



Root and Tuber Crops for Food Security and Income Generation in Hunan, China

RESULTS OF A SCOPING STUDY



RESEARCH
PROGRAM ON
Roots, Tubers
and Bananas

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FoodSTART +
Food Resilience Through Root and Tuber Crops in
Upland and Coastal Communities of the Asia-Pacific

Root and Tuber Crops for Food Security
and Income Generation in Hunan, China:
Results of a Scoping Study

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Acronyms

CCCAP	Centro Internacional de la Papa-China Center for Asia Pacific
CIP	Centro Internacional de la Papa (International Potato Center)
FGD	focus group discussion
FoodSTART	Food Security Through Asian Roots and Tubers
FoodSTART+	Food Resilience Through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific
GDP	Gross domestic product
HARIIP	Hunan Agricultural and Rural Infrastructure Improvement Project
HAU	Hunan Agricultural University
IFAD	International Fund for Agricultural Development
KMU	Knowledge Management Unit
PPMO	Provincial Project Management Office
R&D	Research and Development
RTCs	root and tuber crops

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Executive Summary

The International Fund for Agricultural Development (IFAD) funded projects of Food Resilience Through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific (FoodSTART+) and Hunan Agricultural and Rural Infrastructure Improvement Project (HARIIP) conducted a 4-month **scoping study in the latter's** project sites where root and tuber crops (RTC) play a significant role in the livelihood of farmers especially in mountainous areas. The scoping study is an initial activity of FoodSTART+ to assess the potential and opportunities of RTCs to help enhance food resilience among the poor households in upland and coastal communities through collaborative research and development of RTCs innovations with IFAD investment projects.

The scoping study used primary and secondary methods in gathering information on RTC production, livelihood, food availability, and vulnerability, which included field appraisals (i.e. focus group discussions [FGDs] and key informant interview [KIIs], direct observation) and secondary data gathering (i.e. review of relevant documents and reports, and analysis of secondary data). After consultation with HARIIP, two study sites were identified, namely Linxiang county and Longshan county, where sweetpotato and potato are major crops in the cropping system of farming families, respectively. Two stakeholder validation workshops were also held in Linxiang and Longshan counties to present and validate both information on RTCs and to analyze problems, opportunities, and information gaps as well as provide recommendations on R&D actions.

The province of Hunan has a humid subtropical monsoon climate, with four distinct seasons composed of natural conditions and historical traditions that are favorable for growing RTCs. The study had further supported the importance of RTCs in Hunan province, particularly in the project sites of HARIIP, as majority of the farming families grow these crops as a vital supplement for maintaining food security and sold in markets as vegetables or to starch processors. Potatoes and sweetpotatoes are widely cultivated, while taro and Chinese yams are sporadically grown in the province. The RTCs are considered as the third most produced crop after rice and maize. It is important for intercropping and rotation with other crops in upland and, in some cases, paddy fields. RTCs are also important to the life of farmers in mountainous areas and poor areas as vital supplements for maintaining food security.

The main conclusions of the study are that while there is demand and interest to improve potato and sweetpotato production, this depends on improved markets (and higher profits) from these crops. On-farm labour is limited (due to out-migration) and this influences the

economic activities that can be developed. Processing is seen as one positive option to generate additional income at household and village levels, especially for sweetpotato. Location-specific studies into value chain options are needed to identify market opportunities for both potato and sweetpotato (fresh and processed) in and beyond the target counties. Investment in these crops should be focused on improved varieties (for better yields and processing quality), seed systems (for higher quality clean seed supply) and on production technologies such as disease control/management and fertilizer applications. Lack of capital also limits the ability of many households to take advantage of new technologies. In addition, capacity building for men and women in key aspects of potato and sweetpotato production technology is needed. Both potato and sweetpotato are seen as having a complementary or secondary role in the diet, and this could be enhanced through nutritional education. While men are more likely to have off-farm employment than women, household finances are usually controlled by women.

Because of varying resource endowments for product development in the two counties, the main priorities for action differ. In Linxiang, priority could be given to the introduction of new sweetpotato varieties, enhanced crop management and value chain development, building on existing enterprises and value chains. In Longshan, which is one of the very poor counties in **Hunan with potential for poverty reduction projects to increase farmer's income, the priority** should be to enhance the potato sector. This could include attention to variety testing and introduction (including provision of seed systems for clean seed), support for improved crop management (including extension services) and to value chain development for fresh and (potentially) processed potato products. In both counties, attention to nutrition education to make the most of available local food resources, including RTCs (leaves and roots) could help to reduce the dependence on imported and purchased dairy products.

1 Introduction

1.1 Background

The Food Resilience Through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific, known as FoodSTART+, is a 3-year project funded by the European Union and International Fund for Agricultural Development (IFAD), covering upland and coastal communities in China, India, Indonesia, Philippines, and Vietnam. FoodSTART+ aims to enhance food resilience among poor households in upland and coastal communities of the Asia-Pacific region by introducing RTC innovations, primarily within the framework of the IFAD **investment portfolio. The project's objectives are to identify gender-responsive** needs and opportunities through vulnerability assessments among the food-insecure, RTC-producing and -consuming households, and to design and implement innovations with partners and local stakeholders that enhance food resilience. Further, the project will develop and validate effective partnership strategies with IFAD investment projects in promoting RTCs for food security at-scale.

The scoping studies constitute the initial activity of FoodSTART+, contributing to Output 1 (Subnational geographic target areas combining food vulnerability with significant RTC production and use are prioritized and mapped). The FoodSTART+ scoping study in China was conducted in Hunan province, coinciding with the IFAD investment project Hunan Agricultural and Rural Infrastructure Improvement Project (HARIIP). The scoping study is conducted in selected sites of HARIIP where RTCs play a significant role in the livelihood of smallholder farmers.

HARIIP aims is to reduce rural poverty in targeted areas of Hunan province by enabling rural poor men and women to benefit sustainably from enhanced natural and economic assets derived from improved technology and advisory services in changing environmental and market conditions. Overall, it addressed the mission of IFAD to improve agriculture production, food security and enhanced resilience of small holders. Covering 180,000 rural households out of nine (9) counties, the project effectively addressed rural poverty challenge by locating itself in persistent poor pocket areas where additional supports are required by the government. The two project components on community infrastructure improvement, and sustainable agricultural development and market access support should at least directly reach 35% of those that belong to the poor and vulnerable groups. The community infrastructure improvement will be the basis for expanding and improving agricultural production, improving integration

into the marketing value chains, and improving productive and daily-life assets for the benefit of the rural community and the households in the project area. The sustainable agricultural development and market access support aims to support the sustainable development of diversified and adaptive agriculture through the provision of improved production inputs, technologies, technical services support, and market access. In addition to the loan project, IFAD provided a grant support entitled, **“Hunan’s Tuber Crop Research and Scaling-up Project”** which aims to provide technical assistance to project management and technological innovation on developing root and tuber crops in the province.

1.2 Scoping study objectives

The objectives of the scoping study are:

- a. To collect, collate, and analyze existing secondary information on RTC production, processing, marketing, and consumption in target districts covered by the IFAD investment project partner and in the wider province/state (also to locate RTCs in the context of wider livelihood systems);
- b. To collect, collate and analyze relevant information on diets, food consumption habits, and nutritional status of rural and urban people (men, women, and children) in target areas;
- c. To collect, collate, and analyze additional information from the target area related to the development of climate change scenarios for RTCs;
- d. To identify key actors and stakeholders across public and private sectors and civil society, with whom FoodSTART+ can engage in both action research and policy inputs to improve the contribution of RTCs to food security; and
- e. To identify key problems and opportunities for attention by FoodSTART+ in the context of partnership with IFAD investment projects and information gaps where further assessments on specific topics are justified.

1.3 Scoping process and work team

As per suggestion of HARIIP, the study was led by a researcher from the Hunan Agricultural University (HAU) which is mainly responsible for the data collection and implementation of the entire study. HARIIP supports the scoping study through logistical assistance, field staff involvement and facilitation to their field partners. CIP office in Beijing helped in the over-all coordination of the study. In order to guide and assist the researcher, a technical working group was established to contribute to the scoping study process through review of the results

for quality and identify findings across the sites. The group involved representatives from CIP FoodSTART+ team, experts on RTCs from the national or provincial R&D system, and staff from HARIIP (IFAD investment project) at the provincial and county level. The scoping study team members and focal persons of the IFAD investment projects are as follows:

Table 1. Members of the scoping study team

Name	Sex	Institution	Title	Responsibility
Li Hongmei	F	HAU	Professor	Build the research team in Hunan, develop the survey plan, implement project activities, collect information, and coordinate to write the project reports and papers.
Xie Kaiyun	M	CCCAP	Project manager	Coordinate between CCCAP and Hunan team, develop the survey plan, and supervise the project implementation.
Li Wenjuan	F	CCCAP	Research assistant	Assist in coordinating between CCCAP and Hunan team, develop the survey plan, and translate and proofread the Chinese-English versions of reports.
Zhou Li	F	HAU	PhD student	Implement the project activities, collect information, and assist to write related project reports and papers.
Yan Wuwei	M	HAU	MS student	Implement the project activities, collect information, and assist to write related project reports and papers.
Li Yaqing	F	HAU	MS student	Implement the project activities, collect information, and assist to write related project reports and papers.
Liu Mingyue	M	HAU	Professor	Provide information, data and suggestions for the development of RTC industry in Hunan.
Huang Bojun	M	HARIIP	Deputy Director, Provincial Project Management Office (PPMO)	Assist to develop the survey plan, coordinate project activities in pilot counties, and provide suggestions on how to combine the HARIIP with FoodSTART+.
Xie Zhengrong	M	HARIIP	KMU Coordinator, PPMO	Assist to make the survey plan, coordinate the project activities in pilot counties.
Wu Xianchen	M	HARIIP-	Deputy Director,	Assist to make the survey plan,

Name	Sex	Institution	Title	Responsibility
		Longshan County	Agricultural Bureau, PMO	coordinate the project activities in pilot counties.
Xie Tianbao	M	HARIIP-Linxiang County	Deputy Director, Agricultural Bureau, PMO	Assist to make the survey plan, coordinate the project activities in pilot counties.

1.4 Scoping methods: primary and secondary data collection

1.4.1 Secondary data collection

Collected and reviewed were secondary information on:

- Socioeconomic and development context (relevant livelihood, poverty, and nutrition information);
- Overlap of investment project sites and RTC production;
- Biophysical features (soils, climate) and provincial-level land use;
- RTC production, processing, marketing, and consumption;
- Value chains and key industry players;
- Dietary consumption, and nutrition/health relevant to RTCs, especially for women and children;
- Previous R&D activities in the target region; and
- Policy environment relevant to RTCs.

