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Agrarian Frontiers: A Rural Studies Review

## INTERDISCIPLINARY COLLABORATION

POVERTY IN MISSOURI

NATURAL RESOURCE MANAGEMENT IN  
NEPAL

SUSTAINABLE INTENSIFICATION IN  
AFRICA

Agrarian Frontiers

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# AGRARIAN FRONTIERS

## A RURAL STUDIES REVIEW

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## Note from the Editor

*Anne Cafer*  
*Agrarian Frontiers*  
*Rural Sociology Graduate Student Association*

Interdisciplinary engagementment is at the heart of real problem solving. This issue, in many respects, speaks to this need for communication across disciplines, between scholars and stakeholders, and between the academe and the public.

From addressing issues of poverty in rural settings domestically and abroad, to encouraging socially informed scientific inquiry, the articles published in this volume are part of a growing desire, on the part of graduate students, to be real-world problem solvers. In order to address the most critical issues facing our generation we must look at issues of income disparity, food insecurity, and natural resource management in a holistic way and encourage our colleagues and fellow graduate students to pursue these hard conversations.

Working interdisciplinarily is both difficult and tedious, but the rewards for doing so are well worth the effort. Truly interdisciplinary work leads to sustainable solutions that are both culturally appropriate and economically viable.

It is our hope readers of this journal can appreciate the difficult nature of working in interdisciplinary groups but, through reading this material, are encouraged to do so.

## An Analysis of Distribution and Concentration of Poverty in Missouri

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**ABSTRACT** *The incidence of poverty is not uniform across geographical areas due to differences in socioeconomic, demographic, and locational characteristics. This study analyzes the poverty distribution and concentration across Missouri counties between 2003 and 2012 based on the two USDA county classifications i) Rural-Urban Continuum Codes (RUCC) and ii) Urban Influence Codes (UIC). The result shows that the number of counties with higher poverty rates than that national poverty rate increased between 2003 and 2012. However, the number of counties with higher poverty rate than that of the state of Missouri decreased in the same period. The RUCC 1 and 3 groups (both metro) had the lowest average poverty rates while RUCCs 7, and 9 (both non-metro) groups had the highest average poverty rates during that period. Statistically, there was a significant difference between the average poverty rate of the RUCC 1 group (metro counties) and the average poverty rate of non-metro groups RUCCs 6, 7, and 9 for all these years, indicating a higher poverty incidence in the non-metro counties. We used the concept of Location Quotient to develop an indicator for poverty concentration called Poverty Location Quotient (PLQ). This indicator was used to examine the poverty concentration in different county groups based on RUCCs and UICs. The average PLQ values for different county groups suggests that the poverty concentration was higher in the non-metro and not adjacent to metro area county groups. PLQ analysis also showed that the poverty concentration in the counties that are not adjacent to metro counties increased during the period. The counties with higher concentration of poverty (i.e. PLQ greater than 1) increased from 66 to 83 (out of 115 counties) in Missouri between 2003 and 2012. The results also indicate the percentage of poor living in their counties with 20 percent or more poor has doubled (from 13 to 26 percent) in Missouri between 2003 and 2012, which further supported the results based on PLQ index.*

**[Poverty distribution, Poverty concentration, Poverty Location Quotient, Rural-Urban Continuum Code, Urban Influence Code].**

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## INTRODUCTION AND PREVIOUS WORKS

Poverty incidence is not uniform within a state or the nation. People living in poverty tend to cluster in certain regions, counties, and neighborhoods in the US (Farrigan & Parker 2012; Bishaw 2011). Poverty is prevalent in the inner areas of cities, isolated rural areas, and Native American reservations in the US (Berube 2008; Nord 1998). Poverty in any location is an aggregate outcome of socioeconomic, demographic, political, environmental, and institutional variables and their interactions (Rupasingha & Goetz 2007; Crandall & Weber 2004; Mulherin 2000; Reardon 1995) and poverty represents both people and places (Berube 2008). Therefore, poverty is a multidimensional issue (Khatiwada 2010). Poverty related issues can be studied at individual, family, and different geographical levels. Individual or family level poverty is measured by the pretax money income threshold based on family size and age of family members (Hoynes, Page, & Stevens 2006). This study focuses its analysis on the distribution and concentration of poverty at county level in Missouri, and presents an aggregate picture of poverty rates for geographical locations based on the degree of rurality and their adjacency to metro areas.

Just like the distribution of poverty, issues related to the geographic concentration of poverty is another important aspect of poverty in the United States (Bishaw 2011; Khatiwada 2010; Rupasingha & Goetz 2007). William Julius Wilson's notable work, which is published in a book titled 'The Truly Disadvantaged', created interest in the spatial concentration of poverty in the urban areas. Wilson (1987) stated that during severe economic de-industrialization, inner-city poor black populations were left in the poor neighborhoods by the middle class black and other group of people. Farrigan and Parker (2012) also found that the poverty concentration increased in the US, especially in non-metropolitan areas and the areas where minority lives. The migration pattern also indicated that non-poor do not usually mix with the poor in their neighborhoods (Farrigan & Parker 2012). The migration of poor people from poor areas was lower than the non-poor people (Nord 1998; Grengs 2007). If the people living in poverty migrate from their areas, they end up in a poor neighborhood (Nord 1998; Grengs 2007).

In the literature, two methods are most commonly used to measure poverty concentration i.e Geographic Information Systems (GIS), and statistical method. Many authors have used GIS and statistical methods to examine poverty. For example Granges (2007) used the GIS method to examine the poverty concentration in Detroit by looking at the land use changes. Szwarcwald et al. (2002) used the statistical method by proposing an index and using a chi-square to explain the heterogeneity of poverty concentration among sub-regions (see equation below).

$$P_i = \frac{O_i}{n_i}$$

where,  $P_i$  is the poverty index for the whole area  $i$ ;  $O_i$  is the total number of people living in poverty in a geographical area  $i$ , and  $N_i$  is the total number of residents in a geographical area  $i$ . This index is for the whole area (example state). The sub-areas, the expected values are

$$E_{ij} = n_{ij}p_i$$

where  $n_{ij}$  is the population of the sub-area  $j$ .

Once expected and observed values are calculated  $\chi^2$  (chi-square) statistic is calculated to test differences.

Location based poverty analysis is an essential and complementary to poverty analysis at either the individual or household level. Realizing this fact, Rupasingha & Goetz (2003) identified that analyzing poverty using only income and employment is not enough to explain the complete picture of poverty in any location. This study focuses its analysis on the distribution and concentration of poverty in Missouri counties and presents the aggregate picture of poverty rate for geographies based on the degree of rurality and their adjacency to metro areas based on US Department of Agriculture (USDA) county classifications in Missouri between 2003 and 2012. Identifying the poorer county groups, based on rurality and adjacency to metro counties, will help understand the spatial distribution and concentration of poverty in Missouri. Such understanding is helpful in devising and implementing poverty reduction programs more effectively and efficiently.

## DATA AND METHODS

As indicated before, this study focuses its analysis on the geographical distribution and concentration of poverty based on county classifications. This study assumes that the macro level economic and political factors do not vary substantially among the counties within state political boundary; therefore, it is logical to compare poverty across the counties within the state boundary. Poverty data were collected from the Small Area Income and Poverty Estimates (SAIPE) and the US Census Bureau (UCB). The USDA Rural-Urban Continuum Codes (RUCCs) and the Urban Influence Codes (UICs) county classifications were used to explain the distribution and concentration of poverty in Missouri. RUCC and UIC classifications divide counties into 9 and 12 groups respectively based on the relative rurality of counties. The UIC classification, provides further detail on the adjacency of counties to metropolitan and micropolitan areas. The detailed descriptions of county groups based on RUCC and UIC are presented in table 1 and table 2 respectively.

**Table 1. Classification of Counties Based on RUCCs.**

<b>RUCC</b>	<b>Description</b>
<b>1</b>	Metro - Counties in metro areas of 1 million population or more
<b>2</b>	Metro - Counties in metro areas of 250,000 to 1 million population
<b>3</b>	Metro - Counties in metro areas of fewer than 250,000 population
<b>4</b>	Non-metro - Urban population of 20,000 or more, adjacent to a metro area
<b>5</b>	Non-metro - Urban population of 20,000 or more, not adjacent to a metro area
<b>6</b>	Non-metro - Urban population of 2,500 to 19,999, adjacent to a metro area
<b>7</b>	Non-metro - Urban population of 2,500 to 19,999, not adjacent to a metro area
<b>8</b>	Non-metro - Completely rural or less than 2,500 urban population, adjacent to a metro area
<b>9</b>	Non-metro - Completely rural or less than 2,500 urban population, not adjacent to a metro area

Source: USDA, 2013.

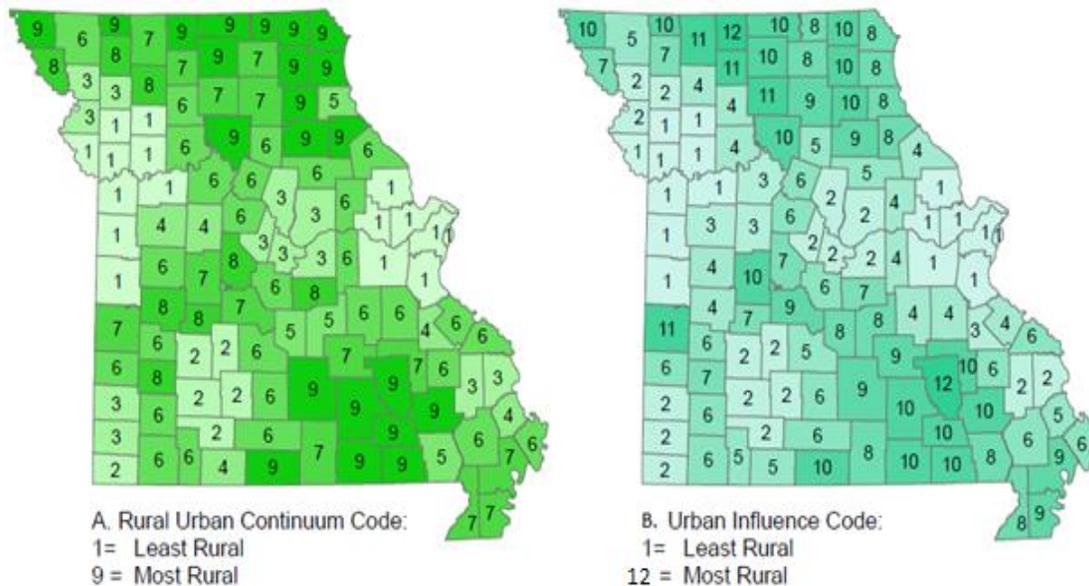
**Table 2. Classification of Counties Based on the UICs.**

<b>UIC</b>	<b>Description</b>
<b>1</b>	In large metro area of 1+ million residents
<b>2</b>	In small metro area of less than 1 million residents
<b>3</b>	Micropolitan area adjacent to large metro area
<b>4</b>	Non-core adjacent to large metro area
<b>5</b>	Micropolitan area adjacent to small metro area
<b>6</b>	Non-core adjacent to a small metro area and contains a town of at least 2,500 residents
<b>7</b>	Non-core adjacent to a small metro area and does not contain a town of at least 2,500 residents
<b>8</b>	Micropolitan area not adjacent to a metro area
<b>9</b>	Non-core adjacent to micro area and contains a town of at least 2,500 residents
<b>10</b>	Non-core adjacent to micro area and does not contain a town of at least 2,500 residents
<b>11</b>	Non-core not adjacent to metro or micro area and contains a town of at least 2,500 residents
<b>12</b>	Non-core not adjacent to metro or micro area and does not contain a town of at least 2,500 residents

Source: USDA, 2013.

