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Julia Quartz[1]

Creative Dissent with Technoscience in India:

The Case of Non-Pesticidal Management (NPM) in Andra Pradesh

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[1] Julia Quartz is a PhD researcher at the Institute for Health Policy and Management at the Erasmus University in Rotterdam. She receives her PhD from the Department of Technology & Society Studies and holds a MA degree in European Studies on Society, Science and Technology (ESST).

ABSTRACT: This article outlines the emergence of Non-pesticidal Management (NPM) in the South Indian state of Andhra Pradesh. By tracing the historical development of NPM since the late 1980s, I aim at demonstrating how the project developed in the (Gandhian) tradition of performing creative dissent with science and technology - a method which combines creative work with (activist) dissent. I address how scientists and activists used the method to generate alternative pest management practices that could help marginal farmers to better cope with their vulnerable livelihood conditions.

If we can make agriculture a way of life once more, most of the problems will be taken care off. (M.V. Sastri)

1. INTRODUCTION

If small agriculturalists could afford a lower level of income while they were applying non-pesticidal components to their lands, many problems of current agricultural productions systems could be solved, said M. V. Sastri (interview Sastri 2008 b).[2] Sastri is the convener of the Centre for World Solidarity, and his statement captures the central goal of the non-pesticidal management project (NPM): the alternation of agricultural production systems into small-scale, village-based units of sustainable production, where locally-appropriate technologies, such as non-chemical pest repellents and low-cost plant protection strategies take central stage.[3] Sastri, who is one of the founding fathers of the NPM project, told me about his life-long goal to foster *community-based sustainable agriculture* - a goal that he shared with many other engaged scientists and activists in Andhra Pradesh.[4]

This article traces the historical development of the non-pesticidal management project, which emerged as a tool to *reduce the livelihood vulnerability of marginal farming communities* in the Telangana region of Andhra Pradesh.[5] It is the aim of

[2] For a list of interviewees see *Appendix*.

[3] The Centre for World Solidarity (CWS) characterizes itself as a voluntary organization, which works through a network of partnerships with NGOs "to promote people-centred, participatory development." (CWS, 2008) The CWS aims to "develop and strengthen the capacity of partners, networks and fellows for promotion and protection of rights and justice, particularly of the marginalised sections of the society, for advancement of people-centred and participatory governance." (CWS, 2008)

[4] NPM predominantly deals with problems of pest management for small and marginal farmers, while the problems of rural communities are multi-dimensional and comprise a broad range of issues. Zakir Hussain, agricultural scientist and project manager at the CSA, explained that farmers had difficulties to restore and maintain their soils in a fertile equilibrium at the same time that they lacked access to rural credits within the current credit system. Moreover they were in demand of increased knowledge about disease management for crops. Therefore the NPM project extended its work beyond non-pesticidal agricultural strategies and committed to the broader approach of *community-managed sustainable agriculture* (CMSA) in 2007 (interview Hussain 2008). Because this article deals with the creative dissent project NPM, we will not further follow the developments in the CMSA project.

[5] Andhra Pradesh is divided in three regions: Costal Andhra, Rayalaseema and Telengana. "Costal Andhra is the most developed region and dominated by a fertile delta. (…) Rayalaseema region with the

this article to contribute to the understanding of how NPM was able to mitigate livelihood vulnerabilities for small and marginal farming communities.[6] By following NPM's history, I will demonstrate how the project developed in the Indian tradition of dissent with technoscience. In this context, I highlight how the Red Hairy Caterpillar (RHC) project emerged as a crop specific pest management strategy for castor crops, which gradually transformed into NPM, and which served as a cost-efficient and non-pesticidal agrarian pest management strategy for the economically vulnerable marginal cultivators. I will use the *method* of creative dissent and show how both the creation of alternative agrarian pest management methods and the dissenting discourse with mainstream science and technology co-evolved, and how this double strategy of creative practice and articulated dissent contributed to reduce livelihood vulnerability for marginal farmers.

The focus on the vulnerability of marginal farmers deserves some clarification. The common meaning of 'being vulnerable' is to be at risk, exposed to damage, or susceptible to physical or emotional injury. The notion of vulnerability is often used as a descriptive dimension to portray the (weakened) condition of an individual or a group, be it due to social inequalities (Hogan & Marandola, 2005), spatial disadvantages (Cutter, Mitchell, & Scott, 2000), natural hazard (Cannon, 2008a, 2008b), environmental change (Kasperson & Kasperson, 2001; Turner, et al., 2003), or medical reasons (Rogers, 1997).[7] I am making use of the notion as a descriptive research dimension too. Yet, when I spent time in marginal farming villages in Telangana I didn't meet a single farmer who described him/herself as vulnerable. Vulnerability in this elaboration, then, is not an *actor perspective*. When I use vulnerability as a descriptive tool to highlight the dynamics, which contribute to a reduced capacity of villagers to cope with, anticipate, resist, or recover from a particular impact (Wisner, Blaikie, Cannon, & Davis, 2004: 13), I use it as an *analyst concept*.

When I discuss the vulnerability of marginal farmers in the following, I take the dimension of livelihood as my unit of analysis. So far, scholars concerned with the issue of vulnerability gave detailed attention to (natural) disasters (Blaikie, Cannon, Davis, & Wisner, 1994; Levine, 2004; Wisner, et al., 2004) and the failure or breakdown of technological systems. Much emphasis was placed on the failure of (complex) technological systems (Rochlin, 1994; Wackers & Kørte, 2003), on

lowest rainfall is a semi-arid rainfed agricultural area facing chronic drought situation. Telengana is an agriculturally backward area with large areas under dryland farming." (Venkateshwarlu and Srinivas 2000: 5)

[6] Small farmers are usually considered as owning less than 5 acres of land, marginal farmers as those who possess less than 2 acres of land.

[7] Social-constructivist studies of vulnerability have moreover shown that practices and technologies, which are intentionally created to increase safety, might exhibit vulnerabilities under particular circumstances (Bijker, 2006; Law, 2003). Mesman (forthcoming) shows in her ethnographic study of a Newborn Intensive Care Unit that efforts to reduce vulnerability in one work process might relocate risks and uncertainties into other practices. Vulnerability diminishes, changes, and relocates; but it does not disappear. There are no 'safe' or 'in-vulnerable' practices and technologies. And also the NPM project demonstrates this in a later stage of its development: while the project emerged as a means to reduce vulnerabilities for marginal farming communities in Andhra Pradesh it also produced new challenges for farmers and NGOs alike.

(industrial and military) accidents (Fortun, 2001; Perrow, 1999; Snook, 2002; Vaughan, 1996) or on the malfunction of critical infrastructure (Law 2003; Weick, 1990).[8] My case study focuses on the vulnerability of farming communities, and while that might relate to dimensions of (technological) risk and uncertainty, it also integrates social factors that shape vulnerable conditions of people, such as poverty (Farrington, 2004; Sulaiman & Holt, 2002), gender (Cahn & Lui, 2008; Garikipati, 2008) and (structural) inequality (Sen, 1981; Swift, 2006). I therefore suggest to understand the *vulnerability of livelihoods* not only because 'livelihood' is used as a synonym for daily life in India, but also because academic studies of livelihoods contributed many useful research dimensions to understand the pervasive and daily character of vulnerability in marginal rural communities (Appendini, 2001; Chambers, 1987; Farrington, Carney, Ashley, & Turton, 1999; Hoon, Singh, & Wanmali, 1997; Kaag, 2004; Scoones, 1998).

This article is based on 7 months of fieldwork in India. It draws on semi-structured interviews with activists, governmental officials, farmers and scientists across India. A particular emphasis is on the historical accounts from key actors involved into the historical development of the NPM project. My analysis also gains from my frequent visits to marginal farming villages, scientific conferences and workshops with civil society actors. Additionally, I base this history on the NPM projects' written sources, such as NPM conference notes, annual reports, progress reports, and field study reports. Audiovisual media accounts and (scientific) papers published by key actors further contribute to a contextualized understanding of the project's history.

I start by elaborating on the notion creative dissent before I describe what NPM ideally is constituted off. Thereafter, the historical part of this paper is divided into three phases and sections respectively: establishment, demarcation and institutionalization. The paper ends with a conclusion, where the notion of creative dissent is re-visited. Let us now turn towards creative dissent and understand both its genealogical sources and its relevance for the NPM project.

2. THE TRADITION OF DISSENT IN INDIA (LARGELY REPLACED BY BETTER MATERIAL)

In India, a rich tradition of dissent with science and technology for development exists, which questions the unrestricted beneficial character of (Western) science and technology.[9] This tradition is indispensably linked to the thought of Mahatma Gandhi and his alternative imaginations of science and technology. Having said that, two concessions have to be made immediately. First, Gandhi's work is not limited to dissent with science and technology. Dissent, for Gandhi, simultaneously calls for creative

[8] For a detailed review see (Hommels, Mesman, & Bijker, forthcoming)

[9] In my analysis of the history of creative dissent before and after Independence I gratefully draw on both the texts and a series of conversations with Shiv Visvanathan. Some of Visvanathan's work on creative dissent is still unpublished. These pieces are therefore marked *forthcoming*. They will be published in a three-volume compendium on the sociology of science and technology since Colonial Rule by the author in the near future.

engagement with alternatives. While Gandhi himself didn't coin the term creative dissent, his method of dissent carries both elements of creative practice and dissent.[10] Second, the tradition of dissenting creatively with science and technology in India is not limited to Gandhi's thought (interview Visvanathan 2010). Thus, when I draft a historical sketch of creative dissent, I also extend my analysis to the work of other creative dissenters. This will allow me to draw a picture of creative dissent, the sort of technologies creative dissent projects generate, and the method of creative dissent.[11]

2.1 DISSENT WITH SCIENCE AND TECHNOLOGY IN INDIA

Scientists, activists, citizens and politicians in the global north and the global south articulate dissent with modern science and technology. In India, a rich tradition of dissent with technoscience exists, which is to a large extent inspired by the life and thinking of Mahatma Gandhi. Gandhi's criticism of western science is fundamental. In his seminal piece on Indian Home Rule, the *Hind Swaraj*, he wrote with respect to 'machinery':

> *It is machinery that has impoverished India. It is difficult to measure the harm that Manchester [i.e. the spinning mill industry] has done to us. It is due to Manchester that Indian handicraft has all but disappeared. (…) The workers in the Bombay mills have become slaves. The condition of the women working in the mills is shocking. When there were no mills, these women were not starving. (Gandhi, 1910)*

Often, Gandhi's approach to technology was considered as anti-technological (Mukherjee, 2009). Yet, some scholars propose that his take was neither Luddit nor anti-science.[12] When highlighting that the Hind Swaraj was a very early writing in his public life, they rather argue that Gandhi's dissent with science should be understood as a criticism of the secular scientific worldview, where a double split between the researcher and his object, as well as between cognition and feeling eliminated transcendent elements from science. For Gandhi, a non-transcendent theory was not acceptable, both morally and cognitively (Nandy, 1987: 130). Cognitively, he resisted the hegemonic opposition of science and religion and propagated a co-existence of both. He refused to give total autonomy to what he called 'technicism' and 'scientism'.[13] "He saw religions and traditions themselves as

[10] Since long, Indian academics have described the empirical phenomenon of creative forms of dissent (Nandy, 1990), yet the notion of creative dissent as a concept for alternative practice was articulated only recently (Prasad, forthcoming).

[11] A review on creative dissent with science and technology in India before and after Independence can be found in (Quartz, forthcoming).

12 Prasad (2001; 2008) states that one needs to look at Gandhi's work at a whole instead of only focusing on the *Hind Swaraj* if one is trying to understand his critique on western science and technology (also see Nandy 1987: 162).

