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Health consequences of nutritional deficiencies remain a concern for more than half of the global population. Agriculture improvement has helped to alleviate nutritional deficiencies, especially among the rural developing world, where populations are more susceptible.

In China, approximately 80% of the population lives in rural areas with close to 40% suffering from at least one nutrient deficiency. Current agricultural development projects in China are geared toward enhancing crop nutrition, but more research is needed to determine the relationship between food practices, agricultural diversity and the nutritional health in rural areas.

The purpose of this research was to evaluate the direct relationship of agriculture on human health through assessment of agricultural practices and agricultural policy on human health symptoms in rural populations in China. A comparative study was performed on data from the University of North Carolina Population Center- China Health and Nutrition Survey (CHNS) and a case study based on field research in western China. The study demonstrated relationships between agricultural practices with human health symptoms. In addition, agricultural and environmental policies adopted in rural areas did impact ability to engage in agricultural practices as well as diet and human activity among rural households. Future agricultural and environmental policies should consider repercussions of policy effects on community social infrastructure, economy and health and create measures to address these issues.

THE MECHANISM OF AGRICULTURE AND HEALTH- EXPLORATION OF LINKS BETWEEN AGRICULTURAL PRACTICE AND HUMAN NUTRITION IN RURAL CHINA

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Chapter I

INTRODUCTON

Over the past century human beings have succeeded in developing methods of agricultural management, disease control, communication, transport and information sharing to affect an overall improvement in the quality of life. Given this tremendous progress, it is tragic that we have allowed something as basic as ill health and malnutrition to persist in many parts of the world - for at least half a century too long. Health symptoms attributed to malnutrition continue to have huge impacts on survival, social and economic status of millions of people.

Health status in China, especially in rural areas has been poor over the last decade, with over 29 million people suffering from vitamin A deficiency and almost onefifth of China's woman and child population experiencing iron deficiency. New methods and techniques have been explored in rural populations with agricultural resources available. Current agricultural development projects in China are geared toward enhancing crop nutrition and even modifying vitamin levels in crops to meet the needs of communities, but more research is needed to determine the relationship between food practices, agricultural diversity and the nutritional health of rural areas.

The purpose of this dissertation research is to evaluate the direct relationship of agriculture on nutritional health through assessment of agricultural practices and agricultural policy on human health in rural populations in China. This research will illustrate the mechanism by which agricultural practice and policy in rural populations will impact population health and overall population productivity.

Research Aims

The research question of interest is by what mechanism is agricultural practice and human health linked in rural populations of China? The central hypothesis is that the practice of agriculture and adoption of its policy in Chinese rural society will directly impact health status among the population. Three specific aims will further explore this hypothesis.

Specific Aims for this research include:

Aim 1: Assess the relationship between agricultural practice and sufficient access to food in rural populations.

Hypothesis 1: Communities dependent on agricultural products for nutrition in their diet will not rely on outside food sources.

Assess the food sources in rural communities

Assess the types of practices and consumption patterns of rural households.
Aim 2: Assess the link between agricultural practices and human health status.
Hypothesis 2: Application of effective agricultural strategies will negatively impact human health symptoms experienced.

- Examine how types of agricultural practices are associated with health symptoms in rural communities.
- **#** Assess the number of agricultural strategies applied

Aim 3: Examine the role of agricultural policy in improving health among rural developing areas.

Hypothesis 3: Agricultural policy focused on improving crop production and crop health will improve prevention of health symptoms due to nutrition deficiency in developing areas.

Examine the number of policies that apply to rural agricultural practices

* Assess the level of intervention policies play toward access to food
Each of these aims will explore links between agriculture and nutritional health as
portrayed on the Nutrition-Agriculture Conceptual Model created from already
established relationships found in the literature. [Figure 1]

This model was created from two more popular conceptual frameworks found in the literature. The first aspect of the model (left side), a pathway by which agriculture affects nutrition, was derived from L. Haddad's "*A conceptual framework for assessing agriculture-nutrition linkages*" and the second model (right side) was derived from UNICEF's Conceptual framework of malnutrition. The three aims proposed in this research will be testing relationships not yet established in the literature between these two models.

Limitations, Assumptions and Design Control

This proposed research consists of two related components both verifying these aims and relationships. The intent is to explore aims in each of the related components and comparing results of the relationship. The first component is analysis of a secondary data set from the China Health & Nutrition Survey (CHNS). The second component is analysis of primary data from fieldwork among a Chinese-Tibetan population on the Tibetan Plateau in Qinghai province.

One limitation of this research is that the data represent only a few provinces of China and with a vast population such as China, more representative samples will need to be explored in further research. The CHNS data set represents 9 provinces primarily on the east coast of China and the Tibetan case study, one province in the western region of China (near Tibet).

Chapter II

LITERATURE REVIEW

Significance

Good health is fundamental for individuals and populations to reach their maximum mental, physical and social potential. According to the Food and Agriculture Organization of the United Nations (FAO), well nourished and healthy populations have the "energy, creativity, and security their daily lives with dignity and to contribute actively to their families, their communities and countries" (Food and Agriculture Organization of the United Nations, 2005). Problems arise, however, when populations do not have access to the food or daily essential nutrients. Deprivation and hunger are central to nutritional concerns in low-income and developing countries. These factors can lead to nutrient deficiencies (micronutrient malnutrition) and chronic health consequences, thus creating loss of potential labor and economic productivity. [Figure 2]

Health & Agriculture

Agriculture has played a significant role in enhancing human health in the developing world. When agricultural production is low among low-income individuals in developing countries, the populations are more susceptible to poor nutrition, poverty and food insecurity (Pinstrup-Andersen & Babinard, 2001). More than 50% of food insecure and poor communities live in rural areas and majority of these populations depend on agriculture for their livelihood (directly or indirectly) (Pinstrup-Andersen, 2002). "In developing countries, poor consumers depend heavily on agriculture for their livelihoods

and spend the bulk of their income on food" (Pinstrup-Andersen & Babinard, 2001). Thus, the impact of agriculture resource and practices is immense in improving the economy as well as good health in a community.

The pathway by which agriculture affects health and nutrition is outlined in Figure.3. The agricultural practices and resources available to any community are dependent on the political, physical and economic environment. Specific effects by which agriculture impacts nutrition include: declines in food prices, own-consumption, processing and preparation and plant breeding (Haddad, 2000).

Currently, agricultural practices have increased focus on helping to alleviate health symptoms relating to nutritional deficiencies. One strategy involves focused plant breeding to enhance nutrient uptake and that fortify their own seeds with higher amounts of minerals and vitamins. This innovation, termed biofortification, provides access and nutrient bioavailability to nutrient deficient populations without causing a huge burden on society, local and national (Underwood, 1999). This method is one of the lesser plant invasive strategies that have been introduced via food biotechnological research. Unlike the genetically created "golden" rice where vitamin A in the form of beta carotene (contributing to the golden color) was genetically inserted producing a crop that offers the same level of nourishment as a vitamin A supplement capsule, biofortification enhances the level of nutrition of a crop by natural introduction. For a population of over 3 billion who depend on rice as a staple crop and with 10% at risk of deficiencies in a certain vitamin carried by the rice, the potential impact on health is enormous (Nash & Robinson, 2000).

Other ways by which agriculture can influence human health and nutrition include changes in and access to income, labor allocations, energy and nutrient expenditure, nutrient composition of foods, exposure to diseases, contaminants and chemicals. For agriculture to improve nutrition, more attention should be given to factors that promote consumption of foods to ensure good health and to the persons who influence productions and consumptions (Johnson-Welch, 2000).

The Food and Agriculture Organization of the United Nations has begun a new global agriculture census beginning in 2006. This census is geared toward collecting information on community socio-economic data and farm structural data. The goal of this census is to move toward meeting the current Millennium Development Goals. The U.N. distinguishes data collection and analysis at the community level as an essential method to help "explain how changes in the agriculture sector affect household food security", helping to "eradicate extreme poverty and hunger" (FAO Newsroom, 2005). Hunger among poor, "increasingly manifests itself through excessive consumption of energy-rich but nutrient-poor foods" (Hawkes, 2006). To maximize agriculture's nutritional potential, strategies must address concerns about food shortages and growing population and specifically focus on staple food production, generation of income among agriculture households and micronutrient-rich foods as well as increase women's knowledge of good nutrition (Hawkes, 2006).

China & Agriculture

China is working to reduce poverty and malnutrition among its population of over 1 billion and has used agricultural and educational programs as a means to do so (IFPRI, 2005). In the midst of achieving this goal, an increasing population and decreases in the amount of arable land provide areas of concern. Globally, at least 50% of arable land, allocated for crop production, is low in the availability of one or more essential nutrients. Even increasing crop production may still leave the population nutrient deficient. Currently in China, despite supplementation and fortification efforts, stunting and underweight , symptoms of poor nutrition, remain high in the poor western provinces. Approximately 20% and 40% of rural areas are deficient in essential vitamins and minerals, such as vitamin A and iron respectively (UNICEF, 1997).

Current studies are underway with the International Food and Policy Research Institute (IFPRI) to begin a plant breeding program to decrease micronutrient malnutrition among the rural poor. However, this project has not yet been implemented among the rural Chinese. More research is needed to explore the distinct relationship between the cultural food practices of the Chinese, agricultural diversity and nutritional status in rural areas of China (IFPRI, 2005).

Agricultural Practices of Chinese Tibetans on the Tibetan Plateau

(Qinghai Province)

Known as the largest and highest plateau in the world (averaging 4000m), the Tibetan Plateau is tagged the 'roof top of the world'. Located in southeast China, the

Tibetan Plateau covers 2.5km² and is bordered by the Kunlun and Alijin mountains (NE) and the Himalayas (SW) (Wu, 2001).

Tibetans have inhabited these high altitude grasslands for generations with the majority practicing yak herding and/or farming. Because of high altitude, farmers reside at no more than 4500m (limit for crop growth) and nomads at 4800-5500m. However, most Tibetans have shown "lower incidence of chronic mountain sickness" compared to other groups living at high altitudes (Wu, 2001).

Agriculture and the Tibetan Plateau

The Tibetan Plateau covers over 25% of total land area in China, however, land usage is low due to the significant portions (45%) covered by snow-capped peaks, deserts, lakes and forests. Land that is utilized is mainly for aspects of agriculture including mountain pasture for nomadic grazing and farmed fields for plant agriculture. The majority of communities on the Plateau rely on these two sources for their primary income. Land used for nomadic grazing (pastoral) composes more than half (53%)(1.35 million km²) of the plateau's total area however, plant agriculture (farm based) composes less than one percent (0.94%) (23,500km²) (Wu, 2001).

