Going With the Grain:

Development, Knowledge Creation, and Database use at the International Maize and
Wheat Improvement Center (CIMMYT)

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**Abstract:**

Record keeping is not a static way to document history but rather a way for people in the present to engage with, and be affected by, the past.  This is especially true in the case of online databases.  Databases store information but their use also encourages the adoption of specific methodologies for apprehending reality because it is through those methodological agreements that the information in the database becomes relevant.  In the summer of 2012 I spent four months observing and interviewing wheat researchers and database developers at a major agricultural research center in Mexico as part of my M.A. thesis project.  This paper argues that people using the International Wheat Information System (IWIS) database at the International Maize and Wheat Improvement Center (CIMMYT) are involved in a process that documents wheat pedigree information while also enacting a reality based on assumptions about the value of certain types of human pedigree.

**List of Abbreviations Used**

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| CBD | Convention on Biological Diversity |
| CG | Consultative Group |
| CGIAR | Consultative Group on International Agricultural Research |
| CIMMYT | International Maize and Wheat Improvement Center |
| CRIL | Crop Informatics Research Department |
| FAO | Food and Agriculture Organization |
| GCP | Generation Challenge Program |
| GMO | Genetically Modified Organism |
| IBPGR | International Board for Plant Genetic Resources |
| IP | Intellectual Property |
| IRRI | International Rice Research Institution |
| ITPGRFA | International Treaty on Plant Genetic Resources for Food and Agriculture |
| IWIS | International Wheat Information System |

## Chapter 1: Introduction

The International Maize and Wheat Improvement Center known as CIMMYT, an acronym for its Spanish name[1], is an organization that sees its role in development as one focused around improving the daily lives and food security of underprivileged populations around the world.  In this thesis I argue that how CIMMYT goes about actually "doing" that improvement speaks to an almost nostalgic view of agricultural improvement strategies, one that we might expect to have changed.  In order to make this argument I use the International Wheat Information System (IWIS), a crop-information sharing initiative, as a lens to explore social relationships within CIMMYT.  CIMMYT's attempts to implement the IWIS and Intellectual Property (IP) agreements demonstrate how the organization's vision of development remains centered on the practice of classical plant breeding, despite historical developments that would expect it to have moved on.  I argue that CIMMYT is making a political statement about what it is that "doing development" means in agriculture.  As a way to discuss this idea I have focused my research on an indexing system, the IWIS.  I will demonstrate how the use of this database and the framework in which it has been developed and used can be interpreted as promoting a development strategy rooted in a historical tradition that might need revamping.  I speculate that how CIMMYT utilizes IP agreements may in fact be transferring the ideologies that maintain that historic tradition of what development means to its partners.

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[1] The Spanish name is Centro Internacional de Mejoramiento de Maíz y Trigo. This is where the acronym comes from.

In order to make this argument about this indexing system I will draw on three main concepts from social science literature. In chapter two of my thesis I outline the three concepts I will use and situate them in the literature surrounding agricultural development, standardization and the way that specific realties are enacted through methodological approaches to problems. I will apply ideas from Thevenot (1984), focusing on what he characterizes as an investment in forms, to the methodological standards that CIMMYT has created in house. I argue that specific form that the IWIS has taken speaks to social arrangements at CIMMYT. In order to expand on CIMMYT's investment in forms I discuss the ontological and methodological framework that CIMMYT has developed. Continuing with a methodological focus I use Star and Griesemer's (1989) concept of boundary objects to demonstrate how the use of similar methodologies by different groups does not imply that those groups will have similar goals or motivations. To expand on these ideas I will look at a few of CIMMYT's internal relationships as well as some of the interactions that CIMMYT has with its global partners. Finally I will use Fujimura's (1992) concept of standard packages to build a speculative argument that the way that CIMMYT uses IP agreements might have the effect of changing the way that its partners conceive of their own development projects and initiatives.

Indexing systems or databases are tools used by people to store and distribute information. They are record keeping tools which document the historical record. Databases can also act as sources of information which allow new interpretations of old data. For example, databases allow historical comparisons and statistical analysis of crop data such as yield quantities as they change from year to year or month to month.

Keeping in mind the old cliché "history is written by the winners", I wondered who decided on the form of this particular database and why it was designed in the way it has been. I have imposed this idea that records are the products of the most powerful group. Would that idea hold true at CIMMYT? How has power developed at CIMMYT? What is it about the IWIS in particular that speaks to the way that CIMMYT employees think about what development means? How does this database forward those ideals?

In chapter three I answer these questions by looking at some of the relationships of power within the CIMMYT social structure. Comparing the relationships of wheat breeders with other departments within CIMMYT I argue that the breeders, as a result of historical associations with the place, have greater access to CIMMYT resources. Likewise I argue that international staff, also as a result of historical associations with the place, have greater access to and subsequently control over CIMMYT resources. Using examples from CIMMYT employees I make the case that one consequence of both of these power imbalances is tension between groups and discomfort and disharmony within the organization. A second consequence of this imbalance is that some groups have their needs prioritized when new tools are developed. I show that when the IWIS was developed the needs of the breeders were prioritized in the way that the system functions.

Part of the process of building power is the ability to create and maintain alliances with other groups. In order for alliances to form what is needed is cooperation and triangulation between groups (Star & Griesemer, 1989). Star and Griesemer (1989 p.393) have developed a concept that helps in understanding alliance building which they call "boundary objects". They argue that scientific work is not characterized by consensus in thought but rather consensus in practice (ibid). I argue that their concept of

boundary objects is useful for looking at how different groups in agricultural

development cooperate in order to understand how groups with unlike motivations share

the same methodological approaches to problems.

In chapter four I develop an argument applying Star and Griesemer's (1989)

concept of boundary objects to CIMMYT's methodological approaches to crop

improvement. My argument is about how authority is exercised, in part, through the

application of standards. To tease this out I look at the situation of an engineer's struggle

to maintain specific standards and the difficulties he faced. I also look at how scientists

use standards and the perception of standards to speak authoritatively about their fields.

To expand on this I look at how scientists talk about their published materials as a way to

convince me of the authority vested in their work. Lastly, I look at one way that

methodologies are exported by CIMMYT to national partners around the world. I argue

that the international nurseries program helps us to see the IWIS and the field books that

it prints as boundary objects and as attempts by CIMMYT to exert authority on its

partners' crop improvement programs.

In chapter five I look at how CIMMYT employees perceive public sector

practices and products in relation to private sector practices and products. I argue that the

way that CIMMYT researchers explain the failure of the IWIS's implementation speaks

to a divide in how they perceive of public and private practices. My aim in this chapter is

to point out that that the private sector is being criticized for its purely economics based

practices by CIMMYT at the same time as it is admired for its ability to implement new

technologies. I also point out the negativity that researchers display towards the simple

economic motivations that they perceive as driving the private sector. This negativity is

interesting because breeding and recent donor strategies are also based on simple economic-style arguments. The second major theme that I cover in chapter five is how IP is perceived within CIMMYT. I highlight some ironies in the perception and of IP and it subsequent use at CIMMYT as a way to break into a discussion about how IP regulations are seen working against the interests of the public good at the same time as IP regulations are seen as necessary for protecting the public good.

In the final section of the argument of my thesis, chapter six, I explore how CIMMYT uses IP. Although many people disparage IP and consider it part of private, and not public, sector practices IP is still used by CIMMYT. How it is used is in contracts which create fiduciary relationships of reciprocity. I argue that these contracts are attempts by CIMMYT to further entrench CIMMYT standards by asking their partners to build off CIMMYT's own work. In doing so, I speculate that CIMMYT is cementing those partners into seeing the world of development in ideologically similar ways to the way that CIMMYT does. I use the analogy of open source software to argue that although CIMMYT says it is doing an open source style of development it seems more like a proprietary one, where partners are expected to use CIMMYT products in a particular way and not with the freedom which "open source" implies.

In this thesis I will highlight some of the apparently contradictory ways that CIMMYT staff members have explained their work and their world view. The reason for highlighting these contradictions is to explore some of the difficulties faced by researchers in disentangling politics and science. My overall argument is that by examining the IWIS we are able to see political relationships embedded in scientific practices and tools. I argue that the information which the IWIS contains about wheat is

more representative of what is known about the political arrangement of CIMMYT's wheat department than it is representative of what is known about wheat.

**The Setting**

CIMMYT is located about an hour outside Mexico City, Mexico. It is a crop improvement center that works primarily on developing new wheat and maize varieties to help agricultural development projects worldwide. Often it is also referred to as El Batan, a name for the specific area on which CIMMYT's headquarters was built. El Batan is a small rural area close to Texcoco, a relatively small "city"[2] on the outskirts of Mexico City. CIMMYT is a research center that has been made famous, in part, due to one of its alumni, Dr. Norman Borlaug. He is a Nobel laureate who was instrumental in developing CIMMYT's wheat department. CIMMYT is part of the Consultative Group on International Agricultural Research (CGIAR), which is the world's largest international agricultural research organization. CGIAR has15 centers spread around the world and is involved in projects in about 100 countries.

Because of this worldwide network of associations and relationships CIMMYT is an ideal place for research into how scientists and researchers share the information resulting from their crop improvement initiatives. I was curious how it is that knowledge was created and shared between the centers. Scientific knowledge is often framed as being objective and untarnished by politics (Brooks, 2005). My project starts from the premise that actions are always political (e.g. Arendt, 2006) but that those politics can be

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[2] By any comparison to México City Texcoco is not much more than a village but relative to the other communities in the area Texcoco is a City. It has more than 150,000 residents

obscured through the use of the language of science (Brooks, 2010; Smith, 2008). When I use the word *science* I mean a particular methodological approach to knowing about the world. While many scientific practices may be technical and apolitical in their designs, the motivations for experimentation are not (Smith, 2008). I wanted to know what sorts of politics were involved in the generating and the subsequent sharing of that "objective" knowledge at CIMMYT. In order to look at this question I decided to look at one place where information is indexed and stored.

CIMMYT and other CGIAR centers frame themselves as being involved in generating crop improvement initiatives to help the underprivileged populations around the world. CIMMYT's mission is to "sustainably Increase the productivity of maize and wheat systems to ensure global food security and reduce poverty" (CIMMYT.org, 2013). How could one database of information help people across the globe and what sorts of information did it contain that would make it locally relevant across contexts? Discussions about information are especially relevant at the moment because of the controversy surrounding agriculture and IP (e.g., Brooks, 2005; Hayden, 2003; Jansen & Roquas, 2008; McAfee, 2003; Waltz, 2009). There have been concerns about the modification of crops and of patenting food technologies leading to protests like the march against Monsanto, which took place May 25th 2013. Added to concerns over IP are cooperative ventures that include private companies like Bayer and Monsanto working with development research organizations like CIMMYT. I was interested in exploring if, and if, how, these associations shaped talk about information and data sharing. These are the sorts of questions that drove me as I planned my research period at CIMMYT.

CIMMYT is an interesting case study because it is one of the Consultative

Group's (CG's) flagship centers and it has played a large role in the movement that led to

the Green Revolution in agriculture. Technologies and crops developed at CIMMYT are

in use all around the world. Because of its strategic placement as a historically impactful

research center, exploring how CIMMYT shares information will help to shed light on

how local contexts shape and are shaped by information technologies like the IWIS

database. I interviewed people in the Wheat Department, the Plant Genetic Resource

Center (seed bank), the Crop Informatics Research Department (CRIL), the Physiology

Department, the Generation Challenge Program (GCP) and the Intellectual Property (IP)

department. I will explain more about each of these departments later on. What connects

them all is that they all have some vested interest and some involvement in the IWIS and

in the International Crop Information System (ICIS).

The ICIS[3], which was developed out of the IWIS, is a generic platform for storing

crop information. Although the IWIS was developed first the ICIS has now absorbed the

IWIS into its own super structure. Within the ICIS's databases there are other crop

databases as well. The ICIS website claims that it has developed distinct databases for

rice, wheat, maize, chick pea, sorghum, cassava, cow pea, barley, cotton, potato, sugar

cane and sweet potato (CGIAR, 2013). This scope of this thesis is too narrow to speak to

the varying contexts, relationship and situations that shaped the other databases within

the ICIS. I chose to focus on the IWIS because it was the first crop information system

developed on this scale at within the CGIAR system and it was developed primarily at

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[3] The IWIS is now part of the ICIS. All of the other information systems within the ICIS
are based on a generic plant-breeding information platform that was developed out of the
IWIS. I do not focus on the situation surrounding the implementation of the ICIS
because it's story is significantly larger and more complicated than the IWIS's.

CIMMYT, a site I felt I could access relatively easily. The other databases within the ICIS were modeled on the IWIS so I felt it was the most compelling place to start in a discussion about how CGIAR centers share their information.

When I first started researching the IWIS at CIMMYT it was advertised as an "unambiguous wheat identification system" (CIMMYT.org, 2011). I wanted to know how CIMMYT disambiguated its wheat identifiers and what "ambiguities" existed that necessitated this identification system in the first place. It was interesting to me because this statement called attention to the fact that there were some disagreements in how wheat ought to be identified but also expressed CIMMYT's ability to overcome those disagreements with this unambiguous system that it had developed. I was curious what different ways there are for representing wheat and what the decision process was in choosing one over another. The reason I was so intrigued by this database is because using a tool like this implies some sort of shared understanding of the world (Thevenot, 1984). For example, using a specific measuring system, like the metric system vs. the imperial system, implies that your audience will also be familiar with that understanding of how to measure. Because of CIMMYT's global impact we can assume the way it has chosen to describe wheat must have some global relevance and I was curious what decision process went into creating that descriptive framework.

I use the reflections on the ICIS and the IWIS from some people from each of the groups mentioned above as a way to get at how crop improvement has been conceived and developed at CIMMYT. The connections between these groups are sometimes complementary and sometimes adversarial when it comes to opinions on the databases. By looking at their interactions and the contexts that shape those interactions I hoped to

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gain some understanding of the forces that were involved in imagining, developing,

implementing and using the IWIS database. I argue that the development,

implementation and use of the IWIS is a demonstration of (a) how resources are allocated

within the organization; (b) how authority is constructed and maintained through the use

of standards in agricultural research; (c) how CIMMYT employees perceive distinctions

between public and private enterprises; and finally (d) how IP might be used to spread a

particular worldview at the expense of other worldviews.

During the summer of 2012 I spent four months working five days a week on the

CIMMYT campus in El Batan. I gathered the bulk of my information from in-person,

one-time, semi-structured, open ended interviews.[4] Generally I would interview people

in their offices but I also conducted interviews in one of the CIMMYT cafeterias. As part

of obtaining consent I gave all of the interviewees the option of choosing a pseudonym

and gave them the option of allowing me to quote them in my paper. As part of the

quotation option I gave them the choice to allow me to use their quotations without

review or to review any quotations that I might wish to use. The population was pretty

evenly split between those wishing me to use their real names and between those wanting

to review their quotations before publication. The general feeling from those wishing to

see their quotations was they wanted to ensure factual accuracy and make sure that I did

not quote them out of context, for example if they were saying something in a sarcastic

manner and I quoted them as being sincere.

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[4] Interview times ranged from 35 minutes to 85 minutes. I also conducted two interviews via Skype and had various follow up contacts through emails.

I interviewed 18[5] people who I identified first through connections with the IWIS and later because of connections drawn out by other respondents. I also found some interviewees simply by asking around, for example in the cafeteria, if anybody had any contact with the IWIS and was willing to talk about it. I made an effort to interview people in different departments who had different contact with the IWIS. For example, I interviewed both users and developers of the IWIS. Among the users, I interviewed people who had daily contact with it and its products as technicians and those who utilized it as part of their programs, for example breeders, but were not directly in contact with it on a daily basis. On the developer end I spoke to people who were responsible for the conceptual development of the IWIS as well as those developers whose job it was to build the actual program framework and functions, which became the IWIS.

In addition to the interviews I also spent many afternoons interacting with CIMMYT students and staff during lunches in the cafeteria. I also attended CIMMYT social events like house warming parties, farewell parties, and excursions to activities like "luchas" (Mexican wrestling matches). While these interactions did not focus on the IWIS they did help me to get a sense of the departmental associations and interactions. My research was based entirely at CIMMYT's headquarters in El Batan. Although I did take a day trip to one of CIMMYT's field stations in Tlaltizapan I did not conduct any interviews there.

In the following pages I will develop an argument based on the way that knowledge sharing is impacted by contextual elements. I have structured this argument

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[5] Of the 18, Six are women and 12 are men. 13 are "international staff" (one of which was Mexican) and five are national staff. I explain the distinction between national and international staff in chapter three.

in a way that involves four main sub-arguments shaped around a review of the literature

related to methodological standardization, agricultural development studies, and

relationships of power shaping the transfer of ideology and methodology between groups.

I have separated the literature review into its own chapter at the beginning because I want

these ideas to be present from the outset as a guide through the four arguments.

**Chapter 2: Standard Forms as Investments and as Exercises of Power**

My motivation for using the forms that agricultural research employs as a focus in this project is because looking at the *hows* of agricultural science is one of the most controversial, and therefore accessible, ways to discuss the *whys* which motivate those decisions. If IWIS is how CIMMYT employees have chosen to communicate wheat information, why have they decided to do it that way? The one thing that almost everybody researching development agrees upon is that there is a need for thoughtful intervention into the lives of the underprivileged. That there are poor people in the world and that something should be done to better their living situation is the only part of this problem that breeds consensus. The conversation starts with explanations about why this is a reality or how we might remedy it.

In order to explore this issue I will draw on work from three different areas of scholarship. The first one is standardization, forms, and constructions of reality. I use this scholarship as guide to look at how and why it is that groups of people become invested in particular methods for describing abstract concepts (like hours and minutes for time). The second area that I will be drawing from is social researchers' perspectives on agricultural research. My main objective in using literature about agricultural research is to look at how agricultural systems have been modeled and what relationships are emphasized in those models. The third research area that I will explore is development studies. Specifically, I will look at how developmental rationales are conceived and how we can read them out of practice. Using these three areas of scholarship I work towards some examples of forms as exercises of power. I do this because development is often

about powerful groups attempting to empower underprivileged groups and I believe that it is crucial to see how that power is being distributed, shared and exercised.

**Standard Forms**

When I talk about forms I talk about them in a sense informed by Thevenot (1984), Star and Griesemer (1989) and Fujimura (1992). Thevenot (1984) uses the word "code" to discuss the means by which people classify and order objects, concepts, and relationships (p.2). A code is basically how we talk about abstract concepts. An example of a code which is almost universal is time. Most large-scale, state-sized human populations divide their days with units of standard time. Minutes and hours are one code for or one *form* of conceptualizing an abstract thought. In this way I see the IWIS as a systematized way for recording a specific code for classifying, ordering and organizing wheat. While hours and minutes are not intrinsically meaningful or useful they have become the dominant form used by people to speak about time (Thevenot, 1984).

