CLIMATE CHANGE PERCEPTIONS AND ADAPTATION PRACTICES BY RICE-GROWING COMMUNITIES IN TAMIL NADU, INDIA

By

Society for Rural Education and Development (SRED)

In collaboration with Pesticide Action Network Asia and the Pacific

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Climate Change Perceptions and Adaptation Practices by Rice-Growing Communities in Tamil Nadu, India

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Editor: Peter Gillespie

Proofreading and Layout: Brigette DePape

Enquiries may be directed to: Ms Fatima Burnad, Society for Rural Education and Development (SRED), at burnadfatima@gmail.com or panap@panap.net.

This study was part of a regional project conducted by the Save Our Rice Campaign of PAN AP in collaboration with sixteen network partner organizations. The aim was to assess the level of vulnerability and adaptive capacities of rice-growing communities in the Philippines, Indonesia, Cambodia, Sri Lanka, India, Pakistan, Nepal and Bangladesh by documenting the impacts of climate change on the communities and their adaptation practices. The longer-term goal was to identify ways to improve the adaptive capacities of these and other vulnerable communities. From 2009 to March 2011, twenty studies were carried out.

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April 2011
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1.0 INTRODUCTION

India is one of the more vulnerable and risk-prone countries in the world. Over the centuries, its population has learned to cope with a wide range of natural and human-made hazards. Rapid population growth, high densities, poverty and high differentials in access to housing, public services and infrastructure have led to an increase in vulnerability over the last few decades.

Climate change is change in climate over time, whether due to natural variability or as a result of human activity. Climate change is expected to increase the frequency and intensity of current hazards and the probability of extreme events, and also spur the emergence of new hazards and new vulnerabilities with differential spatial and socioeconomic impacts. This is expected to further degrade the resilience of poor and vulnerable communities. Climate change is set to become an increasingly important strategic economic and political concern as it starts to impinge upon India’s high economic growth rates and affect the lives and livelihoods of millions of people.

Floods

- Over 40 million hectares of landmass in India is prone to floods.
- Nearly 75% of the total annual rainfall is concentrated over a short monsoon season of three to four months from June to September. As a result there is a very heavy discharge from the rivers during this period causing widespread flooding.
- On average, as much as 6.7 million hectares of land is flooded annually.
- The average annual total damage due to floods to crops, houses and public utilities during the period 1953-95 was about Rs.972.00 Crore.¹
- Flood problems have become chronic in at least 10 states.

Drought

- Drought is a situation of less moisture in the soil (which makes the land unproductive) and scarcity of water for drinking, irrigation, industrial uses and other purposes, usually caused by deficient/less than average rainfall over a long period of time.
- It is one of the perennial features in some States of India, such as Rajasthan, Orissa, Madhya Pradesh, and Gujarat.
- 16 percent of the country’s total area is drought-prone and approximately 50 million people are affected annually by drought.
- In India, about 68 percent of net sown area in the country is drought-prone.
- Most of the drought-prone areas identified by the Government of India lie in arid, semi-arid and sub-humid areas of the country. The rainfall behavior in the past 100 years reveals that the frequency of below-normal rainfall in arid, semi-arid, and sub-humid areas is 54 to 57 %.
- In the arid and semi-arid zones, very severe droughts occur once in every eight to nine years.

¹ 1 Crore = 10 million
Table 1 provides an overview of the frequency of disasters in India.

Table 1: Frequency of disasters in India

<table>
<thead>
<tr>
<th>Types of Disaster</th>
<th>No of Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floods</td>
<td>40</td>
</tr>
<tr>
<td>Earthquakes</td>
<td>04</td>
</tr>
<tr>
<td>Cyclones</td>
<td>19</td>
</tr>
<tr>
<td>High Winds</td>
<td>09</td>
</tr>
<tr>
<td>Epidemics</td>
<td>06</td>
</tr>
<tr>
<td>Human-made</td>
<td>12</td>
</tr>
<tr>
<td>All Other</td>
<td>12</td>
</tr>
</tbody>
</table>


In 1988, only 11.2% of the total land area of the country was flood prone; in 1998 floods inundated 37% of the geographical area of the country.

The impact of these disasters has been devastating. Between 1988 and 1997, disasters killed an average of 5,116 people and affected 24.79 million people in the country every year. The death toll due to natural disasters has been increasing, with about 10,000 people killed in the super cyclone of 1999, about 20,000 killed in the earthquake of 2001, and more than 11,000 in the Tsunami of 2004.

Agriculture is extremely vulnerable to climate change. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. The overall impacts of climate change on agriculture are negative, threatening food security. Climate change results in additional price increases for the most important agricultural crops—and has affected the vulnerability and food security of the poor and marginalized.

This report presents the study results on the impacts of climate change, community perceptions and adaptation practices by rice growing communities in the 7 villages of Thakkolam Panchayat and 8 villages of Nemili Block of the Vellore District in the State of Tamil Nadu, and assesses the consequences for food security.

