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Agricultural Transitions in Northwestern Argentina

by

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An undergraduate honors thesis submitted in partial fulfillment of the

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Abstract

Worldwide, agriculture has seen a transition from small scale subsistence farming to large scale commercial operations, often associated with green revolution technologies and support by government policies and western models of economic development. Argentina with its history as a salient agricultural exporter serves as a valuable example of the agricultural transition from subsistence to commercial production. In the small town of San Pedro de Cololao, Tucuman, we studied the agricultural transitions that are taking place and analyzed the role that socioeconomic, cultural and political factors play in the shift.

Through the case studies of agricultural practices in San Pedro de Cololao this report will give greater insight into how agriculture in rural communities is responding to economic development. This paper finds that two types of agricultural transitions from subsistence to commercialized production are occurring in NW Argentina and evaluates how they follow trends in development theory to greater conceptualize the patterns that led to these transitions and the potential social, economic and environmental implications they present.

The agriculture changes taking place in San Pedro can be viewed as a representation of two paradigm shifts in the rural development discourse, the “small-farm-first narrative” and the shift towards internal resources and markets. Three agricultural models are present in San Pedro, 1) subsistence, 2) agroecological, and 3) small scale commercialized production of vegetables. Subsistence agriculture is slowly being abandoned in a transition to agroecological, and small scale production of vegetables for commercialization. The transition to agroecology can be identified with both the small-farm-first approach as well the shift towards internal resources and markets. The transition to the small scale commercialization of vegetables while associated with the small-farm-first approach, applies some industrial agriculture technologies.

Modernization and Agricultural Development

The role of agriculture in economic development

To better understand the influences and potential outcomes of agricultural transitions in San Pedro, one must first look into the theoretical frameworks and actors that influence agricultural practices and markets. Perhaps of most significance has been the adaptation of large scale “modern” industrial agriculture by use of modern technologies and

global market integration.

Modern agriculture development has been introduced through the green revolution and mainstream or modernization development theorists. Modernization theorists recognize the significance of agriculture in economic development and thus support industrial agricultural development. It is a growth oriented paradigm in the development discourse that focuses on Gross Domestic Product (GDP), large scale development and infrastructure projects that depend on top down approaches to create economic opportunity and equality in developing nations.

Industrial agriculture projects in developing nations are supported by modernization theorists and international organizations such as the World Bank and USAID. Over the past sixty years the implementation of intensified agriculture has evolved significantly and can be found in several countries of the world.

As noted by several scholars in the field, agriculture plays a significant role in economic growth and wellbeing. This is because the agriculture sector accounts for a significant proportion of the national income in many developing nations and thus plays a substantial role in economic development. According to development theorists, relying on the concept of economies of scale, traditional methods used for agricultural production in developing nations often show low levels of productivity and are resource intensive, in their use of labor and land (Johnston & Mellor, 1961). Thus, according to mainstream development theorists, a more efficient agriculture model is needed. Development models, describe a transition to a more productive agriculture that relies more intensively on inputs other than land and labor, yet can expand and utilize the concept of economies of scale.

Johnston and Mellor (1961), created the “general transformation model” to explain the factors behind modern agricultural development. They are, 1) demand for agricultural products must not decline with increase of national income; 2) the ability for agricultural production to grow significantly with a constant or declining farm labor force, and 3) the introduction of modern technology to reduce costs of the manufacturing industry that aid in changing the patterns of output and consumption. In total, these factors are thought to be essential in achieving cumulative and self-sustaining growth and aid in the structural transformation of an economy (Johnston & Mellor, 1961).

Johnston and Mellor (1961), tell us that agriculture contributes to economic growth through five factors: 1) Economic development is defined through a substantial increase in demand for agricultural products. 2) Agricultural exports play a significant role in increasing income and foreign exchange earnings, and thus expanding these exports is very important. 3) The labor force for other industrial sectors is drawn primarily from the agricultural sector. 4) Agriculture should make a net contribution to the capital required for overhead investment and expansion of

secondary industry. 5) The increase of net incomes of the agricultural population could stimulate the growth of the industrial sector.

The first factor is stating that an increasing demand for food will increase along side the national income, GDP and population (Johnston & Mellor, 1961). Thus if food production does not increase with growing population and thus demand, there will be a significant rise in the price of food which will hamper individual well being, industrial profits, investment and economic growth (Johnston & Mellor, 1961).

The second factor, discusses how agriculture exports are one of the most promising and important aspects of national development efforts as it increases income and foreign exchange (Johnston & Mellor, 1961). However, as Johnston and Mellor (1961) warn the expansion of specific commodities for export can leave underdeveloped countries vulnerable to price declines based on the income elasticity of the county and the lack of stability on the global market. Lastly, they suggest that increasing the diversification of commodities for export in the long run is preferable in order to lessen the economic risk of relying on a single commodity (Johnston & Mellor, 1961).