1.4.2 Field appraisals

1) Key informants selected after consultation with IFAD investment project staff (The field appraisals aim to verify the secondary data gathered; understand trends, opportunities, and challenges that have been identified; and establish contact and working relationships with stakeholders for later joint action):

- Government agencies/institutions in agricultural R&D (including extension agents), natural environment, trade and industry, planning and investment, and health/nutrition sectors;
- **Farmers' cooperatives;**
- Value chain actors, including the private sector in all levels (small households/cooperatives to large multinationals); and
- Documents from previous projects on RTCs.

2) Focus group discussions with farmers, gender-disaggregated (five participants each county, for a total of 10 participants) that aim to understand:

- RTC production, marketing, and rural processing in the context of production, livelihood, and food system and RTC contribution to the agro-ecosystem;
- Issues related to vulnerability, resilience capacity, role of RTCs in post-disaster situations and extreme weather events;
- Perceptions of food security and insecurity, and changes in household diets;
- Changes **in roles of men and women, perceptions of “good” food/diet;** consumption and nutrition, livelihood activities, migration; and
- Adaptive or organization capacity in terms of scoping.

1.4.3 Stakeholder validation workshops

Workshops were held to present and validate both information on RTCs and to analyze problems, opportunities, and information gaps. Participants included representatives of target communities (women and men) as well as public sector agencies, private sector staff, and other R&D partners (national, international) as appropriate and relevant.

2 Situational analysis

2.1 Hunan: socioeconomic profile and development

2.1.1 Land use, climate, and soil

Hunan province is located in central China, south of Tongting Lake. The province has 13 prefectures and one autonomous prefecture covering 122 counties (Figure 1). Land area has not changed much from 2010 to 2012 (Table 2). A high percentage of the total land is used as farmland. Residential and mining areas accounted for only 7% of total area.

In Hunan, farmland has remained at 67,200 ha, which is 34% of total land. However, it decreased by 25 ha in 2011, and by another 30 ha in 2012. Land utilization (for all types) decreased in 2012, especially grassland, which decreased by 21% (1,497 ha). In comparison, there is a small decrease in total land dedicated to farming.

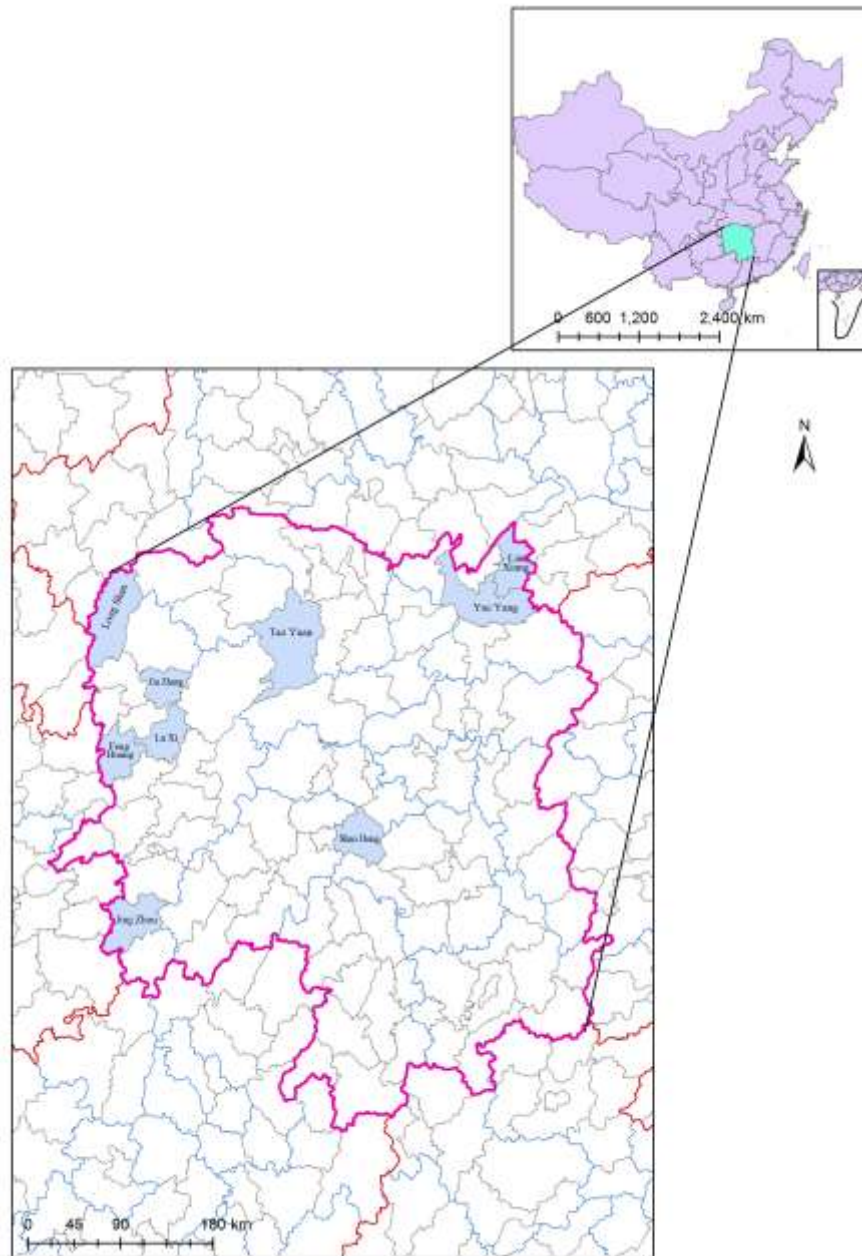


Figure 1. Location of the HARIIP project sites in nine counties.

Table 2. Land use in Hunan.

	2010	2011	Increase/decrease (2010-2011)		2011	2012	Increase/decrease (2011-2012)	
			Absolute number	%			Absolute number	%
Total land area (ha)	197,563	197,563			197,563	197,563		
Farmland	67,271	67,246	-25	-0.04	67,246	67,216	-30	-0.05
Pasture	7,124	7,124			7,124	5,627	-1,497	-21
Forest land	27,998	28,693	695	2.5	28,693	28,493	-200	-0.7
Water bodies	40,875	40,875			40,875	40,652	-223	-0.5
Mulberry tea area	7,869	7,950	81	1	7,950	7,572	-378	-4.8
Reclaimable wasteland area	1,682	1,581	-101	-6	1,581	1,409	-172	-10.9
Suitable forest land	7,293	7,293			7,293	7,265	-28	-0.4
Residential areas and mining	14,154	14,179	25	0.2	14,179	14,091	-88	-0.6
Other areas	23,297	22,622	-675	-2.9	22,622	25,238	2,616	11.6

Source: Hunan rural statistical yearbook, 2011-2013.

Hunan province has a sub-tropical monsoon humid climate with distinct four seasons. There are sufficient sunshine and rainfall with an annual average temperature between 16 and 18.5°C and annual sunshine hours of 1300-1800h. Between 2011 and 2015, average annual rainfall ranged between 1026 and 1581mm/y. Rainfall is high at the end of spring and the beginning of summer, with drought common at the end of summer and autumn; the weather in spring (February, March and April) is changeable and wet; with more sunny days in summer (May, June and July) and (August, September and October). Rain decreases from south to north. Hunan lies in the path of the wet monsoons, which pass from west to east along the Yangtze

basin in summer, bringing with them at times long periods of heavy rain, which can result in extensive flooding of low-lying lands (<https://www.britannica.com/place/Hunan>).

The north generally experiences more extreme weather conditions than does the south. In winter, occasional waves of cold air from Mongolia sweep southward, injuring crops such as tea bushes and fruit trees in northern Hunan. The average minimum winter temperature is 43 °F (6 °C). Summers are long and humid, the average maximum summer temperature being 86 °F (30 °C). The north has an average of 260 frost-free days per year, while in the south the average is 300 days.

The soils of the province are largely pedalferic (rich in alumina and iron) and are mainly lateritic (leached, iron-bearing) yellow earths or red clays. In the hilly regions of central and southern Hunan, the soils are for the most part lateritic clays that are strongly acidic and poor in organic material. The alluvial soils of the northern plains are less acidic and are used for growing rice. The project area of HARIIP is basically located in the poorer, less fertile, less accessible and less developed areas of the province. Fifty-one percent (51%) of the area of Hunan (21.9 million ha) is classified as mountainous, with another 15% as hilly, while 26% comprises plains and basins.

2.1.2 Poverty incidence

Since the onset of reforms in 1978, the rapid economic growth in China has resulted in a dramatic decline in poverty. The broad participation in the reform-driven economic growth, together with a well-funded national poverty reduction programme, have brought about a tremendous reduction in absolute rural poverty in China during the past 30 years. From 2010 to 2014, there was an annual decrease in poverty incidence in the entire country (Table 3)—from 17.2% in 2010 to 7.2% in 2014. It shows China's **big** success in its poverty reduction efforts in recent years. Government policies and the scale of funding of public poverty reduction and rural development programmes are exemplary. Beginning in the 1980s, the government approach towards poverty reduction focused on area development programmes targeted on poor counties. Regional economic development then was achieved through improvements in natural resources and the provision of infrastructure and capacity-building for the poor. Priority support is targeted at extremely poor areas in the central and western provinces. Since 2001, the strategy of poverty reduction has shifted to a village- and household-based approach, through identification of focal villages for poverty reduction and setting up records and development tracing of individual poverty households. In 2011, the government development strategy delineated under the Twelve Five-Year Plan (2011-2015)

addresses the challenge of poverty eradication and builds on the Development-Oriented Poverty Reduction Programme for Rural China (IFAD 2011)

Table 3. Poverty incidence in China, 2010-2014.

China	Poverty incidence (%)
2010	17.2
2011	12.7
2012	10.2
2013	8.5
2014	7.2

Source: China statistical yearbook, 2011-2015.

2.1.3 Poverty incidence in the four HARIIP counties

The rural average net income per capita in the HARIIP project counties is CNY 3,974. While using the current austere poverty line of income per capita of CNY 1,196, the poverty incidence **is around 4%. However, the poverty incidence is estimated at 43% if applying the World Bank's** USD 1.25 per day per person, or some 868,000 people living in the project area. It is noteworthy that poverty is not an income issue; it also relates to access to opportunities, resources, and services (IFAD 2011).

Four of the nine targeted regions of HARIIP in Hunan belong to the key counties in the national program to reduce poverty. These are Longshan, Guzhang, Luxi, and Fenghuang, all located in Xiangxi prefecture. The second highest incidence of poverty (30.7%) was seen in Longshan, one of two target sites of the FoodSTART+ project.