Thevenot (1984) argues that some of the most powerful forms are those used by the state because they are agreed upon by a large number of people over a large geographical area. As populations grow the investment that they have in particular forms is affected. For example, time, as a unit of expression, becomes increasingly important in large scale governance as it allows people to ensure that their discussion is centered around a standard set of terms that everybody imagines in the same way. Standardization aids large scale interaction and communication by limiting the resources spent on translation. For example, militaries use the 24 hour clock to clarify the way they express time as a standard unit to limit ambiguity when giving orders. Through standardization,

populations become *invested* in the forms they use (Thevenot, 1984). I argue that wheat, like time, is an abstract concept which needs to be coded into a specific form. By understanding how it has been coded we can extrapolate some sense of the social relationships involved.

Thevenot (1984) focuses his discussion mainly on the way that people think about forms and the resources which they then invest in those forms, those standard ways of thinking. Star and Griesemer (1989) take this train of thought further to argue that methodologies (i.e. units for measuring and describing temperature, time, or distance) are a type of form (á la Thevenot) which is directly involved in standardizing relationships between groups. While the relationality of groups is clearly implied by Thevenot (1984), Star and Griesemer (1989) are explicit in their exploration of how a shared methodology constitutes an adherence to form which facilitates interaction and cooperation between groups that may have different motivations and goals. Star and Griesemer's (1989) example is one of museum curators who create a standard methodological approach to how natural specimens (animals in this case) are caught, preserved, and transported to the museum for archiving. This shared methodological approach allows other groups with unlike goals (trappers, amateur naturalists, botanists, etc.) to cooperate through standard practice, if not through similarities in motivation (Star & Griesemer, 1989). By focusing on the form of interaction this allows groups to deemphasize the reasoning for action (the *why*) and focus on the action itself (the *how*) of human interaction (Star & Griesemer, 1989). Looking back to our example of time, an emphasis on the how allows us to use the forms given to us (hours and minutes) and forego thinking about why it is that we use these specific units. As I will show, this shifting of focus from the political decisions

surrounding the *choices* of forms to the *use* of the forms has interesting consequences for agricultural development.

Fujimura (1992) takes the idea of forms one step further than Star and Griesemer (1989) in that she is concerned with how allegiance and cooperation is facilitated through specific methodological choices *as well as* how worldviews are also transferred through those methodologies. In the example of the trappers and the naturalists working with the museum curators we have three distinct groups who have very different motivations for cooperation. Their worldviews and their relationships with the animals they are preserving are very different. What Fujimura (1992) is interested in is in how the use of similar forms leads to similar conceptions of reality. The museum example does not clearly lend itself to a shared worldview because it is precisely the difference in worldviews that interest Star and Griesemer (1989). The example of time helps to explain Fujimura's (1992) approach to forms. Eventually, one method of discussing time (minutes and hours) becomes the way in which each cooperating population *thinks* about or imagines time.

Bruce Knauft (2013) provides a great example of changing worldviews in his book about the Gebusi people. In his book, Knauft (2013) describes the way in which the influence of Christianity and state government affects the Gebusi peoples' conception of time. Throughout his visits to Papua New Guinea he sees the conception of time shift due to the adoption of new methodological ways of describing it. He describes his amazement at the growth of western sense of punctuality based on a 24 hour clock in a society where no such concept previously existed. The adoption of a new form of

describing a phenomenon such as the passing of time fundamentally changed the way

that the Gebusi related to "time" as a concept.

**Emphasis in Agricultural Systems**

Arguing that forms like the IWIS are significant because they have the effect of changing

worldviews is of particular importance in agricultural development because of the

precarious situation of the populations affected by this sector. How those populations are

framed within development circles had a profound effect on the services they receive and

the help they can be offered. For example, if a population of women's hunger is blamed

on the poor quality of their food and not on the male dominated social system that

restricts those women's access to food the outcomes for how development is conceived

can be vastly different. It's this relationship to reality, specifically in agriculture, that I

want to tease out here.

In order to develop further on the notion of forms it is also important to

understand their relationship with enactments of reality. I take the stance, like Law

(2004), that there is no one underlying reality with which people can build a relationship.

Law (2004) argues that methodology[6] does not discover and depict realties but rather that

methods participate in the *enactment* of those realities (p.45). An explanatory example of

this comes from Law's (2004) exploration of Mol's (2002) book on atherosclerosis. Law

(2004) explains how, in a hospital, different departments use varying methods with which

to apprehend knowledge about an illness. The clinic, the pathology department, and the

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[6] I use methods and methodology interchangeably in this discussion. Although some
scholars find important differences between the two (i.e. King, 1994), those differences
are not important for this discussion.

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radiology department all use different tools and methodology to apprehend the existence of medical ailments. In each case, a different "assemblage" of methods is producing its own version of illness (Law, 2004, p.48). Having different methodological ways of *enacting* different "realities" of an illness is counter to most western ideas about science. Scientific action is generally understood to underlie a belief that there is one independent reality which exists without the observer (Law, 2004, p.143).

Law's (2004) point is that while research processes have become so technical as to mask their ideological positions, those positions are still present and, with attention, can be explored. I find this point helpful because it explains not only that researchers' relationships with their subjects are contextual and negotiated but that the reality that those interactions enact is also contextual and negotiated. For my purposes, this explanation of how we might think about reality helps to smooth the tension over any idea that someone might have a complete or definitive explanation for a phenomenon. At the same time this stance strengthens an analysis of forms because it firmly places notions of "reality" within the realm of a negotiated space that is necessarily contextual and negotiated within social groups.

CIMMYT, and other CGIAR centers, take one approach to dealing with the problem of poverty. The approach they take is indicative of the way they think about what it is that development means. CIMMYT takes the stance that rural food security issues are best met with good scientific processes whose role it is to ensure that crops are grown which meet the social and environmental needs of their target populations (CGIAR, 2012). This stance implies a temporal relationship with the problem of food security. It implies a perception of the historical circumstances that led to this problem

and it implies a solution which they can work on in the present in order to alter the future. Kortright (2011) argues that for some scientists it is perceptions about the future which motivate them in the present. Using Kortright's (2011) argument as a guide I suggest that it is this temporal relationship that is at the heart of most of the disagreements that come out of conversations about standard practices. The relationship between the "reality" of a situation and the form of action required to alter a historically visible trajectory are intimately linked through enactment. That is why it is possible only to say that most people agree that there is problem which involves the amount and quality of food that poor populations are able to eat. Anything beyond that assertion becomes controversial because of the implications it has for a historical and future relationship with how to tackle the issue. Some groups call this a food resource access issue, with the associated social implications, while others call it a nutrient problem to be rectified through scientific advancements (Brooks, 2011; Enserink, 2008; Waltz, 2009). For this paper, the associated decisions and their implications for direct action that relate to a specific stance on development are what are interesting.

When we talk about the forms that agricultural science has taken it is important to note that they are numerous and hotly contested. Forms gain in recognition based on the political backing which they receive. Science is one methodology, among many, whose form is practical for achieving political ends (Whatmore, 2009). Using the language of science, however, is a particularly powerful method for making political arguments because scientific discourse frames itself in such a way as to appear apolitical (Star & Griesemer, 1989). As Star and Griesemer (1989) demonstrate, authority is, in part, exercised through the standardization of methods. The standardization of methods

emphasizes one methodological approach to tackling an issue at the expense of other approaches (Shepherd, 2006). Fitting (2011) also argues that the use of scientific methods is a highly powerful way to create an argument, in part, because it denies its own political affiliation. In her study on small-scale corn producers in Mexico, Fitting (2011) found that a lack of training in scientific language and methodologies excluded small-scale farmers from conversations about government policy. The farmers' inability to adapt to the form of the conversation effectively excluded them from the decision making process involved in creating government conventions whose implementation directly affected their interests (Fitting, 2011).

Scientific knowledge is often portrayed as being objective, rational, and above the subjective interpretations that are often attributed to other, *non-scientific*, ways of knowing. On the other hand, many scholars argue that calling something "objective" merely helps to hide its political affiliations (Fitting, 2011; Freidberg, 2007; Smith, 2009; Whatmore, 2009)[7]. The cataloguing of scientific information is representative of a specific form of understanding and conceptualizing of the world which privileges certain discourses over others (Law, 2004). This belief about objectivity and "objective information" has a profound effect on how development projects are shaped (Shepherd, 2006). As mentioned, part of the effect that scientific methods have is to make arguments which appear apolitical (Star & Griesemer, 1989). For scientists, having the

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[7]I do not have the scope in this project but I think it would be interesting to compare the results from this project with researcher at other CGIAR research centers as well as at private companies. It would be interesting to see how interpretations and evaluations of the IWIS's functionality vary between these places. There is research that shows that when large scale projects like this happen the inputs are often regionally specific and useless to others involved in the program (Brooks, 2010).

ability to assert authority over topics which appear apolitical gives their language strength in political arenas. The language of science is able to reframe political discussions as technocratic ones (Jansen & Roquas, 2008). Jansen and Roquas (2008) found that, in international plant biodiversity conferences, political decisions were re-classified as technocratic ones, in part, through the use if international expertise (Jansen & Roquas, 2008). By reframing the issue as a technocratic one the form of the debate and the social arena in which it is handled become very different.

Science is one powerful form for making political arguments but there are other social forms which inform or influence what people think about when they think scientifically. The forms used to explain, understand, and apprehend social phenomenon have many far reaching consequences. This relationship between ideology and practice stretches to almost any manner of social interactions that might be re-framed, in this instance, around agricultural conversations. Kloppenburg (1998) argues that one such influence is capital (i.e. through business investments, bio-prospecting, public private partnerships). He argues that, over time, agricultural sciences have increasingly subordinated to capital and that this ongoing process has shaped both the content of research and necessarily, the character of its products (Kloppenburg, 1998). For him, it is impossible to see the benefits of one form of development (in this case improved seed quality) without putting them in a framework that includes other social implications as well (Kloppenburg, 1998). Having an investment in large scale agricultural research centers also necessitates an investment in capitalist economic principles because it is through those capitalist economic principles that large scale agricultural research centers' goals and ambitions make sense. Some researchers argue that this method of

development is contradictory as it is those same capitalistic principles which are helping to create the inequality in the first place (Brooks, 2010; Enserink, 2008; Kloppenburg, 1998).

Before going further I think it is important to dissect the meaning of information and the verb inform as they relate to Thevenot's (1984) ideas about forms. The Oxford English Dictionary (OED) defines *inform* as the "process of shaping the mind" (2012). That is to instruct, teach or somehow impart knowledge or information. Like a very literal reading of forms (shapes or objects) the process of transferring information is one that shapes the mind of the recipient. Information, according to the OED (2012), is the "shaping of the mind or character". Inform is a verb—an active process where as information is a noun—a static statement referring to the character of what it is that is being imparted. Interpretations of forms are subjective. They are also dynamic. What one form means today may vary highly with its future significance. This dynamism speaks to the character of forms as attempts to standardize human interactions (Star & Griesemer, 1989). At the same time that human relationships change and develop through time and across space so too do the forms that we use to communicate with each other. In order for a form, like units of time, to survive the changing geopolitical landscape it must be extremely durable and adaptable across contexts (Thevenot, 1984). That is to say, in order for a form to achieve semi-permanence it must be incredibly flexible and situationally relevant.

This situational flexibility is something that ideas must harness in order to maintain salience through time and across space. As I mentioned, Kloppenburg (1998) believes that scientific research is increasingly being subordinated to capitalism. This

subordination of scientific insight to a capitalistic worldview is a topic which many researchers feel we can see in the actions of developmental projects (Brooks, 2005; McAfee, 2003; van Dooren, 2009; among others). McAfee (2003) argues that forms of interaction in agricultural sciences based on models of capitalism exaggerate the achievement of biotech firms. Patent law requires that applicants can demonstrate how their product significantly differs from a competitor or what is found in nature (McAfee, 2003). McAfee (2003) argues that this focus on demonstrable differences over emphasizes the achievements of biotech firms because they can more easily be seen to actively and consciously be doing *work* on specific seed varieties. In order for the category of what is patentable to make sense there also has to be a category of what is not patentable. Landraces, crop varieties that have not been improved through conventional research facilitates, fall into the category of un-patentable. McAfee's (2003) argument is that landraces have been worked on for millennia by local producers but the *work* that local producers have done to refine their varieties is not quantifiable and identifiable in the same ways that are meaningful to capitalist modes of understanding. To McAfee (2003), this model of understanding has two consequences. It exaggerates the achievement of biotech firms (who are building off the work started by small scale producers) and it implies that social welfare is achieved through the market (McAfee, 2003). This type of thinking is prevalent in the USA right now. Mitt Romney, in the first presidential debate of 2012, argued that it is the private sector that will improve healthcare in the USA and that the government should allow the market to promote the wellbeing of the population (Romney, 2012). It remains to be seen if this assertion that the market will help attain social wellbeing is true but the example points to the very

political nature of the debate.  Scientific methods are being used to support political

ideologies (and vice versa) in such a way that it is hard to disentangle the two.

The adaptability of forms is a characteristic that is vital to their continued survival

(Thevenot, 1984).  Brooks (2010) found that, in the case of bio-fortified rice, a strictly

economic based approach to solving a food crisis was not accepted by local populations. [8]

For example, vitamin-A deficiency is a huge problem in Asia.  Thousands of people go

blind every year due to it (Waltz, 2009). In an attempt to put a stop to the problem,

international researchers came up with the idea of bio-fortification.  This is when plants,

in this case rice, are genetically modified to  contain amounts of a substance that is

desirable to a population (Brooks, 2010).   The rationale for bio-fortification was

explained through simple economic reasoning, ignoring social circumstances;

malnutrition was reduced to nutrient deficiencies, not problems of inequality and access

to resources (Brooks, 2010).  This reduction, while adequate for researchers, was not

adequate for the populations for whom the rice was intended (Waltz, 2009).

Golden rice, as it was called, was ultimately a scientific breakthrough but met

harsh criticism from the public and groups like Greenpeace (Waltz, 2009).  No one would

eat it.  At this stage in the debate about agricultural development policies, Genetically

Modified Organisms (GMOs) do not have enough traction politically to be seen as an

acceptable solution to the problems of nutrient deficiency.  Protesters preferred

explanations and, by extension, solutions that had to do with wealth distribution and

government intervention into domestic feeding issues (Brooks, 2010).  This case is also

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[8] When I use the word economic in this context I am not referring to the profit motive but
to a logic that uses "accounting" type explanations for problems.  Malnutrition framed as
a nutrient deficiency is an economic argument because it classes the problem in terms of
a quantifiable numerical assessment.

demonstrative of Kloppenburg's (1998) argument that capitalist thinking has subordinated crop research. Producers are recast as consumers (vying for the new rice variety) and complex needs are transformed into demand for a predetermined product (Brooks, 2010). As I mentioned above, forms take on this temporal quality where, as part of their construction, their use aids people's claims to understand historical events. The effect of this claim is that it allows people to then say that their present day actions can affect the trajectory of perceived social or scientific issues.

I feel that involving a narrative about the past which connects to the future through the actions of the present is vital to understanding the way that forms of interaction develop. CIMMYT's mission is founded on a belief that in order to meet the demands of present and future food requirements, what is needed is higher producing grain varieties (CIMMYT.org, 2011).[9] Kortright (2011) identifies what he calls doomsday scenarios used by agricultural researchers in an attempt to describe this temporal relationship. These "doomsday scenarios" are future scenarios where, due in large part to overpopulation, famines threaten much of the world's human population (Kortright, 2011, p.2). CIMMYT's mission is founded on a belief that in order to meet the demands of present and future food requirements, what is needed is higher yielding grain varieties (CIMMYT.org, 2011). This is based on a Malthusian view of the world's economies whereby overpopulation, and the subsequent strain on food resources, is the root cause of human misery (Ross, 1998). Seen in this light, expertise or the mastery of scientific processes is akin to having the ability to see into the future. The implication of

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[9] In this paper I refer a lot to high yielding varieties of wheat. CIMMYT works extensively on disease, drought and pest resistance as well as yield. The first three characteristics are essential parts of the third so when I talk about "yields" the use of that term implies disease, drought and pest resistance as well.

this is that the expertise also grants the scientists license to do what they deem necessary in the present to combat these horrible future events.

Ross (1998) argues that the reasoning behind these types of futures is based on flawed logic. Brooks (2011), Kortright (2011) and Ross (1998) see global agriculture focusing on symptoms of a problem but not actually targeting the root causes. Global inequalities may not appear as a result of overpopulation but rather as a complex series of factors related to the unequal distribution of resources in a market based economy (Brooks, 2005, 2011; Enserink, 2008; Kortright, 2011; Ross, 1998). These are very different interpretations of how to think about development and social change. These interpretations have implications on the types of actions that people take in their attempts at resolving problems of social inequality (Brooks, 2010). By looking at the International Wheat Information System (IWIS) as a form of action we can gain some insight into how it is that CIMMYT does development in order to gain a better idea of what it is that development means to CIMMYT. This subject is especially pertinent given all of the criticisms of international agricultural development (i.e., Brooks, 2005; Ross, 1998; Shepherd, 2006; Waltz, 2009; to name a few).

**Investment in Forms**

In the preceding section I have attempted to outline some of the main issues that arise in the creation, use, and maintenance of specific forms of communication and interaction. Any given form implies a specific set of relationships and standardized interactions between people, objects and ideas (Star & Griesemer, 1989). In this milieu there is the potential for innumerable combinations of ideology, political motivation, truth making

and justification for actions. Thinking about this last item, the process of taking action is a process of *enacting* realities (Law, 2004). As I have shown, the forms used to transmit and express ideas contain subtle aspects and facets which affect the implications of the reality that is being enacted. Beyond the power of the ideology threaded into the forms of interactions that communities use there is also a secondary type of authority that needs examining. This is the authority of one form over another. Science offers one explanation for how the cosmos has come to be; religion offers another. While these two explanations need not be competitive they are often discussed in a way that presumes them to be mutually exclusive. I take the stance that forms are not mutually exclusive but that they can, at times, be in direct competition (Brooks, 2011). In the following section I will look at forms as investments and tease apart the costs of selecting one form over another. I argue that the IWIS's from speaks to a specific set of investments in how wheat ought to be imagined and that by understanding the IWIS's from we can gain some greater understanding of the ideas in which agricultural research is invested.