The RUCC ranges from 1 (least rural) to 9 (most rural). Figure 1a shows the distribution of counties based on RUCC county groups in Missouri. The RUCC 9 counties in Missouri are generally more concentrated in the Northeast and Southcentral regions while the RUCC 1 counties, as expected, are clustered in two major metro areas, St. Louis City/ County and Kansas City of Missouri. All of the six counties included in RUCC 2 are in the Southwest regions of Missouri, and 5 of them are clustered together in and around Springfield metro area. The RUCC 3 counties are also clustered around Kansas City and other cities like Columbia, Jefferson City, and Joplin. Most of the RUCC 6 counties surround the metro areas of the

RUCCs 1, 2, and 3 counties. In addition to RUCC county classifications, this study also uses the UIC county classification to analyze poverty distribution and poverty concentration. The UIC county classification is similar to the RUCC county classification, but offers more detail (1= least rural, 12= most rural) on adjacency to the metropolitan and micropolitan areas (table 2). The distribution of counties based on UIC is presented in figure 1b.



**Figure 1. Map showing the distribution of RUCCs and UICs in Missouri.**

Source: Mapped with USDA data.

This study also tests the average rate of poverty based on different socioeconomic and demographic variables. In order to compare the counties based on six different socioeconomic and demographic variables, we divided the counties into two groups for each variable based on the rate in the county against the national rate (table 3). The data related to these socioeconomic and demographic variables were collected from US Census Bureau and USDA. These variables are used in this study because they are reported to be significant contributing factors in explaining poverty in the US (Farrigan & Parker 2012; Rupasingha & Goetz 2003; Madden 2000; Jargowsky 1997).

Poverty analysis was completed in two stages. In the first stage, the study examined the distribution of poverty (the average percentage of people living in poverty) based on county classification of the RUCC and the UIC classifications. A one-way Analysis of Variance (ANOVA) was used to determine the statistical differences in the percentage of people living in poverty among different counties.

**Table 3. List of Variables Used for County Classification.**

Variables	Definition
<b>Population 65 and Over</b>	1 if the county with higher percentage than national percentage, 0 otherwise.
<b>Single Parent</b>	
<b>Less Than High School Education</b>	
<b>Unemployment</b>	
<b>African- American Population</b>	
<b>Median Household Income</b>	1 if county with higher median household income than national median household income, 0 otherwise

This study uses poverty rate rather than the actual number of people living in poverty to compare the averages across county groups. This is because the counties with higher population likely to have more people living in poverty. The one –way ANOVA tested following null hypothesis.

$$H_0: \mu_1 = \mu_2 = \dots = \mu_n$$

$$H_a: \text{at least one county category is different from other county categories}$$

where  $\mu_i$  is the mean percentage of a county group  $i$ . Once the null hypothesis was rejected, all possible pairs of county groups were compared using the TukeyHSD (Tukey Honest Significant Differences) method.

In the second stage, poverty concentration was analyzed. Our measure of poverty concentration is different from two methods ( i.e GIS and statistical) commonly found in the poverty literature. This study uses a poverty concentration index based on Location Quotient (LQ) technique. LQ is frequently used in regional economics to determine the specialization or concentration of an industry in any location as compared to reference economy (Swanson & Tayman 2012; Shaffer, Deller, & Marcouiller, 2004). The LQ technique has been extensively used as an indicator for specialization or concentration of an industry. This study utilizes the same concept of industrial concentration of LQ to calculate the poverty concentration and is called the Poverty Location Quotient (PLQ) index which is defined as follows:

$$PLQ_{ij} = \frac{\frac{\text{Number of people living in poverty in county } i \text{ in year } j}{\text{Total population of county } i \text{ in year } j}}{\frac{\text{Number of people living in poverty in the US in year } j}{\text{Total population in the US in year } j}}$$

where,  $PLQ_{ij}$  = Poverty Location Quotient index for county  $i$  in year  $j$ .

The PLQ is the ratio of a county poverty headcount ratio to national poverty headcount ratio. A PLQ greater than one and less than one indicate higher and lower concentration of poverty respectively in a county as compared to the nation. PLQ one indicates the poverty concentration in a county is same as the nation's poverty concentration. The PLQ index is simple to estimate, and compares the poverty concentration among the counties based on the nation's poverty concentration. The average PLQ value was compared among the RUCC county groups using the one way-ANOVA in order to establish the statistical differences.

## RESULTS AND DISCUSSION

Poverty rates (percentage of people living in poverty) increased both nationally and in Missouri between 2003 and 2012 (table 4). In Missouri, the poverty rate increased from 11 to 16 percent, while the national poverty rate increased from 12 to 16 percent during the same period. The number of counties with a poverty rate higher than that of the nation increased from 66 to 83. However, the number of counties with poverty rate higher than the state of Missouri decreased from 80 to 77 (table 4). This suggests an increase in concentration of poverty during the ten-year period in Missouri compared to the nation.

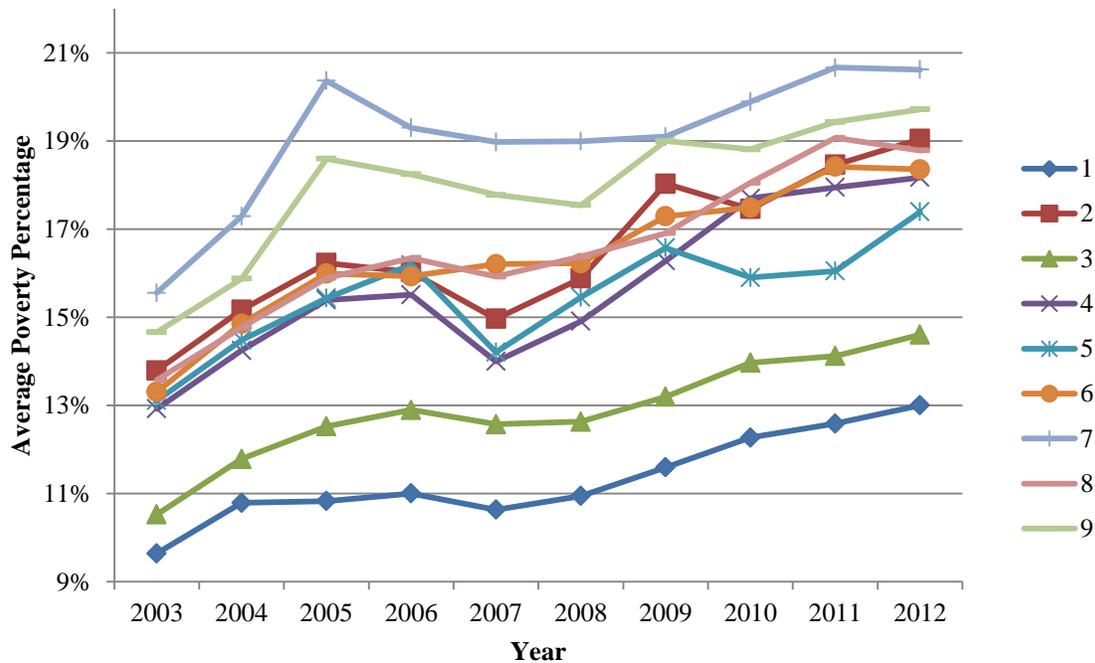
**Table 4. Poverty Trend Between 2003 and 2012 in Missouri and the US.**

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Missouri Poverty</b>	11%	13%	13%	13%	13%	13%	14%	15%	15%	16%
<b>Number of counties with higher poverty rate than the state of Missouri</b>	80	76	83	80	86	85	83	79	78	77
<b>National Poverty</b>	12%	13%	13%	13%	13%	13%	14%	15%	16%	16%
<b>Number of Counties with higher poverty rate than US</b>	66	77	83	84	86	86	86	79	77	83

Note: Total number of counties is 115.

Source: Constructed with data from SAIPE, US Census Bureau.

The average poverty rate was varied across different county groups as defined by RUCCs and UICs in the ten year period (table A and table B in the appendix). The RUCC 1 group (metro) had consistently had the lowest average poverty rate followed by RUCC 3 group (metro). The RUCC 7 group (non-metro and not adjacent to metro area) had consistently higher average poverty rate followed by the RUCC 9 group (non-metro and not adjacent to metro area) among nine different RUCC county groups (figure 2). The overall analysis shows that the rural counties had a higher poverty rate than the metro counties in Missouri. Surprisingly, the RUCC 2 group even though composed of metro counties, had a higher poverty rate than non-metro county groups and other metro county groups. Contrary to the general expectation, the RUCC 7 has the highest poverty rate than the RUCC 9 group, which is the most rural county group.



**Figure 2. Average poverty rate in different RUCC county groups in Missouri.**

Source: Constructed with data from SAIPE, US Census Bureau.

Figure 2 and table A (see appendix) indicate differences in the average poverty rate among different RUCC groups. One-way ANOVA results showed the average poverty rates of the RUCC 1 group (most metro) was statistically different from the average poverty rate of RUCC 6 (non-metro, adjacent to metro) 7, and 9 (both rural, non-adjacent to metro) groups and statistical differences hold for the entire period of time (table 5). The average poverty rate of RUCC 1 group was also significantly different with the RUCC 8 (rural, adjacent to metro) group but only in 2007 and from 2010 to 2012. There was a significant difference (in all ten years) in the average poverty rate between the RUCC 3 group (metro) RUCCs 7 and 9 groups (both non-metro, non-adjacent). This statistically significant difference suggests that the adjacency to the metro area likely to have some effect on the poverty rate. Contrary to expectation, the statistical difference observed between the RUCC 1 and RUCC 2 groups in the year 2009 even though both RUCC groups include metro counties and have significant higher population size than other counties.

**Table 5. Test of Average Poverty Rate Between the RUCC County Groups.**

RUCC County Group	Significant Year(s)
<b>RUCC 1 vs RUCC 6</b>	All years (2003 to 2012)
<b>RUCC 1 vs RUCC 7</b>	All years (2003 to 2012)
<b>RUCC 1 vs RUCC 9</b>	All years (2003 to 2012)
<b>RUCC 3 vs RUCC 7</b>	All years (2003 to 2012)
<b>RUCC 3 vs RUCC 9</b>	All years (2003 to 2012)
<b>RUCC 1 vs RUCC 8</b>	2007, 2010, 2011, 2012
<b>RUCC 1 vs RUCC 2</b>	2009

Note: This table only shows significant (at the 0.05 level of significance) pairs.  
Source: Estimation.