1.1 Study Sites

The Vellore district in Tamil Nadu is located between 12-15° and 13-15° Northern Latitude and between 78-20° and 79-50° Eastern Longitude. The total area of this district is 6,077 sq. km. As per the 1991 census, the district has a population of 30,26,432 comprised of 15,29,944 males and 14,96,488 females. Vellore district has an arid and dry climate, reaching high temperatures during summer. The district experiences wet winters and dry summers and has an elevation of about 224 meters with the north-east monsoon the highest contributor to rainfall. The maximum and minimum temperatures during summer and winter vary between 38.3°C and 18.95°C.
The highest temperature recorded is 44°C and lowest is 10 °C. The humidity ranges are 40% – 63% during summer and 67% – 86% during winter. The average annual rainfall is 996.7mm. The maximum rainfall occurs during September and October through the north east monsoon. The area used to get heavy rainfall during the southwest monsoon.

Vellore district is predominantly an industrial region with 725 large scale industries, 13,708 small scale industries and 5,932 cottage industries, most of them leather and leather-based industries. However the Taluks of Arakkonam and Gudiyatham are primarily agricultural areas. The selected villages fall in Arakkonam Taluk.

Out of the 15 villages that were included in the study, 7 villages belong to the Thakkolam Panchayat and 8 villages are in Nemili Block.

VILLAGES IN NEMILI AREA

1. Reddivalam
2. Vettangulam
3. ArasaNellikuppam
4. Paadi
5. Ochalam
6. Nagavedu
7. Sirunamalli
8. Nemili

Nemili

Nemili is the name of a panchayat town, lying in the eastern area of the district of Vellore. Nemili has a population of 51 % male and 49 % female. 10 % of the total population are children who are below six years of age.

The average literacy rate of Nemili is 69 %, which is higher the national rate of 59.5 %. Both male and female literacy rates are quite high. The male literacy rate is 79 %, while
the female literacy rate is 60%. Nemili is well connected with other places via roads and railways. Takkolam Railway Station and Arakkonam Junction Railway Station lie in close proximity. Nemili is located 55 kms from Vellore, 24 kms from Kanchipuram, 16 kms from Arakonam, 30 kms from Sholingur, 20 kms from Kaveripakkam. There is a myth that Nemili Sri Bala is a small and young Goddess, the size of the little finger but considered as powerful as the sun by her devotees. About a hundred years ago, the Goddess appeared in Shri Subramania Iyer's dream, asking him to come and fetch her from the river Kushasthalai. He searched and got hold of the three-inch bronze idol in the river, which he consecrated which is now currently the Bala Peetam.

VILLAGES IN THAKKOLAM AREA
1. Thakkolam
2. Anandapuram
3. Kesavaram
4. Uriyur
5. Kadambanallur
6. Mangattucheri
7. Nagarikuppam

Thakkolam

As of the 2001 India census, Thakkolam had a population of 54% male and 46% female. Thakkolam has an average literacy rate of 70%, higher than the national average of 59.5%: male literacy is 80%, and female literacy is 58%. In Thakkolam, 10% of the population is under 6 years of age. Thakkolam is a panchayat town in Vellore district in Tamil Nadu.

Thakkolam is a place of historical importance. In 949 AD, the Chola forces of Parantaka I led by his son Rajaditya fought against the Rashtrakutas under Krishna III.

Thakkolam has a temple called Jalanatha Eswar Temple. The Gangadheeswarar temple is very beautiful. The temple has been rebuilt several times and this is evident from the different stones one can observe on the walls and the compound. Even the inner and outer prakarams seems to have been constructed during different periods.

These 15 villages were selected since these villages have a long history of rice cultivation. There used to be three seasons of rice paddy cultivation per year. The areas used to be very fertile due to the Kusasthalai River and Nemili River, the tributaries of Palar. The fertility encouraged farmers to cultivate rice and minor millets. Lakes and ponds were other sources of water. The area of Nemili was known for its rich bio-diversity and for the rivers, lakes and ponds.
1.2 Study Participants

The survey was undertaken among 150 farmers and agricultural workers. 75 were Dalits, 5 Irulas and 70 other caste people. Among these, 104 were small farmers and 46 were landless agricultural workers.

1.3 Population

All the 15 villages have a total population of 72,129 people with 35,853 females and 36,277 males. As of the 2001 India census, the Thakkolam area had a population of 54% male and 46% female and the Nemili area had a population of 51% male and 49% female.

2.0 OBJECTIVES OF THE PROJECT

1. To identify and document the impact of climate change in the rice growing study sites.

2. To identify and document community perceptions of climate changes and community responses.

3. To identify and document existing and effective adaptation practices to cope with the identified climate change impacts especially in relation to rice production in the study sites.

4. Based on the above, to assess the needs of the study community in terms of climate vulnerability and coping with climate hazards arising.

5. Based on the foregoing, to use the documentation on adaptation strategies to build the adaptive capacity of similarly affected vulnerable rice growing communities in the region.

2.1 Methodology

- Collection of secondary data from the local meteorological department on climate, climate change.

- Collection of primary data on climate change, impacts and adaptation practices was organized via primary research, focus group discussions, surveys using face to face interviews, field visits and observations by the research team.

- The team was oriented and questionnaires were shared with the team and they were guided to collect data. After a series of field interactions, the team gathered to share progress and experiences and returned to the field for further collection of data.
- Focus group discussions were held at the Sirunamalli, Reddyvalam, Kadambanalloor and Nagavedu.