The third factor states that the labor needed for the growth of the manufacturing sector can easily be taken from the agricultural sector, due to its surplus of labor (Johnston & Mellor, 1961). However, this labor must be taken early on in the development phase, as there is virtually no other place in the labor sector to draw labor from for non-agriculture sectors (Johnston & Mellor, 1961). Some agricultural labor should remain in the agricultural sector to fuel the growth of cash crops for export (Johnston & Mellor, 1961). However, whereas the general transformation model assumes that there is a surplus and unlimited supply of labor from the agricultural sector, the two sector classical growth model shows that this labor force may not be absorbed into the nonagricultural sector until much later in the development process, and depends on the availability of employment in the non-agricultural sector (Johnston & Mellor, 1961). Rather, the general transformation model becomes irrelevant if the labor force is not absorbed into the industrial sector as expected.

The fourth factor speaks to the reliance on the agriculture sector, unless the country possesses significant mineral wealth or resources to create the capital needed to drive and expand economic growth and industry within the country (Johnston & Mellor, 1961). This calls for a reduction in labor and or prices, which is to be achieved desirably through an increased use of technologies (Johnston & Mellor, 1961). The final factor suggests that in order for a demand in domestically produced non-food items to grow, and thus fuel the manufacturing sector, the per capita income for rural farming communities must increase as well, to support that demand, especially if investment is to

take place. In conclusion, several factors, as discussed above, within the agricultural sector play into the likelihood of economic development in an agriculture dependent country.

One can view today that the factors and steps to agriculture development discussed by Johnston and Mellor (1961) have occurred and are currently playing out in the transition to industrialized commercial agricultural production. The commercialization of agriculture can be characterized by an increased dependency and use of technology in order to drive efficiency and reduce labor, an orientation around income, growth, and non-local markets as well as the specialization and commoditization of food products to drive that growth. Later trends of commercial agriculture following the Green Revolution experience an increase in the use of hybrid species and genetically engineered (GE) and genetically modified seeds (GMO).

Green Revolution

From the 1960's onward the adoption of industrial agriculture has grown exponentially. The "modernization" of agriculture through industrial practices grew at its greatest capacity during the time of the green revolution with the implementation of high yielding crop varieties for staple grain production. The green revolution aimed to reduce the global hunger epidemic by increasing production efficiency and using high yielding crop varieties (HYV's); however its shortcomings with regard to access, distribution and environmental impacts are strongly critiqued by some development practitioners. As Cleaver (1972) argues it also opened up new global markets for large multinational seed, chemical and fertilizer corporations who made and continue to make significant profit from the new agribusiness. The farming techniques and technological innovations, although beneficial for productivity and economic growth, have also proven to be environmentally damaging and are considered by critics to be unsustainable.

Technological progress is the most significant factor in the green revolution. The use of higher yielding crop varieties, and increased application of fertilizers as well herbicides and pesticides, are two technological factors which have been noted to significantly increase the productivity of agriculture. Expansion of these innovations also allows for the crop area to increase resulting in a growth in agricultural output.

Trends of the green revolution

Through the support of public and international institutions, organizations and corporations, technological

innovations and capital investment drove the green revolution. These technologies can be classified into four categories: 1) Mechanical—tractor, harvester and windmill; 2) Biological—hybrid seeds; 3) Chemical—fertilizers, insecticides and pesticides, and; 4) Agronomic—cultural practices and management techniques (Janvry, 1973).

Although Janvry is not implicitly speaking about the green revolution, these categories of technological innovations hold true to the technologies introduced during the green revolution, technologies, which have become developed, improved and more abundant with time.

Green Revolution innovations allowed for an increase in production, efficiency and profit of agricultural goods. Mechanical innovations such as the tractor or seed distributing machines reduced the amount of labor needed thereby increasing the area of land that a single worker can maintain (Janvry, 1973). This reduced the labor costs (capital) and thus increased the economic efficiency of the farming operation (Janvry, 1973). Packages of biological, chemical and agronomic technologies can greatly increase the yield and decrease the use of resources when used together (Janvry, 1973).

Used in isolation, outside of a package that includes chemical and agronomic elements, biological innovations tend to increase the cost and only slightly increase the yield, making the need for other innovations necessary to obtain optimal efficiency (Janvry, 1973). Chemical innovations increase yields significantly, yet also increase the need for on site management (Janvry, 1973) to ensure proper application. The importance of using the complete “technological” packages is significant to ensure economic and productive efficiency. These innovations are made available primarily through private, often multinational corporations that sell parts of the package deal, specifically seeds and chemicals, to national and regional middlemen who then distribute the packages to the farmers. A precondition to purchase the packages or specific technologies is access to capital or credit. As emphasized by dozens of scholars in the development discourse, these innovations and the frameworks in which modern agriculture exists, can have adverse impacts on environmental and human health, and affect the socioeconomic circumstances of the community involved.

Shortcomings of Industrial Agriculture

Research indicates that industrial agriculture practices can lead to negative impacts on the environment through the use of monocultures, synthetic chemical pesticides and fertilizers, irrigation, and intensive use of land (Horrikan, Lawrence & Walker, 2002). On a larger spectrum, industrial agriculture is claimed to account for twenty

percent of manmade global greenhouse emissions and significantly contributes to global land use change, which accounts for fourteen percent of manmade global greenhouse gas emissions.