The Tibetan Plateau has one of China's largest pasture areas where Tibetans raise livestock including yak, sheep, horses, cattle and even camels (Gobi area), however, the most popular for breeding are yak and sheep. The yaks are preferable due to their tolerance to high altitude. Tibetan nomads permanently reside between 3000-4500m and move only in the summer to higher altitudes (up to 5500m) (Wu, 2001).

Although farmland is not as prevalent as pastureland, Tibetans have utilized land to grow a variety of staple crops including wheat, buckwheat, broad bean, pea, potato, rape flax (for canola oil) and highland barley, which is daily in diets of Tibetans in the form of Zamba (tsamba) [highland barley flour mixed with yak cheese, butter and tea] (Wu, 2001).

Nutrition among Tibetans

Little information is available regarding the nutritional status of Tibetans living on the Qinghai Tibetan Plateau, however, nutrition studies elsewhere, among Tibetan children living at high altitude, have shown that undernutrition may be cause for growth failure. In a cross-sectional study where 2078 Tibetan children were assessed (0-84 months) and studied for clinical signs of malnutrition, over 50% had stunted growth (moderate-severe) with stunting being associated with "clinical conditions such as rickets, abdominal distention, hair depigmentation and skin lesions and with a maternal history of hepatitis or goiter. The authors of the study note "stunting was not associated with altitude, after adjustment for type of community" (Harris et al, 2001). In this study the prevalence of wasting was low, demonstrating that the Tibetan children "were not thin. " Maberly and Sullivan passionately point out that this study provides "evidence not only of a very high prevalence of stunting but also of micronutrient deficiencies that constitute a double insult to the developing brains and bodies of Tibetan children, further limiting their ability to reach their genetic potential" (Maberly and Sullivan, 2001).

A 1989 unpublished survey performed by the People's Republic of China (PRC) among sixteen Tibetan counties, concluded mortality rates among infants, children less than five and mothers were much higher in Tibetan counties than the rest of China (IMR-92 per 1000 compared to 68 per 1000; UMR-127 per 1000 compared to 84 per 1000; MMR-73 per 10,000 compared to 20 per10,000) (National Center of Health Information Statistics, 1989).

Nutrition of the water may also play a role in the overall health of Tibetans. One study has concluded that Tibetan Brick black tea may be linked with dental fluorosis among the Tibetan population, since water sources in and around Tibetan areas were noted to be low in fluoride. Dental fluorosis was common among study areas even when water sources were low in fluoride. "The explanation probably lies in the fact that Tibetans, including young children, have a long-standing tradition of drinking high-fluoride brick tea made from old stems and leaves of tea bushes. A "brick tea" type fluorosis that results among many minority populations in China (Cao *et al.*, 2000).

Chapter III

STUDY BACKGROUNDS

China Health and Nutrition: CHNS Data

This analysis seeks to assess the relationship between food consumption and agricultural practices as well as agricultural policy impact on agricultural practice and household health of rural Chinese. The data set of interest comes from the China Health and Nutrition Survey (CHNS) conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Food Safety and the Chinese Center for Disease Control & Prevention between 1989 and 2004 (cross-sectional and longitudinal data).

The data sets to be explored are based on urban and rural data gathered from nine provinces in China. However, this research will focus solely on the rural data. The data sets of interest were the 1997, 2000 and 20004 Household Surveys, which included subset surveys on Home Gardening and Income, Household Farms, Farming Collectives and Income, Raising Livestock/Poultry and Income and Health Care. Each dataset covers more in-depth information on agricultural practices, including household agricultural income and crop production as well as health status and physical symptoms experienced by Chinese households. Data from these surveys were chosen specifically because they included information on agricultural practices in households and communities as well as the health status of these communities.

Case Study: Agricultural Practice of Chinese Tibetans

The case study component of this research focuses on rural semi-nomadic populations in western China. In China, approximately 80% of the population lives in rural areas with close to 40% suffering from at least one nutrient deficiency. Current agricultural development projects in China are geared toward enhancing crop nutrition, but more research is needed to determine the relationship between food practices, agricultural diversity and the nutritional health of rural areas. The impact of improved nutrition among China's crops and its rural population is far reaching, since China is the largest producer of wheat and rice in the world with over a population over 1 billion depending on its agricultural production.

Supported by NorServe, a Norwegian development non-governmental organization (NGO) and the local government in the Yushu Prefecture, this case study provides cross sectional data on nutrition and the level of agricultural activity from six communities in Yushu. This case study was under the supervision of NorServe, established in the Yushu Prefecture to help improve community health through educational training and agricultural development. The purpose of this case study was to gain an understanding of nutrition and agricultural practices among the Tibetan nomads living on the Qinghai-Tibetan Plateau.

The results of this case study will provide evidence for policymakers on whether adoption of policies affecting agricultural practices in rural populations will significantly impact population health and nutrition and overall population productivity. The links

determined in this research may help provide a basis for agricultural policy strategies in improving human health in agrarian-based rural populations worldwide.

CHAPTER IV

METHODOLOGY

China Health and Nutrition: CHNS Data

A multi-stage, random cluster approach was implemented to gather a sample of ~4400 households representing a total of 16,000 individuals in a total of 9 provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, Shandong) varying from rural to urban and varying in economic, geographic, developmental, and health indicators as well as availability of public resources. [See Figure 4.] Community data was also gathered surveying health facilities, food markets, family planning resources/personnel, social services and community leaders.

Analysis

The analyses reported here are based on the cross-sectional data sets from the 1997, 2000 and 2004 China Health and Nutrition Survey (CHNS) and analyzed using SPSS 15.0. Descriptive analyses, logistic regression analyses and multiple linear regression analyses were employed to achieve study aims. Dependent variables will be those affecting human health symptoms. Independent variables will be represented by variables representing agricultural practices, such as gardening and farming.

Case Study: Agricultural Practice of Chinese Tibetans

A total of six villages/townships were surveyed between the months of August through October 2007 in Yushu Prefecture on the Tibetan Plateau. The nutrition household survey focused on demographics, dietary habits, agricultural practices and physical health symptoms experienced in the household. A single stage, random cluster approach was implemented to gather a sample of 205 household nutrition surveys representing a total of 1,042 individuals in Yushu Prefecture, varying from rural to semirural to urban and varying with respect to economic, geographic, developmental, and health indicators as well as public resources. Surveys were performed at random, surveying every 4th household in each section of the communities. The following villages/townships were surveyed in Yushu Prefecture: Changa, Chirigu, Hashu, JiaJieNiang, Gyêgu (Yushu) and Zamo. [See Figure 5.]

Inclusion Criteria: All households living in each of the selected communities in Yushu County (Yushu Prefecture) are included in this study population. A representative (head of household) in every fourth household over the age of eighteen was invited to participate in the survey.

Exclusion Criteria: All households not living in the selected communities in Yushu County in Yushu Prefecture, not randomly selected or households with head of household under the age of eighteen were excluded from the survey.

Data Collection

Data collection was performed through household surveys. The survey did not include subject identifiers and was designed for completion in twenty minutes. The survey outline consisted of thirty-three questions pertaining to types of agricultural practices, food sources, food consumption and human health. [See Appendix A.] Translation of the survey to Mandarin Chinese was performed by Norserve staff prior to data collection and was orally translated from Mandarin Chinese into Kahm Tibetan during household surveys. There was one Norserve staff member performing all 205 household surveys.

Analysis

Descriptive analysis and multiple logistic regression were applied to the data using SPSS 15.0. Dependent variables will be those affecting human health symptoms. Independent variables will be represented by variables representing agricultural practices and consumption.

Chapter V

RESULTS

China Health and Nutrition: CHNS Data

Agricultural Practice among Rural Households

Results of analyses relating to farming are presented in Table 1. More than half of rural households surveyed were engaged in farming in 1997, 2000 and 2004, with a small percentage (3-4%) self-reported as specialized. Specialization in farming may include extensive training and/or equipment available for more technological agricultural practice. Household farms were more common among those households that engaged in farming (99%). No drastic changes were observed in percentage of household farms between 1997 and 2004.

The time and effort of household labor toward farming did not change over time. Over two-thirds of households engaged in farming six to twelve months a year and nearly half of households allocating less than five hours of their daily time to farm work. Households farms are spending less time daily engaged in farming. Between 1997 and 2004, households participating in farming five hours or less daily increased from 45% to 60%.

Although collective farms were not as common as household farms between 1997 and 2004, the number of households receiving income from these farms increased between 2000 and 2004, from 1.1 to 28% and those households receiving produce from collectives also increased from 0.6 to 11%. Results of analyses regarding gardening are presented in Table 1. From 1997-2004, more than 60% of households were engaged in gardening in rural areas of nine provinces in China. The number of rural households specializing in gardening is minimal, with only 5% participating. Over half of rural households engaged in gardening participated more than 7 months but labored less than 5 hours per day. On average, from 1997-2004, onequarter of rural households sold their garden produce for income.

Results of analyses regarding animal raising are presented in Table 1 (cont.). More than half of rural households raised livestock and/or poultry between 1997 and 2004 with an increase from 48% to 70% by 2004. Specialization in livestock was observed in less than 3% of households.

For those rural households raising livestock, not necessarily involved in livestock business, more than 60% consumed household livestock and more than 40% received income from livestock between 2000 and 2004. Approximately half of rural households were engaged in raising livestock/poultry almost year-round (10-12 months) but spent less than 5 hours daily in labor.

A shift is observed from household livestock businesses to collective livestock businesses between 1997 and 2004. A household livestock business may involve household management of production and selling operations while a collective livestock business is a larger unit, usually offsite of household property, where a number of households and/or personnel participate in business operations. Over 90% of all rural households surveyed were engaged in operating a household livestock business between 1997 and 2000, however the percent decreased by 50% in 2004, where close to 60% of

households were no longer operating the livestock business. A shift is observed between the number of households operating livestock raising from 99% in 1997 to 31% and 28%, in 2000 and 2004, respectively. Livestock collectives increased from 0.2% in 1997 to 58% and 64% in 2000 and 2004, respectively. Only a small percentage of households (1-8%) were noted to receive livestock from participation in the collective and/or income from collective livestock.

Health among Rural Households

Most rural households noted to be in good to excellent health with only one-fourth self-reporting "fair" to "poor" health when asked about current health status. The most common health symptoms experienced among rural household members in 1997, 2000 and 2004 were high blood pressure (2-8%) and bone fractures (1-4%). Very few individuals experienced physical symptoms of goiter or blindness which have been attributed to micronutrient deficiencies. Only one-third of households engaged in tea drinking with most of these households (~70%) consuming tea on a daily basis.

Health Status/ Symptoms and Agricultural Practice

The results of logistic regression analysis exploring association between fair to poor health and possible factors are found in Table 3. Households engaged in farming and tea drinking were significantly more likely to report being in good to excellent health. Households engaged in farming in 2004 (OR 0.805 (0.659-0.982); p-value=0.032) and households engaged in tea drinking in 2004 and 2000 (OR 0.809 (0.720-0.909) p-

value<0.001; OR 0.798 (0.648-0.982); p-value=0.033, respectively) were less likely to report fair to poor health.

