

FINAL TECHNICAL REPORT / RAPPORT TECHNIQUE FINAL

IDRC FINAL TECHNICAL REPORT

China Development Research Foundation;

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Project Title: Nutrition and Food Security in Rural China: Evaluating the Impacts of the National Nutrition Improvement Plan for Rural Students

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Research Organizations involved in the study:

China Development Research Foundation

Location of Study: Beijing, China

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Final Technical Report

Period covered by the report: December 15, 2016 – December 14, 2019

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Abbreviations

ATT: average effect of the treatment on the treated

CDC: Chinese Center for Disease Control and Prevention

CDRF: China Development Research Foundation

DID: Difference in Difference

DRC: Development Research Center of the State Council

IFPRI: International Food Policy Research Institute

PSM: Propensity Score Matching

UNICEF: United Nations International Children's Emergency Fund

WFP: World Food Programme

1. Executive Summary

The overall purpose of this research is to analyze how the school feeding system in China under the National Nutrition Improvement Plan affects local food security and economic situation, nutrition, health, and education outcomes of girls and boys.

During the first six months of the research, preparations to ensure a successful research have been done in collaboration with different agencies: project inception meeting was conducted in March 2017 with researchers from China Central Disease Control and Prevention and United Nations Children's Fund; Sampling strategies were considered.

In 2017, we conducted a study on the effect of school feeding in the past five years and generated important policy implications for the central government. A few research results to date include: 1. School feeding system has effectively helped rural students in poverty-stricken areas. 2. School feeding has met basic nutritional needs of most students. 3. Students' physical health has remarkably improved. On June 1st, CDRF held an international symposium on school feeding and child nutrition and published the data analysis report on school feeding system.

The in-depth research was conducted from 2017 to 2018 to find out whether the increase of average height from 2012 to 2016 is caused by the intervention of school meals. The results showed that 1) The school meal plan has significant impact on students' height change; 2) Among the three meal-providing types, lunch (hot meals) are the most effective; 3) School meal contributes differently to height change between boarding school students and non-boarding school students.

We also looked at how school meals are related to poverty reduction, how poor families' burdens have been relieved because of the school meals in 2018. We administered two field researches to Guizhou and Ningxia provinces (2 counties at a time, 4 counties in total) to look at the use of the data system, to interview students, school employees, families and school administrators to better understand how school meals are carried out locally and how students and families view the school meal plan. The results showed that more than 90% of students never felt uncomfortable after eating school meals and more than 50% of students on average thought meals at schools were better than meals at home. Also, more than 75% of parents were satisfied with school meals.

The team compiled previous reports on school meals and submitted to different levels of government for review and suggestions in 2018. Reports were disseminated on the Sixth International conference on Poverty Reduction held in Beijing by CDRF from November 3 to 5 and the Fourth Silk Road Forum held by Development Research Center of the State Council (DRC) from December 5 to 6 in Paris, France. About half of the counties responded by acknowledging the importance of providing hot meals instead of just cold drinks and bread (or snacks). The access to nutrition knowledge and data helped local school administrators improve their school meals.

From 2018 to 2019, we implemented "save your canteens" activities in 6 schools in Ledu County, Qinghai Province, 7 schools in Yongdeng County, Gansu Province, 7 schools in Xundian, Yunnan Province, 10 schools in Yizhang, Hunan Province, and 4 schools in Qianxi, Guizhou Province. We provided funds for schools to refurbish school canteens, to equip the canteens with necessary equipment, to train school chefs, and to carry out nutrition knowledge training. We conducted a field research in Xundian County, Yunnan Province in 2019 to investigate the progress of kitchen facilities improvement

and the National Nutrition Improvement Plan for Rural Students. We held a training in nutrition and health knowledge for 68 teachers in schools and officials in the County Education Bureau who were in charge of the National Nutrition Improvement Plan from 11 counties in 2019 in Chengdu, Sichuan Province. We also added a new module in the mobile phone APP to upload training materials of nutrition and health knowledge so that teachers and chefs in pilot counties could have access to these materials more easily.

In order to study the influences of changes in the purchase price of materials for school meals on the implementation of the National Nutrition Improvement Plan in recent years, our team conducted a study on the difference in procure prices of 5 main school meal materials between national average and pilot counties. Results showed that the purchase price in poverty-stricken counties monitored by the platform was generally slightly higher than the national average. For example, pork price was about 3 yuan per kilogram higher than the national average. Also the purchase price and purchasing methods have direct impacts on students' nutrition intake. Under the self-purchasing mode, each pilot school can purchase foodstuffs from nearby farmers or small businesses with more choices. They can purchase the ingredients at a cheaper price, but the food safety risks of self-purchasing are larger. Under the government-centralized procurement mode, the county governments are responsible for bidding suppliers. This method can appropriately reduce the risk of food safety hazards, but the bidding process is complicated, and the costs would increase, leading to higher purchase price than under self-purchasing mode. This policy report was published by the Development Research Center of the State Council and was commented by the leaders of China in November 2019.

In 2019, we commissioned the research team in Chinese Academy of Fiscal Sciences to conduct the overall evaluation on the effectiveness of the data-collection system established by CDRF, and completed the evaluation report. The final research report was published by Chinese Academy of Fiscal Sciences in September, 2019. Since the Chinese Academy of Fiscal Sciences is an affiliated institution of the Ministry of Finance, in 2019, this evaluation was served as one of the examples the Academy submits to the Ministry of Finance on how to better monitor national welfare policies and the use of central fiscal money at a large scale.

In the China Children Development Forum held in June 1st, 2019, we invited the chefs in Diaoyutai State Guesthouse to prepare the lunch for guests with recipes from one of our pilot schools. We also invited teachers, students and administrator of school canteen from Zhongyixiang primary school, Shizhu County, Chongqing Municipality to our Forum, to share their experiences on school canteen management and data uploading work of our project during the luncheon. The luncheon gave all the conference guests a first-hand impression of school meals in rural China and raised their concerns on school meals.

In order to better publicize the School Nutrition Improvement Initiative, we edited and printed 100 project handbooks with information of the project system, experience from pilot counties and evaluation research.

This project directly engages policymakers from national, provincial and local governments by giving feedback and improvement suggestions of the implementation and effect of the national plan. Our research reports were submitted to Ministry of Education, Ministry of Finance and the State Council, and some of them were commented by the leaders of China. Also, some provincial education bureau

started to re-inform the county-level governments about the policy implementation and change in priorities of local work to put actual implementation first and try best to provide hot meals by paying kitchen staff and equip the school canteens. In addition, we communicated with officials from Mexico, Brazil and Liberia through field visits, and shared research results with ministers from different countries, renowned scholars and international organizations by holding international conference.

2. The research problem:

The overall objective is to provide evidence-based policy outcomes to equitably improve the nutritional status of rural school children – boys and girls – and increase food security in impoverished regions in China.