One-way ANOVA results based on the UIC classification are presented in the table 6 below. The results show that the average poverty rate of the UIC 1 group (metro) was significantly different from the UICs 6 (non-core and adjacent to a small metro area), 9 (non-core and adjacent to micro area), and 10 (non-core and adjacent to micro area) groups for the entire period (table 6). The average poverty rate of the UIC 1 group was also significantly different with the average poverty rate of the UIC 8 group (micropolitan and not adjacent to metro area) only between 2005 and 2010. Additionally, the average poverty rate of the UIC 1 group was significantly different with the average poverty rate of the UIC 4 group (non-core adjacent to large metro) but only in the year 2007 (table 6).

**Table 6. Test of Average Poverty Rate Between UIC County Groups.**

UIC county group	Significant Year(s)
<b>UIC 1 vs UIC 6</b>	All years (2003 to 2012)
<b>UIC 1 vs UIC 9</b>	All years (2003 to 2012)
<b>UIC 1 vs UIC 10</b>	All years (2003 to 2012)
<b>UIC 1 vs UIC 8</b>	2005 to 2010
<b>UIC 1 vs UIC 4</b>	2007
<b>UIC 2 vs UIC 10</b>	2003, 2005 to 2011

Note: This table only shows significant (at the 0.05 level of significance) pairs.  
Source: Estimation.

In addition to making comparison among RUCC and UIC groups, counties were also compared by classifying the counties into two groups based on socioeconomic and demographic characteristics of counties comparing with the national average (table 3). These variables are identified in the literature as the major factors affecting the poverty rate in the US. As expected, results indicate that the average poverty rate is significantly different and remains different throughout the decade (table 7). This result supports the findings of the other studies and established the evidence that these variables are also important in explaining the distribution of poverty in Missouri too.

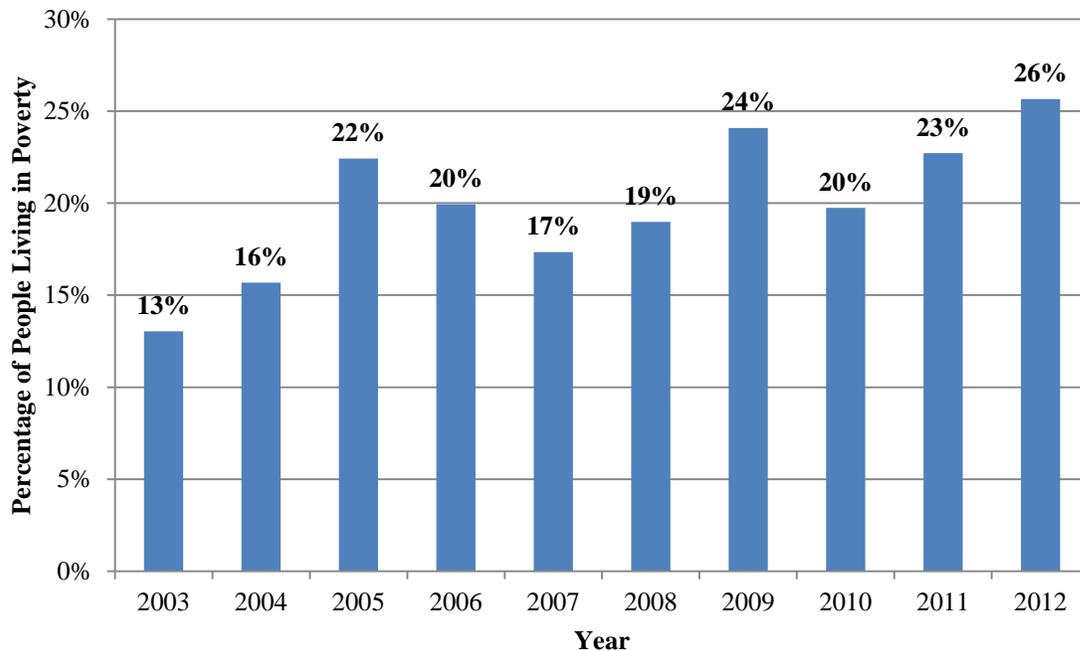
**Table 7. Test of Means Between County Groups Based on Different Socioeconomic Variables.**

Types of counties	Significant Year(s)
<b>Population of 65 and over</b>	All years (2003 to 2012)
<b>Single parent</b>	All years (2003 to 2012)
<b>Less than high school education</b>	All years (2003 to 2012)
<b>Unemployment</b>	All years (2003 to 2012)
<b>African- American Population</b>	All years (2003 to 2012)
<b>Median household income</b>	All years (2003 to 2012)

Source: Estimation.

### *Poverty Concentration*

The increasing trend in the poverty concentration is another issue raised by many researchers. In the United States, about 50 percent of all people living under poverty were in the census tracts that have poverty rates of equal or greater to 20 percent during 2006-2010 (Bishaw, 2011). The result of this study shows that about 26 percent of total people under poverty were living in counties that had poverty rates equal or greater to 20 percent in 2012 in Missouri. The results also show that there was an increasing trend of low income people living in the counties that had poverty rates of equal or greater to 20 percent. In 2003, there were only 13 percent people under poverty living in the counties that had poverty rates of equal or greater to 20 percent, but it reached 26 percent in 2012 (figure 3). During this period, the number of counties with poverty rates of equal or greater to 20 percent also increased from 4 to 34. These trends indicate an increasing trend of poverty rate and poverty concentration in Missouri.



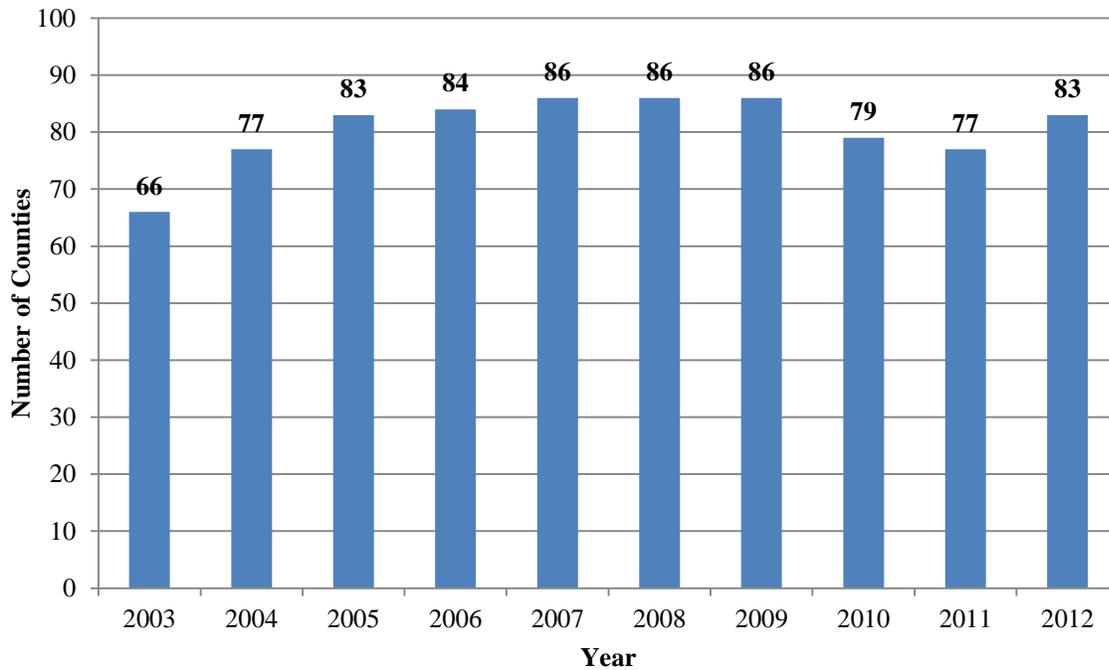
**Figure 3. Percentage of People Living in Poverty in the Counties with Poverty Rates Equal or Greater to 20 Percent.**

Source: SAIPE, US Census Bureau.

To examine the poverty concentration among the county categories, the average PLQ value was used. The number of counties with greater than one PLQ value increased between the period 2003 and 2012 indicating increasing concentration of poverty in Missouri compared to the poverty concentration at the national level. In 2006, there were 66 counties in Missouri with greater than one PLQ; it reached to the highest 86 counties in 2007, stayed this level till 2009, and decreased to 83 counties in 2012 (figure 4).

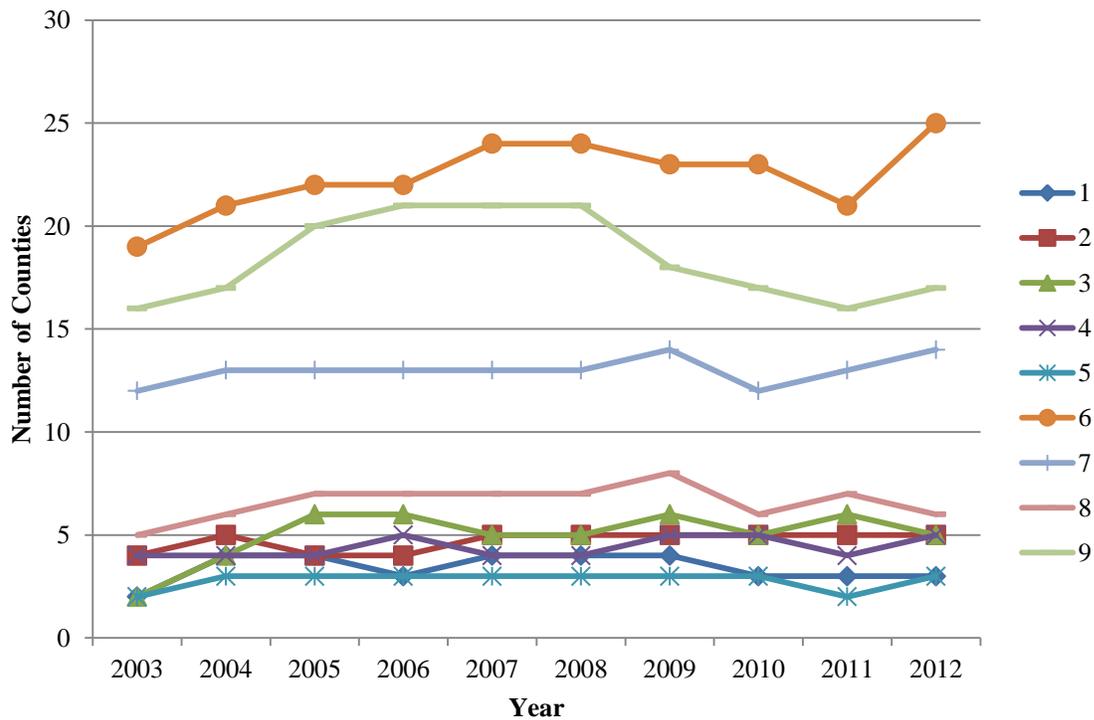
The increasing number of counties with higher than one PLQ values warranted further analysis of poverty concentration based on county types and the trend over time.

