Task Report

Title of the report: Climate change and the
role of gender: A study from Andhra Pradesh
and Tamil Nadu in South India

Sustaining rice production in a changing climate

Title of the report: Climate change and the role of gender: A study from Andhra Pradesh and Tamil Nadu in South India
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Contents

Tables

Figures

Maps

Xenarios et al, ClimaRice Report No.2, 2012

1. Introduction

There is a blossoming literature on gender and climate change issues broadly focusing on the effects of extreme climatic conditions on gender and its role (Lussier et al, 2007; DFID, 2007; Parikh, 2007; Vogt et al, 2009; Skinner, 2011). The studies mostly focus on gender inequalities in agrarian communities within developing countries, where the dependence on stable climatic conditions for living is more apparent (Lambrou and Piana, 2006; IPCC, 2007). In recent years, climate change and impacts on poverty, gender and economic empowerment are being addressed as the most prominent in developing regions (Chen et al, 2005; Grown et al, 2005; Esplen and Brody, 2007; Skinner and Brody, 2011).

In some cases, the studies narrow down the focus to specific weather events like droughts, floods (Mendez et al, 2007; Pincha, 2008) or natural disasters in rural communities (ICIMOD, 2007). In other cases, particular gender groups like the adolescent girls in certain developing countries are analyzed (Vogt et al, 2009).

The agrarian communities within less developed parts of South Asia are some representative examples that are frequently referred in climate change and gender studies (Lambrou and Nelson 2010; Øvstegård et al, 2010; Suman et al, 2011). In India, special emphasis is given on the role of gender a as a determinant for the unequal distribution of climate change impacts not only at a household but also at community level (Rao, 2001; Acosta-Michlik et al, 2005; Brenkert and Malone, 2005; Ahmed and Fajber, 2009). However, a quantitative research on gender's role in climate change and livelihoods in rural India is still inadequate.

In this study, a quantitative analysis was carried out to study the link between climate change and the role of gender. The survey was carried out in Andhra Pradesh and Tamil Nadu states in South India for the delineation of gender's role towards the current and the anticipated climate change impacts. The analysis is based on a household survey applied through a questionnaire form and a random sampling in eleven selected villages of the two states.

A preliminary study has already been conducted in the same areas as a preamble of the gender and climate change effects through the ClimaRice II project (R. Øvstegård, 2010). In this analysis however, we further proceed to a quantitative and more in-depth analysis of the current situation, the drivers and the policy measures to be potentially adopted for gender improvement against climate change impacts.

This report initially presents some descriptive analysis of the sampled households. Particularly, the socio-economic data of the respondents is presented while the gender role in the undertaking of family decisions is explored. In turn, the initiatives adopted from households in case of unpredictable weather conditions, crop losses and drought effects are delineated. In the later part, more attention is given to gender's role and reaction towards the adaptation to the current climate change effects. The importance of the Self Help Groups (SHGs) in the improvement of women's livelihoods is also addressed.

The analysis further applies some inferential statistical approaches for the understanding of gender's role in coping with climate change impacts. In particular, the gender role in agricultural activities and in land property ownership as an influential factor for adopting new measures is examined. Some further inferential results are derived from a multinomial regression analysis. The potential relation of the socio-economic status of the respondents with their response stance on the observation of adverse climatic conditions is explored.

2. Materials and Methods

This report steps on the results of the preliminary analysis conducted along ClimaRice II in December 2010 for the gender and climate change effects in selected sites at Tamil Nadu and Andhra Pradesh states. In particular, the preliminary analysis, has conducted a thorough literature review on the gender role towards climate change adaptation with a particular focus on India. The perspectives of international organizations towards the role of gender in the climate change debate was discussed (FAO, 2004, 2007, 2009; UNDP, 2007,2009; UNECA, 2009). Further, a brief description of women's role in confronting with climate change effects in the states of Tamil Nadu and Andhra Pradesh was presented. The representation and tasks undertaken by women in regard to household and labor activities and their access and control to natural resources was analyzed. Also, the involvement in decision-making structures and processes and the importance of SHGs was highlighted.

The current survey attempts to identify gender's role in coping with climate change effects through descriptive and inferential statistical analysis as presented in Box 1 in a stepwise manner.

Box 1. Methods and Materials

- *Interrelation of socio-demographic indicators (descriptive –inferential statistics)*
- *Gender's role in household activities (inferential statistics)*
- *Gender's role in household welfare towards adverse climate effects(inferential statistics)*
- *Potential effects of socio-demographic factors towards the relation between gender and climate change (inferential statistics)*
- *The role of Self Help Groups (SGHs) in the potential adoption of measures for the alleviation of climate change impacts (inferential statistics)*

In particular, the study is initially focused on collecting information related to key socio-demographic indicators namely, the age, the family size, the education and the land size ownership of the farmers. The interrelation of different socio-demographic parameters is examined through some basic inferential statistical analysis. Namely, a correlation between the selected parameters is attempted to conceive any potential relations and trends while a cross-tabulation analysis reveales frequencies of observations that belong to specific categories on more than one parameter. By examining these frequencies, the study identifies how the distribution of different parameters is related to each other.

Further, relative frequencies are introduced to comprehend gender's role in determining household and family activities. In particular, the gender's significance in controlling the household's finances, undertaking household works and arranging household socialization and mobility is portrayed. A descriptive analysis of relative frequencies attempts to identify the most prevalent impacts of gender towards the current climate change effects as reflected at a household level.

A cross-tabulation analysis is further applied for a better understanding on the potential relation between land ownership status and practical alleviation measures for the mitigation of climate change impacts at a household level. It was noticed that there is a tendency for adoption of different adaptation measures at households in South Asian communities, depending on the ownership status of agricultural land (Mitchell et al, 2007). To this end, the study attempts to further clarify this assumption by also investigating the potential effects emerging from different landholding ownership status. The role of gender role in the household income is also explored as another potential factor that affects households in taking measures against the impacts of extreme climate and weather conditions.

The significance of gender in controlling the financial matters of the household and in deciding on the specific cropping patterns is further investigated. The study uses a Multinomial Logistic Regression (MLR) where the gender's role in the economic welfare of the household act as dependent variable while the socio-demographic indicators act like predictors. The concept of logistic regression is based on the application of maximum likelihood estimation after transforming the dependent into a logit variable (the natural log of the odds of the dependent occurring or not). In this way, logistic regression estimates the odds of a certain event occurring (Garson, 2010). The advantage of MLR over other regression analyses is the capability of coping with the range of an exponential family of distributions, such as normal, Poisson, binomial, and gamma. Also, MLR model performs less stringent requirements than other regression analyses by still offering reliability in results.