The specific objectives of the Project are as follows:

1. To assess whether and how the implementation of the National Nutrition Improvement Plan had an impact on nutritional, health and education outcomes of rural girls and boys (aged 7 to 15);
2. To analyse the impact of the school feeding system on local economy (income and employment, in particular for women), food security situation (food production), and on local poverty reduction;
3. To assess, strengthen and evaluate the local capacity and knowledge on nutrition and health education with approaches to engage men and women's participation

3. Progress towards milestones

Milestone	Evidence/Indicator	Comments
Milestones for reporting period Dec 15, 2016 -June14, 2017		
Overall project preparation work:		
1.1. Project inception activities held, including ethical approval procedures, project team workshop with researchers	1. a small group project inception meeting was held on March 27th 2017 with experts from IDRC, UNICEF and Chinese Center for Disease Control and Prevention (CDC) 2. On June 1st, CDRF held a seminar on school feeding with around 50 speakers. 3. We held an advising meeting with Dr. Horton on June 2nd to learn more about cost-benefit analysis and the possibility.	
Objective 1:		
1.2. Cohort study research design, including sampling strategy and surveys drafted.	1. data collection: 1.1 By using the data we collected from the school feeding platform in the past two years (about 10 million data items), we conducted descriptive analysis from various perspectives 1.2 students' historical physical health data (height and weight) from 1.92 million students of 62 counties (from year 2012 to 2016, for each age group, the sample size is around 200,000) 1.3 education outcomes data from 10 counties 2. sampled 5 counties 3. finished drafting three surveys to county-level point person for the nutrition plan, school staff (administrator and kitchen staff), students and caregivers (parents preferred)	
Objective 3: Strengthen local capacity and knowledge on health education		
1.3. The standard test of nutrition knowledge determined and administered to sampled schools.	Completed surveys included in the three surveys mentioned before in 1.2	
1.4. Health education class curriculum adapted to rural context and administered to sampled schools.	1. planed to work with Mars. Incorporated and China CDC to adapt existing materials to new curriculum 2. provided 3 counties in Ningxia Province with Healthy Eating Habits Cartoons	
1.5. "Save your canteens" activities designed and related resources prepared, implemented in sampled schools (4 schools).	On June 18-21, CDRF research team went to Gansu, Qinghai and Guizhou to conduct field research. Resources for local cooks were prepared and further information gathered from local schools	
Milestones for reporting period June 15 2017 to Dec 14, 2017		
Objective 1		

2.1. Field research conducted; includes surveys, interviews and meetings with local government officials.	Large amount of time is dedicated to data collection from local government and schools on students' individual/family level data items.	
2.2. Data on education and health indicators accessed through local education and health bureau.	Completed by cooperating with mainly local CDCs	
2.3. Report on the implementation of the school meal affect students' education and health outcomes prepared and discussed.	Test results were discussed among internal research team as well as external experts.	
Objective 3		
2.4. Continued implementation of "save your canteens" activities (4 schools).	<p>1. Curriculum development is still under review because of the long turn-over of partners from Mars incorporates and CDC</p> <p>2. Baseline of the nutrition education status among rural students in compulsory education was done in cooperation with China CDC.</p> <p>3. Round-table discussion on child nutrition education was held to talk about the importance of nutrition and health education in developing countries.</p>	
2.5 Round table discussion on child nutrition education	Round table discussion held in cooperation with DCP3 major team members talked about the importance of nutrition and health education in developing countries	
Milestones for reporting period Dec 15, 2017 to June 14, 2018		
Objective 2		
3.1 Household survey and school employee survey developed and finalized.	Completed Household survey was developed taking into consideration of different geographic locations, local food characteristics and eating habits. School employee survey was also developed and tested by small scale local canteen employees (in 2 schools of Gansu Province). Finalization of the survey was made in early July.	
3.2. Data related to local food production and local poverty-related indicators accessed through collaboration with respective government agencies.	Indicators related to local poverty and food production has been accessed through different local education bureaus in 62 counties out of 100 counties.	
Objective 3:		

3.3. Continued implementation of “save your canteens” activities (4 schools).	Completed: “save your canteens” activities are implemented in 27 schools in Yongdeng county, Gansu province and Ledu county, Qinghai province.	
3.4. Project Annual review meeting held to discuss progress and review work plans	Project annual review was conducted internally with project team in March.	
Milestones for reporting period June 15, 2018 to Dec 14, 2018		
Objective 2		
4.1 Field research to administer the household survey and school canteen employee survey conducted.	1. the research team administered two field visits to 2 counties Guizhou and 2 counties in Ningxia provinces for the household survey. 2. Surveys about school meals, data platform and school employees were conducted in two counties of Guizhou province	
4.2 Survey and interview data analyzed.	completed	
4.3. The second report for objective 2 on the effect of the national school meal plan on local economy and agricultural production written and disseminated.	1. The report on economic development and agriculture production is under review and revisions by expert. 2. In September 2018, invited by The Lancet, the research team drafted the article called Comprehensive Intervention in Child Development: A Chinese Case, introducing the school meal plan’s background, measures of the intervention and the policy suggestions. This article is now under review.	
Objective 3		
4.4. Continued implementation of “save your canteens” activities (4 schools).	Save your canteens activities were implemented in 6 schools in Ledu, Qinghai Province since September 2018. 1. We equipped them with basic cookers, storage and cleaning facilities to ensure food safety while providing nutritional meals for students. 2. Education program was delivered on October 19th 2018 in Ledu Qilidian School in Qinghai Province to help students and families better understand healthy food and develop good eating habits.	
Milestones for reporting period Dec 15, 2018 to June 14, 2019		
Objective 3		
5.1 End test of nutrition knowledge of students, employees and parents held.	completed	

5.2 Students' satisfaction survey about the health education classes and the cartoon posters conducted.	<p>Not complete:</p> <p>Health education classes were canceled as reported before because phone interviews by the research team during regular check-up with local bureaus of education and school principals showed that although health classes are scheduled, they were also replaced by more important lessons such as Math, Chinese and English.</p> <p>So we only held training sessions in nutrition and health knowledge for teachers in schools and officials in the County Education Bureau who were in charge of the National Nutrition Improvement Plan from 11 counties in August.</p>	
5.3 Data for objective 3 analyzed and report prepared.	completed	
Objective 1, 2 and 3		
5.4. Data from the first two objectives integrated with objective 3 for further analysis	completed	
5.5 Comprehensive data analysis conducted.	completed	
Milestones for reporting period June 15, 2019 to Dec 14, 2019		
Objective 1, 2 and 3		
6.1 Final report drafted and discussed with domestic and international experts. Report revised after the consultation.	completed	
6.2 Final report and manuscripts finalized; policy briefs submitted to relevant government agencies.	<p>Completed</p> <p>This policy brief on the difference in procure prices of 5 main school meal materials between national average and pilot counties was published by the Development Research Center of the State Council and was commented by the leaders of China in November 2019.</p>	
6.3 Dissemination conference held with domestic and international participants.	1. Reports were disseminated on the Sixth International conference on Poverty Reduction held in Beijing by CDRF in November, 2018.	

	<p>2. Reports were disseminated on the Fourth Silk Road Forum held by Development Research Center of the State Council (DRC) in December, 2018 in Paris, France.</p> <p>3. Experiences on school canteen management was shared in the China Children Development Forum held in June, 2019 by CDRF in Diaoyutai State Guesthouse, Beijing.</p>	
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4. Synthesis of research results and development outcomes

4.1. Research objective 1: To assess whether and how the implementation of the National Nutrition Improvement Plan had an impact on nutritional, health and education outcomes of rural girls and boys (aged 7 to 15) (see Annex 1 and Annex 2 for reports published using the research results)

China's school meal plan was implemented in 2011 (2012 for some counties) in 699 impoverished counties. In order to study its long-term impact on student height, the research team collected a total of 1.92 million data from 13 pilot provinces. After data sort-out and cleaning, we are able to match the height data with students' tracking number (ID number assigned by local education bureau). At this stage, we manage to track students' height data from 62 pilot counties in 11 provinces. The three groups of students were enrolled respectively in 2010, 2011 and 2012. And for these three groups of students, we are able to track them through 2010 to 2016 with multiple variables collected using survey (to local education bureau) and online system, information collected including: gender, student's socio-economic status (left behind children or not, poor family or not), meat-eating frequency at home (nutrient intake condition at home), family income, regional economic development condition etc. .

