

INDIA: LESSONS FROM A LAND OF CULTURE, CONTRASTS, SCIENCE, AND HUMANITY



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CONTENTS

ACKNOWLEDGEMENTS.....	3
I. Learning to Look with Fresh Eyes:	
Rediscovering and Redefining Myself.....	4
II. The MS Swaminathan Research Foundation.....	8
III. The V&A Family.....	10
IV. The V&A Project.....	11
V. Roaming Rajasthan and the Andhra Adventure.....	13
VI. The Felicitation of a Lifetime and a New Beginning.....	22
APPENDICES.....	24
I. Climate Change Adaptation Findings Report: Agrometeorology	24
II. Change Adaptation Findings Report: Farming Strategies for a Variable Climate and Sowing Window	30
III. Official Field Report from Andhra Pradesh	32
IV. Data on Water Scarcity Collected from Andhra Pradesh	35
V. Map of Mahabubnagar District in Hyderabad, Andhra Pradesh	36
VI. Map of Udaipur District in Udaipur, Rajasthan	37
VII. List of Vulnerability Factors and Villages Ranked According to Vulnerability and Adaptive Capacity	38
VIII. Workshops and Lectures Attended During the Human Centered Sustainable Development Paradigm	39

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Charles Saini

I. Learning to Look with Fresh Eyes: Rediscovering and Redefining Myself

Here I am, sitting halfway across the world from home, in a crowded convention center. I fidget in my seat waiting for the next speaker in the long list of scientists, researchers, journalists, prime ministers, governors and gurus to present their topic in the four day conference on the Human Centered Sustainable Development Paradigm. An Indian woman wearing a kimono walks up to the podium and introduces herself as Geeta Mehta, from the *Friends of the MSSRF* (MS Swaminathan Research Foundation) in Tokyo. She begins her presentation talking about how in Japan there is a concept in gardening that translates into English as “looking with fresh eyes.” And while she applies this perspective to



Dr. Monkombu Sambasivan (M.S.) Swaminathan, one of TIME Magazine’s top 100 influential Asians, I am suddenly whisked away, reliving the past two months that I had spent in India. India itself is described as a nation of contrasts and extremes, and it is true. These past two months, I was assaulted on multiple levels: I was forced to obtain a new

perspective on humanity, culture, science, and life itself. During my summer internship in Chennai, I had seen lands that were barren and drought-ridden for years, only to then travel to places where flash flooding was claiming everything that people held dear. Villagers praised me for the color of my skin, honored me for alledgedly being a doctor, and yelled at me for not distributing the seeds from the plant factory I supposedly own soon enough to prevent suicides. My understanding of science and climate change were expanded in ways I never thought possible, and my concepts of life around the world were reset. I made friendships that I know will last a lifetime, and I met many people whose stories about life I will never forget. I grew as a person by learning about the cultural heritage that was part of me, but that had never been explored. When I was selected as a Borlaug~Ruan International Intern, I knew that my time in India would be difficult, yet rewarding at the same time. What I did not expect was the very concept of my “self” to be radically altered. I had learned to look with

fresh eyes, and with these new eyes, I discovered I could see things that I had never known, appreciated, or understood before.

I have always been pulled in many directions when it comes to pursuing my interests. I believe it comes from being exposed to a rich variety of experiences from early on. I was born in the East Bay area of California, and I lived there until I was fourteen years old. California itself is a remarkable place, and I learned to appreciate diversity, the environment, the ocean, and people. I owe a lot to my mother, for she made me the person I am. Being raised in a one-parent family unit taught me that all obstacles can be overcome - if the desire and perseverance is there. She taught me to be creative, to strive for my personal best, and to feel empathy and compassion. For as long as I can remember, I spent my Saturdays in California helping my family volunteer at a food-sharing program.



When I moved to Des Moines, Iowa in the summer of 2001, I carried these principles with me. Although the environment was different, I still was passionate about conservation and ecology, and my compassion towards others was still strong. I decided to pursue a teaching major, so I could help make a difference, and I also decided to study conservation and marine biology/environmental science so I could learn how to help our world be a better place to live in. Keeping these two concentrations in mind, I took courses in high school that I thought would help prepare me. I enrolled in the Teacher Academy program, a course that places students in student-teaching internships and that allows students to tutor at-risk-youth, and I also took science classes like Marine Biology, Advanced Placement Environmental Science, and Food, Fiber, and Environmental Sciences. These courses enforced my desire to help others and help the environment, and they also expanded my interests further. Susan Stroope, my AP Environmental Science teacher, told me of the 2004 World Food Prize Youth Institute, and I knew immediately that the program was an excellent opportunity to

marry my two passions of the environment and humanity. Because I took courses at three different high school campuses, I was given invaluable support and encouragement from my mentors at each campus. Attending the Youth Institute Symposium was very valuable for me. When I heard Dr. Norman Borlaug speak, I could see the passion in his eyes, and I could hear the fighting spirit in his voice. The symposium was the first event that made me really *aware* of issues facing third world nations, and that we could help make a difference. I will never forget how his urging determination touched me, and made me want to be a better person for a better cause.



Group Photo from the 2004 WFPF Youth Institute

When I applied for the Borlaug~Ruan International Internship, I kept an open mind. Even though I desperately wanted to get out into the field and immerse myself in science and culture, I knew that even if I was not chosen, I had still achieved growth from the incredible experiences the World Food Prize Foundation had provided me with thus far. I also kept an open mind about the countries that were available to intern in. I knew that even though every place had something difficult and challenging, I remembered my mother's strength, and I knew I could overcome any obstacle as long as I persevered. I also felt that I could find something wonderful to get out of my internship no matter where I went. However, I was secretly hoping I would be sent to India. My father was from India, and I had never learned

about my heritage or culture. I thought that if I was sent there, it would be a dually enlightening experience, as I could explore my heritage, and do real science. I was in Florida for a Marine Biology field trip when I discovered that I was selected to go to Chennai, India. I was ecstatic and honored to be part of the Borlaug~Ruan Internship Program, and I vowed that I would try my hardest to make Dr. Borlaug proud, and to help impact whatever project I was to be working on.



FROM IOWA TO INDIA!

