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# Report

## "Assessing the Impact of the SASA/CASREN Technology Interventions in the *Sweet potato-Pig Production Systems in Zitong County (Sichuan, China)"*

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# Assessing Impacts of the SASA/CASREN Technology Interventions in the *Sweet potato-Pig Production Systems in Zitong County (Sichuan, China)*


***Abstract***

*The present paper describes the processes applied by the Sichuan Animal Science Academy (SASA)/CASREN Team in Zitong County in order to improve the sweet potato-based pig production systems that are predominantly present in that area, which is representative of the rainfed uplands of Sichuan Province (China).*

*The methodology applied by the CASREN project to scale up promising technology interventions in crop-livestock systems is described. Some of the differences between the work in the benchmark site in Sichuan Province and other CASREN sites is also briefly described.*

*The last part of the report contains a detailed description of the basket of technology options proposed by the SASA/CASREN Team, as well as some of the findings in the preliminary assessment of their impact. The technologies included in the basket of options are: improved sweet potato varieties (high yielding, starch-rich); conservation of sweet potato roots and vines as silages as a means to increase the efficiency of utilisation of sweet potatoes as animal feed; use of a premix or a protein-rich concentrate to supplement sweet potato-based diets; upgrading the local pig genotypes using improved breeds; implementation of a simple preventive disease control program; and improved housing.*

*The report contains some of the preliminary results obtained applying a set of criteria for assessing the impacts at the plot and household level, after applying the technology interventions as proposed by the SASA/CASREN Team. Among those criteria are: increased sweet potato yield; larger area planted to the improved varieties; reduction of losses due spoilage when sweet potato roots and vines are ensiled; savings in fuel when silages are prepared instead of offering fresh roots; shorten the growing/fattening period; increased numbers of pigs marketed; increased income from pig; reduced costs of feeding; faster capital turnover in the pig enterprise; and finally improved livelihood for household members. At the end of the report there is a brief section on institutional impacts.*


## Introduction

In January 2002, ILRI and its partners in South East Asia started the project entitled "Improving Crop-Livestock Production Systems in Rainfed Areas of South East Asia", which followed a previous three-years long project entitled "Increasing Productivity of Crop-Livestock Systems in Asia" that was carried out from January 1999 to December 2002. Both are funded by the Asian Development Bank (ADB). All project partners constituted the Crop-Animal Systems Research Network (CASREN) as a mechanism to link research and development (R&D) activities among the five participating countries.

Both projects have as their main components: technology development, policy research and training of researchers and extension workers of NARS. Regarding the technology development component, the project moved from its research emphasis in the first stage (Objective 1 was "to develop improved livestock feed production and utilization technologies that could help to improve the productivity of smallholder crop-livestock systems") to a development-oriented approach (Objective 1 is now "to use participatory approaches to spread the application of appropriate technologies by farmers to enhance the productivity of crop-livestock systems"), and its ultimate goal is to reduce poverty among smallholder farmers in rainfed environments in South East Asia.

The present report is an attempt to make a preliminary evaluation of the impact CASREN technology interventions have had on the sweet potato-pig production systems in Renhe Township (Zitong County), which are the focus of the Sichuan Animal Science Academy, who is the CASREN partner institution for the work in Sichuan Province (China). The present report is also an effort to illustrate the application of a general methodology to assess the impact of CASREN technology interventions, because we do recognize that there has not occurred wider adoption of the proposed interventions given the short duration of the project efforts in Sichuan

Province (less than three years). Also, the project did not include a massive extension and diffusion component (Figure 1); therefore, the real IMPACT of the project has been on strengthening the R&D capacity of national partners, which in turn would lead to have impact on the ultimate goal of the project which is to reduce poverty.

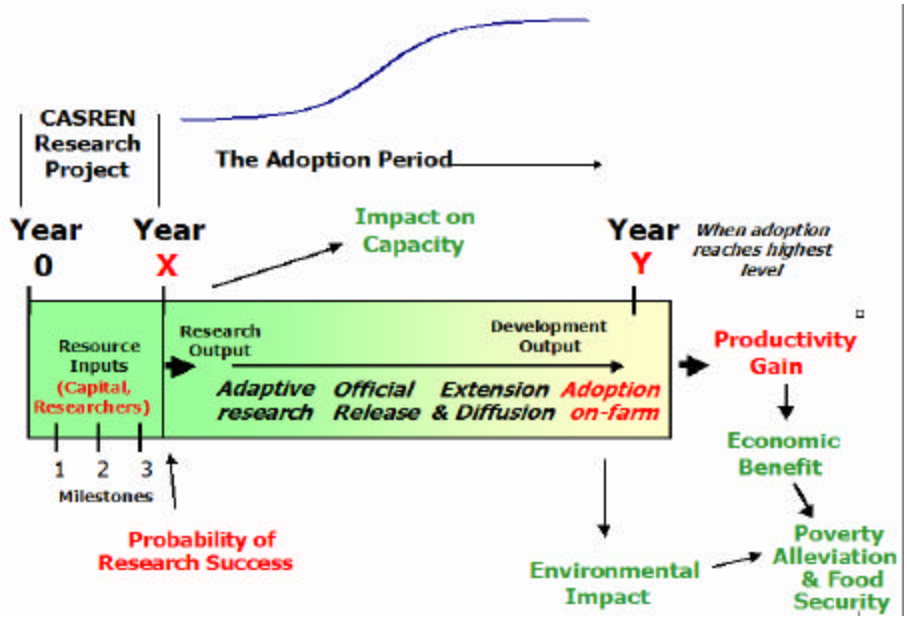


**Figure 1. Conceptual framework for assessing impact of CASREN R&D efforts**

## The use of sweet potatoes as animal feed in Sichuan Province: Some experiences before CASREN

Two survey studies conducted by the Feed Research Institute of the Sichuan Animal Sciences Academy in1988 and 1996 showed that smallholder pig producers commonly fed their animals with grains, green feeds (mainly leaves), and rice bran with hulls. In general, feeding systems used could be classified into four types:

(1) Corn - green feed - rice bran with hulls
(2) Sweet potatoes – corn - green feeds - rice bran with hulls
(3) Corn – wheat - green feeds - rice bran with hulls
(4) Corn – barley - green feeds - rice bran with hulls

Sweet potatoes are extensively planted in the province, except for those districts (i.e., Aba, Ganzi, Liangshan) with e predominance of farmers who belongs to ethnic groups (minority nationalities). The utilisation of sweet potatoes is highly seasonal, mainly from November to February, but this is the peak period for fattening pigs as the major demand coincides with the Chinese New Year. During that period sweet potato is the main feed source, while corn is added in small amounts only as means to improve intake.

The average diet composition for growing and finishing pigs as detected in a survey conducted in the eight main sweet potato producing counties of Sichuan is shown in Table 1. For both groups of animals sweet potatoes and maize made the major contribution to energy consumption, whereas were green feeds the main crude protein sources in those diets. The diets shown in Table 1 provided 87.3 and 97.5 % of the DE requirements as defined in the Chinese Feeding Standards for Lean-Type Pigs, for growing and finishing pigs, respectively; but were very limited in CP, lysine, and sulphur-containing amino acids (35, 50 and 63% of the requirements, respectively). In the case of minerals, the diet only provided 92 and 60% of the calcium and phosphorus requirements, and there was an imbalance in the calcium to phosphorus ratio. Essential trace elements like iron, copper, manganese, and iodine exceeded the standard while zinc and selenium were 80% and 70% below the standards, respectively.