13 He rejects 'scientism' because if would "reduce human rationality to a particularly narrow version of objectivity and objectification and it defines large parts of critical consciousness as irrational, romantic irrelevancies." (Nandy 1987: 136). 'Technicism' is rejected because it would introduce a concept of social change, which "allows one to destroy part of a person, society or nature" (Nandy 1987: 136) for the euphemistic good of 'development' and 'progress', which would inherently miss morality as a fundamental rationale to structure science and society.

a means of criticizing the existing and challenging the dominant." (ibid.: 133). Morally, he refused the epistemology of modern science because it facilitates violence in scientific production; his elaborations on vivisection demonstrate this. Already in *Hind Swaraj* he argued for a non-violent science, where the scientist is not to be separated from his object (Gandhi, 1910). Gandhi, who took a radical stand against animal vivisection, instead proposed to engage into self-experimentation, where the scientist himself/herself decides which issues to work on.

Gandhi's view on science, it was argued, integrated the secular spirit of inquiry with traditional techniques and non-western beliefs in his idea of 'critical traditionalism' instead (Prasad 2001: 8). Therefore, it would run short to characterize Gandhi's views on science 'alternative Indian' or even 'non-western'. Rather, his work might be understood as a critique of science and technology, where not technology transfer but a collaborative effort between experts and civilians is central (Prasad 2001).

Gandhi was not alone in his attempt to criticize modern technoscientific practice. After the period of Nehruvian technological optimism celebrated hydroelectric dams as the 'temples of modern India', a group of Delhi-based intellectuals grew increasingly disappointed with the path, which development had taken in India since the first days of independence (Jamison & Hard, 2005a: 141). The *Centre for the Study of Developing Societies* sparked off a trend to re-evaluate the relevance of Gandhi's work on the violence of technoscience and non-violent movements (Grewal, 2005: 141). In the 1970s, when civil rights were suspended by proclaiming emergency, and when social movements such as the Chipko tree-huggers gained prominence, the CSDS "quickly became a hub of dissenting intellectuals, journalists and civil rights activists." (Nandy, 1996)[14] For example, the human rights' researcher Shiv Visvanathan began to work with CSDS (interview Visvanathan 2008). He remembered that that the violence that emerged during India's Emergency situation in 1977, which amongst others justified forced sterilization in the name of science, was the reason to engage with dissent with modern technoscience. Also the forceful displacement of local populations, which amounted to some 30 - 50 million people in the case of the Namada dam alone (Visvanathan, 1998), triggered his dissent with large technological development projects.

Visvanathan shared a long collaboration at the CSDS with Ashis Nandy, and together they worked on issues of violence and technoscience, where they argued that "[t]he violence of modernity arises not merely from the violence of the state, but from the violence of science seeking to impose its order on society." (Visvanathan 1997: 20) In this period, Nandy also published an influential piece of work, *Alternative Sciences* (1980), where he performed a micro-level analysis of two Indian Scientists in order to show how they made use of their Indian tradition

[14] The Chipko movement was part of a the environmental movement and practiced Gandhian methods of non-violent dissent by hugging trees in order to protect them from being felled. The Chipko movement was one of the most important dissent movements in the 1970s (Guha, 2000, 2007; Shah, 2004).

to create dissent with western science.

In the same period, J.P.S. Uberoi's *Science and Culture* (1978) demanded a re-evaluation of the separation of scientific facts and values. In his 'Theory of Science and Culture under the Modern Western Regime" (ibid.: 84) he called for a scientific order, where a

> *new philosophy will adopt as its guiding principle the sense of self-aware, non-violent participation or communication between man and man and between man and nature, equal to equal, and totally discard the old Western policy of divide and rule. (…) [T]he new special sciences will learn to live and let live within the new vision of the whole.* (1978: 85)

Within the same dissenting tradition the dissertation of the environmentalist Alvares *Homo Faber: Technology and Culture in India, China and The West 1500 to the present day* (1980) argued for the integration of indigenous scientific traditions into strategies for appropriate technologies in India, where

> *the model of social and technological development idealized out of the industrial revolution in England, the United States, and certain parts of Western Europe is no longer the sole means by which the Southern countries and nations of Asia, Africa, and Latin America can hope to survive.* (1980: 45)

In sum, debates on and dissent with development policies emerged in the 1970s mainly as a response to the violence that was inflicted by technoscientific practice. In order to better understand the particular Indian character of dissent, I now turn towards the *method* of creative dissent, which was enacted by many dissenting projects on the Indian subcontinent. The method of creative dissent is also the organizing principle of the NPM project.

2.2 THE METHOD OF CREATIVE DISSENT

Creative dissent has a long tradition that moves beyond the Gandhian call for non-violent, village-based and appropriate science and technology (interview Visvanathan 2010). Because creative dissent projects recognize the mutual shaping of technology and community, technologies that are generated in creative dissent projects are geared to serve the demands of individual marginal communities and thus wish to function in *locally* appropriate manners. Moreover, creative dissent projects do not prioritize scientific knowledge above non-scientific expertise and practice and creative dissent technologies are usually *hybrid* ensembless that are constructed in close interaction between scientists and local communities. Creative dissent cuts across various *domains*, such as health care, agriculture and energy consumption. The *actors* that employ the method of creative dissent are manifold - scientists and engineers generate alternative technologies and social scientists develope alternative imaginations for equitable development. However, creative dissent can also be considered as a *method* that scientists and activists use to generate alternative practices, knowledges and artifacts for

marginal communities, and I exemplarily highlight one experience from India's social movement history to demonstrate this.

The enactment of creative dissent through the creation of alternative practices also strongly reverberates in many of India's social movements. I will now show how social movement groups used the method of dissenting creatively in order to oppose the construction of a large dam. In the small South Indian state Kerala a group of science writers, the Kerala Scientific Literacy Society (KSSP), started publishing scientific literature in the local language *Malayalam* in the 1960s. Thereafter, the KSSP quickly broadened its focus and addressed issues of technology and development. One of the most recognized projects undertaken by the KSSP was the independent assessment of the Silent Valley Hydroelectric project in Kerala,

When the State Electricity Board planned to construct a dam across the Kunthi River, the KSSP felt that engineers did not pay much attention to the flora and fauna, which would be submerged by the dam (Parayil, 1992: 343). Amongst other arguments the KSSP presented evidence from interviews with valley inhabitants, who observed that the rainforests were able to trap monsoon clouds that otherwise might have slipped past the bare mountains (ibid.). This evidence was also supported by research from the Western Ghats (Meher-Homji, 1991). The KSSP, in its final assessment, took up the foresters' insights and argued that the de-forestation, which would be inveitably induced by the dam construction, would reduce monsoon rains. After long and fierce debates, the hydroelectric project was abandoned and the area was transformed into a nature reserve instead.

The example of Silent Valley shows how dissent with science and technology can not only generate alternative trajectories creatively, but also how such projects may create additional knowledge, based on dialogue between scientists and communities. In the remainder of this article, I make use of creative dissent in two distinct manners. First, the notion serves as my empirical searchlight, and I demonstrate how the NPM project forms a part of the civilian-societal tradition of creative dissent in India. I show how the project was able to *create* 'alternative pathways' for agricultural production (Hess, 2007) at the same time that it engaged into *dissent* with western science and technology in general and with GMOs in particular. This article offers an insight into how technoscientific dissent is enacted on the Indian sub-continent. Second, I develop the notion of creative dissent as a theoretical concept, which enables me to understand the development of civil society projects that dissent with technoscience in order to reduce vulnerable livelihood conditions of rural communities.

3. NPM: A PROJECT AMONGST MANY?

The idea to reduce pesticides for agricultural production is no novelty to India and the international context alike. The US-based natural historian Rachel Carson's book *Silent Spring* (1963) was the first written account, which documented the detrimental effects of pesticides on the environment. This book gained broad public attention and inspired widespread concerns about the use of chemical

pesticides. Since the late 1950s, researchers from the Universities of California and Arkansas developed biological control strategies in order to supplement the use of synthetic pesticides, the so-called Integrated Pest Management strategies (IPM) (Kogan, 1998). In India strategies of Integrated Pest Management have been part of the official agricultural policy since 1985 (Singh, 2005). In the 1990s IPM experienced further impetus when India confirmed its commitment at the Rio Earth Summit (GoI, 1997). A national Centre for Integrated Pest Management was established in 1999 (Ramanjaneyulu, Chari, Raghunath, Hussain, & Kuruganti, 2007) and the FAO (Food and Agriculture Organization of the United Nations) implemented a five-year IPM program for cotton across Asia (Mancini, 2006). Alternative pest management is practiced in India for a long time in the form of IPM. I therefore show in how far NPM carries features similar to IPM and in how far the NPM project draws boundaries towards institutionalized IPM strategies.

IPM utilizes a large range of pest management measures that focus on preventive control and pest reduction. The preventive tactics demand an "understanding of the ecology of the cropping system, including that of the pest, their natural enemies, and the surrounding environment." (Hoffmann & Frodsham, 1993: 63) Non-chemical IPM control mechanisms are multiple and comprise diverse methods, such as physical barriers, mechanical control, cultural methods and biological control strategies. IPM allows farmers to use chemical pesticides and insecticides, when pest infestation on a particular crop would incur "unacceptable economic loss (...) above a tolerable economic threshold." (ibid.)

Physical barriers and mechanic control mechanisms prevent pests from attacking a particular target plant. For example, trenches may inhibit pests from reaching their targets; sticky (yellow) boards attract particular pests and capture them; various picking methods allow farmers to remove pests from plants manually; pheromone traps, which contain a sex hormone that attracts male moths, capture, kill and monitor pest populations on plants (see figure 2.1). *Proactive strategies* are also referred to as *cultural control practices.* They try to select the best possible varieties, repellents and strategies for locally (i.e. culturally) appropriate conditions in order to make a particular environment less favorable for pests. For instance, trap crops attract pests and keep them on crops, where they are easily managed. Border crops, which are planted around fields, offer alternate feeding opportunities. Seed treatment with various locally available inputs often generates potent pest repellents. *Biological control* refers to the reduction of pest populations by the increase of natural enemies and includes predators, parasitoids and pathogens (ibid.). Natural enemies might be preserved, augmented or introduced. For example by establishing bird perches and by planting trees predators might find a new settlement space in the habitat.

Figure 2.1: a farmer demonstrating the pheromone trap (author's picture)

NPM, to a large extent, builds on the vast experiences of IPM. Also, the project adapted existing IPM strategies and generated new practices, as I will show below. Yet, one crucial difference is that non-pesticidal management prohibits the use of chemical pesticides in any stage of crop cultivation. A project scientists: "What is essentially needed is to restore the pesticide free environment from the beginning itself to bread down the resistance of the endemic insect pests and encourage the multiplication of natural parasites and predators." (Qayum & Rao, 1998) NPM is thus more radical than conventional IPM strategies, as it assumes that nature "can restore itself if it is not meddled with too much." (Ramanjaneyulu 2007: 11) NPM proposes that pests and crops can establish a balanced co-existence, where non-chemical inputs repel and divert pests from crucial cash- and edible crops.

Pest behavior differs from crop to crop, and so do non-chemical strategies. Ideally, NPM then differs from village to village, depending on the problem at hand and the availability of natural resources. NPM, in its ideal type, is multiple and containing both standardized products and adaptive processes. My case study will demonstrate this in greater detail. Let us therefore start our journey through the history of the NPM project. I divide my account into three phases: establishment, demarcation and institutionalization.

3.1 ACTION AGAINST THE RED HAIRY CATERPILLAR (1988-1994): DISSENT AS CREATIVE PRACTICE

This historical journey starts in the late 1980s, in the Warangal district of the semi

arid area of Telangana, which was long considered to be economically backward and upset with violent peasant resistance in the past (Vakulabharanam, 2005). In Warangal, different farming conditions prevail. While the district's northern mandals to a large extent dispose of black, fertile soils and relatively well-irrigated areas, the southern regions have rather light, red soils.[15] Here, much of the agricultural practice depends on non-irrigated conditions, and often it is particularly the marginal farmers that labor under rainfed conditions.[16]

In the late 1980s, the Red Hairy Caterpillar pest infested the region's castor oil seed plants. In consequence, many farmers had to re-sow their crops and suffered high losses in yields (interview Sastri 2008 a). The repetitive use of chemical pesticides did not help to encounter the massive infestation, and some entomologists even assumed that the RHC infestation accumulated because excessive pesticide spraying had caused biotic disturbance and killed most of the caterpillars' predators (Rajan, 1994). The RHC put farmers into an economically vulnerable condition, where the repetitive spraying of chemical pesticides together with the massive pest infestation generated crop loss, increased the overall cost of cultivation and drove many farmers into debt (Gupta 1991; Mishra 2009).