Finally, the involvement of women to Self Help Groups (SHG) is assessed through a descriptive statistical analysis. The reasoning for the examination of the SHG in a separate field was due to the significant role of these groups in the encouragement of women to significantly empower their livelihoods and decision making.

3. Case Study

The data has been adopted through a household questionnaire survey. The questionnaire was conducted in 214 in Tamil Nadu and 122 farmers in Andhra Pradesh states, 326 responses in total. After a screening for the outliers and incomplete questionnaire responses, 244 responses were examined in total.

In the case of Andhra Pradesh state, the data was collected from Nagarjuna Sagar Project Right Canal (NSPRC) and Krishna Western Delta (KWD) area of Krishna river basin. The survey was conducted in four villages with mixed male and female headed households as presented in Map 1.

Map 1. Selected villages (spotted in red) in Krishna river basin

Similarly, in Tamil Nadu, the data was collected from males and females from five villages distributed in Thogaimalai, Kulithalai (Karur district), Orathanadu and Thiruvaiyaru blocks (Tanjore district) of Cauvery river basin as depicted in the map 2.

Map 2. Selected villages (spotted in Green) in Cauvery River Basin

Cauvery River Basin
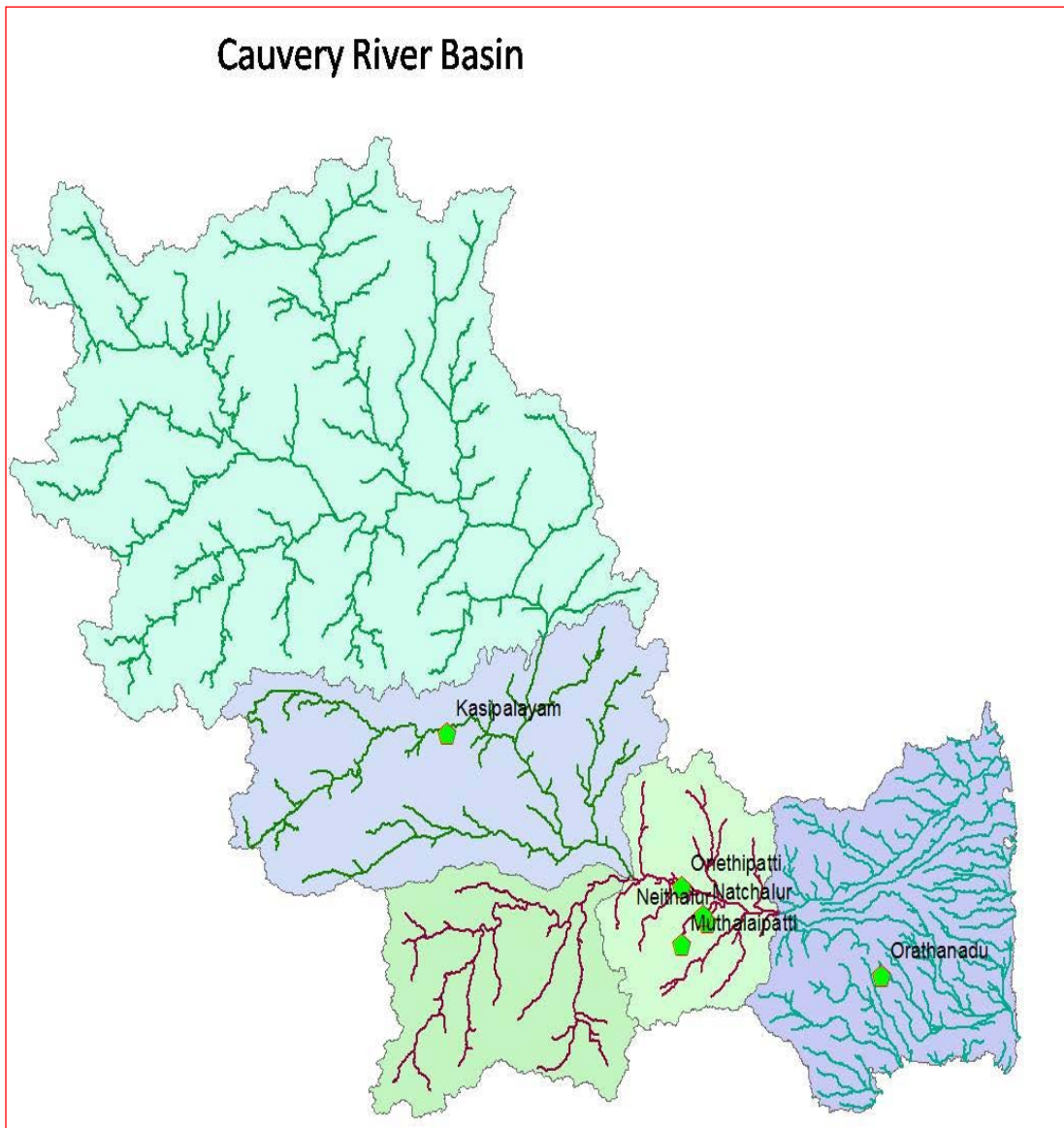
4. Results

4.1 Socio-demographics

The results showed an almost equal representation of middle aged and old farmers while the younger groups were highly underrepresented. In the case of family size, the majority was medium sized families (4-6 persons) while the small families (3 persons) also take a high share.

The educational status of the sample seems to be well distinguished by primary school graduates. However, the accumulation of the college and postgraduates is even higher (42%) than the primary school farmers by indicating an equally high percentage of well-educated respondents. The welfare distribution is reflected in Figure 4, in the landholding size allocation status. There, an almost balanced distribution between small and large farmers is observed although the marginal landholders are underrepresented.