Monocultures decrease plant and animal biodiversity by replacing diverse habitat and introducing a single variety of crops rather than allowing a diverse variety of crops to evolve and keep pace with ever evolving plant diseases (Horrigan, Lawrence & Walker, 2002). Synthetic chemical herbicides, pesticides and fertilizers pollute soil, water and air and threaten both human and environmental health (Horrigan, Lawrence & Walker, 2002). They decrease soil fertility and nutrient composition, and runoff contaminates surface and groundwater (Horrigan, Lawrence & Walker, 2002). Synthetic fertilizers specifically, increase the acidity of soils, which causes a decrease of biotic activity in the soil leading to the impediment of plant growth and sometimes results in non-arable land (Horrigan, Lawrence & Walker, 2002).

Intensive land use from the combination of monocropping, tilling and chemical inputs causes soil to erode faster than it can replenish leading to a decrease in the percent of arable land available per person (Horrigan, Lawrence & Walker, 2002). Intensive irrigation due to lack of shading, expansive land use and water soluble chemicals leads to an unsustainable rate of water consumption and also diverts water from surface water and aquifers that could have other anthropogenic and ecological significance (Horrigan, Lawrence & Walker, 2002).

In the context of socioeconomic implications, industrial agriculture operations can displace rural communities, particularly when they are small scale subsistence farmers with tenuous tenure rights and who lack the capital to invest in chemical inputs, seeds, irrigation and technology needed for commercial production. Thus, individuals will migrate to urban areas or will work as wage laborers on newly developed large-scale commercial farms. The migration from rural to urban areas can be viewed as two different responses, either to hardship or an opportunity to raise income, accumulate wealth and gain skills and knowledge (Elliot, 2006). In the scope of industrial and commercialized agriculture, migration can occur from either of these responses.

Yet, borrowing from Johnston and Mellor (1961), this migration can also be viewed as a phase in economic development as labor from the agricultural sector transitions into non-agricultural sectors, which are more abundant in urban settings. However, if it is a response to hardship, via the lack of work or affordable land following the implementation of large industrial farming operations, critics observe this migration as a negative repercussion of industrial agriculture. Thus, these critiques bring into question, alongside the known environmental impacts, whether the costs of industrial agriculture outweigh the benefits and if there is perhaps another, more beneficial approach to

agricultural development. As discussed below, many scholars and practitioners argue that there is and this is known as the small-farm-first narrative.

Small Farm First Narrative

Industrial agriculture development can be seen as one track in which the agriculture sector contributes to economic development and describe why the transition from small-scale subsistence farming to large-scale commercial farming takes place. However, an alternative narrative argues for another track known as the “small farm first narrative.” According to this narrative small scale commercial farms can contribute to economic growth as much as large scale commercial farms.

Ellis and Biggs (2001) discuss how the idea of agriculture growth through small-farm efficiency has come to dominate rural development thinking. They demonstrate that traditional and subsistence agriculture play a role in economic growth and productivity which is not solely restricted to the commercial sector (Ellis & Biggs, 2001). In this case, the narrative diverges from the concept of economies of scale by recognizing the productive capacity of subsistence or traditional farms regardless of their size (Ellis & Biggs, 2001). This approach does agree with the ideas of Johnston and Mellor (1961) in stating that agriculture is a key factor in economic growth by means of “labor, capital, food, foreign exchange and a market in consumer goods” (Ellis & Biggs, 441, 2001). Specifically, and on the contrary to mainstream development theorists, they believe that small scale agriculture is at the center of this growth and success (Ellis & Biggs, 2001).

Ellis and Biggs (2001) argue that : 1) Small farms make efficient farm decisions because they are rational economic agents; 2) small farms are equally able to use external input combinations of seeds, fertilizers, and water as these innovations are neutral to scale; 3) for small scale farms that use HYV cultivation, and substitute scarce land for labor reflects resources scarcities and can be viewed as in “induced innovation; 4) small farmers are more efficient than large farmers in their use of abundant labor in combination with small land holdings and low requirements for scarce capital; 5) these factors lead to a unimodal agricultural strategy that favors small family farms rather than a bimodal strategy that bets on the modern farm sector composed of large farms, and; 6) rising agricultural output in the small-farm sector results in rural growth linkages that spur the growth of labor-intensive non-farm activities in rural areas, and which are higher than for large farms.”

Shift of agriculture towards internal resources and markets

The apparent social and environmental shortcomings of industrial agriculture have led some researchers to seek alternatives. Borrowing from the small farm first narrative, some identify a shift away from external inputs and markets and towards internal markets and resources. Van Der Ploeg (2000) finds that a shift in paradigms of rural development practices is occurring. The shift indicates a movement away from modernization theory (market integration model) and towards a more sustainable model. As previously discussed by Johnston and Mellor (1961) the mainstream rural development discourse assumes that farmers will specialize and increase the scale of their operation as they intensify production using inputs through the mobilization of resources by external markets. Due to the commodification of crops and dependency on inputs and thus income from output, outputs became increasingly dependent on a few markets (Van Der Ploeg, 2000). Due to this dependency and concentration, studies indicate that farmers become increasingly vulnerable and have little flexibility with regards to income generation, as they are often highly indebted (Van Der Ploeg, 2000).