The RHC infestation occurred after a series of regional developments changed the agrarian production system in Telangana region (Vakulabharanam 2004).[17] Warangal's farmers began to cultivate high-yielding varieties (HYVs) since the late 1970s and both large landholders and marginal dryland farmers, who earlier focused on the cultivation of food grains, millets and oilseeds for personal consumption, now switched to the cultivation of high-yielding cash crops like cotton and paddy (Vakulabharanam, 2005). Together with the HYVs the application of chemical fertilizers and pesticides gained importance, while traditional organic practices, like farmyard manure application or composting, increasingly disappeared from the agenda of agricultural practices in the region (Venkateshwarlu, 2004). Research indicates that the chemical input overuse triggered resistance development amongst insect pests across India (Shetty, 2004b). Also in Warangal the repetitive use of pesticide and fertilizer led to pest resistance development, which induced economic loss (Reddy, 2006). In such distress situations farmers were often unable to repay agricultural credit (interview Ramanjaneyulu 2007, Natesh 2008). Particular small and marginal farmers had little financial resource to cope with the economic risks of cotton cultivation (ibid.). The RHC project developed in this context, where agricultural distress manifested itself in high input costs, risky returns, and indebtedness.

[15] A *mandal* is the smallest administrative unit in the Indian administrative system.

[16] Marginal communities have a long history of agricultural vulnerability in Warangal. Since the beginning of the 20th century, when the Telangana was part of the princely state of Hyderabad (the *Nizam*), marginal farmers often earned nothing more than basic grains for survival (Vakulabharanam 2004). With the cultivation of non-food crops for international trade in the 1920s the dependency on international markets emerged: the Great Depression and World War II induced tragic famines and the death of many.

[17] For a historical account on local agrarian change in Telangana since the 1920s see (Vakulabharanam 2004).

3.2 MAKING THE CASE FOR NON-PESTICIDAL MANAGEMENT

N. K. Sanghi was trained as agricultural scientist and previously served as zonal coordinator of the Technology Transfer Unit at the Indian Council for Agricultural Research (ICAR) in Hyderabad. Actors in the civilian social realm knew him because of his belief in participatory methods for agricultural knowledge production (interview Sastri 2008 a). Sanghi "was seeing that indigenous knowledge is extinct primarily because we ourselves had lost value for such things." (interview Sanghi 2008) Sanghi felt that traditional knowledge should be re-evaluated. Further inspired by the urgent need to find a solution against the Red Hairy Caterpillar infestation, he planned to use the Red Hairy Caterpillar pest to demonstrate the relevance of traditional knowledge. He wanted to demonstrate the value and relevance of farmers' knowledge, or of 'farmer's science' as he put it. In conversations with old farmers in the Telangana region he

> *discovered that indigenous knowledge was there about the caterpillar at moth stage, that they were attracted to light. There were some hear-says and bonfires were traditionally used to attract moths.* (interview Sanghi 2008)

Sanghi found that farmers traditionally ignited bonfires at the onset of the monsoon rains. After conversations with an experienced volunteer from Maharashtra, a retired Additional Director of Agriculture, and the consultation with an entomologist working in another district in Andhra Pradesh (Rajan, 1994) he realized that in order to create impact with the help of bonfires collective and time-specific group action would be needed across large areas of Telangana's Warangal region.

Around that time Vittal Rajan, a political economist who is running the Hyderabad-based NGO *Think Soft*, had an interest in engaging civil society more into agricultural practice.[18] He recalled:

> *It was strange that NGOs and civil society were not involved in agriculture, even though it is so central to livelihoods. (…) They didn't want to do anything with agricultural technology. That was considered as something belonging to the government. (…) A bulk of our rural population is poor. So, if you want to do something, you have to work on agriculture. Agriculture is central to our country* (interview Rajan 2008).

Together, Sanghi and Rajan decided to make the urgent RHC infestation a showcase for community-based pest management strategies that are rooted in traditional knowledge. They chose to focus on non-pesticidal management particularly because the pesticide overuse did not help to save the region's cash crops. Furthermore, existing sets of non-chemical pest management methods, which slowly began to emerge from experiments with Integrated Pest

[18] For further in formation on Think Soft, the NGO that is focusing on the "empower of communities, enabling them to successfully engage with the challenges and opportunities of development", see http://www.thinksoftconsultants.com (last visited 15.02.2010)

Management (IPM) across the country, were rather easy to apply. Also, the aspired results of community-managed non-chemical practices were immediately visible to observer (ibid.). Hence, the development and promotion of non-pesticidal management was both a need-based intervention against the Red Hairy Caterpillar and a choice that was guided by the non-chemical pest management methods' ability to demonstrate the 'success' of community-based practices.

Sanghi and Rajan were faced with the question of whom to turn to for help in this matter, as the Indian Council for Agricultural Research, which was predominantly promoting chemical pesticides at that time, was not interested in the promotion of alternative agricultural practices (ibid.). They turned towards M. V. Sastri, who was back then consultant (and later convener) of the Centre for World Solidarity (CWS) in Hyderabad. The CWS, which acted as a knowledge and resource hub for many local NGOs in the regions of Andhra Pradesh, was well known for its experiences in associating farmers and Sastri recapitulated:

> *We ourselves were not sure whether all this was going to help, but Dr. Sanghi was a respected agricultural scientist and we decided to look and see what is going to happen with it.* (interview Sastri 2008 a)

Sastri respected Sanghi for his close collaboration with farmers (interview Sastri 2008 a).[19]

The technical advisor to and chairman of the CWS committee, M. S. Chari, who formerly served as entomologist at the Indian Council for Agricultural Research (ICAR), showed interest in the RHC project. During his work at the ICAR he realized that farmers were making inadequate use of preventive pest management strategies (interview Chari 2008). Chari decided to support the RHC project as he hoped that this would enable him to extend preventive pest management knowledge into Warangal's farming communities. Chari gave technical advice to the project coordinators, visited the fields frequently, and helped to solve technical problems (ibid.). Abdul Qayoom, who was at the point of retiring as the Director of Agriculture in Andhra Pradesh, got involved in the RHC project too. He wanted to support the fight against excessive pesticide use in Andhra Pradesh (interview Qayoom 2008). He was trained as extension scientist and was assigned as project director.

3.3 DEVELOPING CHEAP PRODUCTS

Above, I have shown that many of the non-pesticidal management methods were adopted from existing Integrated Pest Management (IPM) strategies. But the project scientists also adapted many of the strategies towards local needs and

[19] In India, existing governmental extension systems for agrarian development were repeatedly criticized for not sufficiently responding towards the needs of rural communities (Sulaiman & Holt, 2002). Also, a majority of agrarian scientists and policy makers were said to actually visit farmers only in rare cases (interview Kumar 2008).

resources. Because much of the project's emphasis was on the generation of cheap products for marginal cultivators who labored under vulnerable economic conditions (interview Qayoom 2008), many of the IPM physical, proactive and cultural methods were adapted in such ways that they could use locally available and hence cheap resources. The various pest management products that were derived from *Neem* are one such example of cheap inputs. The tree's seeds, leafs and oil are relatively drought resistant and widely available in semi-arid regions like Warangal, and the RHC scientists reintroduced Neem products as non-chemical and cheap pest repellents.[20] Also, the pest repellent *Pancha Gavya*, which is an old ayurvedic recipe and which builds on cow products, was rediscovered in the context of low-cost pest management.[21] Most non-chemical pest management strategies thus represent a shift from external inputs and pesticides towards locally available and cheap resources.

Next to the adaptation of existing IPM strategies, the RHC project also generated innovative methods for non-chemical pest management, which usually emerged in collaborative interaction between scientists and farmers. I take the case of bonfires as an example. Traditionally, farmers used bonfires to attract and kill moths at the onset of the monsoon rains. After Sanghi found that traditional knowledge about bonfires still existed, the project director Qayoom was responsible for the evaluation and refinement of these strategies.

In the early phase of the RHC project old rubber tires fueled the bonfires. These were ignited right after the first monsoon rains fell, just like farmers had traditionally done it. According to Qayoom, some farmers observed that moths did not necessarily emerge immediately after the first rains fell (interview Qayoom 2007). Building on these observations, Qayoom reckoned that the emergence of the caterpillar moths might relate to the respective levels of rainfall. Consequently he started to study the relationship between rainfall levels and moth emergence together with farmers from some 30 marginal farming villages. For this reason Qayoom supplied the villages with rain gauges, where rainfall was measured on a minimum/maximum thermometer.

> *I was getting daily … postcards. (…) And from that I came to understand … that the moths emerged only when sufficient rainfall was present.* (interview Qayoom 2007)

In correspondence with the rainfall data collection Qayoom found that moths only emerged from hibernation when the rain levels rose above 25 mm. Qayoom evaluated the farmers' observation that there was a relationship between moth emergence and rain. Consequently, the farmers in the RHC project started to ignited bonfires only after a sufficient amount of monsoon rain fell (ibid.).

Qayoom also worked towards changing existing bonfire containments, particularly

[20] Traditionally the trees' various components served as input for non-chemical contraceptives, the treatment of (skin) diseases and for dental care.

[21] Pancha Gavya, which means in Telugu 'mixture of five cow products', contains milk, curd (=clarified butter), ghee (yoghurt-like milk acid), urine and dung.

because burning rubber was not considered as a very eco-friendly solution (interview Qayoom 2007). Initially, rubber was replaced by agricultural waste but soon a situation emerged where only insufficient waste was available in order to perform bonfires across the region. Again it was Qayoom who developed an alternative: he designed a cheap trap where a small light bulb, which was installed above a bucket of water that was covered by a small amount of sticky kerosene, was to attract the animals. If attracted to the light trap, insects would eventually fall into the water and drown due to its kerosene content.

Yet again, the availability of electricity at night was a severe problem. Often farmers were cut off from electricity, and particularly so in hot summer nights, when large amounts of power were requested in the cities for air conditioning systems. Sastri negotiated with electricity suppliers and remembered that he "had successful negotiations with the electricity department, which would grant that electricity supply would be uninterrupted at those times. But then the electrical department granted some money, so we could try out solar energy." (interview Sastri 2008 a) By the help of governmental grants solar panels were purchased and operated in several selected villages.

Like Qayoom's experiments with the bonfires and the (solar) light traps, many cheap and innovative practices for non-chemical pest management were refined throughout the years. Slowly a comprehensive set of strategies emerged in accordance with the life cycle of the Red Hairy Caterpillar.[22] The RHC pupa hibernates in the soil during the hot South Indian summer. Ploughing the soils deeply during the severely hot Indian summer months exposes and kills the RHC pupa - a method that is also known to IPM systems (Rama Rao, Srinivas Rao, Srinivas, & Ramakrishna, 2007). While RHC larvae have the ability to migrate across long distances, setting up trenches around castor fields helps to catch the pest (Ramanjaneyulu, Kuruganti, Hussain, & Venumadhev, 2004). And because farmers found that migrating caterpillars were attracted to Calotropis, a flowering, milky-sap producing plant, the placing of calotropis twigs around the fields serves as a locally-available trap crop and distracted the migrating RHC larvae from the castor crops (ibid.). In the years since the project's inception, many such low-cost products, which draw on locally available non-chemical resources, were developed or adapted from existing IPM treatment regimes. The Red Hairy caterpillar project created a multitude of innovative *products* in the form of agrarian knowledge, pest management methods and material components.

In 1989 the Department of Agriculture at the Government of Andhra Pradesh recognized the benefit of the project and provided financial assistance. 3 years after the group action processes started, the RHC disappeared and the area became RHC free "over an area of 4000 to 5000 hectares in 30-35 villages." (CWS, 1998) The non-chemical pest management strategies thus reduced famers' vulnerability towards the massive crop infestation through the Red Hairy Caterpillar pests.

