsibility to sell the crop, women, who were responsible for ensuring the family's food supplies and also for cooking and distribution of food, would hide some of the crop without the knowledge of the men for the family's consumption.

In Malkapur, the rains in the June to October season of 2008 were late and yields were low, meaning income was also low. The farmers sought income from other sources in order to pay the loans they had taken for farming activities during June to October and to prepare the fields for the November to February season. The yields during the November to February season were also low, and so by the start of the third season, some of the men of Malkapur migrated and the women collected firewood to sell in order to overcome their severe food shortages. In addition to the low rainfall, the need to guard the land from animal attacks was of serious concern. The experiences in this village show how unfavourable climatic conditions in one season can be compounded over the course of the year and impact the subsequent year.

COPING STRATEGIES: FUTURE SCENARIOS

If confronted with persistent below-normal rainfall or dry conditions in the future, farmers' coping strategies would likely shift from modifications in on-farm activities to other income-generating opportunities. If there were not enough rain for a few years in a row, respondents suggested their preferences would be as follows:

1. taking waged labour (59 percent)
2. going to neighbouring villages for work (35 percent)
3. migrating (27 percent)
4. and taking loans (27 percent).
There was no significant gender differentiation in these responses.

However when asked if the weather was no longer predictable from year to year, i.e. not just persistently dry as above but continually unpredictable, gender differences emerged. Both men and women would seek additional income through wage labour, however women would prefer to do so closer to home whereas men were prepared to go farther away. More male respondents preferred migration in search of wage labour (47 percent) to local wage labour (38 percent) as a coping strategy, whereas more women preferred local wage labour (57 percent) to migration in search of wage labour (18 percent) as a coping strategy. This statistically significant difference along gender lines suggests that if climate becomes unpredictable for the foreseeable future, men and women would prefer wage labour in different locations, with men prepared to face a greater distance from home. There are implications of these different preferences for family structure and their long-term sustainability, and how they will be reconciled with each other.

D Men and women farmers rely on institutional support but have different levels of access

This section describes the broad findings regarding men's and women's access to and use of institutional support (mostly through government and NGO programmes), and also highlights some areas that warrant further investigation.

KEY FINDINGS:

◎ 1. Farmers reported a strong reliance on support from government employment schemes and loans.

◎ 2. Men and women farmers made different use of the available institutional support and it appeared that women had limited access to information relevant to farming in comparison to men.

LIVELIHOOD SUPPORT TO FARMERS

The farmers in the study area found support for farming and food security from numerous sources. The top four programmes were the Public Distribution System (PDS, supply of foodgrains at reasonable prices by the Department of Public Distribution); the National Rural Employment Guarantee Scheme (NREGS, legally guarantees provision of at least 100 days of wage employment to rural households whose adult members are willing to do unskilled manual labour); Arogya Sree (a medical insurance scheme of the Andhra Pradesh State Government); and thrift and credit Self-Help Groups. The large majority of participants also reported receiving assistance from the government bank.

In the study area, government subsidies for inputs, microirrigation, and information on agriculture were accessed, as were employment and food distribution schemes. In general, prior to an extreme event or dry season, institutional support was available in the form of information on cropping patterns; credit; crop insurance and government subsidized seeds. In the event of a dry season or drought, institutional support was mostly in the form of a loan waiver; subsidized food through the Public Distribution System; and wages via the National Rural Employment Guarantee Scheme.

INCOME SUPPORT TO FARMERS

Indebtedness[27] among small farmers in Andhra Pradesh has been documented as a major problem with multiple causes, including agricultural stagnation, increased production and marketing risks, an institutional vacuum, a lack of alternative livelihood opportunities, and environmental degradation (Government of India, 2007). The farmers in the sample group were characteristic of farmers in Andhra Pradesh in their use of loans to supplement their livelihoods in order to meet domestic and farm needs, and also apparently in their low capacity to pay back the loans.

In reference to the year 2008, 53 percent of respondents noted they took loans, although this differs significantly by gender with 66 percent of men and 41 percent of women reporting they had taken loans[28]. The source of loans varied by gender, but the main source was the bank, followed by self-help groups and big farmers or money lenders. The amount of the loans ranged from Rs. 3 000 to Rs. 930 000, with the majority in the range of 10 000 to 59 000. It was not possible to determine the amount of loans received by men and women, because when respondents reported on the amount of loan received they did not differentiate between loans they themselves received or those that a family member received. However, nine of the eleven female-headed households in the study population received loans, ranging from Rs. 4 000 to 40 000 (average Rs. 24 000). In

Borewells dried up due to heavy exploitation

one case, a female-headed household received a loan through the head-of-household's son; in that case, the loan was for Rs. 100 000. These figures suggest that while women have access to loans, they may have access to smaller loans than men.