II. *The MS Swaminathan Research Foundation*



The research center I was chosen to intern at was the MS Swaminathan Research Foundation (MSSRF). The MSSRF is based on the following principles:

- pro-nature
- pro-poor
- pro-women

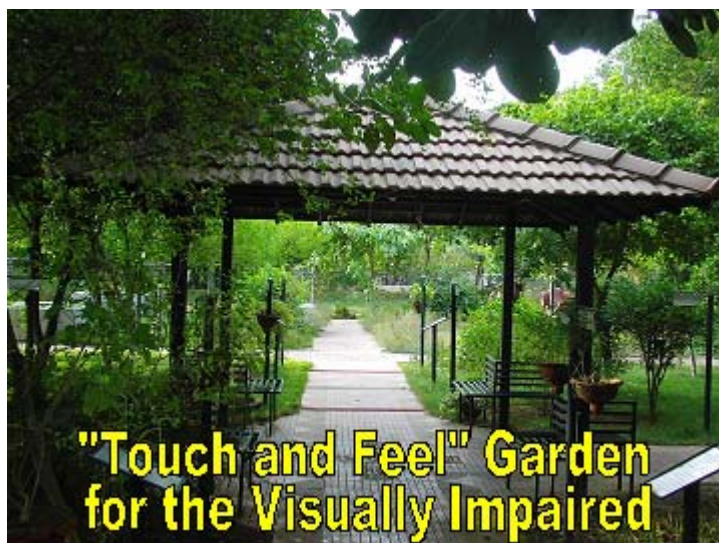
“The MSSRF strives to create a job-led economic growth strategy in rural areas through harnessing science and technology for environmentally sustainable and socially equitable development.” ~MSSRF Mission statement

The MSSRF was registered as a non-profit organization in 1988, and was funded by the award money Dr. Swaminathan was given as the recipient of the very first World Food Prize. In addition to some special concentrations, the MSSRF focuses on the following areas: Coastal Systems Research, Biodiversity and Biotechnology, Ecotechnology, Reaching the Unreached, and Education, Communication, Training and Capacity Building. The MSSRF is also constantly expanding ways in which they can help benefit the public and the needy:

“MSSRF has operated during the last ten years on the principle of partnership with rural and tribal women and men. Consciously, the Foundation chose not to have its own experimental farm, but to work with farming families in their fields in a participatory research mode. It has considered the tribal and rural families working with its young staff members as partners and innovators, and not as "beneficiaries". The aim is to encourage young researchers to respect all knowledge, whether emanating from an illiterate or semi-literate rural woman or man, or from a Ph.D.-holding scientist. It is this genuine partnership based on mutual esteem, between those whose wisdom grows from real life experience and toil in sun and rain and those with advanced academic training, that has given MSSRF its scientific strength. The last ten years have been a time of adventure, in fostering a new social contract between scientists and the economically and socially underprivileged sections of rural society.” ~Dr. MS Swaminathan

The MSSRF is well respected in India. I spent a majority of my internship at the foundation researching my project on climate change. However, the MSSRF also taught me a great deal of other things as well. The faculty at the MSSRF are experts in their fields, and they are kindhearted as well. I learned valuable information about the other projects taking place at the MSSRF such as using mangroves for tsunami barriers, applying GIS (Geographic Information Systems) for political science, and the process of making impoverished children computer illiterate.

Besides the outstanding faculty taking me under their wings, the building itself is a lesson in modern science. The foundation is solar powered, and the building is laid out according to the geographically diverse regions in India, and



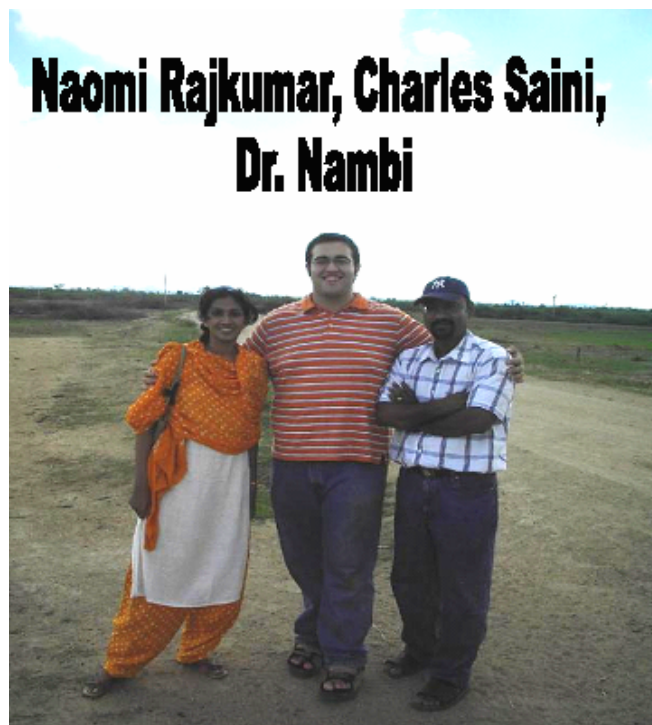
represents each different zone. Another incredible component of the MSSRF is the “Touch and Feel” Garden for visually impaired children. The garden consists of medicinal plants (with identification in braille), and the paving changes with the direction of the garden paths.

I was amazed at the MSSRF's mission to reach the unreachable, and awed by the fact that the center goes out of its way to make sure that all types of people can overcome their respective obstacles to learn whatever they wish to pursue. I also noted the MSSRF's open door policy, where researchers come from all over the world to share their findings, and utilize the foundation's resources. The visitors I had met ranged from a Cornell student, a scientist researching the indigenous tubers of Southern Asia, and the director of the WorldFish Center, among others. The MSSRF cultivates a desire for higher learning and the pursuit of one's interests, and I am honored to have been a part of the center's work. I simply can not thank everyone who worked at the MSSRF for sharing with me their studies, and inviting me into their family.

III. The V&A Family

The project I was chosen to work on was the "Vulnerability Assessment and Enhancing the Adaptive Capacity to Climate Change in Semi-Arid and Arid Regions in India" program (also called V&A).

The V&A was launched the January before I was placed at the MSSRF, and a few components were still developing. Because the project was forming, the staff had not been hired yet. Up until my last week in India, there were only three people on the V&A team: myself, the project leader, Dr. A. Arivudai Nambi, and an intern from the Madras School of Economics, Naomi Rajkumar. The three of us worked closely together and formed a family during my internship there. Naomi Rajkumar is a native of Chennai, and she became my guide to India



itself (especially Chennai), the culture, and the project we were working on. Dr. Nambi was also an incredible supervisor, friend, and mentor. Being a native of India, but having lived in the US, Dr. Nambi was able to help connect with me, and he understood some of the difficulties I was facing being abroad for the first time. Dr. Nambi was also an invaluable resource in my studies on climate change and during my field visits. I would not have been able to accomplish as much if he had not been there to guide me. During my last week at the MSSRF, two more people joined the V&A family. One was Diya Paul, a social scientist who had recently graduated from the Delhi School of Social Work, and had other specialties in ecological security and economics. While I was not able to spend much time with Diya, we were able to go to the Symposium on the Human Centered Sustainable Development Paradigm together during the remainder of my internship. Finally, Dr. T.N. Balasubramanian was also a member of the V&A family. Dr. Balasubramanian is an accomplished agrometeorologist who has had over 310 publications, led twelve workshops, and had been an educator for nine years. It was a privilege to work with him, and I learned a vast amount of knowledge from all members of the V&A family.

IV. The V&A Project

The Vulnerability Assessment and Enhancing the Adaptive Capacity to Climate Change in Semi-Arid and Arid Regions in India project has multiple parts, phases, and goals. The main objective is to secure the livelihoods of rural poor as well as other vulnerable populations in the face of climate change by promoting adaptation strategies and increasing disaster preparedness. This is analyzed in three levels: rural energy/biomass, water, and agriculture. Climate change vulnerability and adaptive capacity must be examined in each one of the three factors as a single unit, then reexamined at the interconnectivity level, and then analyzed for how each aspect impacts and alters the others.