Figure 1. Age distribution	**Figure 2. Family size**
Figure 3. Educational status	**Figure 4. Lanholding size**
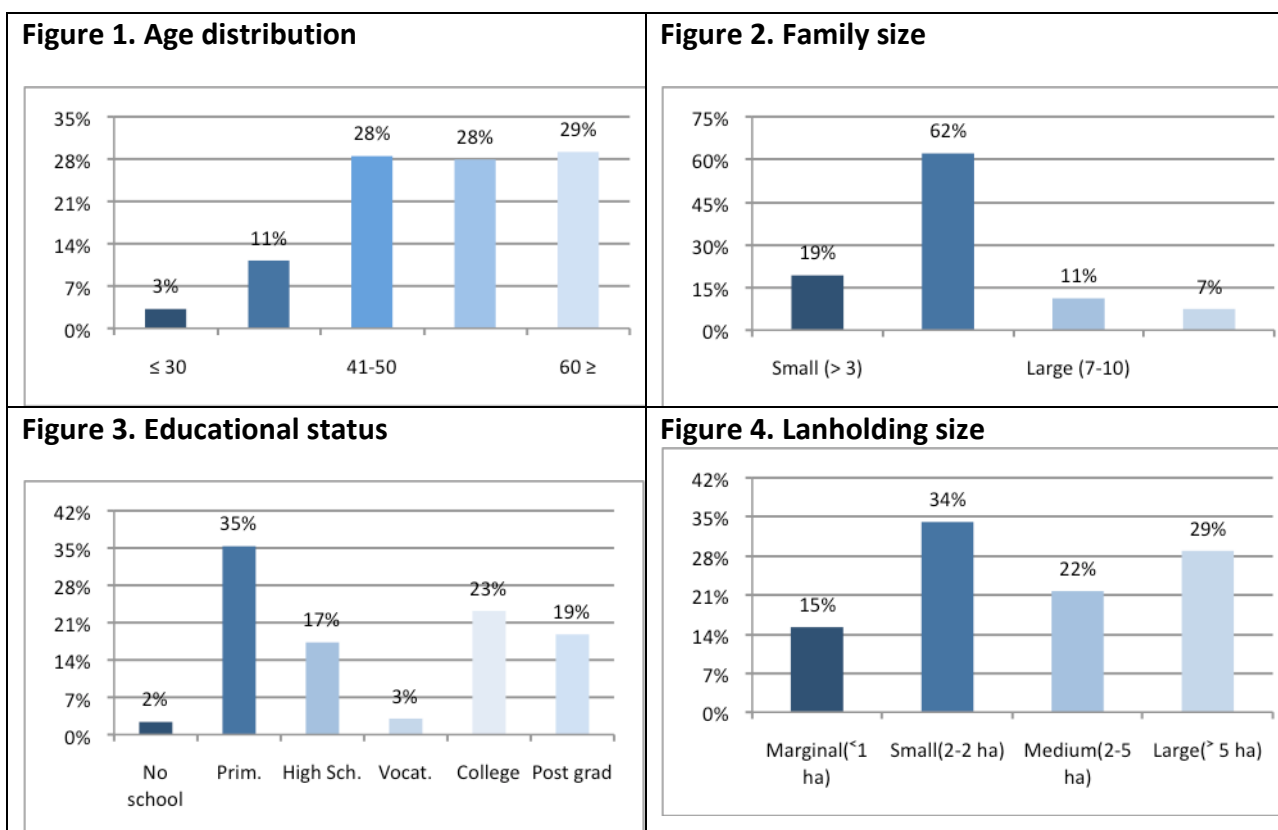
Note: Prim= Primary School, High Sch.= High School, Vocat.= Vocational School, Post Grad= Post Graduate studies

When a correlation analysis between the socio-demographic indicators is conducted, it appears that only the landholding size seems to affect positively the other three indicators to a significant level. This means that the farm size seems appears to get larger when also the farmers' age is getting higher, the household size is getting increased and the education level is raised (Table 1).

Xenarios et al, ClimaRice Report No.2, 2012

Table 1. Correlation of socio-demographic parameters

Correlation parameters		Farm Size (ha)
Age	Pearson Correlation	,249**
	Sig. (2-tailed)	,000
	N	244
Hsd Size	Pearson Correlation	,190**
	Sig. (2-tailed)	,003
	N	244
Education	Pearson Correlation	,184**
	Sig. (2-tailed)	,004
	N	244
**. Correlation is significant at the 0.01 level (2-tailed)		

A graphical cross-tabulation analysis among the farm size groups and the other three socio-demographic parameters is presented in Figures 5a,b,c. In these figures, the upper horizontal axis represents the farm size in hectares (0-5), while the vertical axes represent the age, household size and education respectively, and the bottom horizontal axis represents the absolute frequency of the farmers as distributed among the examined parameters.

**Figures 5a,b,c. Graphical cross-tabulation analysis of socio-demographic parameters**
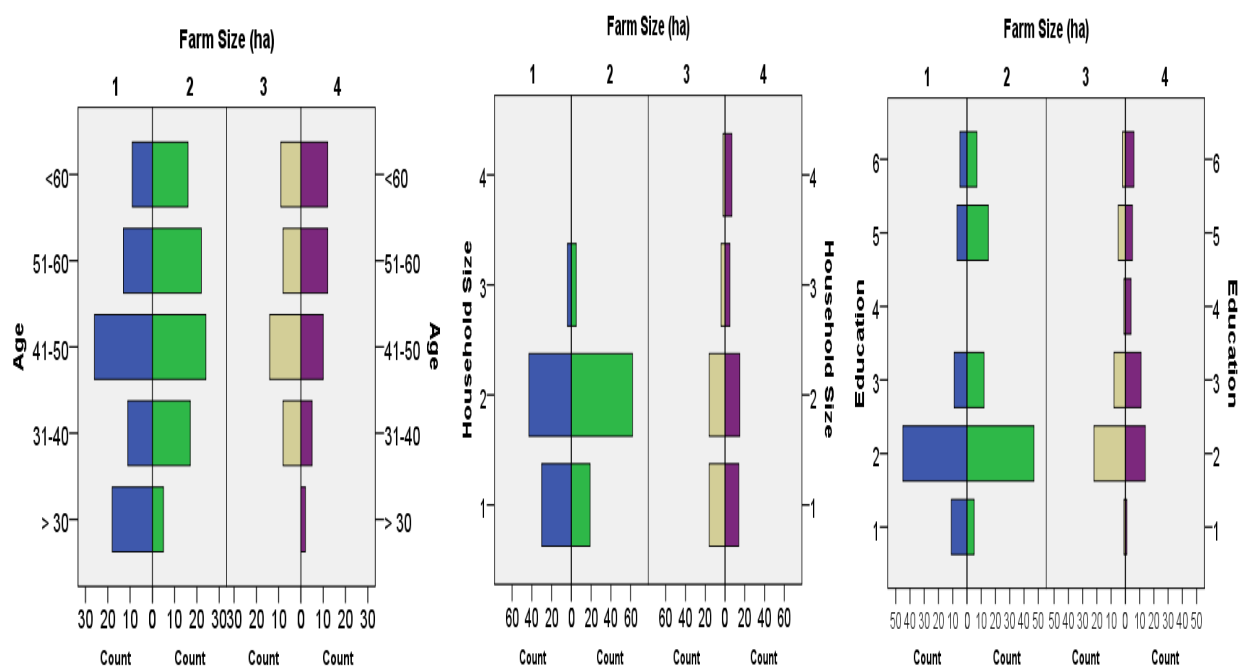
Note: Household Size (1=>3 members, 2= 4-6 members, 3=7-10 member, 4=<10 members), Education (1=No School, 2=Primary School, 3=High School, 4=Vocational, 5=College, 6=Post Graduate)