Table 1. Average composition of pig diets in the eight main sweet potato producing counties in Sichuan

| Intake (per animal)[1] | Growing pigs | Finishing pigs |
|---|---|---|
| Sweet potatoes, kg | 2.1 - 2.5 | 4.5 - 7.8 |
| Maize, kg | 0.4 | 0.36 - 0.85 |
| Green feeds, kg | 5.0 - 5.8 | 4.5 - 5.8 |
| Rice bran with hulls, kg | 0.16 - 0.20 | 0.16 - 0.50 |
| Dry matter intake, kg | 1.84 - 1.90 | 2.89 - 3.19 |
| DE intake, MJ/animal | 20.5 - 21.8 | 33.9 - 41.3 |
| CP intake, g/animal | 198 | 237 - 270 |

[1] All feed intake data is as fed (in fresh)

Based on the information above, was clear that feeding pigs with sweet potatoes alone or the traditional feeding system, in which sweet potatoes are the main feed ingredient, will result in poor pig performance. Field surveys conducted in 851 farms in Dazhou District (Sichuan Province) confirmed this hypothesis, with live weight gains from 10 kg to market weight (90 kg) of 263 to 346 g/day (Table 2).

Therefore, between 1987 and 1990, the Sichuan Animal Science Academy carried out a series of on station experiments in order to identify appropriate supplementation procedures for sweet potato-based diets. Basically, protein-rich supplements were formulated containing about 35% CP. Also specific ***premixes*** to meet the nutrient requirements of pigs in terms of minerals and essential amino acids were formulated. The use of CP-rich concentrates to supplement sweet potato- based diets resulted in 69 – 92% increase in live weight gain, and 30% improvement in feed conversion rate, whereas the feeding cost per unit of live weight gain decreased by 17.8 - 19.8%. The corresponding responses to the use of premixes were: 9.9 to 15.1; 15 to 80; and 10 to 20%, respectively.

Table 2. Average performance of pigs during the growing/finishing phase in 857 farms in Dazhou District (Sichuan Province)

| Region type | Initial weight, kg | Final weight, kg | Average daily gain, kg | Length of fattening period, days |
|---|---|---|---|---|
| Plains | 12.5 | 91.0 | 0.315 | 249 |
| Lower uplands | 13.4 | 100.0 | 0.346 | 250 |
| Higher uplands | 7.6 | 89.6 | 0.263 | 312 |

## The R&D process for Improving Sweet Potato- Pig Systems in Zitong County (Sichuan, China)

The Sichuan Animal Science Academy (SASA) became a CASREN member only until March 2002, but activities effectively started in late April 2002, when staff of its Feed Research Institute (SASA - FRI), were assigned to the project. The mandate for SASA as a new CASREN partner was to work on the improvement of those systems in which there are opportunities for the better use of sweet potato tubers and vines as feeds for pigs. Those crop-livestock systems are not only relevant in Sichuan Province, but in other provinces of South-western China and Vietnam as well, and are potentially applicable in other CASREN member countries.

At the time SASA-FRI joined CASREN already had data from its *on-station* research on the integral use of sweet potato (tubers and vines) as feed for pigs, including its conservation as silage, as well as on the use of appropriate feed premixes (i.e., synthetic amino acids and vitamins) to supplement sweet potato-based diets, but lacked experience on methodologies and

approaches for *on-farm* research. Therefore, at the beginning the SASA-CASREN team required more support from the ILRI-CASREN staff, particularly on training them for on-farm R&D methodologies and participatory approaches.

In order to scale-up the most promising technology options identified during the first phase of the project, all CASREN teams followed the steps as defined in Table 2. In the case of the work with sweet potato-pig systems some adjustments were needed, as there was not a previous *on-farm* research experience.

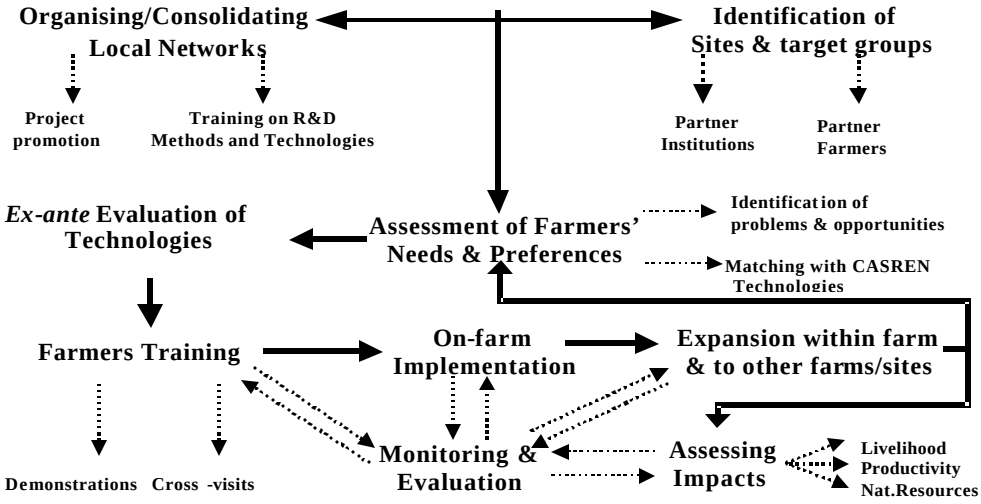


**Figure 2: Conceptual framework to scale-up CASREN technologies (2002 - 2004)**

**Identification of Sites and Target Groups**

Sichuan province is located in Southwest China, between longitudes 97°21' to 108°31' East, and latitudes 26°03' to 34°19' North. The province covers 568 thousand km$^2$ and has a population of 85 millions, 80% of which is engaged in agriculture. The area of arable land is 44,500 km$^2$, and the arable land *per capita* is only 0.053 ha. Sichuan is the main pig producer in China (60 million pigs per year). Although industrial pig production systems are important in the province, a large number of pigs are raised in smallholder crop-animal systems, in which sweet potato is one of the main components of the cropping system, and in many farm households pigs contribute a larger share of the family income, although productivity per farm is low, and many poor farmers continue to endure production losses.

The selection of the site where the project started its operation followed a hierarchical procedure (County/District/Village), applying a combination of secondary information with household surveys and participatory rural appraisal (PRA) techniques. Once the county was identified, staff of the Animal Husbandry Bureau (ZCAHB) was invited to participate in the selection of the district and village where the project would operate. The whole hierarchical selection process was carried out in consultation with the corresponding provincial, county and district authorities, as well as the People's Committees, to be sure that the BMS was an area prioritised in the government agricultural development plans. In all cases the criteria defined by CASREN for the selection of benchmark sites (e.g., rainfed area, national/provincial priority, households facing poverty and food insecurity, animals are important sources of income, R&D institutions active in the area, etc.) were used as a reference frame. However, for the work in Sichuan Province the presence of sweet potato and pigs as important components of the farming systems was an additional selection criterion.

Based on the criteria listed above, two counties (Zitong and Anyue), and within those three districts in Zitong (Renhe, Baoshi and Xiaoya) and two in Anyue (Xiehe and Gaowu) were

chosen as potential candidates to start CASREN activities. In those districts, a total of 225 farmers were interviewed. As a result of the survey, the research team identified Zitong County as the benchmark site (BMS) where the project will operate. Within this Renhe district was selected, and Tian Le was chosen as village where the project should start operating.

The capital of Zitong County is located 170 km northeast from Chendgu, the Provincial Capital of Sichuan. The county human population is 370,000 (90.8 % involved in farming activities), with an average annual gross income *per capita* of US$ 230 (US$ 146 in farmers' households). The BMS is representative of the rainfed uplands in a sub-humid sub-tropical agro ecological zone; since less than 2% of the area is under irrigation, and also a very limited area belongs to the rainfed lowlands. The animal population is 360,000 pigs, 150,000 cattle, 120,000 goats and 4.5 million poultry, and those altogether in average contribute 45% to the farmers´ income. The main crops are wheat, maize, rice, sweet potatoes, peanuts, rape (*Brassica spp*.) and mulberry (*Morus alba*). The latter is a relatively new crop in the region, and is cultivated for silk production.

Tianle village, which belongs to Renhe is located at 105°10' E and 31°33' N, about 50 km far from the capital of Zitong County, and its average elevation is 558 meters above sea level. The majority of the land corresponds to the rainfed uplands, the average annual rainfall is ca. 800 mm, and the dry season last up to eight months. The majority of farmers in Tianle are very poor, their average income *per capita* is less than US$ 100 per year, and livestock contributes with up to 80% of the total farm income. The average farm size is only 0.28 ha, and there are 3.2 persons per household.