[22] The RHC, like most other pests, develops from egg to larvae into a hibernating pupa and finally into a moth, which again lays eggs. While the RHC hibernates for more than 10 months in the soil, the first heavy Monsoon rains in the beginning of June trigger the moth to come out. Moths then lay batches of eggs on plants and soon thereafter the RHC caterpillars infest and devastate crops.

3.4 ENABLING LOCAL PROCESSES

Ideally, NPM embraces both locally-available products and represents a community-based process, where village-specific pest management packages develop in due consideration of local problems and resources.[23] Next to the cheap and locally available pest management *products* the NPM project then simultaneously generates local *processes of negotiation and experimenting.* Enabavi, a marginal farming village in the mandal Lingalaganapur of Warangal District, demonstrates that point.

The village was founded when some farmers from a formerly 'backward caste' settled near the well of the Ena, the Ena*bavi*, after they were given some lands through a governmental housing program in the 1950s. 55 families, who cultivate various food crops on their 280 acres of land, and who have 50 acres of grazing zone for the livestock, inhabit Enabavi. 50 acres of the land are under irrigation. Enabavi is part of the NPM program since the initiation of the RHC project, and the farmers collaborate both with a local NGO, the *Centre for Rural Operations Programs Society* (CROPS), and the solidarity organizations of the Centre for World Solidarity.[24] Enabavi is one amongst 50 NPM 'core villages.'[25] An excerpt from my research diary highlights the dynamic mix of NPM products and local processes.

> *Malliah, a respected village elder, is sitting next to me. Gangadhar [a NPM scientist from the Centre for Sustainable Agriculture in Hyderabad] translates. I ask Mallaiah about the NPM methods he uses for the cultivation of cotton. He explains that he doesn't have a fixed treatment pattern, that he bases his action on observations in the fields. Because he knows how cotton pests behave, when the pests hibernate, when they migrate, and when they finally feed on his plants, he can prevent much infestation. NPM scientists explained that already years ago. Nevertheless, when difficult problems in the fields emerge, Gangadhar and other scientists help him and his fellow farmers to think about possible solutions. In such cases, farmers and scientists try to find solutions to the problem together, based on field observations, available resources, and*

[23] I intentionally refer to the relationship between product components and the process elements as ideal types. They changed through historic time and institutional space. For example, a recent initiative to geographically scale up NPM in Andhra Pradesh fundamentally reorganized the relationship between products and processes in NPM.

[24] NGO work in India takes place at different geographic scales. While 'local NGOs' usually operate within the confinements of a particular region, 'state NGOs' like he Centre for Sustainable Agriculture or the Centre for World Solidarity collaborate and network within and far beyond the state. For further information on the support NGOs in Enabavi see: www.crops.co.in, www.cwsy.org, www.csa-india.org, www.wassan.org,

[25] NPM scientists coordinate and supervise each core village individually. These villages are the very heart of innovative work in NPM. In the 'core villages' new methods are tested and new processes discussed. The work in Enabavi does therefore not only focus on the sustainment of NPM but also the implementation of new projects for sustainable agrarian change. In 2006 the village declared itself totally organic, free of pesticides, chemical fertilizers and genetically modified crops, after some farmers stopped using pesticides in 2001.

sometimes testing. These negotiations would usually generate a mix of NPM methods and decoctions, which is used.

Yet, he also has some practices that he regularly sticks to. Malliah usually rotates the crops on his fields, like his father did. In one year, he cultivates cotton. The second year, he will change crops and rather cultivate sesame, tobacco or maize. He explains that cultivating the same crop season after season affects his yields and increases pest infestation on the fields, too. In the season, in which he cultivates cotton, he ploughs the fields in the summer. His father told him to do that just before the rainy season starts. It kills worms and thus prevents pest outbreak. After that, he sows out the cottonseeds to his field, which he sprays with Neem spray in the first 30 days after sowing. He repeats that process every 10 days for approximately three times. He learnt that method from the CSA and it works well. After the Neem sprays, he treats his fields with a tobacco decoction against sucking pests and aphids. In some difficult cases he also uses a chilly garlic decoction, when small caterpillars (or their eggs) would be detected on the cotton plants. But he only uses the chilly garlic treatment if there is too many of the caterpillars. When is it too much then, I ask him? When he, his fellows and Ganghadar decide that action is needed, he tells me. (…)

(Excerpt research diary, Enabavi, 24.01.2008)

Mallaiah's elaboration is insightful. It characterizes an ideal type of non-chemical pest management, where scientists and farmers together learn from the experiences in the fields, and where treatment options evolve gradually out of a collaborative negotiation effort between farmers and NPM scientists. These negotiation processes are based on different forms of agrarian knowledge, and the choice of NPM products in Enabavi is based on a process of negotiation between farmers and scientists. Partly, the non-chemical pest management strategies are present in the villagers' memory, and partly relevant pest behavior and treatment knowledges are conveyed through the NGOs. Farmers do not follow overall fixed treatment pattern, but test various NPM treatment options in their fields and then decide on village-specific NPM product packages. Available NPM treatment options are evaluated on the basis of available resources. Non-chemical pest management in Enabavi then makes use of existing non-chemical *products*, while it is an interactive *process* between farmers and scientists too.

4. CREATIVE DISSENT THROUGH INNOVATIVE PRACTICE

It's time for a little break on our historical journey. We have witnessed the *establishment* of a creative dissent project, where agricultural scientists together with farmers generated innovative practices for pest management.

The agricultural scientists had different motives to engage with the RHC project: while Sanghi wanted to promote indigenous knowledge, Rajan had an interest to engage NGOs more into issues of agrarian development. Sastri was interested to

help empowering the farmers, while Chari wanted to refine agricultural management strategies, and Qayoom was determined to 'fight' pesticides. Motives for engagement differed, yet all actors shared a belief in the farmers' ability to manage their agricultural problems by support of their own practical expertise and their inherited knowledge. The farmers' *ability to cope with adverse impacts* in locally appropriate ways was acknowledged and creatively worked into the NPM products. In the RHC project, the farmer was not understood as a recipient of technology but as a knowledgeable co-producer of expertise.

The project members perceived of marginal rural livelihoods to be decisively shaped by the high costs of cultivation and the uncertain returns. The RHC project emerged as a purposeful strategy to deal with these vulnerabilities and most of the adopted, adapted and emerging NPM products were intentionally developed by means of cheap and locally available inputs in order reduce the agrarian cultivation costs. The NPM methods were a cost-efficient answer to the economic vulnerability of marginal farmers. NPM emerged as a *coping strategy* to deal with the economically vulnerable livelihood conditions of marginal farmers.

I have accumulated a first insight with regard to the concept of creative dissent. In this initial phase of the project dissent was expressed through creative work: being able to cultivate crops without the use of pesticides can be considered as the non-verbal pursuit of dissent with the dominating pesticide-dependent regimes of input-intensive agricultural practices in India. The NPM project generated *dissent through practice*. NPM is then is both a reply to vulnerable livelihood conditions, and a non-verbal critique of the high-yielding cultivation paradigm.

4.1 BECOMING NPM (1994-2003): TOWARDS RADICAL ARTICULATIONS OF DISSENT

Again, we are in the Telangana region - this time in the mid 1990s, when agricultural distress continued. By then, the agricultural production system largely shifted from subsistent food crop cultivation, where a cultivation mix of different food crops covered basic nutritious demands within farming communities, towards input-intensive cash crops strategies, where nutrition became an issue of monetary expense (Vakulabharanam 2004).

Cotton cultivation emerged as a major income-generating practice due to its assumed high profit margins (Vakulabharanam 2004), yet its cultivation is a risky business. Over the years evidence accumulated that many cotton pests had developed resistances towards conventional pesticides (Shetty, 2004a). Suicides, also by marginal cotton farmers, occurred repeatedly by the end of the 1990s (Citizen Report, 1998; Revathi, 2006; Stone, 2002). Research proposed that particularly rain-dependent marginal and small farmers were challenged by the increasing demands of agriculture because of their inability to recover from financial loss (Mishra, 2006; Revathi, 2006).

Also, the global process of economic liberalization, which the World Bank's structural adjustment policies and later the WTO treaties were significant drivers off, was considered to contribute to a decrease of agricultural subsidies for farmers

(Vakulabharanam, 2005: 990). The liberalization of import barriers benefitted fluctuating, competitive and - as in the case of cotton - falling prices for agricultural output (Bhat & Kumar, 2006: 15). Many observers from science and civil society argued that also the rise of production costs due to increasing input consumption contributed to the agricultural distress situation (Bhat & Kumar, 2006; CitizenReport, 1998; Vakulabharanam, 2004; Vakulabharanam, 2005). In this context, the NPM project continued its effort to reduce the vulnerable condition of rural communities (Prasad, Ravindra, & Ramanjaneyulu, 2008), and I demonstrate how the extent of NPM methods grew beyond castor crop management and how the project members made a particular effort to react towards the demands of cotton cultivators.

4.2 ABOUT NOT BEING IPM ANYMORE

Sastri remembered that NPM initially "was a one-dimensional one-pest-one-crop approach" for the management of the Red Hairy Caterpillar (interview Sastri 2008 a). Simultaneously, the NPM project actors were aware of cotton's relevance for the agrarian production context and it was argued that "cotton was the target of several pests and treated with the highest amount of pesticides" (Qayum & Rao, 1998). Deliberations in the national workshop *Non-pesticidal Approach to Pest Management – new Directions*, which was jointly organized by the Centre for World Solidarity and the National Academy of Agricultural Research Management (NAARM), identified the relevance of pesticide-free cotton cultivation as one of the NPM project's priorities in 1994 (Qayum & Rao, 1998: 7). In the following years a series of "consultative meetings under the auspices of Dr. N.K. Sanghi" (ibid.) identified a detailed set of strategies for the management of cotton pests. Particularly Chari supervised the development of non-chemical cotton management practices, which were again based on existing IPM strategies to a certain extend (interview Chari 2008). As soon as 1996 field experiments on cotton cultivation began in collaboration with farmers and local NGOs, and with support of the CWS affiliates. By 1997, farmers were practicing non-chemical cotton management on some 40 hectares (ibid.), which extended to 460 hectares by 2000 (CWS, 2000).

And while the NPM project team identified cotton management as a main problem of rural communities (CWS, 2001), they also recognized that a broad set of cash and food crops had to be managed by the help of the non-chemical methods, if the methods wanted to be of help for the marginal farmers. Therefore, trials on groundnut and pigeon pea started in 1996 and a broad spectrum of non-chemical management strategies emerged for these crops. Chari again acted as a principle driver of these experiments (CWS, 1998 2000, 2001). Successively, many communities in Andhra Pradesh started to cultivate groundnut and pigeon pea by non-pesticidal methods. After 1996, the NPM project developed from a strategy to encounter the Red Hairy Caterpillar plague into a more comprehensive set of non-pesticidal management methods for a multitude of relevant food and cash crops.

Many of my respondents remembered that the NPM project was initially named

IPM. But that created much confusion. It was unclear how the project could be differentiated from state-lead IPM initiatives, where the use of pesticides was still a common practice. The inclusion of pesticides as an 'emergency strategy' in IPM subtly ignited a re-appreciation of pesticides, and a member of the Indian Planning Commission explained:

> *IPM doesn't say not to use chemicals; it says to use chemicals rationally towards a minimum and do other things, which reduces the requirements of high doses of chemicals. But that is the same as prescribing that exercises are good for health: it requires discipline, and people don't have that. So whenever a chemical was involved, it started increasing beyond the limits. So, IPM was also predominantly based on chemicals.* (interview Chopra 2008)

The NPM project scientists feared that the use of chemicals might gradually re-increase if pesticides were allowed in cases of massive pest infestation. It was felt that naming the project 'IPM' would not really bring across the message of using *no* chemical pesticides. Thus, they began to think about an alternative project name.