2.1.4 Disaster situation

Intensive farming is practiced in HARIIP project areas; each parcel of farmland is used to the fullest possible to achieve food self-reliance at household and regional levels. However, the acreage and production of crops are highly attributable to various factors including weather conditions during the production season. Natural disasters greatly affect crop production in Hunan. Droughts and floods bring a lot of damage to large areas in the region (Table 4). The HARIIP baseline survey report in 2011 included natural disasters as one of the main factors affecting the economic status of households. Drought, flood, and pest are perceived as the three main natural disasters (HARIIP 2011). This shows the great need for the government to

improve dissemination of agricultural information, launch a system to forecast natural disasters, and develop an agricultural insurance system to encourage farmers to plant.

Table 4. Areas (000 ha) affected by disasters in Hunan, 2010-2014.

	2010	2011	2012	2013	2014
Drought	407.3	1977.4	0.23	2165.2	-
Flood	2011.3	689.5	1064.4	634.2	1041.1
Wind and hailstorm	82.6	0.03	0.11	0.144	0.002
Diseases and pests	4.3	-	0.54	4.6	-
Frost	31.0	0.82	0.009	0.05	0.073
Others	9.6	-	0.019	-	0.004
Total	2482.4	3116.1	1165.7	2936.6	1120.8

Source: Statistical yearbook of Hunan 2010-2014; "-" means no data.

2.2 Socioeconomic profile of HARIIP and FoodSTART+ sites (Linxiang and Longshan counties)

2.2.1 Gross domestic product (GDP)

The GDP of the two target regions (Longshan and Linxiang) of the FoodSTART+ project is shown in Table 5. The data showed an annual increase in GDP growth from 2010 to 2014, but at a slower rate, which was in line with China's overall economic performance.

The average GDP per capita was 31,687 yuan (2010-2014) in Linxiang, but it was only 9,750 yuan in Longshan. It implies significant differences in economic development between Linxiang and Longshan. Longshan is included in the nationally-defined poor counties (Longshan, Guzhang, Luxi, and Fenghuang).

Table 5. Gross domestic product in Linxiang and Longshan, 2010-2014.

Region			2010	2011	2012	2013	2014
Linxiang	GDP (yuan)	Primary industry ¹	192,840	223,155	229,136	242,765	259,724
		Secondary industry	623,457	804,018	900,897	1,016,494	1,114,726
		Tertiary industry	338,888	381,670	466,739	530,955	602,967
		Total	1,155,185	1,408,843	1,596,772	1,790,214	1,977,417
	% in previous year's GDP		115.5	114.3	124.2	113.3	110.3
Longshan	GDP per capita (yuan)		23,986	28,256	31,897	35,394	38,903
	GDP (yuan)	Primary industry	123,351	126,108	137,640	149,301	163,497
		Secondary industry	90,184	100,656	116,133	130,472	143,707
		Tertiary industry	163,847	210,466	239,585	271,443	308,430
		Total	377,382	437,230	493,358	551,216	615,634
	% in previous year's GDP		112	113.1	110	110.1	109.5
	GDP per capita (yuan)		7,524	8,701	9,754	10,791	11,980

Source: Statistical yearbook of Hunan, 2010-2015.

In terms of industrial structure, the contributions of the primary, secondary, and tertiary industries to GDP in Linxiang and Longshan are shown in Table 6. The contribution of the first industry to GDP declined year by year in both target counties. In Linxiang, the secondary industry accounted for 56.1% of the GDP in the last 5 years. But in Longshan, it was only 23.5%. In Linxiang, the average contribution of the tertiary industry to GDP was 29.2%; the value for Longshan was 47.8%.

Table 6. Industry contribution to GDP (%) in LinXiang and Longshan.

		2010	2011	2012	2013	2014
Linxiang	Primary industry	16.7	15.8	14.3	13.6	13.1
	Secondary industry	54.0	57.1	56.4	56.8	56.4
	Tertiary industry	29.3	27.1	29.2	29.7	30.5
Longshan	Primary industry	32.7	28.8	27.9	27.1	26.6
	Secondary industry	23.9	23.0	23.5	23.7	23.3
	Tertiary industry	43.4	48.1	48.6	49.2	50.1

Source: Calculated from Table 5.

¹ China's GDP is broadly contributed by three broader sectors or industries – primary industry (agriculture), secondary industry (construction and manufacturing), and tertiary industry (service sector).

The data indicated the following: 1) GDP and gross agricultural production continued to reduce annually in the two regions; 2) GDP per capita in Linxiang was 3.25 times higher than that in Longshan; 3) the secondary industry had the highest contribution to GDP in Linxiang while the tertiary industry contributed the most to GDP in Longshan.

2.2.2 Soil and climate data at the FoodSTART+ sites

The mountain area accounts for more than **half of Linxiang's total area**. In Longshan, the mountainous terrain is more than 82%. Mountainous terrain lead to limited arable land, however, potato and sweetpotato can be planted in steep slopes hence making the mountain area suitable for RTC cultivation.

In Linxiang, climate is moderate. Annual average temperature is 16.4 °C with a frost-free period of 259 days, a sunshine rate of 41%, and precipitation of 1,469 mm. Moderate climate also characterizes Longshan, annual average temperature is 15.8°C with 270-day frost-free period, lowest annual sunshine in the province, and 1,376-mm precipitation. In spite of the mild climate, abundant rainfall and other favorable conditions, local agriculture is at risk as natural disasters such as flood, drought, and freezing occur frequently. It is imperative that attention be given to introducing good varieties with drought/waterlogging tolerance, building farmland and water conservation infrastructure, and stabilizing agricultural production.

Soil in the five targeted villages in Linxiang is sandy clay and very fertile. Longshan soil, which is sandy, also has high fertility. Nearly half of the soil developed from plate shale, river alluvium, and purple sand shale with high mineral nutrition. Plant growth is exuberant due to frequent rain and adequate heat in the same season, conditions favorable for organic matter accumulation.

2.2.3 Infrastructure for irrigation and water conservation

In Hunan province, 1.26 million ha are irrigated by electrical facilities, accounting for 38% of total arable land. There are 13,321 reservoirs with a total storage capacity of 29.5 billion m³, which provide irrigation for 1.66 million ha of arable land (62% of total effective irrigation area). Sixteen large reservoirs irrigate 301,000 ha; 232 medium-sized reservoirs irrigate 539,000 ha, and 13,073 small reservoirs irrigate 815 800 ha (Tang 2012). The infrastructure for irrigation and water conservation has improved (Table 7). The effective irrigation area and length of embankments also increased in the last five years.

In Linxiang, effective irrigation area increased from 27,210 ha in 2010 to 36,620 ha in 2014, with a growth rate of 35.6%. In Longshan, growth rate was 23.9% (from 18,130 ha in 2010 to 24,930

ha in 2014). In Linxiang, the length of embankment increased from 51 km in 2010 to 215 km in 2014. From 2011 to 2012, the increase was most rapid at 329%. In Longshan, it increased to 35 km in 2014, seven times to **that of 2010's 5 km**.

Table 7 indicates no change in the number of reservoirs in Linxiang (290) mainly because the existing system could still meet the **county's irrigation** requirements. However, in Longshan, which is in a mountainous area, the number of reservoirs increased from 66 in 2010 to 95 in 2014. The government invested in irrigation infrastructure to meet local needs. A new reservoir was established at Baita Vegetable Base in Longshan, and this was supported by IFAD to solve the problem of water deficiency and thus **increase farmers' income** from vegetable planting (including yellow potato).

Table 7. Infrastructure for irrigation and water Conservation in Linxiang and Longshan, 2010-2014.

County		2010	2011	2012	2013	2014
Linxiang	Tractor-plowed Area (000 ha)	45.1	41.3	41.6	41.92	43.4
	Irrigated area (000 ha)	27.21	27.82	36.5	36.56	36.62
	Reservoirs (no.)	299	299	293	293	293
	Dikes (km)	51	58	330	314	315
Longshan	Tractor-plowed area (000 ha)	6.36	6.9	15	17	17.79
	Irrigated area (000 ha)	18.13	18.15	24.88	24.91	24.93
	Reservoirs (no.)	66	94	95	95	95
	Dikes (km)	5	9	20	34	35

Source: Statistical yearbook of Hunan, 2010-2015

2.2.4 Population density

There are a total of 1,285,250 households in the nine HARIIP project counties, and with a total population of 4.3 million (IFAD 2011). Total population increased yearly in the two counties. However, at the same time, rural population decreased and urbanization rate increased (Table 8).

Table 8. Population density (10⁵) in Linxiang and Longshan, 2010-2014.

Region		2010	2011	2012	2013	2014
Linxiang	Total households	13.3	13.32	13.86	14.01	14.14
	Total population	49.83	49.89	50.23	50.48	50.83
	Male	26.04	26.06	26.31	26.44	26.24
	Female	23.8	23.83	23.92	24.04	24.59
	Urban population	19.96	20.91	21.62	2.51	23.32
	Rural population	29.87	28.98	28.61	27.97	27.51
	Urbanization rate (%)	40.06	41.91	43.04	44.59	45.88
Longshan	Total households	13.33	14.68	14.82	16.71	16.94
	Total population	50.16	50.33	50.83	51.33	51.47
	Male	25.55	25.97	26.23	26.47	26.54
	Female	24.61	24.36	24.6	24.86	24.93
	Urban population	14.45	15.23	16.25	17.15	17.56
	Rural population	35.71	35.1	34.58	34.18	33.91
	Urbanization rate (%)	28.81	30.26	31.97	33.41	34.12

Source: Statistical yearbook of Hunan, 2010-2015

Moreover, Hunan is home to a number of ethnic groups, such as Tujia, Miao, Yao, Dong, Bai, Hui and Zhuang. There are five counties which are considered ethnic autonomous counties (Jingzhou, Longshan, Guzhang, Luxi, Fenghuang).

2.3 General information on root and tuber crops (RTCs)

2.3.1 RTC production in Hunan and in HARIIP counties

Statistical data from the project counties only reports RTCs in aggregate, while data for potato and sweetpotato can be obtained at provincial level. The provincial data for the two crops are shown in Table 9.

Table 9. Potato and sweet potato production, area and yield in Hunan province from 2010 to 2015

Year	Planting area (1000 hectares)		Total Output (ton)		The average Output (kg/hectare)	
	Potato	Sweetpotato	Potato	Sweetpotato	Potato	Sweetpotato
2010	97	157	364000	816000	3573	5187
2011	93	-	356000	-	3828	-
2012	91	155	362100	886300	3973	5707
2013	100	186	367600	900000	3662	4832
2014	112	172	399800	851000	3556	4943
2015	105	164	40500	782800	3872	4779

Source: Statistical yearbook of Hunan, 2010-2015.