There are two cropping seasons; during the cool season (autumn), the main crops are wheat and rape, whereas during the warm season (spring/summer) are corn, sweet potato and rice. Sweet potato is widely planted, and is the main food-feed crop as 75-80% of the farmers use it as feed. Pigs, chickens, cattle, goats and ducks are the animals most frequently raised by farmers. Among animal species, pigs play a very important role in farmers' income, as each family holds 4-5 pigs; however, farmers are lacking technology options to improve the productivity of this enterprise.
After the first year of operation in Tianle village with only 20 farmers, the project expanded to six new villages (Liehuo, Baiguo, Aiquo, Guanlong, Xinming and Zhandou) in the second year, with a total of 218 farmer partners applying/testing some of the new technology options proposed by the SASA/CASREN team.

**Organizing the CASREN Local Network in Sichuan**

As indicated before, the main CASREN partner in Sichuan is the Sichuan Animal Sciences Academy (SASA), but as the project progressed new partners became part of the local network. Some of the partners were more members of a sort of advisory committee to the project activities in Sichuan, such as Provincial Science and Technology Bureau, the Provincial Bureau of Animal Husbandry, and the Institute of Agricultural Economics of the Chinese Academy of Agricultural Sciences, where Dr. Zhang Cungen, the Chinese Representative in the CASREN Steering Committee belongs to. Later on, Dr. Xianglin Li the ILRI Representative in China started to interact more effectively with the project team.

From an operational point of view, for the *on-farm* work mostly County and Township level governmental institutions have been the network members participating in all project activities. Among these are: the Zitong County People's Government, the Zitong County Animal Husbandry Bureau, and the Renhe Township Animal Husbandry and Veterinary Services Station. For the agronomic work with sweet potato a scientist from the Sichuan Academy of Agricultural Sciences (SAAS) have been very much involved in training technical staff and farmers. In all villages, the local authorities (Village Committees) and farmer groups were important project partners.

More recently, other projects and institutions started coordinating operation activities with the SASA-CASREN team. Among those are: the Poverty Alleviation Project of the Sichuan Animal Husbandry Bureau, the joined SASA and Sichuan Agriculture University project on Food Security, the Pig Development project of the Zitong Animal Husbandry Bureau, the collaborative

Sweet-potato Breeding project carried out by the International Potato Center (CIP) and the Sichuan Academy of Agriculture Sciences, and the Heifer Project International-China (HPI-China).

**Matching Farmer Needs with Technology Options**

Participatory rural appraisal (PRA) techniques combined with surveys using a structured questionnaire were used to identify problems and opportunities in the crop-livestock systems practised by smallholder farmers in the benchmark site. Although farmers identified problems covering a wide range of topics (e.g., market opportunities, access to credit), for this report are only listed those problems related to the sweet potato and pigs components of their farming systems, on which the CASREN team concentrated their efforts. It must be indicated that similar problems were identified when PRA techniques were applied in other villages.

| Sweet potatoes | Pigs |
|---|---|
| Lack of improved varieties | Poor housing facilities, including poorly designed feeders that contribute to feed losses |
| Inadequacy of fertilisation | Poor knowledge on how to provide pigs a balanced diet using local feeds nutrition |
| Diseases and pests | Seasonal scarcity of feeds, being April and May the most critical months |
| Inadequate planting methods | Diseases (mostly diarrhoea in piglets) |
| High post-harvest losses due to lack of facilities and knowledge for proper storage | Low productive genotypes |
| Lack of knowledge on other uses, and/or processing options for sweet potato roots | Reach market-weight very late |

During the first year of the project (2002) most project efforts were testing/validating the best bet technologies tackling some of the problems as identified by farmers. However, as sweet potato was already planted at the time project activities started, no agronomic interventions were apply, only those associated to post-harvest management (i.e., conservation of sweet potato roots and vines as silage using additives), and two pig feeding trails (i.e., supplementation of sweet potato roots-based diets for weaned piglets, and use of a premix of amino acids, vitamins and minerals to supplement a sweet potato roots and vines-based diet) were carried out with farmer partners. In year 2003 most efforts were oriented to scale up the technologies tested in the first year, except for a trial to evaluate three new high yielding sweet potato varieties, compared to the local genotype.

Based on the problems identified and the validation experiments run by the SASA/CASREN team, a basket of options to be offered to farmers was designed. The technology interventions included in the basket of options were:

- ***Improved sweet potato varieties***, probed to be high yielding, rich in starch content and tolerant to pests and diseases
- ***Sweet potato (roots and vines) silage preparation*** to extend the use of roots and vines as animal feed
- ***Use of premixes (amino-acids, vitamins, minerals) or high protein concentrates*** to increase feed efficiency of sweet potato-based pig feeding systems
- ***Upgrading local pig genotypes***, by using AI with improved breed males
- ***Simple preventive disease control program***, emphasising the control of diarrhoea in piglets and gastro-intestinal parasites in growing pigs
- ***Improved housing***, to reduce feeder losses and facilitate cleaning

***Ex ante* evaluation of technology options**

As Sichuan joined the CASREN project only in 2002, there was no previous *on farm* research under CASREN which could provide enough information to be used for the *ex ante* evaluation of the proposed technology interventions. Therefore, during the first and second year there were few experiments carried out with farmer partners to evaluate some of the best bets the project staff had to support those interventions aiming to improve the efficiency of utilization of sweet potatoes as pig feeds. In all cases interventions were compared to the technologies currently applied by farmers (control treatment).

***a) Evaluation of sweet potato varieties***

Three improved sweet potato varieties identified by Prof. Wang Dayi, the expert in sweet potato breeding of the Sichuan Academy of Agricultural Science, as promising for the prevalent conditions in the benchmark site (e.g., soil structure, soil fertility status, harvest time) were introduced in February 2003. The varieties evaluated were: a starch-rich variety (Chuan-34), a high yielder (Chuan-383) and a high starch and high yielding variety (Chuan-788). These varieties were planted in three farms in Tianle Village, and compared to the native variety. The results obtained in the on farm experiment either in terms of root and vines yields (Table 2) and chemical composition of the roots (Table 3) suggested that the variety Chuan-384 should not be promoted among farmers, as it showed poorer results than the local control, in both yield and starch content.

Table 2. Yield of sweet potato vines and roots for the improved and the native sweet potato varieties evaluated in Tianle (Zitong County, Sichuan Province) kg/mu[a]

| Variety | SP Vines kg/mu | Improvement (%) | SP Roots kg/mu | Improvement (%) |
|---|---|---|---|---|
| Chuan-788 | 5215.8 | +11.91 | 758.40 | +22.77 |
| Native | 4660.8 | | 617.76 | |
| Chuan-383 | 4701.3 | +7.14 | 679.08 | +12.34 |
| Native | 4387.9 | | 604.47 | |
| Chuan-34 | 3421.8 | -7.94 | 737.47 | -19.36 |
| Native | 3716.8 | | 914.46 | |

[a] 1 mu equals 666.67m$^2$

Table 3. Nutritive value of sweet potato roots for the improved and the native sweet potato varieties evaluated in Tianle (Zitong County, Sichuan Province)

| | % | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Variety | DM | CP | Ash | Ca | P | EE | CF | NFE | |
| | | | | | | | | | Imp.(%) |
| Chuan-788 | 23.28 | 2.24 | 1.22 | 0.50 | 0.25 | 0.14 | 0.55 | 19.13 | +14.69 |
| Chuan-383 | 28.28 | 2.12 | 1.16 | 0.50 | 0.14 | 0.15 | 0.57 | 24.28 | +45.56 |
| Chuan-34 | 17.84 | 1.20 | 0.86 | 0.35 | 0.19 | 0.14 | 0.44 | 15.20 | -8.87 |
| Native | 19.96 | 1.55 | 0.95 | 0.28 | 0.19 | 0.18 | 0.60 | 16.68 | |

***b) Use of additives for ensiling sweet potato vines and roots: Silage preparation***

Farmers identified post-harvest losses as one of the constraints in the sweet potato production systems, for the crop to make a significant contribution to pig feeding systems. As the crop is only produced once a year, and vines and roots are highly perishable, the conservation of both components as silages were identified as an option to be tested based on the results obtained in on-station experiments conducted by SASA and other research institutions, as well as the

lessons learnt by the International Potato Centre (CIP) and the National Institute of Animal Husbandry (NIAH), working with farmers in Vietnam.