As sources of credit dried up or became too expensive, and as the dry period extended beyond a period when the hopes of having a good yield would be possible, the households needed to sell some of their assets to compensate for the shortfall in agricultural incomes. Twenty-three percent of respondents reported selling assets during 2008 and these were mostly livestock.

Income from farming did not appear to be enough in order to repay the loans. Loans were repaid by selling crops (68 percent); earning wages (53 percent); taking loans from self-help groups (15 percent) as well as selling some land, getting help from the wife's maternal family which seemed to want to assist their daughter whenever possible even if she lived away from them; as well as selling milk or by receiving support from family members working in the cities and; as a last resort by sending children to work.

"We know it is fatal, because rains are late." – Male farmer

Commenting on the Agricultural Extension officer's advice to sow groundnut up to end of August

"There is no more faith that we can live on our land."

- Group of male and female farmers

Working in the National Rural Employment Guarantee Scheme was clearly very important to the livelihoods of the study population. More than half (61 percent) noted that they or a family member did NREGS work during 2008-9. The farmers, especially women, did not have any idea of the allocated budget for their village; they only knew that there was work available the next day in a designated farm. Women were paid lower wages than men for their work in NREGS projects and sometimes were unaware of how much they made as their pay usually went directly to their husbands.

AGRICULTURAL SUPPORT TO THE FARMERS

Much less than one quarter of respondents reported receiving assistance (information, trainings, materials) from the government agricultural department, although this is significantly gendered with 36 percent of men mentioning the agricultural department and only 22 percent of women mentioning it. The type of support received was also gendered: 23 percent of men and 7.5 percent of women reported receiving agricultural information. In qualitative focus groups, farmers reported that the extension networks were poor and considered the advice not to be appropriate.

With regards to receiving information related to on-farm production, 33 percent of respondents said they receive information on cropping patterns/practices, however this was significantly gendered with 47 percent of men and 21 percent of women responding positively. Most agreed that more information was given to farmers with larger land holdings (who happened to always be male); there was a general perception that women farmers did not receive information (this was not necessarily related to the size of land holding but primarily due to gender) although this was not confirmed in the quantitative analysis. The expectations of government assistance also appeared to be gendered; more men than women reported knowing about and receiving timely information on weather and irrigation schedules; whereas women were less aware of the availability of such assistance.

Men and women appeared to have different sources of information about the weather, which has implications for how information on weather and seasonal variability is disseminated to community members. Table 5 outlines these differences and highlights the importance of television and relationships with neighbours in obtaining information related to weather forecasts. In particular, women appeared more likely than men to rely on neighbours for information, whereas men appeared more likely than women to rely on traditional knowledge. These sources of information were important factors in disseminating information to farmers on responding to weather events and seasonal climate conditions.

Table 5. Sources of information on the weather, by gender

SOURCE OF INFORMATION	Percent of female respondents	Percent of male respondents
Radio	5	12
Newspaper	0.9	18
Television	**42.5**	**52**
Neighbour	34	23
Family member	17	8
Traditional knowledge	14	33

These results of gender differences in access to institutions and information reflected differences in men's and women's education levels and literacy, as well as their culturally-defined roles in decision making and division of labour. For example, cultural practices discouraged women's interactions with outside men, thus women would not interact with extension agents and as a result would be less likely to report having access to this information. In confirming that gender was a factor in accessing precisely the information and support necessary for responding to climate variability, these results suggest that women are disadvantaged with regards to access to institutional support, which has major implications for building resilience to long-term climate change. However, there are many programmes that extend institutional support specifically to women in India. Nevertheless, there is a greater need to recognize the role of women in agriculture and the impacts on their livelihood of agricultural related decisions. It is important to increase the efficiency of institutional support to ensure that climate related information also reaches them to the degree that it is needed for making good decisions with or without referring to men.