Number of data items for students enrolled in 2010 is 34843, 41385 for students enrolled in 2011 and 51556 for students enrolled in 2012. In the datasets, 32% of the students are left-behind children whose mothers are not at home for a long time; 16% of them are from poor families receiving special fund from the government; 62% of the students attend boarding schools; and 74% of the students' mothers don't finish their junior high schools.

Ages of students starting to be covered by school meals in the three sample groups are 7 years old, 8 years old and 9 years old respectively. And there are three types of school meal interventions, breakfast, lunch and in-between classes snacks. Four basic research questions are tested using the three-group sample:

Question 1: Impact of school meal plan on height growth of students;

Question 2: Differences in effect of students' height change with different time of exposure to school meals;

Question 3: The effect of different meal-providing modes to students' height change;

Question 4: The different impact of school meals on the height change between boarding school students and non-boarding school students;

As the school meal plan were implemented in all 699 counties in our sample since 2012 (2011 marked the announcement of the plan by the central government but the actual implementation started in 2012 locally), the 8-year-old group (shown in the table below) in 2011 can be treated as the control group; while the 8-year-old group in 2013 could be treated as the experiment group with one-year exposure to the school meal plan.

Sample frame and composition (Age)

	2010	2011	2012	2013
Enrolled since 2010	7	8	9	10
Enrolled since 2011		7	8	9
Enrolled since 2012			7	8

Question 1: Impact of school meal plan on height growth of students

Measuring the effectiveness of school meal plan could be interpreted as the impact of participation (having school meals) and non-participating (not having school meals) on the height of students. For this problem, we use two methods, one is OLS regression analysis, the other is Propensity Score Matching (PSM).

a) OLS regression model: $Y = \alpha + \beta_1 \text{Meal} + \beta_2 X + \varepsilon$

Meal1 = 1 refers to the participation of school meal plan (8-year-old students in 2013), Meal1 = 0 refers to not participating in school meal plan (8-year-old students in 2011); Y is height; and X refers to other control variables.

In the OLS method, explaining variable is the student's height, "whether to participate in school meal plan" is treated as the binary virtual explanatory variable into the regression equation. Also, individual, family and county level variables that may affect the height of the students are introduced in the equation. The regression coefficient of "whether to participate in nutrition improvement plan" can roughly reflect the height growth effect of participating in the school meal program. However, this method may have a problem of selection bias because it is not completely random to participate in the school meal plan.

In order to mediate this issue, the research team attempts to use propensity score matching (PSM) method. The basic idea is to use the logit model to estimate the probability of each student's participation in the school meal plan and match the students in the two groups (experimental and control) with same or similar propensity scores. The difference between the two ATT (average effect of the treatment on the treated) is caused by the school meal plan.

b) Propensity Score Matching (PSM):

First calculate the probability of students' participation in the school meal plan (propensity score)

$$\log \left(\frac{p_i}{1-p_i} \right) = a_0 + a_1 X_i + \varepsilon_i$$

$p_i = P(\text{treat}_i = 1 | X_i)$ represents the probability that student i participates in the school meal plan; X refers to other control variables.

Our idea is to match the students with the same or similar propensity scores, and test the matching results for balance test and the supporting test. Then we would calculate the mean treatment effect (ATT) and compare the results with those of OLS.

Question 2: Differences in effect of students' height change with different time of exposure to school meals

We choose to use Difference in Difference (DID) method for this research question. The specific model is as follows:

$$Y_{it} = \alpha_0 + \sum_{k=-2}^{k=4} D_{it}^k \delta_k + x_{it}^T + z_{it}^T \gamma + c_i + \mu_t + \varepsilon_{it}$$

Where k is the difference between the current year (2010-2016) and year (2012) when student i started to eat school meal. The value of k is from -2 to 4. Negative number refers to not having school meals for -k years. Positive number refers to having school meals for k years. By putting k as a dummy variable into the model, the value of k refers to the impact of the length of exposure to school meals on student i's height. x and z are family (individual) and county-level covariates.

Question 3: The effect of different meal-providing modes to students' height change

To study this problem, the above DID model will be used. Meal providing model (breakfast, lunch and in-between classes snacks) will be added to the equation as a dummy variable and difference of students' height will be calculated.

Question 4: The different impact of school meals on the height change between boarding school students and non-boarding school students

In order to determine the difference in height between students who attend boarding schools with those do not, we use the same DID model and add dummy variables to indicate students' boarding status. Then, we can infer to a certain extent whether students' nutrition status at home is satisfactory.

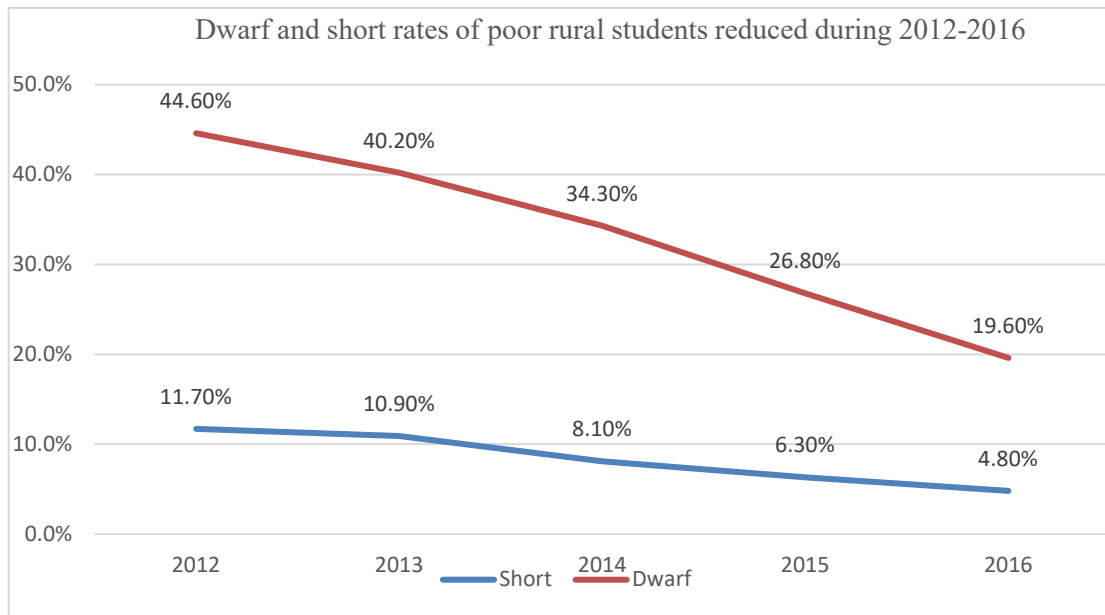
Key results:

1. Nutritional improvement program can improve student's height.

Multiple linear regression model and propensity score matching method results show that the National Nutritional Improvement Program can improve student's height.

We put all individual level, family level and county level control variables into the model. The results show that the average height of boys who participated in the National Nutrition Improvement Program is 2.67cm higher than those who did not. The same results for girls, the average height of girls who participated in the program is 1.5cm higher than those who didn't. So the National Nutrition Improvement Program has a positive effect on student's physical condition.