Xenarios et al, ClimaRice Report No.2, 2012

In figure 5a, the large landholdings seem to be owned by farmers aged in the range of 40 years old and higher. In the case of the household size, a significant amount of small farmers seems to belong to the medium families size while only some few large-size families seem to be identified with large landholdings. The educational status does not present a distinctive trend among the different categories except for the fact that the primary school graduates seem to be the vast majority among marginal farmers.

The descriptive statistics related to household activities reveal the role of gender (Figure 6). In particular, the decisions about financial matters seem to be influenced by both male and female sexes, with a slight predominance of the male influence. The situation is however altered in the case of family mobility and control where women take the lead. The role of women becomes more distinctive in decisions related to household works.

Figure 6. Gender's role in household activities
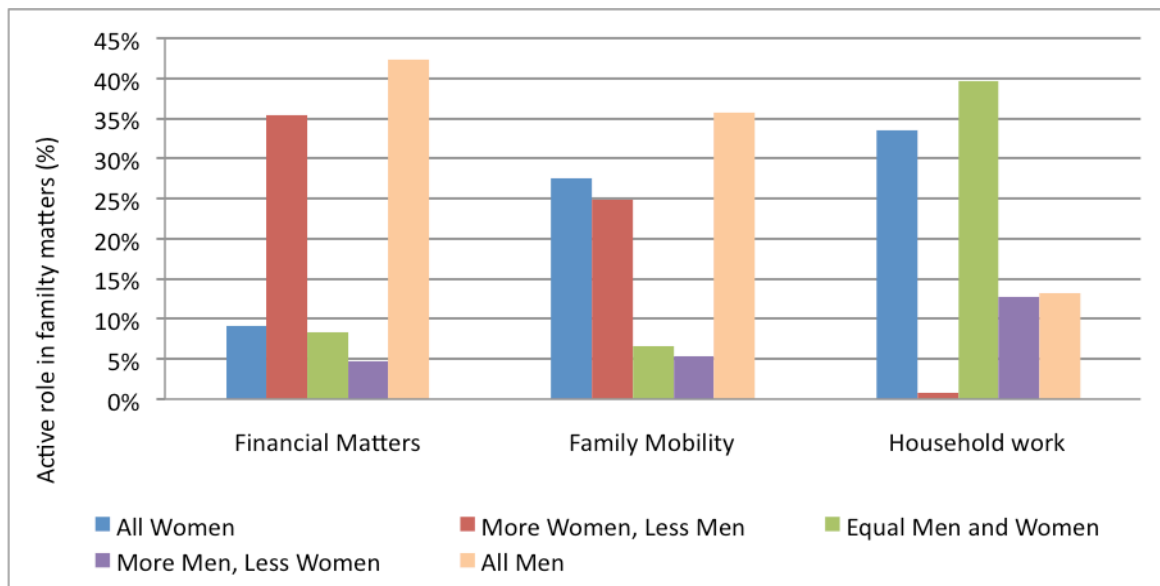
4.2 Gender and climate change effects

The household impacts and response towards extreme climate and weather cases seem to be highly linked to gender role. As presented in Figure 7, men appear to signify their own labor input to farm as the most significant variable to be influenced by climate change. It is then the loan potential which seems to constitute a reaction towards the climate change effects. There seems to be however some other variables linked to men which could not be captured in the present study and are categorized as "Others".

In the case of women, the greatest concern was the availability of food during extreme climate and weather events. The increased violence is also another major concern. If this will be

accumulated with the factor of the increased family arguments, then the conflicts to be emerged within the households should be probably better scrutinized.