The RUCC 6 group (non-metro and adjacent to metro) had the highest number of counties with higher than one PLQ throughout the period of analysis. There were 19 RUCC 6 group counties (non-metro and adjacent to metro) with greater than one PLQ value in 2003 and increased to 25 in 2012 (figure 5). Similarly, the RUCC 9 group (rural and not adjacent to a metro) had the second highest number of counties with higher than one PLQ value. The RUCC 7 group (non-metro and not adjacent to metro area) had the third highest number of counties with greater than one PLQ value. The results suggest that the concentration of poverty was higher in the metro adjacent rural counties and most rural counties. Surprisingly, the RUCC 5 group (non-metro and not adjacent to metro area) had the lowest number of counties with PLQ value higher than one (figure 5).



**Figure 4. Number of Counties with Greater than One PLQ.**

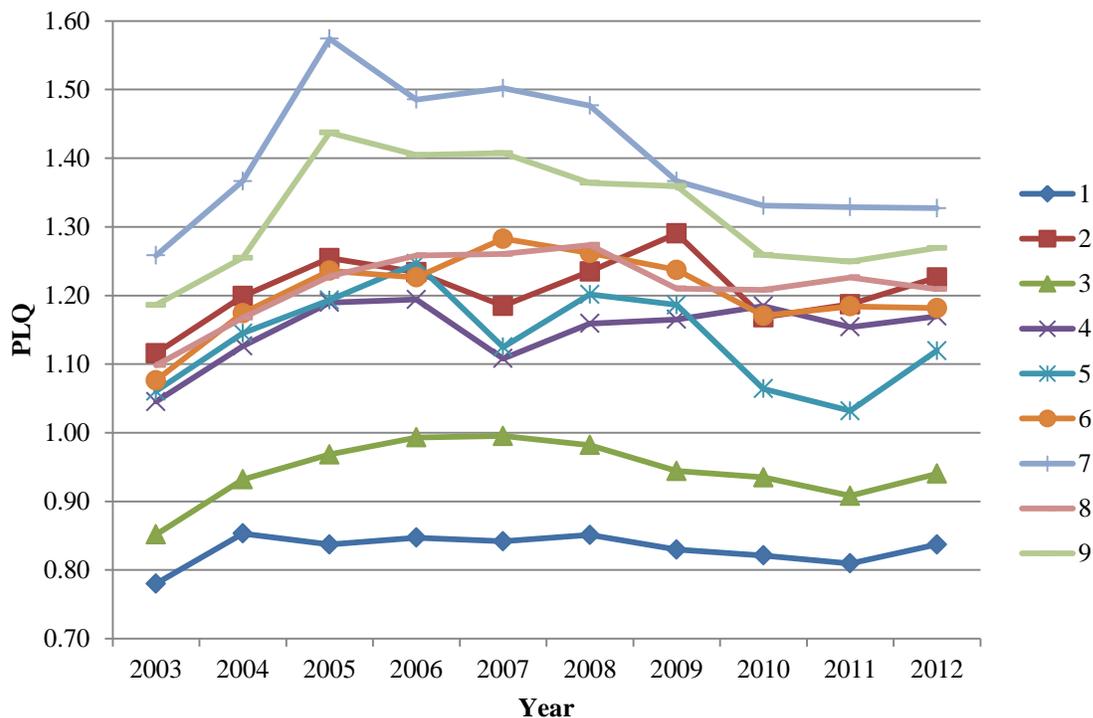
Source: Constructed with data from SAIPE, US Census Bureau.



**Figure 5: Number of Counties with Greater than One PLQ by RUCC County Groups.**

Source: Constructed with data from SAIPE, US Census Bureau.

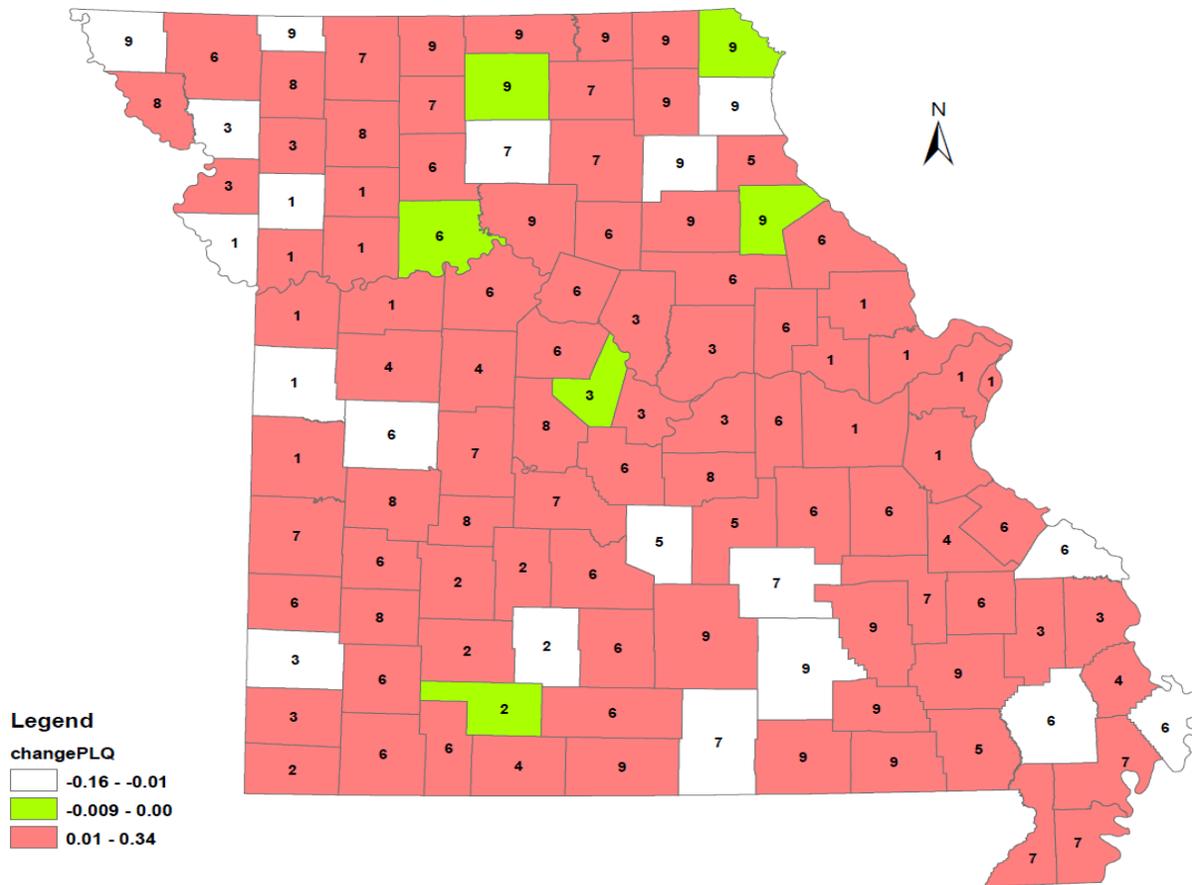
While looking at the trend of average PLQ values, the RUCC 1 and RUCC 3 groups (both metro) had consistently one or less than one average PLQ value throughout the period of analysis. This suggest that poverty was less concentrated in these two groups compared to the extent of poverty concentration at the national level (figure 6). The remaining RUCC groups (2,4,5,6,7,8, and 9) had PLQ value greater than one for the entire duration suggesting a higher concentration of poverty compared to the nation. The RUCC 7 group followed by the RUCC 9 group (both non-metro and non-adjacent) had the highest concentration of poverty for the entire duration. The RUCC 2 group even though comprises metro counties had a higher concentration of poverty similar to other non-metro county groups like RUCCs 4, 5, 6, and 8.



**Figure 6: The Trend of Average PLQ Values by RUCC County Groups.**

Source: Constructed with data from SAIPE, US Census Bureau.

Finally, a change in poverty concentration analysis was done at the individual county level. The analysis shows very little change in PLQ value between 2003 and 2012. There was a reduction in poverty concentration in 19 counties in the ten-year period. Out of 19 counties, 6 were metro counties and 13 counties were non-metro counties (Figure 7). Again, of the 19 counties, 8 were not adjacent to metro area. This suggests that poverty concentration was more in the non-metro and non-adjacent metro counties. There was basically no change in PLQ value in the six counties over the 10 year period, with half of them fall in the RUCC 9 group. The change in PLQ values were also examined using UIC groups and had shown the similar results.



**Figure 7. Map showing changes in PLQ values.**

Source: Mapped with data from SAIPE, US Census Bureau and USDA.

## SUMMARY AND CONCLUSIONS

Poverty is not uniformly distributed across geographical locations. Therefore, it is important to understand poverty in a locational perspective. This study attempted to analyze the spatial distribution and concentration of poverty for Missouri using USDA county classifications. The results indicate that poverty rate and poverty concentration in Missouri was increasing between 2003 and 2012. In general, the metro counties had a lower poverty rate than rural and non-adjacent to metro counties. However, the most rural county group did not have the highest poverty rate among all rural county groups. Additionally, a metro county group (RUCC 2 group) had higher average poverty rate than some of the non-metro counties. The study also found that the socioeconomic and demographic variables like population of 65 and over, single parent, population with less than high school education, an unemployment rate, African- American population, and median household income were important to describe the differences in the poverty rates in Missouri. A new poverty concentration index PLQ based on Location Quotient concept was used to explain to poverty concentration in Missouri. Again, in general, the poverty was more concentrated in non-metro county groups than that of metro counties. Within the non-metro county groups, the county groups that are not-adjacent to metro had higher poverty

concentration. Given the fact that number of counties in some of the groups was too small (due to the fact that we consider only the state of Missouri), it may be useful to consider more number of states or the whole nation in the analysis to validate the difference among different county groups. Even though the results based on this study can not be generalized to the county groups at the national level, this study does provide an alternative way of comparing poverty concentration (PLQ index). The result of this study at the individual state and it's validation at the national level can provide better understanding in devising and implementing regional and rural programs aiming at poverty reduction more effectively and efficiently.