(Note: RTC production and yield are reported on a grain equivalent basis i.e. fresh root weight x 20%).

Converted to fresh weight, the yield data show that potato and sweetpotato are producing around 20 and 25ton/ha respectively. Sweetpotato yields appear to have been decreasing since 2012, while potato yields are fairly constant. Both potato and sweetpotato production areas peaked between 2013-4, with a decline in the latest year for which data are available in 2015.

At county level RTC production data cannot be disaggregated by crop. However, as Longshan was selected as a country with large potato production, it is reasonable to assume that most of the RTC production represents potato. In Linxiang, a similar supposition can be made regarding sweetpotato. From 2010 to 2014, RTC production did not change much in some counties (Guzhang and Fenghuang). In others (Luxi and Yueyang), there was an increase, even reaching 46.4% in Luxi. In the other five counties, which includes Linxiang and Longshan, RTC production decreased. The decrease in Linxiang (mainly sweetpotato) was reported at 50% (Table 10).

Table 10. RTC production (t) in nine HARIIP counties.

County	2010	2011	2012	2013	2014
Guzhang	2,517	2,509	2,453	2,306	2,519
Luxi	4,687	4,198	4,398	4,034	6,864
Fenghuang	13,261	13,522	13,376	13,035	13,078
Jinzhou	5,307	5,577	6,170	5,753	3,662
Taoyuan	25,480	12,055	11,225	13,927	15,740
Shaodong	33,706	23,519	24,407	16,832	18,511
Yueyang	14,776	17,178	19,004	17,411	17,846
Linxiang	12,674	2,313	4,507	5,132	6,200
Longshan	59,614	47,946	46,569	44,814	45,846

Source: Statistical yearbook of Hunan, 2010-2015.

RTC production both decreased in the targeted counties; nevertheless, Longshan has always been the biggest RTC (mainly potato) producer in Hunan. Linxiang ranked seventh in terms of RTC (mainly sweetpotato) production (Fig. 2). The FGDs revealed that in these counties there were government subsidies available for rice, maize, and wheat production, but not for RTCs.

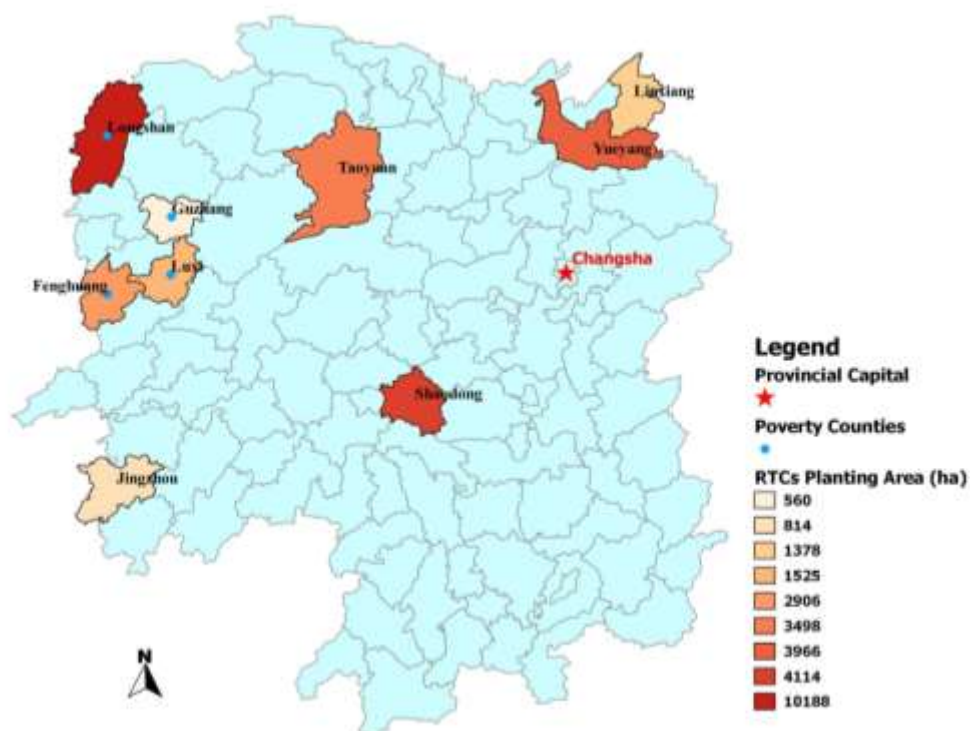


Figure 2. Area planted to RTCs in the nine HARIIP counties.

2.3.2 RTC production in FoodSTART+ sites

2.3.2.1 Agricultural production in Linxiang

From 2010 to 2012, production of rice, maize, soybean, RTCs, and pork decreased, with RTC (mainly sweetpotato) registering the biggest negative growth percentage (-0.64) between 2010 and 2012, but coming in with a second largest growth rate at 0.20 between 2013-2014, just after maize (Table 11).

Table 11. Agricultural production (t) in Linxiang, 2010-2014.

	2010	2011	2012	Growth percentage (2010-2012)	2013	2014	Growth percentage (2013-2014)
<i>Crops</i>							
Rice	310,168	296,750	299,255	-0.0352	292,890	298,142	0.0179
Wheat	2,471	1,900	2,708	0.0959	3,075	3,275	0.065
Maize	6,772	5,600	6,111	-0.0976	5,687	6,925	0.2177
Soybean	4,375	2,500	2,653	-0.3936	1,982	2,293	0.1569
Root crops	12,674	2,313	4,507	-0.6444	5,132	6,200	0.2081
Oil plants	17,508	19,052	17,889	0.0218	18,986	22,566	0.1886
Cotton	2,501	3,733	4,066	0.6257	3,509	3,476	-0.0094
<i>Livestock and poultry</i>							
Pork	48,688	47,084	48,314	-0.0077	48,389	49,599	0.025
Beef	1,000	975	1,013	0.013	1,020	1,068	0.0471
Mutton	324	315	327	0.0093	338	368	0.0888

Source: Statistical yearbook of Hunan, 2010-2014.

The crop production structure in Linxiang is shown in Figure 3. Rice was the most important crop, accounting for 88% of the total crop production. Oil crops, RTCs, and maize accounted for 5%, 2%, and 2%, respectively. These results imply that the contribution of RTCs to agricultural production in Linxiang has opportunities for growth.

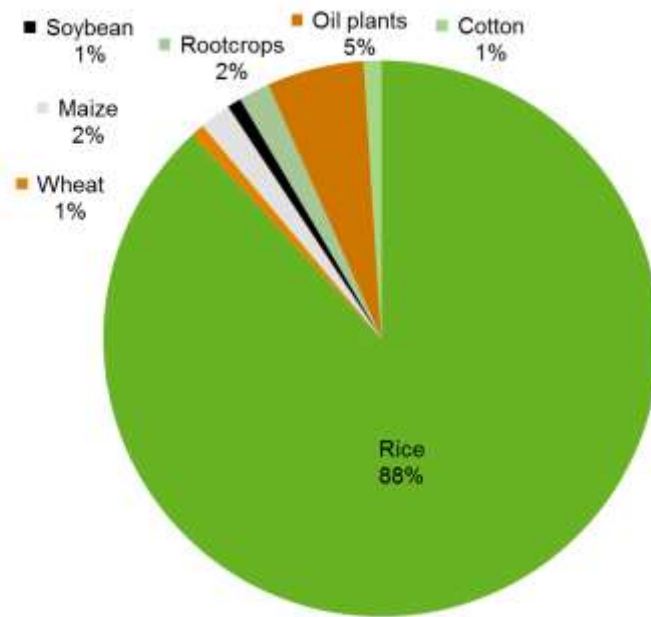


Figure 3. Crop production structure in Linxiang.

2.3.2.2 Agricultural production in Longshan

From 2010 to 2012, production of wheat, maize, RTCs (mainly potato), oil crops, beef, and mutton decreased. The largest negative growth ratio was seen in RTCs (-0.22) (Table 12). The production of rice, soybean and pork increased, and growth ratio was minimal. From 2013 to 2014, production of all crops increased, but the range of increase was not significant.

Table 12. Agricultural production (t) in Longshan, 2010-2014.

	2010	2011	2012	Growth percentage (2010-2012)	2013	2014	Growth percentage (2013-2014)
<i>Crops</i>							
Rice	96,284	94,192	96,669	0.004	95,761	95,974	0.0022
Wheat	134	134	67	-0.5	45	46	0.0222
Maize	36,694	31,640	32,499	-0.1143	32,718	33,892	0.0359
Soybean	3,002	3,024	3,155	0.051	2,953	3,096	0.0484
Root crops	59,614	47,946	46,569	-0.2188	44,814	45,846	0.023
Oil plants	15,129	15,351	14,822	-0.0203	14,971	15,054	0.0055
Cotton	-	-	-	-	-	-	-
<i>Livestock and poultry</i>							
Pork	15,239	14,776	15,375	0.0089	15,409	15,932	0.0339
Beef	962	938	908	-0.0561	896	932	0.0402
Mutton	856	830	855	-0.0012	897	946	0.0546

Source: Statistical yearbook of Hunan, 2010-2014; "-" means no data.

The changes in crop production were more significant in Linxiang than in Longshan in recent years. It may be because the former is located in a more economically developed area and is influenced by external factors such as markets, policy environment, etc. while the latter is situated in a more remote mountain region and is less influenced by external factors.

2.3.3 Production season of potato and sweetpotato in Hunan

In Hunan, potato can be grown all year-round. Summer potato is usually planted in late March and harvested in early August, accounting for 25% of total potato production. Autumn potato is usually planted in August and harvested in December, accounting for 5% of the total. Accounting for 70% of total production is inter-potato; it is planted in December and harvested in April. There is great potential to develop summer and autumn potatoes.

In Linxiang, sweetpotato is usually planted in two seasons: spring sweetpotato and summer sweetpotato. Spring sweetpotato is usually planted in the middle and late April and harvested in October; summer sweetpotato is usually planted in mid to late May and harvested in November.

2.3.4 Value chain descriptions

2.3.4.1 Sweetpotato value chain in Linxiang

The value chain includes steps in production, processing, and marketing until the product reaches the end users. An overview of the sweetpotato value chain in Linxiang is shown in Figure 4.



Figure 4. Sweetpotato value chain in Linxiang.

There are quite large differences in utilization patterns of sweetpotato between the villages included in the FGDs. The white and yellow fleshed sweetpotato are preferred for processing. In villages where processing is found, 80% of roots are processed, with the remainder used either for direct consumption or animal (pig) feeding. The vines and leaves are also fed to pigs, with the tender leaves eaten as a vegetable in some cases. In other villages where processing is not found, most roots are fed to pigs with a smaller proportion eaten fresh (boiled or fried).