For Thevenot (1984), an investment is a costly operation to establish a certain relation within a lifespan. His example is a patent. When someone buys a patent they have a relationship with a product for a certain length of time and that relationship immobilizes some aspect of their portfolio (Thevenot, 1984). What that means is that by tying up some assets with a specific product it then becomes important to the investor that that product does well. That is to say, they are invested in its success. In social relationships this investment has less to do with actual monetary capital and more to do with social capital. As university students we have an investment (years of training) in our field of study. This investment might affect our future choices of employment

because, for example, a high level university arts degree might not serve as an entryway into the resource extraction industry in the same way that an engineering degree or a skilled trade would. Through this example I hope to illustrate that the investments we make, as individual or as communities, have effects on the outcomes we may later experience.

In deciding which forms to utilize there are some that will gain precedence over others. This tendency is part of the decision rational when electing to use one form over another. When one chooses to use miles vs. kilometers in a conversation they are saying something very specific about the audience they want to reach and the ideas they wish to communicate. In this sense, forms are involved in a type of competition. Enserink (2008) argues that because competition focuses resources on, for example, agricultural development vs. other development modes the differing resource allocation interferes with the development of other forms. Enserink's (2008) example is one of public goods. He argues that, in the case of golden rice, the public has rejected this so called public good (Enserink, 2008). The development of golden rice, for Enserink (2008), has come at the expense of other forms of development that focus more on social problems that are having the effect of interfering with people receiving adequate nutrition. [10] For him, the matter is one of resource allocation. Development agencies have a limited amount of resources and a high investment in agricultural science means a reduced investment in

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[10] I must re-emphasize that forms and our investments in them are not static and unchanging. The meanings that are attributed to them and the ways that they are employed are in a constants state of flux. It is precisely the adaptability to that flux, as Thevenot (1984) points out, that makes particularly resilient forms, like standard time, so strong and long lasting. I see forms as being about making ideas and thoughts mobile. They allow knowledge to be packaged and moved across contexts. This is different from structure, which has been used in the past to describe certain underlying, unchanging parts of a system (i.e., class structure)

other types of public goods.  Enserink (2008) is asking us to rethink what we mean when we talk about public goods.  I think that the term "goods" has two meanings.  The first is obviously the way in which research agencies think about it—as an action or objective that is in the interest of the general wellbeing.  The second meaning, one that I believe Enserink (2008) is driving at, is that the outcomes of public institutions are increasingly seen as consumables.  Seen this way, seed varieties are much easier to quantify than other types of social interventions.  It is much harder to quantify and display things like education, market policies or other social interventions.  Another way to see public goods, and the way that I use the term in my paper, is to signify a selection of ideas and products that are freely available to all that can be used as they see fit.

One critic of agricultural development, Michael Cernea (2005), argues that in order for the research products within CGIAR centers to be effectively utilized there must be greater input from qualitative social scientists.  In 2000, CGIAR centers laid out a plan that pointed out the importance and relevance of social scientists to its endeavors (Cernea, 2005). By CGIAR's own assertions, a new form of development, one with greater social science input, is needed to help continue the work that CGIAR has started.  Cernea (2005) does not feel that this is happening.  He argues that the CG centers' tradition of breeder centrality has made it such that no clear path for incorporating social scientists into the centers has been developed.  Social science adds cognitive value to the products of CG centers (Cernea, 2005).  The work is not just about creating high yielding crop systems but about how to encourage their application to high yielding human systems (Cernea, 2005).  In CIMMYT, where I did my field work, there was only one anthropologist on staff.  Cernea (2005) argues that the situation in CGIAR centers is as a

result of the weak institutionalization of social research. It is under staffed and underrepresented, underfunded and under accepted. For him, the high investment in crop science has come at the expense of greater development of other forms of development that place a greater emphasis on social science.

In contrast to Cernea's (2005) view of development science and its direction is one put forward by Fernando (2007). Fernando (2007) argues that Cernea's (2005) argument is altogether of the wrong proportion. Fernando's (2007) view is that perhaps changing the structure within CGIAR centers is not as important as looking at the CG as a whole and understanding how it, as an organization, is positioned in such a way as to be negative to the poor. What this means is that changing some of the internal forms and relationships within CGIAR centers to place greater emphasis on social science will not, in Fernando's (2007) mind, affect the overall direction of the organization. The model of development that is advocated by the CG group will still be one that negatively affects poor populations by encouraging them to take part in a system of relationships that is ultimately going to affect them negatively (Fernando, 2007). Development agriculture, as it is conceived at in the CGIAR, is a form of development that is modeled around a set of relationships which values capital accumulation and competition over cooperation and equitable redistribution (Fernando, 2007).

**Forms as an Exercise of Power**

The tension that arises over the use and salience of different forms of development is especially interesting in democratic countries because of accusations that some forms of development are part of an *apparatus* of power and governance that defy democratic

ideals.  In this argument I borrow the definition of apparatus as it is described by

Foucault (1980):

> …a thoroughly heterogeneous ensemble consisting of discourses,
>
> institutions, architectural forms, regulatory decisions, laws, administrative
>
> measures, scientific statements, philosophical, moral and philanthropic
>
> propositions–in short, the said as much as the unsaid. Such are the
>
> elements of the apparatus. The apparatus itself is the system of relations
>
> that can be established between these elements. (p.194)

It is this definition which Feldman (2012) uses in his argument about what he

calls the European Union's (EU) migration "apparatus" (p.15).  He explores various

bureaucratic agencies and departments in the EU to understand their workings.  Feldman

(2012) further explains that these diverse bureaucratic elements coalesce in times of

crisis.  The notion of coalescence is important to anthropologists, as ethnographic

explorations of the various apparatuses almost *require* the sustained coalesce of the

elements which lead to structuring the apparatus.  As Kortright (2011) describes, many

development personnel feel they are in a constant state of crisis due, in part, to

"doomsday scenarios" which inform their motivations for work (p.2).  Many researchers

argue that a structure (in this case a development structure) formed as part of a larger

apparatus of social structuring runs the risk of being accused of being undemocratic as its

un-elected elements have the power to exert authority  and certain types of governance

over populations (Brooks, 2010; Fitting, 2011; Freidberg, 2007; Jansen & Roquas, 2008;

Mitchell, 2002; Shepherd, 2006; Smith, 2008, 2009). Being part of a structure of power like the apparatus I have just described puts researchers in the uncomfortable position of being able to make decisions which affect populations in an undemocratic way (Jansen & Roquas, 2008).

As I have shown, the forms that development takes are hotly contested. There are myriad reasons for this contestation but the main thing I want to express is that in selecting a methodology with which to apprehend a problem we are also enacting a reality (Law, 2004). This reality that we enact has implications for the way that the past is perceived and how actions taken in the present will affect the future (Kortright, 2011). The second main idea that I have expressed is that developing forms is a costly process which requires significant resource investment (Thevenot, 1984). The third point that I want to cover is how, taken together, the enactment of reality and the use of resources are an exercise of power between groups (Star & Griesemer, 1989). Star and Griesemer's (1989) idea of "boundary objects" (p.392) is useful to explore how authority is exercised through the advancement of specific forms. As stated above, the standardization of methods emphasizes one methodological approach to tackling an issue at the expense of other approaches. As I mentioned earlier, standards allow groups who might have ideologically different stances to divert focus from the "whys" that separate their opinions to "how" (Star & Griesemer, 1989).[11] This emphasis on the "how" in research depoliticizes why certain methods have been adopted and allows for the methodology to

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[11] Star and Griesemer's (1989) example is of how amateur scientists, farmers and environmentalists can be convinced of a particular way of recording data for a museum. These allies might not relate to the reasoning behind these methodological standards (for greater scientific accountability and use value) but are able to adapt those methods to their own motivations (i.e. conservation, interest, cash rewards).

act as a "boundary object,,,[an] anchor or bridge" between groups (Star & Griesemer, 1989, p. 414). These boundary objects, or methodological approaches to a process, help to develop a state of relations between objects (á la Thevenot, 1984). Power is exercised by having mastery over the methodological approach used in the form (Hetherington, 2011a).

To explain how power works in this way I will provide two examples from two different areas. The first is from super markets and the second is from a land tenure system. To expand on how supermarkets exert power I first want to expand a little on the way in which governments spread their rule. Governments are akin to standards agencies because they have the ability to affect how institutions/agencies/businesses under their control interact. Governments set standards and best practice policies which industries within their jurisdiction must follow in order to exist in accordance with the law. Freidberg (2007) argues that supermarkets also act in a similar way by setting their own best practices frameworks. Although not backed by government support, supermarkets in England were able to implement their own best practices protocol by acting as a group and providing producers with quite a severe ultimatum—if the producers would not produce items in accordance with the chain's wishes they would lose their customer base (Freidberg, 2007). Supermarkets framed these best practices as being best for consumers because it allowed consumers to have greater control over the quality of the products they were purchasing (Freidberg, 2007). The qualities of products include the taste and freshness but customers were also assured that their products were being grown or manufactured in locations where workers were receiving a reasonable wage and acceptable working conditions (Freidberg, 2007). Authority over how products should be

grown was harnessed by the supermarkets with no public consultation whatsoever.  Many

of these policies were implemented in countries outside of England (if local producers

were selling to British supermarkets).  When a foreign non-governmental body starts

dictating working conditions some researchers feel that this leads to the charge that, in

some sense, these standards are leading to the advancement of imperial interests

(Freidberg, 2007).  By controlling the methods used to create and deliver food products

the supermarkets were exerting a type of undemocratic governance over producers.

The second example of how authority is exercised through a particular form of

interaction comes from Paraguay.  The Paraguayan cadastral (land tenure) system is

exemplary of how forms of communication come to be used in competition between

groups. This example of negotiations of power through state apparatuses comes from the

work of Hetherington (2011a, 2011b).  Hetherington's (2011a) focus is on campesino

groups in Paraguay and the way that they negotiate interactions with agents of the

government's land cadastral system (Hetherington, 2011a).  In this usage the term

campesino is a "…*structure of aspiration* building on Raymond Williams's "structures of

feeling (1977)" (Hetherington, 2011a, p.31, emphasis original).  This framework for

naming campesinos as a structure of aspiration versus a demographic category is useful

because it is tied directly to how peasants in Paraguay frame themselves in relation to

their potential for social and geographic mobility.

Hetherington's (2012) focus is on how the Paraguayan government promotes a

policy of *transparency* in land tenure by providing more *information* about an issue.

Hetherington (2011a) argues that what the Paraguayan government is doing when it says

it is "creating more information" (p.158) is actually acting as a translator, discarding old

inefficient systems of knowing in favor of new ones.  In the case of the Paraguayan land

system, this means discarding old, *subjective* ways of measuring and determining land

ownership in favor of a unified system which can be used as an *objective* measure of land

rights.  The intention is that more *information* will equal less conflict in land disputes.

Hetherington (2011b) is critical of the cadastral system because although it may appear to

be a more efficient way with which to deal with land disputes it does nothing to address

the underlying inequalities which generate those disputes in the first place.  In fact, one of

the most poignant characteristics of the cadastral system is that it increases the

Paraguayan government's control over how land is allocated, used and monitored

(Hetherington, 2011b).  In this sense we see the bureaucratic apparatus which controls the

land rights of campesinos strengthening over time by framing itself as more and more

transparent (Hetherington, 2011a, 2011b).

What is clear in the preceding examples is that the use of forms is an exercise of

power between groups.  In both cases we see forms being used as a type of governance.

One example comes from a government's actions and one from the private sector.  What

these cases illustrate is that the exercise of power comprises a form of governance which

is more diffuse and more pervasive than the work of governments (Smith, 2008). Seeing

the use of forms in this way is important to this argument because only by understanding

forms as exercises of power and authority between groups can we make their analysis

relevant.  In development, this is especially important because of the way that

controversies have been mapped onto the different forms of action which that

development can take.  Whatmore (2009) calls controversies "generative events" (p.592)

because they are when a swarm-like movement focuses attention on areas in order to

build new understandings.  For example, when Golden Rice was released, people paid attention to see what would happen and the global community took note of the reaction to it.

The IWIS is a tool which, its designers hope, can be used worldwide.  This hope is linked to the belief that CIMMYT has enough social traction for its ideas to set the standard for how people think about wheat.  Barry (2006) argues that a space within which  "…differences between technical practices, procedures and forms have been reduced, or common standards have been established" can be called a "technological zone" (p.239).  The technological zone occupied by standard time (minutes and hours) stretches almost the world over.  There may still be areas that conceptualize time slightly differently but in general these are the units that people use.  As I will show, there is very little agreement between departments at CIMMYT as to what constitutes good or useful wheat information.  What people do agree on is how important certain departments' information is to the work that CIMMYT does.  By looking at the IWIS I will demonstrate that the form of development that CIMMYT has adopted, one focused on breeder centrality, has affected the way that internal information systems have been conceived, developed, and implemented.

**Chapter 3: Access**

About my fifth day in Mexico I found myself stepping off a bus on the side of the highway outside of Texcoco. I had an appointment with a contact in the communications department to talk about my summer plans and my aspirations to work at CIMMYT. As I approached the gate I was struck by how many guards there were waiting outside of the little entrance to CIMMYT's main grounds. I approached cautiously and said hi. The guards made me stand to the side as they asked me who I was, why I was there and who I was going to see. The experience made me quite nervous as it made me think about my purposes and my place. I was a broke grad student who had flow down to Mexico in order to try and find out something about a wheat information system. I was back in the country of my childhood and needed to build comfort and confidence in my Spanish skills. I had no assurances from CIMMYT that I would be able to conduct my research. I had not even adequately finished my proposal to the department at my university so that I was in a position to ask CIMMYT for those permissions. I was frightened that after all of the time and effort (not to mention money) I would not be granted the permission needed to conduct my study. I was afraid that I would have no access to the information which I needed to move on in my project, my program, my life.

My father worked at CIMMYT when I was young and, as a result, he maintained some friendships there. One of those people, who would become my friend as well, had agreed to assist me in getting into CIMMYT for the summer. The security guards called ahead to my CIMMYT contact and, satisfied that everything was in order, let me pass on into the CIMMYT grounds. Every morning for the first few weeks I had a similar encounter with the front gate. It took time for the different rosters of guards to know my

name and to feel comfortable letting me through. This experience was one of my first interactions with an organization whose job it was to control inputs.

Like scientists trying to control for variables in their experiments, the physical structure of CIMMYT was also designed around controlling inputs. For those on the inside this makes perfect sense because in order for valid scientific research to occur, there need to be known variables which must be tightly controlled in order for results to be meaningful. Interestingly, after the first few days I would pass by unchecked, once the security guards had written down my name. They would only interact with me to find out what my name was and then I was free to pass. I felt our interactions were quite cool, especially when I compared them to the way the guards reacted to a Mexican man who arrived behind me on my first day. He received a warm smile and the hand slap and fist bump that was a common greeting among Mexican men during my stay. On the other hand, like the guy who arrived behind me, many of the Mexican would-be-entrants would be detained for much longer while their admission was authorized. This slight distinction between myself—greeted coolly but admitted freely and the Mexican men—greeted warmly but admitted with tighter scrutiny started me thinking about what access is and how it is monitored at CIMMYT.

This theme of access has many potential variations at CIMMYT. It is an organization that is trying to promote food access for poor populations. As mentioned above, CIMMYT also implements security practices which limit certain people's access to its land holdings. The IWIS, which I was here to study, was promoted as an

information-sharing[12] venture. It was imagined as a means to provide CIMMYT's

partners with access to their crop information. In this way we can start to see access as a

type of relationship. The forms of action involved in contact speak to larger sets of

relationships (Thevenot, 1984). CIMMYT partners could access CIMMYT resources and

non-partners would not have access to these resources. I started to see access as a way to

think about the IWIS. Thinking about the IWIS in terms of access is helpful because of

the way in which the form of the IWIS has been shaped around the different groups

whose access has been prioritized, accepted, or denied.


**History and the Importance of Classical Breeding at CIMMYT**

To expand on the idea of access as it relates to the example in CIMMYT I would like to

first provide a bit of background about some of the key moments in the history of

agricultural development as it is conceived at CIMMYT. The establishment of state level

relations had a large influence in agricultural development. Farming practices in parts of

Mexico have changed from traditional, small-scale, subsistence farming in the pre-war

era to large-scale, cash crop operations during and after the Green Revolution. I argue

that by looking at border relations we can start to see the development of those state level

interactions and get some sense of the effect that those interactions have had on

agriculture.

Migration for wage earnings from Mexico to the USA started in the 1800s and

was fueled by expansion in the railways and in the copper mining industry (Heyman,

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[12] In this context sharing is the cooperative construction of searchable data bases.
CIMMYT hoped that its partners would make use of its data bases and add to them by
retuning completed field books—something I will come to later.

1990).  This migration was fairly consistent until the depression.  During the depression many Mexicans stopped migrating and stayed on their home lands concentrating on subsistence farming because there were no wages to be made in the US (ibid).  Mexicans who were already in the US fared differently than those remained in Mexico.  In some cases, the companies that migrants had been working for repatriated them back over the border.  In other cases, migrants who had settled in the States were discriminated against and many of them were forcefully relocated back across the border by the communities to which they had migrated  (ibid).  They returned to smallholdings retained by family members and continued subsistence farming relying on traditional crops such as local maize and bean varieties (ibid). As the USA started to strengthen its own self-image as a nation it also spread that image to other countries by treating with them as nations.  Another signal to the changing times was that worldwide passport use started to grow in usage in the early 1900s, around WWI (Löfgren, 1999).  On the US/Mexican border this meant limiting Mexican access to the US's territories.

This strengthening of the border continued during the depression until a larger world even started to have greater impacts in the USA.[13]  During World War II the Mexican/US border became permeable again in a new way.   The Bracero Program was started in 1942 as a war labor program (Heyman, 1990).  Braceros, which means "strong arm" or laborers, were allowed entrance to the USA to work in various manufacturing and agricultural sectors to help the Allies win the war.  The success of the Bracero Program let to its continued use until 1964.

[13] Typically I will refer to the United States as the US or the USA.  I avoid using America as many Mexicans and Canadians feel this term gives the US too much dominance in relation to the continents occupied by many other nations.