## APPENDIX

**Table A: Average number of people living in poverty and poverty rate based on RUCC county groups.**

RUCC code		1	2	3	4	5	6	7	8	9
Number of counties		16	6	12	5	4	28	14	8	22
Poverty 2003	Number	20021	8424	6033	5927	5111	2738	3214	1322	1269
	Percent	10%	14%	11%	13%	13%	13%	16%	14%	15%
Poverty 2004	Number	22685	9454	6808	6648	5700	3073	3583	1449	1383
	Percent	11%	15%	12%	14%	15%	15%	17%	15%	16%
Poverty 2005	Number	22067	9470	7615	7243	6133	3299	4197	1574	1592
	Percent	11%	16%	12%	15%	15%	16%	20%	16%	19%
Poverty 2006	Number	23348	9744	7617	7398	6448	3341	3970	1629	1578
	Percent	11%	16%	13%	16%	16%	16%	19%	16%	18%
Poverty 2007	Number	22041	9966	7723	6826	5752	3405	3920	1604	1524
	Percent	11%	15%	13%	14%	14%	16%	19%	16%	18%
Poverty 2008	Number	22306	10828	7850	7246	6263	3419	3943	1616	1533
	Percent	11%	16%	13%	15%	16%	16%	19%	16%	17%
Poverty 2009	Number	24828	12727	8452	7991	6769	3651	4026	1704	1638
	Percent	12%	18%	13%	16%	17%	17%	19%	17%	19%
Poverty 2010	Number	26289	13162	8766	8877	6665	3683	4208	1805	1643
	Percent	12%	18%	14%	18%	16%	17%	20%	18%	19%
Poverty 2011	Number	27605	12907	9160	9062	6732	3847	4358	1908	1675
	Percent	13%	19%	14%	18%	16%	18%	21%	19%	20%
Poverty 2012	Number	28539	13290	9303	9237	7301	3885	4318	1849	1729
	Percent	13%	19%	15%	18%	18%	18%	21%	19%	20%

**Table B: Average number of people living in poverty and poverty rate based on UIC county groups.**

UIC		1	2	3	4	5	6	7	8	9	10	11	12
Number of counties		16	18	4	11	7	13	6	11	7	16	4	2
Poverty 2003	Number	20021	6830	5299	2096	4069	2791	1307	3693	3135	1371	1807	809
	Percent	10%	12%	13%	13%	13%	14%	13%	14%	15%	16%	14%	15%
Poverty 2004	Number	22685	7690	5963	2344	4560	3130	1436	4129	3475	1505	1981	821
	Percent	11%	13%	14%	14%	14%	16%	14%	15%	17%	17%	15%	15%
Poverty 2005	Number	22067	8233	6302	2631	4912	3339	1540	4637	3986	1770	2287	977
	Percent	11%	14%	14%	16%	15%	17%	15%	17%	20%	20%	17%	18%
Poverty 2006	Number	23348	8326	6588	2453	4967	3525	1606	4598	3970	1672	2251	992
	Percent	11%	14%	15%	15%	15%	18%	16%	17%	20%	19%	17%	18%
Poverty 2007	Number	22041	8471	6384	2596	4787	3474	1589	4308	3815	1652	2243	966
	Percent	11%	13%	14%	16%	15%	17%	15%	16%	19%	19%	17%	18%
Poverty 2008	Number	22306	8843	6396	2548	5339	3396	1628	4598	3766	1641	2242	910
	Percent	11%	14%	15%	15%	16%	17%	16%	17%	19%	19%	17%	17%
Poverty 2009	Number	24828	9877	7059	2684	5751	3644	1737	4795	3874	1775	2285	1041
	Percent	12%	15%	15%	16%	17%	18%	17%	17%	19%	20%	17%	19%
Poverty 2010	Number	26289	10231	7960	2745	5788	3724	1832	4855	4116	1768	2274	1062
	Percent	12%	15%	18%	17%	17%	19%	18%	18%	20%	20%	17%	20%
Poverty 2011	Number	27605	10409	7959	2922	6159	3822	1918	5025	4096	1806	2399	1169
	Percent	13%	16%	17%	17%	18%	20%	19%	18%	20%	21%	18%	21%
Poverty 2012	Number	28539	10632	7996	2896	6319	3901	1828	5108	4359	1853	2259	1156
	Percent	13%	16%	17%	18%	19%	19%	18%	18%	21%	21%	17%	21%

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## Social Capital and Collective Management of Natural Resources in Nepal: A Case Study of Community Forestry

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**ABSTRACT** *Community-based forest management has been popular and effective in Nepal. Community forest comprises 96 percent of the total forest under different community based management regimes. This case study of Debnagar community forest shows that forest protection (grazing bans, forest fire control and cessation of illegal timber harvesting) is the first important objective. Members of the Community Forest Users Group (CFUG) reported feeling proud and satisfied with working in a group for the management of forest resources. The theoretical underpinning of the social capital approach was used to analyze the process and progress of the CFUG. They have been successful in linking forest management practices with economic activities such as marketing forest-based products, saving-credit, and the domestication of high value medicinal and aromatic plant species. The CFUG has noticed an improvement in regeneration and increased floral and faunal diversity in forest areas.*

**[Social capital, Community forest, Non timber forest products, Resource]**

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## INTRODUCTION

Nepal is a landlocked and agrarian country with a total land area of 147,181 sq. km. It lies between 26° 22' N - 30° 27' N latitudes and 80° 4' E - 88° 12' E longitudes. Roughly rectangular in shape, the land extends approximately 885 km. east-west and ranges from 145 km. at its narrowest to 241 km. at its broadest, north-south. The country is bordered by China in the north and by India in the south, west, and east. The landmass is divided into three geographical zones, the high Himalayas, the mid- Himalayas or mountainous region with long terraced slopes leading to fertile valleys, and the flat, sub-tropical Terai region (MOAC 2011).

Nepal has a great variety of topography, which is reflected in the diversity of weather and climate. The country experiences tropical, mesothermal, micro-thermal, taiga, and tundra types of climate. Annual precipitation ranges from less than 250 mm in the central part to 1500 and 2500 mm over different parts of the country. Monsoon season (June-September) receives about 60 to 80 % of annual rainfall. Wide variations in agro climatic regions from tropical to temperate and alpine climates provide opportunities to produce a wide variety of agro commodities. Based on physiographic delineation of presently cultivated area, four distinct ecological zones are distinguishable in Nepal (MoFSC 2012):

- **Tropical zone:** The tropical zone runs east-west along the southern part of Nepal, with elevation ranging from 60 to 1000 m.
- **Subtropical zone:** The subtropical zone also runs east-west along the middle part of the country with elevation between 1000 and 1500 m.
- **Warm temperate zone:** The warm temperate zone is restricted to hill slopes in the mid and high mountain physiographic regions and has elevation ranging from 1500 to 2000 m.
- **Cool temperate zone:** In the cool temperate zone, elevation ranges from 2000 to 3000 m.

## NATURAL RESOURCES

### *Forest and Non Timber Forest Products (NTFPs)*

Broadly, Nepal can be divided into three regions, namely Terai, Hills, and Mountains. These regions comprise 23%, 42% and 35% respectively. The major land use categories in Nepal are forest, agriculture land (including non-cultivated), grassland, shrub lands, water, and others. The major agricultural systems are tropical, subtropical, warm temperate, cool temperate, subalpine, and alpine. The land use statistics of Nepal are presented in Table 1.

**Table 1. Land Use Pattern of Nepal.**

Land Use Category	Land Area ha. ('000)	Percent
Forest (including shrub)	5828	39.59
Agricultural land (cultivated)	3091	21.00
Grass land and pasture	1766	11.99
Agricultural land (uncultivated)	1030	6.99
Others	3003	20.40

Source: Ministry of Agriculture and Cooperative (MOAC), 2011

Various types of forests are found in Nepal. Nepalese forests are rich in medicinal and aromatic plants. Timber and herbs are valuable natural resources. Forests sustain a wide range of animals. Birds and wildlife have been good sources of foreign currency as they attract a large number of tourists. Still, the majority of livestock rearing relies on the forest for fodder and grazing. Numerous National Parks and Wildlife Reserves have been established in the forested regions. The forestry sector has received significant attention in Nepal's periodic development plans as a means to achieve Nepal's poverty reduction goal (APP 1995).

Non-Timber Forest Products (NTFPs) support the poor in many parts of Nepal. In the past, the rationale for forest conservation was simply to sustain the timber industry. With the rise of community forestry in Nepal, local people are gaining better access to significant benefits from NTFPs. NTFPs are often common property resources and in some places serve as open access resources too (Arnold 1995). The use of medicinal and aromatic plant species has been an overwhelmingly remunerative business for the mountain endogenous people (Edwards 1996). NTFP-based enterprises contribute to foreign exchange earnings; they also support biodiversity and other conservation objectives (Shrestha 1998). Edwards (1996) estimated that every year 10,000-15,000 tons of NTFPs, representing around 100 species, are harvested from forest land in the mid-hills and high mountains regions of Nepal. Studies show that more than 700 species of medicinal and aromatic plants are available in Nepal (Shrestha 1998). The distribution has been found to be approximately 31% in tropical and sub-tropical zones, 55% in the temperate zone and 14% in the alpine zone (Hara et al. 1978). It can be argued that NTFP management should be understood as complementary to timber management, though NTFPs have comparative advantage in the high mountain region (Shrestha and Joshi 1993; Banjade and Paudel 2008).

### Water Resources

Despite being small and landlocked, Nepal is endowed with abundant water resources. There are about 6000 rivers in Nepal. Of the total, 33 rivers have a watershed coverage that exceeds 1000 square kilometers. Water resources sustain abundant floral and faunal species. Water resources play a critical role in irrigation. The majority of the rivers originate in the Himalayas. These rivers are perennial and have tremendous potential as a source of irrigation and hydropower development. About 23% of Nepal's total area lies above the permanent snowline of 5000m (MoPE 2010). Presently, about 3.6% of Nepal's total area is covered by glaciers and about 10% of the total precipitation in Nepal falls as snow (UNEP 2001).

### Keystone Wildlife

Nepal is one of the most biodiverse countries in the world. Compared to its small area of 141,181 km<sup>2</sup>, Nepal is home to 4.2% of all mammals, 8.5% of all birds, and 2.2% of all flowering plants on the earth (Shrestha et al. 2001). Nepal possesses the following threatened flagship species.

- Royal Bengal Tiger (*Panthera tigris tigris*)
- Asian Elephant (*Elephas maximus*)
- Greater One-horned Rhino (*Rhinoceros unicornis*)
- South Asian River Dolphin (*Platanista gangetica*)

The government of Nepal estimates the vast faunal diversity in 35 forest types and 118 ecosystems in Nepal (Shrestha 1998; MoFSC 2005). Almost 25% of the country's landmass is designated as protected area, with 10 national parks, three wildlife reserves, five conservation areas and one hunting reserve. The wildlife diversity status (in numbers) is presented in Table 2.

**Table 2. Diversity of Wildlife in Nepal.**

Categories	Total species	Endemic species	Threatened species
Amphibians	50	13	3
Birds	864	8	31
Mammals	203	4	29
Reptiles	123	11	6
Total wildlife	1240	36	69

Source: Ministry of Forest and Soil Conservation (MoFSC 2012); NPC 2004

## AIM AND OBJECTIVES

The aim of this study was to better understand the issues involved in forest resource management from the collective action perspective. Specific objectives include:

- Assess how social capital accelerates collective resource management, and
- Determine the effectiveness of community forestry in the tropical region of Nepal.

## METHODS

This research was primarily a desk study. The case study of one community forest user group was prepared from personal communication with a representative of Debnagar Community Forest Users Group (CFUG), Chitwan, Nepal.