The V&A program is unique in the sense that it is one of the first projects that looks at adaptation, and not mitigation. Since over 70% of rural India is dependent on the current climate for agricultural productions, it is necessary that farmers and villagers learn how to adapt to a different climate, not how to avoid it. In addition to the main objective, there are also three specific goals that this program is working towards. One is promoting policy dialogue at different (micro and macro) levels, and have it be in sync with the process

established by the United Nations Framework Convention on Climate Change (UNFCCC). The second goal is to build community-level capacities while utilizing the most ideally situated technologies, strategies, and practices in the sectors of rural energy/biomass, water, and agriculture. The final goal is to take the other goals and apply them to the chosen sites, the states of Andhra Pradesh and Rajasthan.

The length of time allotted for the V&A program to be completed is four years. These four years have been subdivided into three phases. Phase I is a documentation and stock-taking period, where national data and official records are examined. Phase II is a phase of implementation, where data at the micro/village level is gathered. At this phase the data from Phases I & II can be critically examined together and help show us the history of climate change, and the impacts of current climate change in that area. The final phase involves consolidation, networking, outreach, and dissemination. This phase involves creating knowledge centers for the villages to utilize. The knowledge centers will contain a library of information, strategies, and records/data to help educate farmers and rural workers about how they can adapt their agricultural systems to provide more sustainable yields.

The V&A program also utilizes the 80/20 concept of selecting areas where other NGOs (Non Government Organizations) have established relationships to the area, gained knowledge, and are willing to partner with us for this project. This method allows for integration, which is a key component in the V&A program. This project is based on the collaborations and cooperations of multiple research foundations and NGOs. The MSSRF is part of a multi-tiered system of collaborations. In addition to the MS Swaminathan Research Foundation, the research centers and NGOs of AFPRO (Agriculture for Food Production) and MANAGE (National Institute of Agriculture Extension Management) are also helping to execute this project. Because one of the goals of this project is to be involved at the international level, in addition to the village level, the program is overseen by the International Consortium, consisting of the agencies of INFRAS (Zurich) and Inter-cooperation (Bern). This project was launched by the SDC (Swiss Agency for Development and Cooperation), and the SDC oversees and guides the program.

My role in this project had multiple parts. The first part of my internship was researching climate change and adaptive strategies for the resource library. My initial

concentration was national policy. After that portion was complete, I moved on to researching policies and case studies from other countries as well. It is necessary to learn what regulations were in place, and what other countries have done to adapt to the changing climate. This way, the climate change and resource library would have many diverse strategies and data to help villagers in India. The next part of my internship was writing and presenting research findings reports and data summaries. The first report I wrote was on Agrometeorology (Appendix I). I also wrote a report on Farming Strategies for a Variable Climate and Sowing Window (Appendix II).

The next phase of my internship involved field visits to the selected field sites in the states of Andhra Pradesh and Rajasthan. During these visits, I went to the rural villages and participated in discussion for data analysis and research, ultimately leading to the eventual decision of where to house the knowledge centers. I also went to meetings the V&A team held with NGOs and government officials to ask for cooperation, collaboration, utilization of resources, and partnership. After the Andhra Pradesh visit, I also composed the official field visit report (Appendix III) that was sent out to our partner agencies and supervisors.

The last part of my internship was participating in the four-day symposium on the Human Centered Sustainable Development Paradigm in honor of Dr. Swaminathan's 80th Birthday. This was an enriching experience where I was able to hear the presentation of world renowned scientists, governors, journalists, and even a guru. I particularly learned a great deal about many disciplines outside climate change (Appendix VIII).

V. Roaming Rajasthan and the Andhra Adventure

At 5:30 in the morning on July 18th, Dr. Nambi's car pulls up to the MSSRF. As he gets out of the car, he smiles at me. "You get to see the *real* India."

The time had come for the V&A team to leave the MS Swaminathan Research Foundation, and head out to the field sites. I will admit that I was a bit frightened to see the "real" India. The first site we were going to visit was in the state of Andhra Pradesh. I had

heard horror stories about this place. I had attended seminars held by visiting scientists and lecturers, and I remembered learning about poverty so terrible that whole families committed mass suicide to prevent starvation. Naomi and Dr. Nambi informed me of other maladies that plagued the state, which is what made it an ideal place to establish a knowledge center. I also found it very unnerving when the *Lonely Planet* travel guide to India said something similar to “not too many people visit here” at the very beginning of the Andhra Pradesh section. Long before I arrived in India, I had realized that it was not going to be an easy internship, but I had grown accustomed to the metropolis of Chennai, and had ignorantly redefined my notion of India according to that city. During my weeklong visit to Andhra Pradesh, I was confronted head on with the atrocity of hunger and poverty, I saw first-hand the lingering anguish of starvation-driven suicide, and I questioned my notion of humanity. My time in Andhra Pradesh was the most life-changing experience I had ever had, and it opened my eyes wider than anything else had before.

The places marked as potential field sites were the mandals around the city of Hyderabad (Appendix V), in the Mahabubnagar District. Hyderabad is considered the



“high-tech capital” of India, and has lured people such as Bill Gates and former President Bill Clinton. However, outside the city, there seems to be a schism between the bustling hyper-reality of the cyber world, and the suffering of the occupants of the real world. After a train ride out of the state of Tamil Nadu, Naomi, Dr. Nambi, and I were driven to the guest house of the agricultural university where one of the partner NGOs were located. There, we met team members from our partner foundations, including Dr. Sai Bhaskar, Dr. Reddy, and Dr. Kumar. After checking in to the guest house, members from all three partner NGOs (AFPRO and MANAGE) crammed into an all-terrain van, and we headed out into the villages a couple hours outside Hyderabad. The first thing that captured my attention was the landscape. While there were breathtaking mountains in the distance, I noticed that the ground

was dusty, and most of the vegetation was dead. Then I remembered: Andhra Pradesh had been drought-ridden for years (Appendix IV). The farther we drove from Hyderabad, the poorer the conditions around us became. The cows were getting thinner and bonier, the number of workers in the rice paddies and fields increased, and there appeared to be more shacks. We even passed the bodies of a family that had been killed in a rickshaw accident. This was my first glimpse of death in India, and my visit to Andhra had much more to show me.