Therefore different additives for silage making using either sweet potato vines or roots were tested with farmers using plastic bags as silos. Nine (9) farmers were involved in the trials with vines and eleven (11) in the ones with roots. All farmers involved in each trial (roots or vines) tested all treatments. Silages were evaluated on a sensorial basis (smell, colour, consistency), and pooled samples combining those taken in each farm were carried to the laboratory for analysis of pH and ammonium nitrogen (as percentage of total nitrogen).

All silages made of sweet potato vines –regardless of treatments-, although showed good to excellent sensorial evaluation scores (Table 4), showed higher pH than the ones made of sweet potato roots, and some values are greater than the ones accepted for a good silage. However, these results must be influenced by the fact that laboratory analysis were made 5 days after opening the silos (no electrical power in the laboratories), and bags may have not been properly sealed. In all cases (vines and roots), the addition of urea did not seem appropriate as it resulted in levels of ammonium nitrogen that exceeded the maximum recommended level (13% $NH_3^+$-N, as % of Total N). Based on the results obtained, it was recommended to use 6 % of corn meal as an additive when ensiling sweet potato vines, and 0.5 % salt and 13% rapeseed meal when roots were ensiled Based on these results those were the silage additives recommended to farmers in 2003. All inputs used as additives are safe and easily available in smallholder farms in Sichuan Province.

Table 4. Effect of additives on the quality of silages made of sweet potato vines or roots, under farm conditions in Tianle Village

| Treatment | Sensorial evaluation | pH value* | $NH_3^+$-N, as % of Total N |
|---|---|---|---|
| ***Vines*** | | | |
| 94% vine +6%corn meal | Excellent | 4.65 | 3.78 |
| 93.5% vine + 0.5% salt+ 6% corn meal | Good | 5.04 | 6.67 |
| 93% vine + 6%corn meal+1% urea | Good | 4.62 | 40.48 |
| 92.5% vine + 0.5% salt+ 6% corn meal+1% urea | Good | 4.77 | 42.55 |
| ***Roots*** | | | |
| 86.5% roots + 0.5% salt + 13% rapeseed meal | Excellent | 3.8 | 4.05 |
| 97.5% roots + 0.5% salt+2% urea | Good | 4.09 | 32.88 |

***c) Supplementation of sweet potato-based diets for weaned piglets and growing pigs***

Two sets of *on farm* trials, involving crossbred (Yorkshire x Native) animals were carried out to assess the effect of improving the supplementation strategies in sweet potato-based diets for weaned piglets and growing pigs. In all cases five animals per treatment were considered. In the case of the piglets two rations were tested: control and protein-rich concentrate diet, whereas in the case of the growing pigs a third diet involving a Premix was also considered.
The composition of the experimental diets was as follows: (i) A control diet that mimics the average diet used by farmer, which is composed of 50% corn meal, 30% wheat bran, and 20% sweet potato silage (most farmers tend to use more sweet potato and less corn in practice, resulting in poor appetite and performance of pigs). (ii) A protein rich concentrate diet composed of 50% corn meal, 10% wheat bran, 20% high protein concentrate and 20% sweet potato silage. The high protein concentrate, which contains 45.2% CP, is composed of 6.3% rapeseed meal, 43% soybean meal, 22% corn gluten meal (contains 60% protein), 15% fish meal, 3.95% limestone, 5% dibasic phosphate ($CaHPO_4$), 1.35% Lys-HCl, 0.8% salt, 0.05% vitamins, and 2.55% of others (mainly microelements). (iii) A Premix Diet composed of 80% a basal diet and 20% sweet potato silage; and the ingredients of the basal diet are 52.6% corn meal, 19% baked soybean meal, 17% baked horse-bean meal, 6% rapeseed meal, 0.4% salt and 5% of a Premix

containing amino-acids, vitamins, macro- and micro-minerals. The basal diet contains in average 17.9% crude protein. In Table 5 is shown the composition of the diets.

Table 5. Nutrient composition of the experimental diets

| Diets | DE (MJ/kg) | CP , % | Ca, % | TP, % | AP, % | D-Lys, % |
|---|---|---|---|---|---|---|
| Control | 11.21 | 8.9 | 0.07 | 0.35 | 0.11 | 0.23 |
| Protein Concentrate[a] | 11.30 | 14.77 | 0.72 | 0.53 | 0.33 | 0.87 |
| Premix[b] | 11.46 | 14.51 | 0.54 | 0.48 | 0.28 | 0.82 |

***Note:*** Ca - calcium, TP- total phosphorus , AP- available phosphorus , D-Lys - digestible lysine
[a] Supplemented w /microelements (mg/kg diet): Fe 100, Cu 150, Mn 40, Zn 100, Se 0.3, I 0.2, Co 0.2
[b] Supplemented w /microelements (mg/kg diet): Fe 120, Cu 150, Mn 40, Zn 150, Se 0.45, I 0.15, Co 0.2

The results obtained in the on-farm feeding trials with weaned piglets and growing pigs are shown in Tables 6 and 7, respectively. In general, the results obtained in both trials confirmed what was expected. In the case of piglets, balancing the basal diet through the use of a protein-rich concentrate resulted in a 62% increase in average daily gain, and a 30.8% improvement in the feed conversion rate. In the case of the growing pigs trial, the use of the protein-rich concentrate resulted in improved live-weight gain (LWG) and feed conversion rate (42.5 and 29.2%, respectively), but even greater improved was obtained using the amino-acid, vitamins and minerals premix to supplement the sweet potato-based diets (51.1 and 33.8% improvements in LWG and feed conversion rate, respectively). Economic analysis applied to the results of both trials (Table 8) showed that the higher costs associated to the improved diets were over-compensated by extra-income obtained due to improved LWG and FCR

Table 6. Live weight gain (LWG) and feed conversion rate (FCR) for piglets receiving the farmers control diet and supplemented with a protein-rich concentrate

| Treatments | Initial weight (kg) | Final weight (kg) | LWG (kg) | Feed consumed (kg) | Average Daily Gain (g) | | FCR (kg/kg) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Improv. (%) | | Improv. (%) |
| Control | 14.1 | 19.7 | 5.6 | 18.0 | 267 | 0 | 3.21 | 0 |
| Protein-rich concentrate | 14.0 | 23.1 | 9.1 | 20.2 | 433 | 62.2 | 2.22 | 30.8 |

***Note***: Five pigs per pen in each group. The period of experimentation lasted 21days.

Table 7. Live weight gain (LWG) and feed conversion rate (FCR) for growing pigs receiving the farmers control diet and supplemented with a protein-rich concentrate

| Treatments | Initial weight (kg) | Final weight (kg) | LWG (kg) | Feed consumed (kg) | Average Daily Gain (g) | | FCR, kg/kg | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Improv. (%) | | Improv. (%) |
| Control | 41.0 | 50.2 | 9.2 | 44.7 | 438 | 0 | 4.86 | 0 |
| Protein-rich Concentrate | 40.9 | 54.0 | 13.1 | 45.0 | 624 | 42.5 | 3.44 | 29.2 |
| Premix | 41.1 | 55.0 | 13.9 | 44.7 | 662 | 51.1 | 3.22 | 33.8 |

***Note***: Five pigs per pen in each treatment. The period of experimentation lasted 21days.

Table 8. Economic analysis (in Yuan RMB) for the supplementation trials with piglets and growing pig's diets.

| | LWG (kg) | Price per kg BW (Yuans) | Feed consumed (kg) | Price per kg feed (Yuans) | Economic benefit (Yuans) | Improv. (%) |
|---|---|---|---|---|---|---|
| ***Piglets*** | | | | | | |
| Control | 28.0 | 6 | 90 | 0.95 | 82.5 | |
| Protein-rich Concentrate | 45.5 | 6 | 101 | 1.314 | 140.29 | +57.79 |
| ***Growing pigs*** | | | | | | |
| Control | 46.0 | 6 | 223.5 | 0.95 | 63.68 | |
| Protein-rich Concentrate | 65.5 | 6 | 225.15 | 1.314 | 97.15 | +33.47 |
| Premix | 69.5 | 6 | 223.65 | 1.232 | 141.46 | +77.78 |

Based on the growth rates obtained in separate trials with weaned piglets and growing pigs fed the farmers control diet and supplemented with the protein-rich concentrate, an estimate of how long will take pigs to reach the market weight (Table 2). The results obtained showed that with the improved diets the growing/fattening period could be shortened for at least 63 days. It must be indicated that the estimates for the control diet are shorter than the values frequently detected at farm level (up to 9 months to reach market weight), because the control diet actually had a higher corn meal content than the one usually fed by farmers.