Van Der Ploeg (2000) claims that farmers are now working actively to decrease dependency on external inputs by using and putting emphasis on internal resource flows as well form famers' co-ops on new, non-commodity circuits. This strategy makes the farm unit more economical and less vulnerable, especially to the pressures of globalization (Van Der Ploeg, 2000). Agroecology is an agricultural model which has responded to the shortcomings of industrial agriculture and supports the paradigm shift towards small farms.

Alternative route of agricultural transitions: agroecology

Agroecology, as described by Altieri (2009), is the application of ecological concepts and principles to the design and management of sustainable agricultural ecosystems. This is a system that creates the potential to provide access to a sufficient amount of a diverse variety of foods for communities around the globe (Schutter 2010).

Agroecological methods include agroforestry, crop and animal combinations, and a variety of methods which properly allocate resources and use techniques which are suitable and sustainable for the ecosystems in which they are located (Altieri 2009). Methods also tend to mimic the naturally occurring processes which create a self-sustaining feedback loop. Instead of introducing external inputs, agroecology seeks to integrate energy and nutrients from the farm into production (Schutter 2010). The idea is also to focus on the interactions between native species and species being farmed, rather than on one specific species (Schutter 2010). These synergistic interactions allow for more

sustainable and efficient production and allocation of water and nutrient resources.

A common misconception is that polycultural systems, which is essentially what agroecology calls for, are not as efficient and productive as highly mechanized, monocropped farms. However as Schutter (2010) makes clear in his address to the United Nations, agroecology actually raises productivity at field level. Increased productivity and sustainability are both accomplished under a variety of integrated sustainable and ecological farming techniques which include: the introduction of agricultural biodiversity, integrated nutrient management, agroforestry, water harvesting and integration of livestock into farming systems (Schutter 2010).

Through the introduction of agricultural biodiversity in and around the farm, ecological systems create a healthier and more sustainable environment to farm in (Altieri 2009). This farming environment requires less chemical inputs due to the use of poly cultures that help create natural pest and weed control through predatory insect species and the reduction of crop vulnerability due to biodiversity (Altieri 2009). Integrated nutrient management calls for the use of on farm fertilizers, such as compost, and legumes which control erosion and fix nitrogen in the soil (Schutter 2010). Also, integrating livestock and fish into the farming system provides more nutrients and can interact in a symbiotic manner with crops (Schutter 2010). Introducing animals onto the farm also adds to food diversification which helps improve nutrition in diet and creates more markets for the selling of food goods.

Agroforestry is an exceptional method which incorporates trees into agriculture and also opens up more opportunity for income through the diversification of products such as timber (Reid 1997). According to Reid (1997), there are four primary reasons why agroforestry techniques are beneficial to farms. The first is that trees have the potential to create direct cash flow through the harvest of trees for uses such as oils, wood and fibers and thus provide resistance from fluctuations in agricultural markets (Reid 1997). Second, the trees can add value to existing farm enterprises allowing shelter for animals in the off season of pastures, creating windbreaks for fields and alleviating water logging in low lying fields (Reid 1997). Third, trees aid in protecting the soil and water resource base by addressing issues of erosion and salinity which both ensure long term survival of the farm (Reid 1997). Lastly agroforestry can provide shelter and corridors for wildlife thus enhancing wildlife conservation as well as providing a buffer zone for plants (Reid 1997). Reid (1997) also states that aesthetically, planting trees is very pleasing to both nature and human beings. Furthermore, there are specific nitrogen fixing trees such as acacias. In Zambia acacias have been used and improve the average maize output from 1.3 tons per hectare to 4.1 tons per hectare, avoiding

dependency on chemical fertilizers (Schutter 2010). By using natural methods such as agroforestry that require no inorganic chemical inputs, small farmers have the potential to save the money that would have otherwise been used to purchase chemical inputs, and spend it on education or medical needs (Schutter 2010).

Another agroecology technique is water harvesting which seeks to capture water during the rainy seasons, especially in dry climates, and save it and use it for crop irrigation. Stone barriers in West Africa allowed for the collection of water for irrigation but also replenished water tables, reduced soil erosion and improved soil moisture (Schutter 2010). According to Schutter (2010) by harvesting water, crop production increased by ten to fifteen times which once again allows for a higher potential for income, savings, production and thus food security.

With the combination of biological diversification, nutrient intensification, integration of livestock and fish, agroforestry, and water harvesting it is possible to create a farming model which is a system of symbiotic relationships inspired by the ecosystem of the farm location. This relationship, as discussed below, is highly sustainable, not only for the farmer and the farming Enterprise but also is found to be more resistant to climate change than industrial agriculture practices.