Figure 7. Impacts and responses towards climate change and the role of gender
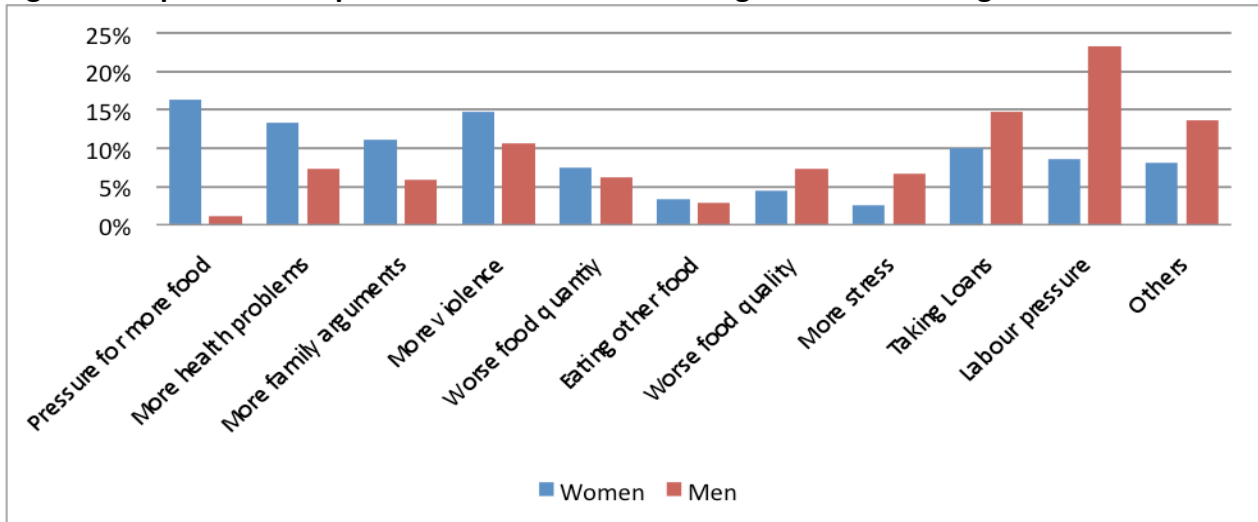
The study also explored the potential significance of gender and land ownership and insufficient rainfall for farming practices. As presented in Figure 8, the majority of land is owned by both female and male household members while only less than one fourth of the land belongs to only male household's owners. A significant percentage of land remains "undefined" due to unresolved legal and technical constraints.   As shown in Figure 9, more than one third of the respondents preferred to change cropping pattern in scarce rainfall years and shift towards more water resistant crops. An almost equally significant amount opted to shift to livestock while one fourth of the sample wanted to maintain the status quo.
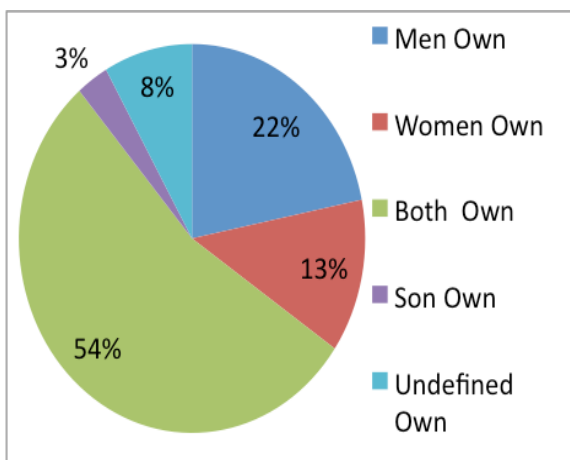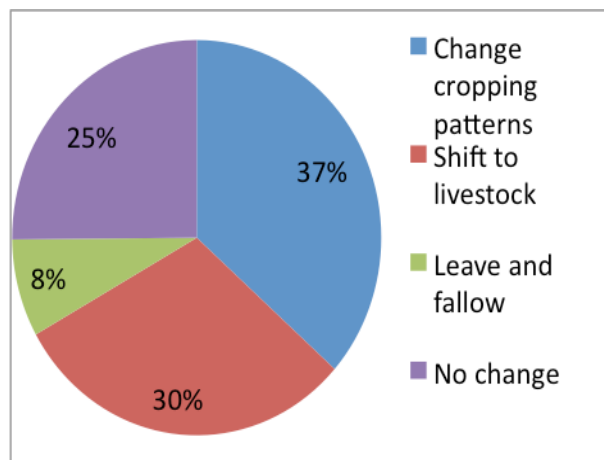
Figure 8. Land Ownership

Figure 9. Changes against deficient rainfall

Xenarios et al, ClimaRice Report No.2, 2012

The cross tabulation analysis (Figure 10) reveals that when the land is owned by both wife and husband (Both Own), then there is a higher chance for the household to adopt some measures against deficient rainfall years. Interesting is though, that in the case where no change is preferred, it appears to be mostly decided by male land owners.

Figure 10. Land Ownership and measures against deficient rainfall years (in %)
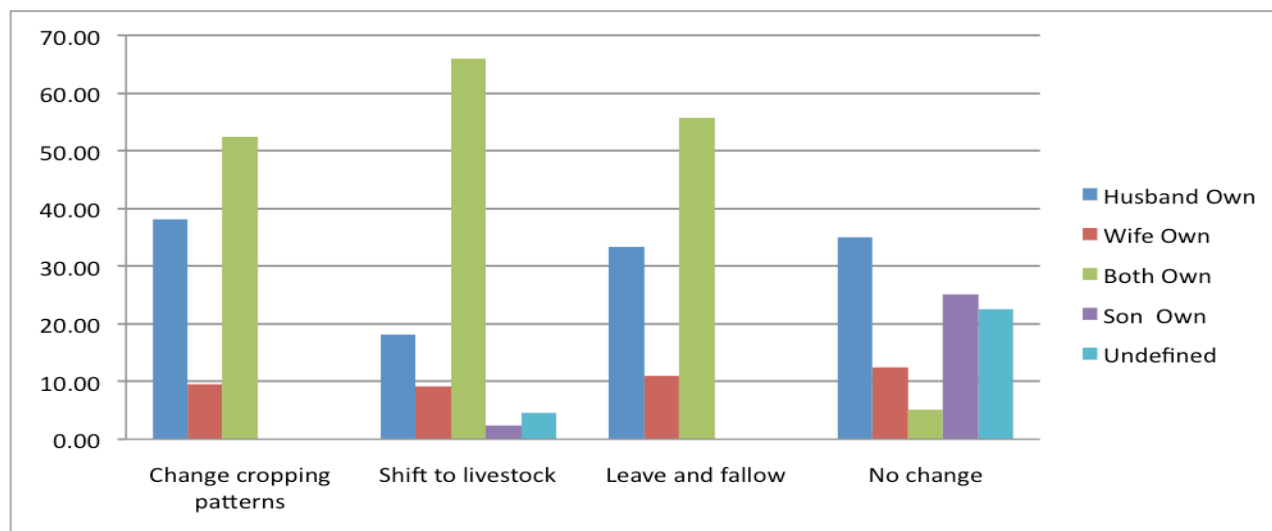
The study analyzes the gender role as a determinant for household income and its relation with long-term initiative against climate change. In particular, the women appear to play a major role in earning cash income, by contributing to more than one fourth of the household income (Figure 11). When this percentage (28%) is added with the percentage of the category "More Women, Less Men" (18%), the contribution of female gender in the household livelihood becomes more than apparent.

The long-term initiatives to be taken against adverse weather conditions were further assessed. As presented in Figure 12, the majority of the respondents opted for family support to respond to extreme weather. The support was either in kind (i.e. food assistance, crop seeds, agricultural machinery) or in the need of financial resources. A noteworthy also amount decided to take loans. Less than a quarter of the famers adopted crop insurance to cover the risks due to against extreme weather conditions in the long run. A few households preferred to shift to new jobs and migrate.