Based on the "Standard for Height Level Classification Among Children and Adolescents Aged 7-18 Years" issued by the National Health Commission of China, a child is defined as being "short" if his height falls below the median level for his age by 1SD, and is defined as a "dwarf" if his height is below the median for his age by 2SD. The proportion of children classified as "dwarves" or "shorts" in 7-12 age group children living in poor and remote areas has decreased year over year. The proportion of shorts has dropped from 44.6% in 2012 to 19.6% in 2016. The proportion of shorts has dropped from 11.7% in 2012 to 4.8% in 2016.



2. Lunch is the most effective feeding model for improving student's height?

We use the following model to find out which feeding model among these three (breakfast, lunch, snacks) is most effective for improving student's height:

$$Y = \alpha + \beta_1 \text{diet1} + \beta_2 \text{diet2} + \beta_3 \text{Year} + \beta_4 X + \varepsilon$$

Multiple linear regression results showed that, there was no significant difference in height between students who ate breakfast and snacks. But the average height of students who ate lunch was significantly higher (1.25cm) than the average height of students who ate snacks. Therefore, lunch is the most effective feeding model among these three for improving student's height. Moreover, continued nutritional intervention is necessary, because the height of students will increase 0.64cm if they eat 1 more year nutritious meals.

3. Impact of time of exposure to school meals on students' height (different time exposure)

We split our dataset into 9 years old group and 11 years old group, and we analyze the impact of time exposure to school meals on the height of students using students who do not receive school meals as control group.

The average height of 9-year-old students, who has participated the project for one or two years, in the treatment group is higher than those who are in the control group. Girls who receive school meals for 1 year and 2 years are 1.3 cm and 2.1 cm taller than girls who do not receive school meals respectively. Boys who attend school meals for 1 year and 2 years are 1.5 cm and 2.3 cm taller than boys who do not receive school meals respectively. Students who receive nutritious meals for 2 years are higher than those who only are enrolled in school meals for only one year.

For 11 years old group, regression result shows that time exposure to school meals impacts the height

increase for both girls and boys. Using exposure to school meals for 2 years as the baseline, height of students with exposure of 3 and 4 years is better. Girls with 3 years' exposure are 0.84 cm higher than those with only 2 years exposure. Girls with 4 years' exposure are 1.28 cm higher than those with 2 years exposure. The same results are shown in the 11-year-old boys' group. Boys with 3 years' exposure are 1.01 cm higher than those with only 2 years exposure. Boys with 4 years' exposure are 1.51 cm higher than those with 2 years exposure.

Difference in Difference (DID) method result (gender controlled) shows that students who eat school meals for 1 year is 1.25cm higher than students who do not eat school meals; students who eat school meals for 2 years is 1.52cm higher than students who do not eat school meals; students who eat school meals for 3 years is 1.88cm higher than students who do not eat school meals; students who eat school meals for 4 years is 2.5cm higher than students who do not eat school meals, moreover, boarders are 0.8cm higher than externs.

The results demonstrated that by controlling the factors of local economic status and family social economic status, students who eat school meal are 1.3cm-1.5cm higher than the students who do not eat these meals. Moreover, when students were divided into different age groups for regression analysis, results showed that the longer students eat school meals (the earlier the treatment is given), the taller the students become. Therefore, long-term nutritional interventions for students in rural areas are necessary.

4. Girls' growth compared with boys

Based on the analysis, compared with boys, the school meal program has had more impact on girls' height than that of boys. The average height for girls is 1 cm higher than boys. But factors affecting this will need more analysis and we intend to collect more information on how girls are treated at home to better understand this issue.

4.2. Research objective 2: To analyse the impact of the school feeding system on local economy (income and employment, in particular for women), food security situation (food production), and on local poverty reduction

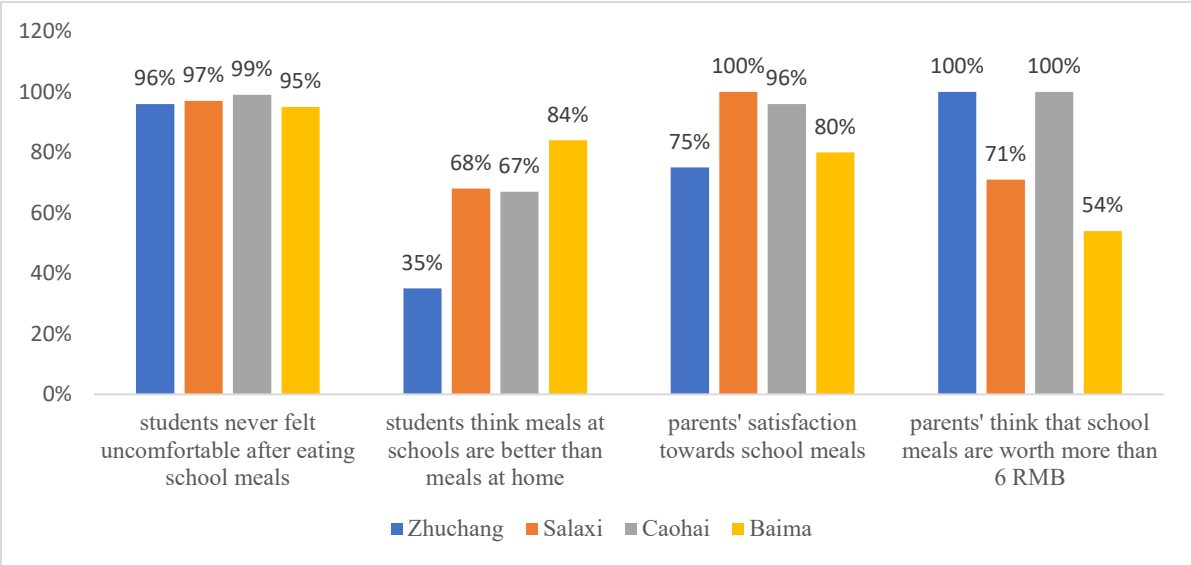
1. Surveys about school meals and school employees

The research team administered two field visits to 2 counties Guizhou and 2 counties in Ningxia provinces. Survey questions include basic demographic information such as age, grade, and family situation (income, food consumption at home etc.). Subjective questions such as whether you eat breakfast every day, how many meat/vegetable dishes you eat for one particular meal, time exposure (how many semesters) to school meals were addressed to students. Subjective questions such as which dish you like the best in school meal, whether you think the food is clean and safe, whether the school kitchen is clean (and whether spoons and chopsticks are clean), how much do you think the school meal will cost if not provided by the school.

Interviews were conducted in the above-mentioned schools in Guizhou and the four schools in Ningxia province. Altogether 18 people (school administrator, school canteen employee, parents, students and county-level official) were interviewed about the overall impact of school meals. Interview questions include: how the school ensures food safety; how the school employees are trained about nutrition and

food safety; how school employees view their job working in the school kitchen; how county-level officials and school administrators perceive the school meals as a way to address poverty issues.

Preliminary descriptive results for some major questions in the survey in different schools of Guizhou Qixinguan District (County):



One typical interview results of a county-level official on school meal, school employee in Tongxin County in Ningxia Province are provided below:

There are 570 cooks in school canteens around Tongxin county, the student cook ratio is 80:1. Monthly salary of cooks is 800 RMB for those working in boarding schools and 700 RMB for those working in regular schools. No social insurance is provided to these cooks because they belong to a category of temporarily-hired workers. There are 490 cooks, accounting for 86%, who have received training from the local government on food safety and healthy diet. Other training opportunities are provided on township level schools.