Table 9. Estimated length of a pig cycle from weaning to market weight under farmers conditions *versus* using the protein-rich concentrate as proposed by the SASA-CASREN Team

| Growth Phase | 10-20kg | | 20-40kg | | 40-60kg | | 60-100kg | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | ADG(g) | days | ADG(g) | days | ADG(g) | days | ADG(g) | days | days |
| Control | 250 | 40 | 350 | 57 | 450 | 44 | 550 | 73 | 214 |
| Protein-rich Concentrate | 400 | 25 | 500 | 40 | 600 | 33 | 750 | 53 | 151 |

***On-farm* Implementation**

Based on the results obtained in the different on farm experiments described above the technology interventions as tested at farm level were adjusted as follows:

***(a) Planting an improved (high yielding/starch-rich) sweet potato variety***

Chuan 383, the variety that showed the highest yield and also had a high starch content was the sweet potato variety more frequently recommended for farmers to plant; however the other improved variety that out-yielded the local variety was also available for farmers to plant. In fact, in year 2003 about 1000kg of seeds of the improved varieties were introduced mainly to Tianle Village, and more than 200 farmers in this and other neighbouring villages voluntarily planted at least one of the improved varieties (Chuan 788, Chuan 383, and Chuan 34). Recommendations for planting and management included the following:

- Planting ratio: 500 kg of roots/mu[1] and use 5 tons of manure in the multiplication (plantlet) production area.
- Planting time of multiplication (nursery) plots: between 1 - 20 March.
- Final planting in beds 80-90 cm wide and 30-25 cm high, and 20-30 cm apart.
- Planting time: between second half of May to the first 10 days of June. Bed borders using plastic (poly-chlorothane) sheets.
- Planting materials: Plantlets taken of the basal section of an adult stem, have 5 - 7 nodes, and are about 25 cm long.
- Planting density: 4000 stems per mu
- Fertilisation: 5 kg N, 2.5 – 3.0 kg $P_2O_5$ and 6 – 7.5 kg $K_2O$ per mu.
- Defoliation during growth cycle: Avoid if wants high root yields, but if needed vines for animal feeding, partial defoliation could be applied, but always evenly distributed in the plots.

***(b) Conservation of sweet potato vines and roots as silages***

Based on the results obtained in the *on farm* trials, the recommended silage additives were 6% corn meal when ensiling sweet potato vines, and 13% rapeseed meal and 0.5% common salt when roots were ensiled. In both cases silages were prepared in plastic bags containing about 50 kg each. Before ensiling, sweet potato vines were partially wilted, and chopped either by hand or using a small chopper. In the case of roots, farmers used a high-speed disintegrator. In both cases, was easy to exclude air by hand pressure.

Generally silage can start to be used 3 week after ensiling, and can be stored up to 5 – 6 months. It is not recommended to offer sweet potato silage to young pigs (< 20 kg or 2.5 months), but can be offered to any other animal category, including sows. Usually root silages are fed between December and February, whereas offering silages made of vines will depend of the availability of green feeds. In all cases, SASA recommended that silages should represent 20-30% of the pigs diets.

***(c) Use of a premix or a protein-rich concentrates to supplement sweet potato diets***

The premix and the protein-rich concentrate were formulated to provide those nutrients that were limiting good performance of pigs fed sweet potato-based diets. Farmers decided, based on their feeding systems whether they use the premix or the protein-rich supplements, which were made available to users through the Renhe Township Veterinary Service Station at low price. The premix contained a high protein concentrate feed, amino-acids, vitamins, macro- and trace minerals. Its formula is as described in a previous section. The protein-rich concentrate had 42% CP, and its composition was also described in a previous section. The recommended sweet potato-based diets for weaned piglets and growing pigs were the same tested in the *on farm* trials.

Table 10 shows the diets recommended by the SASA/CASREN Team to farmers when the Premix was used, and their recommendation was to offer it *ad libitum*. However, they also said farmers that in case did not have enough money to get some ingredients, they only add the Premix to the ration they usually fed, and supplement piglets, growing and finishing pigs with 80, 100 and 150 g/day, respectively.

In the case farmers opted for the use of the protein-rich concentrate, the diets recommended were as described in Table 11; however, if farmers had difficulties getting some of the feeds listed there, they could supplement the traditional diet with 100 – 200 g/day of the protein-rich concentrate.

[1] 1 mu equals 625 $m^2$

Table 10. Pig diets as recommended by the SASA/CASREN Team to Zitong County farmers using the Premix

| Animal Category | Maize | Rice | Wheat | Wheat bran | Fried soybean | Rape-seed meal | Rice bran | Fried horse bean | Salt | Premix |
|---|---|---|---|---|---|---|---|---|---|---|
| Piglets (15-30 kg) | 59.6 | | | 8 | 15 | 5 | | 32 | 0.4 | 5 |
| | 43.6 | | 20 | 8 | 15 | 5 | | 28 | 0.4 | 5 |
| Growing pigs (30-60kg) | 73.7 | | | 10 | 10 | 10 | | 16 | 0.3 | 5 |
| | 46.7 | 25 | | 10 | 10 | 10 | | 18 | 0.3 | 5 |
| | 48.7 | | 31 | 10 | 10 | 10 | | 10 | 0.3 | 5 |
| Finishing pigs (>60kg) | 44.7 | 30 | | 10 | 10 | 15 | 10 | | 0.3 | 5 |
| | 77.7 | | | 10 | 7 | 15 | 10 | | 0.3 | 5 |
| | 47.7 | | 37 | 10 | | 15 | 10 | | 0.3 | 5 |

Table 11. Diet composition recommended by the SASA/CASREN Team to Zitong County farmers using the protein-rich concentrate

| Animal Category | Concentrate | Maize | Fried bean | Rape meal | Rice bran | Wheat bran | Rice hulls |
|---|---|---|---|---|---|---|---|
| Piglets (15-30 kg) | 20 | 70 | 10 | | | | |
| | 20 | 60 | | | 10 | 10 | |
| Growing pigs (30-60 kg) | 15 | 60 | | 5 | | 20 | |
| Finishing pigs (>60 kg) | 10 | 60 | | 10 | | | 20 |

The SASA/CASREN Team also recommended farmers to raise animals until they reach about 90 kg as slaughter weight, but not all farmers followed that recommendation, given that Chinese consumers have special demand for high-fat carcasses.

***(d) Upgrading pigs using improved breed boars***

The use of crossbred animals was recommended. It was recommended to start working with $F_1$ animals (Yorkshire or Landrace x Native) for fattening, but later to move on to the triple cross. Only few farmers could utilise the crossbreds resulting from artificial insemination using semen of improved animals, because the boars were introduced late to the Renhe Township Veterinary Service Station.

***(e) Simple preventive disease control plan***

Diarrhoea prevention in weaned piglets is an important component of the disease control plan. Besides improvements in hygiene by upgrading the housing facilities with cemented floors to facilitate cleaning, good feeding practices, the use of antibiotics approved by the Ministry of Agriculture of China was recommended to treat diarrhoeas. is also the use of sulphonamides and antibiotics for treatment. Also, the use of Ivermectin to control gastro-intestinal and external parasites is part of the disease prevention package.