Figure 11. Cash income source and gender
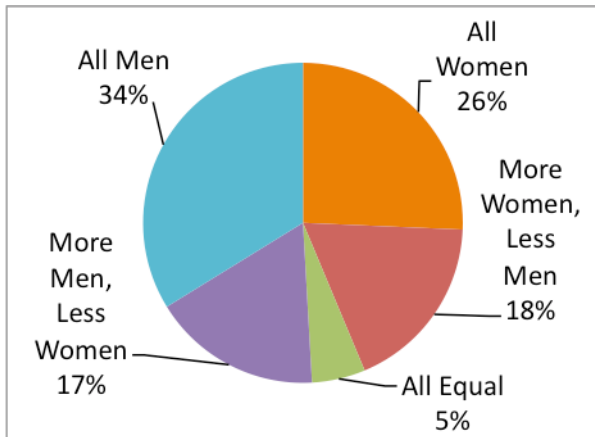
Figure 12. Initiative against adverse weather
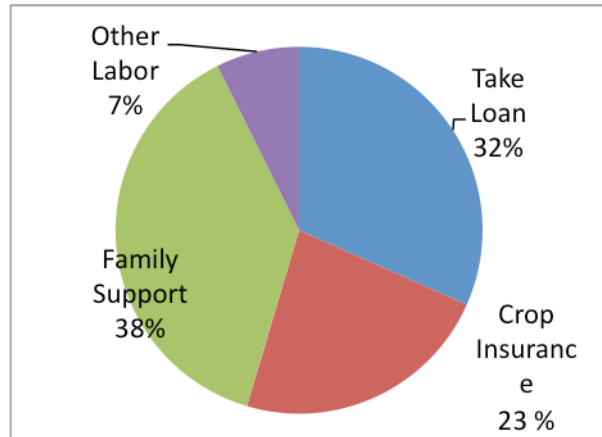
The relation between gender and household cash income and its role in addressing the impacts from extreme weather was examined (Figure 13). It appeared that the family support was important in households in the cases where the females were contributing the most to cash income. Females also opted for crop insurance as a means of covering risk. In the households where men earned a major part of the cash income, they favored in taking loans from the banks, followed by the option of crop insurance. An equal amount of female and male gender cash incomers seem to opt to other labor options when adverse weather conditions are present.

Figure 13. Gender's role in cash income and initiative towards adverse weather conditions

Xenarios et al, ClimaRice Report No.2, 2012
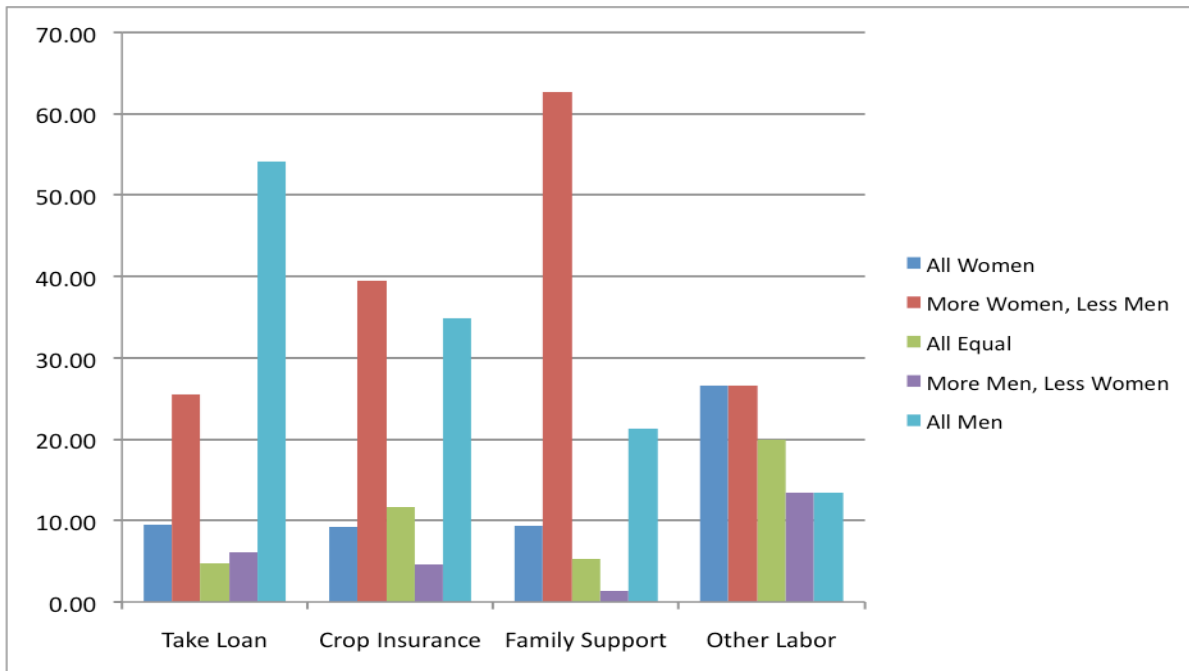
4.3 Gender, socio-demographics and welfare

The potential effects of key socio-demographic parameters towards gender and decisions which affect household's welfare were further analyzed through multinomial logistic regression (MLR). The socio-demographic parameters or else the predictors to be examined were the age; the household size; the farm size; the educational level; the land ownership status; the potential training in agricultural related seminars and the participation in associations like cooperatives and Self-Help Groups.

The role of gender in the decision to grow different crops or changing cropping pattern was initially delineated as a dependent variable from the socio-demographic predictors. As presented in Figure 14, it was mainly both the man and woman in the household and grown up children who decided the type of crops to be grown. In some families, the elder's opinion was also considered. It is interesting to note that the government's advice did not matter much to households in choosing the crop type.