The first village we went to was Kothur. The second I had stepped out of the van, the villagers started bowing to me. One elderly woman bowed to my feet, and cried. I was not able to understand her, but she followed me around, and was begging to me. Dr. Sai Bhaskar informed me that she thought I was a doctor, and she was asking that I heal her eyes. One of the hardest things I had to ever do was try to explain to this frail, delicate woman that I could not help her heal her eyes. This experience still moves me to tears, because she followed me, pleading and

crying during the whole visit. It made me think about how much I take for granted, and that I should appreciate every gift I have, even something as simple as eyesight. I wish I could go back and help heal her, and it is tragic that her eyes will probably



become worse without proper medical care. However, this incident was not the only thing that moved me during my visit to Kothur. I saw a real village for the first time, and I saw conditions that were heartbreaking. As the village leaders and our research team sat on a large, red, rug and conversed about the village, they told us about a terrible drought that had left them without water for three years, and how there was a high female to male ratio because men have a higher suicide rate than women (ten men had killed themselves from the span of January to July). After the discussion, we were given a tour of the village. The village leader proudly showed us a new addition to Kothur. As he spoke about the new, upper-caste houses that had been built, I looked upon the structures of his pride: some tilted huts. This

kind of pride was common in all the villages we went to. I noticed that villagers were proud of what they had, and were willing to share with us whatever they could. Despite impoverished conditions, the villagers seemed happier in general than the people I observed in the cities. Before we left

Kothur, I was shown multiple wells that had run dry, and a school house. Since I am interested in becoming an educator, I was delighted to see rural Indian schools. The children seemed very shy, but the teachers let me walk around and observe.



While the one-room school was falling apart, and there did not seem to be many supplies, the children still seemed happy to learn. I was dazed as we left Kothur. My head was spinning with the overload of life I had just taken in. I had been moved in more ways than one. I had the regret of not being able to help the sick and needy as much as I would have liked, and I also learned a great deal about materialism and happiness. It does not matter what you have—just be grateful and find joy in it. After all, after the basic needs of food and shelter, we are all the same.

Over the next few days, I had learned similar lessons from other villages we went to (Matpur, Jaganatha Palli, and Sriragapuram) in the Mahabubnagar District, and each one

opened my eyes to humanity and poverty a bit more. For example, in Sriragapuram, I was thought to be an owner of a seed company, and I was blamed for the recent suicide of a woman whose seed order did not come in time. This incident was riveting. To be yelled at for the death of another chilled me. I understood Dr. Borlaug's anger from the Youth Institute Symposium. There is no reason why these people had to take their lives. There has to be



another way to help prevent starvation. Innocent, hard working people do not deserve to feel

like the only way out of hunger is death. Because debt falls on the next generation, whole families kill themselves to prevent their babies from dealing with their burdens. To me, this waste of humanity is the worst thing in the world. And it could all be prevented. I take some pride in knowing that my part in the V&A project will help these people. For instance, in Sriragapuram, a farmer had learned about vermiculture/compost production, and then educated four other villagers. Before the vermiculture training, the cost of chili for ¼ acre was Rs. 2,000 and the expected income was Rs. 6,000. After this vermiculture training, the cost of chili per ¼ acre was Rs. 1,000, and the income soared up to Rs. 10,000. This incidence shows how even with the knowledge of one person, positive outcomes can be far reaching. With our team's goal of creating a knowledge center, this would allow a broader scope of people to be reached. This demonstrates how a more secure future can exist in agriculture if more people were educated.

This also shows how partnership between organizations and villages can yield positive results. The Principal Agricultural Polytech Regional Agricultural Research Station in Palam, Bijanpalli Mandal in the Mahabubnagar District has developed a Vermiculture station and created a model for bore well efficiency. Village utilization of such resources can be mutually beneficial. This is why the second component of the Andhra Pradesh visit consisted of reaching out to other organizations. In addition to strengthening collaborations between AFPRO, MANAGE, and the MSSRF, our team received aid and support from the following people, and establishments/NGOs:

1. Full cooperation/support from the District Collector, Mr. Jagadishwar
2. Mr. Balaji, Project Director of Water Shed studies, and has warned us about the mandals with Naxallite (rebel) opposition
3. Mr. Chandrasekhar, director of the Eco-Club School for the Mentally Handicapped, and of a watershed program, in addition to working for the Non Government Organization, AME
4. The Principal Agricultural Polytech Regional Agricultural Research Station in Palam, Bijanpalli Mandal (through Dr. Raja, Associate Director)

We visited each of these people in their respective organizations and informed them of our project. Since each organization has relations with villages already, and other valuable

information, a team-effort and marriage of these resources will help make the knowledge center more productive and outreaching.

My final visit in Andhra Pradesh was to the Pioneer Hybrid, International Corporation outside Hyderabad. I was taken on a tour of the administrative headquarters, and then to the process factory. I was taught about new seed hybrids that were being produced, and how the seeds are cultivated, stored, and shipped. This information was very helpful, and I included it in my contribution to the research library. I had gathered valuable data from the villages that will help our project, and teach us about the area history, and climate change in Andhra Pradesh.

After returning to the MSSRF from Andhra Pradesh, I had only a couple days to prepare for the next field visit, the journey to Rajasthan. During that time, I was also responsible for writing the official field visit summary (Appendix III) of Andhra Pradesh that was to be sent out to the SDC and partner NGOs. I was still haunted by my experience in Hyderabad, but I was willing to continue my lessons on humanity, climate change, and India. I was more optimistic about Rajasthan, even though on paper this place looked even harsher than Andhra Pradesh, for it is known as the desert state. However, the lessons from Rajasthan were completely different from Andhra Pradesh. While I learned a great deal about climate change from both, I had learned about humanity from Hyderabad. My trip to Rajasthan would be my education in Indian culture.

I had been told that India is a land of conflicts. This is true, but I found this out the hard way. While Andhra Pradesh is usually a wet state, I had come during a time of drought. And even though Rajasthan has been called the desert state, I arrived during a period of intense flash flooding. The field site chosen to be



examined in Rajasthan was the mandals around the city of Udaipur (Appendix VI). Udaipur had once been known as one of the most romantic cities in India, because of its many lakes. In fact, Lake Pichola was even featured in a James Bond movie. However, years of drought had dried up the lakes, and people had been farming on the bottom of them. Excessive storms and a burst dam had caused flash flooding, and the lakes filled up in less than three days. It was quite a contrast from Hyderabad, as there were picturesque lakes, temples, mountains, and green vegetation everywhere.

I was told I had come at a good time to study climate change, as the weather in India was completely unusual. There was a different agenda for Udaipur than Hyderabad. In Hyderabad, the mandals to establish the knowledge centers had been almost chosen, and we



were gathering data from the villages, and support from other organizations.

However, there had been various problems getting the project launched in Rajasthan, and we were there to help start of the project. The first goal was to determine which areas around Udaipur would be appropriate for our project. After a long debate about which indicators are most important, the V&A team, in addition to

the other NGOs, compiled a list of 23 factors and indicators to measure climate change vulnerability, and adaptive capacity. The list was narrowed down to 7, and we were able to arrange a list of blocks/mandals in the order of most vulnerable (Appendix VII). This was intense as all members contributed their feelings and rationalized which factors were the most important. Because this project is only funded for four years, we had to look at villages that were not too vulnerable, but not too well adapted. These outlier villages would not allow us to pinpoint villages that would be most successful with a knowledge center, so from the list of villages we prioritized, the most suitable would be from the middle.

The next goal in the Rajasthan visit was hiring a lead consultant to work with the MSSRF and the V&A team in Hyderabad. Once we have a lead consultant, we can start



gathering and analyzing data from the area.