As new relationships were forged with Mexico different facets of inter-state cooperation and interaction started to take place. The Mexican Agricultural Program (MAP), which developed into CIMMYT, was started before WWII ended.  The MAP was started in 1943 as a crop improvement initiative.  The Ford Foundation initially funded the MAP and was aided in this venture by the Rockefeller Foundation. Agriculture had been reimagined as an essential element for US foreign policy (Brooks, 2005).  There was a concern, articulated through private organizations like the Ford and the Rockefeller Foundations, to expand US markets into developing countries through integrated policies aimed at enhancing trade and investment (Brooks, 2010). The two foundations helped to start the Green Revolution in agricultural production by funding institutions like CIMMYT, which was imagined as a place that would provide international level research for people in developing countries (Chandler, 1982; Smith, 2009).

This model of development evolved into the Consultative Group on International Agriculture (CGIAR) which now has institutions spread through Latin America, Asia and Africa.  These institutions have changed the face of agriculture (Smith, 2009).  Between 1965 and 1970, wheat yields more than doubled in India and Pakistan due in large part to the work of Dr. Norman Borlaug, a researcher at CIMMYT(Brooks, 2010).  Borlaug had started his career in Mexico working with the MAP before moving to CIMMYT when it was started in 1963 (CIMMYT.org, 2011). He won the Nobel Peace Prize in 1970 for his work on promoting food security. Borlaug's work was dedicated to breeding dwarf varieties of grain which, although requiring greater resource inputs, have the ability to vastly increase crop yields.   Before concentrating on grain production in India and

Pakistan, Borlaug and CIMMYT had increased Mexico's wheat production 6-fold (Hickman, 2009). Through his work at CIMMYT, Borlaug is credited with saving millions of lives in the developing world because of the increased wheat yields he bred.

I heard this narrative echoed back at me everywhere at CIMMYT. It came from the people, from the newsletters, from the walls. At the central entrance to the main building there is a newly erected statue of Borlaug along with a plaque commemorating his Nobel Prize. Similar statues have been commissioned to be sent to various centers around the world. On the walls of the buildings there are photos of him standing in afield, clipboard and pen in hand, recording the characteristics of the wheat surrounding him. Govindan Velu, a wheat breeder told me "…CIMMYT has a long history with wheat breeding. Norman Borlaug started in the 1940's and the purpose of his research at that time was to develop wheat lines with stem rust resistance, he came with another fellow here and initiated the Mexico global wheat project". For Velu, the name Borlaug is almost synonymous with wheat breeding. A Japanese ship builder, appreciative of Borlaug's work, paid for a commemorative plaque emblazoned with the quotation attributed to Borlaug:

> No matter how excellent the researcher done in one scientific discipline,
> its application in isolation will have little positive effect on crop
> production. What is needed are venturesome scientists who can work
> across disciplines to produce appropriate technologies and who have the
> courage to make their case with political leaders to bring these advances to
> fruition.

For Borlaug, wheat breeding was not just about scientific achievement but about harnessing the power of scientific potential to help change the Earth's political landscape for the better (Hickman, 2009). Development was then a lens for seeing scientific achievement advancing co-currently with social justice. The particular form of scientific advancement which he advocated was strengthening food security through plant breeding (Hickman, 2009).

CIMMYT's identity is almost inseparable from Borlaug's because they have had such a close relationship in the past. As noted above, Borlaug, as the head of the wheat department, changed the face of modern agriculture through his work at CIMMYT (Brooks, 2010). CIMMYT, on the other hand, uses Borlaug's face and his legacy as totems to promote their organization, goals and ideals. The connections between Borlaug, classical breeding and CIMMYT are such that they have all started to become synonymous with each other. This connection could be quite frustrating to departments who did not fit into the image of classical breeders.[14] For example, I overheard a conversation between a wheat physiologist and a breeder where the physiologist was complaining that he had to continually fight the impression outside of CIMMYT that CIMMYT was only involved in classical breeding.

> I have never been a classical breeder; we have entire departments
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> dedicated to research that are distinct from breeding yet still people tell me
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> that all we do at CIMMYT is classic breeding. I suppose it does not help

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[14] Physiology can be considered a type of breeding which is much more qualitative and takes into account many more plant traits. For the purposes of this I will use "breeding" to denote classical breeding, which is the selection of plant crosses through characteristics observable through the naked eye.

that we have Borlaug's face plastered all over our promotional material.

We need to change this image of us a strictly classical breeding center.

(CIMMYT physiologist, July 28th, 2012)

The frustration at being labeled a breeder was apparent because it diminished the importance of the physiology department but, more importantly, it made them have to work harder at promoting themselves to donors in order to access funding. Access is the key theme because how access to funding is mediated at CIMMYT is dependent on many variables and power differentials within the organization and with CIMMYT's relationship to outside donors. Seeing the physiologist's frustration at the image of CIMMYT and his own department's disjuncture with that image is demonstrative of some of the tensions that arise from the relationships and expectations implied within the organization structure. His frustration is an evocation of his own sense of disempowerment. It is in situations like this that we can see the enactment of power within CIMMYT's walls.

**Pedigree Tracking and the Differences between National and International Staff**
When I first arrived at CIMMYT's front gate I was not only about to enter the compound, I was also about to enter into a social situation that had many established relations of power. One of the most apparent relationships was the difference between national staff and international staff. CIMMYT, as well as other CG centers, are conceived of as locations that would bring top level international expertise to bear on the problems of the developing world (Chandler, 1982). The image that this conjures is that the "best of the best" get drawn from the entire world and are pulled together to work on issues that have

international importance.   Local staff is involved because they are drawn to these centers to work in supporting roles to the international staff.

Peter Redfield (2012) has explored some of the tensions that arise in situations where groups of expats congregate for development purposes.   His study on Doctors Without Borders looks at how perceptions of "the local" and of "the international" employees are created through development schemes.    He argues that in situations of international migration where people move to aid regions in development, health care or economic recovery, there are often tensions that arise between international and national populations (Redfield, 2012).  Tied to Redfield's (2012) examples are notions of exceptional volunteerism (international workers) vs. paid labor (nationals) and how these two labor categories are valued differently.  At CIMMYT, I did not encounter the ideas contrasting volunteerism as all of the international staff members are full time employees. I did encounter some tensions to do with pay rates, potential for advancement, and language use.

In my first few weeks at CIMMYT I started having lunch with a Mexican MA student who I will call Alberto.  Alberto and I were talking about the difference between national and international staff.  We discussed salary differences (which are huge) and the different ways that each labor force is perceived.  Alberto mentioned to me that there was only one Mexican person working at CIMMYT in Mexico that was considered "international staff" in terms of pay and the associated benefits.  Alberto told me there were Mexicans working abroad for the CG but in Mexico there was only one scientist who held that rank.  He thought that this was a bit ridiculous—especially considering there were many Chinese, Germans and Americans hired as international staff in Mexico.

For Alberto, there was some tension with the idea of international staff because their work was valued on a different scale than that of Mexican workers. As an international student, this tension worked in my advantage in some ways.

As a foreigner I was immediately given a certain degree of status in CIMMYT. Generally foreigners have greater control over the CIMMYT grounds and receive greater access to positions of power at CIMMYT. Due to this, and to personal connections that I have through my father with CIMMYT employees, I believe I was granted access much more readily than would have been the case had I been Mexican. As noted above, the man behind me at the gate, although known to the guards, was detained for much longer, while I, a relative stranger, was allowed through with minimal inspection. The Mexican guards' historical relationship with international staff, and my nominal links to that staff, opened doors for me very easily. For the man behind me at the gate, a related combination of associations was at play with his trajectory through the gate. A historical relationship with Mexican nationals, and the man's nominal links to the staff, opened doors for him but with greater friction and less assurances.

This conversation starts to sound like a conversation about race. I want to avoid making distinctions about race because I have not focused on how race plays a role at CIMMYT. When I say international bodies I mean people who are easily identifiable as being different from Mexicans. White, Asian and African bodies are generally easily identifiable as non-local or non-Mexican. It may be that there are perceived racial distinctions between these groups within CIMMYT staff but I have not heard those types of narratives. My focus here is not on how race plays into power at CIMMYT but how other characteristics such as nationality or educational potential are talked about. What I

heard were comparisons between national staff and international staff, Mexican and non-Mexican. To that end I see pedigree, and not race, as a more useful concept to describe power relationships at CIMMYT.

I argue that international staff, and by extension the bodies of international people, due to a historical association with the place, have greater and easier access to CIMMYT resources. You might say that international bodies, by virtue of their relationships, connections, and opportunities for educational advancement demonstrate a better *pedigree* for selection in positions of power at CIMMYT. Similarly I argue that wheat breeders, as opposed to other groups within the organization (e.g. physiologists, conservationists), due to a historical association with the place, have greater and easier access to CIMMYT resources because of their demonstrated characteristics. Again, the analogy with pedigree here is unavoidable. Wheat breeder centrality is a key issue to accept in order to understand the social relations at CIMMYT.[15] The relationship between Borlaug, CIMMYT and classical wheat breeding is imperative to understanding this centrality. The crops developed at CIMMYT became part of the spearhead for the Green Revolution (Brooks, 2010). The importance of CIMMYT wheat breeders, in terms of global relationships with crop management, needs great emphasis. It is this legacy which has shaped the much of the wheat departments internal structuring.

Pedigree data is the information about the lineage or parentage of the crop in question. Wheat is a self-pollinating crop. This means that one plant in isolation can pollenate itself and reproduce. Essentially, it can clone itself. A clone is created with no

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[15] It may be that relationships within the maize department vary quite differently from the wheat department. It was explained to me that maize is a crop that is easily hybridized and therefore maize geneticists, for example, may have greater access to resources than in the wheat department. This argument about breeders is limited to wheat breeders.

introduction of foreign genetic material. A wheat plant can also be pollenated by another

plant. If two plants are nearby to each other it is possible for one plant to pollenate the

other. The resulting offspring will be a cross of the two parents. What wheat breeders

do, in a very simplified way, is select plants whose characteristic they like and cross them

with other plants that have favorable characteristics. The hope is that the offspring of that

cross will inherit the favorable characteristics from both parents. Breeders hope that the

offspring will express the traits they are selecting for. If I were to cross a dwarf variety

of wheat that has low yield with a taller variety that has a high yield I could hope to breed

an offspring that expresses shorter stems with a higher yield.

Every year, individual breeders cross hundreds or thousands of different pairings

of wheat plants and then evaluate them visually by walking through their fields and

noting what characteristics they can measure with the naked eye. For this to happen

effectively there are some data management problems to overcome. The first one is a

clear awareness of which plants are being crossed and what characteristics each of those

plants have. The second data management problem is having a system to which the

information recorded in the field can be fed into, after having crossed each pair. The

system has to be able to apply naming conventions to the plants and also link the

information gathered about each plant to the name given. Genealogy is the analogy that

breeders use to accomplish this process. Plants are given names. Let's say we have four

plants: A, B, C and D. If we cross A and B with each other and C and D with each other

we must have a way of naming their offspring which clearly explains the parental lines.[16]

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[16] Plant lines are traceable trajectories of crosses which give us a picture of where a plant
came from. Conversationally the word line is used to denote a specific plant that is

At CIMMYT they use both of the parents' names in the naming of the offspring. The mother's name, that is the plant that is pollinated vs. the one that is doing the pollinating, comes at the front of the name  So the offspring of A and B, where A is the mother, becomes AB. Likewise the offspring of C and D, where C is the mother, becomes CD. If we go one step further and cross the two offspring, where AB is the mother, we would get a line called ABCD. We could also cross one of the offspring back with one of the parents. AB crossed with A, where AB is the mother, would be ABA.

The second issue with data management that comes with breeding wheat[17] is how to link the data that is gathered about a line to the line's name. How this has been achieved in the past is through spreadsheet organizing like the Windows program Excel. A spread sheet is created and then the associated information is filled in by hand. Using spreadsheets in this manner is of limited value to organizations like CIMMYT because there is a lot of labor involved in filling in the fields and there is a large margin for human error—particularly in the naming of plants. In the example above I named plants using letters of the alphabet. The names used by CIMMYT are much more elaborate and complex. There is a large margin for error in the copying of names and creation of new ones. Based on the traits they observe, breeders will make decisions about selections for crosses in the next breeding cycle. Pedigree tracking means being able to distinguish lines from each other by name based on the characteristics they display.

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being crossed. This is different from a variety which is an established line—one that is in high demand for breeding and has probably been released to the public.

[17] There are many more than two issues with wheat information management. I do not wish to imply that the two mentioned here are the only ones—they are an effective means of explaining what is happening.

**The International Wheat Information System**

Graham McLaren worked in the Generation Challenge Program (GCP) spoke to me about

the IWIS one day. The GCP is the program that as responsible for implementing the

ICIS, that is the crop information system based on the IWIS that CGIAR hoped would be

a successful generic platform to store many different crops' information.[18] McLaren

explained the story behind the IWIS to me. In the 1980s a breeder at CIMMYT saw a

computer system for horse breeding. It listed animals genealogically and categorized

them with associated individual and family traits. The breeder who saw this thought to

himself "I could use that". From there the breeding department connected with what was

the Information Technologies (IT) department, now the Crop Research Informatics

Laboratory (CRIL), to develop a wheat information system. Developers prioritized two

facets of the system. They wanted a system that would track pedigree data and be able to

generate field books for use by the researchers. A field book is literally a book used by

data collectors to record the characteristics of lines found in test plots. When I was doing

my research they were paper books but in the future it is hoped that a digital medium like

an application in an Android tablet will be used to record plant data.

Beyond the two facets named, pedigree tracking and field book generation, the

developers hoped that the IWIS would work as a searchable repository where information

related to the characteristics of lines could be stored and used for statistical referencing

and data mining. It would be extremely beneficial for the stored data to be accessible to

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[18] ICIS is a generic platform for data storage that was based on the form of the IWIS.
There have been some significant problems with successfully implementing the IWIS and
the ICIS because of some inter-departmental issues. I introduced the ICIS in the
introduction and I cover the interdepartmental conflicts related to the IWIS in Chapter
five.

many users because through clever manipulation of the IWIS's information, new findings could be pursued with existent data. I only spoke to one researcher who actively used the IWIS in this capacity. He told me that the work involved with using banked data was very difficult and he felt that in order to extract data in a meaningful way the process had to be made easier. With this in mind, although the IWIS's databases were planned as a type of information breadbasket that would help wheat researchers by giving them access to large amounts of raw data, the effective parameters of the system were reduced to two. The IWIS is good at tracking pedigree and it is able to generate field books.

It is hard to stress how important these two characteristics of the IWIS are to breeding. Pedigree tracking is essential for good breeding because it gives information about the traits of specific lines and organizes the naming conventions related to wheat breeding. Field book generation is also hugely important because it reduces the human labor hours involved in experiments substantially. Many breeders told me horror stories of having technicians writing out field books manually on computers. The time needed and the potential for human error in naming make manual processes of field book generation hugely disadvantageous. Breeding as it is conceived at CIMMYT, requires these two characteristics of the IWIS. Any other function is secondary. How we can tell that the IWIS is indicative of breeder centrality is that these are the only two functions that have been used with any regularity.

Developers at CIMMYT imagined the IWIS as a tool for sharing large amounts of data. This included but was not limited to pedigree information and the potential to generate field books. The reason for generating field books, to collect raw data from the fields—points to another use of the IWIS. Storage and dissemination of all the raw data

associated with wheat trials. For researchers, meaningful (that is functioning) access to this data is hugely valuable for a number of reasons. The first is that having data clearly organized in one repository lets people go back and check to ensure that data is correct and uncorrupted (there are statistical tools for this). A second way that having data accessible is valuable is that new research can be generated through statistical analysis. In the interviews I conducted only one person had used the IWIS in this way. Researchers from other sections within the wheat department complained about the IWIS's un-usability, clunky-ness, and confusing layout. A third way that having data clearly organized is valuable is as a record. CIMMYT can use the IWIS as a means to demonstrate the work it has done in plant breeding, as the culture of transparency and of intellectual property infiltrates development circles this is becoming more and more relevant.

To summarize, the developers of the IWIS created it with many goals in mind. It was to be a useable, searchable data repository that would contain many wheat lines and all the characteristics associated with them. The IWIS would have the ability to generate field books and would be an effective means to track plant pedigrees. The IWIS would store data collected in field books in ways that were accessible to partners working in centers that could not develop their own data management program. It would facilitate knowledge sharing and improve development by giving people access to greater resources with which to diversify their programs. These goals have a variety of applications across the wheat department and could be incorporated into other programs (i.e. sustainability, conservation agriculture, physiology, the seed bank). The only goals

that seemed have been achieved are that it tracks wheat pedigrees effectively and that it generates field books. Of all the tools, these two are most central to the breeders' role.

**Access as a Demonstration of Power**

I hope that by this stage it is clear what access means at CIMMYT. Access is vetted through channels that run concurrently with certain types of demonstrable social relationships or human characteristics. On the one hand, gaining access to CIMMYT resources means demonstrable links to historically significant developments in agriculture. Within the CIMMYT superstructure this works out in a few ways. The first way is how the pedigree of foreign bodies is identified through links with specific characteristics. Because I am not Mexican, have a limited grasp of Spanish, am the offspring of a former CIMMYT scientist, and I had an international staff member "vouch" for me I was given greater access to CIMMYT resources. Alberto, who is a Mexican, was annoyed at the differences between national and international staff because he saw his "Mexicanness" as a stumbling block in his ability to get a higher paying, higher status "international" designation.

Another example that illustrates the tension that Alberto felt was in his job working with Mexican field workers. Alberto is very light skinned and has very curly short cropped hair. He told me that some of his ancestors were European Jews and that he thinks that is where he got the curly hair from. He also said it was possible that his family had some African descent. In any event, he looked physically different from many of the other Mexicans at CIMMYT. This difference was highlighted to him when fieldworkers would complement him on his mastery of Mexican Spanish. Although his

family had been in Mexico for more than 4 generations his body marked him as a foreigner and this had been pointed out to him on several occasions.  It was frustrating to him because he felt he had to "prove" himself as a Mexican to other Mexicans because of the perceived distance he felt at being identified as a foreigner.

The second way that access works out at CIMMYT is in the relationship that departments have with prestigious historical developments. The IWIS is the largest information management tool in the wheat department.  Many other sections still use Excel spread sheets to record and analyze their data.  When electronic resources were made available to CIMMYT researchers the adaptation that occurred was one that followed suit from CIMMYT's legacy as a breeder centric center.  Borlaug, CIMMYT and now the IWIS are names synonymous with classic wheat breeding.  Access to electronic resources, like my access to CIMMYT's compound, are shaped by existing relationships of power.  As a foreigner I was able to cross easily into CIMMYT and start my research.  The people in charge of developing a new piece of information software made access between breeders and the software a priority because wheat breeders and their groups' characteristic pedigree are the most powerful in the organization.