The above-mentioned 1994 workshop on non-pesticidal approaches already paved the way towards NPM's nomenclature.[26] The workshop report concluded:

> *The ongoing thrust on IPM should continue on a large-scale basis. However, the alternative approach of non-pesticidal methods may be restricted only to cases where successful examples do exist. The future thrust in the research programme should, however, shift primarily towards the non-pesticidal approach so that conventional pesticides are eliminated from the package and natural ecology is restored.* (Sanghi, Qayoom & Chari, 1998: 3)

While the workshop still acknowledged the relevance of IPM strategies for pest management, it also represented the first articulation of NPM as an independent approach. It was felt that the RHC project should differ from IPM both in its nomenclature and its central practice, where no chemical pesticides would be allowed. And while many actors used the term NPM from that workshop onwards (interview Sastri 2008 a), M. S. Chari officially devised the project as non-pesticidal management (NPM) in 1998. With NPM's nomenclature a clear boundary to state-led IPM initiatives was drawn.[27]

26 The workshop carried many agendas and amongst others paved the way for a specialized institution dealing with the growing demand for and the plural experiences with NPM. M. V. Sastri wrote in a letter to me that this workshop "paved the way for the establishment of Centre for Sustainable Agriculture" (Personal communication 13.05.08)

27 Later, in 2006, G. V. Ramanjaneyulu remembered that naming the project NPM was also inspired by a strategic component. He recalled in an interview: "We consider pesticides the costliest input in farming. NPM conveys a direct message to the farmers: that they don't need pesticides. It is a communication strategy." (Ramanjaneyulu in Sopan 2006).

4.3 VERBAL ARTICULATIONS OF DISSENT WITH TECHNOSCIENCE

In the same year that NPM received its name, G. V. Ramanjaneyulu associated with the Centre for World Solidarity. Until then, he was working as extension scientist within the government of Andhra Pradesh. He also was a member of India's movements for scientific dissent since long.[28] For example a report on farmers' suicides in the Warangal region, which he prepared together with two other colleagues, illustrates his oppositional stand with technoscience.[29] *The Cotton Tragedy* was published in Telugu in 1997 and Ramanjaneyulu summarized the content of that report as following:

> *This report was the first one to state that technology failure is the central point of farmers' suicides, that pesticides are the central problem. (…) The argument was that the Indian agriculture right from the beginning was on a wrong footing. (…) Cotton is a typical example to explain the crisis in agriculture: how traditional varieties were replaced, and how varieties, which suited the machines, were brought in, the pesticides and all that.* (interview Ramanjaneyulu 2008 a)

Ramanjaneyulu's elaboration relates to an argument, which analyzed the replacement of the short-staple and sturdy Indian cotton varieties (arboreum and herbaceum) with long-staple pest-prone varieties from the American cotton family (hirsutum) since the end of the 18th century (Prasad, 1999). It was argued that while industrialists considered the American cotton varieties as more suitable to European cotton processing units due to their longer staple length. This replacement (and the subsequent labeling of Indian cotton varieties as of inferior quality) significantly contributed to the pest management problem of cotton cultivators in India (ibid.). Taking this case study as an example, Ramanjaneyulu argued that modern agricultural technoscience was not ex ante beneficial but first had to prove its appropriateness within a particular context.

The Cotton Tragedy was the first verbal articulation of a critique of technoscience from within the NPM project. But the report signified more than that. Ramanjaneyulu explained:

[28] In one conversation Ramanjaneyulu explained that his participation in Peoples Science Movement, the Patriotic People for Science and Technology group (PPST), influenced on his dissenting stand with some contemporary technoscience (interview Ramanjaneyulu 2007). Creative dissent with technoscience through means of constructive work finds many expressions on the Indian subcontinent. For example, critics of western science formed the PPST (Patriotic and People Oriented Science and Technology Foundation) in order to advocate the development and promotion of "technologies and practices which help our people to retain greater control over their lives". The PPST reflected on western methods of scientific practice by conducting "studies on the sciences, technologies, social structures, educational, legal, political, religious and other systems of the West." (PPST, n.d.) The PPST also published a bulletin, which dealt with the "dual purpose of strengthening the critique of Western science along with valorizing the contribution of traditional technologies to human well being."(Prasad, 2008: 4)

29 The report was published together with Uzramma and Rama Rao, who are working with weaver communities at Dastkar Andhra. For further information on the trust see: www. Dastkarandhra.org

When writing about the cotton issue, we also wrote about NPM. (…) We explained the politics behind pesticides, too. (…) From then onwards we started theorizing NPM. (interview Ramanjaneyulu 2008 a)

The report was also the first written account, which coupled the articulation of dissent with technoscience with an elaboration on the benefits of non-pesticidal management. *The Cotton Tragedy* was the first effort to link the creative strategies of NPM with articulations of dissent with technoscience.

4.4 DEMARCATION PRACTICES

In 1999, a collaborative project amongst policy makers, pesticide producers and civil society members emerged in order to address the massive pesticide overuse of cotton cultivators. The *Andhra Pradesh Cotton Initiative* (APCOT) aimed at evaluating and implementing IPM strategies. Vittal Rajan, one of the 'fathers' of the Red Hairy Caterpillar project, was its coordinator. Over the course of NPM's history, he association with the AME foundation (*Agriculture, Man and Ecology*), a Bangalore-based foundation that was promoting sustainable agriculture by the help of IPM. His experiences at AME allowed him to share a rich set of experiences with the participating members (interview Rajan 2008).[30]

Syngenta, a pesticide-producing company, was as much part of APCOT project as NGOs and governmental actors.[31] Initially, APCOT was founded to explore different, non-chemical cotton management strategies for Andhra Pradesh's dryland farmers. Yet, research suggests that the project also constituted an opportunity for Syngenta to illegally test its lab products, such as its recently developed pesticides, in the dryland fields (Thummuru, 2006). It was moreover suspected that "Syngenta controlled the way APCOT operated and also decided on the priorities as it had major financial resources." (Thummuru, 2006: 10)[32]

In March 1999, a first roundtable meeting on the situation of cotton farmers in Andhra Pradesh was held. The overall issue of more eco-friendly and non-chemical pest management methods for cotton was very important to the NPM project members. Nevertheless, the Centre for World Solidarity (CWS), who carried most of the NPM work these days, refrained from cooperation with the APCOT project. Ramanjaneyulu recalled that

[i]t was that workshop where positions were taken, and where the CWS said that they will not be part of any program where the pesticide industry is part of, because they are not

[30] For further information see www.amefound.org.
[31] Participants were amongst others the NGO Agriculture, Man and Ecology (AME), the Centre fore Environmental Concern (CEC), and the Department of Agriculture, Government of Andhra Pradesh. (Syngenta, n.d.)
[32] The APCOT project ended after 6 years. Thummuru reports that this was due to the farmers' limited interest in participation and the NGO's restricted experiences with issues of project implementation. (Thummuru, 2006: 11)

interested in reducing pesticides, they only extend them. (interview Ramanjaneyulu 2008 a)

One reason for this self-chosen abstinence from APCOT was the radical dissent with any pesticide-related agricultural practices. Syngenta's participation intrigued the NPM project members to decline cooperation. It was also felt that the non-pesticidal management strategies would only be able to reveal their potential if farmers would not be tempted to return into 'the pesticide spiral' (interview Ramanjaneyulu 2008 b).[33] Ramanjaneyulu and others took the decision to draw the line at pesticide companies and state-led IPM initiatives - a step, which the head of the Centre for World Solidarity M.V. Sastri described as a "difficult decision." (interview Sastri 2008 a).

It may come at no surprise that many scientists and civil society representatives critically questioned the benefits of the CSA's radical stand. Also civil society actors, who engage in agrarian change, such as the Hyderabad-based Centre for Environmental Concern, argued that any emerging alternative production system within the agrarian production scenario would benefit from cooperation rather than exclusion (interview Gopal 2008).

5. CREATIVE DISSENT THROUGH ACTIVIST ARTICULATION

Again, my journey through NPM's history invites for a short reflexive stop. Over the years, the NPM project changed significantly and while it extended its practices and diversified its agenda, it also made efforts to *demarcate* itself from other development projects.

NPM developed from a one-crop pest management approach into a multi-pest and multi-crop approach. Recalling the first NPM workshop in 1994 one can also observe a strategic shift in the project's relationship to IPM: while the 1994 workshop acknowledged the usefulness of IPM strategies where no better NPM options were available, the declined participation in APCOT ascertains that NPM should be regarded as an exclusive alternative to pesticide-related options, such as IPM. Its key actors increasingly *delineated NPM* from other approaches towards agrarian development.

In this context of demarcation, also the enactment of creative dissent changed. Ramanjaneyulu's summary of 'The Cotton Tragedy' was the first articulation of a critique of technoscience. This critique was coupled with an elaboration on the benefits of non-pesticidal management, and the NPM project was now also utilized as an opposite to mainstream technoscience. NPM developed into a tool against which the presumed shortcomings of mainstream technoscience were compared, the project served as a carrier for a wider political debate on appropriate

[33] To recall: integrated pest management allows for the use of pesticides in cases, when pest infestations exceeds beyond 'an emergency threshold', and this emergency condition was often observed to increase the indiscriminate use of pesticides (interview Chopra 2008).

agricultural technologies. While the RHC project focused on the non-verbal articulation of creative dissent through the creation of alternative methods for pest management, these were now supplemented by articulated critiques of mainstream technoscience. We have witnessed how the NPM project developed into a project of creative dissent with a double agenda, where the opposition to mainstream agricultural technoscience was articulated and the alternative practices of NPM enacted. NPM transformed into a project of creative dissent, where the *creative enactment of alternative practices and the articulation of dissent* with technoscience started to travel together through historical time.

The emergence of the double agenda of creative dissent closely related to the ideological orientation of the project. The self-chosen exclusion from the APCOT project can be evaluated as a *radical form of dissent* in at least two ways. First, declining cooperation was a means to avoid co-option with the pesticide-oriented agrarian practices, which NPM dissented with. The exit from APCOT hence challenged the existing agricultural production ensemble by the enactment of dissent through non-participation and voluntary exclusion. Second, APCOT was a state-led large-scale initiative to reduce the use of chemical pesticides. Consequently, non-cooperation with APCOT did not only signify an end to the dialogue with chemical pesticide companies but also affected the NGO's image of being a credible actor for agrarian development with the government of Andhra Pradesh. Creative dissent served as a radical strategy to distinguish mainstream technoscientific practices from the assumed benefits of NPM.

I can now specify how my notion of creative dissent differs from Prasad's. Taking amongst others the case of Systems of Rice Intensification (SRI), Prasad describes creative dissent as a form of non-verbal dissent, which puts particular emphasis on innovative and creative work (S. Prasad, forthcoming). Prasad gives less attention to the dynamics that emerge through the simultaneous processes of creative practice and articulation of dissent (S. Prasad, 2009; S. Prasad, et al., 2008). In contrast, the case of NPM demonstrates how creative practices and articulated forms of dissent coincide. I therefore propose to make an analytical distinction between *practice-oriented creative dissent projects*, like in the case of Prasad's case studies, and *hybrid projects of creative dissent*, which are simultaneously oriented towards creative practice and towards (activist) articulations of dissent. This difference is crucial as the next section demonstrates.

5.1 TOWARDS THE MULTIPLICATION OF NPM (SINCE 2004): TOWARDS OPPOSITION WITH BT COTTON

Once more, we are in the Telangana region. At the turn of the millennium the overuse of pesticides and fertilizers had seriously damaged the region's ecosystem, and a plenty of pests had developed resistance to various pesticides (Shetty, 2004: 278). While farmers invested into various sorts of expensive treatment options, crops repeatedly failed due to massive pest infestations. Apart form the socio-economic despair, the chemical pesticides were also reported to have compromised human health: chronic diseases of pesticide sprayers were observed

and pesticide residues were found in human milk (Chitra, Muraleedharan, Swaminathan, & Vijayaraghavan, 2006; Kuruganti, 2005; Mathur, Agrawal, Johnson, & Saikia, 2005). Observers from civil society proposed that in 2004 as much as 1200 farmers committed suicide in the Telangana region (Ramanjaneyulu & Rao, 2008). Many of those who took their lives were cultivating cotton on marginal landholdings (Bhat & Kumar, 2006; Menon, 2006). And while actors in science, government and industry started to advocate the cultivation of *Bt cotton*, a form of genetically modified cotton, as a solution to the severe pest problems in cotton management (interviews Mayee, Sharma, Barwale 2008), the NPM proponents increased their efforts to promote non-chemical agriculture.