As I was not allowed to help hire the lead consultant, Dr. Sai Bhaskar (the lead consultant for Hyderabad) and I were given a tour of Udaipur. This is where my cultural education was received. I was taken to historic museums and temples where I got to see Indian history first hand. I was also able to learn how marble is manufactured (Udaipur is famous for its marble), take a

cruise on Lake Pichola, ride camels and an elephant, visit the zoo, see a magic show, go to a festival, and learn how to do traditional Rajasthani dances. While I had immersed myself in culture, I began to learn more about my Indian heritage, and discover more about myself.

Udaipur was not all fun and sightseeing. The field visit in Udaipur to Jhadol and Kholeari were the most intense of all the field visits. While Andhra Pradesh was fairly flat,



Udaipur was mountainous and rugged. A majority of the day was spent driving on narrow, serpentine roads, through heavy mist, and trying to find roads that were not washed away in floods. It was very educational to have Dr. Vishnu, from the International Consortium, with us. He was very knowledgeable about the region, and he showed us where old efforts had taken place, and where desertification was occurring. The village we went to also required a trek on foot that left me exhausted. Once we got to the village, we discovered a new challenge: the communities in Udaipur are not close together. In Andhra Pradesh, the houses were close

together in a visible village. In Udaipur, the houses were spread out, and the only form of communication was when a meeting was called via drum beat. It is much more challenging to set up a communal knowledge center without a visible community. However, we were also well-received. We were taught about sowing techniques used, and we learned about the

history in the village. We also established contact with the NGO *Rajasthan Bal Kalyan Samiti*, which had set up various pro-female education programs and rural development activities. The team also formed a relationship with the organization *Vikas Samiti* (which has 135 acres for Agricultural testing, engages in green fertilizer, and works on livestock breeding, in addition to recently publishing results on fruits and tubers in the region.

My field visits to Andhra Pradesh and Rajasthan were the highlights of my internship. I had left these two places different that when I had come. I was taught about humility, compassion, humanity, and the desire to fight for life in Andhra Pradesh. I learned about culture and myself in Rajasthan. In both places I learned about the history of climate change, and how a little knowledge can go along way. Informally, I also was taught about forging relations between companies, and ranking vulnerability factors, I also learned to really *think* about climate change in context of the villagers at the micro level.

VI. The Felicitation of a Lifetime and a New Beginning

When I returned from Udaipur, the MSSRF had radically transformed. There were lights everywhere, and the courtyard had been set up with chairs. As I hauled my suitcases from Rajasthan into my room, I realized: this is the inauguration of Dr. Swaminathan's 80th Birthday celebration. After the feast tonight, tomorrow there was to be a four-day symposium based on Dr. Swaminathan's life and the Human Centered Sustainable Development Paradigm. I was eager to participate in this symposium, as I had received a great deal from the World Food Prize Symposium the year before. Because there were many different simultaneous presentations, I was able to select a combination that meshed together my desire for environmental education with the desire to help people (Appendix VIII). This event was a once-in-a-lifetime opportunity for me, and I gained a great deal of knowledge of other issues present in the world today, beyond the scope of climate change. I was also amazed at Dr. Swaminathan's accomplishments. He



has become my role model, and I will try my hardest to live like he does, selfless and compassionate, but proactive. After the symposium concluded, I looked back over all forty pages of notes, and reread them. I am reminded of Dr. Geeta Mehta's speech of learning to look with fresh eyes. This project has had a very influential impact on me. I have learned countless facts about climate change, global warming, adaptation, villages in India, India itself, climate problems in other countries, and effective ways for gathering data. This experience has also strengthened my professional skills, has taught me the value of a proactive approach, and has helped prepare me for future endeavors in a science career. I have also gained a new perspective on life by going to the villages, and seeing how blessed I am in life. I have also vowed to follow the villagers model in finding optimism in everyday "little" things, and wanting what you have, not having what you want. This internship taught me that I can help make a difference. I saw first hand in Andhra Pradesh that with just one person being educated in better agricultural techniques, a more secure harvest was possible. I take pride in knowing that I helped work with a program that will educate many people, and have a more promising agricultural yield. I now know that I am capable of anything I put my mind to.

And while I have learned to look with fresh eyes, I cannot say that this internship, this journey, has made me a



completely different person. In fact, that is one of the lessons I learned from India. I noticed, India itself never gives up anything, it just incorporates the old with the new. This redefinition of things is how I must look at my own growth. I must add these new lessons and perspectives to the old me. It is necessary to remember how one starts out and how one changes in order to have enough reflective foresight to see a new beginning. I will never

forget the lessons in science, humanity, humility, and culture that this internship has given me. I will always treasure the inscription Dr. Swaminthan wrote to me in a book before I left:

“Please keep up the great traditions of the World Food Prize Fellows and become an affirming flame in the quest for a hunger-free world.”

I will always keep his kind words in mind. But I also realize that in giving me this internship, the World Food Prize Foundation ignited the match.

APPENDICES

Appendix I: Climate Change Adaptation Findings Report: Agrometeorology

The impacts of climate change have broad reaching effects in already complex climatic systems. One such example is the occurrence of the El Nino and La Nina phenomena. These two events can impact the Indian Summer Monsoon Rainfall (ISMR). El Nino impacts the ISMR by creating a low-pressure system over the equatorial South Pacific and disturbing the low pressure over the Indian Ocean that is necessary for ideal ISMR. La Nina can also lead to ideal ISMR by the same analogy. Research has shown that the relationship between ISMR and El Nino events has a complex, yet weakening, relationship. This could be possibly be due to three things: 1) a non-occurring even overlapping phases, 2) competition for convergence among systems, or 3) sea surface warming.

There is also a relationship between El Nino and the Southern Oscillation and the ISMR. The Southern Oscillation, SO, is a measure of difference between the atmospheric pressure between the Indian region and the Pacific region. The name for the relationship between El Nino and SO is identified as ENSO (the negative phase of SO integrated with the conductive phase of El Nino). This results in very poor ISMR. However, there is also an unprecedented relationship between ENSO and ISMR, where the relationship is inverting and breaking down. Because of the changing relationships between ISMR, ENSO, and El Nino/La Nina, the following about monsoons should be taken into view: 1) The preponderance of El Nino episodes in the last 100 years, 2) the feasibility of the continuation of the present frequency and amplitude of ENSO and its precursors in the forthcoming years, and 3) the likelihood of ISMR entering an epoch of deficient rainfall in the near future. These all indicate a future with highly uncertain monsoon rains.

In analyzing agrometeorology, it is also important to examine the Green House Effect's role in global warming, cloudiness, rainfall, and other changes. It is currently estimated that CO₂ levels in the atmosphere could double by the middle of the 21st century. A 50% increase would raise the air temperature in the winter season in India by 1-2 degrees centigrade. If this happens the frequency of the ENSO will increase during January to

September. In relation to more intense ENSO, the wet regions will increase in wetness, while the dry areas of India shall become drier. Extreme rainfall is also projected to be higher. However, because the relationship between ENSO and ISMR is breaking down (possibly due to Eurasian warming), global warming could possibly be beneficial in mitigating the failure of ISMR.