## THEORETICAL FRAMEWORK

Social capital (SC) refers to an attribute of individuals in the form of networks such as groups, cooperatives, clubs, close-knit functional associations etc. Social capital thus comprises both networks and the assets that could be mobilized to achieve a specific goal of a project or program. Trust is the central element in developing sustainable social capital via personalized, generalized, and institutionalized trust. Social capital explains that social bonds and norms are important for people and communities (Coleman 1988). Most experts agree that social capital consists of three important dimensions: trust, social norms, and membership of social networks (Putnam 1995; Portes 1998). Because of connectedness and effective cooperation, social capital helps to reduce the cost of actions. Social capital lowers the transaction costs of working together (Pretty 2003). According to Pretty, four features of social capital are: i) relations of trust, ii) reciprocity and exchanges, iii) common rules, norms, and sanctions, and iv) connectedness in networks and groups. Trust building is an important component of success in collective resource management. Trust may be derived from various sources. Reciprocity plays a vital role in enabling trust between individuals, groups or communities; however it takes time to build.

In their study of the Mexican farming system, Grunewald and Bulte (2012) revealed that trust explains why some people more readily “catch up” with opportunities created by an expanding market, while others lag behind in poverty. Their proposition has important implications for economic incentives while conducting resource conservation practices. Basically they argued for personalized, generalized, and institutionalized trust. Trust influences adaptive behavior of actors in the collective management of resources and also affects economic outcomes. In Nepal, people who have worked in groups or cooperatives have realized stronger economic incentives than those working individually. People in the high mountain regions of Nepal collect NTFPs

and medicinal plants individually (because of resource constraints) but practice collective marketing to enhance bargaining power and negotiate better prices. Like other assets, trust may be considered an asset for economic activities because it promotes cooperation and stimulates more efficient social and economic exchange (Dasgupta 1998). The involvement and participation in groups can have positive consequences for the individual and the community.

Social capital comprises two elements: first, the social relationships themselves that allow individuals to claim access to resources possessed by their associates and second, the amount and quality of those resources (Bourdieu 1985). A diverse source of social capital reduces the distance between the sociological and economic perspectives and simultaneously engages the attention of policy-makers seeking less costly, non-economic solutions to social problems (Portes 1998). The acquisition of social capital requires deliberate investment of both economic and cultural resources.

### *Social Capital and Collective Management*

Social capital offers a route to sustainable management and governance of common resources (Pretty 2003). The likelihood of resource depletion is higher where natural resources are commonly owned. According to Pretty (2003), people tend to free-ride, both by overusing and underinvesting in the maintenance of resources. Increasing population has to use more and more resources that harm land, water, forest and other resources. Hardin (1968) argues that mutual coercion, mutually agreed upon, is necessary to have effective collective action. In contrast, privatization increases the likelihood that resources will be more carefully managed (Demsetz 1988). Development workers and policy makers generally believe that if communities are given control over their resources and access to technical and managerial assistance, they will act to conserve their natural resources. It has been resulting in better outcomes for forestry, irrigation water management (Pretty 2003) and very recently in watershed too (Pradhan et al. 2012).

Through social capital, stakeholders can improve their capability to access various environmental and economic resources such as forest user groups, irrigation water user groups, group loans, protected markets, etc. It is widely accepted that social capital focuses on social relations that have productive benefits. However, social capital does not have a clear, undisputed meaning (Dolfsma and Dannreuther 2003). It is context specific and differs in conceptualization and operationalization accordingly. It will depend on the discipline and level of investigation (Robison et al. 2002).

## COLLECTIVE MANAGEMENT OF FOREST RESOURCES

Community-based management has been a hallmark in sustaining Nepal's forests and biodiversity. Nepal has taken a number of approaches to community management, including

community forestry, buffer zones around national parks, conservation areas, leasehold forestry, protected forests, and collaborative forest management. Community forestry is the second largest forest management regime after government-controlled management. Local communities in Nepal are managing about one-third of the country's forests. Between the 1960s and 1990s, the forest cover decreased from 60% to 29% (FAO 2009). However, after the advent of community forestry, forest cover increased to 40% by 1994. In addition, community forestry has contributed to decreased poverty and also contributes to social development activities (MoFSC, 2005). Nepal has also been successful in directly conserving biodiversity and forests with one of the highest percentages of land under protection (>23%) in the world, putting it in the top 20 countries (and second in Asia) for most area protected (Allendorf 2007). About 31% of Nepal's forests (1.71 of 5.5 million hectares) are managed by the local communities (Tables 3 and 4). This area does not include buffer zone area forest. The conditions of the community-managed forests are better than the government forests (Allendorf 2007; MoFSC 2012).

**Table 3. Forest Under Different Community-Based Managed Regimes in Nepal.**

Types of Forest	Forest area (ha)	Percent
Community Forests	1,664,918	96.03
Leasehold Forests	38,997	2.25
Collaborative Forests	29,798	1.72
Total	1,733,713	100.00

Source: Ministry of Forest and Soil Conservation (MoFSC 2012)

**Table 4. Status of Community Forests (CF) in Nepal.**

Ecological Belts	No. of HHs	% of HHs covered by CFUG	Community Forests	CF area	Households Members
			Number (%)	Area (ha) (%)	Number (%)
Mountains	319,887	91.85	2,861 (16.07)	269,526 (16.19)	293,801 (13.39)
Hills	1,982,753	71.36	12,882 (72.34)	1,095,054 (65.77)	1,414,835 (64.48)
Terai	1,950,580	24.90	2,065 (11.60)	300,338 (18.04)	485,714 (22.13)
Total	4,253,220		17,808	1,664,918	2,194,350

Source: MoFSC 2012

### *Forest Management Policy*

The government of Nepal has initiated a legislative approach to handover the public forest to the communities as a community forest. This legislation defines and ascertains secure tenure rights and the authority to manage and utilize common property resources. The Forest Act (1993) and the associated Community Forestry Directives of 1995 declare that communities have the right to constitute Community Forest Users Groups (CFUGs), which function democratically. CFUGs can harvest and trade forest products as well as collect the royalties levied on forest products. Community forest management identifies rural users as the true stewards of the forests who are then responsible for conserving, developing, managing, and utilizing the forest resources (Acharya 2002).

### CASE STUDY: DEBNAGAR COMMUNITY FOREST USERS GROUP (CFUG), CHITWAN, NEPAL

This case study was prepared based on personal communication with members of CFUG. Debnagar forest in Chitwan district has been managed by the local Debnagar Community Forest Users Group, which was established in 2003. There are a total of 245 members in the CFUG. The CF is 25 kilometers southeast of the district headquarters. It consists of 351 ha of tropical forest with abundant floral and faunal habitat. In addition, there is one small watershed (37 ha), which plays an important role in water storage. The water accumulated in this watershed is diverted to a permanent irrigation channel, which passes through the middle of the community forest area. In addition, the watershed is a popular site for migratory bird watching in the summer.

The government of Nepal has given priority for women's involvement in resource management. The government office in each region gives incentives (waiver on registration fee, tax and transportation subsidies) for CFUGs headed by women.

Forest protection (grazing bans, control of forest fire, and cessation of illegal timber harvesting) is the first important objective of this CFUG. Community Forest (CF) saw a three folds increase in tree species during the period of 2003-2012. Not all trees are mature yet. The CFUGs have noticed an improvement in regeneration and increased floral and faunal diversity in forest areas. The majority of the people in the CFUG region are farmers and are rearing milking cows on a commercial scale. In the early years of the project, farmers experienced difficulties addressing certain household needs such as fodder, firewood, and some other forest products. After three years, the CFUG developed the "Conservation and Utilization Protocol". They then submitted it to line agencies to get it approved. After some modification in terms of wildlife protection, the protocol was approved. This CF borders Nepal's superior protected

region (Royal Chitwan National Park), where most of the tigers and one-horned Asian rhinoceros have been protected.

For the last couple of years, CFUG members have been successful in harvesting fodder in spring and summer seasons on a rotational basis. They collect felled trees and their limbs once a year (before monsoon) and make arrangements for sale. If a member of the CFUG needs firewood or timber, s/he gets first priority at a 40% discount. Otherwise, they put the material up for bid with a fixed minimum price. The earning goes to a saving-credit cooperative of the CFUG, which is provided as credit at low interest rate (3-5% as compared to 12-14% market rates) to needy members.

The forest supports a number of plant species, most of which have useful values. Recently, CFUG has started domesticating and cultivating some high value NTFPs. These include *Rauvolfia serpentina*, *Asparagus racemosus*, Lemon Grass, Chamomile and Citronella. However, they have not been harvested at a commercial scale yet. It is deemed that these crops would be good sources of income generation via small-scale bio-enterprises.

The NTFP sub-sector contributes about 5% of the GDP of Nepal (CECI 2006). The NTFPs of Nepal possess a comparative advantage in terms of sustainable production and trade. Among the advantages of Nepal's NTFP sector are their use of an organic farming approach, as well as the high medicinal and aromatic properties of these products. About 150 species are considered to be feasible to cultivate in the tropical region of Nepal with economic importance (Bhattari and Ghimire 2006) and potential to raise the living standard of the marginal and resource-poor communities in all regions of Nepal (Larsen and Olsen 2007).

CFUG has experienced occasional conflict over management issues. These issues included free riding and rivalry. The majority of conflicts are related to fodder and firewood collection. One-third of the CFUG members are relatively poor and do not have alternative sources for firewood and livestock feed. It was found that collective action becomes problematic only when there is inadequate information, conflicting interest or there is something intrinsically problematic about the nature of the resource itself (Poteete and Ostrom 2004). However, these problems have been resolving smoothly by linking government's biogas program (for firewood) and practicing agroforestry (for fodder/forage to goat and cattle).

## RESULTS

In the past decade of practicing community forestry, CFUG has seen the following outcomes:

- Sustainable forest products and enhanced biodiversity and environmental amenities.
- Improved access to small to medium sized credit facilities to establish local resource- based micro-enterprises.

- Additional opportunity to operate NTFPs farming, silkworm rearing and other feasible high-value cash crop production (NAP 2004).
- Promising conservation practices by communities through conservation education in the local communities.
- Institutional support at the community level such as conservation grants, non-formal environmental education and scholarships to indigenous communities for their high school children, excursion visits to see similar management practices.

## LESSONS LEARNED

The case study indicates that any conservation program, to be sustainable, should have clear economic impacts for the community. In order to improve their sustainability, conservation programs should have sufficient seed money to foster collective action effectively. Extension education on biological monitoring and conservation management planning must also be initiated from the start. Economic benefits proved to be a critical factor in the formation of cohesive groups, in developing trust and respect among community members, and in gaining their interest in resource management issues.

Finally, access to resources and control over these resources must be defined properly. The state must be guardian rather than umpire for effective environmental resource management. This proves that property right issues are very relevant institutions for the efficient functioning of the economy (Demsetz 1967; North 1991). Enforcement of property rights are essential part of economic incentives. Tenure alone is not sufficient; CFUG must also have access to technical, management, and marketing expertise to effectively manage their natural resources.