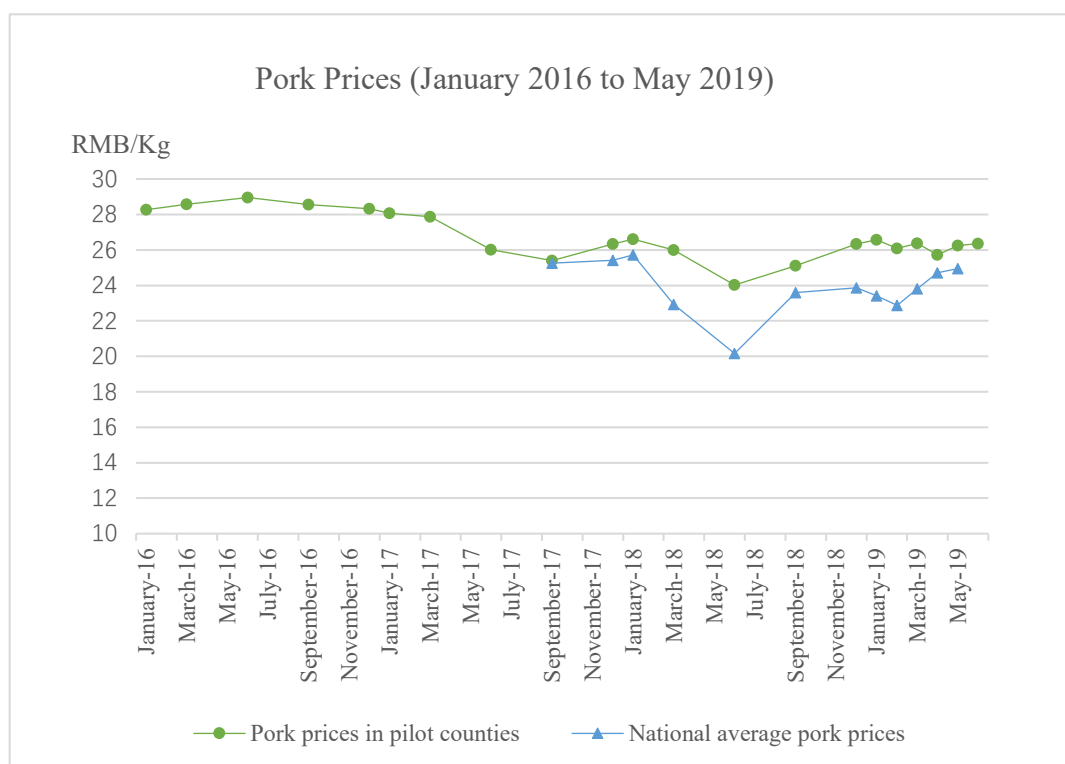
The county level government has spent around 12 million RMB for 49 schools in remote villages for refurbishment of school kitchens and canteens. In 2017, Tongxin county spent 2.64 million RMB to establish the water-cleaning system for all the compulsory education schools within the county. Major ingredients for the school meals, including rice, oil, eggs and meat are procured on the county-level, following strict guidelines of public bidding (tender) for suppliers. Suppliers follow the contracts to deliver the ingredients to schools and shoulder the responsibility to ensure that the ingredients are clean and safe. Perishable products, such as vegetables and spices are provided locally from markets near the schools. Prices are set based on multi-party negotiations in order to make sure that the fiscal subsidy is fully and used most effectively by the schools. School administrators are the key persons for food safety monitoring and assurance.

2. The study on the difference in procure prices of 5 main school meal materials between national average and pilot counties

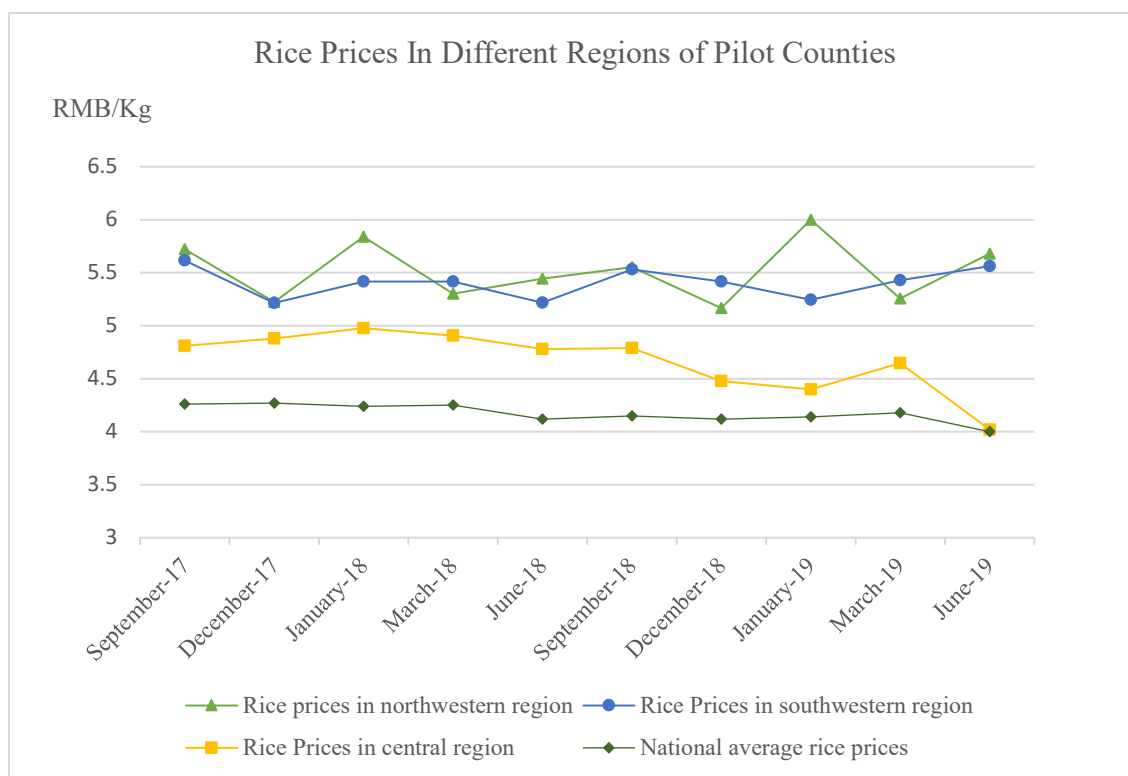
We collected and analyzed 617,571 data items of food purchase price in 100 counties in 13 provinces from

the data platform, and selected five main ingredients that students often eat, including rice, eggs, and chicken, pork and tomatoes. These five ingredients have representative nutritional value, and the popularity and procurement rate in each region are also high, which is more representative in the analysis. In this study, the average monthly purchase price of these five main ingredients from January 2016 to June 2019 was calculated for all the counties and provinces. We also collected the average monthly price of these five ingredients since September 2017 from the official website of the Ministry of Agriculture of China to observe the price fluctuation trend and reasons and to compare with the price of the pilot counties. The main findings are as follows:

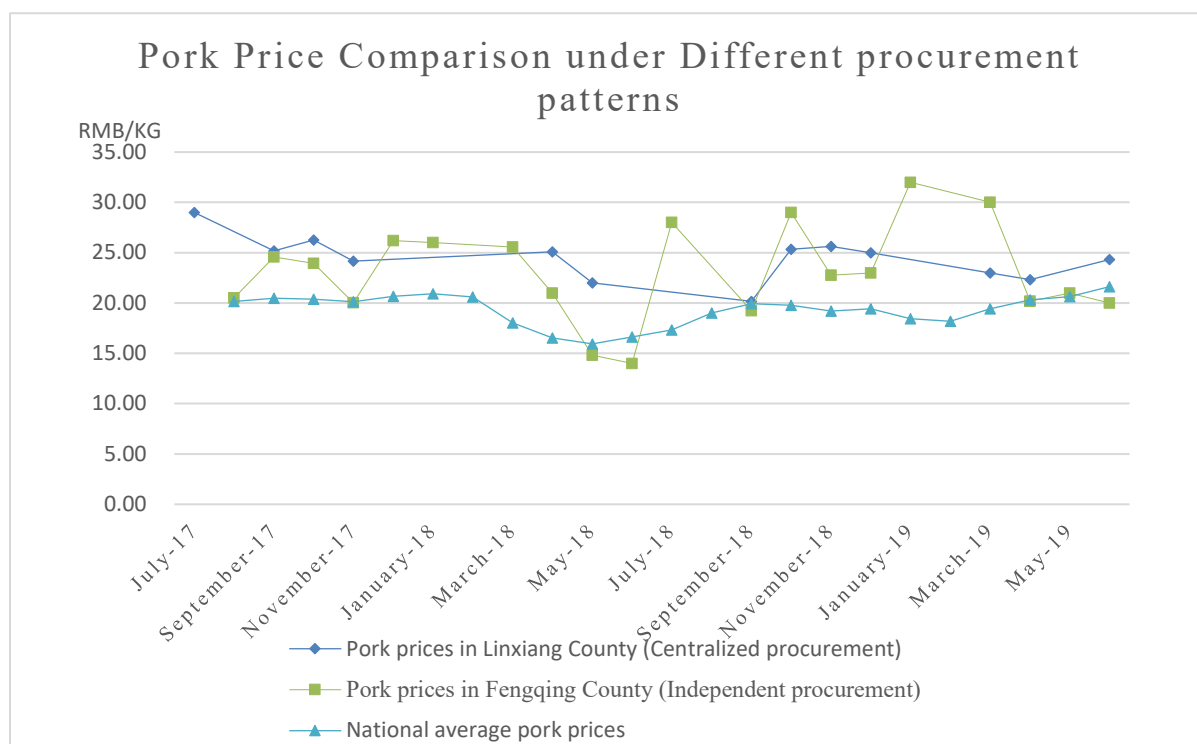
- 1) Since 2016, the prices of agricultural products such as rice, eggs, chicken, pork and tomatoes have fluctuated greatly. The fluctuation trend of the purchase price of eggs, pork and tomatoes in the pilot counties was consistent with the fluctuation trend of the national purchasing price from the Ministry of Agriculture. However, the average monthly purchase price of the five ingredients in the pilot counties was higher than the national average. One explanation is that in the pilot counties, the government-centralized procurement model is used to purchase food from companies and supermarkets, which aim to make profits, so that the purchase price in the pilot counties is higher than the average purchase price of rice in the country.



- 2) We divided 13 provinces by region, namely Southwest China, Northwest China and Central Region, and compared the purchase prices of the main ingredients in these three regions with the national prices to study the regional differences in purchasing prices. In the southwestern region, northwestern region and central region, except for the difference in price of pork and tomato, the purchase price of several other ingredients was quite different, and the price fluctuation trend was not consistent. In the three regions, the price in the southwest region was relatively stable.



- 3) The price difference between different provinces in the same region is obvious. When the purchase price was too low, we must pay attention to prevent food safety problems. If the food was purchased at an excessive price, the national dietary subsidy was not used reasonably, and it needed to be promptly reminded.
- 4) According to the analysis of the purchase price under different procurement methods in the pilot counties, the prices under self-purchasing were very volatile, and the purchase price was lower than the government-centralized purchase price of the county. Under the self-purchasing mode, each pilot school can purchase foodstuffs from nearby farmers or small businesses with more choices. They can purchase the ingredients at a cheaper price, but the food safety risks of self-purchasing are larger. Under the government-centralized procurement mode, the county governments are responsible for bidding suppliers. This method can appropriately reduce the risk of food safety hazards, but the bidding process is complicated, and the costs of bidding agency fees, announcement fees, and bidding production fees would increase the procurement cost, leading to higher purchase price than under self-purchasing mode.



From the data analysis results, it can be seen that the purchase price in poverty-stricken counties monitored by the platform was generally slightly higher than the national average. The proportion of large cities in the national average price announced by the Ministry of Agriculture may be higher. Most large and medium-sized cities have already realized agricultural industrialization and can produce agricultural products in batches. These industrialized agricultural products are also mainly supplied to urban markets. Also, cities are more convenient: The traffic and the circulation channels are smooth, the supply is abundant, and the agricultural products in various places are concentrated in the city. Therefore, the price in cities is lower. The impact of the price of agricultural products on urban residents is relatively small, but this study shows that the procurement price of rural poverty-stricken areas is higher than the national average, which will directly affect the living standards of rural people with higher Engel coefficient. In addition, the high purchase price of school meals will directly affect the implementation of the National Nutrition Improvement Plan.

4.3. Research objective 3: To assess, strengthen and evaluate the local capacity and knowledge on nutrition and health education with approaches to engage men and women's participation

1. Nutrition Awareness of Kindergarten Personnel and Caregivers

Together with World Food Programme (WFP) and International Food Policy Research Institute (IFPRI), our research team conducted a study on nutrition knowledge score and gaps of caregivers in Yongshun county and Longshan county, Hunan province. The samples were from 26 local kindergartens. The caregiver questionnaires contained a 11- question module on nutrition and young child feeding knowledge. A total of 1333 caregivers completed the module.

The results showed that most of the caregivers were not familiar with the food sources of some important nutrients needed by children. Less than 50% of caregivers knew how to improve their children's nutrition through daily food intake and diversity diet. In general, caregivers lacked relevant nutrition knowledge. The nutrition knowledge scores were slightly higher in male caregivers than those of female caregivers. The parents' scored slightly higher than those of grandparents' (or grandparents'). Mothers' scores were the highest in all the caregivers. The analysis of baseline nutrition score revealed the necessity to strengthen various approaches of nutrition and child feeding education targeting caregivers. Caregiver groups which had lower scores, namely grandparents and female caregivers, deserved specific attention in the education activities.

2. Nutrition knowledge score and gaps of kindergarten staff before and after the nutrition training

A nutrition education seminar was held in Jishou, Xiangxi, on July 17, 2018. 37 preschool principals, teachers, and kitchen staff were trained by nutritionist from the China CDC on key knowledge about nutritional diets, cooking techniques, and child feeding. The main group training approach was presentation provided by the expert. Observers from the evaluation team participated in the training and asked all the trainees to complete the nutrition knowledge questionnaires both before and after the training.

The results showed that before training, most of the trainee know little about the food choice. Then the responses were aggregated into a nutrition knowledge score. The scores increased slightly after the training. Score increase was slightly higher among female trainees than male trainees. Although the nutrition knowledge was enhanced a bit by the nutrition education (as the average score increased), little effect or even worse performance were observed on some knowledge points.