Farmers earn more income if sweetpotato is processed at home or sent to local processors – but this approach possesses big risks. If they sell the fresh roots directly to consumers or in the retail market, then they will get very limited profits because of high planting cost, especially that of labour.

Overall, across the village surveyed, sweetpotato is mainly used as raw material for processing into starch and noodles. This accounted for about 60% of the total production. The other uses were for food (20%) and animal feed (20%).

The sweetpotato value chain is rather complex, involving many actors. Starch processing occurs at the village level, either household scale or in larger (cooperative) units. For example, one enterprise processing 100 tons of fresh roots per season was reported. These processing units also generate by-products (residue) that are sold as pig feed. There was an interest expressed by focus group participants in the establishment of larger scale efficient processing operations at village level that could augment their incomes as well as provide a secure market for their fresh produce.

2.3.4.2 Potato value chain in Longshan

The potato value chain in Longshan is simple (Figure 5). There are no potato processing facilities (except a minor amount at farm level for local consumption). The crop is either used on-farm (direct consumption or for pig feed) or sold to local markets. Longshan farmers play significant roles in this short chain, not only as producers but also as traders/retailers. In other words, they transport the potato themselves to the market and sell these to local consumers or retailers. There are no specific marketing intermediaries in this chain.

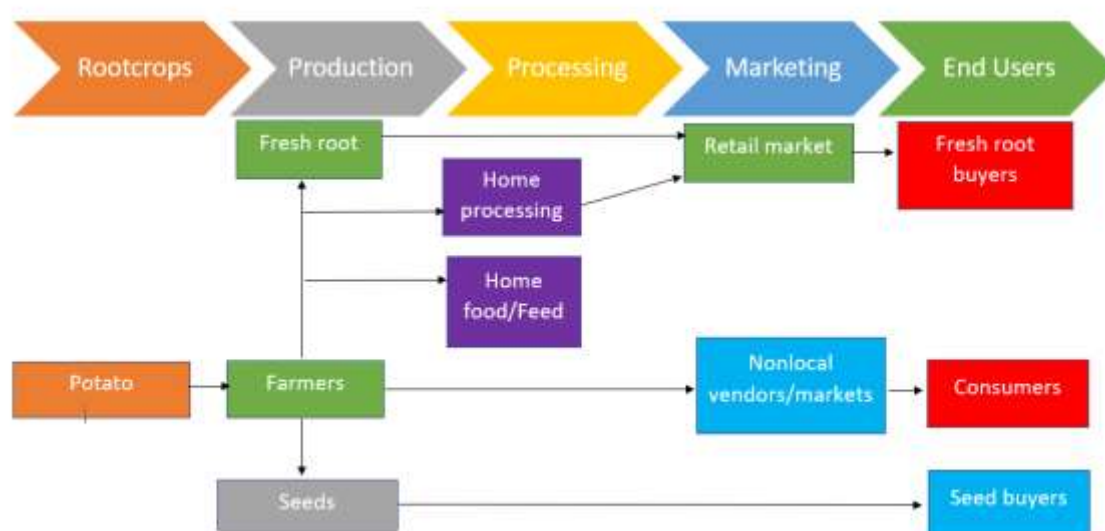


Figure 5. Potato value chain in Longshan.

The Longshan FGDs showed that potato was mainly used for food, accounting for 70% of the total and that potato as feed accounted for nearly 12% with a storage loss of 10% (Fig. 6). Only 5% of the potato produced were processed and about 3% were used as seed. There was variation between villages as regards to the proportion of potato consumed on-farm or sold to the market, with some (more remote) villages having higher on-farm consumption, while households in those areas with better market access sold up to 50% of their production.

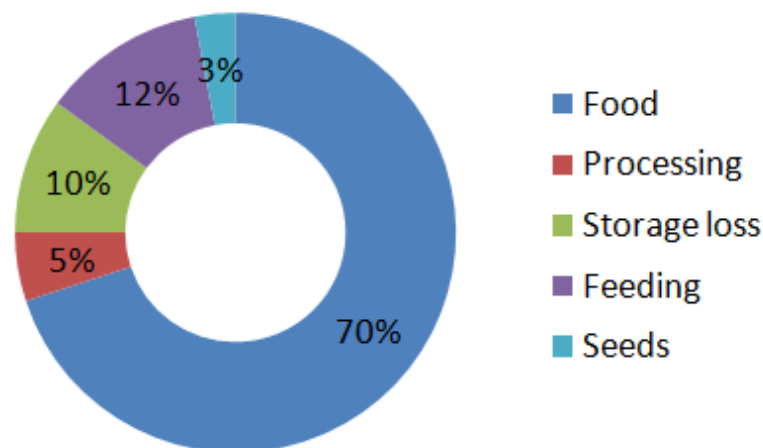


Figure 6. Utilization of potato in Longshan.

2.4 RTCs for food security, nutrition, and livelihood

2.4.1 Food security

Farming households in the HARIIP project sites practiced intensive farming, where each parcel of farmland is maximized to achieve food self-reliance at the household and regional levels. Inter-cropping and crop rotation are widely pursued in the project areas. However, very small farm size and lack of labour in some villages (due to out-migration) may negatively affect food security derived from the production of each household (rather than purchased foodstuffs). The HARIIP baseline survey report in 2011 reported that only one of 957 sample households claimed to suffer from hunger in the last 2 years (HARIIP 2011). This finding was further validated in the FGDs of the scoping study where nobody reported experiencing a hungry season. Income is important for child nutrition, as all villages reported that purchased milk powder is a major dietary ingredient that is considered important for infant nutrition by most households.

2.4.2 Malnutrition status

Relevant information from a 2011 baseline survey report was used by HARIIP to study a total of 957 sampled households.

2.4.2.1 Malnutrition status of children under 5 years old

In the 957 households sampled, 231 children were under five. As 18 were not available during the survey period, anthropometric measurements were taken on only 213 children (120 boys and 93 girls).

There were six children (two boys and four girls) with acute malnutrition [weight to height, W/H (for definitions of malnutrition, please refer to the Child Growth Standards of the World Health Organization)] accounting for 2.8% of the total (Fig. 7). The malnutrition rate for boys was 1.7% and that for girls was 4.3%.

As to chronic malnutrition (height to age, H/A), 68 children (43 boys and 23 girls) had this condition, accounting for 31.92%.

Among the 213 sample children, the number of underweight children (weight to age, W/A) was 14, eight boys and six girls.

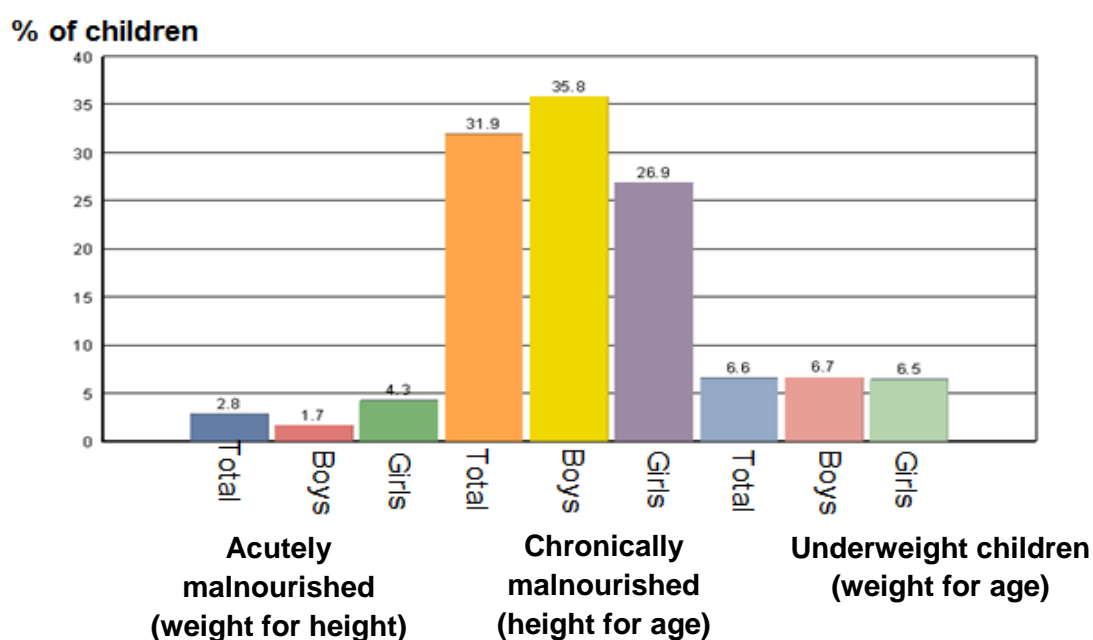


Figure 7. Percentage of malnourished children under 5 years of age.

2.4.3 Livelihood systems

Participants in the FGDs said that, in Linxiang, 45% of farmers were engaged in agriculture, 50% worked in the cities, and the rest were involved in other activities (Figure 8). The corresponding percentages in Longshan were 36%, 45%, and 19%.

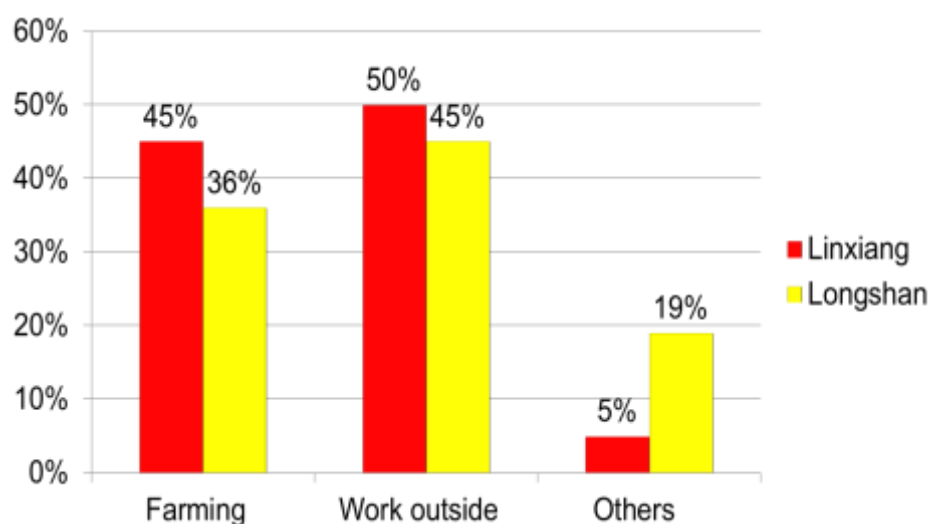


Figure 8. Sources of livelihoods in Linxiang and Longshan.

