Grain Silos for Everybody

"Postcosecha" in Central America: The story of a successful project for post harvest technology

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Agricultural Extension in Development Work

Table of Contents

1 The Idea

The Project POSTCOSECHA started out in 1980 in Honduras with the goal of reducing post-harvest losses of the most important basic foodstuffs for small farmers in Central America. This was to be achieved through targeted extension of tested, simple, user-friendly, clean, economically and socially acceptable technology. The most important foodstuffs were corn, beans, millet and rice. Outstanding results were achieved through the propagation of cylinder-shaped metal silos, which were manufactured in different sizes by local metal smiths under project supervision.

(Rich Corn Harvest)

The project intended to contribute through the creation of additional revenues to the improvement of the target population's living conditions and through the reduction of storage losses to an improved countrywide nourishment security.

Important stages in geographic expansion

1980: Beginning in Honduras
1988: First contact with Guatemala
1990: Beginning in Guatemala
1991: Planning of project Nicaragua
1992: Beginning of project Nicaragua
1993: Planning of project El Salvador
1994: Beginning of project El Salvador
1994: Planning of project Paraguay
1995: Beginning of project Paraguay

A large geographic area could be covered through a finely formulated transfer strategy, which included various development and advising organisations as channels of extension in the field. A considerable multiplying effect was thereby achieved. The unarguably huge success prompted the project to start POSTCOSECHA actions in the neighbouring countries Guatemala (1990), Nicaragua (1992), El Salvador (1994), and with HELVETAS in Paraguay (1995).

The project used an extensive range of technology in addition to metal silos for post-harvest protection. All of the technology was tried and field-tested in collaboration with the target population. In three-day introduction courses, the various technological alternatives were presented to the advisors and promoters. Each transfer channel decided for itself, from cases to case, how it wanted to introduce the technology to the farmers in the field. The project had the transfer channels sign contracts of co-operation which mostly lasted a year but could be extended.

According to the Comision Economica para America Latin -CEPAL- in the four above mentioned countries, of the 3.3 million tons of corn, beans, millet and rice produced, it is estimated that over 520,000 tons (16%) were lost due to improper storage. Depending on the area, damage caused by birds, rodents, insects and fungi could amount up to 27% for corn, 23% for beans and 30% for millet. Approximately 750,000 adult people - an impressive number- could be nourished with the reduction of 50% of these losses. Also, grain which is stored under good conditions is more hygienic and appropriately of better quality. Additionally the project has a number of positive side effects not to be underestimated: it lightens the workload for women and children; it can save space; it improves the hygiene in the house; it gives the farmers a better bargaining position in sales, and it frees a larger area for the production of cash crops. Also it increases the family's prestige in the village and raises their income, which leads to a general socio-economic improvement of the farming family.

Estimates from 1995, conducted by the Natural Resource Institute (NRI) show that in Honduras, where grain stored in silos makes up 20 % of the total storage capacity, feared price fluctuations in the national grain market could be reduced to a 20% fluctuation up or down annually.

2 Background

Several bad grain harvests in a row prompted the United Nations to call a world nutrition conference in 1974 to discuss the world's state of nutrition. As a result of the conference, various supplementary measures were to be used to improve the availability of food supplies. In addition to production and productivity increases, goals were set to protect the harvested products more efficiently.

As a consequence under the patronship of the Swiss Agency for Development and Co-operation (SDC)SDC, the post-harvest protection project POSTCOSECHA in Central America was developed along these lines. By having nourishment security as a main priority, Swiss development work contributes to the fight against poverty . The improvement of the small farmer's storage of food grains is expected to contribute to an improved quality of life for the rural population.

The development of POSTCOSECHA can be divided into three main stages:

1. Stage: 1980-85 Research and Development
2. Stage: 1986-89 Distribution, Consolidation of Transfer Strategy
3. Stage: 1990-95 Expansion, Capitalising on the experience of other countries:
   1990 Guatemala, 1992 Nicaragua, 1994 El Salvador, 1995 Paraguay

The success of the project was not certain right at the beginning. In the critical years 1985/86 the continuation of the project was seriously questioned as more concrete results for the target population were desired. The breakthrough was finally possible as a result of the development and adaptation of the **sheet metal silo**, which helped reduce storage losses to nearly 0%.

Sheet metal silos had been used before, but no institution had previously been able to attain real success with this idea. Poor manufacturing quality and improper handling through lack of knowledge were the most important aspects which led to the farmers' bad experiences with the metal silo. The farmers' prejudiced attitudes had to be taken into consideration during extension in order to re-introduce the discredited technology.

(Standard size of a silo of ca 1 ton)

The project then concentrated increasingly on the refinement of the transfer concept, which built onto channels such as development and advising organisations, NGOs, agricultural associations and state advising services. The latter provided a country-wide technology extension coverage.

Vital to POSTCOSECHA was the increasing expansion of the NGOs which provided favourable conditions for the transfer of post-harvest protection technology. The growth of the NGOs was clearly felt in the mid 1980's in Honduras and in the early 1990's in Guatemala, Nicaragua and El Salvador - a sign of the increasingly democratic local governments.