Results of logistic regression predicting odds of physical symptoms experienced among rural households can be found in Table 4. In 2004, households engaged in farming were three times more likely to report a heart attack (OR 3.508 (1.004-12.261); p-value=0.049) than those involved in other agricultural practices, but were less likely to report high blood pressure (OR 0.530 (0.356-0.790); p-value=0.002). Those households that had members working on a collective farm were less likely to report symptoms of high blood pressure (OR 0.491(0.320-0.753); p-value=0.001) and stroke (OR 0.183 (0.050-0.675); p-value=0.011) than households participating in other agricultural practices. Although not statistically significant, a trend was observed among households involved in collective farming to less likely report symptom of diabetes (OR 0.331 (0.099-1.106); p-value=0.072).

In 2004, households operating a livestock business were more likely to report bone fractures (OR 1.698 (1.172-2.462); p-value=0.005) than households participating in other practices. However, households raising livestock/poultry were less likely report bone fractures (0.634 (0.391-1.026); p-value=0.064), although this finding was not statistically significant.

Between 1997 and 2000, households engaged in gardening were less likely to report symptoms of high blood pressure (OR 0.327 (0.136-0.786); p-value=0.013) and diabetes (OR 0.102(0.016-0.656); p-value=0.016), respectively, compared to involvement in other agricultural practices. However, these trends are not apparent in 2004.

Case Study: Agricultural Practice of Chinese Tibetans

Household Characteristics

From the six villages/townships surveyed, on average, households had five members, with median age of the oldest household member at 53 and youngest at 8 years. Over half of the households surveyed had lived in their community greater than 20 years. Household demographics can been found in Table 6.

Agriculture

A description of agricultural practices and consumption patterns among households are presented in Table 5. More than half of the households surveyed (55%) engaged in at least one type of agricultural practice. The most common practices were animal raising (40%), farming (30%) and gardening (20%) with more than one-third of households practicing more than one. Over ninety percent of all households engaged in agricultural practices consumed the crops and/or animals grown/raised.

Farmland was utilized by forty percent of the households; however, only one-third of these households consumed the crops they grew. The most common crops grown included: barley, oats, wheat and turnip (yung), with barley (tsamba) and turnip (yung) being the only crops used for human consumption. Most crops grown were used primarily as animal feed.

All households surveyed stated that the nearest village/town market was a source of at least one of their staple foods, however, only half of the households surveyed relied solely on the nearest town market for their diet. Close to half of households relied on their agricultural practices for dietary needs. Most of the households with home gardens grew Chinese cabbage and/or potatoes. From those households consuming from yak herds, home garden and/or farmland, over half stated to consume crops and/or yak products on a daily basis.

Dietary Habits

Staple diets of households included: meat (97%), vegetables (96%), tsamba (90%), rice and/or bread (80%) and noodles (73%). More than half of all households consuming meat (65%) consumed less than 10 pounds of meat a week. The most common vegetables consumed included: Chinese cabbage (69%), potatoes (44%), green peppers (25%), regular cabbage (25%) and zucchini (22%) Approximately 70% of households consumed fruit, however only 13% stated daily intake, 50% stated fruits were occasionally part of their diet (at least one time per week). Milk consumption was reported in 88% of all household surveyed, with 43% daily consuming and 33% occasionally including part of their diet (at least one time per week).

Only three (1.5%) of all households surveyed did not drink Tibetan black tea as their main household beverage. Of those households consuming tea, the majority (72%) consumed 2-5 pings of Tibetan black tea on a daily basis. Approximately forty-percent of households stated that a least one person used vitamins, with over half only taking vitamins when sick. The most common vitamin used was Vitamin C (78%).

Physical Symptoms

Households were asked about health symptoms that have occurred more than three weeks at a time. The most common health symptoms stated in Yushu prefecture included: fatigue and weakness (63%), muscle spasms (51%), bone pains (43%), headaches (40%), heart palpitations (31%) and diarrhea (27%).

Agricultural practices, Food Consumption and Health

Agricultural practices and consumption habits can be found in Table 7. Households practicing crop growing in the form of gardening and/or farming are utilizing the arable land they have available and this land has been sufficient to produce edible crops.

Most of the households engaging in agricultural practices, especially households adopting multiple practices, consumed the majority of the animal products/crops raised; however, only 33% of those practicing farming actually consumed what they grew. The majority of these farms only produced fodder and/or specific crops for animal feed. Those households not consuming food from gardens had practiced experimental gardening which relies primarily on the market for staple foods. Less than one-fifth of households participating in livestock raising did not consume the animals but either raised them for animal byproducts or as pets.

Households with access to yak and/or animal herds were more likely to consume milk and other milk products on a daily basis than those households living in urban areas
(where no agriculture is practiced) or those who practiced gardening or farming.

Fruit consumption was occasional among those households practicing at least one type of agriculture. Communities that did not practice agriculture experienced higher fruit consumption than those involved in more than one agricultural practice. Over two-thirds of non-agricultural based households consumed fruit on a daily to occasional basis.

Those households involved in agricultural practices are not solely dependent on agriculture for their diet. The majority of all households engaged in one or multiple forms of agricultural practice do obtain staple foods from the local market, in addition to their crops/animal raised.

Results of health symptoms among households engaging in agricultural practices can be found in Table 8. Fatigue and weakness was experienced in greater than 60% of households practicing any one or multiple types of agriculture, with higher percentages noted among those households engaged in animal raising (only) and gardening (only). Bone deformities, muscle spasms, chronic headaches and weight loss were greater among households participating in at least one or more agricultural practices compared to households not engaging in any practice. Households engaged in animal raising (only) reported higher percentage of tissue swelling, dry skin, sensitivity to sunlight and heart palpitations compared to households engaged in gardening and multiple agricultural practices. (Farming only consists of three households for observation)

Physical Health Symptoms and Agriculture

Results of logistic regression analysis predicting odds of health symptoms are

shown in Table 9. The results of the logistic regression analysis predicting odds of health symptoms by land availability, food source and agricultural practice between symptoms demonstrated significance among food source as a predictor for muscle spasms in the population. Those households relying on a mixture of agriculture product (crop/animal) and market were four times more likely to report muscle spasms (OR 4.240 (1.031, 17.432); p-value=0.045) compared to those households receiving their food source from the market only. In addition, those households consuming vitamins (mainly in the form of vitamin C) were less likely to report bone pain and/or deformities (OR 0.581 (0.319-1.059); p-value=0.077). No discrepancies were observed between variables relating to household agricultural practices/environment and other more common symptoms experienced among households such as fatigue and weakness, muscle spasms, heart palpitations and diarrhea.

Chapter VI

DISCUSSION

China Health and Nutrition: CHNS Data

Agricultural Policy & Practice

Rural households surveyed by the CHNS did participate in agricultural practices with more than half engaged in farming, gardening and animal husbandry. These finding confirm the importance of agriculture among rural households in China.

The high percentage of household farms in these rural provinces demonstrates the effect of the Household Responsibility System (HRS), an agro-business policy adopted by China's government in the early 1980s. In the last half century, China's agricultural production has shifted from a primarily government owned and run institution to household responsibility through HRS. "Under the HRS, farm households were permitted to sign long-term land contracts to cultivate specific plots. Farmers were given greater production and marketing discretion. They were able to produce whatever they wanted and to sell their goods through local open markets as long as they delivered specified quotas to the government" (Fang and Beghin, 2003). This may explain why most farms and livestock business were based out of household property. Much of farm life and activity observed in the CHNS data were based in the home.

The CHNS data demonstrate a small change in adoption of household farming and gardening among rural households involved in these practices; however, resources received from collective farms, such as produce and/or income, increased moderately. By the mid-1980s, the fruit and vegetable market had become more "liberal." "The 'vegetable basket project' launched in 1988, included a component to promote vegetable production; and thus, improve the supply of vegetables to urban markets. During the late 1980s and early 1990s, relatively high returns of fruit production raised concerns the land previous sown to grain, may be withdrawn from grain production to be used for fruit growing. As a result of continuing concerns regarding the transfer of crop lands to other uses the State Council issued the Regulation on the Protection of Basic Farmland in 1998 and reinforced the terms in 2004. The Regulation forbids the transfer of land from grain production unless special approval from the Ministry of Land and Resources is obtained. This Regulation creates a barrier to the development of new orchards, ponds for aquaculture, commercial forests, and prohibits the use of arable land for development of intensive livestock enterprises" (OECD, 2005). The small changes in number of farms and gardens observed between 1997 and 2004, as demonstrated in the CHNS data, have been consistent with this policy.

The shift toward collectives did not begin until the late 1990s and became more pronounced in the early 21st century. "Under the 'vegetable basket project' launched in 1988, the government assisted development of the livestock sector through direct investment in supporting facilities (breeding centers, market facilities, veterinary services, etc.), provision of preferential loans to producers, extension of new technologies and preferential tax rates for the feed industry. In the early 1990s, the national government was keen to establish large scaled production units. Preferential access to loan, secured supply of feed grains, and priority in shipment of livestock products was available to large-scale production units. However, this policy has been only partially

successful as such units are relatively vulnerable to feed price increases, such as occurred in the mid 1990s. In 2001, the Ministry of Agriculture made a proposal to accelerate development of the livestock sector, "highlighting ideas on possible adjustments of production structures and increased government support to the livestock sector" (MOA, 2001; OECD, 2005).

The CHNS data demonstrate a drastic shift in the number of household-based livestock businesses toward collective livestock businesses between 2000 and 2004. This rise in collective livestock production may have been due to increases in production demand among the population. According to recent agricultural trends in China, "the changes in areas and production of cereals have reflected dietary changes that have included declining per person consumption of food grains and increasing consumption of animal products that require feed grains. China's demand for meat is expected to continue to expand markedly." A current trend toward a larger scale livestock business exists, originally starting in smaller household livestock farms with a shift toward "large scale technically efficient production units" (Roberts & Andrews, 2005). The CHNS data demonstrate this trend among rural households practicing livestock agriculture. The results of this trend may contribute to "higher productivity, production growth and more efficient marketing of animal products. The trend also would also be likely to result in greater emphasis on grain and concentrate based feeds, with implications for future demand for feed grains and oilseed meal and other feed concentrates," according to the Australian Bureau of Agricultural and Resource Economics (Roberts & Andrews, 2005).

Consumption & Agriculture

One of five households was selling crops produced, but little is known whether the other four of five households were utilizing crops grown via household consumption or community disbursement. Unlike the CHNS livestock data, no crop or produce consumption information was available for those households engaged in farming and/or gardening. Based on the need for food in this population, these households may have consumed their crops and sold what was necessary for income. In addition, income may have been a resource to purchase food from the markets and/or engage in other agricultural practices, which would have an impact on overall household diet and nutrition.