- Different stakeholders such as block development officers, Village Admin Officer, local self governance leaders, traditional village leaders, nutrition health inspectors and village headmen were interacted with for collection of data.

3.0 FINDINGS AND ANALYSIS

3.1 Historical Data: Past and Present

<table>
<thead>
<tr>
<th>Variety</th>
<th>Before 25 years</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td>Tamarind tree, Banyan tree, Coconut tree, Mango tree, Palm tree, Ashoka tree,</td>
<td>Neem Alexandirian laurel, Mango tree,</td>
</tr>
<tr>
<td></td>
<td>Lemon tree, Guava tree Cashew tree, Badham tree, Custard apple tree, Sappota,</td>
<td>Drumstick tree, Coconut tree, plantain</td>
</tr>
<tr>
<td></td>
<td>Pomegranate tree, Alexandrian tree, Plantain tree, Jambotana tree</td>
<td>tree, papaya tree, teak</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eucalyptus, casuarinas, tamarind tree</td>
</tr>
<tr>
<td>Animals and</td>
<td>Cow, goat (sheep, Lamb) hen, buffalo, ox, cat, Jackal, Wolf, Forest cat, White</td>
<td>goat, cow, hen, buffalo, ox, cat, Mongoose,</td>
</tr>
<tr>
<td>species</td>
<td>Rat, Mongoose, Rat, Mouse, Scorpion, Tortoise, Rabbit, Pig (White/black),</td>
<td>Rat, Mouse, Scorpion, Pig, Frog, Snake,</td>
</tr>
<tr>
<td></td>
<td>Donkey, Horse, Monkey, Frog, Snake, Cobra, Wiper, adder, Green Snake, Bear,</td>
<td>Cobra, Wiper, adder, Lizard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Examples</td>
<td>Examples</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Birds</td>
<td>Deer, Lizard</td>
<td>Deer, Lizard</td>
</tr>
<tr>
<td></td>
<td>Crow, Crane, Maina, Woodpecker, Sparrow, Owl, Blacksparrow, Duck, Pigeon, Parrot, Cuckoo, Vulture, Ostrich.</td>
<td>Crow, Crane, Maina, Woodpecker, Sparrow, Owl, Duck, Pigeon</td>
</tr>
<tr>
<td>Insects</td>
<td>Dragonfly, Centipede, Grasshopper, Caterpillar, butterfly, Earth worm, Golden bee, Millipede, Black bee, Leech.</td>
<td>Grasshopper, Caterpillar, butterfly, unknown varieties of insects</td>
</tr>
<tr>
<td>Rice variety</td>
<td>Vaigunda, Manakkathai, Kullakkaaru, Seeraga Samba, I.R.20, Kichili, Thinai, Samba, Gundu, Super Ponni, Mittakkaru, Vellakaru, Kaattan Samba, Karupu Manikkathai, Kappa Samba, I.R.36.</td>
<td>ADT 36, Ponni, Super ponni, ADT 45, ADT47, ADT 09, Gundu, I.R.20,</td>
</tr>
<tr>
<td>Greens</td>
<td>Siru keerai, agathi keerai, thandu keerai, pasalai keerai, karisailankanni (used for liver malfunction), pulicha keerai, arakeerai, panna keerai seema keerai, aala keerai, mookuthi keerai, vallaarai (for increase in memory power), manal keerai, paruppu keerai, manathakkali, saaravaal keerai, kuppamani keerai.</td>
<td>Siru keerai, agathi keerai, thandu keerai, pulicha keerai, arakeerai vallaarai, manathakkali, kuppamani keerai.</td>
</tr>
<tr>
<td>Grains</td>
<td>Ragi, Millet, Corn, Horse Gram, Red gram, Cowpea, Greengram, Blackgram, Barley, Maize.</td>
<td>Ragi, groundnut</td>
</tr>
<tr>
<td>Vegetables</td>
<td>Brinjal, Drumstick, Ribbed Guard, Snake guard, bottle guard (Long &amp; Short) Mango, Beans, Onion, Lady’s Finger. Chilly, Radish, bitter guard, turnip, Cluster beans, pumpkin, Cucumber, Coconut.</td>
<td>Brinjal, bottle gourd, ribbed gourd, mango, ladies finger, cluster beans, bitter gourd, radish, drumstick pumpkin, water melon</td>
</tr>
<tr>
<td>Roots</td>
<td>Sweet Potato, Tapioca</td>
<td>No edible roots</td>
</tr>
<tr>
<td>Fruits</td>
<td>Papaya, Guava, Banana, Water Melon, Custard apple, Lemon, Tamarind</td>
<td>Papaya, Guava, Banana, watermelon, tamarind</td>
</tr>
<tr>
<td>Food</td>
<td>Raggi porridge, wheat, corn, thinai, Rice. Food made from these grains and rice.</td>
<td>Rice</td>
</tr>
<tr>
<td>Instruments used for farming</td>
<td>Plough, oxen, spade,</td>
<td>Machine</td>
</tr>
<tr>
<td>Seasons of starting of rice cultivation</td>
<td>Thrice a year paddy cultivation June - July October - November January February</td>
<td>Unseasonal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One time harvest with much difficulty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The pump set irrigated gets twice a year and the same also gets destroyed often due to unexpected rain</td>
</tr>
<tr>
<td>Yield</td>
<td>25 to 35 bags of paddy per acre.</td>
<td>10 to 15 bags per acre</td>
</tr>
<tr>
<td>Benefits and status</td>
<td>Good yield The crops were not affected by insects</td>
<td>Low yield Drought, famine</td>
</tr>
</tbody>
</table>
and were Greenish and Fertile.
Healthy both physically and mentally for farmers.
Plants and Creepers well grown and fertile.
The crops were very nutritional
Regular Seasonal Rainfall
More number of farmers
There was no loss and no one needed loan
More employment opportunity
They produced the things which are used for their own use at home.
Wages were less, Laborers were available
They didn’t use so much chemicals
Storage of seeds was there.
Every family had their own domestic animals (Cow, goat)
There were crabs,
Exchange of Seeds was there.
Environmental protection and safeguard
Less consumption of electricity
Low inputs and high returns.