## CONCLUSIONS

Collective resource management programs have been very popular in sectors such as forestry, irrigation water, community hydro, recreational parks, and watershed conservation in Nepal. The majority of the community based forest resource management efforts are working efficiently in the foothill and hilly region of Nepal. The Terai region is also gaining momentum in community forestry, especially near protected areas (national parks and wildlife reserves). Forest protection (grazing bans, forest fire control, and cessation of illegal timber harvest) is the first important objective of CFUGs. Community Forest claims a threefold increase in tree species during the period of 2003-2012. The CFUGs have noticed an improvement in regeneration and increased floral and faunal diversity in forest areas. The CFUG employs democratic procedures, which might have been instrumental in improved management of forest resources. Linking forest products to markets and operating saving-credit programs in rural areas has had positive impacts for the low-income members in the community. Recently

adopted NTFPs domestication would further expand economic opportunities. At the community level, these activities foster the physical environment and the livelihood of the people.

Collective action efforts that seek to build trust, develop new norms, and help form groups have become increasingly common. Development workers and civic society prefer to refer to collective management practices alternatively as community participatory, bottom-up, and co-management. Research on the application of the social capital concept in natural resource management yields nearly unanimous results (eg. Pretty 2003; Ostrom 1990; Ostrom 2007; Deitz et al. 2003). Social capital (group/cooperatives or any functional groups) can help to ensure compliance with rules and keep down monitoring costs, provided networks are dense, with frequent communication and reciprocal arrangements, small group size (Olson 1971) and lack of easy exit options for members.

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## A Socio-Cultural Perspective on Agricultural Development within a Sub-Saharan African Context: Paradigm Shifts and Interdisciplinary Engagement

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**ABSTRACT** *The complexity of agricultural development provides many challenges and opportunities for creative solutions. As was evident at the 2013 World Food Prize and Borlaug Dialogue, the need to intensify agricultural production sustainably is crucial to global food security and poverty reduction. As sub-Saharan Africa (SSA) continues to develop its agricultural sector, innovations from science and technology continue to become exceedingly important in catalyzing progress. While science and technology represent powerful tools for progress in agricultural development, the social contexts in which technological advancements will be employed must be considered. Social context is important not only in the creation and adoption of innovative agricultural technologies but also in the long-term impact of developing human capital in sub-Saharan Africa. These innovations will require an interdisciplinary approach to achieve long-term and sustainable solutions that will make the most efficient use of environmental and human resources. As agriculturalists work toward the next Green Revolution, it is crucial to realize local communities are vital resources and are essential contributors to development, not mere recipients of technology and information. Understanding and appreciating the socio-economic implications of these technological advances ensures agriculture will continue to develop not in spite of communities but through communities. In this participatory fashion, socially embedded technology and innovations become not only a necessity to sustainable intensification but also the most powerful resources available in meeting the great challenges of food security.*

**[Interdisciplinary engagement, Sub-Saharan Africa, World Food Prize, Sustainable intensification]**

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## INTRODUCTION

Agriculture and its role in economic development are dynamic. The constraints associated with intensification of agricultural production are just as dynamic—climate change, natural resource degradation, poverty, land tenure, population increases, capacity, and corruption. In the face of these constraints, innovative and creative solutions, especially for smallholder farmers, are exceedingly important to investing in agricultural development to promote sustainable economic growth. The role of science and technology in this growth is undeniable, offering breakthroughs in quality of living that have the ability to catalyze development of societies.

Currently there are large incentives for creating new technology for developing countries, of which many sources come from developed countries. In particular, the Buffet Foundation in collaboration with the University of Wisconsin, Madison launched the “Ag Innovation” competition in 2013 to award the top student groups with outstanding agricultural innovations for developing agricultural systems. This call for innovation is one of the largest agricultural student-focused competitions in the world, emphasizing the increasing importance of agricultural technology in both the private and public sectors and the reliance on new generations to create new ways of embedding social elements in approaches to agricultural research.

Increasingly, politicians, development professional, scholars, scientists, and advocates use the World Food Prize (WFP) to address pertinent issues such as food insecurity and climate change. Recognizing the growing need for interdisciplinary research and the fact that culture is not static, a critical perspective on the role of socio-economic circumstances in agriculture needs to be considered.

Following the 2013 WFP symposium, there is no doubt that Africa’s food security discourse is based on a rather unique dichotomy: increase productivity versus improving accessibility. In the first case, the argument is that lack of food is caused by technological deficits. As a medium for addressing these technological deficits, often researchers and developers suggest mechanization, genetically modified (GM) crops, and supportive agricultural policies that favor production and facilitate the development of improved markets and infrastructure expansion. In the second case, one notes the limited access to infrastructure, but then stresses increased post-harvest waste and growing income disparities. However, both of these perspectives lack a substantive discourse on the role social norms play in promoting food security. This discourse incorporates social issues, particularly socio-economic disparities; however, the process is slow. One such platform for introducing social concerns into the conversation is the Montpellier Panel, housed at Imperial College London. The Montpellier Panel combines expertise from agriculture, development, trade, and policy. This panel recognizes that current “innovation systems are slowly evolving from a linear transfer of technology approach to a more holistic and integrated system, characterized by greater collaboration across disciplines and institutions, grassroots participation and a focus on development and poverty reduction (Juma et al.

2013:4).” This paper examines this transition in light of the 2013 World Food Prize and Borlaug Dialogues.

## THE TRADITION OF AGRICULTURAL DEVELOPMENT IN SUB-SAHARAN AFRICA

Sub-Saharan Africa (SSA) has one of the fastest growing populations and highest poverty levels<sup>§</sup> in the world today (Ekpe 2008; Anonymous 2013). With some of the largest holdings of arable land and over 70% of its population employed in the agriculture sector, post-Green Revolution theorists emphasize rural development through agricultural development in SSA (Diao et al. 2010).

Development policies implemented to address Africa’s growth predominately focused on markets. As most African nations emerged from colonialism in the early 1960s, the international community’s focus was primarily economic. As a result, World Bank funds targeted programs within the context of Western ideologies of industrialization. For example, emphasis on infrastructure development, particularly railroads and hydroelectric dams, such as the Kariba hydroelectric dam, took precedence over human resource development (Quitkin 2011).

Nigeria’s Minister of Agriculture, Dr. Akinwumi Aesina, made it evident at this year’s WFP that many of the past policies based on government subsidies not only failed to promote agricultural development but promoted fraud across the agriculture sector. As a prime example, fertilizer meant for distribution across the rural poor fueled a vibrant black market. As a result, a generation born into corruption perpetuated a cycle of poor governance and established a culture of dependency among which the government and non-governmental aid agencies of the very poor constantly construct their lives (Lang'at 2008).

In the 1980s, structural adjustment policies (SAPs) focused on liberalization and free markets arguably set the stage for social conflict in many African communities. Emphasis on privatization of the public sectors and free market competition threatened a majority of the population employed in the agricultural sector with unemployment, as government institutions which provided extension services and subsidized farm inputs disappeared (Meertens 2000). Later, African farmers were unable to compete with Western farmers whose governments heavily subsidized their produce. These economic conditions, combined with Green Revolution technologies such as hybrid seed and mechanized farming equipment, and the focus on improving yields, negated the human dimension of food production. The increased emphasis on technology and reduced emphasis on farmers shifted societal values, transforming food and agriculture from a cultural mainstay to an economic activity focused on commodities. As a

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<sup>§</sup> MDG Report 2013: Assessing Progress in Africa toward the Millennium Development Goals ([http://www.africa.undp.org/content/dam/undp/library/MDG/english/MDG%20Regional%20Reports/Africa/MDG%20Report2013\\_ENG\\_Fin\\_12June.pdf#page=1&zoom=auto,544,729](http://www.africa.undp.org/content/dam/undp/library/MDG/english/MDG%20Regional%20Reports/Africa/MDG%20Report2013_ENG_Fin_12June.pdf#page=1&zoom=auto,544,729) Accessed Nov.30, 2013

result, agriculture commodities account for a third of Africa's GDP growth today ([Diao et al. 2010](#)).

Using strictly technical or production-centered approaches to examine the impressive economic development and projected GDP growth for Africa clearly negates the socio-cultural elements, which provide cohesive mechanisms in many African communities. For example, it is arguable that in traditional African communities, seeds served as an instrument of social cohesion through the development of collaborative networks between farmers who trade seed to improve on-farm production and crop diversity. Today, the use of hybrid seed, which cannot be saved from one year to the next and consequently cannot be traded between farmers, leads to decline in social networks and subsequently social cohesion, despite the seeds' role in increasing on-farm yields. Agricultural supply stores replaced the seed trading networks of previous generations. Within the context of this system, the poor become invisible, as competition and efficiency supplanted the traditional systems of reciprocity and charity, which formerly regulated social interactions ([Polanyi, 2001](#)). With a focus on national success as measured by GDP growth rather than more social indicators of well-being reflected in measures such as the United Nations' Human Development Index (HDI), these poor will continue to remain invisible.

Africa is no longer the "whiteman's burden" ([Easterly 2006](#)). Evident from this year's World Food Prize symposium was the recognition among the international community of Africa's agricultural prowess and the important role African scientists will play as partners in development. Though Africa is rich in both land and human resources, it often lacks the technical capacity to build upon and manage these assets. Contrary to Asia's Green Revolution success and the historical tradition of poverty alleviation through new employment opportunities, agriculture in Africa has failed to lift people out of poverty ([Diao et al. 2010](#); [Valdés and Foster 2010](#)). Yet the development discourse continues to place a great deal of importance on agriculture's role in rural development and poverty alleviation ([Diao et al. 2010](#)). Appreciating the socio-cultural norms in African communities is necessary to shift from "transformational" strategies that look for large scale change to a more local and small-scale focus on "marginal" development ([Easterly 2009](#)). An important component of this shift is to not only recognize the socio-cultural norms that shape agricultural practices, but also how these same norms influence technology adoption, market access, and ideological approaches in the field ([Ashraf et al. 2009](#); [Easterly, 2009](#); [Diao et al. 2010](#)).

## INTENSIFICATION: A PARADIGM SHIFT

Primarily, African agricultural development relies on traditional intensification, where research and field priorities focus on maximizing yield through improved genetics and efficient input use. The reliance on these traditional processes to improve food security through increased grain production resulted in higher yields in both food and cash crops without the benefits of food security or improved incomes. As the brief cases above clearly illustrate, the connections

between institutions and technologies do not ensure success. American and European models, despite agronomic and genetic laboratory prowess, do not necessarily directly translate to developing nations' agronomic or socio-political context. Production from a traditional intensification paradigm simply does not work unless implementers take into account the cultural, social and economic context.

The 2013 Montpellier Report bridges this traditional view of intensification with a new sustainability paradigm designed to meet the increasing food demand from rapid population growth. This paradigm provides a framework to “produce more food with less impact on the environment, intensifying food production while ensuring the natural resource base on which agriculture depends is sustained, and indeed improved, for future generations (Montpellier Report 2013:4).” In essence, the authors of the 2013 Montpellier Report pave the way for production that produces more outputs with the same amount of inputs on a maintainable basis while simultaneously reducing environmental damage (Pretty et al. 2011). Though this rhetoric may be a novel concept in development discourse, sustainable intensification is a facet of conservation agriculture born out of the conservation tillage movement of the 1930s in response to the American dust bowl (Hobbs et al. 2008). The breakdown of intensification to three important levels—ecological, genetic, and socioeconomic—sets this report apart from its predecessors. It is this last level of intensification, socioeconomic, that provides a shift in development thinking, and a point of discussion within the context of the 2013 World Food Prize and Borlaug Dialogue.