Approximately 30 million people live in an area of 372,000 square kilometres in Honduras, Guatemala, Nicaragua and El Salvador. About 13 million live in rural areas, half of them on small- or middle-sized farms of 0.5 to about 10 hectares of land. Their nourishment is based on the basic food stuffs such as corn, beans, millet and on a small scale, rice. Their agricultural production system has thus developed accordingly. The production of such

foodstuffs is mainly for the family's personal consumption and feed for animals. Any surplus is sold in the cities or passed on to middlemen.

Lack of knowledge, impractical harvest and storage techniques, as well as unsuitable storage infrastructures led to large grain losses and serious losses to the national economy. Farmers often find themselves forced to sell their corn and other basic foodstuffs cheaply shortly after harvesting in order to reduce their losses, only having to have to buy them back later on at a higher price for personal consumption.

(Corn severely damaged by< insects. In Central America post harvest losses amount up to 30% of the harvest of basic grains.)

Since the 1960's the grain policy of Latin America has been influenced by state grain purchases modelled after the USA. This is supposed to have price regulating effects in that the state buys large amounts of grain during the harvest and sells during supply weak periods. Moreover, it is supposed to ensure the food supply for urban area consumption in times of poor harvest. This policy failed miserably. The highly subsidised state grain buying agencies have mostly been closed down and it is difficult to even find a buyer to privatise them. Few farmers trusted the state buying stations, which in most cases did not operate in the interest of the farmers but in the interest of large producers by guaranteeing them fixed prices. However, there were repeated attempts to build up small grain stores at a local level for purchase by small farmers, especially in Nicaragua, but also in other countries in the region. Almost all of these failed. Those that are still operating are either run privately or supported by an institution.

Small farmers predominantly store their harvest at home to sell gradually and when necessary, or to keep for personal needs. This type of storage costs the state nothing and is based on self initiative. Independence is very important for the small farmers, as the inconsistent grain policies are normally not in their favour. In addition, the import of grain is affected by business trends and short-term political guidelines which normally favour the consumer. Among the countries in Central America, there is an active black market, which moves an estimated 10-15% of production. Farmers are therefore interested in making grain marketing decisions independently and handling sales self-reliantly at the time best for them.

(Corn which is stored on roofs)

3 The Concept

3.1 HEAVY LOSSES IN SMALL HOLDING FARM STORAGE

The rural areas of Central America are predominantly settled by small farmers. More than half of them are subsistence farmers. They plant corn, beans, millet, and on higher ground wheat, on small plots of 0.1 - 1 hectares. Production takes place prevailingly under extreme conditions such as slope position, poor soil, water shortages etc. which make the work difficult and allowing most farmers to harvest only once a year.

According to research done by POSTCOSECHA, a farmer harvests ca. 1.4 tons of corn and 0.4 tons of beans a year. Of this, he sells ca. 30% of the corn directly after harvesting; ca. 20% he sells before the next sowing after about 3 to 5 month's storage.. He uses the rest, about 50% of the harvest, for home consumption. He sells about 60% of his beans directly after harvesting and the rest is kept for himself. If necessary and depending on the harvest, he also sells small amounts throughout other periods of the year. The farmer sells in May and June, about 3 to 5 months after the harvest when the losses from pests increase to some extent. The prices in this period are in the middle range. The farmer admittedly sells his grain before the pests destroy it, nevertheless the losses are high and he often has to buy grain back when prices are much higher.

(Diagram 1: Example of harvest losses and damage)

The traditional storage systems on small farms are often wooden houses, empty rooms or corners in the family house. Frequently they are not hygienic and lack climatic conditions necessary to store grain over a long period without damage: ground moisture, large temperature fluctuations and rain increase the damage caused by pests such as fungi, micro-organisms and insects.

(Corn heavily damaged by insects or a traditional storehouse)

Upon analysis of the initial situation, storage on small farms turned out to be the right starting point for the project as a large part of the rural population is affected by the aforementioned problems.

3.2 THE MOST IMPORTANT POST-HARVEST PROTECTION TECHNOLOGY AND METHODOLOGICAL PRINCIPLES

POSTCOSECHA tried and adapted types of storage technology, especially during its first stage in Honduras. (The procedure is described in detail on pp ????). Using the experience gained and conclusions drawn, the project decided to concentrate on four main types:

- sheet metal silo (5 standard sizes)
- dry racks (various sizes, depending on need)
- improved traditional storehouses
- improved storehouses on stilts (against rodents and water)

The farmers were free to use other alternatives, e.g.

(The improved traditional storehouses on stilts)

oil barrels, bags, brick silos, wood crates, asbestos crates etc. They had to comply for the most part with the rudimentaries of correct storage. The purpose of the promotion and advising was essentially to improve the farmers' and the advisors' understanding by means of a systematic explanation of the connections: What must one pay attention to during harvest, the time of harvest and the handling and storage of the grain?