Unknown and resistant pests
Very unhealthy and low nutrition crops
Less farmers
Unseasonal down pouring of torrent rain
Farmers trapped in debt
More commercialized farming, export oriented
Machines replaced labor
Excessive use of chemicals
Dependency of seed bank
Exploitation of nature and natural resources
No seed bank and seed preservation
High inputs and low return

3.2 State of Natural Resources

The water sources have dried up and the depth of ground water has gone deeper. Earlier the ground water was available at 25 to 40 feet on average in all areas but the ground water now has gone down to more than 250 feet in almost all the villages studied. In Takkolam area the ground water has gone to more than 300 feet.

The river has dried up. The tanks and even the lakes in these villages have gone dry. Hence agriculture is not possible in all seasons as it was earlier.

During the rainy season, flooding destroys the crops. Since the water management system is very poor and the lakes have been encroached, the water cannot be stored during the rainy season.
During the past 25 years in the Nemili area, the introduction of power looms and hand looms for the cloth mills have taken away a considerable volume of agricultural lands. The growth of dyeing factories have polluted the water bodies and ground water in the surveyed villages. There are more than 1,000 power loom units and 2,500 handlooms. Each power loom consumes 1,200 to 1,500 square feet and is put up on cultivable lands. For dyeing, several gallons of water are extracted each day from the ground water which contributes to the drying up of ground water.

3.3 Currently Experienced Climate Hazards

- No seasonal rains and unpredicted torrential rains.
- Too hot temperature, regularly exceeding 40 degree Celsius. Cyclonic wind destroying harvests, houses and properties.
- Water shortage and related drought increasing poverty.
- Agricultural productivity declined from 10 to 40 percent, more frequent droughts.
- Agriculture adversely affected due to the shifts in timing of rainfall. Rice cultivation gradually declining and the land is used for non agricultural purposes for real estate, commercial crops (bore well fed agriculture, for grazing cattle and for industrial purposes.
- Higher temperatures reduce crop cycle and results in lower yields. Soil erosion.
- Heat wave kills people directly and cause diseases. From 2002: heat wave crossed 47-50°C every year.

3.4 Reasons for Non Cultivation of Rice

- In Uriyur village, 120 Acres of agricultural was taken for Central Institute of Security Force. This area was very fertile; situated on the bank of the River Kuzhasthalai, the land was being used only for rice growing.
- Massive land alienation for non-agricultural purposes.
- Excessive usage of pesticides has lent the land infertile and agriculture has become very expensive. The original nature of the soil has changed.
- In 1987, the ground water level was 30 ft in Kadamanallur, Thakkolam, Mangattuchari, Uriyur, Pudhukesavaram, Anandapuram villages. But now it is below 210 feet; and farmers didn't get water; quality of water has also changed.
- Availability of agriculture labourers has become less.
- Export oriented and commercial oriented farming.
- Considerable portions of land have become dry and unsuitable for rice cultivation.
- Heavy input and very low return – the farmers get very low price even though the middle men earns a fat sum.
- Rice cultivators under debt trap (87 percent of the small farmers).
- The effluents from dyeing industries from Panapakkam, Nemili, Sambatharayan pettai are flowing into the river thereby affecting the river water and land of the following villages: Vettangulam, Nemili, Arsanellikuppam, Reddyvalam, Paadi.

4.0 IMPACTS OF CLIMATE CHANGE AND VULNERABILITY

4.1 Direct Impacts

- Flood and drought have direct impacts on rural livelihoods because of crop failure and lower yields. This has increased migration.
- Hunger and extreme cases of starvation in the villages, a new situation as there never used to be shortages of food commodities in these villages.
- Inadequate safe water for human consumption, leading to low sanitation and hygiene.
- Rice yield declined in all the studied villages.
- Agriculture reduced and weeds and pests proliferated.

**Loss of agriculture at Nemili**
- Water shortage: 40%
- Unfit for cultivation: 24%
- House sites: 17%

**Loss of agriculture at Thakkolam area**
- Water shortage: 35%
- Unfit for cultivation: 25%
- House sites: 10%

Short-term crops disappeared and long-run production declined. The environmental risks and burden increased, and livelihood opportunities reduced.

In the 15 villages, disasters have always affected the poor and the socially disadvantaged people the most. They seem to have a higher degree of vulnerability to such situations.