***(f) Improved housing facilities for pigs***

The main element of the improved corral is to have cemented floor and feeder. The former will facilitate cleaning, for better hygiene conditions to prevent infectious and parasite diseases, and the latter a more efficient use of feeds, reducing feed losses due to mud contamination.

**Training of Researchers, Technicians and Farmers**

Several training events, involving different actors (i.e., researchers, technicians, farmers), have been a key element for scaling-up efforts. In most cases it has been a chain of events with a "training of trainers" approach. Trainings offered by the ILRI/CASREN staff mainly focused on methods and approaches for participatory R&D. The trainees were basically SASA staff, but in some cases these events were extended to staff of the partner institutions in Sichuan. Also, the SASA/CASREN staff served as trainers of the Zitong County Animal Husbandry Bureau staff on methodology aspects, as well as technical topics related to pigs-sweet potato systems (the crop-livestock systems that were the main trust of the CASREN Project in Sichuan). Finally, the Zitong County staff frequently were responsible for training farmers, but also some farmers were trained as trainers to respond to the needs at the village level.

Some of the topics covered in the on-the-job trainings and/or specific trainings on methodologies offered to the technical staff of SASA and member institutions of the CASREN local network are:

- Participatory Rapid Appraisal (PRA) Methods for Site Selection and Characterisation (also attended by staff of the Zitong County Animal Husbandry Bureau)
- Participatory Planning of Research in Smallholder Crop-Livestock Systems (also attended by staff of the Zitong County Animal Husbandry Bureau)
- Linking systems characterisation with on-farm research: Designing technology interventions
- Farmers participation in the design and evaluation of technology options
- Doing experimentation with farmer partners

Also, some members of the SASA-CASREN team attended four regional training workshops:

- Methods for Monitoring and Evaluating R&D projects (2002)
- Communicating Research with Policymakers (2002)
- Simulation Models to Assess Year-round Feeding Strategies (2003)
- Assessing the Impact of Technology Interventions in Crop-Livestock Systems (2003)

Besides these, just after SASA joined CASREN, the National Coordinator participated in a one-week study tour to the CIP-NIAH Sweet Potato/Pig Systems Project in Hanoi (Vietnam).

Among the trainings offered on technical topics offered either to staff of the Zitong County Animal Husbandry Bureau and farmers were:

- ***Training Course on Utilization of Sweet potatoes in Animal Feeding***. The course included not only basic principles of swine nutrition, the use of sweet potato as feed, including silage conservation and utilization, but also other topics such as swine management and reproduction. The course included 15 half-day sessions. It was offered to staff of the Zitong County Animal Husbandry Bureau, and after it they not only provided assistance to farmer partners testing CASREN technologies, but even organized a series of short courses for farmers.

- ***Farmers training on Feeding Strategies using Sweet Potatoes, Management, and Disease control in Smallholder Pig Production Systems***. It was a series of theory and practical lectures offered by staff of SASA and the Zitong County Animal Husbandry Bureau to farmer partners. The course was made of eight 4-hour sessions (including demonstrations). In all sessions were distributed printed materials prepared by SASA-CASREN Team staff. The course was a good success at the village level, as there were 20 participants in the first session, but number increased up to 75 farmers in the last session. About 60-70% of the participants in the courses were women, as most of them are involved in pig production.

  Based on the performance in the course, and willingness to cooperate, one farmer in Tianle Village was chosen to receive further trainings in order to function as trainer of other farmers, as well as the project link in the village who provided assistance to other farmer partners during the time project staff was not present. Initially it worked, but later the farmer who was trained, moved out from the village because he got a job in the city.

*However, after interviewing the Tianle Village Leader he indicated that with the trainings they received, he and other farmers have been teaching others what they learned.*

? ***Training course on Sweet Potato Production***. Prof. Wang Dayi, an expert in sweet potato breeding of the Sichuan Academy of Agriculture Sciences, offered the course to farmer partners and staff of the Zitong County Animal Husbandry Bureau. It was made of three half-day lectures (theory and practical aspects), offered before the sweet potato planting season started.

The courses offered to farmers have been replicated in the expansion villages, with staff of the Zitong County Animal Husbandry Bureau as trainers.

**Assessing Impacts**

***a) Some general concepts***

Before describing the results obtained in the short visit to CASREN activities in Sichuan Province, I consider relevant to review some definitions related to the Monitoring and Evaluation of any R&D project, which could help to understand better the results described in this report. ***Outputs*** are the results of activities; ***effects*** are the immediate changes among target beneficiaries; and ***impacts*** are longer-term changes among target beneficiaries. With this definitions in mind, and give that the CASREN project has been operating in Sichuan Province only for two and a half years, it would be more appropriate to say that in this reports are described the ***outputs*** and ***effects*** of the technology interventions introduced by SASA/CASREN team. Also, an attempt is made to assess the changes that occurred in the methods and approaches applied by the participating institutions, i.e., SASA-FRI and the Zitong County Animal Husbandry Bureau, as a result of their involvement in the CASREN project.

There are several approaches to assess the impact of technology interventions in crop-livestock systems. For the purpose of this work we took as a basis the approach proposed by Dr. Patti Kristjanson to CASREN participants in a workshop held in Khon Kaen (Thailand), in April 2001 (Figure 3). During the mission to Sichuan Province was only possible to collect limited information to respond two basic questions: (a) How much impact and on what?, and (b) Impact on whom?. It has been recommended to the SASA/CASREN team to work on a wider coverage of villages and farmers for those two questions, using the methodology applied in this mission, and to continue collecting the information to define in what other counties and villages/counties the findings of this project would have greater impacts, as well as to make a better valuation of the benefits and costs of the SASA/CASREN technology interventions promoted by the project.

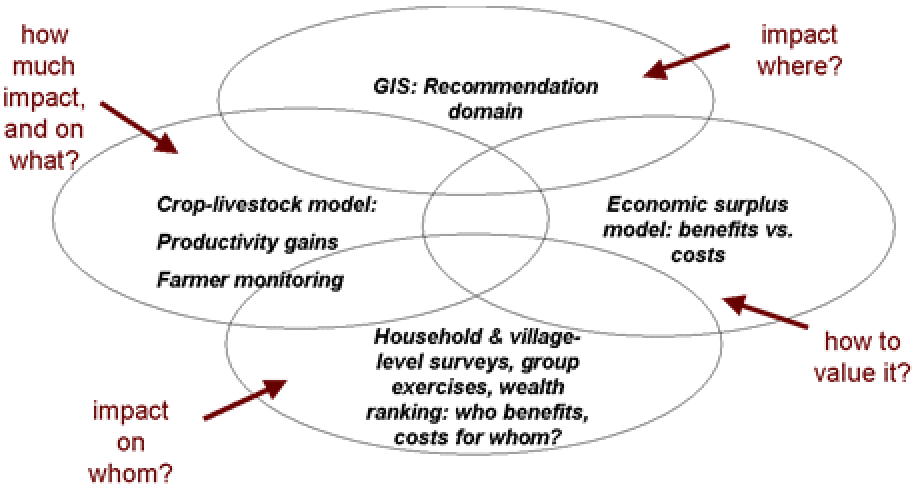


**Figure 3. A linking approach to assess impact of technologies**

***b) Methodologies applied***

The methodological framework applied for the preliminary assessment of "impacts" of the CASREN project considers the following steps:

- ***Planning:*** Defining the purpose and rationale, review of secondary information. This activity was carried out during the first week of this mission in Los Baños, and included discussions with Drs. Jeroen Dijkman and Somkiat Saithanoo. Also all the materials related to Impact Assessment methods which were provided by and produced during the CASREN training workshops held in Khon Kaen (April 2001) and in Bangkok (December 2003), were collected and reviewed.
- ***Designing and instrumentation:*** Defining the scope, methods and instruments to collect primary information. This activity was initiated in Los Baños, but completed after discussions with the SASA/CASREN Team in Chengndu, and project partners in Zitong County. To assess the ***preliminary impacts***, we use as a basis the instrument developed with the SASA participants in the Bangkok IA workshop, but some modifications were introduced after discussions in Chengdu and Zitong. For the assessment we decided to limit potential impacts to the "plot" and household levels, as well as on the institutions (SASA and ZAHB). In Table 10 are listed the expected impacts of the technology interventions, that led us to define the questions asked to farmers.
- ***Data collection:*** Gathering information from the sources. Given the short time available for the field work (only one day), need for translation, and the limited availability of vehicles and staff of the Zitong County Animal Husbandry Bureau to participate in farmers interviews[2], we limited field data collection to Tianle, the village where the project activities were initiated in 2002 (five farmers), and to Xin Min, one of the expansion villages located close to Renhe Township (two farmers). It was suggested that the SASA/CASREN team and collaborators in Zitong continue applying the same methods to a larger number of farmers in Tianle and the other expansion villages. This information should be the basis for the report in the final workshop of the CASREN project, as well as in the SLP workshop on sweet potato-based pig production systems to be organised by the International Potato Center (CIP), both to be held next November in Sichuan Province.

| Plot Level | Household Level |
|---|---|
| ? Higher sweet potato yields with new variety.<br>✍ How much more? | ? Higher total income<br>✍ How much more? |
| ? Less losses in sweet potato vines and roots because of silage conservation<br>✍ How long can you use the vines and roots? | ? Higher contribution of pigs to the total income<br>✍ What percentage? |
| ? Less use of fuel for cooking, as ensiled sweet potato roots no need cooking<br>✍ Amount of charcoal/fuel used for cooking<br>✍ Time saved now that no need to cook<br>✍ Whose time? | ? Lower production costs<br>✍ How much is the reduction in costs? |
| ? Shorter fattening period<br>✍ How long take pigs to reach market or slaughtering weight?<br>✍ What is the market weight? | ? Faster capital turnover of the pig enterprise<br>✍ How many groups of pigs are raised per year? |
| ? More pigs sold per year<br>✍ How many pig are sold each year? | ? Greater benefits from the pig production enterprise (improved livelihood)<br>✍ What he/she could do for the family with the increase in income? |

[2] Most of the Zitong County Animal Husbandry Bureau staff was involved in urgent blood sampling to be sent to the Provincial Diagnostics Laboratory, because of the outbreak of a pig disease called Japanese Encephalitis

? ***Data analysis and reporting:*** **Interpreting and sharing results.** The data collected after interviews to farmers demonstrated that the results obtained in the *on farm* trials were replicated under farmers´ management, therefore expected impacts were obtained. In following paragraphs are discussed the results obtained in the interviews to farmer partners. Results are presented as impacts at plot and household levels.

***c) Some results obtained***

***PLOT LEVEL***

***- Use of improved sweet potato variety***

The use of the improved sweet potato variety resulted in at least 25% increment in roots yield, and all farmers recognised the improved variety has a higher content of starch, which in turn results in better animal responses using the same amount of sweet potato roots. Actually, farmers observed that animals need to eat less sweet potatoes of the starch-rich variety.

One of the points that intrigued me more was how farmers new that the variety had higher starch content, and almost all responded that the starch-rich varieties tend to sink in water, whereas the traditional variety floats. I believe, that is a practical determination learnt through the lectures offered by Prof. Wang Dayi, that can be used by farmers in the future while evaluating sweet potato varieties.

Another relevant point that suggest a trend for the adoption of the improved variety is that all farmers who planted the improved varieties increased the area planted to that variety in the second year. There are differences among farmers in the increase in area planted (0.4 to 2.0 mu) to the improved variety, but it can be explained in terms of the availability of plantlets, area originally planted with sweet potato local variety, number of animals raised, and others factors. Also, as this the first year after the *on farm* trials were carried out, almost all plantlets were provided by the project, but for this year all farmers planted the roots they stored from the previous planting campaign to be used as seeds this year. All have established small multiplication plots to increase the are planted with the improved variety. In many cases the production of plantlets was more that they could use in their own plots. One of the farmers, Mr. Liang Dong Shen proudly told us: *"Last year I could produce enough roots of the new variety not only to ensile, to reserve seeds for this year planting campaign, but also could give 100 kg as present to my friends, and even sold 500 kg. I made extra money, because the local variety is sold here at Yuan 0.30/kg, whereas the improved variety was sold at Yuan 0.60/kg"*.

***- Conservation of sweet potato vines and roots as silage***

Four out of the five farmers interviewed who started preparing sweet potato silages last year, continued applying the same practice this year, and in all cases the amount ensiled was greater this year than in the previous year. According to the Village Leader, Mr. Liang Bo *"about 70% of the farmers in the village are now preparing sweet potato roots and vines silages"*. Another farmer, Mr. Liang Quang Song said: *"In the past I tried to prepare sweet potato silages, but was a complete lost, because mold developed in the silage, and smelled awful. After taking the trainings offered by the project, I know how to make good silage"*.

All farmers interviewed indicated that not having to cook the roots when they ensile is a good practice, because it let them save every day at least two hours cooking sweet potato roots, during the period they used fresh roots to feed animals. Moreover, in the case of those households where fuel-wood was used as an energy source, household members also saved on the time devoted to collect the fuelwood, plus the benefit of putting less pressure on the forest surrounding their village. In two of the households, cooking sweet potato roots was an activity performed by the women, but in the other two was made either by male or female family members. All recognized the importance of saving fuel (mainly

charcoal or fuel-wood) not cooking sweet potato roots, but could not quantify how much less fuel sources were used after silage preparation sweet potato roots became part of the system.

Another potential impact of using silages is that farmers can extend the time using sweet potato vines and roots as animal feed, and this is a means to reduce losses, particularly of vines. Two of the four interviewed farmers who used silage indicated that extended the period of sweet potato use from 1 to 9 months and from 2 to 6 months; but other two farmers said that the length of such period did not change, but at least one of them increased the number of pigs raised, and another could replace other feeds with the sweet potato silages.

***- Improved year-round feeding system for pigs***

The use of either the premix or the protein-rich concentrate to supplement sweet potato-based diets, as well as increasing the efficiency of the use of sweet potato vines and roots as feeds has resulted in better average daily gains (ADG) as predicted, based on the results obtained in the *on station* and *on farm* trials. This has resulted in a reduction of about 1.5 to 2 months for pigs to reach market weight, and in an increased number of pigs fattened per year. The changes shown in the number of pigs fattened vary among farmers interviewed, from 20 to 100% increase. There was one farmer (Mr. Liang Quang Song) who reduced the number of animals fattened, but actually he did it only in one cycle, because for the other cycle he decided to sell most piglets, given an increase in the price of those animals from RMB Yuan 5 – 6/kg to RMB Yuan 14/kg. The important point is that even he, as well as other farmer not listed in Annex I (Mr. Liang Xi) decided to use the sweet potato silages to feed the sows, and got improvements in piglet production, from 11 to 12-13 piglets/litter, and with better weaning weight at 50 days (4-5 to 8 kg). The potential of these results is high, because at least in Tian Le, there are 80 families producing piglets –mostly with one sow per household-, but also fatten some; whereas there are 195 families who buy the piglets and raise them for fattening.

The two lady farmers interviewed in Xin Min Village (Wei Jufang and An Shou Jun) only took the Premix component of SASA/CASREN basket of options. Both could not introduce the new sweet potato variety to their system, because were not able to obtain seeds, but are planning on doing so next year. They already had a concentrate-based feeding system, but with the Premix could reduce the time to reach market in 0.5 to 1 month, and increased the number of pigs fattened in 20.0 and 62.5%, respectively. Mrs. Wei Jufang said: *"The SASA Premix is really a good option. I have been raising pigs for so many years, but definitely after using the Premix, my animals grow faster"*.