In the scope of sustainability and the challenges faced at present and in the near future regarding climate change, it is important to remember the link between food production and climate change. It is estimated that most of the effects of climate change will be felt most strongly in developing countries, which is why it is so vital that small farmers especially adopt agricultural practices which will make them less vulnerable to natural disasters, extreme weather variations unpredictability, and water shortages which are all brought on by a changing climate. Agroecology can be seen and has proven to be a resilient form of agriculture. In their September 2011 report GRAIN suggests that carbon emissions could be cut in half if the current agricultural systems were reorganized around small scale farming techniques such as agroecology, which focus on local markets rather than international markets.

There are numerous ways in which agroecology can both improve resistance to climate change and create an agricultural system which does not contribute to climate change through the intensive use of fossil fuels and land.

One of the most obvious elements is that agroecological techniques essentially delink agriculture from dependency on fossil fuels (Schutter 2010). Due to the nature of agroecology as discussed above, it calls for enhanced agricultural biodiversity which creates greater resistance to extreme weather, weeds, pests and diseases (Schutter 2010). In his 2010 report submitted to the Human Rights Council of the United Nations, Schutter gives the example of smallholder farmers in Nicaragua and their experience and losses during hurricane Mitch in comparison to large scale producers.

He concluded that due to methods such as “rock bunds or dikes, green manure, crop rotation and the incorporation of stubble, ditches, terraces, barriers, mulch, legumes, trees, plowing parallel to the slope, no-burn, live fences and zero-tillage” they “had on average forty percent more topsoil, higher field moisture, less erosion and lower economic losses than control plots on conventional farms.”

The increasing number of droughts and floods that will result from climate change can be handled and supported more aptly through agroecological techniques such as agroforestry which helps improve soil filtration and hold moisture (Shutter 2010). As expressed agroecology has the potential to help rural communities live with climate change and improve the environment around them. Though both are very important issues which must be addressed in a sustainable development model, the issues of hunger and malnutrition must be considered and addressed as well.

In 2010, 925 million people in the world (World Hunger 2012) still lack access to sufficient amounts of food, to meet their nutritional needs. Thus food security and sovereignty are key issues that must be addressed, and can be addressed through agroecological techniques. Agroecology can make an impact on hunger because the practices address three key causes of hunger: poverty, harmful economic systems and climate change (World Hunger 2012).

According to Schutter (2010), agroecology reduces rural poverty by increasing farmer accessibility to markets and goods. One of the key issues of rural poverty and industrial agriculture is the dependence on expensive chemical inputs and unreliable state subsidies (Schutter 2010). Agroecology allows the farmers to become less and less dependent on these inputs thereby decreasing the vulnerability and dependency on “local retailers and moneylenders” (Schutter 2010). It is due to on site nutrient intensification rather than inorganic chemical inputs that farmers can escape the economic system and industrial intensification of agriculture which often drives poor farmers into debt. This is especially true for the most isolated and impoverished farmers whose government often neglects them by excluding them from government subsidies and where the private sector is unwilling to invest due to lack of access and communication to and from the area (Schutter 2010)

In rural areas where out migration and unemployment are high, creating employment opportunities for individuals is an essential element in the fight against poverty as it provides access to income, knowledge and opportunities. The initial startups of agroecology, as well as the diversified tasks of the system are labor intensive which can be viewed as problematic by many yet can however be extremely beneficial to rural individuals in communities (Schutter 2010). By promoting jobs in a more agroecological setting, health risks and exposure to toxins become minimal or nonexistent, and specialization of jobs and knowledge will increase. Thereby, rural out migration

could decrease (Schutter 2010). Agroecology is knowledge intensive, thus education programs and community partnerships in agroecological projects have been observed (Schutter 2010). Thus agroecology not only provides safe and secure jobs to rural communities but it also increases the knowledge base and allows for the spread of such techniques and employment through village to village networking. Investing in knowledge has a profound impact on poverty and agricultural productivity; agroecology, as stated above, is knowledge intensive and will aid in increasing this investment through a few key factors. Agroecology calls for ecological literacy and increases and promotes decision-making skills in rural communities which aids in community and individual empowerment (Schutter 2010).

We now understand industrial agriculture and the responses to its shortcomings, as well as small-farm-first narrative and agroecology. Our study now turns to the farming methods found in San Pedro de Cololao, Tucuman, Argentina.

Agriculture in NW Argentina

As previously mentioned, agriculture has long been an important sector of the Argentine economy. During three weeks of fieldwork we were able to observe how landowners and farmers are adapting to changing conditions and study changes in agricultural practices. We identified two agricultural transitions taking place in San Pedro de Cololao. These can be described as: 1) Agroecological agriculture with a focus on local regional and national markets, internal inputs and non-commodity circuits and; 2) small scale commercialization and local, regional and national market integration through the use of middlemen, transnational seeds and external chemical inputs.

Local Context

San Pedro de Cololao is a small town with a population of 4,500 people located near Trancas in the northwestern region of Tucuman, Argentina. The province of Tucuman is the smallest yet most densely populated of Argentina. The National Institute of Agricultural Technology (INTA) has an office and significant presence in San Pedro and provides technical support to farmers in the region.