Farming was demonstrated to be a household-based practice among rural households which may have attributed to household nutritional needs, in addition to the practice of gardening, where only one-third of households with gardens sold their fruit and vegetables. Livestock production, which is more business-oriented, increased among households, providing food for more than half of households engaging in animal raising and income for less than half. Because rural households participating in agriculture are receiving income and/or product from their practices, the impact of agricultural policies will affect the level of income and/or amount crop/animal product the households receive, and thus possibly affecting what crops/livestock households have access to and/or are able to afford for food consumption.

Health & Agriculture

Agricultural practices may be linked to the health status and health symptoms experienced by rural households. The logistic regression analysis predicting fair to poor health demonstrated a significant association between households engaged in farming and households reporting "good to excellent health". Activities involved in farming and/or the environment conducive for farming may have a beneficial component that improves the perception of health in rural communities. However, households in rural farming communities were more likely to report heart attacks but less likely to report high blood pressure. This trend may be due to the extent of physical labor involved among households engaged in farming, even though perception of health was reported at a healthy level.

However, the stresses of household farms versus collectives may differ. Collective farming involves larger scale, high technology production units where physical labor is not as intense as on smaller household farms. Household members participating on collective farms were less likely to report high blood pressure or stroke than households participating in household farms and/or other practices.

Agricultural practices involving animal raising may also increase the likelihood of body injury. Logistic regression analysis predicting experience of physical symptoms demonstrated that households involved in livestock raising were more likely to report bone fractures. The intense labor and interaction with untrained animals common in livestock production may attribute to a higher number of injuries from occupational hazards such as falls from livestock or equipment or injuries sustained while herding or

controlling livestock herds.

Although the Chinese government has not implemented policies toward livestock or farm occupational hazards among farming communities, "the government has tightened regulation on the used of pesticides in fruit and vegetable production, and promotes and certifies "organic" products and 'green food' products (produced from minimal inputs of hazardous chemicals). The state has also been active in disseminating advanced production and product handling techniques" (OECD, 2005).

Limitations

This analysis sourced from 18 cross-sectional data sets for 1997, 2000, and 2004 with data gathered from nine out of twenty-three provinces. The samples for these surveys were primarily households and results can only be applied to rural households of the nine Chinese provinces surveyed. Further research should address regional and socioeconomic differences in the trends reported here as well as examination of the specific relationship between agricultural food consumption and rural areas. The specific variables of health outcomes and health indicators were limited within the data sets. Thus, only minimum analysis could be performed to assess relationships between the health and/or health outcomes and agricultural practice. In addition, the health status reported by the households may have been biased based on cultural appropriateness and/or cultural norms in the different regions surveyed.

Further Exploration

As agricultural policies are implemented and enforced in provinces throughout China, the nutritional impact of rural agricultural practices needs to be considered and addressed. Federal and provincial agricultural policies should be sensitive to the rural populations and provide appropriate allocation of crops and increased research agricultural investments to improve overall health of the rural poor. "Although the importance of off-farm work as a source of income for rural households has increased substantially during the last two decades, agriculture continues to represent a major component to total income of rural households (OECD, 2005). Further analysis of income, agricultural practice and health should be determined to improve the effects of agricultural policy on rural agrarian households.

Case Study: Agricultural Practice of Chinese Tibetans

The population surveyed was local to the Tibetan Plateau and most of the households had lived in their communities for over twenty years. For a semi-nomadic population, transience is an important factor in determining the level of agriculture these households could practice. Most of the communities surveyed that practiced animal herding had a routine allowing animals to roam a few miles from their village and then herd them back to a location near the village/town homes. Certain members of each household were responsible for herding the animals to and from designated areas.

Agricultural Policy & Practice

The Tibetan population on the Tibetan Plateau has limited dietary intake based on household location (rural vs. semi-rural), access to the market place (which may or may not have a variety of staple food choices) and agricultural practices (availability of grains, animal products and crops). Even though this population is considered semi-nomadic, many households were practicing multiple forms of agriculture, including farming and gardening. To engage in a number of such practices, households had to be established in an area for months at a time (at least a season). Of those households surveyed utilizing arable land, almost all participating in one form of agriculture were producing food from the land (garden/farm). Those households engaged in animal raising, were more likely to consume meat, milk and other animal byproducts than households not engaged in animal raising. Households consumed because they had access to the crops/animal products. However, they were not solely dependent on their agricultural products to maintain their

diet. Almost all Tibetan households surveyed relied on a mixture of staple foods from the local market and agriculture products (when available). The impact of moving households from rural locations or limiting type of agricultural practice can, however, have a tremendous impact on dietary intake.

This Tibetan population is living in a province where a number of environmental/ agricultural policies are in effect, which have impacted (and even limited) the type of agriculture practiced. China has begun to implement a number of policies across the Tibetan plateau for purposes of ecological preservation. One movement in government called the "Western Development Strategy" focused on building infrastructure in the more rural areas and provided telecommunication. One aspect of this strategy, called the "Grain to Green" policy (also given the title "Farmland and Forest" policy) calls for a period of rest for the land. The basis of this policy is that providing a period without animal grazing will help the "degraded grassland to be restored to its former natural state." Because of this policy, livestock are viewed as detrimental to the natural environment and thus should be relocated. Currently, thousands of nomadic Tibetan families have been requested to relocate off the grassland and "to adopt new livelihoods in farming or to live in a new town." Qinghai province currently has 35 resettlement communities established with more under construction. By the end of 2007, more than 60.000 herdsmen from over 13,300 households will experience resettlement (Foggin, 2007).

The "Grain to Green" policy limits Tibetans on where their herds can graze (agricultural practice) and where they can live (household location). The government has

approached a number of Tibetans living in rural areas to sell their land and herds for "better" living in more urban communities (and where their children can have access to better education and healthcare). The government has built a number of resettlement villages on the outskirts of local towns for these relocated Tibetans to live and work. Many of these homes are operational with one television, one DVD player, a one-quarter acre plot of land for home and yard and extra benefits of health care and monthly household stipend.

These relocated populations have been transported from a semi-nomadic lifestyle to a more sedentary and settled one, which has had an impact on household activity level and food availability. Many of these households that relied on their own herds as their main source of meat, milk and cheese now have to rely solely on local markets, where prices are too high to meet the needs of these families. From the case study data, these resettlement villages have increased consumption of vegetables compared to their more rural counterparts due to vegetable availability and affordability (compared to meat, milk and cheese).

In addition, for those households who would have spent long hours herding, milking and producing butter and cheese, now spend time in more sedentary activities. Physical activity levels, before gauged by yak herding practices, have decreased dramatically in resettled areas. Although the level of vegetable consumption in their diets has increased, meat and milk products have dramatically decreased as well as physical activity levels. This may have long-term effects on their household health and even increased incidence of chronic disease among the population.

The impact of this policy is tremendous, not only influencing the future health of these resettled populations, but also the social and economic needs of the community. Most of the households resettled have utilized their animal herding and survival skills in rural areas very effectively. Moving to an urban location where these skills no longer can be applied limits many households to the type of jobs for which they qualify. No job training or increased openings in the job markets have been applied in these communities. The social and economic well being of this population, due to the Grain to Green policy may have negative impacts on the local economy and even the prefecture.

Households participating in gardening and animal raising are consuming their agricultural product. The majority of those who practiced gardening consumed from their garden (80%); however, whether what they are growing is nutritionally sufficient to maintain the household is questionable. These same households also stated a reliance on the local market to meet their dietary needs. Agricultural products consumed may not be sufficient to meet their basic dietary needs. The most common vegetables consumed were Chinese cabbage, potatoes, green chilies/pepper and regular cabbage. Of these, the most common grown in the household were Chinese cabbage and potatoes. Nutritionally, the varieties of vegetables consumed and grown are most likely not providing sufficient nutrients to households. Although this population is consuming what is produced through gardening, other essential nutrients are most probably not sufficient. Most Tibetans households are not trained in gardening and those practicing have engaged in this practice recently to provide supplements to their household diets, as market prices and economic household situations fluctuate.

Farmland use in this community was primarily for the yak herds and other animals. The grains and barley grown were varieties not grown for human consumption; however, the land was arable enough to grow these varieties of crops. When asked why not consuming these crops, households stated varieties were not for human consumption, but for animal feed. A question arises whether this population is able to farm edible varieties or other edible crops for feed and human consumption? Another policy that has impacted and limited agricultural practices on the Plateau has been the Four-Way Scheme policy, developed by the government in the mid 1990's to "alleviate" poverty in Qinghai's rural areas. This policy aims to decrease poverty and the impact of poverty in the more rural populations by providing improved shelter for households and herds as well as techniques to provide more food for animal survival (Foggin, 2007). In addition, this policy calls for more secure and stable housing for Tibetans, so unlike before where tents were the main shelter, more long lasting homes made of mud or concrete have been constructed. This impacts the level of migration for many of the Tibetans. Whereas before, Tibetans would travel with their herds to and from higher elevations for better grazing, they are now limited to how far they can herd. Due to this policy, the Tibetans on the plateau are more stationary than their ancestors had been. In addition, the level of agriculture has been affected. Whereas before Tibetans knew of yak herding as their main source of livelihood, they now are introduced and encouraged to explore farming in their area, since they are now more stationary. But farming is solely focused on producing animal fodder and feed, as encouraged by the policy. Not many homes that were surveyed experimented with other types of crops (besides barley for tsamba) for

household consumption. The impact of this policy has limited the types of farming that Tibetans can explore as well as the ability of households to herd yaks long distance.

Health & Agriculture

Fatigue and weakness appear to be the most common complaint of households surveyed on the Tibetan Plateau, regardless of practice. This may be due to the location of the household, high altitude (~12,000ft.) and sufficient hydration. This population has been native to the higher altitude environment for many generations and may have a genetic predisposition to survival at the high altitude, however sufficient hydration is a necessity at higher altitude. Tibetan culture relies on Tibetan Black tea as their main source of fluid. Tibetan black tea is boiled in water, salted and is commonly consumed with various amounts of yak butter. The high salt content and the caffeine due to the black tea may increase risk of dehydration among this population, especially if small amounts are consumed and activity level is high.

Logistic regression predicting odds of health symptoms demonstrated a significant association between the consumption of vitamins (especially Vitamin C) with bone pain and/or bone deformities. A protective effect over bone health was demonstrated by intake of vitamin C in this population. This may be explained by the impact of vitamin C deficiency on bone pain. One study by Weistein, showed that persons suffering from scurvy (caused by Vitamin C deficiency) have experienced symptoms such as hypertension and "debilitating bone pain", especially in younger children. Treatment of vitamin C in these persons alleviated the symptoms (Weistein, Babyn and Zlotkin, 2001).