Cloudiness is another factor in looking at agrometeorology. A higher CO₂ will make an increase in cloudiness. This should raise the night temperatures as well as the winter norms. One can look at the incidence of the Asian Brown Cloud (ABC) as an indicator of the relationship between crops and clouds. In the winter, a stable atmosphere that is met with uncontrolled air pollution will produce areas and periods of cool and bright weather being increasingly encroached upon by warm and cloudy weather. This is very stressful for winter grain crops, and production will become greatly reduced. This also shows how vulnerable crops are to pollution. Rainfall, as suggested in most of the General Circulation Climatic Models (GCCMs), show an increase in monsoon rainfall associated with global warming. While the increase of greenhouse gases diminishes the impact of El Nino events on ISMR, La Nina remains unaffected. Spatial rainfall variability associated with El Nino and SO will get enhanced in an increased carbon dioxide climate. The higher levels of CO₂ over land will increase the intensification of the ISMR in addition to a greater variability associated with a northwards shift.

These impacts should also be applied to responses from crops. The doubled carbon dioxide levels will also result in a decrease of stomatal aperture and transpiration by 40% and 35%, respectively. However, the lowered stomatal conductance of leaves will not impact photosynthesis, thus the water-use efficiency will be improved. The water lowering needs will also help crops in drought-prone and/or drier climates. Increasing the carbon dioxide will increase crop yields by 30%. When cloudiness is taken into the account of crop response, it is found that this increase will decrease biomass, plant maturity, and greater nocturnal respiratory depletion of photosynthates. The ratio of dark respiration to photosynthesis remains the same at various increased levels of CO₂. Thus the increased CO₂ will not necessarily increase respiration. A reduction in maximum temperature (by cloudiness) will not affect photosynthesis. However, an increase in minimum temperature will increase maintenance respiration and the percentage increase will depend on the fraction of

maintenance respiration vis-à-vis photosynthesis, the quantum increase in temperature, and the level of mean temperature. Crop productivity potential due to global warming and increased cloudiness will: 1) at best be one of status quo in summer and monsoon seasons, and 2) be significantly reduced in the winter season. Another factor in crop response is temperature. Winter crops are generally dependent on two things for output: field life duration, and proper proportional development of the vegetative and maturity durations. These two aspects are *highly* affected by temperature. The extent of crop reductions will be more for crops with a high base temperature for growth, more in cold weather than cool weather regimes, and finally, least in warm weather. Also, there will be an overall reduction in irrigation needs, and better survival of rainfed crops during droughts. This notion, however, is counteracted by the argument that a warmer world would yield a more intense hydrological cycle.

The effects of global warming on monsoons and crops will be great. Some of the follow conclusions can be drawn: 1) the likelihood of monsoon rains entering an epoch of decreasing rainfall in the coming years without any reduction in El Nino activity, 2) no indication of intensification of extreme events in a warm atmosphere, 3) global warming being beneficial in offsetting magnitude of monsoon failures, the envisaged climate change is likely to lead less frequent failure but greater variability of ISMR in the near future, and 4) air pollution, if left uncontrolled, will result in the intrusion of warm and cloudy weather regimes into current areas of cool and bright weather. An increase in carbon dioxide will 1) lead to a decrease in the quantum crop water needs, 2) assist in better performance of dryland crops, 3) reduce life duration and production yields in low latitudes, and 4) an increase in air temperature will facilitate over-wintering survival of pathogens and lower disease resistance of crops.

Because there is possible reduction in yields of grain crops in the future climate, it is important to look at the materials and methods to deal with this issue. One useful tool, Crop Weather Simulation Models (CWSMs) are helpful, for they seek to find out the phenology and yields of weather data. However, CWSMs seem to have better results predicting crop phenology than crop yields. Also, when studying this area, constraints due to soil moisture stress and nutritional deficiencies must be avoided. One must also look at Photosynthetic Capacity (commencement of maturity) and Photosynthetic Opportunity (during maturity).

Photosynthetic Capacity is governed by factors like solar radiation, life duration, cumulated leaf area, and/or earheads per unit area, while the Photosynthetic Opportunity is governed by temperature and solar radiation regimes during maturity. Although factors like radiation and temperature's effects on life duration cannot be manipulated, agronomic strategies can be used for countering attributes of earhead density and leaf area (by thicker sowings). Use of CWSMs show that: (a) for given crops the day degrees above a base temperature required for completion of various crop phases is (i) conservative for many phases and (ii) varies with varieties in a few phases necessitating the use of a "Genetic Coefficient" and (b) the phase from end of juvenile period to panicle initiation is photosensitive and requires an assessment of the additional thermal time required for completion of phase in terms of critical photoperiod at the end of the juvenile phase. Thus, it can be deduced that the percentage reduction in the life duration of a crop for a given rise in mean air temperature will practically be the same for all given cultivars.

There are basically three types of scenarios that can be applied to predicting the changing climate. 1) An optimistic one: a CO₂ level of 460 ppm., and increase of 1 °C in mean air temperature and 10% reduction in solar radiation. 2) A realistic one: a CO₂ level of 550 ppm., and increase of 2 °C in mean air temperature and 15% reduction in solar radiation, or 3) a pessimistic one: a CO level of 660 ppm., and increase of 3 °C in mean air temperature and 20% reduction in solar radiation.

There are mitigation measures which will help take advantage of the envisaged increase in CO₂ level and counter its associated negative effects of increased temperature, reduced solar radiation, and enhanced rainfall variability. The following measures should be taken into consideration:

- 1) Advantage of the optimum date of sowing irrigated crops in various areas by half the expected curtailment in the field-life duration of the crop to avoid maturity of the crop in very warm weather.
- 2) Using a variety or a crop with a heat-unit requirement lesser by the same percentage as the reduction in the envisaged crop-life duration where change in sowing date is not feasible.

- 3) Replacing existing crop varieties or crops in dryfarming areas with those with 15% less heat-unit requirements
- 4) Scheduling of irrigation accurately and with the water so saved increase the net irrigated area so as to compensate for the reduction in unit area crop yields due to shorter crop life.
- 5) Breeding of varieties of important crops with the desired morphology and seasons
- 6) Breeding of varieties with
 - a) Small leaves, low leaf area index, heat tolerance during maturity, and high harvest index.
 - b) Large grain size
 - c) Increased resistivity to atmospheric drought.