In the municipality of Trancas where San Pedro is located, only ten percent of the land is flat agricultural land. Of that ten percent only a small portion is used for farming (Perez, 2013). In 2005 eighty five percent of the farms in the region were small scale producers who typically cultivated between three and ten hectares (INTA, 2013). San Pedro has two seasons: summer (November- April) which is rainy and warm, and winter (April-October) which

is cold and dry. The region receives 1000 millimeters of rainfall annually, which is considered minimal for year round agriculture production. However, this precipitation falls almost exclusively from November to April, making agriculture dependent on irrigation for much of the year.

Agriculture in San Pedro will be analyzed using two paradigm shifts in rural development, the small-farm-first approach and the shift towards internal resources and markets. Three agricultural models in San Pedro were observed: 1) subsistence, 2) agroecological, and 3) small scale commercialized production of vegetables. These practices are the result of two agricultural transitions away from subsistence into either, agroecological, or small scale commercialization. The transition to agroecology reflects both the small farm first approach as well as the shift towards internal resources and markets.

Traditional Subsistence Farming in San Pedro de Cololao

Traditional agricultural production in San Pedro is classified by its subsistence nature. Most small scale farmers produce maize, peas, legumes, and squash for subsistence (Perez, 2013). All the seeds are acquired via seed saving or exchanging and come from local varieties (Perez & Quiroga, 2013). Farmers also keep chickens, pigs goats and cows for meat, milk, eggs and on occasion sell them for extra income (INTA, 2013). Maize is produced for both animal and human consumption. Chickens, dogs, pigs, horses and cows all consume corn (Perez & Quiroga, 2013). Alfalfa is also grown to feed horses and cattle (Perez & Quiroga, 2013). Fruit was traditionally collected by foraging and the traditional fruit is the fig (Perez, 2013). Apricots, raspberries and blackberries are also grown and are often made into preserves to be sold for extra income. These fruits are bought as starts in the city of Tucuman and originally come from Mendoza, one of Argentina's largest fruit producing regions (Quiroga, 2013).

The majority of small scale Argentine farmers in the region use no agrochemicals (Perez, 2013). They avoid them and try to use them as a last resort if there is a visible problem that can only be addressed through their use (Quiroga, 2013). Typically they plant and till by hand and use ditch irrigation. Legumes, peas and barley are winter crops and require irrigation because they are planted in the dry season (INTA, 2013). Corn is planted during the wet season and warm months and therefore does not require as much irrigation (Perez, 2013). All other crops such as berries and winter greens require irrigation (Perez, 2013). Farmers are required to pay an annual fee to access irrigation water (Quiroga, 2013). Due to low incomes, some small farmers in the region receive financial assistance from the government to help with basic needs (Perez, 2013).

Case study: Farm A: Traditional Subsistence Farm

A visit to a small scale Argentine farm revealed a production strategy that mixed subsistence farming with leasing a portion of land to Bolivian immigrants for vegetable production. The primary crops produced are maize, squash, berries, peaches and apricots. Chickens, pigs and cows are also raised for self-consumption and occasional sale in the local market. Of the crops mentioned maize and fruit are the only two sold after they are processed. The maize is ground down and sold for humitas, a local food consisting of meat, and veggies placed in ground maize, wrapped in maize husks, and boiled. Fruits and berries are made into preserves and sold mostly to tourists. The fruit trees and berries are bought as starts in Tucuman and the maize and squash seeds are collected from previous harvests. This farm uses irrigation for all crops, and pay an annual rate for water. They do not use any chemical fertilizers or pesticides on their crops.

To a degree, this subsistence farm agrees with the small-farm-first approach. It shows that small farms play a role in income generation and thus economic productivity. Although primarily subsistence, they do process small amounts of product for income as well rent their land to Bolivian farmers. The rental of land to other farmers, though not mentioned by the small-farm-first approach, could be viewed as an induced innovation where a surplus of land and need for capital, leads to leasing land to those who have a need to produce and the capital to rent it. They are also very efficient in their production and make use of the resources they have.

With regard to environmental impacts, this subsistence farm reveals a low level of impact by use of polycultural systems, heirloom seeds, and virtual absence of chemical pesticides and fertilizers. However, as the owner rents a portion of the land to Bolivian farmers who utilize intensive agricultural practices with known negative environmental effects, environmental sustainability is not fully expressed.

What has been observed to be highly environmentally sustainable has been the transition from farming for subsistence to agroecological farming for both income generation and subsistence. As defined in previous sections, agroecological farms apply the sustainable and efficient practices of subsistence methods yet invest more startup capital and produce more for commercialization and thus income generation. This transition represents the shift away from industrial agriculture by use of onsite non-chemical resources such as animal crop integration and polycultural systems, use of native and heirloom seed varieties and the internalization of markets by sale of honey.

Case study: Farm B, Agroecological Farm

While visiting farm B, a small family operated agroecological farm located in the outskirts of San Pedro, we were able to observe the application of agroecological methods. The farm practices techniques defined within the agroecology framework such as the use of polycultures, animal and crop integration for fertilization, and shading. For subsistence they produce squash, potatoes, corn, roots, chickens, eggs, lettuce, tomatoes and peppers. For commercial purposes, sometimes in partnership with INTA, they raise chicken, roosters, and primarily honey.