Good sources of vitamin C, such as citrus or green leafy vegetables, are not commonly observed among the Tibetan diet. Some households do consume seasonal fruit such as watermelon or Chinese cabbage, which are both good sources of Vitamin C. However, in the more rural Tibetan areas, most households consume a large proportion of meat and animal products and very few vegetables. The low fruit and vegetable diet among this population may be attributed to lower than normal daily intake of Vitamin C. According to the Weistein study, vitamin C treatment was very dramatic in resolving symptoms, and among a potential deficient population, the effect of vitamin supplementation may be instant.

The case study also demonstrated the possible association between food source (and possibly agricultural practice) and health symptoms. Logistic regression predicting odds of health symptoms demonstrated an association between households reporting muscle spasms and food source. Those households practicing agriculture and consuming agricultural products in addition to staple foods from the market were more likely to report muscle spasms. The activity level among those households involved with agricultural practices may be much higher than those households not practicing and receiving most of their staple diet from market sources. High activity, especially involved agricultural practices, may cause overuse from a muscle or from injury. In addition, dehydration during intense activity such as herding, milking, producing butter/cheese, gardening and/or farming, and not replenishing body fluids through rehydration, households will be more susceptible to muscle spasms, which can inhibit

further participation in other household activities.

Limitations

This survey was given to a small sample in each community at random, thus the results represent a small section of each community. Also, because this survey was strictly voluntary, some households were willing to speak but others chose not to participate. Thus, the there may have been sections of the community that were not well represented. In addition, there were some households or sections of communities that were not surveyed due to availability (some villagers were gone to festivals in another village and/or participation in religious celebrations).

Those household representatives who answered the survey may not have been aware of health symptoms or food consumption patterns experienced by all members of their household, thus the data gathered could be limited for each household based on the knowledge of the respondent surveyed. Many of those surveyed were older representatives of the households, since they were the ones home caring for the children and when asked regarding health symptoms experienced, many would focus on their own ailments.

Survey sites were pre-selected by NorServe based on convenience; thus, the communities are representative of just one area of the Tibetan plateau. Communities from the northern and western sections of the plateau were not approached for surveying and thus data presented can only represent those communities in the southeastern section of the Plateau.

The survey tool used for this case study utilized questions from the CHNS agriculture and nutrition surveys but not replicated, therefore, the survey tool has not been validated.

Further Exploration

This household survey distributed among households on the Tibetan Plateau merely skimmed the surface in regard to providing nutritional data from this area. Further, more substantial information is needed to make reliable conclusions on the nutritional status of the population. Nutrition surveys are merely a snapshot from the community's viewpoint of what diets are consumed in the households. The next level of research may include utilizing more detailed survey tools such as Dietary Questionnaires (24-hour recalls), with repeated recalls applied to the community on a more frequent basis. Another more accurate method of data collection includes biochemical analysis from blood samples in the households to determine nutrient absorption in their diets as well as biochemical food analysis of staple diets including yak products, farm/garden products and Tibetan brick black tea. In addition, this survey may need to be redistributed among a wider population representing more of the Tibetan Plateau.

Chapter VII

OVERALL FINDINGS, IMPLICATIONS AND CONCLUSIONS

The CHNS 1997, 2000 and 2004 data sets shed some light on the agricultural practices of nine provinces in East China. The analysis only included rural households that responded to the variables of interest. In these provinces, the most common agricultural practices were farming, gardening and poultry/livestock raising, as addressed by the questions asked to households. Data on specific food consumption for this population was not available, however, variables pertaining to health status and/or symptoms were available as well as questions pertaining to consumption of agricultural products. The study demonstrated that more than half of all rural households surveyed engaged in agricultural practices and that these households consumed what was produced and/or raised.

The perceived health of a household may be linked to the type of agricultural technique practiced by that household. Analysis demonstrated that farming households were more likely to report good-excellent health than those involved with other agricultural practices, however experience heart attacks more than other practices. In addition, those households involved with livestock had increased reports of bone fractures. Policies that have been in play the last ten years in China have had an impact on rural agricultural practices. For example, the high number of household farms was based on the Household Responsibility System adopted almost forty years ago and is still applicable. Other policies that have been developed not only address the type of

agricultural practices populations can adopt, but health codes and regulations that apply to each agricultural practice for the sake of public health.

The case study among Chinese Tibetans in the western province of Oinghai provided more insight on the agricultural practices of one of China's minority populations, the Kahm Tibetan. Unlike the CHNS survey that covered a multitude of rural households across nine different provinces, the case study surveyed households in six rural villages on the Tibetan Plateau, located in southern Qinghai province (bordering Tibet). Of households surveyed, over half participated in at least one form of agriculture, including farming, gardening and/or yak/other animal raising with majority of these household consuming what was produced and/or raised, except for those households involved in farming. Most of these households farmed crops primarily for animal feed and thus did not consume what was grown, but also relied on local markets for staple foods. Health symptoms reported by households may be linked to the type of agricultural practice and vitamin usage. Those households reporting muscle spasms were more likely to practice agriculture and consume from these practices. In addition, households consuming vitamins demonstrated a protective effect over bone health. Other Health symptoms, such as migraines, fatigue and weakness and diarrhea, reported by households do not appear to be linked to apparent nutritional deficiencies. Current agricultural and environmental policies in Qinghai have greatly impacted Tibetans on the Tibetan plateau. Resettlement and environmental preservation strategies have limited Tibetans on where and how yak and other animal raising is practiced. In addition, movement due to resettlement from rural to sub-urban areas has impacted the diets of Tibetans, increasing

fruit and vegetable availability yet, decreasing what used to be their staple foods of yak meat and milk, cheese and butter. The activity level moving from rural to sub-urban areas has dramatically decreased.

These two studies have demonstrated the tendency for rural populations in China to utilize arable land toward agricultural practices and consume what was grown and/or raised. The type and extent of agricultural practice was influenced by environment of the population as well as current agricultural and environmental policies in the region. The extent to which rural households practiced agriculture varied between the two populations. More than half of all rural Chinese households in eastern provinces, focused on specialized farming, livestock raising and/ or gardening. The Tibetan Chinese populations in the rural areas on the Tibetan Plateau, were more involved with livestock raising, primarily yak herding and some gardening. Farming for human consumption was not a common practice among Tibetans on the plateau. The agricultural practices of Tibetans may be limited by the environment, as many varieties of crops that were commonly eaten by Chinese may not grow well at high altitudes. The yaks are known to adjust better to higher altitude than many other types of livestock as well as of the common crops in China.

The aims of this research were addressed in each of these studies. The first specific aim for this research included assessing the relationship between the agricultural practices and access to food in rural populations. Most households involved in agricultural production in rural China consumed their agricultural product; however, as demonstrated in the Tibetan case study, crops/livestock consumed was not sufficient to

meet dietary needs of the household. Many households relied upon the local food markets to meet staple dietary needs. Thus, the impact of the market product on rural household health and nutrition may be significant. Policies affecting produce markets, shipping and disbursement of raw goods will impact rural communities.

The second aim sought to assess the link between agricultural practices and human health status. Communities dependent on agricultural products for nutrition in their diets showed a relationship with human health and agricultural practice. Those households that reported increased health symptoms that were practicing a particular type of agricultural practice were more likely to have consumed food from their practices. It is unknown whether the diets from the crop/plant/livestock products enhanced the severity of the health symptoms that were due to physical labor toward the agricultural practice. Further research is recommended to determine the direct relationship between the food source, diets, agricultural practice and health symptoms experienced among rural populations. In addition, because this study was limited to variables that provided minimum information on crop health, it is recommended to further investigate the relationship between the nutrition and health of crops with the nutrition and health of the communities that consume them. The findings may provide insight on how various approaches of growing techniques and policies limiting varieties or growth of certain crops may affect human population health.

Those households involved in specific agricultural practices demonstrated more negative effects on muscle health. This finding provides evidence for an increased need and support of occupational health resources in agricultural practices in rural China.

Some farm/livestock techniques and strategies may be more strenuous on the human body; and thus, may make persons more susceptible to physical injury. Although China has begun to establish more rigid policies on food safety and standard health codes in the more established farm/livestock collectives, the need exists for public health outreach to the greater number of household farms and livestock businesses. Occupational health standards and preventive practices for farming/livestock techniques should be considered for improved health among China's rural household practicing agriculture. This may involve more public health awareness in these areas as well as demonstration training opportunities for rural residents.

The third aim examined agricultural policy's role in improving nutrition among rural developing areas. Agricultural policy focused on improving crop production and crop health had no significant association on micronutrient deficiencies in developing areas. Relationships with agricultural policies were observed with human diet and activity change and agriculture strategy/methodology. Future agricultural and environmental policies affecting rural populations should be aware of community health nutrition in the area and address the changes that may occur due to implementation of the policy. For example, when moving whole populations from a rural to sub-urban areas, the issues of diet, education and labor skills and training will need to be addressed to smoothly transition these communities into urban society. In addition, if standard agricultural strategies are negatively changed or modified due to the effect of a policy, alternative strategies need to be implemented prior to policy implementation.

Conclusion

China has a growing economy and agrarian-based rural populations are becoming more influenced by the global and government pressures to produce. The gap between rural and urban populations is changing; and with that change, comes new standards of living and health, especially for the more rural populations. These populations are susceptible to increased physical health impairment due to the nature of agricultural techniques and practices, and feel the effects more deeply from agricultural policies that may limit or determine the standards of their practice and diet. To enhance policy effectiveness, governments should recognize and address the health needs of rural agrarian based populations through occupational health training and demonstration directly involved in agriculture in rural China.