Too hot temperatures, regularly exceeding 40 degree Celsius, affects people directly by causing diseases and deaths.
From 2002, heat wave crossed 47-50°C every year in the area. Vellore district is one of the hottest districts in the state of Tamil Nadu. The area once used to be very cool and shady but no more.

**Human Health**

The increase of heat waves has lead to heatstroke and heart attacks. Mosquitoes have increased and are more resistant. The hot conditions cause smoke particles in the air and strange diseases have occurred in the villages. Heat cramps, a sign of dehydration, have occurred in all the surveyed villages. People reported muscular pains and spasms due to heavy exertion.

Heat exhaustion has been very common as the people have to work in the hot condition. These have often led to heat stroke as there has never been the opportunity for proper treatment of heat exhaustion. Skin diseases could be seen due to excessive sweating and heat exchange.

The flood situation resulted in diarrhea and water borne diseases. Outbreaks of infectious diseases exposed millions of people to new diseases. The lack of adequate drainage during floods has lead to the villages as insect-breeding sites. In all the villages, cases of viral fever occurred during the extreme summer and rainy season.

**Social Impacts**

The floods have resulted in women, including the elderly, to have less food. The women have had very limited access to sanitation. This has increased cases of Urinary Tract infections (UTI) among them. During drought, due to the scarcity of water, the women find it very difficult to maintain personal hygiene, bathe regularly and this becomes worse during their menstrual cycle.

**A Comparison on the Increased Expenses for Cultivation**

The expense for cultivation of rice per acre used to be Rs.5000. Now it has increased to 15000/- as farming methods have changed and the cost of inputs has increased.
Table 2: Expenses per acre

<table>
<thead>
<tr>
<th>Expense Head</th>
<th>Expense in INR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sapling</strong></td>
<td></td>
</tr>
<tr>
<td>1 Plough</td>
<td>1000</td>
</tr>
<tr>
<td>2 Seed</td>
<td>1100</td>
</tr>
<tr>
<td>3 Manure</td>
<td>1500</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td><strong>3600</strong></td>
</tr>
<tr>
<td><strong>Planting</strong></td>
<td></td>
</tr>
<tr>
<td>1 Plough</td>
<td>3400</td>
</tr>
<tr>
<td>2 Bund</td>
<td>600</td>
</tr>
<tr>
<td>3 Sapling plucking</td>
<td>800</td>
</tr>
<tr>
<td>4 Planting of sapling</td>
<td>1700</td>
</tr>
<tr>
<td>5 Weeding</td>
<td>2400</td>
</tr>
<tr>
<td>6 Manure</td>
<td>1900</td>
</tr>
<tr>
<td>7 Harvest</td>
<td>2000</td>
</tr>
<tr>
<td><strong>Sub Total</strong></td>
<td><strong>12800</strong></td>
</tr>
<tr>
<td><strong>Overall expenses</strong></td>
<td>3600 + 13200 = <strong>16400</strong></td>
</tr>
</tbody>
</table>

(Source: Sekar s/o A.P. Natarajan of Thakkolam)

Income: 30 bags per acre - @ 720 = 21600
Profit: 21600-16400 = **Rs. 5200/-** This income is for 90 days.

4.2 Indirect Impacts

The adverse impacts of climate change in the studied villages were in the form of declining rainfall alternating with heavy downpours causing floods, and long dry spells leading to drought. These have severely threatened livelihoods, economy and food security. To add to this, poor infrastructure, weak institutional mechanisms, lack of financial resources and vast sectoral and regional disparities adversely affect the adaptive capacity of the people of the studied villages.

In addition, prices for raw materials and the shortage of necessary goods have increased. Inflation is very high and the villagers are unable to afford essential food items. The mechanization process has taken away the availability of straw that has been the only source of roofing of huts of the poor villagers. Now that straw is not available they find it hard to mend the thatched roofs.

These villages have a total area of 92,156,705 hectares of land. 17407.9583 hectares are being cultivated with different agricultural plants. 4939.193 hectares of land that was also used for rice cultivation earlier is now left without cultivation. 77.8.3389 hectares of land are designated as purampoke (government) land that cannot be used for any purpose. Cultivable land is gradually shrinking.

- In February 2010 – in the Thakkolam area 45 acres of rice paddy dried up
- In Nemili all the lakes dried up and the ground water dried up to 300 feet
- Massive alienation of cultivable lands – More than 500 acres
of lands for housing

- In Uriyur, 120 acres of land confiscated by the government for a Naval base – Central Institute of Security Forces
- Nagarikuppam farmers sold 207 acres of cultivable land
- 37 acres cultivable land in Asanellikuppam lacks water
- In Nemili, Padi and Ochalam, 85 acres transferred as housing plots due to drought.
- In Anandapuram, Pudukesawaram, Nagarikuppam and Uriyur and Thakkolam, 243 acres became dry land unsuitable for cultivation.
- The wet land that was cultivated earlier has become dry land (Punjai) and not used for cultivation. A total of 4939.193 of hectares in all the 15 villages.

Climate change has resulted in additional price increases for the most important agricultural products, especially for rice, the primary food of people.

The increase in unemployment has led to migration to the cities and nearby towns. The number of debt-trapped people has increased.