3 Stakeholder Analysis

The stakeholders of the FoodSTART+ project are the farmers, the local government, the departments engaged in creating national strategies, research institutes, cooperatives, and processors.

3.1 Government agencies, institutions in agriculture R&D, and natural environment

3.1.1 Department of Agriculture of the Hunan Province

The Department of Agriculture of the Hunan Province has the following objectives:

- To supervise the production of main agricultural products, develop and implement relevant policies for major agricultural products, and give guidelines on agricultural industrial structure adjustment and quality improvement of products; and

- To provide guidance in the transfer of land use rights pertaining to arable land, agricultural waters, tidal flats, and grasslands; **reduce farmers' burden** by crafting farmer-benefiting policies, and support the development of an agricultural socialized service system, rural economic organizations, farmer cooperatives, and agricultural product industry associations.

These objectives are identical to what the IFAD/FoodSTART+ projects aim to accomplish in their target areas.

3.1.2 Agricultural R&D institutions

The Potato Engineering and Technology Research Center is the sole provincial potato research organization in Hunan. Under the auspices of Hunan Agricultural University, it aims to develop the potato industry in South China and provide technical support for food security, agricultural efficiency, and improvement of farmers' income. Important achievements have already been made in potato germplasm introduction, variety selection and breeding, multiplication of virus-free potato seed, potato processing, etc.

The Potato Industry Association in Hunan was established under the initiative of the Department of Agriculture in Hunan, Hunan Agricultural University, and other organizations. Many institutes and enterprises engaged in potato research, extension, and production are members of the association.

The Longshan Potato Research Institute is engaged in potato industry development and promotion.

3.2 Legislators/policymakers

3.2.1 Potato as staple

In 2015, a document entitled, "Opinions on increasing the intensity of reform and innovation and accelerating the construction of agricultural modernization," was issued "to ensure food security, strengthen agriculture, and adjust agricultural structure." This '**No. 1 central document**' encouraged farmers to plant potato, improve its processing and thereby extend the industrial chain.

3.2.2 RTC deep-processing

Another document encouraged the development of special grain and oil processing, and mainly supported the processing of special products from sweet potato, buckwheat, mung bean, fresh corn grains.

3.2.3 Seed subsidy

In 2015, 20.35 billion yuan was set aside as seed subsidy for rice, wheat, corn, cotton, soybean, winter oilseed rape, and Tibetan barley. Subsidy was likewise given to potato and peanuts in main production areas. For potato, the subsidy was 100 yuan per mu (i.e. 1,500 yuan per hectare)

3.2.4 Agricultural product processing

The central government secured 0.6 billion yuan as transfer payment in 2015 to support farmers' cooperatives in building 18 facilities to process agricultural products. The policy was implemented in many areas, including Hunan.

3.2.5 Agricultural insurance

At present, the central government provides agricultural insurance and subsidies to 15 crops, including maize, rice, wheat, cotton, and potato.

3.3 Trade and industry

Some sweetpotato processing enterprises exist in Linxiang: examples are the Luxi alcohol factory and the Tianjian Sweetpotato Food Company. Total investment in the Luxi alcohol factory, which has an annual output of 18,000 tons of alcohol, is 46.8 million yuan. The Tianjian company is the main producer of glass noodles from sweetpotato starch. The total investment is 12.91 million yuan and annual sale amounts to 50 million yuan. In addition, there are hundreds of sweetpotato starch and noodle processing factories in Linxiang, at both household and village level. These units provide seasonal employment during the harvest/processing period, and also contribute to household income (for those at household level). The residue supports pig production, which was identified as another important source of income. More detailed studies to be carried out during the main processing season will be needed to quantify the role and importance of these enterprises to the local economy. In Longshan county, which is mainly a potato production area, processing enterprises are rare, and none of the focus group villages reported sales of potato to processing factories.

3.4 Department of Health and Nutrition

In February 2014, the State Council issued the "China Food and Nutrition Development Outline from 2014 to 2020," making as state policy the "comprehensive popularization of dietary nutrition and health knowledge." The aim is to improve the nutritional status of Chinese residents in recognition of the fact that health is determined by diet and lifestyle.

A 2012 survey showed that literacy on chronic disease prevention (including nutrition) was only 9.07%. The lack of knowledge on nutrition and health not only results in the prevalence of chronic diseases but also affects food production and the social economy.

3.5 Value chain

Based on the FGDs, as indicated above, sweetpotato is processed into added value products at local level and also at industrial scale. While smaller scale units sell their products to local wholesalers and retailers, the larger enterprises sell to more distant urban markets, including supermarkets. Village level pig production in these villages is supported by use of fresh sweetpotato roots, vines/leaves and processing residue as feed. A small proportion of sweetpotato is sold to local markets, while on-farm consumption of the fresh roots (and some tender leaves) is also found.

For potato in Longshan, there is little added value processing. Potato tubers are either consumed directly, sold to local markets or fed to pigs.

Thus, the field investigations showed that the value chains in the two target counties were relatively weak (apart from the few larger sweetpotato processing enterprises in Linxiang county) and catering mainly to local markets. Future studies are needed to identify viable added-value processing options for these counties, appropriate for their quite remote situation (especially Longshan, where processing is not currently found).

4 Key constraints and opportunities for RTCs to enhance food resilience

4.1 Disaster issues

RTC production is not only influenced by the market, but also, to a great degree, by natural disasters. In Linxiang, only 10% of the farmers have not suffered from natural disasters because of their good geographic location in recent years. The majority, 90% of the farmers, suffered from natural disasters such as droughts, flood, pests, and freezing weather. Droughts were indicated as the main problem.

The survey in Longshan revealed that 75% of the farmers suffered from natural disasters, the most damaging of which was flooding. Nearly 50% farmers suffered from floods, followed by drought, freezing, and pests, in that order.

Drought was more damaging in Linxiang, while in Longshan, flood was more damaging. Farmers do not have any capacity to respond and recover from these disasters.

4.2 Perceptions of food security and insecurity

Food security is in general considered achieved across the province, while some pockets of rural population may experience short and temporary food insufficiency, mostly when adverse natural events occur. While rural income generating activities may have become more diversified across rural China, conventional cropping and animal husbandry remain the principal activities in the less developed areas, such as the central and western regions, and even more present in the ethnic minority areas (HARIIP project design document).

Only one of the 957 sample households suffered from a hungry season in the last 12 months and none has experienced a second hungry season. (HARIIP 2011). The FGD participants reported that no one has experienced a hungry season.

4.3 Changes in household diets

4.3.1 Linxiang (sweetpotato)

In Linxiang, farmers consider rice as their most important staple food, but there existed a big potential for sweetpotato to become a staple too. Although there are diverse ways to cook sweetpotato, farmers prefer traditional cooking (steaming with rice) and fried slices are also popular. The red-fleshed variety is preferred to eat, while white and yellow varieties are mainly for processing or pig feeding. In general, both men and women focus group respondents liked eating sweetpotato, with some reporting that anti-cancer properties were an advantage (perhaps more associated with the red/purple varieties). Some villages also reported no change in sweetpotato consumption patterns over time, i.e. that despite improved incomes, it remains an important component of the diet.

4.3.2 Longshan (potato)

During the interview in Longshan, 6% of the households had potato as their staple food in contrast to the 94% of the farmers who preferred rice. Forty percent of these respondents listed potato as their second preferred staple food, sometimes consumed with rice (as an extender). All of the potato was produced by these farmers.

Farmers prefer eating potato because of its good taste and high nutrient content. There are two old sayings in the community: **"Don't marry your daughter to someone from Luota slope because there is too much potato there,"** and **"When the daughter-in-law cooks three tubers with one rice grain, the mother-in-law still complains that she put too much rice."** It is indicated that Longshan has a long history of potato planting and that it was once a staple. Now, in Longshan, farmers prefer rice to potato and potato is usually consumed as a vegetable. The

increase in people's standard of living highlighted the need for staple food diversification but potato processing endeavors are limited so most of the harvested potato are used for on-farm consumption or to feed pigs and are rarely marketed for human consumption. Suggestions were made to introduce good varieties with good taste and high yield, develop good marketing channels, and promote the potato industry chain.

4.4 Perceptions of good food, consumption and nutrition, and livelihood activities

4.4.1 Linxiang (sweetpotato)

To Linxiang consumers, good food consists of vegetables, fish, egg, sweetpotato, and rice. Some 40% of the farmers thought meat was the best food. With the development of the economy, and as the people's living standards started to rise, more farmers turned their attention to what they perceive as green and non-polluting food. The main considerations of farmers in choosing good food were high nutritional value, good taste, and low price. Dietary preferences must be taken into account during the project implementation phase.

When food is in short supply, 83% of the farmers expressed willingness to consider sweetpotato as a staple food. However, 18% of the farmers were not willing to eat sweetpotato, saying they already had a lot of those when they were young.

About 34% of the farmers eat sweetpotato frequently, 61% do so occasionally, and 5% do not eat sweetpotato at all.

In the target region, farmers have the habit of eating sweet potato and most are willing to eat sweetpotato instead of the traditional staple food when food is scarce. This indicates the big potential of sweetpotato as a staple crop. Consumption of sweetpotato leaves is not high, but tender leaves are appreciated as a vegetable (older leaves and vines are fed to pigs).

4.4.2 Longshan (potato)

In Longshan, what is perceived as good food are rice, potato, green vegetables, meat, and backyard vegetables. About 30% of the farmers thought meat was the best food. Farmers choose good food on the basis of high nutritional value and good taste. Some farmers said that their children do not eat meals without potato. Most villages reported (in the FGDs) that potato consumption habits have not changed in recent years. Developing more potato byproducts can meet the public clamor for diverse flavors and variants.

About 80% of the farmers were willing to eat potato in times of food scarcity. Twenty percent refused to because they ate too much already when they were young. As to frequency of eating,

38% of the farmers eat potato often, 52%, occasionally, and 10%, not at all. The results of the surveys show the big potential of potato as a complementary food in local diets.

4.5 Migration

From the FGDs, trends in migration to other places were taken up. Forty-five percent of the farmers engaged in agricultural activities. The same percentage of farmers worked in the city (45%) and the rest were involved in other activities in Linxiang. In Longshan, about 36% of the farmers were engaged in agriculture, 45% worked in the city, and 19% did other activities.

4.6 Gender issues and changes in the roles of men and women

4.6.1 Younger men as migrant workers

There were more women between the ages of 40 and 60 than there are men. Only one female respondent was between 20 and 30 years old and there were more men between the ages of 30 and 40. More males than females were noted in the 60 and above category. In migrant work, a bigger number of males were involved. Several focus groups reported a shortage of agricultural labour due to migration, a factor that limits the attractiveness of RTC production.