Project Aims in Linking Agricultural practices to Malnutrition



Adapted from Haddad, 2000





Source: Adapted from Stuart Gillespie, John Mason and Reynaldo Martorell, How Nutrition Improves, ACC/SCN, Geneva 1996



Linking Agricultural practices to Malnutrition



Adapted from Haddad, 2000



Map of Nine Provinces selected for the China Health Nutrition Survey (CHNS)



Guangxi
Guizhou
Heilongjiang
Henan
Hubei
Hunan
Jiangsu
Liaoning
Shandong



Figure 5. Map of Survey Areas in Yushu Prefecture, Qinghai Province

	between 1997, 2	000 and 2004	и
	1997	2000	2004
10	3664 (100%)	2953(100%)	2931(100%)
ARMING*			
IH engage in Farming			
No	1557 (45.2)	1267 (44.2)	1225 (41.9)
Yes	1876 (54.8)	1602 (55.8)	1702 (58.1)
H specialized in Farming			
No	1461 (92.2)	1470 (91.0)	1597 (93.9)
Yes	123 (7.8)	146 (9.0)	104 (6.1)
vpe of Farming [†]			
Collective Farm	5 (0.1)	13 (0.4)	5 (0.2)
Household Farm	3627 (99.7)	3433 (99.4)	2234 (99.7)
Both	6 (0.2)	6 (0.2)	3 (0.1)
Month Farmed last year		X N	
<3	574 (15.9)	687 (20.2)	366 (17.1)
4-6	1163 (32.3)	1117 (32.7)	741 (34.6)
7-9	747 (20.7)	712 (20.8)	360 (16.8)
10-12	1118 (31.1)	899 (26.3)	673 (31.5)
verage # of hrs/day Farmed la	st vear		
<5	1613 (45.9)	1750 (54.2)	1199 (59.3)
6-10	1875 (53.3)	1445 (44.8)	803 (39.8)
11+	27 (0.8)	32 (1.0)	18 (0.9)
ollective Farm as Income	27 (010)	()	
No	765 (89 7)	718 (98.9)	13 (72.2)
Vac	87 (10 3)	8(1.1)	5 (28.8)
acained Farm Produce from C	ollective Farm	5 (111)	
No	638 (99 7)	657 (99.4)	16 (88.9)
Vas	2 (0 3)	4 (0.6)	2(11.1)
1 CS	2 (0.5)	(0.0)	- (,
ADDENINC*			
ARDENING"	2452 (66.8)	2316 (65 7)	2315 (78.9)
in engagea in Garaening	2452 (00.8)	2510 (05.7)	(
III Spacialized in Candon (Our	ard		
in specialized in Garden/Orch	1417 (94 5)	1490 (94.2)	1465 (95.3)
NO	87 (5 5)	97 (5 8)	72 (4.7)
Yes	04 (5.5)	72 (5.0)	(= ()
roduce as Income	1104 (75 6)	1110 (71 4)	1154 (75.0)
NO	1104 (75.0)	112 (71.4)	384 (25 0)
Yes	330 (24.4)	440 (20.0)	564 (25.0)
of Months Gardened last year	160 (10 7)	107 (21 4)	585 (25 3)
1-3	458 (18.7)	477 (21.4)	56A (24 A)
4-6	513 (20.9)	200 (12.0)	204 (24.4)
7-9	285 (11.6)	500 (15.0)	223 (7.1) 0.41 (40.6)
10-12	1196 (48.8)	933 (40.3)	941 (40.0)
verage # of hrs/day Gardened	last year	1077 (97.0)	1014 (02 7)
0-5	2056 (85.5)	19/7 (87.9)	1814 (85.7)
6-10	336 (14.0)	268 (11.9)	339(15.7)
11+	12 (0.5)	5 (0.2)	13 (0.0)

Table 1. Agricultural practice among Rural households in Nine Provinces in China

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A THINK AND A LAND

	1997	2000	2004	
Entire Sample	2360 (100%)	2871 (100%)	6426 (100%)	
LIVESTOCK*				
HH Raise Livestock/Poultry				
No	1143 (48.4)	1497 (52.1)	4531 (70.5)	
Yes	1217 (51.6)	1374 (47.9)	1895 (29.5)	
HH specialized in Livestock Raisi	ng	,		
No	1197 (98.4)	1385 (98.4)	1203 (96.7)	
Yes	20 (1.6)	22 (1.6)	41 (3.3)	
HH operated livestock Business		6 51 5 2 0 5		
No	30 (2.4)	38 (2.7)	1721 (58.7)	
Yes	1197 (97.6)	1392 (97.3)	1209 (41.2)	
Type of Livestock Raising Busine.	\$\$			
Collective	3 (0.2)	1408 (58.0)	1216 (64.1)	
Operated by Household	1819 (99.8)	776 (31.9)	545 (28.7)	
Both	1 (0.0)	245 (10.1)	135 (7.2)	
#Month Raised Livestock last yea	r			
0-3	71 (4.0)	77 (4.4)	43 (3.7)	
4-6	129 (7.2)	104 (5.8)	56 (5.0)	
7-9	117 (6.5)	147 (8.2)	64 (5.7)	
10-12	1480 (82.3)	1459 (81.6)	966 (85.6)	
Average # of hrs/day Raised Live	stock last year	2 ¹⁰ 2		
0-5	1683(96.8)	1683 (97.1)	1623 (95.5)	
6-10	48 (2.8)	43 (2.5)	69 (4.1)	
11+	8 (0.4)	8 (0.4)	7 (0.4)	
HH Livestock as Income				
No		1274 (51.7)	1005 (52.7)	
Yes		1189 (48.3)	901 (47.3)	
HH Consumed Livestock				
No		878 (35.8)	661 (34.8)	
Yes		1572 (64.2)	1239 (65.2)	
Collective Livestock as Income				
No	367 (98.7)	297 (99.0)	51 (96.2)	
Yes	5 (1.3)	3 (1.0)	2 (3.8)	
Received livestock from Collectiv	e Livestock	n Mi g R ¹ B	· · · · · · · · · · · · · · · · · · ·	
No	302 (99.0)	265 (99.6)	43 (91.5)	
Yes	3 (1.0)	1 (0.4)	4 (8.5)	

Table 1. Agricultural practice among Rural households in Nine Provinces in Chinabetween 1997, 2000 and 2004 (CONT.)

† Due to data source, may not be total sample size represented

2004					
	1997	2000	2004		
	u t 1	[Household Data]			
Entire Sample	7941 (100%)	6972 (100%)	6427 (100%)		
Current Health Status					
Excellent	1172 (14.9)	1193 (17.0)	980 (15.3)		
Good	4837 (61.6)	3613 (51.5)	2902 (45.3)		
Fair	1551 (19.8)	1824 (26.0)	2053 (32.0)		
Poor	288 (3.7)	382 (5.5)	477 (7.6)		
Drink Tea	A(72 ((1 E)	ALAS (LL C)	4280 (68 2)		
No	46/3 (61.5)	4045 (00.0)	4380 (08.2)		
Yes	2927 (38.5)	2327 (33.4)	2042 (31.8)		
Frequency of Tea Drinking					
Everyday (6-7 days per week)	2310 (78.5)	1572 (67.6)	1501 (74.0)		
4-5 times a week	246 (8.4)	193 (8.3)	140 (6.9)		
2-3 times a week	254 (8.6)	350 (15.0)	243 (12.0)		
no more than once a week	62 (2.1)	96 (4.1)	72 (3.6)		
2-3 times in past 30 days	33 (1.1)	59 (2.5)	24(1.2)		
once in past 30 days	17 (0.6)	20 (0.9)	12 (0.6)		
none in past 30 days	20 (0.7)	36 (1.6)	35 (1.7)		
		[Individual Data]			
			р. т.		
Entire Sample	7851 (100%)	8470 (100%)	、5727 (100%)		
Symptoms Experienced :					
High Blood Pressure *	209 (2.7)	361 (5.2)	460 (8.0)		
Diabetes*	20 (0.3)	26 (0.4)	57 (0.9)		
Myocardial Infarction*	8 (0.1)	28 (0.4)	22 (0.4)		
Stroke*	33 (0.4)	23 (0.3)	54 (0.9)		
Bone Fracture*	118 (1.5)	181 (2.6)	247 (4.3)		
Goiter*		34 (0.4)	7 (0.1)		
Cheilitis*		37 (0.4)	5 (0.1)		
Blindness*	<u></u>	23 (0.3)	7 (0.1)		

Table 2 Health in Rural areas in Nine Provinces in China between 1997 2000 and

* Denotes only positive responses among rural sites

Table 3. Results of logistic house	e regression analysis p holds in nine province	redicting of s in China	dds of fair to poor healt (1997, 2000, 2004). (*Si	h between gnificant a	agricultur at .05 level)	ral practices in	rural	
	(2004)		(2000)			(1997)		
	<u>OR (95%C.I.)</u>	<u>P-value</u>	<u>OR (95%C.1.)</u>	<u>P-value</u>	<u>OR(9</u> :	<u>5%CI)</u>	<u>P-value</u>	
Household had garden/orchard	1.029 (0.834-1.269)	0.793	0.933 (0.679-1.282)	0.669	1.183	(0.804-1.740)	0.394	
Household engage in farming	0.805 (0.659-0.982)	0.032				••• 		
lousehold operated livestock business	1.145 (0.937-1.399)	0.185	1.189 (0.803-1.762)	0.388	0.834	(0.397-1.752)	0.632	
Work in household garden/orchard	1.136 (0.927-1.391)	0.219	<u></u> * *	-				
Work on household/collective Farm	0.859 (0.713-1.034)	0.109	a •• 1	,		••	a Ben o A	
Raise livestock/poultry	0.949 (0.763-1.179)	0.634	 					
Drinks tea?	0.809 (0.720909)	< 0.001	0.798(0.648-0.982)	0.033	0.988	(0.813-1.200)	0.902	

. . . .

Table 4. Results of logistic regression analysis predicting odds of health symptoms between agricultural practices and tea consumption in rural households in nine provinces in China (1997, 2000, 2004). (*Significant at .05 level)