The price for the essential food items increased considerably and the buying capacity is very low in these villages. This has increased malnutrition among children and women.

4.3 Vulnerability

Vulnerability to disasters has social, gender, ecological and economic dimensions in addition to technological capacities. Poverty, environmental degradation and vulnerability to hazards are the outcomes of the climate change in the studied villages. This was seen in all fifteen villages. Already handicapped by gender-related disadvantages, the worsening economic status has made women much more vulnerable socially.

Adaptive capacity is very low.

**Sector Vulnerability: Gender**

Women were the most vulnerable group. Since women are more dependent on nature and the environment for their livelihood rights, Dalits and Tribal Women were the most affected people.

Women suffered more during calamities. The changing land use patterns have displaced them from the land. They have been deprived of their decision-making power in agriculture and their knowledge of seed preservation. They face poverty and have become more dependent on men. This was very common in the villages studied.

Women are excluded from disaster recovery operations and their day-to-day life has been affected. The physical burden has increased. Even during famine, women are forced to shoulder the responsibility of the family and to take care of the family's sustenance.

Girl children have the responsibility to collect and carry water; as water resources are very far and it is a time consuming and a physically demanding task. The wells have dried up.
Women spend more time on unpaid work as they spent their energy on domestic water collection during drought; their workload had increased after each flood. On these occasions, they have to take care of the cleaning and maintenance in addition to routine work.

Opportunities for productive work have decreased. Women have lost sources of paid work as the fields or workplaces are inaccessible. These situations forced them into government drought relief work.

Climate change has gender-specific implications in terms of both vulnerability and adaptive capacity. There are structural differences between men and women through, for example, gender-specific roles in society, work and domestic life. These differences affect the vulnerability and capacity of women and men to adapt to climate change.

In the study area, women are disproportionately involved in natural resource-dependent activities such as agriculture compared to salaried occupations. As resource-dependent activities are directly dependent on climatic conditions, changes in climate variability and projected changes are likely to affect women through a variety of mechanisms: directly through water availability, vegetation and fuel wood availability and through health issues relating to vulnerable populations (especially dependent children and elderly people).

Most fundamentally, the vulnerability of women in agricultural economies is affected by their relative insecurity of access and rights over resources and sources of wealth such as agricultural land. It is well established that women are disadvantaged in terms of property rights and security of tenure. This insecurity can have implications both for their vulnerability in a changing climate, and also their capacity to adapt productive livelihoods to a changing climate.

4.4 Community Perceptions

Serious ecological damage has been inflicted on the basic life support systems of land, water, forests, biodiversity and atmosphere. Renewable energy sources are also a matter of great concern. The social dimension of crises arose from increasing poverty and hunger, economic, social and gender inequities, rapid population growth resulting in reduced per capita availability of arable land and irrigation water. The ‘famine of employment’ (i.e. livelihoods) largely accounts for food insecurity at the individual household level, because of population explosion on the one hand, and rapid technological advances leading to automation and jobless economic growth, on the other.

People have internalized that there is change in the climatic conditions and that nature is altered. However, they take this as the course of nature and do not relate to it as climate change and the consequences of global warming.

The community’s adaptive capacity is very slow. Though they realize that the traditional farming practices are the most effective methods, they have failed to adapt the same. They do not wish to take the risks, and instead depend on the directions from companies’ commercial advertisements that promise higher yields.

Some farmers have taken up organic farming practices and usage of natural pest controllers. For instance Mr. Lakshmanan s/o Rukku, a 62 year old Dalit farmer from
Uriyur village, practices organic farming practices. He uses oxen for plough and uses traditional tools for farming operations.

Sambath, aged 50 years, and Sekar, aged 35 years, from Thakkolam village are following traditional farming practices. They shared that they found that inorganic modern agriculture was very expensive and they incurred losses and debt, and hence went back to the natural farming practices. They use fish amilam, a natural pest controller, and natural manure and compost.

Although there are more farmers taking up traditional methods, the emulation by the community is very slow.

5.0 ADAPTATION PRACTICES AND ANALYSIS

The subject of disaster management was not specifically mentioned in any of the three lists (Union, State and Concurrent Lists) in the 7th Schedule of Indian Constitution. However, the Ministry of Home Affairs of the Central Government, which is the nodal Ministry for disaster management, seems to endorse the opinion that “disaster management is deemed to be a State subject”.

The country has had integrated administrative machinery for management of disasters at the national, State, district and sub-district levels. The basic responsibility for undertaking rescue, relief and rehabilitation measures in the event of natural disasters has been the State Governments concerned.