4.6.2 Status of education

According to the survey, education level in the target region was relatively low. The highest education level attained was high school. Moreover, the women had less education compared to men. People were not encouraged to go to school because of inaccessibility; they lived in remote areas and had no adequate transportation services to rely on. It is suggested that training programs and professional guidance to farmers in target regions be strengthened.

4.6.3 Preference for potato

Through the FGDs, it was learned that eating preferences for tubers differed between men and women (Table 13). Overall, more men prefer potato.

Table 13. Frequency of eating RTCs, by gender.

	Male	Female
Eat tubers usually	43%	25%
Eat tubers occasionally	54%	59%
Never eat tubers	3%	16%

Source: FGDs

5 Conclusions

Considering the results from the FGDs combined with insights from the secondary data presented in earlier sections of this report, the following conclusions can be tentatively identified. These will need to be confirmed with more in-depth studies and actions in future R&D.

There is demand and interest to improve potato and sweetpotato production provided that better markets (and higher profits) can be made. In other words, investment of farm labour and financial resources into these crops is dependent on a positive return to that investment (relative to other crop/livestock production and off-farm income generating options. In most villages in the two counties, on-farm labour is limited (due to out-migration) and this influences the economic activities that can be developed. Processing is seen as one positive option to generate additional income at household and village levels, although this is more feasible for sweetpotato than potato in current conditions. Another option is to develop fresh produce value chains that go beyond local markets, although this will depend on quality as well as price. More detailed location-specific studies into value chain options are needed to identify market opportunities for both potato and sweetpotato (fresh and processed) in and beyond the target counties. It may also be possible to develop niche markets for low-input **“healthy, green”** root crops using local varieties. Improved market information systems would also help farmers in more remote areas to profit from their production.

If justified, then investment in these crops should – according to the focus group respondents – be focused on improved varieties (for better yields and processing quality), seed systems (for higher quality clean seed supply) and on production technologies such as disease control/management, fertilizer applications and so on. Lack of capital also limits the ability of many households to take advantage of new technologies. In addition, capacity building for men and women in key aspects of potato and sweetpotato production technology is needed, especially if new varieties are introduced that require more intensive management/more use of inputs.

Regarding nutrition, both potato and sweetpotato are seen as having a complementary or secondary role, and this could be enhanced through nutritional education, especially as regards diets for children. It is noteworthy that the focus groups (for both men and women) reported on the importance of milk consumption (from purchased powdered milk) as an indicator of good nutritional status, rather than consumption of local produce.

While men are more likely to have off-farm employment than women (who in turn are more likely to work on-farm in agricultural activities) both men and women reported that household finances are controlled by women (in 50-80% of households in most villages). This gives women status and power at household level.

County-specific priorities:

Because of varying resource endowments for product development in the two counties, the main priorities for action differ.

In Linxiang, priority could be given to the introduction of new sweetpotato varieties, enhanced crop management and value chain development, building on existing enterprises and value chains.

In Longshan, priority should be to enhance the potato sector as this county is one of the very poor counties in Hunan with potential for poverty reduction projects that will increase **farmer's** income. This could include attention to variety testing and introduction (including provision of seed systems for clean seed), support for improved crop management (including extension services) and to value chain development for fresh and (potentially) processed potato products. In both counties, attention to nutrition education to make the most of available local food resources, including RTCs (leaves as well as roots) could help to reduce the dependence on imported and purchased dairy products.

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Annex

Annex 1 List of information and target sources per method

Methods	Information	Sources
Secondary information	<ul style="list-style-type: none"> Socio-economic and development context. 	<ul style="list-style-type: none"> Hunan Provincial Department of Agriculture
	<ul style="list-style-type: none"> Overlap of the sites of investment projects and RTC production. 	<ul style="list-style-type: none"> CCCAP IFAD-HARIIP office in Hunan IFAD-HARIIP office at Linxiang County IFAD-HARIIP office at Longshan County
	<ul style="list-style-type: none"> Biophysical data (soils and climate) and provincial level land use map. 	<ul style="list-style-type: none"> IFAD-HARIIP office in Hunan IFAD-HARIIP office at Linxiang County IFAD-HARIIP office at Longshan County Global GIS related sources
	<ul style="list-style-type: none"> Hazard map 	<ul style="list-style-type: none"> Hunan Provincial Department of Agriculture
	<ul style="list-style-type: none"> RTC production (including seasonality, varieties/biodiversity), processing marketing and consumption (fresh roots, processed and derived products, leaves/vines, animal feed use etc.) Industrial applications, if relevant. Current and historical information (back to 2000 if possible.) Attention paid to vulnerability factors/issues. 	<ul style="list-style-type: none"> Hunan Provincial Department of Agriculture HAU-Potato Engineering Technology Research Center
	<ul style="list-style-type: none"> Value chain descriptions, key industry players. 	<ul style="list-style-type: none"> HAU-Potato Engineering Technology Research Center
	<ul style="list-style-type: none"> Dietary, consumption and nutrition/health data relevant to RTCs especially for women and children (e.g. malnutrition, Vitamin A status, level of RTCs consumption if available.) 	<ul style="list-style-type: none"> Heath and Family Planning Commission of Linxiang County Heath and Family Planning Commission of Longshan County
	<ul style="list-style-type: none"> Previous R&D actions in the target region: past project reports (national and international.) 	<ul style="list-style-type: none"> CCCAP HAU
	<ul style="list-style-type: none"> Policy environment relevant to RTCs (crop production planning, market/industry development, nutrition and health policy) at national, provincial and local levels as appropriate. 	<ul style="list-style-type: none"> Agriculture Department of People's Republic of China Hunan Provincial Department of Agriculture Agriculture Bureau of Linxiang County Agriculture Bureau of Longshan County
Field	<ul style="list-style-type: none"> Verifying secondary data (and 	<ul style="list-style-type: none"> PRC Agriculture Bureau of Linxiang

Methods	Information	Sources
appraisals (key informant interview)	filling gaps.) <ul style="list-style-type: none"> Understanding trends, opportunities and challenges. 	County <ul style="list-style-type: none"> Agriculture Bureau of Longshan County NGOs (national and international) Stakeholder validation workshop in Linxiang County Stakeholder validation workshop in Longshan County
Field appraisals (focus group discussions)	<ul style="list-style-type: none"> Understanding RTC production, marketing and rural processing in the context of production, livelihood and food system, RTC contribution to agro-ecosystem. Issues related to vulnerability, resilience capacity, role of RTCs in post-disaster situations and extreme weather events. Perceptions of food security and insecurity, changes in household diets. Changes in roles of men and women, perceptions of “good” food/diet, consumption and nutrition, livelihood activities, migration. Other issues around gender that need to be explored. Adaptive or organization capacity in terms of scoping. 	<ul style="list-style-type: none"> Men and women RTC farmers Farmer group leaders Cooperative leaders Agriculture Bureau of Linxiang County Agriculture Bureau of Longshan County

Annex 2 **Highlights of the stakeholders' validation meeting**

HIGHLIGHTS OF THE STAKEHOLDERS VALIDATION MEETING

1 Background

FoodSTART+ stakeholders' validation workshops were conducted in January 2016 to present and validate the outputs of the scoping study conducted from November to December 2015 in Linxiang and Longshan – sites of the IFAD investment projects. The results presented summarized analyses taken from secondary and primary data-information on root and tuber crops (RTCs). The results presentations and their validation among the different stakeholders helped define the challenge(s), issue(s), and opportunity (ies) in relation to RTCs production, livelihoods, and food vulnerability in the pilot areas; and facilitated the setting of action for research and development action.

The validation workshop is an activity designed to inform the community members in potential sites and relevant stakeholders on the results of the scoping study; ascertain the accuracy of findings; and further discuss or clarify the scoping study results.

2 Objectives:

- To present the findings of the FoodSTART+ scoping study in the context of the collaborative **investment project's focus sites**;
- To gather feedback from the stakeholders on the reliability of data/information gathered by the scoping study team;
- To present and prioritize the opportunities, issues and challenges of the RTCs in relation to the **investment project's focus and priorities**;
- To identify potential RTC innovations; and
- To define areas of collaboration or partnership with stakeholders and IFAD development projects, and develop the next steps of engagement in both research and development actions and policy influence.

3 Workshop Preparations

Preparations included processing of the gathered information in the Tuowu, Yannan, Gongnong, Pingtou, Dongchong sites in Linxiang county and in the Akui, Rejia, Suoluo, Shaqiao, Touche sites in Longshan county; layouting of exhibition boards and banners (including layout and product placement); planning meetings with the assigned core groups by the investment project partners; and sending of invitations to identified farmer group participants, agricultural

technicians, and selected stakeholders. The CIP-FoodSTART+ and core group teams undertook these activities with some co-sharing of logistics.

4. Workshop Proper Activity Details

Exhibit of Selected Rootcrop Products

The Stakeholders' Validation Workshops featured exhibits of selected root crop products from different pilot sites to give the participants a glimpse of RTC utilization and livelihood opportunities. Posters of FoodSTART+ and the investment projects information were used as backdrop, together with RTC information materials produced by CIP-FoodSTART+. As a result, workshop participants like the farmers, technicians, other stakeholders, and project partners were greatly appreciative of the opportunities for potential cooperation. They were also hopeful that RTC products can provide the much-needed livelihood in the poor communities in the upland-coastal systems and in the agro-forestry areas.

5. Workshop Proper

5.1 Venues and Programme

The Stakeholders' Validation Workshops were held in:

Linxiang County at Agricultural Bureau Conference Room on January 13, 2016.

Longshan County at Agricultural Bureau Conference Room on January 15, 2016.

5.2 Participants Profile

The participants of the workshop included representatives of the farmers' groups where the focused group discussions (FGDs) were conducted, agricultural technicians, designated core staff from the investment projects, and selected stakeholders from farmer cooperative organizations, processing enterprises, local government, R&D institutions, academe, and potential support providers.

Table 1 Summary **profile of stakeholders’ validation workshop participants**

Participant Categories	Number of participants, Linxiang	Number of participants, Longshan
CIP-FoodSTART+	2	2
Province Hunan	3	3
R & D institutions	2	2
Local government	8	11
Farmer group representatives	6	8
Processing enterprises	4	1
Farmer cooperative organization	1	3
Staff from investment project	4	4
TOTAL(person)	30	34

5.3 The Linxiang Workshop

Opening of the Program

Mr. Yu Liang, head of the Linxiang Agricultural Bureau, gave the welcome and opening remarks. The development of sweetpotato industry in Linxiang has superior natural conditions and is based on traditional cultivation practices. With the support of CIP-FoodSTART+ project, Mr. Yu **hopes to increase farmers’ income, improve** the production conditions of farmers, promote sweetpotato industry innovation, and achieve scale effect.