		High	Blood Pressure			
	(20	04)	(200	00)	(1997)	
	OR (95%C.I.)	P-value	OR (95%C.1.)	P-value	OR(95%C1)	P-value
sehold had garden/orchard	1.287 (0.834-1.986)	0.254	0.664 (0.327-1.345)	0.255	0.327 (0.136-0.786)	0.013
Eschold engage in farming	0.530 (0.356-0.790)	0.002		-		
sehold operated livestock business	0.859 (0.546-1.351)	0.510	0.843 (0.253-2.813)	0.781	5.2E7 (0.000-)	0.998
rk in household garden/orchard	0.901 (0.586-1.387)	0.636				
ik on household/collective Farm	0.491 (0.320-0.753)	0.001			**	
e livestock/poultry	1.032 (0.632-1.685)	0.900				
iks tea?	1.023 (0.823-1.273)	0.835	1.144 (0.684-1.914)	0.608	0.984 (0.517-1.870)	0.960
	(200		Diabetes			
	(200	4)	(200	0)	(1997)	
	<u>OR (95%C.1.)</u>	<u>P-value</u>	<u>OR(95%CI)</u>	P-value	<u>OR(95% CI)</u>	<u>P-value</u>
usehold had garden/orchard	0.690 (0.221-2.149)	0.522	0.102 (0.016-0.656)	0.016	0.000 (0.000-)	0.989
susenoid engage in farming	1.135 (0.432-2.984)	0.798				
usehold operated investock business	1.150 (0.401-5.528)	0.789	0.219 (0.021-2.239)	0.200	4.4 E7 (0.000-)	0.998
ork an household collective Farm	0.370 (0.203-2.870)	0.820		-		
is a livestock poultry	0.270 (0.052-1.406)	0.072		-		
and a tea?	1 144 (0 736-1 779)	0.120	0.731 (0.120 4.452)	0.734	0.000 (0.000.)	0.001
	1.1++ (0.750-1.777)	0.000	0.751 (0.120-4.452)	0.734	0.000 (0.000-)	0.991
		Hea	rt Attack (MI)			
	(200	4)	(20)	00)	(199)	7)
	OR(95% CI)	P-value	OR(95% CI)	P-value	OR(95% CI)	P-value
lousehold had garden/orchard	0.832 (0.170-4.083)	0.821	0.776 (0.092-6.519)	0.816	1.2E6 (0.000-)	0.997
lousehold engage in farming	3.508 (1.004-12.261)	0.049				
lousehold operated livestock business	0.339 (0.048-2.385)	0.277	1.201 (0.229-6.293)	0.829	1.3 E6 (0.000-)	0.998
Work in household garden/orchard	0.967 (0.181-5.171)	0.969		-		
Nork on household/collective Farm	0.000 (0.000-)	0.989				
taise livestock/poultry	0.624 (0.051-7.709)	0.713	-		-	
Drinks tea?	1.104 (0.510-2.392)	0.801	0.831 (0.185- 3.734)	0.809	0.000 (0.000-)	0.992
		Ano	nlexy (Stroke)			-
	(200	4)	(20)	00)	(199'	7)
	OR (95%C.L)	P-value	OR(95%CI)	P-value	OR(95% CI)	P-value
uschold had garden/orchard	0.974 (0.353-2.687)	0.960	0.522 (0.058-4.739)	0.564	4.4 E7(0.000-)	0.997
ousehold engage in farming	0.723 (0.297-1.763)	0.476			-	
susehold operated livestock business	1.564 (0.777-3.148)	0.210	1.333 (0.191-9.296)	0.771	3.1E7 (0.000-)	0.998
ork in household garden/orchard	1.041 (0.365-2.970)	0.940			· -	
ork on household/collective Farm	0.183 (0.050-0.675)	0.011				
ise livestock/poultry	0.405(0.117-1.399)	0.153				
inks tea?	0.649 (0.325-1.295)	0.220	0.276 (0.030-2.506)	0.253	1.218 (0.383-3.876)	0.739
		Bor	ie Fracture			
	(200	4)	(2000	0)	(1997)	а н
а. 	OR (95%C.I.)	P-value	OR (95%C.I.)	P-value	OR(95%CI)	P-value
isehold had garden/orchard	1.428 (0.854-2.389)	0.174	1.615 (0.574-4.548)	0.364	0.597 (0.225-1.583)	0.300
sehold engage in farming	0.771 (0.456-1.306)	0.334				
sehold operated livestock business	1.698 (1.172-2.462)	0.005	1.193 (0.604-2.358)	0.611	5.6E7 (0.000-)	0.998
k in household garden/orchard	0.822 (0.512-1.320)	0.418			-	-
k on household/collective Farm	1.207 (0.764-1.906)	0.420			···	
se livestock/poultry	0.634 (0.391-1.026)	0.064				
iks tea?	0.961 (0.700-1.319)	0.804	0.720 (0.410-1.263)	0.251	0.686 (0.340-1.384)	0.292
	a conservation of the stands of the stands			9		
					<i>a</i>	
				*	l i	

Distri	bution of Sample	1 Distr	Distribution of Sample			
Entire Sample	205 (100%)	Entire Sample	205 (100%)			
	and the second se	•				
Survey Site		Staple Foods†				
Changa	32 (15.6)	Flour/Noodles	150 (73.1)			
Chirigu	30 (14.6)	Meat	200 (97.5)			
Hashu	32 (15.6)	Rice/Bread	164 (80.0)			
JiaJieNiang	32 (15.6)	Vegetables	198 (96.5)			
Gyegu	61 (29.8)	Tsamba (Barley Mix)	186 (90.7)			
Zamo	18 (8.8)					
		Meat Consumption				
Farmland		>5 lbs/wk	66 (33.0)			
No	115 (56.1)	6-10 lbs /wk	64 (32.0)			
Yes	90 (43.9)	11-15 lbs /wk	27 (13.0)			
anara da	* ************************************	16-20 lbs /wk	14 (7.0)			
		21-25 lbs /wk	2 (1.0)			
Food Source		31-35 lbs /wk	2 (1.0)			
Market (only)	101 (49.3)	36-40 lbs /wk	2 (1.0)			
Market and Agriculture	102 (49.8)	46-50 lbs /wk	1 (0.5)			
Agriculture (only)	2 (1.0)	51-60 lbs /wk	4 (2.0)			
		Vegetable Consumption				
Consume from		Chinese Cabbage	137 (69.1)			
Agriculture		Green Chiles/Pepper	50 (25.2)			
3x Daily	62 (63.3)	Potatoes	89 (44.9)			
2-5xWeekly	19 (19.4)	Zucchini	44 (22.2)			
3-4xMonthly	17 (17.3)	Celery	8 (4.0)			
		Eggplant	1 (0.5)			
		Turnip (yung)	7 (3.0)			
		Regular Cabbage	49 (24.7)			
Hires Others for		Carrots	1 (0.5)			
Care of Herds		Mushroom	2 (1.0)			
Yes	23 (11.2)	Tomatoes	1 (0.5)			
		Spinach	1 (0.5)			
		Green Onions	1 (0.5)			
Agricultural practices [†]		VARIETY	12 (6.0)			
No Agricultural practice	92 (44.9)					
Gardening (only)	23 (11.2)	Fruit Consumption				
Farming (only)	3 (1,5)	Daily	28 (13.7)			
Animal Raising (only)	24(11.7)	Frequent	1 (0.5)			
Gardening and Other	45 (22.0)	Occasional	100 (48.8)			
Farming and Other	59 (28.8)	Seldom	8 (3.9)			
Animal Paising and Other	85 (41.5)	1 ²¹ B				
Aminal Kaising and Other	00 (11.0)	Yak Milk/ Milk Product	Consumption			
		Daily	89 (43.4)			
Concurso All Animala/		*Daily (seasonal)	9 (4.4)			
Crone Daired/Crown		Frequent	5 (2.5)			
No.	0 (8 1)	Occasional	68 (33.2)			
NO	102 (01 0)	Seldom	10 (4.9)			
Ies	102 (91.9)					
		† Denotes categories not m	utually exclusive			

*Daily (Seasonal) refers to households who consume daily during spring and summer seasons but not often during autumn and winter.

1 able 5.	rushu Prefecture, C	ghai Province Survey Summary (cont.)			
Distribution of Sample		Distribution of Sample			
Entire Sample	205 (100%)	Entire Sample 205 (100%			
Tea Consumption/ day		Symptoms Experienced+			
None	3(1.5)	Eatigue and Weakness 131 (63.0)			
Less than 2 pings*	13 (6.3)	Bone Pain & Deformition 80 (43.4)			
2-3 pings	86 (42.0)	Muscle Spasms 105 (51.2)			
4-5 pings	63 (30.7)	Diarrhea $57(27.8)$			
6-7 pings	18 (8.8)	Skin Disorders $12(59)$			
8-9 pings	11 (5.4)	Tissue Swelling $20(14.1)$			
10 pings or greater	11 (5.4)	Dry Skin 22 (10.7)			
		Tendency to Bruise 7 (3 4)			
Vitamin Usage		Night Blindness 2 (1.0)			
No	116 (56.6)	Excessive Hair Loss $2(10)$			
Yes	88 (42.9)	Swollen Abdomen 1 (0.5)			
Daily	20 (22.7)	Reddish Hair Discoloration 1 (0.5)			
Frequent	2(2.3)	Mental Confusion 9 (4.4)			
Only when Sick	49 (55.7)	Sensitivity to Sunlight 16 (7.8)			
	2	Weight Loss 16 (7.8)			
Vitamin Type†		Loss of Appetite 30 (14.6)			
Vitamin C	68 (78.2)	Heart Palpitations 64 (31.2)			
Vitamin E	2 (2.3)	Chronic Headaches 83 (40.5)			
Vitamin A	1(1.1)	Weak Bones 3 (1.5)			
Vitamin D	1(1.1)	Pica 1 (0.5)			
Vitamin B1	1(1.1)	Eye Disorder 7 (3.4)			
Vitamin B6	3 (3.5)				
Vitamin B12	5 (5.8)				
Calcium	1 (1.1)				
Multivitamin	5 (5.8)				
		† Denotes categories not mutually exclusive			
ing holds 2 quarts		1			

Tabl	le 6. Yushu Pi	refecture, Qingl	nai Province Ho	usehold Summary	8
OUSEHOLDS ousehold Members	Mean 5.08	Median 5	Min. 1	Maximum 16	Freq. (%)
ldest Member	53.61	53	25	95	
oungest Member	11.96	8	<1	70	
ime at Site	14.04	20	1	80	
<10 yrs					89 (43.4)
11-19yrs					12 (5.8)
>20yrs					103 (50.24)

Y
Taute 7. Tresence or	Landy I vou c	usamption pat		roou sources	s among nouse	noids involved in	Agricultura	practices
			l	[G= Gardening	F= Farming	AR= Animal Raising	OP=Other Pr	actices]
	Distribution of Sample	No Agriculture Practiced	G (only)	F (only)	AR (only)	G & OP	F & OP	AR& OP
		%	%	%	%	0/0	%	%
Entire Sample	205 (100%)	92 (44.9)	23 (11.2)	3 (1.5)	24 (11.7)	45 (22.0)	59 (28.8)	85 (41.5)
Arable Land Available	90 (43.9)	2.2%	100 %	100%	0%	97.8%	100%	70.6%
Consume all foods grown/raised	102 (91.9)		90.9	33.3	82.6	95.5	94.9	94.0
Yak Milk/Milk Product C	Consumption							
Daily	89 (43.4)	26.1	13.0	0.0	58.3	42.2	72.9	72.9
*Daily (seasonal)	9 (4.4)	0.0	0.0	0.0	0.0	4.4	15.3	9.4
Frequent	5 (2.5)	1.1	0.0	66.7	0.0	4.4	6.8	1.2
Occasional	68 (33.2)	45.7	52.2	33.3	37.5	31.1	5.1	15.3
Seldom	10 (4.9)	6.5	17.4	0.0	0.0	8.9	0.0	0.0
Fruit Consumption								
Daily	28 (13.7)	22.8	8.7	0.0	8.3	8.9	3.4	5.9
Erequent	1 (0.5)	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Occasional	100 (48.8)	46.7	47.8	100	58.3	44.4	50.9	49.4
Seldom	8 (3.9)	4.3	0.0	0.0	8.3	4.4	1.7	4.7
Food Source								
Market Only	101(49.3)	98.9	13.0	66.7	16.7	8.9	3.4	5.9
Market and Agriculture	102 (49.8)	1.1	82.6	33.3	83.3	86.7	94.9	94.1
Agriculture Only	2 (1.0)	0.0	4.3	0.0	0.0	4.4	1.7	0.0

*Duily (Seasonal) refers to households who consume daily during spring and summer seasons but not often during autumn and winter.