At the Central level, the following decision-making and standing bodies have been responsible for disaster management:

- Cabinet, headed by the Prime Minister
- Empowered Group of Ministers
- There has been a National Crisis Management Committee headed by the Cabinet Secretary.
- The Crisis Management Group under the chairmanship of the Central Relief Commissioner comprising senior officers from various Ministries and concerned Departments, responsible for reviewing contingency plans and measures required for dealing with a natural disaster, and coordinating the activities of the Central Ministries and the State Governments in relation to disaster preparedness and relief.
- For all natural disasters except droughts, the Ministry of Home Affairs is the nodal Ministry and the other Ministries play a supportive role. For droughts, the nodal ministry is the Ministry of Agriculture, wherein the responsibility lies with its Department of Agriculture and Cooperation.
- Technical Organisations, such as the Indian Meteorological Department (Cyclone /Earthquake), Central Water Commission (Floods), Building and Material Promotion Council (Construction Laws), Bureau of Indian Standards (Norms), Defense Research & Development Organisation (Nuclear/ Biological Disasters), and Directorate General Civil Defence provide specific technical support to coordination of disaster response activities.
- The Ministry of Home Affairs has set up National Disaster Management Division (NDMD) as the apex body within the Government for this purpose.
State Level

- In a State, disaster response has usually been the responsibility of the Relief and Rehabilitation Department, or the Department of Revenue.
- The Chief Secretary of the State heads the State level committee related to disaster management. This committee is in overall charge of the relief operations and the Relief Commissioners who are in charge of the relief and rehabilitation measures function under the overall direction and control of the State level committee.
- In many States, the Secretary, Department of Revenue, is also in-charge of relief operations. State Governments usually have relief manuals and the districts have their contingency plans, which are supposed to be updated from time to time.
- In the event of severe drought, State Governments are expected to introduce appropriate policy packages to support vulnerable populations through food for work programmes and other employment-generation and income-generation activities. Most of the food for work programmes are supposed to be undertaken to de-silt the existing water tanks, deepen the tanks, and carry out the construction of water harvesting structures.

District Level

- There has been District Level Coordination and Review Committee headed by the Collector as Chairman, with participation of related agencies and departments.
- The district administration is the focal point of all Governmental plans and activities. The actual day-to-day function of administering relief has been the responsibility of the Collector/District Magistrate/Deputy Commissioner who exercises coordinating and supervising powers over all departments at the district level.

However, these plans are not always updated and they have mainly focused on relief. The Government machinery lacks proper training in disaster management and is ill equipped to tackle natural disasters through effective mitigation and preparedness measures. While the crucial aspects of coping with natural disasters, like disaster mitigation and preparedness, have always been ignored, even the post-disaster response of the state through rescue, relief and rehabilitation measures have been found inadequate.

5.1 Effective Adaptation Practices

Analysis of adaptation practices
Adaptation practices are actual adjustments, or changes in decision environments, which might ultimately enhance resilience or reduce vulnerability to observed or expected changes in climate. The capacity to adapt to climate change is not evenly found and uniform in the study villages. Some farmers are able to adapt to these changing conditions of drought and rapid changes in commodity prices, while other farmers experience predominately negative outcomes.
The locally adapted practices in the study areas were primarily the expanded use of traditional rainwater harvesting and water conservation techniques. They have constructed percolation tanks and adapted watershed management for enhancing the level of ground water. However even these are not sufficient to save them from the drought.

Digging small ponds and other traditional practices of water harvesting are being adapted in the 15 villages and in the surrounding villages as shared by the participants.

A collective of Dalit women have joined together to promote chemical free organic varieties and traditional farming practices. They have found that organically-grown food yields are better. However, it has taken more than three years to realize the real effects of organic farming since they had to bring back the fertility of the poisoned lands. They have combated drought by using traditional seeds, organic fertilizers and natural pest controllers. These women have been instrumental in motivating farmers of 75 villages to switch over to organic agriculture.

Another successful intervention has been adaptation of interspersing crops that do not require extra water and are chemical free. They are growing 19 indigenous crop varieties on the degraded lands and in the lands they got from the government. They have promoted community seed banks in which the women can become a member by contributing a fistful of grain. However, these practices are not followed in the surveyed villages.

They have shifted to using drought resistant crops and for irrigation and use shallow tube wells and the rotation method of irrigation during water shortages. Though the rotation method has been found to be very effective, applying it has not been very smooth.

In the villages, new saplings are seen in most places. They knew that trees are instrumental for rain and essential to protect them against the heat wave. They shared that they are in the process of rejuvenating lost and dead trees that used to provide shelter. They are also promoting social forestry with the support of the government.

In three villages there are eco clubs to ensure grazing animals are not destroying the saplings and advising people against cutting the trees. These villages are making use of the various national government programmes to re-create employment options to counter drought and unemployment.

The adaptive capacities of the rural poor of the study area need to be strengthened. The rural poor need access to resources. The storage, mobility, diversification, communal pooling, and exchange need to be under their control. External interventions can reinforce livelihood practices. Local rural institutions can provide informational, technological, financial, and leadership support.

5.2 Potential Adaptation Strategies

- Effective local level dissemination of information on climate change impacts to the rural communities and to sensitize them on the available adaptation and mitigation options.
- Conservation of:
  - Rainwater,
  - Control of soil erosion,
  - Regeneration of green cover in the villages
  - Promotion of dry land farming systems
  - Promotion of agro-forestry,
  - Pasture development
  - Livestock management

- Reduce the pressure on remaining land and pastures by protecting, regenerating and restoring degraded land.

- Work alongside the panchayats to ensure mainstreaming of information and to support community resilience specifically for sustainable agricultural practices.

- Work along the panchayats for assessing the local vulnerability that will identify the projected long term impacts of climate change in the locality and to plan the adaptation and mitigation strategies accordingly.