TOPICS FOR FURTHER INVESTIGATION

The research identified a gap between the institutional advice on cropping provided and its uptake by farmers. In focus group discussions, the farmers, especially men, expressed the opinion that the advice provided was not suitable – either it came too late, or, if followed, it would not result in the highest possible profits. Furthermore, the local government practice of disseminating farming practices via a "model farmer" did not appear to be successful, as many farmers, particularly women, could not identify with, or even identify who the model farmer was. In order to better understand the apparent gap between institutional support and farmer actions, a deeper analysis of the institutional structure is needed and a separate analysis for the reasons behind this gap is essential.

As evidenced by the study population's reliance on loans, NREGS and migration, the farmer as a social actor is changing. The formally recognised 'farmer' of the past is becoming increasingly reliant on multiple sources of income other than farming. With women increasingly taking on waged labour, it is possible that gender roles are shifting. However, their entry into off-farm activities is usually centred in low-return easy-entry activities. Unequal access to diversification opportunities often exacerbates inequalities.

These are shifts that have also been documented in other traditional societies in transition: in view of external socio-economic pressures, farmers disengage themselves from entirely agriculturally-based production activities to a more mixed kit of several survival options. It appears that changes in climate variability are also encouraging a shift away from farming. While the government is supplying support to these 'new' farmers, it is not clear whether this support will be sufficient under continued changing climate conditions. Incentives will have to be invented, to encourage the younger generation to stay on the farm and produce food for both rural and urban consumption in the future, especially as the demand from urban areas will increase. In a similar vein, how the 'formal' farmers who are no longer farming are coping both in the short and long-term as well as how they could be supported to remain on the land also warrants further investigation.

THE FUTURE: LESSONS FOR SUPPORT IN TIMES OF DROUGHT

In the summer of 2009, after the conclusion of the field work for this study, the dreaded drought became a reality in both Anantapur and Mahbubnagar district. Not only did the rainfall arrive late, when it finally did arrive just before harvest, it resulted in floods in some areas. On 9 September, 2009, the Government of Andhra Pradesh declared 971 mandals in 21 districts as drought affected, including the two mandals in which the study villages are located (Gooty in Anantapur and Koilkonda in Mahbubnagar) (a mandal is an administrative level within a district) (Government of Andhra Pradesh, 2009).

The field team visited the village of Ankilla in Mahbubnagar district in the aftermath of the drought, for three days at the end of September, 2009, to get a snapshot of what the farmers' and government's responses had been. It appeared that the drought impacts were harsher than what farmers had anticipated prior to the onset. The farmers reported that these drought times were hard on everyone and that it had affected them in many ways.

All of the farmers that the field team met with had experienced crop loss. Sorghum (the June to September season crop) failed for most farmers because of lack of rain. The lucky few who managed to get some yield were wary that the untimely rains would damage that, too. The sorghum crop sown in June was completely destroyed by rains that came

just before the harvest. The few families in the village with cattle were able to endure the drought by selling milk.

Farmers also reported ill health and a rise in food insecurity. Farmers expressed doubts about their resilience, saying they previously thought their coping mechanisms would ensure their food security, but when the situation worsened they could barely appease their hunger. This was especially true for women. "We are eating once a day, and sometimes not eating, too. We eat broken rice now to survive. This was not the case before," said a woman farmer.

In response to crop losses, farmers turned to wage labour for income. "We need to work as labourers and live, we cannot be farmers" rued a female farmer. Activities through the NREGS provided wage labour for 40-250 persons a day in Ankilla village. Women said that they preferred working in the fields of larger farmers rather than in the construction activities of the NREGS projects because, despite lower wages, field labour was not as heavy or gruelling during the severe summers.

Through the government drought contingency plan, the authorities stepped in to support the farmers. The farmers did not seem to have complete information about the plan and were critical of numerous components, including the following critiques:

- **Farmers hoped for a waiver of crop loans they had taken from the banks and were disappointed that the government prescribed rescheduling of loan repayments.**
- **The farmers were not enthusiastic about the crop insurance scheme because they felt the returns for the premiums were not attractive.**
- **Farmers felt the government advice on alternative crops came too late and the suggested crops were not appropriate.**
- **Farmers found the government-subsidized seeds to be of inferior quality to the ones they had saved, or could borrow or buy.**

These opinions were expressed only a few weeks into the government outreach efforts; a more complete assessment of the programme would be needed to evaluate the eventual impact of the programme in 2009 and identify where improvement may be needed in the future.

Farmers still had hope in farming, but it was unclear how they could be successful in farming if droughts like the one in 2009 were to recur.