			[0	= Gardening	F= Farming AR=	Animal Raising	OP=Other F	ractices]
	Distribution of Sample	No Agriculture Practiced %	G (only) %	F (only) %	AR (only)	G & OP %	F & OP %	AR& OP %
Entire Sample	205 (100%)	92 (44.9)	23 (11.2)	3 (1.5)	24 (11.7)	45 (22.0)	59 (28.8)	85 (41.5)
Patigue and Weakness	131 (63.9)	63%	69.6 %	66.7%	79.2%	64.4%	54.2%	63.5%
Bone Pain & Deformities	89 (43.4)	29.3	56.5	33.3	58.3	57.8	54.2	55.3
Muscle Spasms	105 (51.2)	45.7	56.5	66.7	54.2	53.3	57.6	54.1
Diarrhea	57 (27.8)	30.4	26.1	0.0	29.2	24.4	22.0	27.1
Skin Disorders	12 (5.9)	3.3	4.3	0.0	8.3	6.7	10.2	9.4
Tissue Swelling	29 (14.1)	14.1	17.4	0.0	29.2	13.3	5.1	14.1
Dry Skin	22 (10.7)	7.6	4.3	33.3	20.8	8.9	13.6	14.1
Tendency to Bruise	7 (3.4)	6.5	0.0	0.0	0.0	0.0	1.7	1.2
Night Blindness	2(1)	1.1	0.0	0.0	0.0	0.0	1.7	1.2
Excessive Hair Loss	2(1)	2.2	0.0	0.0	0.0	0.0	0.0	0.0
Mental Confusion	9 (4.4)	6.5	4.3	0.0	4.2	2.2	1.7	2.4
Sensitivity to Sunlight	16 (7.8)	4.3	8.7	0.0	16.7	6.7	8.5	11.8
Weight Loss	16 (7.8)	3.3	13.0	33.3	12.5	8.9	8.5	10.6
Loss of Appetite	30 (14.6)	13.0	21.7	33.3	25.0	11.1	11.9	14.1
Heart Palpitations	64 (31.2)	32.6	30.4	33.3	41.7	24.4	25.4	30.6
Chronic Headaches	83 (40.5)	38.0	52.2	66.7	45.8	44.4	39.0	40.0
Weak Bones	3 (1.5)	0.0	4.3	0.0	4.2	2.2	1.7	2.4
Eye Disorder	7 (3.4)	5.4	4.3	0.0	4.2	2.2	0.0	1.2

Table 8. Health Symptoms experienced (greater than 3 weeks) among households involved in Agricultural practices

Note: Categories are not mutually exclusive

Table. 9 Results of logistic regression analysis predicting odds of health symptoms by land availability, food source and agricultural practice between household health symptoms. (*Significant at .05 level)

	Fatigue & Weakness OR (95%C.I.)	P-value	Muscle Spasms OR (95%C.I.)	P-value	Bone Pain OR (95%C.I.)	P-Value
Arable Land Available	0.549 (0.205-1.468)	0.232	0.773 (0.312-1.914)	0.577	0.722 (0.292-1.786)	0.481
Food Source (Mixture vs. Market)	1.040 (0.267-4.059)	0.955	4.240 (1.031-17.432) 0.045	1.295 (0.357-4.708)	0.694
Agricultural Practice	1.552 (0.365-6.600)	0.552	0.469 (0.110-2.008)	0.308	3.029 (0.780-11.766)	0.109
Vitamin Consumption (Vitamin C)	1.405(0.768-2.570)	0.269	0.707(0.398-1.256)	0.237	0.581 (0.319-1.059)	0.077
Drink tea? [†]	и "к 			2 ² 	· . · · ·	6 ¹⁶ Servel

CONT.	Headaches OR (95%C.I.)	P-value	Heart Palpitations OR (95%C.I.)	P-value	Diarrhea OR (95%C.I.)	P-Value
Arable Land Available	0.569 (0.232-1.397)	0.219	0.723 (0.283-1.849)	0.498	0.544 (0.205-1.439)	0.220
Food Source (Mixture vs. Market)	1.827 (0.483-6.917)	0.375	1.597(0.376-6.789)	0.526	0.845 (0.211-3.387)	0.812
Agricultural Practice	1.017 (0.257-4.015)	0.981	0.749 (0.169-3.327)	0.704	1.378 (0.332-5.730)	0.659
Vitamin Consumption (Vitamin C)	0.668 (0.372-1.200)	0.177	0.844 (0.456-1.562)	0.590	0.704 (0.368-1.349)	0.290
Drink Tea? [†]			· .	•••• •••	· · · ·	

[†] due to small number of cases not reported

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APPENDIX A

YUSHU AGRICULTURE AND NUTRITION SURVEY

Agriculture Nutrition Survey – Yushu Perfecture

AGRICULTURAL PRACTICES & CROP CONSUMPTION

1.Is there farm land in this village/ neighborhood 0 (No) 否 1 (Yes) 是 你所在的村庄附近有没有农田?

2. Where do you get most of your food from?

你的大多数事物来自?

Market 市场 ____ Home garden 温室 ____ Other 其他 ___

2. What percentage of the village farmland has:

百分之多少的农田得到

A. water flowing from the local river (through a ditch) (%)

河水 浇灌

B. water flowing from town ditch(%)

蓄水池浇灌

C. everyone take part to take care of (plowing)(%)

集体锄地

3. Common food crops grown and picked from the village farmland: 本地农田出产的典型食物、粮食?



4. What foods are eaten from village farmland: 在本地的 农田中什么产品被食用?

3.	

5. How often are the foods grown/animals raised from village farmland eaten:

本地的农产品及牲畜被食用的次数

A. 3 x Daily

每天3次

B. 2-5 x Weekly

每星期2-5次

C. 3-4x Monthly

每月3-4次

 6. What type of agriculture/animal raising do you do: 你所从事的是什么样的农业 \ 蓄牧业?

A.None 无

B.Gardening 温室

C. Collective Farming 集营型农田

D.Yak herding 蓄养牦牛

E. Other 其他

7. Does your family eat all the foods grown and picked, or animals raised in your household: 你们家食用所有自己农田产的食物及家牲吗?

0 (No) 否 1 (Yes) 是

8. How many hours a week/month do you work on your garden or herd your animals? 每月 \ 周有多少钟头你得在菜地工作 \ 放牧?

9. What foods that you eat are from foods grown/ picked in thisland?

什么食物是你自己农田里种植的?

Α.	
B.	
С.	

10. What are other main types of food are eaten in your house?

你	家里的主食都是?		
	Α		
	B.	10	
	C.		

11. Can these types of food also produced in your home? 0 (No) 否 1 (Yes) 是

这些是否也是产自于家中?

12. How often do you drink Tibetan black tea with your meal? 你经常在饭间喝藏茶吗?

CROP NUTRITION & HUMAN HEALTH 营养与健康

10. Does you or people in your home take vitamins (pills) in addition to current food sources? 0 (no) 1 (yes)

你或你的家人是否通过服用维生素来补充食物中营养的不足?0否 1是

11. How many hours are used for daily household duties? 料理家务需占据多长时间?

12. What are some common household duties for your home? Who does them? 在你家中一般需要料理有家务都有哪些?由谁负责?

Have you or any one in your household suffered from any of these symptoms for a long period of time (at least 2 weeks) in the last year:

在过去一年当中你或你的家人有谁被任何以下病症长期困扰过吗?(至少两个星期)

#PERSONS/人

DURATION/期限

12. Fatigue and weakness

0 (No) 否 1 (Yes) 是

69

体虚无力 经常困乏

13. Bone pain and deformities 筋骨痛 体质差	0 (No) 否	1 (Yes) 是
14. muscle spasms 肌肉痉挛	0 (No) 否	1 (Yes) 是
15. diarrhea 胃泻	0 (No) 否	1 (Yes) 是
16. skin disorders (itchy skin/ dark purple spots) 肤表出现斑 块	0 (No) 否	1 (Yes) 是
17. tissue swelling (edema) 水肿	0 (No) 否	1 (Yes) 是
18. dry skin 皮肤干燥	0 (No) 否	1 (Yes) 是
19. sore tongue 舌苔溃疡	0 (No) 否	1 (Yes) 是
20. bleeding gums 牙龈 出血	0 (No) 否	1 (Yes) 是
21. tendency to bruise and bleed 淤青和出血迹象	0 (No) 否	1 (Yes) 是
22. Night blindness 広言	0 (No) 否	1 (Yes) 是
23. excessive hair loss 严重脱发	0 (No) 否	1 (Yes) 是
24. swollen abdomen (especially in children) 腹部肿胀	0 (No) 否	1 (Yes) 是
25. reddish discoloration of hair 头发 亦色发红	0 (No) 否	1 (Yes) 是
26. mental confusion 神经错乱	0 (No) 否	1 (Yes) 是
27. sensitivity to sunlight 阳光过敏	0 (No) 否	1 (Yes) 是

28. weight loss 失重 [失重]	0 (No) 否	1 (Yes) 是
29. loss of appetite 食欲下降	0 (No) 否	1 (Yes) 是
30. heart palpitations 心脏剧烈跳动	0 (No) 否	1 (Yes) 是
31. headaches 头痛	0 (No) 否	1 (Yes) 是
32. birth defects (spina bifida/anencephaly) 先天缺陷	0 (No) 否	1 (Yes) 是
33. weak bones 骨软化	0 (No) 否	1 (Yes) 是

34. food craving for coal, soil, chalk, paper, flour, raw potato, starch 0 (No) 否 1 (Yes) 是 (拉)异食癖, 食欲倒错(见于孕妇、缺铁及缺锌患者和营养不良的儿童)

DIETARY CHANGE 饮食变化

24. How long have you lived in this site/village? 你在这里生活了多长时间?

25. What is your primary occupation and has it change since before living at this site? 你现在从事什么职业?以前呢?

27. What were the most common foods consumed in your household this year? 今年你家里最常食用的食物是什么?

28. Since coming to this site, how has your diet changed, if at all? 自从搬到这里以后你的饮食都发生了什么样的变化? In terms of the type of 就以上方面发生了什么变化?

Vegetables 蔬菜:

Meats 肉类:

Traditional medicines 药物:

29. Have the number of times consuming meats changed since coming to this site? 搬迁以来你食用肉类的份量是否发生了改变?

30. Have the number of times consuming vegetables/crops changes since coming to this site? 搬迁以后你食用 蔬菜的份量是否发生了改变?

HOUSEHOLD NEEDS 家庭生活需求 31. In the last year, what has been your family's biggest difficulty? 什么曾是你们家在过去一年当中存在过的最大的困难?

32. In the last year, what has been your family's greatest need? 在过去一年当中什么曾是你们家最大的需求?

33. In this community, has anyone passed away recently? Do you know how? 在你居住的社区中最近是否有人过世?你了解原因吗?