- Advocate locally for renewable energy options as more sustainable and cleaner options that will contribute to reducing climate change impacts in the long run.

- Promote organic agriculture with low input, low volume and high value crops

- Promote System of Rice Intensification (SRI) that consumes less water, uses organic seeds, and natural manure and ensures increased rice production.

- In disaster-prone rural areas, women and men need to be trained in the implementation of emergency preparedness and response actions.

- Promote practical ways of integrating disaster management with sustainable development as a long-term rehabilitation strategy of fostering sustainable livelihood security and putting in place a pool of rural knowledge.

- Community Seed, Grain, and Food Banks can help in enhancing the coping power of the people during natural hazards. A decentralized, community-centered grain and water (food) bank would be able to provide relief almost immediately, and avoid ‘transient hunger’. Built into this ‘bottom-up’ model is a suitable storage system. The storage facilities could be traditional, conforming to traditional knowledge and ethos, but incorporating modern scientific inputs to withstand the impacts of natural disasters.
6.0 CONCLUSIONS AND RECOMMENDATIONS

The direct impact of climate change has affected plant growth, development and yield due to changes in rainfall and temperature. Increases in temperature have reduced crop duration, increase crop respiration rates, changed the pattern of pest attacks, hasten the mineralization in soils and decreased fertilizer efficiency.

All these have affected crop yields in the study area. Simulation results indicate that increasing temperature and decreasing solar radiation levels result in decreasing growth and yield of agricultural crops.

Agriculture is strongly dependent on the availability of water. Climate change has affected and modified rainfall, evaporation, runoff, and soil moisture storage. The occurrence of moisture stress during flowering, pollination, and grain-filling is harmful to most crops.

Excessive rain, unseasonal rains and flooding have destroyed the crops and livelihood source of the people of the study area.

The demand for water for irrigation is projected to rise, bringing increased competition between agriculture, already the largest consumer of water resources in the area, and the growing industrial loom users.

Falling water tables and depletion of the ground water makes the practice of irrigation more expensive, particularly when with drier conditions more water will be required per acre. This further aggravates the drought situation.

Conditions are more favorable for the proliferation of insect pests in warmer climates. Altered wind patterns have also changed the spread of both wind-borne pests and of bacteria and fungi that are the agents of crop diseases. New pest attacks have emerged and affected yields in the study area. This has increased the use of chemical pesticides.

Livestock diseases have been affected and there have been strange deaths of livestock.

People are facing food shortages and lower yields as well as economic losses, malnutrition and even famine. These villages appear to be very vulnerable to climate change.

6.1 Recommendations

The adaptive capacity of the rural poor needs strengthening. The rural poor need access to resources. The storage, mobility, diversification, communal pooling, and exchange need to be under their control. External interventions can reinforce livelihoods practices. Local rural institutions should provide informational, technological, financial, and leadership support.

Ensure effective local level dissemination of information on climate change impacts to rural communities and sensitize them on available adaptation and mitigation options.
Achieve conservation of rainwater, control of soil erosion, regeneration of green cover and promotion of dry land farming systems including horticulture, agro-forestry, pasture development and livestock management etc. By protecting, regenerating and restoring the degraded land, the pressure on remaining land and pastures can be reduced.

The focus should not be merely on relief but should focus on reconstruction activities - construction of housing and public infrastructure, drainage and rural water supply, expansion of communication networks, and shelterbelt plantations, etc.

Enhance the important role that healthcare institutions are required to play in the wake of disasters as the reach and effectiveness of the public healthcare system has been far below the required levels.

The Government should expand the network of public healthcare institutions, especially in rural areas, improve their human resources and infrastructure, and develop proper guidelines regarding their role in the wake of a disaster. It is very important to strengthen the primary healthcare institutions, which must be accessible to a widely divergent population.

Healthcare institutions at different levels - primary, secondary, and tertiary - should be given well-defined and mutually supportive roles vis-à-vis disaster management.

At the village level, emergency healthcare providers, with proper training in life-saving skills, need to be deployed so that they can provide essential services to local communities during disasters.

There should be a decentralization of disaster management efforts in terms of involving the village Panchayats and other local bodies in both planning and implementation of disaster preparedness measures specific to their areas. Planning the management of natural disasters needs to combine both the ‘top down’ approach with a ‘bottom up’ approach.

The proper management of natural disasters in India has been obstructed in the past by Government authorities who have treated disaster management only as an emergency responsibility. The authorities must learn to tackle natural disasters as a regular phenomenon. The officials, drawn from all the relevant branches of the Government, and serving at different tiers of Government, need to be given adequate training and regular practice in handling natural disasters.

Climate change issues need to be placed high on the political agenda. This needs strategic advocacy initiatives. Parliamentarians need to be sensitized to raise questions about climate change in parliament. Government needs to review budgets and spending on climate change adaptation and mitigation measures at state and national levels and allocate greater budget resources to combat the impact of climate change at the grassroots level.
### APPENDIX 1: Details of lands

<table>
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<th>S.N</th>
<th>Nanjai in Hectors</th>
<th>Punjai in Hectors</th>
<th>Natham in Hectors</th>
<th>Purampongu in Hectors</th>
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### 2. Population

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<th>Total</th>
<th>Female</th>
<th>Male</th>
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<tr>
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