The farm has associations with INTA and seeks to address the socioeconomic and environmental issues faced by the community through agroecological practices in partnership with community outreach and development programs. In their opinion the primary problem is the lack of employment opportunities. San Pedro's economy relies strongly on tourism from San Miguel de Tucuman, so work is concentrated for only two months out of the year. Younger adults tend to migrate out of San Pedro to find consistent work. This was indeed the experience of the owner at farm B, who left San Pedro when young, to work in Buenos Aires, only to return decades later.

The solution they propose is to create an environmentally, socially and economically sustainable income and food security off the land using agroecological methods. The family and their farm serve as a working example of how income can be generated using sustainable practices as well as increase food security. They also promote the production of food for self-consumption rather than exclusively for the market, as they believe that the father family unit must be sustainable through self-provisioning. Farm B provides support to individuals and families through skill building. The bulk of the income from the farm comes from honey. In partnership with INTA they promote honey production and have access to 300 hives and small loans from the government to help other farmers get started. These loans come from the Policy for Small Farmers (basically a micro lending operation) through the Ministry of Agriculture that distributes loans to an organization that administers funds and provides technical assistance to the small farmer. Once 85% of the loan is paid back the organization or individual can get a larger loan.

Farm B is also a part of organizing and participating in an annual seed fair in which farmers gather from all over Argentina to exchange heirloom varieties of seeds. The owner believes this is very important and states that seeds are a treasure and as long as they have them and they are theirs they are free and cannot be patented and made GMO's.

The seed exchange also promotes and spreads biodiversity, an essential component of agroecology. This annual seed

exchange is supported by the Social Development Agency of Argentina, with occasional participation of the Minister and even the President.

Farm B also coordinates with INTA a seed packet project that addresses issues of food security and poverty. The seed packets provide families with a diverse variety of heirloom seeds to produce enough for subsistence. The goal with such packets is to allow families to grow their own vegetables thereby increasing food sovereignty and crop and nutrient diversity. According to Farm B, another possibility for the region is to produce seeds for sale. Seed production decreases the risk of the loss associated with perishable foods and provides small farmers with more control over when they sell.

Farm B can be seen as an example of the response to the shortcomings of industrial agriculture through the adoption of agroecological principles. Thus, it resignates with the paradigm shift away from industrial agriculture and towards internal resources and markets. This can be seen through several factors found in previous sections. 1) Farm B internalizes resource use by means of on site fertilizers through the integration of animals and crop integration, and seed saving, though may sometimes trade or purchase new varieties. Farm B also internalizes markets through the sale of honey and other crops at local markets. Furthermore, in partnership with INTA, it distributes seeds, starts and chicks free of charge to community members. Farm B also confirms the small farms first approach as they are efficient producers even though they are small scale.

Bolivian Farmers: Case Study

Also identifying with trends of the small farms first approach are the small scale commercial vegetable farms run by Bolivian immigrants. These farms represent that small scale farms can also serve as a base for income generation in the agriculture sector through small scale commercialization and intensification. This is represented by the observation of four factors: 1) Induced innovation; the Bolivian farmers substitute a lack of capital for a surplus of labor. 2) The use of some technologies such as fertilizers, pesticides and HYV's, GE and or GMO seeds, 3) The use of intermediaries to purchase seed and chemical inputs as well as sell their vegetables and thus 4) the sale of vegetables for external regional and national markets.

From observations and informal interviews we were able to understand the practices as well challenges of three small farms run by Bolivian immigrants. From each of these interviews we identified trends in their practices

that followed patterns of agricultural modernization, as well as trends that define the small farm first approach. The land the Bolivians rent is relatively expensive and thus requires intensive production to generate sufficient income.

Thus it is found to be more profitable for Argentine landowners to rent the land to Bolivian migrants who have a surplus of labor to both intensively produce vegetables and work the land, than it is for the Argentines to produce on it themselves.

The Bolivians typically produce small amounts of winter greens such as chard, kale and arugula, and bean and tomatoes for income. Beans typically make 1500 pesos per hectare and receive an application of pesticides five to six times in a 110 day frame. Tomatoes can generate about 100,000 pesos per hectare and receive pesticides every week, every day or every other day. Pesticide use on tomatoes is thus two to three times that of bean production.

Herbicides are not used as Bolivian farmers typically weed by hand. There is not a long wait period for harvest yet there are significant problems with runoff from pesticides.

The crops Bolivians produce are non-traditional crops, most often hybrids and GMOs (Perez, 2013 & Quiroga, 2013).

The seeds are purchased in Tucuman from seed distributors who source them from multinationals such as Cargill, Continental, De Kalk, Monsanto and Pioneer (Perez, 2013). Due to the fact that these seeds are either hybrids or GMOs they require, as mentioned above, significant chemical inputs both in the form of fertilizers and pesticides.