**Chapter 4: Boundary Objects, Authority, and Methodological Alliances**

Building and maintaining alliances is part of the process of gaining and demonstrating power. Alliances need cooperation and triangulation between groups in order to form (Star & Griesemer, 1989). Sharing standard approaches to describing an abstract phenomenon is one such type of cooperation and triangulation. For example, using a shared vocabulary when discussing a particular issue allows two groups to be specific and clear in their meanings. This alliance in practice does not, however, imply an agreement in ideology. Those same two groups may differ in their ideological motivations and goals but adhere to the same standard practices for describing their positions. It is this adherence to similar standards that allows each group to communicate effectively. The IWIS, as a mode of communication, implies a shared set of methodological approaches to understanding plants because it is only though an alliance of methodology that its information is relevant.

The interesting questions in this scenario are who sets the standards and what motivations do other groups have for applying them? What impact does the standardized relationship between groups have on development practices? It is through mutual acceptance of these standard practices that the practices themselves gain recognition. Before that acceptance is achieved there is some politicking that must occur. I argue, like Star and Griesemer (1989), that alliances of convention demonstrate power because they allow dominant groups to exercise their authority by having other groups accept, with some negotiation, the methodologies of the dominant. Using three different examples from different levels of interaction at CIMMYT I will look at the ways that authority is exercised at CIMMYT through the application of standardized methods. With help from

Star and Griesemer's (1989) concept of boundary objects, I argue that the IWIS can be interpreted as an attempt by CIMMYT to apply its standard practices, which are part of its vision of how development ought to be imagined, to its partners around the world.

Star and Griesemer (1989) discuss how alliances of convention between groups are an exercise of power.   Their example is one of museum curators exercising power over amateur naturalists and trappers.  For them, methodology acts as a "boundary object…[an] anchor or bridge" between groups (Star & Griesemer, 1989, p. 414).  These boundary objects, or methodological approaches to a process, help to develop a state of relations between objects (a la Thevenot, 1984). Star and Griesemer (1989) argue that the conditions that those in power place over the actions of their would-be allies cannot be so stringent as to discourage adoption, in fact the conditions must be structured in a way to provide incentive for other groups to adopt these 'boundary objects' as points of mutual collaboration.   Without suitable incentive to adopt the conventions put in place, forms can fall out of use.  An example that illustrates this in Star and Griesemer's (ibid) article is how, from 1907 to 1939, Berkeley's Museum of Vertebrate Zoology rewarded folks who complied with its methodological approach to collecting specimens.  The first incentive that museum curators offered was that a specimen collected through their methodology had the possibility of being included in the collection.  For many amateur naturalists and hobby scientists this was a nice incentive; it allowed them to contribute in some tangible way to preservation efforts , a cause they believed in, while doing activities they enjoyed (e.g. hiking or exploring) (ibid).  The second way the museum gave folks incentives was through monetary rewards.  They paid trappers and hunters for specimens that were brought in in suitable condition (ibid).  Both trappers and amateur naturalists

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(perhaps quite distinct groups) were able to cooperate with the museum because of the way that the museum exerted power over them through alliance building.

In order to first show how power is exerted and authority is demonstrated at CIMMYT I want to use the example of an engineer I became friendly with during my time in Mexico. His story is one that shows how two people, himself and his boss, are both concerned with the application of certain methodologies but for quite different reasons, yet they both felt significant pressure to adhere to them. For the engineer, the pressure came from his boss and from his own expectations for changing his lifestyle and living situation. For his boss (as a representative of CIMMYT) the pressure came from the way that CIMMYT goes about making claims in research. This example helps to show how authority is exercised at CIMMYT, on a very individual level, through the expectation to adhere to specific methodologies.


**Marco**

One day in the cafeteria I sat down next to one of the engineers who worked at CIMMYT. Engineers at agricultural research institutions have a very specific role: they are in charge of making sure that experiments run smoothly. It is their job to coordinate efforts in the crop fields to ensure that experiment standards are met and that fieldworkers treat specific fields accordingly. These duties includes things like monitoring and recording sowing and plant emergence dates, keeping track of crop inputs (water and fertilizers), and keeping an eye on pest control, among other things. Basically they are

there to ensure that the experiments are constructed[19] and run smoothly to ensure that

they pass the level of scrutiny needed to create new knowledge that is of a quality and

level to be published in international journals.  While publishing is not necessarily the

end product that CIMMYT is seeking it is, as I will show, a hugely important part of the

way that researchers at CIMMYT think about their work.  The use of the word engineer

in this context implies a certain amount of precision, accountability, authority, prestige,

and expertise.  By identifying the people involved in maintaining the integrity of

experiments as 'engineers' versus 'feasibility technicians' or 'experiment managers' or

some other job title CIMMYT is making claims about the specialty and the precise

standards involved in its work.

As I sat down next to this engineer, whom I will call Marco, I asked how he was.

He told me that he was feeling really bad.  He explained that during the previous day he

had made a significant mistake.  He had emasculated an entire crossing block that was

not due to be emasculated.  Marco had been working on a maize field, not wheat, but his

example speaks to the culture of CIMMYT as a whole.  Emasculation ensures that the

male parts of a plant are removed so that it can only reproduce through contact with

another plant.  He explained that for the few days leading up to the mistake, part of the

methodological process that he had been working through in other experimental plots

included emasculating the plants.  On this day in particular he continued doing this

emasculation without first ensuring that it was part of the methodology that had been

designed into this particular field's trajectory.   Left to his own devices he had managed

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[19] Construction in this sense is building, creating, assembling and monitoring the
necessary conditions for an experiment to run smoothly while meeting scientific
standards.

to emasculate a significant number of plants that were not meant to be emasculated. By the time the mistake was noted it was too late to fix. His supervisor told him that he had managed to ruin that particular plot's use value. Marco had been admonished by his supervisor and was feeling pretty bashful by the time I met him in the cafeteria. From CIMMYT's perspective, his digression from the standard methods set out for that particular plot had resulted in a loss of potential information, resources and time.

Apart from feeling some shame at having let down his boss and his coworkers, Marco explained the precariousness of his situation. He was about three months into a six month contract and was hoping to have it renewed. He lived quite a distance from CIMMYT and commuted about two or three hours every day depending on traffic. Before that afternoon, Marco and I had become quite friendly because we both started working at CIMMYT around the same time. I knew that he had been looking for a place to move to which was closer to CIMMYT because he had been relatively confident in securing long term work. He had taken the job at CIMMYT because he was eager to earn money and, eventually, move out of his parents' home. Because of this mistake, he was afraid his contract might not be renewed and thus he had resigned himself to continue commuting every day from his parents' home because he did not want to risk moving only to find himself without work. Marco's ability to raise his own quality of life, by moving in to his own place closer to work and cutting down his commute time, was now jeopardized by his failure to adhere to the scientific standards of rigor expected by his employer. Rigor is often used to describe the steps that scientists take to ensure they have achieved a thorough understanding and explanation for facts that have "verification, validation and validity" (Creswell, 2007, p.327). In the case of methodology, rigor also

indicates an ability to follow instructions meticulously. Marco's lack of adherence to expected standards[20] had threatened his relationship with the generation of scientific knowledge, his boss, and his position within CIMMYT.

Being able to adhere to a group's specific requirements is often an essential part of being included within that group. Sharon Traweek (1992) argues that scientific communities often judge their acolytes based on performance—those who make mistakes and those who don't. In her exploration of communities of experimental physicists she found that in order for young physicists to have success they needed to be connected with a well-connected or well-placed leader who had confidence in their abilities (Traweek, 1992). Marco's anxieties about the experimental failures are also anxieties about acceptance into a group—in this case a workplace group, one that is defined by rigorous and meticulous action in the application of specifically laid our methodological expectations. Marco's position within CIMMYT was weakened because he failed to comply with the work standards with which he was tasked and this led to his boss losing confidence in Marco's abilities. Marco's claims to relevance within the organization are suspect because he is unable to demonstrate a suitable grasp of the methodologies expected to form significant alliances with CIMMYT. His non-standard work led to resource loss, experimental failure and an absence of new knowledge. His insecurity was a result of a loss of authority that he experienced by being unable to comply with the standards that were expected of him.

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[20] In all of the other crop fields where he was working in this was not a mistake. But when the methods changed he did not change with them and this inability to adapt to methodology is what is interesting.

What is interesting in Marco's case, and how we can see CIMMYT's methods as examples of boundary objects, is that his motivation for doing well at work was not specifically to make this particular experiment generate valid data. He wanted to do well so that he could move out of his parents' house and cut down on his commute time. Marco's motivation for utilizing CIMMYT methods is different from the people who decided upon these specific methods. The developers of the methods wanted to generate useful data for research but he has become allied with them because there is some positive incentive for him to do so. Going back to Star and Griesemer's (1989) example we can see a parallel between the connections between Marco and his boss. Like the trappers and the naturalists were able to ally themselves with the museum, Marco is also able to apply CMMYT methodologies while maintaining his own worldview. We can see that Marco has internalized some of this authority because he feels it is in his own best interests to act in the way that his bosses at CIMMYT have laid out for him.

**Ontologies and Publishing**

The second example from CIMMYT that demonstrates methods being used as boundary objects comes from the ways that researchers talk about their published data. At CIMMYT there are various reasons for scientists and technicians to apply conventions rigorously in their experiments. Among the interviews I conducted, people told me that they followed protocols in order to earn a living, build a reputation, make falsifiable statements, participate in an international conversation, and of course, to affect positive social change. How this is monitored at CIMMYT is interesting because of the way it has developed its own, site specific, ways of knowing about crops.

I argue that publishing and speaking about publishing is another type of boundary object at CIMMYT. Saying that something has been published is a way for scientist to demonstrate authority in their field and to give credibility to their assertions. In some cases, as I will show, the notion of publishing in conversation replaces methodology as a form of explanation when discussing the relevance of ideas (although methodology is implied in publishing). I think publishing is especially pertinent as a way to discuss results in an environment like CIMMYT because there are many different groups involved in many different methodological approaches to generating knowledge. Physiologists, breeders, geneticists, and conservationists apply different methodologies to their work experiments but publishing is one shared method for demonstrating the significance of their ideas.

To explain what publishing means I'd first like to explain a bit about how CIMMYT researchers are able to craft arguments in their respective academic fields. There is a researcher at CIMMYT whose job it is to curate tools for how to systematize the way that data is collected. This scientist's role is to locate CIMMYT published materials about methodologies in order to build models for how crops information should be apprehended. On the website www.cropontology.org users can access peer reviewed/published research papers which have been organized to help create a shared vocabulary and ontology among CGIAR center employees worldwide. The scientist working on ontologies uses the papers that she has curated to create models and directions for how specific types of plant information are to be apprehended. These methods are then outlined in the crop ontology website. In this way, we see CIMMYT setting its internal standards and crafting those standards from the published work of its

researchers. The ontological part of this website provides a shared lexicon for researchers to use when discussing plants and also a methodological process to be used in determining/finding each plant characteristic.

I was fascinated by this practice because it tells me that CIMMYT is very self-assured in the way it considers its work. CIMMYT is building a model of how to understand crops based entirely on its own research. This practice seems a bit incestuous or self-fulfilling in some ways. Extrapolating from the crop ontology website we can see that CIMMYT is framing its research as the world standard. By curating an ontology tool based entirely on CIMMYT publications, CIMMYT is implying that CIMMYT's way of conceiving of wheat is the "best way" or the "most useful". Any partner that wants to cooperate with CIMMYT by using its materials and databases has to have a shared understanding of how to make sense of those things. Cooperation, in this sense, implies consensus on how it is that people talk about a certain thing but not necessarily why they are talking about it.

CIMMYT is framing its own work as a world authority on crop science. For researchers who work at CIMMYT using this understanding has two outcomes. The first is that they are pressured to use CIMMYT methods as those methods help to serve their own self-interest (conducting globally recognized research). Beyond accepting the authority of CIMMYT's methodologies, the second outcome that researchers experience is that if a researcher is published they can leverage CIMMYT's authority in backing their own arguments. Those two outcomes are clear examples of a Star and Griesemer's (1989) boundary objects. Scientists ally themselves with specific methods in exchange

for a desired outcome, although they may not necessarily have similar goals or ideological worldviews in mind.

One of the main ways that CIMMYT researchers demonstrate the rigorous application of a specific methodology in their work is by having it published in peer reviewed academic and scientific journals. When other experts give credence to the work done, through publication, it enhances the credibility of the efforts of researchers on a larger scale. I found this notion of publishability especially interesting. My background is not in hard sciences. For this reason I often found myself asking people to explain agricultural concepts. After many of my questions I started noticing a trend. In lieu of an explanation, many researchers would tell me that some fact had been published. For example, I was asking a plant physiologist about why drought resistance was such a highly sought characteristic. It's clear why drought resistance would be desirable in some contexts, but I figured there must be land areas or contexts where drought resistance was much less of an issue. The physiologist explained to me that in a recently published paper, researchers had identified that drought resistance is a generally desirable characteristic. I had to press the researcher further to discover that this reasoning was based on information which demonstrated that drought resistance is desirable because it has been shown that a drought resistant plant is generally hardier. While this might make intuitive sense the physiologist did not explain to me why that was so until after I pushed for more information. At first the researcher relied on the fact that a published paper existed to attempt to convince me that drought resistance was a generally desirable trait. I had to follow up with other questions before it became clear what the reasoning in the published paper was.

Another example of people using publication to convince me of something comes from a wheat breeder. We had been discussing the possibility that wheat yields had been saturated.  Saturated, in this context, means that wheat yields could no longer be improved.  I wondered if wheat crops would ever reach a point where breeders could no longer improve the yield of specific plants.  I thought there might be a point where crop improvements would come only in terms of disease resistance or other quality traits not associated with yield.  The breeder told me that wheat yields could still be improved and that he knew this because he had just published a paper on it.  It was only through follow up questions that he outlined how he had determined that wheat yields could be improved.  Initially, he relied on the fact that his paper had been accepted by his peers and published to convince me that his information was correct.  In both cases, the researchers cited not the arguments in the papers but only their conclusions and the fact that the papers had been published to attempt to convince me of something.

How people talked about publishing, as a signpost for confidence in work already done, is extremely interesting because it gives us some sense of the significance placed on the application of CIMMYT standards, which are necessary for publishing, and the authority which that implies.  In her exploration  of physicists Traweek (1992) found that particle physicists often scanned pre-prints in an effort to have access to information before it reaches academic journals.  The reason for this, argues Traweek (ibid), is because by the time results are written up in journals the field of particle physics has moved on so much as to make them uninteresting.  Part of the reason to scan preprints was so that scientists could then speak to the authors on the phone in an effort to get more information about the direction in which the authors were now moving (ibid).  I think that

once a paper was published at CIMMYT the fact that it had been published symbolized that all of the methodology and the interpretations contained within it were based on sound and reasoned judgments and that they no longer needed to be used in discussions to justify certain assertions. It sounded a lot like publication, as a method, has come to replace rigor or even proof as a measure of credibility, in conversation at least, although by all accounts publishability implies rigor and proof.[21]

Published materials feed back into the ways that CIMMYT researchers now apply methodology in their experiments because it is from material published by CIMMYT scientists that the crop ontology website is curated. As I tried to emphasize before, to me, this practice seems a bit self-assured. As new methods are developed, which replace old ones, the ontology website is adapted to affect the way in which CIMMYT researchers determine how to run experiments. Traweek (1992) noted in the case of physicists that as soon as a method is published it might be interpreted as outdated. This is because once an idea has been published the state of the discipline has moved on from that idea and people are attempting to develop newer, more sophisticated, ideas. I did not note people at CIMMYT talking about their work this way so I do not want to get sidetracked by this thought here but in this thesis I am arguing that some of the methods used by CIMMYT might be outmoded. It is possible, because of the delay in changing methodological approaches through things like publishing, that centers like CIMMYT are using older

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[21] Part of publishing is a process of peer review where other experts critique and analyze methods and conclusions. For scientists, publishing is a clear measure of the validity of their conclusions and thoroughness in their methodology because it demonstrates in the eyes of other experts that they are competent. It may be that referring to published articles indicates that proof of the information available and that I could check it if I wanted to, or as a way to ensure that their statements are being properly contextualized. What is interesting is that they did not explain themselves this way.

versions of methods when creating information systems like the IWIS.  The point I want to make here is that although researchers within CIMMYT might have different goals in their work, the way they go about accomplishing their work and the way that they talk about their results use certain methodological approaches as standard conventions.  It is these conventions found in places like the ontological website and in the idea of publishability that allow alliances of practice to form.

**Tools as Boundary Objects and as Exercises in Authority**

So far I have given two examples of methodologies at CIMMYT as boundary objects. The first one was the methodological standards that individual employees, in this case a technician, have to adhere to in order to succeed at CIMMYT.  The second example, one that I chose because it shows a higher level of interaction, is how those conversational conventions might differ in emphasis from those in actual scientific practice although both are developed based on published materials.  Related to the ontological frameworks at CIMMYT was how researchers discussed those published materials and the significance that publishing has, in the mind of researchers, with their claims of authority. I focused on researchers and publishing because in that level of interaction methodologies became secondary in importance to the knowledge which they help to generate. The experimental methodologies are implied in conversations about the published paper but they are not evoked.   I argue that this manner of discussion is another method for researchers to demonstrate authority in their field.  The third example of boundary objects at CIMMYT comes from the International Nurseries program.  I will show how in the context of International Nurseries the IWIS itself can be interpreted as a boundary object.

CIMMYT's International Nurseries program is an initiative which provides seeds and field books to CIMMYT partners around the world. Each year CIMMYT sends out bundles of seed packets called 'nurseries' from its headquarters in El Batan, Mexico to partners working on crop production worldwide. Partners include other CGIAR affiliated organizations like NGOs or national agricultural programs throughout the world.[22] A nursery is a box filled with different seeds that a partner can then plant to recreate a plant nursery out of CIMMYT seed.[23] The International Nurseries are packets of seed of CIMMYT approved wheat lines; these are wheat lines that have met CIMMYTs goals for production in previous years. Depending on which partner they are mailing the nursery to it will include different seed packets. The partner and their CIMMYT counterpart will have discussed the different types of seeds which would be most relevant and useful to aid the partner in their own breeding programs.