5.2 THE ISSUE OF GEOGRAPHIC SCALE

Punukula is a tribal village in the Khammam district of Andhra Pradesh. The village is inhabited by approximately 900 farmers and most of them are smallholders (Arora, 2009). Before NPM was introduced, the village used huge amounts of chemical pesticides, particularly on cotton. Farmers were said to have sprayed up to 12 times more than what was required in official pest treatment regimes (ibid.) Some farmers in the village committed suicide, others were reported to be sick due to extensive pesticide spraying (Ghosh, 2004; Ramanjaneyulu, 2007a; Ramanjaneyulu, et al., 2004; Thummuru, n.d.) The local NGO *SECURE (Socio-Economic and Cultural Upliftment in Rural Environment*) was already working with the villagers on watershed programs and tried to persuade farmers to try out NPM methods on cotton and other crops. After an influential village elder, whose son was hospitalized due to pesticide poisoning, could be convinced to tryout NPM in 1999, some 20 farmers were reported to have joined the program in 2000 (Marten & Williams, 2006). In 2004 the village council, the *gram panchayat*, declared the village pesticide free: all farmers in Punukula reported to practice NPM without the further help of pesticides.

After years of work in the civilian social realm, the village Punukula seemed to deliver a proof that the non-pesticidal methods can work for marginal farming communities. A large amount of media coverage on Punukula supported this assumption (e.g. Joshi, 2004; Marten & Williams, 2006; Rao, 2004; Sharma, 2005)(see figure 3.1.).[34] Ramanjaneyulu started to use the visibility of NPM in the media as a means to promote NPM with policy makers (interview Ramanjaneylu 2008 a) (CSA, 2008a). He hoped that the overall positive publicity of NPM would open up spaces where the non-pesticidal management strategies (NPM) would be taken up in agrarian policy strategies in and beyond Andhra Pradesh (interview Ramanjaneyulu 2008 a).

[34] However, research also indicates that some NPM farmers in Punukula re-appreciated pesticides *after* the village declared itself pesticide-free (Arora, 2009).

Figure 3.1: NPM in the media[35]

In November 2004, Andhra Pradesh's agriculture minister Raghuveera Reddy traveled to the village. He was accompanied by a couple of high officials: two members of the state's legislative assembly, some senior officers from the Department of Agriculture, and the district commissioner of Khammam, the district within which Punukula is located in (Arora, 2009: 85). Also onboard the bus to Punukula was Ramanjaneyulu, together with a well-chosen sample of media representatives and scientists from agricultural universities. Ramanjaneyulu remembered very engaged discussions and recalled that the agricultural minister, who himself cultivated by the help of NPM, was convinced that the non-chemical methods would work for cotton and were particularly valuable for resource-poor farmers with small and marginal holdings (interview Ramanjaneyulu 2007, see figure 3.2). During the visit to Punukula the minister was said to implement the NPM strategies in at least 200 villages in Andhra Pradesh on a pilot basis (interview Ramanjaneyulu 2008 a). After all, NPM's potential for various crops and cotton in particular was acknowledged by all visitors (Ramanjaneyulu, 2007b: 2).

The agricultural minister R. Reddy's visit to Punukula[36]

[35] Figure courtesy of *Down to Earth* magazine.
[36] photos courtesy of CSA

M.V. Sastri recalled that the visibility of Punukula brought up the question of what the NGO should do with the experiences and insights that were gathered since the Red Hairy Caterpillar was tackled in the late 1980s.

> *The question is what to do with our ideas: [we are] knowledgeable about what is wrong with Indian agriculture, we developed our insights through interacting with farmers in Enabavi or Punukula, and we feel that this is how it should be done. And if you do it like this, it should be for the good of the farmer, the environment.* (interview Sastri 2008 b)

The NPM scientists were convinced that the non-chemical methods could encounter the vulnerable livelihood conditions of marginal communities. Sastri, Ramanjaneyulu and others at the CWS solidarity organizations felt that the experiences with NPM should therefore be extended beyond Punukula and serve a broader audience of marginal farmers. According to the project advocates, NPM should be scale up to a larger geographic area in Andhra Pradesh and benefit more marginal cultivators.

The question remained of *how* the NPM experiences could be scaled up, and Sastri felt that the spreading of NPM should happen with the support of governmental agents (interview Sastri 2008 b). He explained that the main reason to cooperate with governmental agents was the wide-scale vulnerable condition of rural communities in the drylands of Andhra Pradesh and the governmental ability to administer large-scale development projects. Also the CSA action campaigner Kavitha Kuruganti explained:

> *The reason for [us at the Centre for Sustainable Agriculture] to develop NPM is to develop ecological alternatives. Our mandate is not to establish alternatives per se. The objective of ours is to adopt the approximately 50 villages we work with, to make sure things develop well there, that we can support them. It is not our objective or mandate to set up ecological farming across the state. That falls into the realm of the government. Our objective is only to establish alternatives and challenge the government as to why they don't do it. (interview Kuruganti 2007)*

For CWS scientists the development of agrarian alternatives was located within the realm of NGO work, while the scaling up of relevant practices for rural development was considered to be in the catalogue of state responsibilities. Consequently the question of how to proceed with the alternative insights, which were gathered in Punukula and elsewhere, was translated into the question of how a small NGO might be able to cooperate with agrarian policy makers in order to implement NPM methods in state policies for sustainable agrarian development.

This was a difficult agenda to achieve because any cooperation with governmental extension networks had to be considered against the background of creative dissent work at the CWS solidarity institutions. I have demonstrated how NPM transformed into a hybrid project, which simultaneously endeavored to develop alternative practices for rural communities *and* effect agrarian change with governmental technoscience. The APCOT episode has shown that the project's

ability to function as a cooperative partner for agrarian development projects inflicted with the project's ideological conviction that collaboration with pesticide-related agents was not possible. The enactment of hybrid creative dissent was not only not consensus-oriented but also oppositional towards mainstream technoscientific policies. Cooperation with governmental actors to scale up NPM and continue with the enactment of hybrid creative dissent was a difficult endeavor. The next section shows how the NPM scientists tried to adjust these inconsistencies strategically.

5.3 THE INSTITUTIONAL SPLIT

The increasing visibility of NPM stimulated Ramanjaneyulu to join the Centre for World Solidarity on a full-time basis in December 2003. By that time Bt cotton was already officially released and put forward as a technological solution to the problem of excessive pesticides consumption on cotton by policy makers. Yet, Ramanjaneyulu and other actors from science and civil society observed that distress amongst farmers continued. They mainly ascribed this to the bad performance of the initially released Bt cotton varieties.[37] Ramanjaneyulu remembered that the accumulating evidence of crop failure in Warangal demanded for immediate reaction and necessitated an organization that could build alternative perspectives and technologies (interview Ramanjaneyulu 2008 b).

Based on his decision to join the 'Agricultural Desk' of the Centre for World Solidarity on full-time basis, the CWS steering committee together with its funding organization Hivos decided to transform the 'Agricultural Desk' into an independent NGO. The *Centre for Sustainable Agriculture* (CSA) was founded on 4 March 2004 as one of the CWS solidarity organizations, and Ramanjaneyulu became its executive director. Like the CWS, the CSA is based in Secunderabad, the twin city of Andhra Pradesh's capital Hyderabad. The CSA, to the present day, is almost exclusively steered and managed by agricultural scientists.

Kavitha Kuruganti, who is trained as communication scientist and who is one of India's prominent anti-GMO activists, joined the CSA in August 2004. She took over the responsibility for "research on detrimental impacts of GMOs." (interview Kuruganti 2007) With Kuruganti joining the project, the hybrid creative dissent of NPM work was split in two parts. Until the CSA was founded, Ramanjaneyulu was propelling both the creation of NPM strategies and enacting verbal dissent with mainstream technoscience. Since the foundation of the CSA, dissent with agricultural technoscience and (activist) protest against GMOs became Kuruganti's area of expertise, while Ramanjaneyulu focused on the development of alternative pest management strategies. The promotion of NPM and dissent with Bt cotton

[37] The first three Bt cotton varieties (Mech 162, Mech 12, MEch 182), which were licensed for sales in Andhra Pradesh, were largely considered as unsuitable (Abhay, 2005; Krishnakumar, 2004). Instructed by the repetitive evidence of the malfunctioning of the Mech-hyrbids in Andhra Pradesh, the Genetic Engineering Approval Committee (GEAC) decided to take the Bt cotton hybrids off the market in Andhra Pradesh in 2005. The reason for this decision was the inappropriateness of the hybrids for the local conditions of Andhra Pradesh's drylands, the inefficient yields, and the high pest infestations.

became two separate areas of work. The strategy of hybrid creative dissent was institutionalized and neatly cut into two areas of expertise: creative work and dissent work. Kuruganti remembered that this was a purposeful strategy in order to "give the CSA two faces," (ibid.), where Ramanjaneyulu would represent the "creative worker" and Kuruganti the "activist" dissenter (ibid.).[38]

Within this process of institutionalization of creative dissent also the agenda of dissent work changed:

> *Until [2004], most of the work was on alternatives. Fighting GMOs was on a low key. We used to follow the field trials, analyze the problems etc. After I joined here, the starting problems with Bt, 2 years after commercialization, coincided, and also the time when NPM started catching eyes.* (interview Ramanjaneyulu 2008 b)

Increasingly, dissent with technoscience was concerned with GM crops and the cultivation of Bt cotton in particular. On the CSA's webpage one can read that

> *Genetic Engineering as an agricultural technology is an imprecise and imperfect technology, which offers no real solutions to real-life agricultural problems facing Indian farmers. The technology is fraught with many environmental, social and political problems and CSA believes that transgenics in agriculture should be opposed by farmers and their supporters.(CSA, 2008b)*

Scrawling down the webpage, the reader is also informed that NPM therefore endeavored to produce

> *sustainable models in agriculture, which are local resource based, knowledge intensive, environmentally safe and profitable to the farming community.(ibid.)*

At the CSA, dissent with GM crop cultivation became successively intertwined with the display of an agricultural alternative: NPM.

We have already encountered the intertwinement of a critique of mainstream technoscience and NPM as an alternative practice in *The Cotton Tragedy*. At the CSA this oppositional strategy was reinforced. NPM transformed into an agrarian practice that was considered as a sustainable opposite to mainstream agricultural technoscience. A clear distinction between sustainable non-chemical methods for agrarian development and unsustainable mainstream technoscience emerged. The two technologies Bt cotton and NPM started to serve as *opposite narratives* for and against sustainable development at the CSA.

[38] The institutional division of creative dissent retained its currency in later years, and in 2007 a self-evaluation exercise confirmed the double agenda of creative practice and dissent, when members of the CSA described the organization as "a farmer-centric resource agency, which challenges mind-sets and establishes alternatives." (ibid.)

5.4 CREATIVE DISSENT AS OPPOSITION

Again, I stop for a short reflection. In the last phase of this historical journey creative dissent *institutionalized*. Hybrid creative dissent projects produce a paradoxical situation, where project proponents try to engage with prospective collaborators *and* simultaneously criticize the technoscientific choices of these prospective partners. The split of creative work and activist dissent, which happened amongst Kuruganti and Ramanjaneyulu, can then be understood as an effort to *reconcile* the two faces of hybrid creative dissent.

The project matured into a form of creative dissent, where NPM started to function as a counter-narrative to GMOs. Bt cotton and NPM started to travel together within the narratives and actions of the CSA as opposite strategies, where NPM was increasingly depicted as a sustainable means to reduce the livelihood vulnerability of farming communities at large. This was *opposed* towards the existing and presumably unsustainable system of agrarian production. Dissent in the creative dissent project NPM developed from a creative practice into a radicalized articulation of dissent and finally into a strategy to systematically oppose mainstream technoscientific practice. Creative dissent in the NPM project became an activist tool.