***HOUSEHOLD LEVEL***

***- Increased income from pig production***

According to Mr. Liang Bo, the Village Leader. *"Two factors have contributed to increase the household income from the pig enterprise: (a) pig prices have increased due to higher demand, even at township level; (b) the CASREN project brought new technologies such as new sweet potato variety and silages that help to increase productivity, and consequently more pigs going to the market. To have an idea, last year Tianle Village sold 300 pigs, this year only during the first semester we already sold 380 pigs. I estimate that by the end of this year we will sell at least 1200 fattened pigs in 2004, when the average for previous years was a little less than 800 pigs. The number of pigs per capita in the village has increased from 2 to 3 animals per person"*. The relative increase in income from pigs varied from 19.5 to 150%. Even one farmer (Mr. Liang Ming Quan) who reduced his pig production activity because have other business, also increased his income from pigs, but only in 8.3%.

In all cases the relative contribution of pigs to total income increased, but the lowest relative increases occurred in those households where pigs contributed more than 80% before SASA/CASREN technologies were introduced. On the other hand, none of the

farmers could give estimates of how much was the reduction in costs of production –if any- that can be attributed to the new technologies, because none of them have records. This is an aspect that the SASA/CASREN team needs to emphasize in the following months. In many cases, could be that total costs of production have increased, but the net income from the pigs enterprise, and the costs per kilogram of body weight gain should have decline. Only one farmer, Mrs. Ye Yongju could estimate the net income in her pig production enterprise before and after the implemented some of the technologies present in the SASA/CASREN basket of options. In her case, the net income changed from RMB Y 2000 to 3500/year.

When farmers were asked how many groups of pigs they could take to the market, only one (Mr. Liang Dong Shen) said he increased from 1.5 to 2.0, whereas the others practically had the same number of groups per year for fattening. Moreover, one farmer (Mr. Liang Quang Song) moved from two to one groups, but was because having very good prices for piglets, he decided to sell one of the litters at weaning, instead of fattening both groups.

***- Improved livelihoods***

The most difficult question to ask to farmers was how the new technologies brought by SASA/CASREN have changed their lives. It is difficult to say that with the short period farmers have been participating in the project big changes could occur, but there are some indications that farmers are confident that if conditions continue as up now, they can commit themselves to "investments"/expenses that will tie them fro some time. Two lady farmers (Mrs. Ye Yongju and Mrs. Wei Jufang) indicated that thanks to the project, they were able to send their children (one each) to an agricultural college; other three farmers said that some of the additional income have been reinvested in the farm, and the rest is for saving. One of the farmers also indicated that bought a motorcycle, and the Farmers Leader (Mr. Liang Bo) told that 25 farmers in Tianle Village have bought motorcycles this year, thanks to the extra-income obtained from the pig enterprise.

One important aspect that came out of the interviews with farmers is the confidence they now have in their knowledge on pig production and sweet potatoes, and the eagerness they showed for acquiring/testing new technologies. Some examples of expressions recorded from them are as follows: Mrs. Wei Jufang said: *" Now I know how to prevent that my animals get sick, and also learnt how to feed better my animals, then can take them faster to the market".* Mr. Liang Quang Song said: *"Before, I could not use much of the sweet potato, particularly the vines, because it was available only for one month. Then, I heard that sweet potato roots and vines could be preserved as silages, and tried to do so, but failed and loose all. Now, with the training courses I attended, learnt how to make a good silage, and can use for my pigs all the roots and vines I produce*". Mr. Liang Xi who is a piglet producer, but also keeps some for fattening said: *"Thanks to the lectures in the training courses offered by SASA/CASREN I learnt to feed better my sows. Now I feed them sweet potato roots and vines for a longer period, they eat more and produce more milk. Also, I found a simple design to improve my pig pens, and learnt of the importance of having clean conditions in the pens. This year none of the piglets had diarrhoea. Before I lost at least 3 piglets in each litter".*

An additional aspect that came out of the farmers interviews is that the lessons learnt through the project do not only benefited the participants. Mrs. Wei Jufang said. *"What I learnt in the courses was not only for me, but I taught my relatives and neighbours, because not all could attend the trainings. The ones who visit me say that if the things I learnt work well in my farm, should also work well in theirs"*. Mr. Liang Bo, Tianle´s Farmers Leader said: *"Tianle had the privilege to be the first village where the SASA/CASREN project started, and now is a sort of practical school where farmers from other villages come to learn how to manage better their systems of pig production using sweet potatoes. Even if the project finishes, I believe we can continue improving our systems and teach others about our experiences".*

**INSTITUTIONAL LEVEL**

To assess the impacts of the CASREN project in the institutions directly involved in Sichuan activities, were interviewed Mr. Zou Chengyi, the Director of the Feed Resources Institute of the Sichuan Animal Science Academy, and Mr. Chen Yuanjan, the Director of the Zitong County Animal Husbandry Bureau, who have been the persons directly leading the two institutions more directly involved in the CASREN project in Sichuan.

Some of the changes attributed to the CASREN project that Mr. Zou Chengyi identified were:

- Before joining the CASREN project, the Feed Resources Institute of SASA did some research work *on farm*, but it was neither systemic nor participatory.
- In the past, the staff of SASA Feed Resources Institute concentrated basically on the feeding component of the pig production system, ignoring the potential interactions with other components of the system. Now they work with a systems´ approach, and have had to learn even some on sweet potato agronomy, to look for means to improve the sweet potato-based pig production systems that are the focus of their research.
- CASREN brought to SASA the demand-driven approach for research. He said: "*In the past, we seldom did on farm research, and when we did so was to test some technologies we developed, not checking if these responded to real needs for the farmers. I can not say this approach has been adopted by the whole Academy, but several members of the institution recognise is a means to have impact on the poor farmers in Sichuan*".
- The staff of SASA´s Feed Resources Institute have learnt a lot on methods and approaches to do research with poor farmers, is now more focused on looking for solutions to the problems faced by smallholder farmers, which represent more than 80% of the population of farmers in Sichuan Province.
- After the work done by staff of the SASA Feed Resources Institute, a new sector of pig producers (the smallholders in Zitong County) is using the Premix that one of SASA divisions produces. It is not much, compared to the demand of the commercial feed mills, but the potential demand is quite high, considering that at least 60% of the pigs slaughtered in Sichuan are produced by smallholder farmers.

On the other hand, Mr. Chen Yuanjan had some comments similar to the ones brought by Mr. Zou Chengyi, but also referred to how has changed the work of the Zitong County Animal Husbandry Bureau (ZAHB), and institution that depends basically of the local government, and has a mandate on providing direct services to the farmers, including technical assistance. He identified the impacts of CASREN as follows:

- In the past ZAHB provided some guidance to farmers, but was really very little in practice, and basically responded to specific problems or to campaigns. After the trainings received the ZAHB staff knows better every stage of the sweet potato-based production systems present in Sichuan, then can advise pig farmers on any problem they face, from the agronomy of sweet potatoes, conservation as silages, utilization for feeding pigs, etc.
- In the past they learnt about new technologies by attending some seminars, but each topic was offered more or less isolated, no materials were distributed, and definitely no practical trainings. With CASREN things changed completely, we had a series of trainings covering pig production systems in a very complete way, and almost each lecture included practical sessions, then the staff feels confident when interacts and gives recommendations to farmers.
- In the past, the ZAHB basically offered only animal health services to the farmers, after CASREN we continue offering those services, but also on production and market aspects. Farmers are every time more opened to its recommendations, and the demand for its services have increased markedly.
- In the past, staff of ZAHB did not have any simple *on farm* trial comparing the farmers' practices *versus* technology innovations, to base their recommendations for farmers. Mr. Zheng said: *"I am convinced that the experiments carried out with the farmers, in*

*their own farms, have been the most effective means for them to learn the advantage of new technologies. In fact, farmers talked to other farmers, and they joined the courses, and started applying the CASREN technologies we proposed. I has increased credibility in our services. We know CASREN is finishing by the end of this year, we would not like this to occur, but feel confident that we are now better trained to help pig farmers in Zitong County, even not having assistance from our friends from SASA and ILRI".*

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