The second thing that is sent along with the seed packets as part of the International Nurseries are IWIS generated field books. The field books are large spreadsheets which have lists of all the seed varieties contained within the International Nurseries (box) and a series of rows and columns with which to record the plant data from the nursery once it has been planted in a test plot. CIMMYT sends out two field books with each International Nursery. The intent of the field books is to give the partners some way to arrange and order their data but also to allow that data to be added

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[22] A national agricultural program might be something like, for example in Canada, Agriculture Canada or the Grain Commission. It might also refer to provincial or state level entities like Agriculture and Rural Development program in Alberta. Basically it means a program run within a nation (of any scale regional or statewide) vs. entities like CIMMYT which are international programs.

[23] What comes to mind for me when I think of a plant nursery is a greenhouse filled with sprouting plants—International Nurseries are a box of seed that will provide the material to create all the sprouts.

to the IWIS's database. CIMMYT's main goal with the International Nurseries is to help improve the breeding programs of their partners by allowing them free access to CIMMYT germplasm. A secondary hope is that the partners will record data about the sowing and planting of those International Nurseries to then send back to CIMMYT for inclusion in the IWIS. In order for the information to be usable in the IWIS database it is imperative that the collection methods match those on the crop ontology website.

Many of the CIMMYT researchers I spoke with told me that the product that CIMMYT was producing was seed. I found this a bit curious because I always think of scientists as trying to advance a specific field of study and to me this often means producing ideas or publishing—this view might be born of my background in Anthropology where ideas, more than objects, are the output of academic pursuits. While the researchers I spoke with regarded publishing as important they saw themselves and the role of CIMMYT primarily as seed producers. The head of the wheat department, Hans Braun, told me with a sense of pride and responsibility that more than 50% of all of the spring wheat areas in developing countries were growing CIMMYT developed lines. Publishing, although important at CIMMYT, comes second to the goal of producing useable seed for developing countries.

The seed however is not the only product which is pertinent to CIMMYT partners. Attached to that seed is the information which CIMMYT researchers have collected and used to make deliberations about the seed. This information has been recorded, stored and made accessible to partners through the IWIS and its ability to generate field books. Integrating field books into the International Nurseries also implies an integration of CIMMYT generated methodology as those field books are created with

the intent that recording wheat traits will be accomplished according to CIMMYT standards. The wealth of knowledge that helped to generate the field books, the information contained within the IWIS, is also made available to partners through a relatively easy software download.

The Crop Research Informatics Laboratory (CRIL), who manages the upkeep of the IWIS and the development of new tools for the database[24], assists partners in accessing the IWIS by allowing them to download current versions of the database. The versions that are available to be downloaded give all of the information about selected lines that has been generated to date. The downloadable versions of the database do not allow the partners to make changes to the database or enter their own findings. They do provide partners with access to an already established infrastructure for data recording, storage, and display. In order for the data generated by a partner to be implemented in the IWIS the partner's data first has to go to a curator at CIMMYT. Using statistical tools and other methods to determine the reliability of the data the CIMMYT curator makes decisions about whether CIMMYT standards, as outlined in the crop ontology website, have been met in the data gathering, and whether or not that data should be incorporated into the database.

Partners are under no obligation to use CIMMYT field books nor are they required to share their findings with CIMMYT regarding the International Nurseries they receive. The nurseries are a gift that comes from CIMMYT's role a repository or generator of public goods. There is an incentive for partner to share their finding though; this is how the IWIS and the field books help to exert CIMMYT's authority in an alliance

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[24] Tools like search functions, data mining assistants, statistical analysis tools etc.

of convention. That incentive is access to larger scientific resources which smaller national programs may not have the capability of generating on their own. Many Latin American, African and Asian countries rely on the help of CIMMYT grown wheat to bolster their own domestic breeding programs. Adhering to CIMMYT standards may not be possible for many reasons. National programs lack the funding and the support that international centers require for their experiments (Chandler, 1982). However, aspiring to meet those standards makes sense because implementing CIMMYT's methodologies means partners can gain more meaningfully from CIMMYT's vast reserves of seed and data resources.

Using CIMMYT methodology gives partners access to greater resources. It also promotes the credibility of their partners' research because CIMMYT research methodology is being validated by peer reviewed articles curated on the crop ontology website. Partners who do wish to gain this infrastructure and support from CIMMYT must ally themselves with CIMMYT through methodological adaptations to facilitate this allegiance. The IWIS and its associated field books are one method, or one boundary object (Star & Griesemer, 1989), through which partners are able "anchor or bridge" (p.414) their own programs with the work that CIMMYT does. This alliance does not mean that partners have the same goals or motivations as CIMMYT but CIMMYT's role as an international authority does encourage alliances of convention from their partners.

Star and Griesemer (1989) say that scientific work is not characterized by consensus, although myth says that it is. They see collective action as an interaction that creates alliances between groups with perhaps unlike motivations. In this chapter I have shown some of the ways that CIMMYT creates alliances. These alliances are formed

through the acceptance of standardized methods. I agree with Star and Griesemer (1989) when they argue that standardized methods are one way that authority is expressed. This is not the only way that authority is expressed in agricultural development. Another type of authority, one that I will explore in chapters five and six, is the authority that Intellectual Property (IP) rulings exert on agricultural practices.

**Chapter 5: Notions of Public and Private Enterprise and Intellectual Property**

**Regulations**

When I was trying to get breeders to speak to me about the IWIS one of them responded by saying "I appreciate your interest but I am afraid I will decline to speak with you because I feel that I have spoken enough about the IWIS and I don't think any more talk will benefit the situation".[25] I was asking him to speak about the IWIS as an object or a thing but to him the IWIS was not an object but rather a social encounter, one that he disliked and that he could see no benefit from speaking about.    I was very curious when I read this email because until this point I had not registered any real dislike for the situation surrounding the IWIS.  Many people had given me opinions about the usability of the IWIS but not many had talked politically about its implementation.  After that email, the conversations I had took a different tone because I was more aware of the problems and tensions associated with the integration of this new database.

The IWIS could have met the needs of many groups but failed.  There are a myriad of reason why this might have occurred.  Poor planning, mismanagement, technological failure, lack of infrastructure, poor prioritization, and a lack of communication: all of these reasons were highlighted to me by staff as potential reasons why the IWIS has not been well received.  The most salient theme, however, that I came across when discussion the perceived failure of the IWIS was a comparison to the nature of office culture in public organizations vs. private companies.  In this chapter, I want to

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[25] From some respondents there was a real sense of frustration at how the IWIS has been implemented.   I heard reports that some of the debates had become so serious that jobs may have been lost, in part, as a result of divisions over this system.  The frustrations ranged from simply finding its interface unwieldy and cumbersome to outright anger over what was seen as a complete waste of time and money.

tease apart notions of public vs. private sector work at CIMMYT to explore some of the ways in which CIMMYT staff explain their own work in contrast to that done by members of the private sector. The difference between how public and private enterprises work, and how people *think* they work*, plays out at CIMMYT in how people talk about office culture and in how people conceptualize seeds. In order to get at this tension I will explore what impact the IWIS has had and how some people have interpreted that impact. In the first part of this chapter I argue that CIMMYT employees criticize private sector practices because of their purely economic approaches to work. I find this ironic because breeding, and recent donor strategies are also based on simple economic arguments (ones that highlight transparency, accountability and returns on investments). In the second part of this chapter I explore the sometimes contradictory relationship that CIMMYT employees see with IP agreements and their own ability to work.

Staff described the IWIS as having a few positive impacts on the work that CIMMYT does. The first and probably most important reason why the IWIS was adopted was that it promised to make the work that technicians and researchers were doing easier and more efficient. Within CIMMYT, breeders were the first to use it because it gave them the ability to easily track the pedigree of the seeds they were crossing. Breeders adapted the IWIS technology to their work because it made their work much easier by saving them time and resources.

Following the breeders, the engineers and the technicians working on experiments jumped on board with the IWIS. They adopted the IWIS for two reasons. The first reason was because of pressure from their bosses, the breeders, to start using the new

system.  The second, and probably more immediately gratifying to the technicians and engineers, reason was because the IWIS generated field books.  It was capable of printing off spread sheets for recording the information of their grid plots *in the same order as the crops were planted.*[26]  Before the IWIS, the crop technicians would have had to enter all of the values into a spreadsheet program manually—the IWIS generated the field books almost instantaneously.  It saved them time and resources as well.  With the breeders, engineers and technicians there is this notion that the first thing the IWIS did was that it saved them time with activities they were going to do anyway.

The second thing that developers promised the IWIS would do was one of its biggest selling points.  The IWIS would help people order, categorize and classify information easily—a process which all breeders and researchers would have to work through individually if a collective system for organizing information had not been in place.   In essence, the IWIS would not only make the work of CIMMYT researchers easier to do but it would allow for greater things to be accomplished by systematically categorizing and storing large amounts of data.  This data bank would then act as a searchable repository that would be a resource to researchers all around the world by giving them first hand access to CIMMYT results.  This part of the IWIS has never been fully realized for of a number of reasons. What is most interesting about the failure of the IWIS to take hold is not its failure but the way people describe its lack of success and how that description relies on a dichotomy between public and private sector work-place cultures.

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[26] Crops are planted in significant geographical pattern developed by the breeders.  The IWIS has the ability to model its field books off those patterns so that the orders of the entries on the field book pages correspond to the order of the crops in the field.

**Public vs. Private Sector Work Culture**

Graham McLaren, one of the leaders in the Generation Challenge Program (GCP), which

is the unit responsible for upgrading the IWIS and integrating it into the ICIS, told me

that one of the biggest issues that he saw with people adapting the IWIS and the

subsequent ICIS databases to their research programs was a lack of strong management.

What is most interesting about his description is that he located the blame for the

weakness of public sector management in the nature of public enterprises. He told me

that CIMMYT, in his mind, did not have strong enough power in leadership to push

through new technologies like the IWIS. There was no one who said "alright… this is

the future so now bash your heads together and make it work". He characterized this

failure as weakness of public sector organizations, something which he felt the private

sector was better at overcoming. To emphasize this situation he gave me an example of a

private vegetable producer in the Netherlands who had implemented a generic crop

information system modeled on the IWIS. The only difference between the IWIS and the

commercially used version was the application. The database structures were identical

but the commercially used version of the system stored and catalogued the information

for dozens of vegetable crops instead of just wheat.[27]   To McLaren, this meant that there

was incontrovertible proof that the system worked as a generic crop catalogue—provided

management had the power to enforce its implementation.

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[27] Essentially this was what Graham had hoped the ICIS would do. It would be a generic
data storage platform, based on the IWIS, that could maintain crop information about any
plant.

I asked McLaren what he saw as the main differences between how private and public sector companies take to new technology. He told me that to him the difference is the ability of leaders to make decisions which then bind their subordinates to clear action. For example, a boss might say "we are implementing this new technology and either you make it work or we will find someone who will". He felt that this ethos does not and will never prevail in public institutions. To his mind there are a few reasons for this lack of successful implementation. One of the main reasons he cited is what he called the "not invented here" phenomenon. This is the tendency of departments to be distrustful of anything that is not developed in house.

One of the narratives that I heard quite often was a comparison between CIMMYT and academic institutions. People described CIMMYT to me as organized similarly to a university. They described a vision where departments were somewhat linked in some of their general goals[28] but who have dissimilar ideas about how those goals might be accomplished. Added to this dissimilarity in terms of driving ideologies was a sense of entitlement to those differences. People in different departments accepted that other departments saw development differently but felt that they were entitled to that difference. One researcher told me that the head of her department was absolutely hated by the head of another department because they had different goals and ideals. The segmented nature of the organization meant that those two department heads did not have to actively collaborate unless they chose to so the separation between their groups increased.

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[28] i.e. teaching students and generating original research · At CIMMYT the goals would be generating useable plant material and publishing original research or something like that

Another IWIS developer, Paul Fox, who had left CIMMYT before I arrived, told me that one of the biggest problems that the IWIS faced was inter-departmental conflict. Database development is costly so the wheat department needed help in raising the resources to go ahead with creating the IWIS. Originally, the wheat department had approached the maize department in CIMMYT to ask them to collaborate on the IWIS's design in the hopes that they too would benefit by being able to create a generic platform that would be able to accommodate both the wheat and the maize departments in their respective data and information needs. After some joint scoping exercises, the maize department declined, citing what they saw as irreconcilable differences in how the two crops are conceived and therefore how their crop information should be structured and stored. Fox told me that when cooperation with the maize department failed to materialize the wheat department courted researchers working on rice at the International Rice Research Institution (IRRI), another CGIAR center, in the Philippines. IRRI was receptive and so the development went ahead as part of the joint ICIS initiative

There are a number of different reasons why the maize department might have declined to help in developing a shared crop information system. The stated one was that both crops, and by extension their information, were too distinct to be able to amenable to one system. The company in the Netherlands which did implement a system of crop information which eventually catered to two dozen crops provides some anecdotal evidence that this was not the case.

A second reason is the one stated above, the "not invented here" phenomenon. The rivalries that fuel this type of segmented thinking between departments could be due to personal rivalries. I spoke with many people at CIMMYT who disparaged other

research groups based on personality conflicts with certain key members of the other group.  One research told me that he did not want to give any credit to another because as he put it, his colleague's "head is fat enough as it is".  Another possibility for rivalry comes from the way that public institutions are funded.   A large part of departmental funding comes from international donors.  At the time of my research the Bill and Melinda Gates Foundation was giving a lot of money to CIMMYT for its research efforts.  Carlos Slim, a leading Mexican business magnate, and the Bill and Melinda Gates Foundation jointly funded a capital injection of $25 million to CIMMYT six months after I finished my fieldwork(CIMMYT.org, 2013).  Departments have to write grant applications to various funding organizations in order to fund their research.  Because they are relying on outside sources for funding it puts departments in the uncomfortable position of having to compete with each other for recognition of their work.

I believe that this funding structure has had an effect on how office culture has developed in CIMMYT.  There is evidence to suggest that the way that research organizations are funded has an effect on the way that office culture is structured (Traweek, 1992). Traweek (1992) demonstrates how the bureaucratic culture surrounding high energy physics laboratories in Japan and the USA led to differences in institutional identity in both of those nations.  These differences translated into very different approaches to approaching experiments and the aspects of science that they valued (Traweek, 1992).  At CIMMYT, one part of being a researcher is self-promotion.  This self-promotion might have come about at the expense of interdepartmental co-operation

because each department wants to be known for particular innovations because it is through publicizing innovation that further funding opportunities arise.

Saying that CIMMYT departments are competitive, self-promoting, and perhaps jealous is not to say that these things do not exist in the private sector. I am sure they do. What is interesting is the way in which CIMMYT scientists feel that private sector managerial power has the ability to overcome these obstacles because of its commercial nature. As I said in my example, McLaren thought that the main distinction between public and private sector implementation was the strength of management to implement new technologies. This was a strength that overruled interdepartmental differences and was able to unite people with unlike motivations by providing them with some sort of tangible joint goal. Perhaps this was accomplished through monetary reward or simply the ability to retain their jobs.

One researcher working on updating the IWIS told me that the reason the IWIS had not been adopted by all departments was because there was no bottom line. Again, the allusion the private industry is heavily influencing this conversation. This researcher felt that if people's salaries depended on their adopting a piece technology then technological adoption would be much more likely. At CIMMYT, people's salaries did not depend on them adopting specific technology. In fact, the way they receive funding might have encouraged them not to adopt new technologies. At CIMMYT, the "products" of each department are promoted as being significantly different because it is their difference that helps each department to carve out funding opportunities. Departments market themselves and their respective achievements to the donor community in order to get more funding. One example of how people advertise their

departments is the *Informa*, CIMMYT's weekly newsletter.  While I was at CIMMYT I did some work editing the *Informa*. The *Informa* is an electronic newsletter that is circulated through CIMMYT staff and to select donors and public relations channels to advertise the work that CIMMYT is doing.   Each week, different departments write in to talk about their achievements and accomplishments.  Writers saw this as an exercise which helped to grow the status and renown of departments, programs and of individual researchers.  For writers, the *Informa* was a way to record and document their achievements in their respective fields.  It helped them to "get the message out" about their work and let people know what they were doing, how they were doing it and who they hoped to impact.   This strategic reporting helped to build a public view of specific projects to encourage donors to assist them.

One of the lawyers working on intellectual property (IP) for CIMMYT, Carolina Roa, told me that there has been a cultural change in CG centers due to the way funding has been allocated.  She told me that in the 80s money was doled out to CIMMYT with very little oversight. As the 90s were rounding out this was no longer an acceptable model for donor expenditures.  She told me that new funding agencies, like the Bill and Melinda Gates Foundation, demand much more in the way of mile stones and clear projected results from their funding recipients. Roa felt that through changes in donation strategies, CIMMYT's own work culture has been changed to one that is more closely aligned with a corporate model.  This change in workplace culture—one with greater expectations of accountability—puts more pressure on individual departments and programs to promote themselves, inadvertently at the expense of others,  in order to receive their portion of a limited amount of funding.

This narrative of accountably and transparency is similar to one that is being discussed in development circles. There is a growing concern that neoliberal values are expressing themselves in development projects. Neoliberalism has largely been characterized as a movement within capitalism where the market is seen as the answer to economic problems such as disparity (Babb, 2001). Governments have latched on to this idea and used it in their national schemes. In some case, like in Nicaragua, this ideological movement has led to massive government deregulation of certain sectors (Babb, 2001). One of the consequences that this neoliberal movement has had on development is that the products of development institutions have also been shaped around market values. Kloppenburg (1998) showed that development has changed seed from a use value object to an exchange value object in the early 20th century. I argue that this change has been accelerated and entrenched through neoliberal practices in development (i.e Fitting, 2011; Shepherd, 2006). Historically, seeds were seen as valuable for their properties as providers of food whereas now they are seen as valuable for their properties as marketable goods. Critics like Fitting (2011) argue that this has placed small scale producers in unfair direct competition with large scale companies. By encouraging people with limited resources to compete in large markets the feeling is that their overall livelihood is diminished because they are competing for resources with suppliers much better situated to meet market demands. These are some of the impacts that neo-liberal policies are having on the products of development.

Within the development organizations themselves, within their organization and structuring, there have also been changes to bring them closer to neo-liberal values. As Roa mentioned, at CIMMYT there has been a cultural change in the way people receive

funding.  Now there is much more oversight and accountability demanded by donors.

This model is much more in keeping with a neoliberal point of view.  As Hetherington

(2011) argues, transparency is one of the key neoliberal ways to promoting modern

democracy.  In the same way that a population might demand transparency in the actions

of its government a donor would demand transparency from their recipients.  It seems

that particularly in scientific circles, where inputs and outputs are controlled and

accounted for, this transparency would be deemed necessary.  Transparency is definitely

deemed necessary in the way that scientific research is published.  The sea change is in

how the funding allocations that came to create that publishable material are now also

subject to that scrutiny.