Data Tables:

Table 1: Percentage Reduction in Field-Life Duration of Crops due to Increase in Temperatures																						
Mean Temp °C	Base of Mean Air Temperatures																					
	10 °C			9 °C			8 °C			7 °C			6 °C			4.5 °C			3.3 °C			
	Increase in Mean Air Temperatures – Degrees Centigrade																					
	+1	+2	+3	+1	+2	+3	+1	+2	+3	+1	+2	+3	+1	+2	+3	+1	+2	+3	+1	+2	+3	
15	17	19	37	14	25	33	13	22	30	11	20	27	10	18	25	9	16	22	8	15	20	
16	14	25	33	13	22	30	11	20	27	10	18	25	9	17	23	8	15	21	7	14	19	
17	13	22	30	11	20	27	10	18	25	9	17	23	8	15	21	7	14	19	7	13	18	
18	11	20	27	10	18	25	9	17	23	8	15	21	8	14	20	7	13	18	6	12	17	
19	10	18	25	9	17	23	8	15	21	8	14	20	7	13	19	7	12	17	6	11	16	
20	9	17	23	8	15	21	8	14	20	7	13	19	7	13	18	6	11	16	6	11	15	
21	8	15	21	8	14	20	7	13	19	7	13	18	6	12	17	6	11	15	5	10	15	
22	8	14	20	7	13	19	7	13	18	6	12	17	6	11	16	5	10	15	5	10	14	
23	7	13	19	7	13	18	6	12	17	6	11	16	6	11	15	5	10	14	5	9	13	
24	7	13	18	6	12	17	6	11	16	6	11	15	5	10	14	5	9	13	5	9	13	
25	6	12	17	6	11	16	6	11	15	5	10	14	5	9	14	5	9	13	4	8	12	

26	6	11	16	6	11	15	5	10	14	5	9	14	5	9	13	5	9	12	4	8	12
27	6	11	15	5	10	14	5	9	14	5	9	13	5	9	13	4	8	12	4	8	11
28	5	10	14	5	9	14	5	9	13	5	9	13	4	8	12	4	8	11	4	7	11
29	5	9	14	5	9	13	5	9	13	4	8	12	4	8	11	4	8	11	4	7	11
30	5	9	13	5	9	13	4	8	12	4	8	11	4	8	11	4	7	11	4	7	10

Table 2: Likely Percentage Reductions in Yield of Wheat Rabi Maize and cool-Weather Rice due to Climate Change in Various Regions of India.

Crop	Wheat			Maize			Rice		
Climate Scenario	A	B	C	A	B	C	A	B	C
Region									
NW India	5	7.5	8	12.5	20	27.5			
North India	5	6.5	7	12.5	19.5	26.5			
East India	4	6.5	7	11.5	18.0	24.5	12	20.5	26
NE India	4	5.5	6	11.5	17.5	24.0	11	18.5	24
E.S.E India	4	5.5	5	10	16.5	22.5	10	16.5	22
Central India	4	6.5	7	11.5	18.0	25.0	12	20	26
SE India	4	6.5	7	11.5	18.0	24.5	12	20.5	26
W & SW India	3	4.5	4	10.5	18.0	21.5	10	16.5	22
South India	3	3.5	3	9.5	18.0	20.5	9	14.5	20

Appendix II: Change Adaptation Findings Report: Farming Strategies for a Variable Climate and Sowing Window

Sources:

Gadgil, Sulochana; Rao, Seshagiri P. R. "Farming Strategies for a Variable Climate - A Challenge." Current Science, Vol 78, NO. 10 25 May 2000: 1203-1215.

Rao, Narahari K; Gadgil, P. R; Savithiri, K. "Tailoring Strategies to Rainfall Variability – The Choice of the Sowing Window." Current Science, Vol 78, NO. 10 25 May 2000: 1216-1230.

In spite of the progress the green revolution has made, agriculture in India is still a gamble because of the reliability on the monsoons. Almost half of the country's agriculture is produced in the rainfed belt, an area where progress has been slow overall. There are numerous reasons: the programs brought about by green revolution are science-oriented, not farmer/user centered. These programs were developed from small plots, and were not associated with critical cost-benefit studies. The farmers in the rainfed belt are doing as well as possible with current conditions and technology. For instance, in seasons with very high rainfall, crop yields are much lower than what they could be if they had access to techniques and knowledge. Another important aspect to examine is the variability from year to year. Farmers in irrigated regions have better yields in variable climates, while those without a knowledge base have yields that suffer.

Different regions in India have taken a variety of different measures to deal with the changes in climate. In the Pavagada region of Karnataka, the traditional crop (the groundnut) is vulnerable to changing conditions. If the sowing rains become delayed, soyabeans or horsegram is planted. However, a lack of market demand sometimes hinders these efforts. Other efforts, such as farm ponds, are not well received, for in the farmer's estimate, conservation measures provide more benefit than cost.

There is work being done in the semi-arid Anantapur region with the groundnut. One major problem is that the rainfall is so variable, that the cost of cultivation itself is sometimes not met. During the kharif (July-October) season in 1998 the marginal and small farmers and researchers held a discussion. The following decisions/benefits were examined:

- 1) Apply soil amendments (ex: manure) once every 4 years – 10% benefit (as % of basic cost of cultivation)
- 2) Increase fertilizer application to recommended dosage – 10-40% benefit
- 3) Seed treatment (fungicide) – 10-20% benefit
- 4) Late leaf spot, spray fungicide – 10-50% benefit

These decisions depend on the farmers' estimate of the expected profit, which in turn depends on the production and market price. Also, farmers deal with climate variability in units of time, nakshatras (13-14 day periods based on the sun and constellations). When time units are communicated using this system, it strengthens the relationship between the farmer and the new innovative techniques being presented. Farmers adjust their methods by adapting to these in place systems.

Appendix III: Official Field Report from Andhra Pradesh

The villages in Andhra Pradesh are a prime example of why the application of climate change adaptability is necessary. Some of the villages visited included Jaganatha Palli, Kothur, Matpur, and Srirapuram, as well as other villages. The interviews at the villages took place between July 18th and July 20th, 2005.

All of the villages visited had problems with water. For instance, in Srirapuram, water could once be reached in wells at ten feet. However, the climate has changed to provide less rain, irregular/delayed monsoons, and coupled with overuse of the water tables, water now has to be reached between 150-200 feet. There has also been a recorded eight-year drought. Such instances are not atypical. In Matpur village, there are only 50 functioning wells, where there were once 200 functioning borewells that support the 400 households – 2,000-member population, and water can only be found starting at 300 feet. Kothur Village (also Midgil Mandal) has had barely any traces of rain for the past three years. Similarly, in Jaganatha Palli, only 25% of their 150 borewells have not dried up. Regional information shows that rainfall has only yielded 500-550 mm, and the monsoon in Jaganatha Palli as already been delayed by 1½ months. The examination of the strained water supply alone provides evidence of how establishing a Knowledge Center could help cope and adapt to a shifting climate.

Villages have also been forced to take some adaptation measures themselves. In Kothur, the lack of water has forced the village from being able to make a sustainable yield of rice, to now being dependent on Public Distribution Systems. Kothur village has now adopted a very pessimistic view about agriculture, and has switched to producing cotton during the past ten years in hopes of a better yield. Subsequently, they have had poor yields for past ten years. Also, there are a large number of villagers who migrate. Jaganatha Palli has taken a slightly different approach in using Food for Work Programs, and obtaining insurance (hailstorm, etc). However, one cannot overlook drastic measures that villagers have taken to escape the bleak conditions. A woman killed herself in Srirapuram only three months before the visit, in May, and in Kothur in the past year there have already been ten male suicides, revealing that the largest proportions of suicides are males in that village,

which could help account for the unusually high female to male sex ratio, despite that fact that there is a large amount of female migration.