Figure 14. Gender's role in cropping pattern decision
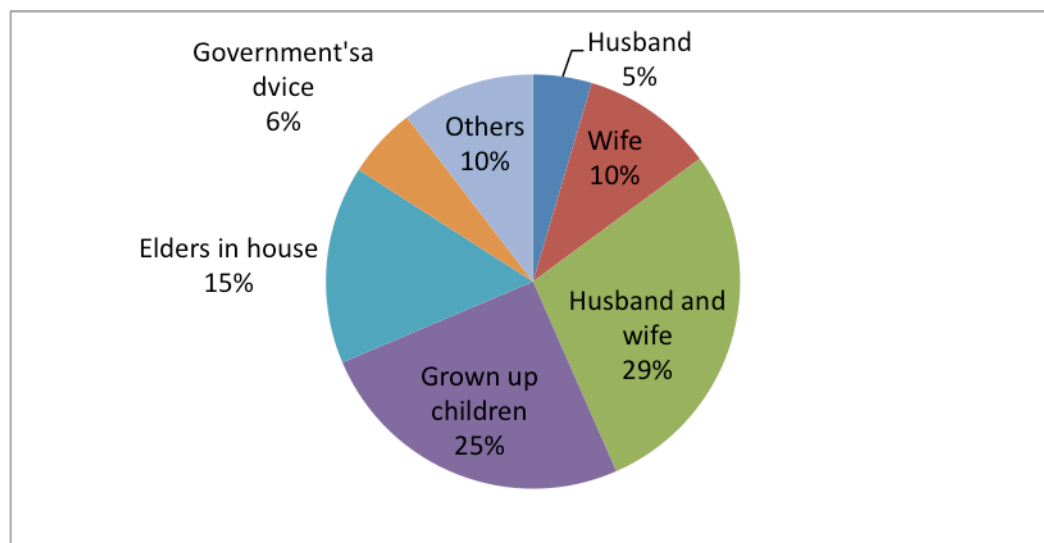
When the MRL analysis is conducted for the potential effects of the socio-economic parameters (prediction variables) in cropping pattern decision groups (dependent variable), the model seems to comply satisfactorily and with a high degree of correlation as presented in Table 2.

Table 2. Modell fitting in deciding on cropping patterns

Model	Model Fitting Criteria	Likelihood Ratio Tests			Pseudo –Square R	
	-2 Log Likelihood	Chi-Square	df	Sig.	Cox and Snell	,748
Intercept Only	719,731				Nagelkerke	,787
Final	383,083	336,649	112	,000	McFadden	,460

In table 3, the MLR results show only the relations which present a statistical significance to 95% level and thus considered as reliable results. The land ownership, the group membership, the training courses undertaken and the farm size were the most influential parameters towards the adoption of specific cropping patterns by men and women. Particularly, the male members of the family seemed to be in favor of joint decisions - as shown in Figure 14. The training courses seem to positively impact the decision undertaken by men while a negative indication occurs in case of women. Further, the small farm size is likely to positively affect to cropping decision by the females and the grown up children in the household.

Table 3. Socio-demographic effects in deciding on cropping patterns

Deciding Cropping Patterns groups (as classified in Figure 14) [a]		B	Std. Error	Sig.	Exp(B)
Husband	Training 1-5 courses	5,430	2,161	,012	228,179
	Training 6-10 courses	0[b]	.	.	.
	Group member with 10-20 members	7,730	3,343	,021	2276,323
	Group member with <20 members	0[b]	.	.	.
Wife	Farm size 1-2 ha	3,251	1,493	,029	25,822
	Farm size <5 ha	0[b]	.	.	.
	Training 1-5 courses	-5,436	2,203	,014	,004
	Training <40 courses	0[b]	.	.	.
Husband &Wife	Land own Husband	6,928	3,385	,041	1020,747
	Land own Wife	3,849	1,620	,018	46,949
	Land Own Undefined	0[b]	.	.	.
	Group member with 10-20 members	5,602	2,749	,042	270,933
	Group member with <20 members	0[b]	.	.	.
Grown up Child.	Farm size 1-2 ha	2,756	1,329	,038	15,740
	Farm size <5 ha	0[b]	.	.	.
a. The reference category is "Others" (see Figure 14)					
b. This parameter is set to zero because it is redundant.					

A similar analysis is conducted on the *potential effects from socio-demographics (predictors) to the decision on financial matters in a household level (dependence variable).* As displayed in Table 4, The MLR is also well fitted with a satisfactory degree of significance and correlation level.

Xenarios et al, ClimaRice Report No.2, 2012

Table 4. Modell fitting in deciding on financial matters

Model	Model Fitting Criteria	Likelihood Ratio Tests			Pseudo –Square R	
	-2 Log Likelihood	Chi-Square	Df	Sig.	Cox and Snell	,549
Intercept Only	437,185				Nagelkerke	,651
Final	243,155	194,030	56	,000	McFadden	,430

The MLR results for the decision on financial matters entail that only women's leading role in financial matters seems to have a statistical significance with regard to specific socio-demographic parameters. In effects, when the land belongs to both the genders, then there are higher possibilities for women to decide on household's finances. It is rather significant to mention that the young farming age, the belonging to a group member and the participation to training course seems to discourage the decision on financial matters by gender female.

Table 5. Socio-demographic effects in deciding on financial matters

Deciding Financial Matters groups (groups as classified in Figure 6) [a]		B	Std. Error	Sig.	Exp(B)
All Women	Age >30	-4,232	1,709	,013	,015
	Age 51-60	-1,780	,650	,006	,169
	Age <30	0[b]	.	.	.
	Training 1-5 courses	-2,927	,749	,000	,054
	Training <40 courses	-2,359	,661	,000	,095
	Training <10 courses	0[b]	.	.	.
	Land own Husband	-2,363	,865	,006	,094
	Land own Husband and Wife	1,319	,644	,040	3,740
	Land Own Undefined	0[b]	.	.	.
	Group member with 10-20 members	-2,165	,954	,023	,115
	Group member with <20 members	0[b]	.	.	.
a. The reference category is "More men Less Women" (See Figure 6)					
b. This parameter is set to zero because it is redundant.					

4.4 Self Help Groups (SHGs)

The SHGs are comprised of rural poor women who have volunteered to organize themselves into a group for the eradication of poverty among the members with the support of the local government agencies. In recent years, SHGs have shown good results in the two states where the study was conducted. The members make small savings on a regular basis for the financing of certain activities and services. The establishment of SHG is helped by NGOs or even formal

governmental bodies as a serious institutional form to enhance women's lives in rural areas (Brody et al, 2008).

In the preliminary analysis conducted in ClimaRice project in December 2010, it was mentioned that in Andhra Pradesh, the Village Organizations, SHG Clusters and SHG Federations are well recognized by the state and are registered under the Mutually Aided Co-operative Society Act. The SGHs examined in the preliminary analysis in Andhra Pradesh were getting loans from the government banks at the lower interest rate with the support of District Rural Development Agency (DRDA). The amount generated was used for the helping small activities (e.g. crafts) for income generation in a group level; initiating of training workshops and seminars; lending capital to other group members mainly for solidarity purposes.