There is an irony that starts to develop here.  CIMMYT, in part due to its funding

structure, is moving towards a corporate style of organization that promotes seeds as

commodities and advertises its own transparency.  At the same time that this

organizational change is happening people are still finding significant differences

between their own structure and that of private companies.  One of the differences

between the abilities of the public sector and the private sector that was highlighted to me

was the greater ability that the private sector had at incorporating new technologies like

the IWIS.  CIMMYT employees, in some respects, are envious of the ability of private

companies to implement new tools into their own workplaces.  CIMMYT's failure in this

respect is articulated through a lack of a "bottom line" or financial incentive to work

together.  The implication being that because CIMMYT is a public sector enterprise there

is no bottom line at all.  There is no financial incentive to staff and the organization to

work together.  Ironically, at CIMMYT there is a bottom line, one that is being

emphasized to a greater extent through the changing donor strategies which demand transparency and accountability. Unfortunately, CIMMYT's bottom line is one that pits departments against each other in attempts to garner greater resources from donors through innovative practices. I argue that these donor strategies emphasize the "not invented here" phenomenon which discourages groups from working together.

**Public and Private Seeds**

The first way that people at CIMMYT discuss the public and private dichotomy is in their office cultures, as explored above. The second way that the public vs. private divide enters into the world of CIMMYT employees is in the way genetic resources, specifically seeds, have been conceptualized through time. This conceptualization has changed because of developments in international treaties and due to the growing importance of IP regulations. The IWIS is intimately tied to seed because a seed without informational context is of very little value. It is through providing histories of seed that CIMMYT-grown varieties have value; CIMMYT seeds have *demonstrably* performed well in suboptimal conditions like under drought or in diseased areas.

Until the 90's, crop seeds and their associated information were freely exchanged between agricultural institutions worldwide. Plant genetic resources were considered to be part of the global commons. They were considered to be the "common heritage of mankind" (FAO, quoted in Kloppenburg, 1998, p.152). Before 1974, seeds were not formally controlled at an international level. In 1974 the Food and Agriculture Organization (FAO) created the International Board for Plant Genetic Resources (IBPGR) whose job it was to collect and safeguard plant genetic resources from around

the world (Kloppenburg, 1998).  The IBPGR was initiated by the FAO but its running was constituted as a CGIAR institution (Kloppenburg, 1998).  We can see from the mandate of the IBPGR that crops were seen to be a mobile and shared public good which was managed in part by United Nations funded departments like the FAO.

CIMMYT and other CG centers would receive crops from other institutions as well as go on seed collecting excursions.  Some people have criticized some of the seed, and associated seed information, collecting techniques that CG centers were involved in (Shepherd, 2006).  Shepherd (2006) found that the Rockefeller Foundation, which funded much of the CG's work, was critical of collection techniques that gathered the knowledge of local farmers about potatoes rather than relying on knowledge generated within laboratories.  Collection methods aside, the fact is that seeds, and their associated information, were freely imported and exported across international borders with very little oversight (McAfee, 2003).  This all changed in 1992 when political changes resulted in a halt in almost all international seed transfers.

In Rio de Janeiro in 1992 the Convention on Biological Diversity (CBD) took place.  As it was explained to me by people working at CIMMYT, this convention was an attempt by countries in the global south to control and assert sovereignty over their own bio-diversity in an attempt to stop large pharmaceutical companies from appropriating and marketing plant and organic compounds found within their borders.  The rationale was that countries in the south felt that northern countries were exploiting vast reserves of biological resources without giving any type of royalties to the developing countries in which most global bio-diversity is found (Hayden, 2003a).  The convention covered many aspects of the transfer of organic materials across national borders.  Basically,

according to the researchers I interviewed, southern countries hoped that this convention would allow them to assert sovereignty over resources which they felt were being unfairly appropriated by the north. The narrative I encountered described southern nations being afraid of "big pharma" taking their resources and then patenting them. Here we have an interesting situation. National fears over the interests of private enterprise led to an approach to property where organic materials became the national property of their country of origin. The hope was that by asserting ownership over these materials nations could then benefit from royalties should these materials ever get used in commercial ventures (Hayden, 2003b).

To the great dismay of the people I was interviewing, one of the unintended results of the 1992 CBD in Rio was that crop seed transfers ground to an instant halt. One IP specialist I was speaking to in CIMMYT told me that some programs and departments in international centers were shut down due to their inability to conduct any kind of meaningful research after this convention. Graham McLaren told me that this convention essentially stalled all international seed transfers because everyone was afraid to raise the ire of international lawyers. He said that anybody seen to be giving away the property of nation states was eyed with great suspicion. During this time pedigree tracking systems like the IWIS became important for another reason; they helped nations to track crop varieties back to the original land races (native varieties) from which they were originally bred. I was told that in theory, this information would aid nations in legally requesting royalties from anybody who tried to commercialize varieties which were the result of breeding with their native varieties. Essentially the idea was that by using a type of genealogical map, nations could claim specific percentages of each wheat

variety as belonging to them and could demand a share of royalties based on this percentage. I was told that in practice this has yet to happen as the courts dealing with this issue are newly formed and complex, but the ramifications were seen as being possible so places like CIMMYT stopped sharing crops for fear of being embroiled in a legal battle.

This state of affairs continued for about 14 years. Carolina Roa told me that during this same time major funding sources for places like CIMMYT dried up. Reduced spending by governments is one aspect of a neoliberal approach to development. Because CIMMYT is funded largely by national donors we can interpret this change as a repercussion of neoliberal policies in governments around the world. This was happening at the same time that donors started to change their expectations for the money they gave to CIMMYT. Roa said that donors required greater accountability and required centers to take greater steps towards transparency in research. In order for institutions like CIMMYT to survive and to continue to function they had to change how they operated. This relates back to her original comments that a cultural change was occurring in CIMMYT as donors started to expect private enterprise models of accountability with their funds. I argue that we can interpret these changes as part of a growing neoliberal approach to agriculture development. Transparency, accountability and competition are all values emphasized in market interactions. In 2006 the food crop research climate changed again, resulting in food and agricultural crops being freed from the strict control of the CBD. It was in 2006 that the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was signed by UN member states.

People in CIMMYT told me that, for them, the ITPGRFA had the effect of creating a caveat within the CBD which allowed the transfer of genetic resources used in food and agriculture. In that same year the CBD met again and accepted the decisions of the ITPGRFA into their own structure (cbd.int, 2013). This meant that CIMMYT researchers could go back to following their method of development, which largely involved generating genetic resources for national partners and other institutions to use in their own agricultural programs. For example, one of the breeders explained to me that after CIMMYT trials, new varieties are released to national partners in places like India who would then run their own trials on the CIMMYT approved seed and then release those varieties to their domestic farmers. As part of these two treaties CG centers gave the contents of their gene banks to the FAO which would care for them in trust as part of the global commons. Their entire stock of crop resources *once again* became a legally protected public good.

When I asked many CIMMYT employees who were below the administrative level of their departments (i.e. not department heads) what they thought about IP many of them said it had little to do with what they did. They said this despite the fact that IP regulations had essentially crippled them for close to 15 years. For many of them, IP, and the notion of patenting plants, was irreconcilable with their self-image as serving the public good. Because they felt that IP implied specific relationships with a crop they told me that CIMMYT does not deal with IP because all of their products are part of the global commons. Again, I think that CIMMYT staff sees public goods and the global commons as a selection of ideas and products that are freely available to all people to be used as they see fit.

I think that part of this distrust for IP is due to the image of IP in agriculture in popular culture. For many people, myself included at the time, IP in agriculture is synonymous with patenting seeds and taking them out of the global commons. The IP stigma brings to mind terminator technologies and proprietary seeds which appear morally corrupt (Waltz, 2009). Companies like Monsanto have been viewed as being bullies and their products are suspected of putting corporate interests above the needs of the global poor (Brooks, 2010; Smith, 2008). Some critiques have argued that as technological zones grow, IP has a greater effect on restricting the food choices of underprivileged populations (Brooks, 2011). Technological zones are places where people adherer to similar practices (Barry, 2006), such as legal jurisdictions where IP rules can be implemented.

I argue that related to this view of patented technology is the way that researchers see IP as a negative thing because ultimately they feel it restricts people's access to food. Restricting access to food is an idea that many folks at CIMMYT find repulsive because it stands in stark contrast to CIMMYT's mandated goals of increasing and strengthening food supplies for the underprivileged. One day I was speaking to an editor for one of the research departments about a colleague in the physiology department. "[Her colleague] is absolutely brilliant—she could make bundles of money working in the private sector because her research is so topical at the moment". When I asked the editor why her colleague did not change positions she told me "no she would never work in the private industry. She feels it is evil". This way IP is framed as being morally corrupt is especially forceful because IP and the privatization of crops by nation states (e.g., through the CBD) makes the work of these researchers very difficult to accomplish.

Here are two sides to the idea of public vs. private in CIMMYT. On one side, many CIMMYT managers applaud the ability of private sector organizations to push through innovations and new practices. Those managers attribute this success to the managerial power that private enterprise because of its commercial, and therefore somehow unified, intents. There is some sense that the public sector has missed the boat because departments have too much autonomy from each other. This autonomy creates a tension where too much time is spent in committees and on decision boards and not enough on implementation. The IWIS is a perfect example of this tension. One developer told me that "we want more feedback, we'd love to hear what the breeders have to say… but we don't have enough contact with them". He felt there was not enough communication. The breeder who declined to speak with me because he had already spoken too much on the IWIS thought there was too much communication—and that the communication was not effective at resolving implementation issues. Interestingly, the lack of success in implementing the IWIS is attributed to a breakdown of communication whereas the success of the same system in another location is attributed to managerial styles.

The idea is that in the private sector adapting new technology is more readily enforced because it seems to signify "you do this—or you are out". Although this sounds harsh, to the managers of the wheat department, GCP and CRIL, this power in management was admirable because it meant that decisions on practice stick because the culture is more amenable to specific types of authority. The is perception of the private sector also nullified arguments about communication because, as the narrative suggests, strong management breaks down barriers in communication by forcing departments to

accept and implement new technology because their jobs depend on it. It is possible that problems framed as communicative ones are really just departments disagreeing on what course to take and having the autonomy for that disagreement to last.

On the other side of this perceived divide between public vs. private enterprise is how the practices of the private sector are framed. While some might applaud the private sector's ability to push through new practices, the general feeling at CIMMYT is that actual practices themselves are immoral (e.g., developing terminator technologies, Genetically Modified Organism (GMO) foods). Private sector culture is good but private sector practices—and, by extension, products are bad. For many of the CIMMYT employees who I spoke with IP regulations were synonymous with seed patenting and, to them, which was the antithesis to their work. Patenting is viewed as excluding people from food and this is viewed as morally corrupt. By that logic, because IP is involved in patenting, then IP is also viewed as morally corrupt.

A second point that needs to be emphasized here is that after the CBD in 1992 countries were given some proprietary rights over genetic material whose origins could be traced back to their territory. This ownership or "privatization" of all food crops by nation states was a significant burden to the work that CIMMYT does because CIMMYT's work is based on a model that sees food and agricultural crops as part of the global commons. They were unable to provide seed transfers to other nations, except in circumstances of repatriation, and thus their usual procedure of transferring seed nurseries came to a halt. This affected research programs, departments and individual jobs. It was not until the ITPGRFA was ratified into the CBD in 2006 that seeds were mobile again. For researchers, seeds as private property symbolize moral corruption

when they are privatized in the private sector and produce job insecurity and impotence when they are "privatized" by international treaties. I think it is this social climate that has created such a distain for private practices and the notion of IP among many workers at CIMMYT.

There are two things that I want to highlight from this conversation. The first is about scope. CIMMYT employees have found in the past that IP regulations have narrowed the scope of their work. IP regulations had the effect of halting plant transfers. During these periods where seeds were immobile researchers had to adapt to a new way of achieving results that did not include producing mobile seeds. I did not hear any narrative about how researchers adapted to this new political environment that reduced the scope of their abilities, only that it was difficult and hurt many workplaces. IP has had the effect at various times of making researchers feel that their scope in development, the options available to them for action, has been limited. This limitation affected how CIMMYT researchers had to conceive of how to continue doing their work. I want to highlight this because, as I will argue in the next chapter, CIMMYTs own use of IP might also have the effect of narrowing the scope of their partners' programs and limiting how those partners conceive of development. I will use Fujimura's (1992) concept of standard packages to make this speculative argument.

The second thing I want to highlight, and the most significant thing that relates to IP, is the contradiction that exists in CIMMYT employees' interpretation of the effect of IP regulations. CIMMYT employees are critical of IP because it has damaged their ability to work in the past. The CBD seriously curtailed CIMMYT's ability to share its products with the world. CIMMYT employees are also critical of IP because they see

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IP as being morally corrupt because IP regulations take some crop varieties and make them unavailable to the global commons. Companies like Monsanto, whose practices dictate the specific use of certain seeds, are viewed as morally corrupt because they limit people's access to food crops. In essence, CIMMYT employees feel that a world without IP would make their jobs and their ability to help people more secure. The irony is that the reality of crop science today is not that IP regulations have been removed from internationally traded food crops but rather that those crops, and their international transfers, are now enabled and protected by international IP regulations like the ITPGRFA. It is precisely because of strong IP regulations that crops are once again mobile and that the public sector can work effectively in the knowledge that their products are freely available to the world's hungry. In the next chapter I will discuss some of the ways, beyond international conventions and regulations, that IP has become part of the way that CIMMYT practices development.

**Chapter 6: Conclusion**

When I first started thinking about CIMMYT I was interested in how communities were formed between people from various points around the globe when they move to a new center to work and live for extended periods of time. I was curious how people related to each other and what sorts of identities were forged in situations where people with different cultural and professional backgrounds came together to work on the problems faced in agricultural development. I expected to focus on transnationalism (e.g., Ong, 1999) and the formation of group boundaries (e.g., Castles, 2002; Epstein, 1992; Wimmer, 2008) and other similar ideas. As I began to do research around these questions I was exposed to many ideas that related more to how is that conventions in practice create communities (e.g., Fujimura, 1992; Star & Griesemer, 1989; Thevenot, 1984; Timmermans & Berg, 2003) and literature about the way that development has been framed historically and what effects that has had in the present (e.g., Brooks, 2010; Kortright, 2011; Shepherd, 2006; Smith, 2009). This focus became significant to me because I found that the questions about how a community of practice develops and spreads more personally compelling and interesting to think about. I think this change in my thinking had to do with scope. Looking at how a community of expats developed an identity through CIMMYT did not have the same ramifications for development that looking at how the international spread of CIMMYT's practices did. This change in scope led me to search for a new way to frame my project.

To help me explore a community of practice I needed a focus which would speak to the implementation of specific methodologies and specific ways of representing some phenomenon. With these purposes in mind I started looking for something that would

help to demonstrate the way that CIMMYT employees frame their actions and how they conceptualize that action. In this thesis I have argued that CIMMYT's attempts to implement the IWIS and IP demonstrate how the organization's vision of development remains centered on the practice of classical breeding, despite historical developments that would expect it to have moved on. In order to make this argument I have used the IWIS as a case study that demonstrates the importance of classical breeding at CIMMYT and how the expectations of the breeders had shaped the development of this database. I have not done research at other centers but I speculate that how CIMMYT uses IP regulations in its partnerships might have the effect of adapting those partners' worldviews to match CIMMYT's own. The effect that CIMMYT might be having in changing the worldview of its partners is significant because CIMMYT employees see their products as being modeled after an "open source" style of development where partners can use CIMMYT products in any way they see fit.

As I hope I have made clear in the preceding chapters, the IWIS is a product of a particular era and from it we can interpret very specific things about agricultural development as it is performed at CIMMYT. I have tried my best to problematize some of the interactions at CIMMYT. I have tried to point out contradictions in perceptions and in practice. I have done this not to act as an outright detractor of CIMMYT's mode of development. I feel very strongly that the work that CIMMYT does is valuable and that the people there are dedicated to improving the lives of the underprivileged. I think that they are doing so in the best way that they know how with the tools available to them. What I hope to highlight are some of the issues that CIMMYT staff themselves have brought to my attention in an effort to explore some of the contradictions within the

organization.  I have tried to develop and contextualized these points of tension because, as almost all of my professors have explained to me at some point, it is through looking at disagreements and contradictions in a society that the anthropologist gets a broad window into how groups think, feel, and act.

I have observed and listened to respondents express to me the fallibility of their work and of their methods.  I do not think that this is any real revelation.  Many people would say that in all situations there are good and bad things which could be extrapolated from their actions.  The actions of large scale development institutions will inevitably have such ramifications.  What I can do, and what I think anthropology's role is, is to highlight some of the tensions and contradictions that exist in this situation as they are reported by people involved.  Development critics have a history of doing the same. Critics accuse such institutions of encouraging  mono-crops (Van Dooren, 2009),  using irrigation techniques which damage groundwater levels (Enserink, 2008), encouraging people to take part in markets where they cannot be competitive (Kloppenburg, 1998), privileging laboratory knowledge over that of local farmers (Shepherd, 2006), and promoting the needs of private companies at the expense of small scale farmers (Fitting, 2011).  The purpose of these types of conversations is to encourage a more critical involvement with the ways in which development agencies attempt to improve the daily lives of others.

## What's in a Name? Databases and IDs

CIMMYT is an organization that privileges some groups of experts over others. Historically, it has been a classical wheat breeding center.  This has to do with how

development was conceptualized after World War II.  At that time, foundations like the

Ford Foundation and the Rockefeller Foundation funded development schemes outside of

the US in an effort to help create new markets for American businesses (Brooks, 2010).

These schemes were incredibly successful due, in part, to the work of people like Norman

Borlaug.  He managed to stamp his name, and his methodology for crop improvement,

onto agricultural development by creating dwarf varieties of wheat which were well

adapted to drought and disease (Gav, 2009; Hickman, 2009).  Because of Borlaug's

success with classical breeding methods, and CIMMYT's close ties to that legacy, the

breeders at CIMMYT have remained a powerful institutional force.  This has resulted in

breeders getting greater access and control over CIMMYT resources, sometimes at the

expense of other groups and departments.  We can read this power relationship out of the

IWIS because it is a database that was planned as a resource for many groups in the

wheat department but the only group who it benefited in the end was the breeders.