Ecological intensification implies better soil management practices, diverse cropping systems, and integrated pest management, while genetic intensification implies higher yields, improved nutrition, pest resistance, and stronger varieties due to genetic factors housed within the seed. Although both of these approaches may increase food production through technological advances promoting improved crop varieties and management practices socio-economic intensification is unique in that it allows for successful implementation of the other factors. The socioeconomic intensification factors include establishing enabling environments, which the report defines as the “creation of efficient, fair and transparent input and output markets and the connectivity that makes them work for smallholders (Montpellier Panel 2013:26),” as well as building social and human capital, and creating sustainable livelihoods. For the panel of development professionals, economists, and researchers who develop the Montpellier Report, social and human capital is important to the future adoption and adaptation of agricultural technologies as well as the acquisition of skills, knowledge, and experience, which ultimately lead to improvements in the management and practice of food production at the smallholder level.

A holistic approach, inherent in the socioeconomic intensification paradigm, is important in terms of sustainable intensification and promoting both awareness on the part of implementers and capacity within the recipient communities. On-farm practices, which comprise a region's agricultural system, each possess important and unique cultural characteristics that vary

depending on region, kinship relations, socio-political circumstance, and economic conditions. There is no blanket solution that applies to every community or situation, despite similar agro-ecological conditions or crop types. In addition to specific cultural contexts that influence agricultural production, there are a number of issues affecting food distribution, storage, and ownership. Factors such as corrupt governments, limited infrastructure, and a disabled post-harvest sector can significantly decrease or negate the impact of improved yields. Additionally, although women make up a large percentage of subsistence farmers, and are responsible for 60-80% of agricultural production worldwide, they own less than 2% of arable land, and many countries have yet to develop or systematically enforce policies promoting women's rights to land ownership (Jemimah Njuki, CARE Pathways, Borlaug Dialogue October 2013, Des Moines, IA).

The tenets of sustainable intensification represent a new wave in thinking about agricultural technologies and agricultural development, particularly in Africa. This new paradigm is important not only for the laboratory and initial research efforts in agricultural innovation but also in the implementation and promotion of new technology in the developing world. Positive working relationships between scholars, governments, private industry, extension agents, and farmers housed within this new paradigm are key to a long-term approach to sustainable agricultural development. As agricultural science and technology continues to adapt to unpredictable global conditions, a mechanism for knowledge dissemination will be important to the widespread employment of these innovations. Embedding social values and an awareness of the importance of social norms in scientific investigation and technology dissemination are crucial components of a development model that responds to farmers' needs and empowers smallholders.

## SCIENCE AND SOCIETY: EMBEDDING THE SOCIAL IN SCIENTIFIC INQUIRY

Innovation is a main export of developed countries, which have university and government infrastructures that harbor creativity most developing markets are unable to support. Economic gain in the private industry drives most agricultural development. Due to pressures associated with competitive markets and customer purchasing power, highly industrialized cropping systems dominate private sector research priorities at the expense of developing nations' indigenous agricultural practices. This often leads to short-sighted products that drive out better long-term, environmentally and socially sustainable solutions. Therefore, the ability of public-private partnerships to allow new markets to emerge is key in launching long-term, sustainable solutions that may be slow in generating profit (Spielman and Gebmer 2006). Furthermore, continued innovation is important to agricultural development, as it can be more effective than governmental cash transfers, which in the past were re-routed to non-target projects and groups (Moyo 2009).

When technology attempts to address issues of poverty and food insecurity in developing nations, which are complex and largely social in nature, it is important to consider the social context in which the technological implementation will occur. If the initial phases of product design and functionality do not incorporate societal context, the society may resist adoption of the technology or abandon the technology after the removal of adoption incentives. In a study conducted for the Water Efficient Maize for Africa Project, several participants attributed social resistance to genetically modified crops to a perception that the crops were, "... some effort by the Western world to come and take advantage of poor Africans (Ezezika et al. 2012:39)." If local inhabitants produced the technology, it was no longer viewed as a foreign imposition (Ezezika et al. 2012).

The greater vulnerabilities of societies must be considered while addressing agricultural development, particularly through the implementation of technology (WTW 2013). For example, where inhabitants do not own land rights, a disincentive is in place that severely inhibits adoption of technology to improve the quality of the land. For women who farm land that does not belong to them, the possibility of authorities or private enterprises taking their land from them is an ever-present danger. Although improvements would make the land more productive, they would also make it more attractive to foreign investors or wealthy farmers willing to buy the land from the government. Therefore, with no legal claim to the land, investing in the property increases the farmers' risk of losing their most valuable resource and ironically increases their relative food insecurity. Although communities may not be ignorant of the irrigation incentives and available subsidized fertilizer, the societal risk of losing land may paralyze agricultural development.

In order to develop useful technology, the design must consider the primary users of the technology. Half of all agrarian labor in sub-Saharan Africa is female, and the Swiss Agency for Development and Cooperation (1995) suggests that female to female interactions increase the efficiency of knowledge transfer (FAO 2011). Yet, most extension agents in Africa are male (UNESCO 2003; BEINTEMA 2006). Additionally, research shows that the presence of female extension agents and all-women's groups builds confidence and leadership skills in female farmers and increases their participation in extension services, even if it did not directly impact adoption rates (FAO 1993; Manfre et al. 2013). Therefore, it is important to consider the effects of the launch of new technologies on societies.

Improved agricultural development will require interdisciplinary research on an international level. Although not without its challenges, research born of interdisciplinary collaborations is more creative and pragmatic than research conducted in an intellectual or theoretical vacuum (Elfner et al. 2011). This creativity is a necessity, as the shift from strict technology transfer to collaboration between nations requires dexterity to work with foreign local governments, markets, and societal structures. This helps ensure that useful technologies and management practices created in developed countries will have a relevant impact on agricultural progress in developing regions. Secondly, but perhaps most importantly within the scope of international

interdisciplinary collaboration, the role of capacity building cannot be ignored. This may be the most vital role the developed nation plays in international agricultural development. Stakeholders in developing countries must have the opportunities, through collaboration, to develop their human capital in order to bridge the gap between developed nations and their own countries. Development of human capital is crucial to the communication process. When developing nation professionals and scholars are able to transcend the often technical language of development, which in many ways acts as a barrier, they can work to help developed nation scientists understand the practical and cultural conditions of implementation, increasing the impact of technological innovation. However, in order to increase the effectiveness of these collaborations, the collaborators must address issues of trust, power, culture, and distance (Gray 2008).

#### IN PRACTICE: EXAMPLES AND CASE STUDIES FROM THE BORLAUG DIALOGUES AND BEYOND

It is important to acknowledge that in light of panels, presentations, and discussions within the World Food Prize Foundation's Borlaug Dialogues, many of the recommendations and concerns expressed in this paper are making their way into mainstream development discussions, both in the private and public sector. For example, Ritu Sharma, president of Women Thrive Worldwide, while on the "Innovative Solutions to Maximize the Potential of Women and Girls in Agricultural Development" panel at the 2013 Borlaug Dialogue, expressed concern that "[t]here is a common misconception we have that the people we are trying to serve are passive recipients of knowledge, technologies, etc. Indeed, this is not the case! Smallholder subsistence farmers in developing countries are creative, innovative, and passionate." Here, she reiterates a common criticism of international development projects as we often implement them today. With her fellow panel members, she encouraged current practitioners to focus their efforts on engaging with communities, identifying issues at the local level, and using a variety of agricultural techniques to address those specific problems.

Faso Jigi, a farmers' cooperative in Mali set up in 1995, is a successful example of how current practitioners engaged with local communities to identify key issues and culturally appropriate solutions (Canadian Department of Foreign Affairs, Trade and Development 2012). Initially the cooperative aimed at assisting smallholder farmers in marketing their cereal crops in order to capture the newly deregulated grain markets of the 1990s (OECD N.d). The cooperative, funded by the Canadian International Development Agency (CIDA) through the Grain Marketing Support Project in Mali, grew to fill roles in information dissemination, reduce transportation costs, make collective purchases of inputs, and create an insurance fund to assist farmers (OECD N.d.). As a result of the collaboration between international agencies and local community leaders, this approach to agricultural development generated 134 new cooperatives

with over 5,000 members producing over 28,000 tons of grain (Canadian Department of Foreign Affairs, Trade and Development 2012).

Another such case is the Kenya Agrodealer Strengthening Programme (KASP), made up of over 85 agricultural districts in Kenya, which sought to improve input supply and output marketing distribution as well as access to finance and microfinance for smallholder farmers (CNFA 2014). This is particularly important for women agriculturalists (CNFA 2014). For example, Flora Kahumbe, a rural farmer, owns two agrodealer shops. The Rural Agricultural Market Development Trust trained her, and thus she is now an integral part of networks such as KASP. Importantly, though, Flora trained as a private extension agent (The Montpellier Panel 2013). In this, she will be a part of developing human capital in her community by disseminating information and training community members. Additionally, as a female, now trained as an extension agent, Flora has unparalleled access to other female farmers, a significant portion of the rural community. Keeping knowledge and expertise within the community and targeting women are not only crucial to developing human capital and promoting ecological and social sustainability, but are also tenets of socio-economic intensification. Working with local affiliates, among them the Agricultural Market Development Trust (AGMARK), KASP certified over 1,900 agrodealers in business management in the last three years (CNFA 2014).

American and European organizations recognizing the importance of accessing the smallholder farmer are embracing efforts to strengthen sociocultural approaches to agriculture. For example, in the new wave of knowledge transfer through technology, the non-profit organization Digital Green capitalizes on the ability to share knowledge through videos, in ways that farmers can understand through a peer-mediated participatory approach. The group partners with local leaders in communities to share informational videos on farming practices, which they help produce with other local farmers. Digital Green sees high adoption rates among its participants through its practice of pairing knowledge dissemination and socio-cultural awareness, making it roughly ten times more cost-efficient than traditional agricultural extension (Digital Green, 2013).

## LOOKING FORWARD

Reflecting on the panels, discussions, and experiences of the 2013 World Food Prize and Borlaug Dialogues it becomes apparent that though there is a modicum of momentum in the direction of holistic socially informed approaches to agricultural development in Africa, there is much ground to be covered. Calls for innovative student projects and panels that boast social scientists will not be enough to meet the growing needs of African smallholder farmers. As the world's growing population looks to sub-Saharan Africa as the next breadbasket it becomes apparent that agricultural and social scientists alike will need to collaborate across disciplines, across geo-political borders, and across the public-private boundary. These collaborations will be crucial in promoting the paradigm shift to sustainable intensification and ensuring

developing nation practitioners and scholars have the resources they need to make the most out of their human and natural resource capital.

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