The preliminary study also showed that in the case of Tamil Nadu, all the members of the group should belong to families below the poverty line as this is defined by the government of India (MoRD, 2012). The group should be able to collect a nominal even voluntary contribution from all the members regularly in the regular group meetings. The State Government of Tamil Nadu encourages the self help groups by providing subsidies through schemes to start any venture. The typical activities the SHG's are mainly focused on tailoring, food flavor and masala powder preparation, hand bags production, bottle cleaning, mushroom production and jewelry (copper and brass based) selling. However, training sessions and workshops are also encouraged for gaining knowledge in various activities.

In our analysis, the quantitative results showed that almost half of the respondents belonged to either a small (1-20) or a large (>20) SHG (Figure 15).

Figure 15. SGHs percentage in the sampling areas
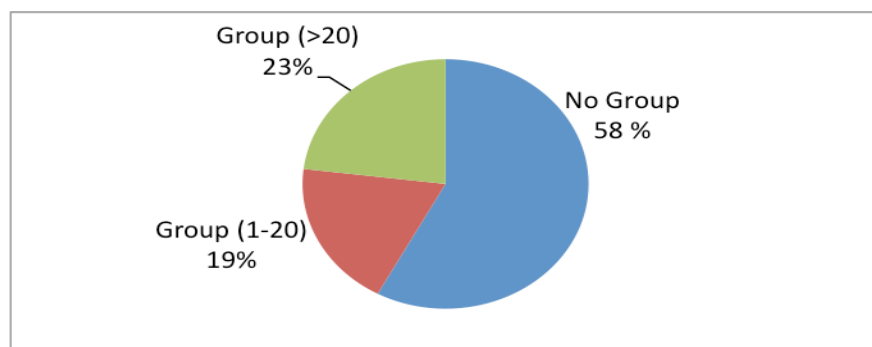
The main reasoning for the establishment of the SGHs groups was the interest of women to learn different skill sets for earning more income. Of slightly less importance is the establishment of SGH for loan and savings purposes while very interestingly, the reason of skill training only seems to be an equally significant cause.

Xenarios et al, ClimaRice Report No.2, 2012

Some rather interesting results are also derived from the benefits' assessment query related to the enrollment in the SGHs as noted in Figure 17. The most prominent reason for women to be enrolled in SHGs appeared to be the involvement in decision making at community level which addresses women's need to get fairly represented in a village or higher level. Also, the social benefits gained from the SGHs, as for instance the equal recognition of these members in the society, the ability to take initiative and alike comprise the second major benefit. SHGs also provided women with the access to credit and the skills training.
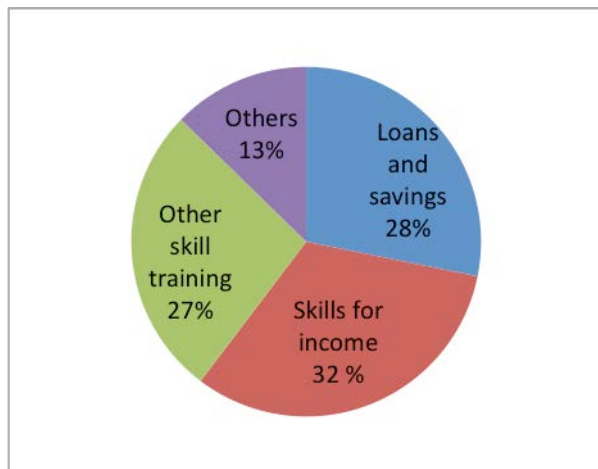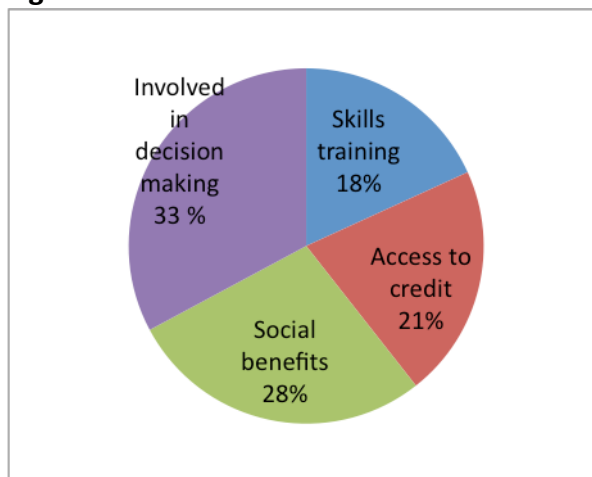
Figure 16. Reasoning for making SHGs

Figure 17. Benefits from SGHs

5. Conclusions and Recommendations

The current report inferred some key messages related to the role of gender in addressing impacts due to extreme weather and climate change in rural communities of Andhra Pradesh and Tamil Nadu states. The socio-demographic parameters revealed a well-balanced sample in terms of family size, age, educational level and landholding size. The farm size appeared to be the only factor to get positively correlated with the other parameters and hence to potentially affect the socioeconomic status of each household.

When analyzing the role of gender in family decisions, a strong presence of the role of female was revealed, which sets in doubt the stereotypical assumptions of women occupied only in household menial works (UNEP, 2007). A worrying increased violence situation against females is raised in case of adverse climate conditions from males which should be further examined in future researches. The women seem to frequently take the lead in addressing the impacts due to extreme weather and climate change by taking active role in deciding the type og crops to be grown or shifting to livestock rearing. Women seem also very keen on taking crop insurance to cover risk, while men preferred taking loans.

Xenarios et al, ClimaRice Report No.2, 2012

The MLR models showed that the training sessions and the enrolment to different groups (i.e. SGHs, cooperatives) was important. Oppositely, the training and group involvement seems to be negatively related with female gender in crop decision as well as in controlling financial matters and this should be further elaborated in a future research. The establishment and operation of SHGs groups seem to be well encouraged in both Andhra Pradesh and Tamil Nadu states.

The results are based on a relatively small statistical sample and thus the quantitative analysis may have deviated from the actual situation in Andhra Pradesh and Tamil Nadu states. However, it is obvious that the women seem to take part in important household decision making with regard to family welfare and farming and this should be contemplated when applying measures for improving households' livelihoods under adverse climatic conditions. Also the SHGs seem to be important institutions in the future to work with, especially in improving farmers' adaptive capacity.

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