Some pesticides are brought from Bolivia illegally, and although prohibited in Argentina due to their toxicity, are used due to lack of enforcement of existing regulation.

The Bolivian farmers on Farm A's property produce tomatoes, lettuce, arugula and peas. Instead of paying him a flat rate to rent the land, they give him 50% of their profit when they sell their crop. All of the seeds are sourced from seed distributors in Tucuman. The seeds are known to come from North America. The Bolivians heavily apply pesticides and some nitrogen fertilizer to the tomatoes due to the fact that they are hybrid seeds and require the additional inputs to achieve ...yields.

Another Bolivian farm we visited produces primarily tomatoes, but also produces beans, peas, onions, chard, lettuce, arugula and maize. Tomato seeds are their highest expense, but they do not always have to pay up front for the seeds as they have special arrangements with seed distributors. The seeds are purchased in Tucuman are taken to the farm and planted in containers, later to be transplanted as starts. The farmer provides an example of how much he

made last time he sold his tomatoes; one carton of tomatoes sold for 30 pesos but it costs 18 pesos to produce due to the inputs used and transportation, thus were left with roughly 12 pesos profit. After the tomatoes die off, they grow peas and beans in their trellises. All produce is sold on the market except for some maize, which is used for animal and human consumption. One large extended family rents the land and lives onsite year round. During the busy season they bring other Bolivian workers because Argentines will not work in the fields. He explains that every lease is different. Some split the profit 50/50 with the landowner, some pay a yearly rent (some agreements can last up to 15 years) and some just keep the land clean and get to produce on it without charge. They pay annually for irrigation and use a tractor to till the land.

The third Bolivian farmer we visited worked on rented land in an extensive farm shared by eight Bolivian families. The amount of pesticide residue left on the tomatoes was visible. The method of production was monocropping and pesticides were applied liberally. Tomato plants were all hybrids and were separated by variety. Irrigation through canals and drip systems were used. Due to the expanse of the land they use tractors to till the land in preparation for selling or transporting. Protections against chemicals are not used when applying them.

Rural out migration creates a higher availability of land, as it opens land up. However, due to trends created by industrial agriculture, access to land and cultivation for commercial production requires capital or access to credit. Traditional subsistence agriculture in San Pedro, which has focused on corn and cattle production, seems to be evolving into small scale commercial production of vegetables by Bolivian immigrants. While this transition does embody elements of modernization theory and agricultural development, such as the use of intermediaries to reach a larger consumer base, as well as the commoditization and specialization of vegetable commercialization it does not comply with the pattern entirely due to the scale and labor intensity of the farming units. As it turns out the small-farm-first approach best describes how small scale farms also use green revolution technologies with induced innovation and some access to capital or credit.

The socioeconomic and environmental implications of these farm operations are little understood, though one can speculate due to the heavy use of agrochemicals, environmental degradation is significant. Although these farms are making a profit, farmers continue to live in poverty. They make their money during harvest time and must make payments on the land lease, inputs, irrigation and any machinery. Because we did not calculate their yearly net profit, it is not possible to say how economically efficient their operations are. The production itself remains very labor

intensive in response to the lack of capital and the surplus of cheap labor. These practices can be viewed as yet another response by individuals to increase their wellbeing and economic status in a agricultural sector which is significantly influenced by western models of development calling for expensive technologies and thus gaining access to the capital to invest in them.

Conclusions

Agriculture has long played a role in rural development. Through the modernization development paradigm agriculture has been pushed and predicted to evolve in specific directions. There is no question that traditional agriculture in rural communities is transitioning. These transitions are following patterns of mainstream industrial development, agroecological models or the small-farm- first approach. During a one-month period in a small rural community in NW Argentina, our research found that an agriculture transition is indeed happening and has been influenced by global, regional and a local forces and practices. We found three farming practices to be significant.

First, there are the traditional small-scale farms that produce primarily for subsistence. Second, we found agroecological farms that have commercialized and specialized aspects of their harvest, such as honey. Third, we found, small scale farms run by Bolivian immigrants on rented land for the commercial production of vegetables making use of hybrid seeds and extensive labor inputs.

Further research would be required to establish the cause of the transition from subsistence to agroecology or small scale vegetable production. Of particular interest are the small scale commercial vegetable farms run by Bolivian immigrants. More information is needed on their socioeconomic circumstances to gauge the success of their operations. Also, more research is needed to grasp the socioeconomic and environmental impacts these transitions lend for the future. What is unclear is if one of these transitions will become dominant, and which one that will be.

Because these transitions are occurring in a response to global and national economic development, they can be viewed as both a phase and a adaptation to economic pressures. Partnerships with national and international organizations may become of great importance to the future outcome and progression of these small farming operations. Thus if regulation is taken against the use of illegal chemical inputs by Bolivians, they may not be as supported as the small scale agroecological establishments who already hold a partnership with INTA. The complex web of cultural, social, economic and environmental interactions of agriculture in San Pedro cannot be fully understood in this report, however it does serve as an important base to understanding how farming practices and

individuals in rural communities are adopting to globalizing forces.

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