It is also important to realize the dependent relationship between other agencies and the villages, such as Public Distribution Systems (PDS), Self Help Groups (SHGs) and the Food for Work Program. Villages are also dependent on the punctuality of seed companies, such as Pioneer Hi-Bred International. There often seems to be a misconception of the motives behind such corporations, especially as in Sriragapuram, the seeds did not arrive in the ideal sowing window as arranged. However, in a tour of Pioneer, one can see the different measures the company is taking to improve yields, such as different chemicals to coat the seeds with and rigorous germination testing. In this instance, a lack of efficient communication and misunderstanding prevents the “quintessential” relationship from being the most productive and beneficial.

A closer look at Sriragapuram will show the enormous benefits of establishing knowledge centers. A farmer there had learnt about vermiculture/compost production, and he has so far educated four other villagers. Before the vermiculture training, the cost of chili for $\frac{1}{4}$ acre was Rs. 2,000 and the expected income was Rs. 6,000. After this vermiculture training, the cost of chili per $\frac{1}{4}$ acre was Rs. 1,000, and the income soared up to Rs. 10,000. This incidence shows how even with the knowledge of one person, positive outcomes can be far reaching. This also shows how partnership between organizations and villages can yield positive results. The Principal Agricultural Polytech Regional Agricultural Research Station in Palam, Bijanpalli Mandal in the Mahabubnagar District has developed a Vermiculture station and created a model for borewell efficiency. Village utilization of such resources can be mutually beneficial, as the Associate Director, Dr. Raja explained. The Regional Polytech Extension also has set up Regional Research Laboratories (RRLs) so that areas will have more specific research and application knowledge/data available.

It is also necessary to recognize the support other agencies/organizations would provide to the villages. It is essential to secure as much local support as possible, as to insure cooperation and to maintain contribution. This project has also been confirmed to receive

support from the District Collector, Mr. Jagadishwar. Mr. Jagadishwar is willing to extend all possible help from his end, and to convene a meeting of appropriate officials and departments to assist. This project has also received aid from Mr. Balaji, Project Director. He has promised to contribute, and has warned about the dangers of setting up a knowledge distribution center in the Kalawkurthy Mandal, and the lower half of Midgil Mandal due to Naxalite opposition and forces there. This input is most valuable, as it would allow this project to maintain effective knowledge distribution centers in the most successful areas. The V & A Climate project has also received support from Mr. Chandrasekhar, director of the Eco-Club. Dr. Chandrasekhar works in an extensive watershed program, and assists in AME's agricultural program in the Kondurg Mandal as well. He is willing to help facilitate between our project and the villagers to help clear any misunderstandings, and to develop communication, and to assess any other projects in the region. Because organizations are in these local areas, it is highly important to seek their respective advice, so that another perspective on the region is attained.

It seems as though the strains placed on villages will not lessen in the coming years. The most helpful way to spread the knowledge of adaptation is through knowledge systems (ex: vermiculture), application of knowledge to technology, and better relationships with organizations. While there will have to be sacrifices on different levels, there is still a chance for a more sustainable village life, if only there is cooperation.

Appendix IV Data on Water Scarcity Collected from Andhra Pradesh

Village	Issues
Sriragapuram	<ul style="list-style-type: none">● Water can only be reached starting at 150–200 feet (used to be 10 ft)● 8 year drought
Matpur	<ul style="list-style-type: none">● Of the 200 bore wells, only 50 are functioning● Water now found at 300 feet
Kothur	<ul style="list-style-type: none">● Only traces of rain for the past 3 years
Jaganatha Palli	<ul style="list-style-type: none">● Only 25% of the 150 bore wells (about 37) have not dried up● Monsoon delayed over 1½ months.

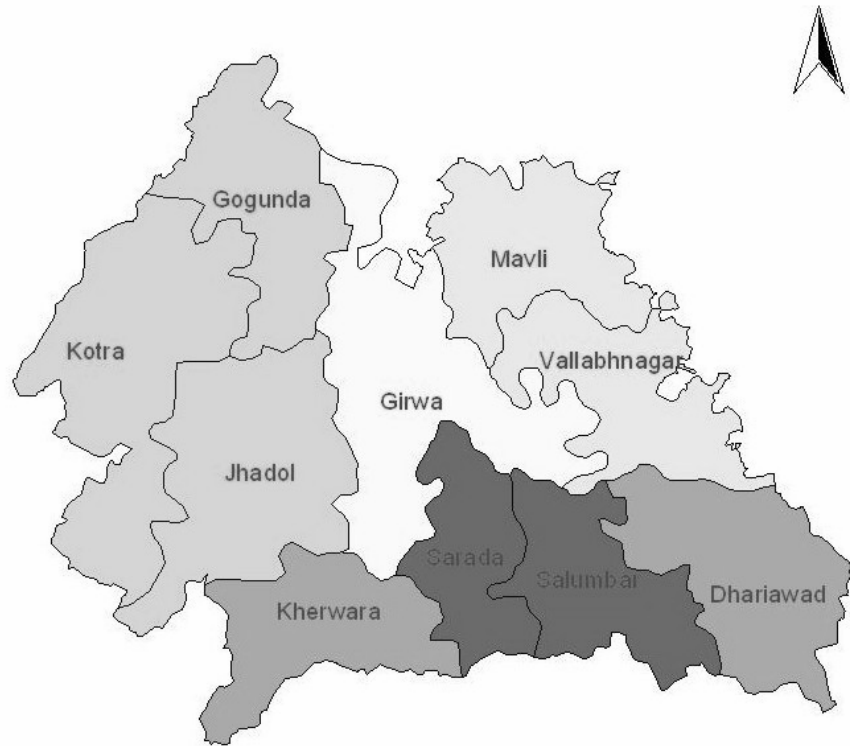


Appendix V: Map of Mahabubnagar District in Hyderabad, Andhra Pradesh

MAHABUBNAGAR DISTRICT



Appendix VI Map of Udaipur District in Udaipur, Rajasthan



Appendix VII List of Vulnerability Factors and Villages Ranked According to Vulnerability and Adaptive Capacity

Indicators Prioritized:

- Net Sown Area
- Small & Marginal Farmers
- Extent of Sowing Area
- Livestock Density
- Pasture Land
- Sex Ratio
- Rainfall

**Vulnerability Ranking:
Village:**

- Kotda
- Sarada
- Jhadol
- Vallabhnagar
- Mavli
- Gogunda
- Girwa
- Salumber
- Kherwada
- Dhariyawad

Appendix VIII Workshops and Lectures Attended During the Human Centered Sustainable Development Paradigm

- I. Professor MS Swaminthan's Contributions to Science
- II. Professor MS Swaminthan's Contributions to Public Policy
- III. Science and Technology for Improving Human Lives
- IV. Biodiversity Conservation
- V. Ecojobs
- VI. Gender and Development
- VII. Development, Empowerment, and Social Justice
- VIII. Natural Resource Manangement
- IX. Grassroots Institutions and Linkages
- X. Policy Issues in Biotechnology and Biodiversity
- XI. Food and Peace