Presentations from CIP-FoodSTART+

Ms. Arma Bertuso, Senior Research Associate from CIP, presented the background of the FoodSTART+ project in Asia in relation to the IFAD Investment Projects in five countries, specifically China, the Philippines, Vietnam, and Indonesia. Ms. Bertuso introduced that the FoodSTART+ project is the continuation and promotion of the FoodSTART project led by CIP. She discussed that CIP works with partners to achieve food security, well-being and gender equity. It was also discussed that the goals and objectives of FoodSTART+ China and HARIIP were similar as both projects aimed to alleviate poverty, and address food security in vulnerable agri-aqua communities. She also mentioned that FoodSTART+ works with HARIIP IFAD investment project in China located in two counties, Linxiang and Longshan. Finally, she emphasized that root crops can greatly contribute in making communities and households more food resilient, especially in areas that are highly vulnerable due to being prone to disasters.

Research team report previous research results

Dr. Li Hongmei, professor of Hunan Agricultural University and CIP-Collaborating Researcher for the CIP-FoodSTART+ project, presented the results of the scoping study. She highlighted the results based on the secondary information and FGDs conducted in Linxiang and Longshan. She discussed the relevance of the results to the existing problems, opportunities, proposed interventions for the RTC industry in Hunan.

Workshop Outputs

Linxiang Outputs by Cluster of Sites with Stakeholders

Table 2. First group discussion outputs

Stakeholders category	Problems	Present opportunities	Action/Intervention
Farmers group	<ul style="list-style-type: none"> Variety problem Infrastructure is not good Lack of labour 	<ul style="list-style-type: none"> R&D institutes Policy supporting IFAD 	<ul style="list-style-type: none"> Improved varieties Encourage migrant labours to return to home farming
Processing enterprises	<ul style="list-style-type: none"> Mechanization is seldom used Lack of funds Information block No agricultural insurance Industry chain is short 	<ul style="list-style-type: none"> Crop insurance polices are revising Information on agriculture found in the internet FoodSTART+ 	<ul style="list-style-type: none"> RTCs machinery subsidies. Establish information sharing platform Provide crop insurance The government should Value chain development
Farmers' cooperative organization	<ul style="list-style-type: none"> Lack of price protection mechanism 	<ul style="list-style-type: none"> Government pays attention to RTCs 	<ul style="list-style-type: none"> Policy support
R & D institutions	<ul style="list-style-type: none"> High labour costs Pest infestations 	<ul style="list-style-type: none"> R&D institutions 	<ul style="list-style-type: none"> Strengthen research and development for new varieties
Local government	<ul style="list-style-type: none"> Low profits Difficulty of agricultural technology extension 	<ul style="list-style-type: none"> Existing agricultural technology extension system 	<ul style="list-style-type: none"> Protection of price and deep processing of sweetpotato Technology training

Table 3. Second group discussion outputs

Stakeholders category	Problems	Present opportunities	Action/Intervention
Farmers group	<ul style="list-style-type: none"> • Lack of cooperatives organization • Lack of technology extension • Lack of good varieties 	<ul style="list-style-type: none"> • High planting enthusiasm 	<ul style="list-style-type: none"> • Introduce varieties <ul style="list-style-type: none"> • Policy subsidies • Government to strengthen the training and promotion of agricultural technology
Processing enterprises	<ul style="list-style-type: none"> • More rain • Small processing size • Financing difficulties • No machinery subsidies • Sweetpotato starch is easily affected by moisture • Sewage problem 	<ul style="list-style-type: none"> • Good profits • Sweetpotato processing products sell well 	<ul style="list-style-type: none"> • Policy supporting processing • Provide financing channels • Fight for dryer subsidies • Introduction of a high powder rate variety
Farmers' cooperative organization		<ul style="list-style-type: none"> • Mechanization can be rented 	

Agreed Action in Linxiang

IFAD projects can play a leading role in future meetings of stakeholders to discuss issues, opportunities and action measures to improve sweet potato industry in Linxiang. Suggested action measures involved industry development based on the following:

- Variety introduction
- Technical support on technologies (pest and disease control, fertilizer management) at township level – field training/mentoring
- Machinery
- Financial support
- **Develop niche market for “healthy” potato (good taste, no pollution, ethnic produce)**
- Market information for farmers

5.4 The Longshan Workshop

Opening of the Program

Mr. Chenhong, head of the Longshan Agricultural Bureau, gave the welcome and opening remarks. He discussed that the development of potato industry in Longshan has superior natural conditions and is based on traditional cultivation practices. With the CIP-FoodSTART+ project, **Mr. Chen hopes to increase farmers' income, improve the production conditions of farmers, promote potato industry innovation, and achieve scale effecting Longshan.**

Presentations from CIP-FoodSTART+

Ms. Arma Bertuso, senior research associate from CIP, presented the background of the FoodSTART+ project in Asia in relation to the IFAD Investment Projects in five countries, specifically China, the Philippines, Vietnam, and Indonesia. Ms. Bertuso introduced that the FoodSTART+ project is the continuation and promotion of the FoodSTART project led by CIP. She discussed that CIP works with partners to achieve food security, well-being and gender equity. Arma introduced the FoodSTART+ project is the continuation and promotion of the FoodSTART project and stressed that CIP or International Potato Center works with partners to achieve food security and well-being and gender equity. She also mentioned the background-theoretical basis of FoodSTART+-HARIIP collaboration and FoodSTART+ works with IFAD investment project, HARIIP in China and in counties –Linxiang and Longshan. It was also discussed that the goals and objectives of FoodSTART+ China and HARIIP were similar as both projects aimed to alleviate poverty, and address food security in vulnerable agri-aqua communities. She also mentioned that FoodSTART+ works with two IFAD investment projects in China located in Linxiang and Longshan. Finally, she emphasized that root crops can greatly contribute in making communities and households more food resilient, especially in areas that are highly vulnerable due to being prone to disasters.

Research team report previous research results

Dr. Li Hongmei, professor of Hunan Agricultural University and CIP-Collaborating Researcher of CIP-FoodSTART+ project, presented the results of the scoping study. She highlighted the results based on the secondary information and FGDs conducted in Linxiang and Longshan. She discussed the relevance of the results to the existing problems, opportunities, proposed interventions for the RTC industry in Hunan.

Workshop Outputs

Longshan Outputs by Cluster of Sites with Stakeholders

Table 4. First group discussion outputs

Stakeholders category	Problems	Present opportunities	Action/Intervention
Farmers group	<ul style="list-style-type: none"> • Lack of high quality planting materials • High cost of farm inputs • Lack of market information • Lack of post-harvest facilities • Limited access to finance 	<ul style="list-style-type: none"> • R&D institutions • Policy support from IFAD • Presence of research agencies • Offered planting material 	<ul style="list-style-type: none"> • Improved varieties • Link to related agencies for marketing, post-harvest facilities and farm inputs • Establish a revenue-generating mechanism for farmers to return to farming
Processing enterprises	<ul style="list-style-type: none"> • Procurement process is not standard • Mechanization is not universal • Lack of funds and technology • Variety problem • Information block 	<ul style="list-style-type: none"> • Good profits from RTC sales • Revised crop insurance policies • Information on agriculture found in the internet • FoodSTART+ 	<ul style="list-style-type: none"> • R&D of small machinery • Provide subsidies for RTCs machinery • R&D of good varieties • Establish information-sharing platform • Provide crop insurance • The government should drive the financing platform; establish a coordinated industrial chain
R&D institutes	<ul style="list-style-type: none"> • Lack of research funds • The government does not pay 	<ul style="list-style-type: none"> • R&D institutes 	<ul style="list-style-type: none"> • The government should pay attention to the demonstration of new technologies

	attention to the development of potato industry		and new varieties
Local government	<ul style="list-style-type: none"> • Low yields • Lack of technology, policy support 	<ul style="list-style-type: none"> • Present of agricultural technology extension system 	<ul style="list-style-type: none"> • Provide the guidance of industry development, financing, deep processing • Policy support

Table 5. Second group discussion outputs

Stakeholders category	Problems	Present opportunities	Action/Intervention
Farmers group	<ul style="list-style-type: none"> • Degeneration of variety • Financing difficulties • Lack of labour • Lack of cooperatives organization • Lack of technology extension • Lack of good varieties • Poor infrastructure 	<ul style="list-style-type: none"> • Planting enthusiasm high 	<ul style="list-style-type: none"> • Introduced varieties. Provide policy • Governments improve the work of cooperatives • Strengthen the training of agricultural technology.
Farmers' cooperative organization	<ul style="list-style-type: none"> • Limited budget for livelihood program and capacity building • No agricultural insurance • Lack of price protection mechanism • Varieties need to be improved 	<ul style="list-style-type: none"> • Mechanization can be rented • Governments pay attention to RTCs 	<ul style="list-style-type: none"> • Provide insurance policy • Implement the protection price • Improved variety • Develop and promote the suitable potato planting machinery
R&D institutes	<ul style="list-style-type: none"> • High labour costs 	<ul style="list-style-type: none"> • Product of research benefits 	<ul style="list-style-type: none"> • Develop technique training • Infrastructure development
Local government	<ul style="list-style-type: none"> • Lack of labour • Lack of technology on production and processing • Lack of high quality planting materials for distribution 	<ul style="list-style-type: none"> • Potential RTC areas • Availability of agricultural technicians 	<ul style="list-style-type: none"> • Conduct of technology trainings • Provision of hybrid planting materials

Agreed Action in Longshan

For meetings of all stakeholders in the issues, opportunities and measures, make full use of IFAD projects play a leading role; emphatically in the follow-up industry development gradually solve the local potato industry development in Longshan based on the following:

- Financial support for the construction of the local seed-potato storage room
- Develop potato industry value chain
- Create local potato characteristics brand
- Technical support on technologies (pest and disease control, fertilizer management) at township level – field training/mentoring
- Transportation



The International Potato Center (known by its Spanish acronym CIP) is a research and development organization with a focus on potato, sweetpotato, Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change, and the preservation of our Earth's fragile biodiversity and natural resources.

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The International Center for Tropical Agriculture (CIAT) develops technologies, methods, and knowledge that better enable farmers, mainly smallholders, to enhance eco-efficiency in agriculture by making production more competitive and profitable as well as sustainable and resilient through economically and ecologically sound use of natural resources and purchased inputs.

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The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a broad alliance led by the International Potato Center (CIP) jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute for Tropical Agriculture (IITA), and CIRAD in collaboration with research and development partners. The shared purpose is to tap the underutilized potential of root, tuber and banana crops for improving nutrition and food security, increasing incomes and fostering greater gender equity, especially among the world's poorest and most vulnerable populations

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