6. CONCLUSION: CREATIVE DISSENT WITH TECHNOSCIENCE

We have reached the end of our historical journey, and I can now locate NPM in a tradition of creative dissent projects and the concept of hybrid creative dissent. I start with the former.

The RHC project actors identified vulnerable livelihoods predominantly in relation to economic vulnerability and I have shown how a set of cheap and non-chemical pest management strategies were used to mitigate vulnerable livelihood conditions of small and marginal farming communities. The creative dissent project NPM and its alternative non-pesticidal agricultural strategies tackled the infestation of the Red Hairy Caterpillar, and there is indication that the project was able to reduce marginal farmers' economic vulnerability by eliminating pesticides from the farmer's agricultural expenses. The NPM project emerged as an alternative pest management practice that was designed to reduce the (economic) vulnerability of the livelihood conditions of marginal farming communities in the Telangana region by re-connecting available human and material resources towards inexpensive methods of non-pesticidal management.

We have traveled a long way through the history of the creative dissent project NPM, and looking back I can now empirically locate the NPM project within the broader Indian tradition of dissent with (western) technoscience and within the method of creative dissent, starting with the former. Visvanathan once argued that critical reflections on science and technology in India "have found their impetus and site in social movements rather than in the academia and science policy centers." (1998: 3685) The case study has demonstrated that NPM is a fine example of an alternative science project, which emerged as a critique with

existing technoscience in civilian social spaces in South India. Also, by generating dissenting practices, the NPM scientists placed the NPM project within the Gandhian tradition of non-violent dissent. Moreover, the NPM project placed expertise at the intersection of scientific forms of knowing and traditional Indian experiences with agriculture, an approach to dissent with technoscience in India that was for example found in the work of dissenters like Alvares (1980). NPM is a typical Indian dissent project with technoscience, where the collaboration between scientists and non-scientists and the appreciation of local and indigenous forms of knowing are central.

The introduction of this article has shown that the method of creative dissent forms the method of a broader range of social movements. Prasad had highlighted that dissent in the Gandhian sense may be articulated through creative practice. And for example the Silent Valley Project has highlighted how dissent with science and technology may be expressed through the creation of additional knowledge. Also, my NPM case study has demonstrated that creative dissent projects may generate dissent by means of creative practice. NPM runs in a long tradition of social movements that utilizes the method of dissent through creative practice.

Theoretically, I am now also able to sketch the notion of creative dissent as an analyst concept. My elaboration has traced the development of the NPM project through three distinct phases, namely: establishment, demarcation and institutionalization. I have shown how creative practice was central to the establishment of the project, how dissent inspired demarcation processes, and finally how the hybrid elements of creation and dissent demanded for the split of the two components in the CSA's personnel. I have shown how the project enlarged its focus from a need-based alternative management option towards a project of (activist) dissent. Making use of the notion of creative dissent enabled me to highlight how NPM changed over the years and how it emerged as an umbrella for both creative practices and articulations of dissent. Creative dissent, then, is a *dynamic concept* that permits the analyst to trace the historical development of civil society projects like NPM.

While the project scientists characterized the vulnerable livelihood condition of marginal cultivators as a severe threat to human life and economic wellbeing, the farmers' ability to cope with adverse impacts in locally appropriate ways was acknowledged and creatively worked into the NPM products. Studying creative dissent projects like NPM enables a researcher to study the vulnerability of livelihoods not only as an individual's or a community's reduced ability to cope with and react to hazardous impact. It may also enable the researcher to focus on the *creative dissent practices as a means to cope* with vulnerable livelihood conditions.

My analysis has brought to the fore that it is crucial to make an analytical difference between *practice-oriented* and *hybrid creative dissent* projects. Prasad argued that creative dissent projects are apt agents for cooperative multi-stakeholder development projects due to their innovative capacity (S. Prasad, 2009; S. Prasad, et al., 2008). That is slightly different in hybrid creative dissent

projects, as the case of NPM has highlighted. Here, the creative production of alternatives co-evolves with the pursuit of dissent with mainstream technoscience. In cases where hybrid creative dissent projects endeavor to scale up the creative practices with the help of governmental support, dissent has to be balanced against the need to dialogue with policy makers as possible cooperative partners. Yet, hybrid creative dissent projects are only to a limited extent able to function as a cooperative partner for agrarian development projects, and the APCOT experience has shown how ideological opinion inflicted with multi stakeholder projects. Dissent through practice *and* dissent through activist articulation may function like antagonist muscles do: they work into opposite directions. Hybrid creative dissent projects that plan to cooperate with governmental actors are prone to produce a paradox situation.

REFERENCES

Abhay, V. (2005, 4. June 2005). Monsanto's cotton has deficiencies. *The Times of India*,

Alvares, C. (1980). *Homo Faber: technology and culture in India, China and the West from 1500 to the present day*. Dordrecht: Kluwer Academic Publishers.

Appendini, K. (2001). Land and Livelihood: what do we know and what are the issues? In A. Zoomers (Ed.), *Land and Sustainable Livelihood in Latin Amerika* (pp. 23-38). Amsterdam: Royal Tropical Institute / Vervuert Verlag.

Arora, S. (2009). *Knowledge Flows and Social Capital. A Network Perspective on Rural Innovation.* Maastricht: Universitaire Pers Maastricht.

Bhat, K. S., & Kumar, V. S. e. (2006). *Undeserved Death: A Study on Suicide of Farmers in Andhra Pradesh (2000-2005)*. Hyderabad: Allied Publishers, New Delhi.

Bijker, W. E. (2006). The Vulnerability of Technological Culture. In H. Nowotny (Ed.), *Cultures of Technology and the Quest for Innovation* (pp. 52-69). London: Berghahn Books.

Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (1994). *At risk. Natural hazards, people's vulnerability, and disasters.* London: Routledge.

Cahn, M., & Lui, M. (2008). Women and rural livelihood training: a case study from Papua New Guinea. *Gender & Development, 16*(1), 133-146.

Cannon, T. (2008a). *Reducing people's vulnerability to natural hazards. Research paper No 2008/4*. Maastricht: United Nations University.

Cannon, T. (2008b). Vulnerability, "innocent" disasters and the imperative of cultural understanding. *Disaster Prevention and Management, 17*(3), 350-357.

Carson, R. (1963). *Silent Spring*. London: Hamish Hamilton.

Chambers, R. (1987). Sustainable livelihoods, environment and development: putting poor people first. Discussion Paper 240. *IDS Discussion Papers*

Chitra, G. A., Muraleedharan, V. R., Swaminathan, T., & Vijayaraghavan, D. (2006). Use of pesticides and its impact on health of Farmers in South India. *International Journal of Occupational and Environmental Health, 12*, 228-233.

CitizenReport (1998). *Gathering agrarian crisis. Farmers suicides in Warangal District (A.P.) India*. Hanamkonda: Centre for Environmental Studies Warangal.

CSA (2008a). About CSA Retrieved 11.11.2008, 2008

CSA (2008b). http://www.csa-india.org/morelinks/cmsa.htm Retrieved 15.11.2008, 2008

Cutter, S. L., Mitchell, J. T., & Scott, M. (2000). Revealing the vulnerability of poeple and places: a case study of Georgetwon County, South Carolina. *Annals of the Association of American Geographers, 90*(4), 713-737.

CWS (1998). *Recommendations of the national workshop on non-pesticidal approach to pest management. A new direction.* Paper presented at the National Workshop on non-pesticidal management 1994, Hyderabad, NAARM Rajendrannagar.

CWS (2000). *Non-pesticidal management of cotton, pigeonpea nad groundnut pests. Progress Report 1999-2000.* Secunderabad.

CWS (2001). *NPM in Cotton, Pigeonpea and Groundnut. Progress Report 2000-2001*. Hyderabad.: Centre for World Solidarity.

CWS (2008). Mission Statement Retrieved 04.05.2010, from http://www.cwsy.org

Farrington, J. (2004). Recognizing and addressing risk and vulnerability constraints to pro-poor agricultural growth. Overseas DEvelopment Institute.

Farrington, J., Carney, D., Ashley, C., & Turton, C. (1999). Sustainable Livelihoods in practice: early applications of concepts in rural areas. *Natural Resource Perspective, 42*.

Fortun, K. (2001). *Advocacy after Bhopal: environmentalism, disaster, new global orders*. Chicago.: University of Chicago Press.

Gadgil, M. (2002). Anil Agrawal. [Personal News]. *Current Science, 82*(3), 357-358.

Gandhi, M. K. (1910). *Hind Swaraj or Indian Home Rule*. Ahmedabad.

Garikipati, S. (2008). The impact of lending to women on household vulnerability and wmen's empowerment: evidence from India. *World Development, 36*(12), 2620-2642.

Ghosh, J. (2004). Detoxifying the village. *Frontline, 21*(22).

GoI (1997). *Natural Resource Aspects of Sustainable Development in India.*

Grewal, G. (2005). Feminism, Poverty, and Grassroots Movements in India. In R. Lee Harris (Ed.), *Globalization and Sustainable Development: Issues and Applications*. University of South Florida: Dr. Kiran C. Patel Centre for Global Solutions

Guha, R. (2000). *The unquiet Woods. Ecological Change and Peasant Resistance in the Himalaya.* (Vol. Expanded paperback Edition). Berkley and Los Angeles, California: University of California Press, copublished by Oxford University Press.

Guha, R. (2007). *India after Gandhi*. New York, NY: Harper Collins Publishers.

Gupta, A. K. (1991). *Building upon peoples' ecological knowledge: Framework for studying culturally embedded CPR institutions.* Paper presented at the Second Annual Conference of the International Association for the Study of Common Property, Winnipeg, Manitoba.

Hess, D. (2007). *Alternative Pathways in Science and Industry*. Cambridge, Massachusetts: MIT Press.

Hoffmann, M. P., & Frodsham, A. C. (1993). *Natural Enemies of Vegetable Insect Pests*. Ithaca, NY: Cornell University.

Hogan, D. J., & Marandola, E. (2005). Towards an interdisciplinary conceptualisation of vulnerability. *Population, space and place, 11*, 455-471.

Hommels, A., Mesman, J., & Bijker, W. E. (forthcoming). General Introduction: studying Vulnerability in Technological Cultures. In A. Hommels, J. Mesman & W. E. Bijker (Eds.), *Vulnerability in Technological Cultures - New directions in research and governance*. Cambridge, Massachusett: MIT Press.

Hoon, P., Singh, N., & Wanmali, S. (1997). Sustainable Livelihoods: concepts, principles and approaches to Indicator Development Retrieved 10.01.2009, from www.undp.org/sl/Documents/documents.htm

Jamison, A. (1994). Western Science in perspective and the search for alternatives. In J.-J. Salomon, F. R. Sagasti & C. Sachs-Jeantet (Eds.), *The Uncertain Quest: Science, Technology and Development*. New York: The United Nations University Press.

Jamison, A., & Hard, M. (2005a). *Hubris And Hybrids : A Cultural History Of Technology And Science*: Routledge.

Jamison, A., & Hard, M. (2005b). *Hubris And Hybrids: A Cultural History Of Technology And Science*: Routledge.

Joshi, S. (2004). Village Punukula is different. *Down to Earth*.

Kaag, M. (2004). Ways forward in livelihood research. In D. Kalb, W. Pansters & H. Siebers (Eds.), *Globalization and Development: Themes and concepts in current research*. Dordrecht: Kluwer.

Kasperson, J. X., & Kasperson, R. E. (2001). *A workshop Summary*. Paper presented at the International Workshop on Vulnerability and Global Environmental Change.

Kogan, M. (1998). INTEGRATED PEST MANAGEMENT: Historical Perspectives and Contemporary Developments. *Annual Review of Entomology, 43*, 243-270.

Krishnakumar, A. F. (2004). Bt Cotton, Again. *Frontline, 21*(10).

Kuruganti, K. (2005). Effects of pesticide exposure in development task performance in Indian children. *Children, Youth and Environments, 15*(1), 83-114.