3. "Save your canteens" activities

1) Yongdeng county, Gansu province

Save your canteens activities are implemented in 7 schools in Yongdeng county, Gansu province. Yongdeng county is a national designated poverty-stricken county. In June 2017, CDRF research team went to do field visit and found out that across Yongdeng county, national school meal subsidy was not used to provide hot meals, but rather snacks/bread/soft drinks to students. In 2018, funding and activities were implemented at local level. The 7 schools now have refurbished the school canteens and has hired additional canteen staff to prepare hot meals for students. Also, local government has conducted onsite job training and education knowledge training to cooks and canteen employees to better prepare them for the job.

2) Ledu county, Qinghai province

Ledu, similar to Yongdeng, is a poverty county with a large proportion of ethnic minority groups. In remote mountainous areas of Ledu County, transportation of food is quite difficult and hard to reach the most remote schools. So local government chose to implement the school meal plan by providing cold food and snacks to students in remote areas. After communicating with local government and consulting school teachers in remote areas, the team decided to help 6 schools in Ledu county with canteen improvement and nutrition education training. The schools are selected based on original canteen status and students' nutrition intake analysis by the data-collection system. Primary schools located in remote mountainous areas were the ones the research team specially focused on. In these remote schools,

number of students was much fewer than in urban areas, usually under 100. They usually did not have adequate equipment to cook hot meals for students.

In 2018, funding was donated to equip them with basic cookers, storage and cleaning facilities to ensure food safety while providing nutritional meals for students.

Nutrition education programs and activities were conducted to help students and families better understand healthy food and develop good eating habits. Education program was delivered on October 19th 2018 in Ledu Qilidian School in Qinghai Province. Around 500 students participated in the activity. Nutrition experts from the national CDC nutrition institute gave classes and training sessions to students and parents. Chefs from local areas and Beijing played cooking games with students and taught about micronutrients and healthy foods. Outdoor games were used to teach students about nutrients intake, risks of taking too much salt and sugar, and how to balance diets in and out of schools.

3) Xundian County, Yunnan Province, Yizhang County, Hunan Province, and Qianxi County, Guizhou Province

In 2019, Save Your Canteens activities were implemented in 7 schools in Xundian, Yunnan Province, 10 schools in Yizhang, Hunan Province, and 4 schools in Qianxi, Guizhou Province since March 2019 (spring semester). We provided funds for schools to refurbish school canteens, to equip the canteens with necessary equipment, to train school chefs, and to carry out nutrition knowledge training.

With the funds we provided, these schools refurbished school kitchens and canteens and equipped the kitchens with basic cookers, storage and cleaning facilities during the summer holiday. All the new kitchens and canteens were put into use since September 2019 (the beginning of fall semester). This could ensure food safety while providing nutritional meals for students.

In July 2019, a field research was conducted to investigate the progress of kitchen facilities improvement and the implementation of the National Nutrition Improvement Plan for Rural Students in Xundian. The new facilities in pilot schools were bought and installed. In the beginning of the next semester, these facilities will be put to use, and the County Education Bureau will held nutrition knowledge training for teachers and chefs in schools.

Local teachers and officials also mentioned some difficulties and challenges. 1) The 4 yuan school meal subsidy per day per student provided by the government was not enough for a full meal with both meat and vegetables, but because Xundian is a poverty-stricken county, local schools were not able to cover the extra school meal expenses. In addition, as a Hui and Yi Autonomous County, most of the residents in Xundian are Hui people who are forbidden to eat pork. Due to the much higher purchase price of mutton and beef than pork, the funds for school meals were tighter. 2) Most of the chefs and staff in schools canteens were hired temporarily with low qualification and low incomes because of the tight funds.

In order to carry out nutrition knowledge training in local schools for students, we designed a series of nutrition health knowledge comics. The comics consists of six topics: 1) do not waste food and do not overfeed; 2) having breakfast every day, and having lunch and dinner on time; 3) an excess of salt is unhealthy; 4) do not eat snacks without food production license; 5) having a balanced diet; 6) drinking

milk and eating eggs. Local schools posted the comics on the bulletin boards for students to learn since September 2019.

To ensure the efficient implementation of the National Nutrition Improvement Plan, and to improve the nutrition and health status of children in poor areas, the program team held a training in nutrition and health knowledge for 68 teachers in schools and officials in the County Education Bureau who were in charge of the National Nutrition Improvement Plan from 11 counties from August 8th to 9th in Chengdu, Sichuan Province.

The 6 teachers were experts from Chinese Center for Disease Control and Prevention, Sichuan Provincial Disease Prevention and Control Center, Chengdu Center for Disease Control and Prevention, School of Public Health in Chongqing Medical University, and Sichuan Tourism College. They taught lessons of the basic concepts of a nutritious meal, nutritious meals for school-age children, guidance tools for nutritious school meals, scientific food cooking and processing methods, student nutrition education practice activities, food safety, and oral health.

5.Synthesis of results towards AFS themes

5.1. Improved access to resources.

The national nutrition plan targets the 699 poverty-stricken counties in mid and western rural areas of China. The beneficiaries of the plan are 23 million children who are most vulnerable. Based on the data we collected, 20% of the children live in families that both parents migrated to cities for work (what we call left-behind children in China) and 16% of the children's families are enrolled in the new national poverty alleviation strategy that aims to eliminate poverty by 2020. The success of this project will help those children understand food and nutrition better (education of nutrition knowledge) and the results of the evaluation provides advice to government's decisions and improvement of the national plan, which in turn benefits the children and their families.

The positive results of students' height change, which means better nutrition status of children living in poor rural areas encourage local staff who implement the school meal plan and gives credit to their hard work since 2011. Local resources are crucial to the implementation of the school meal plan and by communicating positive results to local heads of government can better improve their investment in school meals (staff, money and attention). Research itself does not include actual improvement of resources since the school meal plan is mainly handled by local governments, but by informing high-level policymakers that the plan is actually working but needs improvement, local resources can increase accordingly.

In June 2018, we communicated with local government education bureaus to grant them access to the data platform and analysis reports. Feedback of research was reported on the data platform for different counties and different provinces. In this way, local education bureaus can check their own performance of school meals timely and we recommend them to do it on a weekly basis. Data include nutrient and food intake analysis, height change analysis and recommended menus. Local administrators can use the data to generate report and guide their work in the future. Nowadays for policy evaluation and performance check in China, data and research become more and more important evidence for administrators.

The Save Your Canteens Activities in Yongdeng, Ledu, Xundian, Qianxi, and Yizhang not only refurbished the school kitchens but also provided nutrition education to students/parents/school employees.

Feedback from the county level officials, teachers and students were positive on the education programs. Students learned about food processing, categories of nutrients, balance diets; Parents learned about the consequences of malnutrition for children and how to avoid it. School kitchen employees learned about food safety principles and how to balance safety with taste, and how to prepare various foods to supplement students' needs.

5.2. Improved nutrition and knowledge of nutrition.

This project's aim is to evaluate the national nutrition improvement plan so as to improve students' nutrition status and to provide them with adequate and diversified diets, particularly for children. By using the feedback system of the data platform, we could first calculate the nutrition and food intake of students and give feedback to individual school after two hours of their successful uploading of pictures and data. School staff responsible for school meals will closely examine the feedback and they will know what kind of nutrients and foods are not enough for the meal and readjust their menus accordingly. In the results section, we report the current condition of nutrition and food intake for students.

The research team sent the analysis of students' height change (boys and girls, different types of meal-providing) results to local officials and school administrators. About half of the counties responded by acknowledging the importance of providing hot meals instead of just cold drinks and bread (or snacks). The access to nutrition knowledge and data helped local school administrators improve their school meals.