Similarly I argue that foreign staff members have greater control over CIMMYT

resources than do local staff members.  CIMMYT was planned as a location where the

"best of the best" were brought together to work on problems that were truly global in

their scope (Chandler, 1982; Smith, 2009).  Because of this model there is a relationship

that privileges foreign staff in positions of power over local staff whose roles are often in

support of the foreign staff.  At CIMMYT, at the time of my field work, there was only

one "local" or Mexican staff member in the organization in Mexico who was considered

"international staff" in terms of pay and benefits.  This hierarchy is uncomfortable

because, like breeders selecting wheat plants for their crosses, foreigners can be seen to

demonstrate a better "pedigree" for positions of power at CIMMYT.  This situation is

because of a relationship with development that has put highly placed international staff in locations where development problems are most apparent. Although Mexicans at times feel slighted by this state of affairs it is not strictly because they are Mexican that they are in less powerful roles but rather because they are local. For example, at IRRI in the Philippines, the Pilipino workers would likely find themselves in a similar state of affairs, where their local group's power over resource control was contrasted with the foreign, perhaps Mexican, workers who congregate there to work on rice.

It is clear that in some ways it makes sense for foreigners to receive more pay and greater benefits. They are being asked to move out of their home countries to make a new life away from their kin and social networks. This burden will likely create increased financial need that needs to be compensated (mortgages in two countries, sending children to non-Spanish speaking schools in Mexico etc.). Added to that increased financial need there is some expectation that their performances will be exemplary (what other reason would there be for recruiting people from around the world). In those cases it seems relevant that some increased status might be conferred on these people because there is a sense that their position and role has earned it. I am not saying there are not some good reasons for the different treatment. My point is that I also received similar preferential treatment although I had no claims to any of those qualities that other foreign staff had.

These relationships of power are quite frustrating to many of the people with whom I spoke. People who were not breeders had to work harder to get their messages out and to access funding for their projects. They felt their work was, at times, undervalued when compared to the work done by the breeders. Similarly, Mexican staff

felt that their work was also being measured in a different scale than foreign staff.  It was

not only Mexican staff who felt that this state of affairs was uncomfortable.  Before I

arrived at CIMMYT for my fieldwork the entire Mexican staff received a raise, almost

across the board, of something like 30% of their wages.  One of the department heads

whom I was speaking with, a foreigner, felt that the way that the raise had been

implemented helped to further increase tensions between Mexicans and international

staff.  He told me that a raise of that size, while absolutely warranted, essentially told

every one of the Mexican staff that for years their work had been undervalued.  It was

uncomfortable for him because he felt it bred more resentment between his staff and their

leaders because the raise highlighted how long their work had been undervalued—even

by local standards.

The key point here, one that we see embedded in the IWIS, is that CIMMYT is

emphasizing one approach to crop improvement in its informational database.  This

narrow approach to data storage is surprising given CIMMYT's broad approach to crop

improvement.  The socio-economists, wheat physiologists, and conservationists have not

had their informational needs included in the International Wheat Information System.  I

do not think this is just a problem of semantics either.  If it was called the International

Wheat Breeder's Information System that would not change the fact that particular

groups are not being encoded in CIMMYT's databases although they are important parts

of CIMMYT's larger developmental infrastructure. Why has this happened? It may be

that some sections are simply better at getting their needs met by the larger organization.

The breeders may simply be exemplary negotiators.  I do not think this is the case.  I

think that the breeders are in an organization that privileges and valorizes their work over

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the work of others.  As I have argued, I believe that CIMMYT's image is almost inseparable from that of the breeders and as such, the breeders have greater access to and control over resources like those needed to develop and implement information systems.

The second major theme that I developed used Star and Griesemer's (1989) concept of boundary objects to explore how CIMMYT has created alliances of convention.  Importantly, these methodological alliances do not imply a shared worldview (Star & Griesemer, 1989).  In general, scientific arguments are constructed with a strict adherence to methodological standards.  Standard procedures are needed for complex types of interactions (Timmermans & Berg, 2003).  It is through an adherence to standards that scientists can make claims about phenomenon they have observed.  These standards are a particular methodological approach to knowing about the world.  Science, as I said in the beginning of this paper, while sometimes thought of as a dialogue that makes objective representations of the world is really a particular methodological approach to knowing about the world.  CIMMYT has developed and curates an ontological framework which explains what standards it uses to make claims about the crops with which it works.  All of the standards which it uses come from research developed in house from CIMMYT published materials.

In order for the knowledge that CIMMYT generates to be valuable to their partners it is necessary that their partners understand the same standard conventions. This has certain ramifications.  If a partner does not use the same standard conventions as CIMMYT then there is some work that needs to be done in translating from one into the other.  In small scale interactions this may not be an issue.  Where larger interactions are occurring it may be that the partner adopts CIMMYT's standard framework.  Because

many of CIMMYT's partners are research programs in developing nations it seems

reasonable that those partners would adopt CIMMYT's methodological approaches,

where possible, because those frameworks are already formed.  For the partner this

means that they have access to internationally accepted guidelines for accomplishing crop

research.  It also frees the partner from burden of the cost of developing those standards.

Additionally, by using CIMMYT standards, partners are then able to have more

meaningful relationships with the research that CIMMYT is doing which means that the

partner stands to gain more from the work that CIMMYT is accomplishing.  I argue that

the particular way that CIMMYT employees use methodological standards acts as

"boundary object…[an] anchor or bridge" (Star & Griesemer, 1989, p. 414) between

CIMMYT and its partners.

This transfer of standardized methodology is strengthened by a few other factors

as well. One of those factors is the contrast that workers at CIMMYT find around their

own work and that of private companies.  Companies like Monsanto and Bayer who have

made significant investments in public sector work, are often eyed with suspicion by

critics because their ultimate goal is to make money (Waltz, 2009).  CIMMYT's mission,

on the other hand, is to "sustainably increase the productivity of maize and wheat systems

and to reduce poverty" (CIMMYT.org, 2013).  In this way CIMMYT's standard practices

are also positioned as being in the interest of the public good.  Politically, it is much

easier for national partners to link their own programs to CIMMYT's practices because

those practices are seen as having been developed with the best interest of the global

community and not of one specific corporation.  Within CIMMYT, the perceptions of the

public and private divide are expressed in terms of respect for the ability of private

companies to implement new technologies but suspicion over the specific outcomes for which private companies are aiming. As I mentioned before, I think that people at CIMMYT frame public goods as selection of ideas and products that are freely available to all people and that can be used as they see fit. This conception of public good is modeled off an open source development model that became prevalent in software development.

CIMMYT employees are critical of the private sector because some of its practices are often based on simple economic arguments that emphasize returns on investments. This is paradoxical because CIMMYT's own strategies for development are also based on simple economic arguments. As I outlined in chapter five, breeding practices which aim to increase yields while reducing inputs and recent donor strategies that highlight the importance of transparency and accountability are both neo-liberal arguments about better returns on investment. An emphasis on high yields (vs. new practices, conservation, and socioeconomics) and transparency are ironic because they are very simple economic arguments for crop improvement that are being carried out in and environment that is highly critical of what it perceives as the purely economic ideals of the private sector.

One of the most interesting things about the perceived public and private divide within CIMMYT is the perception of many CIMMYT employees about Intellectual Property (IP). For many people, IP is the antithesis to the work that is being done at CIMMYT. As I explained, when private companies privatize crop varieties, CIMMYT employees feel threatened because those private interests take newly created plant resources out of the global commons. Restricting people's access to food is something

that flies in the face of the work to which CIMMYT researchers are dedicated. Also, an international agreement, the Convention on Bio-Diversity (CBD), which essentially nationalized crop privatization, resulted in the paralysis of many breeding centers. For these reasons, IP is seen as counterproductive and damaging to the goals and ideals of agricultural development workers at CIMMYT. In many cases, people described their work as an open source model of work because that model allows all users to dictate if and how they use a product.

The reason this perception is interesting is because CIMMYT does, in practice, use IP contracts in its programs. They do so by managing some of their relationships with partners through contractual agreements. As it was explained to me, the reason for doing this was to "add value" to CIMMYT products. The idea is that CIMMYT could enhance its products by giving them to partners with certain expectations attached. Negotiating partnerships in this way makes logical sense because it allows for complementary relationships which can be explained as benefiting all. For example, CIMMYT might provide one aspect of a laboratory analysis to a partner with the expectation that the partner conduct another (perhaps cheaper) form of analysis. Both CIMMYT and its partner stand to gain from this relationship because both of them gain new knowledge with less resource input. In theory this is a very sensible thing to do because each gets more for less.

For this cooperation to occur it is necessary that both the partner and CIMMYT are adhering to similar sets of understandings, or standards, for how research ought to be done. CIMMYT has a particular methodological framework for acquiring knowledge. In order for the work of their partners to fit that framework those partners must base their

own work on CIMMYT's methods so that each contribution is complementarily relevant. Failure to do so would not "add value" to CIMMYT products because it is precisely because of CIMMYT's adherence to set standards that makes their work valuable in the first place. I argue that this relationship, one with that uses IP to generate a fiduciary responsibility, is much less like an open source model of development and much more like a proprietary one. I argue that Fujimura's (1992) concept of standard packages is useful for understanding this interaction because CIMMYT is using IP agreements to create legally binding contracts. I speculate that this fiduciary responsibility may have the effect of making their partners adopt CIMMYT worldviews at the same time as those partners accept CIMMYT methods. CIMMYT is encouraging its partners to form a specific type of relationship with seeds; a relationship that is based within CIMMYT's own political framework.

**Conclusions**

Through the use of the above examples I argue that CIMMYT is actively involved in a political argument about what it is that "doing development" means in agriculture. By focusing on the IWIS I have shown what "doing development" means at CIMMYT and how that meaning has shaped the tools which CIMMYT creates and uses. I have used the IWIS as a guide to demonstrate this because I believe that using a tool as a lens with which to understand CIMMYT's work allows clear and precise examples for the ways which CIMMYT's methods have shaped their own tools. Further, I argue that CIMMYT's methods, in conjunction with IP agreements, help to shape the methods and the perceptions of their partners. In this way I speculate that through the process of

knowledge transference there is transference of the political situation which exists within CIMMYT. This transference encourages one model of development thinking at the expense of others and renders other points of view to the margins.

I have great respect for the work that CIMMYT, as an organization, has done and continues to do. CIMMYT workers have had significant positive impacts on the lives of millions of people around the world through their research initiatives. What I have tried to express here is that, like any entity or organization, CIMMYT is fallible. Like any human endeavor, CIMMYT has both positive and negative attributes. I have focused on a few negative attributes because it is those negative attributes which I feel need to be understood in order to diminish their impact on the world. Like any bureaucracy, CIMMYT has structures of power which sometimes seem unfair, and at times even sinister. The significance of IP as it is adopted by international, public sector enterprises is that some of those hierarchies may then also transferred to national agricultural programs and other partners around the world. Given the scale of the impact that CIMMYT has, and will continue to have, on the world, it is absolutely reasonable that attention be focused on minimizing harm where possible.

In the past, cooperation implied that people would have similar methodological understandings. Historically, when CIMMYT provided seed to its partners the intention was that those other centers would then use that seed to generate further resources for public use. Implying similarity in methodological practice is very different from enforcing standardization in worldviews. I argue that IP regulations entrench specific ways of characterizing seed and development. We can see this in the ways that the CBD and the ITPGRFA have profoundly affected the ways that CIMMYT does its job. The

major fear that CIMMYT employees have over privatization is that the effect of privatization is that it narrows the scope of their own work. Privatization defines and limits public researchers' ability to try and generate crop improvements. In this way I feel that Fujimura's (1992) concept of standard packages is a great way to understand IP regulations because, as we have seen with the implementation of the CBD, the worldview of many scientists was completely altered due to new international regulations. Many researchers and institutions did not adapt well to this change and so research suffered through these periods.

Importantly, privatization is not the only way that IP has been used but it is one of the few ways that low and mid-level CIMMYT employees talk about it. The CBD has instituted changes in its own structure that come from the ITPGRFA. These changes in the international IP regulations that control food and agricultural crops re-opened a social environment where seeds could be exchanged freely between research institutions. In this way IP has also been use for creating, defining and protecting a sense of what types of crops are available to the global commons. IP regulations have played a role in outlining which crops are to be considered public goods and how they ought to be used. What I have drawn attention to in this thesis is the possibility that CIMMYT may be narrowing the scope of how its partners think about seeds through its own IP contracts. I think that this action may have the effect of further narrowing the field of how public goods ought to be imagined and used. To my mind, this is counter to CIMMYT's stated ideals of providing their partners with options that allow those partners to achieve their own development goals because its asks them to think about seeds in the way that CIMMYT thinks they ought to.

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**Appendix 1: Interview Guide**

**Sample Interview Questions**

**Questions for all Participants:**

Describe the work CIMMYT does.
Describe your role in that work.

Why did you choose to pursue this type of work?
How do you relate to CIMMYT's mission?

What contact do you have with the IWIS tool?
How is it useful for you?
How is it useful for other researchers?
Why do you think it was established?
How was it established?

Do you think that the creation of the IWIS tool has impacted the way that CIMMYT works?

- If so, how has it changed?
- What influenced these changed to take place?
- Do you feel that these changes have helped or hindered the work that CIMMYT does? How and why?

**Questions for Developers:**
In what capacity were you involved in the development of IWIS?
Why do you think it has taken the form it has?
What influenced the form?

What relationships did you consider when creating this tool?
- How did these relationships influence its form?

Where did the user interface come from? Was it build specifically for the IWIS tool or was it co-opted from another design?
Where do the inputs come from?
What, in your mind, are its outputs?
- How do you value them?

How did the decisions for tracking and inputting information get made?
What do you think was the impetus to build the IWIS?

How does it help to manage information?
Has it met your expectations?

**Questions for Users**:
In what capacity do you use the IWIS tool?
Why do you think it has taken the form it has?
What do you think about its form/design?

What do you think about the information the IWIS tool provides?
What relationship do you have with other users of the IWIS tool?
- How does this tool facilitate your interactions?

Does the IWIS tool affect the way you do your work?
- If so, in what ways?
- Are these affects positive or negative?

Does the IWIS tool aid you in meeting your professional/personal work goals?
- How so?

What information from the IWIS tool is most useful to you?

**Appendix 2: Written Consent Form**



### Participant Consent Form

**Project title**: Going with the Grain: Value and knowledge systems integrated into the International Wheat Information System

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**Introduction:** I invite you to participate in my research project on the International Wheat Information System. I am a graduate student in the Department of Sociology and Social Anthropology at Dalhousie University in Halifax, Nova Scotia, Canada. My research is <u>not</u> connected to any other governmental, institutional or educational research studies, past or present. Participation in this research project is entirely voluntary and you may withdraw from the study at any time without repercussions.

**Purpose of study**: This research project will be investigating the development and use of the International Wheat Information System (IWIS). Specifically, it will be looking at how the values of science have shaped the form and content of the IWIS tool to best suit a broad range of researchers' needs. I hope this study will contribute to the ongoing debate about how information is shaped, stored and shared for the purposes of scientific advancement.

**Study Design**: In order to best understand how the IWIS tool is valued by researchers, and how that value has played a role in its design, I intend to observe and, to a limited extent, participate in some of the work that CIMMYT will be doing while I am conducting my research in this area during [insert timeframe here]. My study will include a minimum of 15 interviews with individuals involved in developing or using the IWIS tool. Additionally, I intend to observe CIMMYT scientists working in their crop fields as they gather data for input into the IWIS tool.

**Participation in this Study**: You must be over the age of 18 and speak English fluently in order to participate in this research. Participation in my research project is entirely voluntary and you may withdraw from the study at any time for any reason without any repercussions. Interviews are estimated to take between 30 minutes and an hour; however, the exact length of time that the interview takes is up to you because it depends on how much information and detail you choose to share with me. You have complete control over what and how much information you choose to share with me during the interview. You may decline to answer any of the questions posed to you, and you are free to end the interview at any time for any reason without repercussions. You will <u>not</u> be receiving any form of compensation, reward, or payment for your participation in this study.

Provided consent has been given to do so, direct quotes from participants of this study <u>will</u> be used in the final report of this research (initial below). If you consent to the use of your quotes in the final report, you may specify whether you would prefer to have your quotes identified with your real name or a pseudonym (initial below). If specific quotations contain information that could compromise participant anonymity they will be left out of the final report. To ensure accuracy and mitigate the risk of misquoting a participant, direct quotes will only be used with reference to data collected during digitally recorded interviews. Participant observation will not be digitally recorded and, therefore, quotes will not be used from this part of the research.

**Possible Risks and Benefits:** This project has been reviewed by the Dalhousie University Office of Research Ethics Administration. There is minimal risk associated with your participation in my research. It is my hope that the information you share may be of use to other researchers working in the field of Anthropology and Science and Technology Studies.

**Confidentiality:** If you give your consent, interviews will be recorded using a digital audio recorder; otherwise, I will take handwritten notes during the interview in order to verify content. If you consent to having the interview recorded, you may ask that the recorder be turned off or paused at any time during the interview. Any information of a sensitive or personal nature that may arise during the interview will not be included in the final report. This form, along with the digital recording of the interview and/or notes pertaining to the interview will be kept in a secure location for the duration of the fieldwork. Upon return to Halifax, all information pertaining to this interview will be kept in a secure location for a maximum of five years after the publication of the complete master's thesis. After the five year storage period, all information pertaining to this research will be erased.

**Summary and Follow-up:** You are welcome to contact either the Principal Investigator or the Supervisor at any time with any questions or concerns about to this research project. You may have access to the final report upon request. Our contact information is

at the top of this page. Upon request, you will be sent a summary of the final report. The summary can be sent to you via email, fax or mail.

**Please write your initial next to the following statements if you agree:**

\_\_\_\_\_ I consent to having this interview digitally recorded.

\_\_\_\_\_ I give my consent to use direct quotes from this interview in the final report of

this research project.

**If yes**

   \_\_\_\_\_ I wish to review which direct quotes will be used in the final report
of this research project.

   \_\_\_\_\_ I *do not* wish to review which direct quotes will be used in the final
write up of this project.

\_\_\_\_\_ I would like my real name to be used in the final report.

**OR**

\_\_\_\_\_ I would like a pseudonym to be used in place of my real name in the final report

to protect my identity.

"I have read and understood all of the information outlined in this consent form. I have been given the opportunity to discuss it and my questions/concerns have been answered to my satisfaction. I hereby consent to participate in this study. However, I understand that my participation is entirely voluntary and that I am free to withdraw from the study for any reason at any time without any repercussions."

Participant_____ Date: _____

Principal Investigator_____ Date: _____

*If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, you may contact Catherine Connors , Director, Research Ethics, Dalhousie University at (Collect calls will be accepted) (902) 494-1462, [ethics@dal.ca](mailto:ethics@dal.ca)*