Law, J. (2003). Landbroke Grove: or how to think about failing systems. Discussion paper. Centre for Science Studis, Department of Sociology, Lancester University.

Levine, C. (2004). The concept of vulnerability in disaster research. *Journal of Traumatic Distress, 17*(5), 395-402.

Mancini, F. (2006). *Impact of Integrated Pest Management Farmer Field Schools on health, farming systems, the environment and livelihoods of cotton growers in Southern India.*, Wageningen University, Wageningen.

Marten, G., & Williams, D. K. (2006). Getting clearn: recovering from pesticide addiction. *The Ecologist, 1*, 50-53.

Mathur, H. B., Agrawal, H. C., Johnson, S., & Saikia, N. (2005). *Analysis of pesticide residues in blood samples form villages in Punjab*. New Delhi: Centre for Science and Environment.

Meher-Homji, V. M. (1991). Probable impact of deforestation on hydrological processes. *Climatic Change, 19*(1), 163-173.

Menon, S. V. (2006). Globalisation, state and disempowerment: study of farmers suicide in Warangal ICFAI Business School Ahmedabad.

Mesman, J. (forthcoming). The relocation of vulnerability in critical care medicine. In A. Hommels, J. Mesman & W. E. Bijker (Eds.), *Vulnerability in Technological Cultures - New directions in research and governance*. Cambridge, Massachusett: MIT Press.

Mishra, S. (2006). Farmers' suicides in Maharashtra. *Economic and Political Weekly*, 1538-1545.

Mishra, S. (2009). Made it. *Down to Earth, 17*(16).

Mukherjee, R. (2009). Gandhi's Swaraj. *Economic and Political Weekly, 44*(50), 34-39.

Nandy, A. (1980). *Alternative Sciences*. New Delhi: Allied Publishers.

Nandy, A. (1987). From outside the imperium: Gandhi's cultural critique of the West.

Traditions, Tyranny and Utopias. Essays in the Politics of Awareness. Delhi: Oxford University Press.

Nandy, A. (1990). *Science, Hegemony and Violence* (Vol. Sixth impression 1999). New Delhi: Oxford University Press.

Nandy, A. (1996). Bearing Witness to the Future. *Futures, 28*(6), 636-639.

Parayil, G. (1992). Social movements, Technology and Development: a query and an instructive case from the Third World. *Dialectical Anthropology, 17*, 339-352.

Perrow, C. (1999). *Normal Accidents: Living with High-Risk Technologies.* (2nd edition ed.). Princetion: Princeton University Press.

PPST (n.d.). PPST foundation.

Prasad, S. (1999). Suicide Deaths and the quality of Indian Cotton: perspectives from the History of Technology and the Khadi movement. *Economic and Political Weekly, 34*.

Prasad, S. (2001). *Exploring Gandhian Science: A Case Study of the Khadi Movement.*, Indian Institute of Technology, Delhi.

Prasad, S. (2009). Conversations on knowledge and democracy: fables from SRI. *Seminar, 597*, 2-6.

Prasad, S. (forthcoming). Creative dissent: Linking vulnerability, democracy and knowledge in India. In A. Hommels, J. Mesman & W. E. Bijker (Eds.), *The Vulnerability of Technological Cultures. New directions in research and governance.* Cambridge, Massachusetts: MIT Press.

Prasad, S., Ramanjaneyulu, G. V., Ravindra, A., & Sanghi, N. K. (2008). *Learning Alliances: Emerging trends in knoweldge intensive agriculture.* Paper presented at the Rethinking Impact: Understanding the complexity of Poverty and Change.

Prasad, S. C., Ravindra, A., & Ramanjaneyulu, G. V. (2008). *Learning alliances: Emerging trends in knowledge intensive agriculture.* Paper presented at the Rethinking Impact: Understanding the Complexity of Poverty and Change from www.prgaprogram.org/riw/files

Qayum, M. A., & Rao, D. V. R. (1998). *Overview of the collabroative programme of non-pesticidal management of pests of cotton and pigeonpea for 1996-1197 and 1997-1998.* Paper presented at the Non-pesticidal management of cotton and pigeonpea pests., National Institute of Agricultural Extension Management (Manage).

Quartz, J (forthcoming). *Constructing Agrarian Alternatives. How a creative dissent project engages with the vulnerable livelihood conditions of marginal farmers in South India*. Dissertation. Maastricht University Press

Rajan, V. (1994). The Case Of The Red Hairy Caterpillar Retrieved Think Soft.

Rama Rao, C. A., Srinivas Rao, M., Srinivas, K., & Ramakrishna, Y. S. (2007). Adoption and Impact of Integrated Pest Management in Cotton, Groundnut and Pigeonpea. *Research Bulletin of the Central Research Institute for Dryland Agriculture (CRIDA), 2*.

Ramanjaneyulu, G. V. (2007a). *NPM Scaling up in Experiences in AP*. Paper presented at the Policy matters. Insights from Civil society engagement with Science and Technology.

Ramanjaneyulu, G. V. (2007b). Visit to NPM and organic villages Unpublished Fieldvisit Report. Centre for Sustainable Agriculture.

Ramanjaneyulu, G. V., Chari, M. S., Raghunath, T. A. V. S., Hussain, Z., & Kuruganti, K. (2007). Non-pesticidal Management: learning from experiences. Centre for Sustainable Agriculture.

Ramanjaneyulu, G. V., Kuruganti, K., Hussain, Z., & Venumadhev, K. (2004). *Managing pests without pesticides.* Secunderabad.

Ramanjaneyulu, G. V., & Rao, R. V. (2008). Sustaining agriculture-based livelihoods. Experiences with non-pesticidal management in Andhra Pradesh. *Development, 51*, 4.

Rao, D. C. B. (2004). Village bids farewell to pesticides. *The Hindu*.

Reddy, V. R. (2006). 'Jalayagnam' and bridging regional disparities. *Economic and Political Weekly, 41*(43-44), 4613-4320.

Revathi, E. (2006). Farmer suicides in Andhra Pradesh: intra distirct and inter distirc pattern and policy options. In K. S. Bhat & S. V. Kumar (Eds.), *Undeserved death. A study on suicide of farmes in Andhra Pradesh (2000-2005)*. Hyderabad: Council for Social Development.

Rochlin, G. I. (1994). Broken Plowshare: System Failure and the Nuclear Power Industry. In J. Summerton (Ed.), *Changing Large Technical Systems*. Boulder, CO: Westview Press.

Rogers, A. C. (1997). Vulnerability, health and healthcare. *Journal of Advanced Nursing, 26*, 65-72.

Scoones, I. (1998). Sustainable Rural Livelihoods: a framework for analysis. IDS Working Paper 72. *IDS Working Paper Series* Retrieved 20.01.2009, from http://www.ids.ac.uk/ids/bookshop/wp/wp72.pdf

Sen, A. (1981). *Poverty and Famines: An Essay on Entitlement and Deprivation*. New York: Oxford University Press.

Shah, G. (2004). *Social Movements in India*. Thousand Oaks, California: Sage

Sharma, D. (2005). No pesticides, no Bt cotton, no pests. *India Together*.

Shetty, P. K. (2004a). Socio-ecological implications of pesticide use in India. *Economic and Political Weekly, 39*(49).

Singh, M. (2005). *India.* Paper presented at the Proceedings of the Asia regional workshop on the implementation, monitoring and observance., Bankok, Thailand.

Snook, S. A. (2002). *Friendly fire. The Accidental Shootdown of US Black Hawks over Northern Iraque.* Princeton: Princetion University Press.

Stone, G. D. (2002). Biotechnology and suicides in India. [commentary]. *Anthropology News, 43*(5).

Sulaiman, R. V., & Holt, G. (2002). Extension, Poverty and Vulnerability in India. Working paper 154. Overseas Development Institute.

Swift, J. (2006). Why are people vulnerable to famine? *IDS Bulletin, 37*(4), 41-49.

Syngenta (n.d.). Sustainable agriculture and Syngenta: the APCOT example.

Thummuru, L. (2006). Integrated Pest Management (IPM) in Andhra Pradesh: three case studies in rural innovation. Working Paper. Centre for Research on Innovation and Science Policy (CRISP).

Thummuru, L. (n.d.). NPM as a means of enhancing rural innovation capacity. Working Paper. Centre for Research on Innovation and Science Policy (CRISP).

Turner, B. L., Kasperson, R. E., Matson, P. A., Mc Carthy, J. J., Corell, R. W., Christensen, L., et al. (2003). A framework for vulnerability analysis in sustainable science. *Proceedings of the National Academy of Science of the United States of America, 100*(4), 8074-8079.

Uberoi, J. P. S. (1978). *Science and Culture*. New Delhi: Oxford University Press.

Vakulabharanam, V. (2004). *Immiserizing Growth: Globalization and Agrarian Change in Telangana, South India between 1985 and 2000.*, University of Massachusetts, Amherst.

Vakulabharanam, V. (2005). Growth and Distress in a South Indian Peasant Economy during the Era of Economic Liberalization. *The Journal of Development Studies, 41*(6), 971-

997.

Vaughan, D. (1996). *The Challenger Launch Decision. Risky Technology, Culture, and Deviance at NASA*. Chicago: University of Chicago Press.

Venkateshwarlu, D. (2004). Wisdom in Traditional Farming Systems. Centre for Sustainable Agriculture.

Visvanathan, S. (1997). On the annals of the Laboratory State. In S. Visvanathan (Ed.), *A Carnival for Science*. New Delhi: Oxford University Press.

Visvanathan, S. (1998). A celebration of difference: Science and Democracy in India. *Science, 280*(5360), 42-43.

Visvanathan, S. (2006). Alternative Science. *Theory, Culture and Society*, *23*(2-3), 164-169.

Wackers, G., & Kørte, J. (2003). Drift and vulnerability in a complex technological system: reliability of condition monitoring systems in North Sea offshore helicoptor transport. *International Journal of Engineering Education*, *19*(1), 192-205.

Weick, K. (1990). The vulnerable system: an analysis of the Tenerife aid disaster. *Journal of Management, 10*(2), 571-593.

Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (2004). *At risk: Natural hazards, people's vulnerability and disasters* (2nd edition ed.). London: Routledge.

Appendix

Name	*Function*	*Date, Location (all in English)*
Barwale Jr., Dr. R.	Managing Director, Maharashtra Hybrid Seeds Co. Ltd.	22.02.2008, Mumbai
Chari, Dr. M.S.	Trustee CSA, former senior entomologist at Indian Council for Agricultural Research	15.04.2008, Hyderabad
Chopra, Dr. V. L.	Member Planning Commission, Government of India	26.03.2008, New Delhi
Kumar, Dr. V.	CEO Society for the Elimination of Rural Poverty	18.12.2007, Hyderabad
Kuruganti, K.	Former action campaigner at Centre for Sustainable Agriculture	13.12.2007, Hyderabad
Mayee, Dr. C.D.	Former director Institute of Cotton Research, Nagpur	29.02.2008, New Delhi
Natesh, Dr. S.	Senior advisor for the Department of Biotechnology, Government of India	26.02.2008, New Delhi
Qayoom, Dr. A.	Agronomist, Deccan Development Society	13.04.2007, 09.02.2008, Hyderabad
Rajan, Dr. V.	Executive Director Think Soft Consultancy	20.03.2008, Hyderabad
Sanghi, Dr. N.K.	Advisor Watershed Support Services and Activities Network	15.04.2008, Hyderabad

Sharma, Dr. M.	Former secretary Department of Biotechnology, Government of India	01.03.2008, New Delhi
Ramanjaneyulu, Dr. G.V.	Executive director Centre for Sustainable Agriculture	24.12.2007, 14.02.2008 (a), 18.04.2008 (b), Hyderabad
Sastri, M.V.	Convener Centre for World Solidarity	05.02.2008 (a), 17.04.2008 (b), Hyderabad
Visvanathan, Dr. S.	Anthropologist and Human Rights Researcher, Centre for the Study of Developing Societies (CSDS), Delhi.	04.05.2008, Ahmedabad