The Save Your Canteens Activities in Yongdeng, Ledu, Xundian, Qianxi, and Yizhang not only refurbished the school kitchens but also provided nutrition education to students/parents/school employees. It improved school canteens' building infrastructure, trained chefs in cooking skills and nutrition knowledge, and promoted the exchange of experiences between counties.

5.3. Informing policies.

This project directly engages policymakers from national, provincial and local governments by giving feedback and improvement suggestions of the implementation and effect of the national plan. CDRF has long been engaged with different levels of government in the process of policymaking and the national nutrition improvement plan is one of the successful example of our comparative study in 2006.

Project leader Secretary General Lu Mai signed 100 letters to county-level party leader to reflect the current situation of the implementation of the plan and made suggestions on how to improve in 2017. The party leaders disseminated the letters to local education bureau and local governments are giving us feedback on the letters and some of them have already changed local practice based on our suggestions.

The comprehensive report on students' height change was sent to Ministry of Education and the State Council. On June 14th 2017, Mr. Lu Mai was invited by the Vice Premier Madam Liu Yandong of the State Council to present the results in a seminar on children and women's health. The results of our current study were accepted and highly praised by Ministry of Education and the State Council, in which they often use the height change of the students to understand the effectiveness of the plan. They also reflect on the problems and made administration orders to local governments to improve the plan. Madam Liu Yandong made two long comments on the policy brief we wrote and the work CDRF has been involved in doing, praising our continuous efforts in research and drawing the public attention to the nutrition issues of rural children living in poverty.

In 2017, Minister of Development Research Center of the State Council, Mr. Li Wei, published an article about school meals and our research results on China Reform, which is a state-known policy magazine. The article receives attention from the central government as well as the public.

The research team went on a visit to Mexico and Brazil in October, 2017. In Mexico, the research team presented the research results up till then to the audience in the 17th International Conference on Child Development. In Brazil, the team presented the school meal website and data platform to the Brazil Ministry of Social Development as well as the Brazil's Fund for Education (the agency that provides funding for the school meal). Presentations of the school meal data platform and results raise great interest of the two countries and we agree to have more communications among each other.

In September 2017, the research team briefed the Ministry of Education about our research progress and results. National supervisor of the school meal plan in the Ministry of Education expressed his support to our project and promised to give national-level resources to enrich our research.

In April 2018, CDRF wrote a policy brief to Governor of Hunan province, which is one of the project sites of school meals. The brief used data analysis of the platform CDRF established and conveyed the message of better implementing the school meal in some of the province's counties, especially those who provide only snacks but not hot meals. The governor took our advice very serious and assembled provincial level team to conduct field visits to the respective counties. In the following months, the research team has been in close contact with local governments in looking into the problems and issues they face in the implementation process of school meals. Provincial education bureau started to re-inform the county-level governments about the policy implementation and change in priorities of local work to put actual implementation first and try best to provide hot meals by paying kitchen staff and equip the school canteens.

In June 2018, deputy secretary general of CDRF Dr. Fang attended the national meeting on progress of implementation of school meals. He reported the progress of the project and made suggestions to the national government to pay attention to the significant problem that some of the counties still use snacks/cold/soft drinks to carry out the school meal plan. And based on our estimate of price increase, the subsidy 4 RMB per student per day is no longer enough for some local governments to implement the school meals with high quality. Thus, an increase of school meal subsidy is necessary and needs action in the next few years.

In September 2018, the research team cooperated with the Chinese Academy of Fiscal Sciences to conduct a holistic evaluation on the impact of the school meal data system. This evaluation focuses on the platform's mechanism, effectiveness and cost-benefit situation.

In November 2018, the Sixth International Conference on Poverty Reduction and Child Development was held in Beijing. The conference invited eight Ministers from different countries, including China, Cambodia and Malaysia, and around 200 renowned scholars whose research were on Nutrition and Education for disadvantaged children. International organizations such as WFP, UNICEF and Save the Children were present and gave talks on global situation of malnutrition and school meals. The research team presented the most up-to-date research findings on the conference and printed several reports for dissemination.

The two field visits to Guizhou and Ningxia also informed local policies on school meals in 2018. The research team generated specific data reports before the field visits and provided the two reports to local governments. During the field visits, researchers communicated with local officials on the necessity of increasing the subsidy standard (now it's 4 RMB per student per day, 200 days per year) but also emphasized the nature of school meals as a supplement and poverty eradication strategy to the most disadvantaged group of students.

In September 2018, the First Lady of Liberia Hon. Clar M. Weah visited CDRF and further communicated with the research team on introducing the school meal initiative to Liberia to enhance local students' health and increase enrollment rate of elementary education in Liberia. Based on the field visit to Liberia in June 2018, the research team submitted the proposal to conduct the school meal plan in Liberia and use the cellphone application to collect relevant data. Now the proposal is being reviewed by the National South-South Cooperation committee for funding support. If approved, the research team will soon start to implement the project in Liberia. Data analysis will be of great value in comparing China's practice with that of Liberia.

The research team cooperated with the Chinese Academy of Fiscal Sciences to conduct a holistic evaluation on the impact of the school meal data system. This evaluation focuses on the platform's mechanism, effectiveness and cost-benefit situation. The final report was finished and was reviewed by experts. This evaluation will serve as an important document for the research team to expand the scale of the data system in order to better generalize the research outcome. At the same time, the Chinese Academy of Fiscal Sciences is an affiliated institution of the Ministry of Finance. In 2019, this evaluation was served as one of the examples the Academy submits to the Ministry of Finance on how to better monitor national welfare policies and the use of central fiscal money at a large scale.

In 2019, the research on purchase price explored the implementation and actual results of central poverty alleviation policy in the pilot counties, and the local government's management and operation mechanism. The research results informed local schools and governments the impact of different purchasing modes on purchase price, which would help them make decisions. The state's dietary subsidies for children in poor rural areas could refer to the price level at the county level, and appropriately adjust the dietary subsidy standard. This policy report was published by the Development Research Center of the State Council and was commented by the leaders of China in November 2019.

6. Problems and Challenges:

Shortage of personnel to implement the nutrition education and knowledge and do relevant research on this part was the biggest problem. Save the Canteens activity, hiring chefs and invite them to go to local areas require a lot of cooperation and coordination with local government, education and health bureaus. We found that the cost of doing such an activity is higher than what we expected.

local government sometimes declines to provide precise county level economic conditions, including household income index and poverty alleviation effects. For research purposes, we may need to ask each household we sample to get the number, which is not usually accurate.

To solve the issue of collecting data on various levels, besides going on field research, we cooperated with local education bureaus and send out surveys to the bureaus. Staff locally helped us collect data and went

on field research for us. One of the disadvantages is being unable to oversee and supervise the process of collecting data, which may compromise the quality of data.

We saw a decrease of data submission rate on the data-collection system. The reasons are various: repetitive data submission may cause decreased reporting; delayed incentives due to administrative process is another reason.

Although school meals were provided to almost all the students, the quality of school meals still need improvement.

List of Annexes:

1. China Development Research Foundation Flagship Report: Progress of Nutrition Improvement Plan for Students in Poverty-stricken Rural Areas, China Development Research Foundation, June 2017
2. Evaluation of Nutrition Improvement for Students in Poverty-stricken Areas with Big Data Platform, China Development Research Foundation, April 2018