(Even in the traditional storehouse losses can be reduced through better hygiene and careful handling.)

With the adoption of a new technology, the farmer was precisely instructed and given a users guide in the form of pictures series. From the beginning it was to be avoided that something would go wrong due to improper handling.

3.3 THE CONCEPT OF THE TRANSFER OF POST-HARVEST TECHNOLOGY

The basic idea was to build up a market for the sheet metal silo. Supply and demand should be the driving force in order to ensure the sustainability of the project. As the follow diagram shows, the supply and demand relationship grows between the metal smith (supplier) and the small farmer (consumer).

In order for this market economy approach to work, the farmers had to be oriented and made aware of the problem. The metal smith had to be chosen, educated and supervised.

(Diagram 2: Market economy approach: Supply and Demand)

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To achieve this, the project aimed to mobilise a range of parties in order to attain the widest possible multiplication effect. With this in mind, the project only wanted to work through the so-called transfer channels. (As mentioned, the transfer channels can be a development

organisation, mostly an NGO, the state advisory service, an agricultural association or a self-help organisation.)

As a prerequisite to collaboration, the project did not set high conditions for the channels. They only had to have the same target population in common, be prepared to distribute post-harvest technology and integrate these activities into their work program. The project offered a good technological solution and the know-how. This mutual dependence created a certain pressure to succeed - results had to be achieved. Collaboration had the advantage of being able to cover larger areas, as the project did not have the money or work capacity itself to work with the total target population.

Collaboration occurred when the following minimal conditions were fulfilled:

* Collaboration with the same target population; small farms of up to 10 hectares
* Adoption of the technical requirements of the project (technical norms)
* Active extension of the post-harvest technologies of the project
* Keeping to the given criteria in the selection of trainees (advisors, craftsmen)
* Staying in accordance with the quality standards set by the project
* Supplying information on progress
* Willingness to supervised in the field
* Open and voluntary willingness to co-operation

Collaboration was formalised through a contract of collaboration, which basically lasted a year but could be extended. These collaborative relationships have usually had good results and lasted many years.

Besides the advising and development organisations, many other parties were involved in the transfer process (compare diagram 3):

-agricultural schools
-banks, agricultural savings and loans banks
-local craftsmen i.e. metal smiths
-local commerce
-agricultural advisors, promoters and village leaders.

The combination of these parties produced a synergy-effect, which had region-wide impact.

The project as the central unit took over the following tasks (services):

* Co-ordination of the parties
* Negotiating contracts of collaboration with the transfer channels
* Promotion and public relations work
* Training of advisors, promoters and metal smiths
* Development of school and promotional material
* Implementation of national promotion campaigns
* Assistance for the procurement of the inputs - sheet metal, soldering tin, etc.
* Setting-up and enforcement of quality standards
* Supervision of field work
* Monitoring project progress
* Administration of the project and funding

The individual tasks will be described in detail in the section "Implementation and Transfer".

(Diagram 3: Extending Post-harvest technology: parties involved and their functions.)

3.4 STRUCTURE OF THE PROJECT

3.4.1 NATIONAL PROJECT STRUCTURE

The post-harvest protection project was annexed to the advisory service of the Ministry of Agriculture and placed directly within the competence of the Director of Agriculture.

The project was manned by the following personnel:

-1 national director
-1 international advisor, counterpart of the director
-2 advisor trainers
-1 researcher
-1 communication specialist
-1 economist
-2 craftsmen instructors
-3-5 advisor promoters
-6 support staff

A managing and monitoring body was superordinate to the project and met twice a year to check the project's progress and sanction the operation plans. This committee consisted of the Director of Agriculture, the co-ordinator of the SDC, the national project leader and his international counterpart.

The number of personnel was reduced in the consolidation phase. The positions for the researcher and the economist were made redundant first. An attempt was made in Honduras to have the advisors trained at an agricultural school and the metal smiths at a trade school. Following this, the project concentrated on the key functions of:

* Co-ordination
* Promotion and Publicity Work
* Controlling i.e. Monitoring

This gradual reduction coincided with the idea that the transfer process should become independent through supply and demand mechanisms between the local suppliers (metal smiths) and the farmers (s. diagram 3).

3.4.2 INTERNATIONAL PROJECT STRUCTURE

With the expansion into different countries, a co-ordination office serving as an neutral and independent (without counterpart) ad hoc office was created with the function of planning and co-ordinating the activities to be accomplished in each individual country, as well as encouraging an exchange of experiences.

The international co-ordination office consisted of:

- 1 co-ordinator
- 1 communications specialist
- 1 administrations assistant
- 1 secretary
- 1 monitoring assistant (temporary)

A supervisory and orientations committee met once a year to check the progress of the project and to ratify individual countries' operation plans which had already been labelled good. The committee was composed of the four Vice-Ministers of Agriculture, the four Directors of Agriculture, the co-ordinator of the SDC and the regional international advisor of the project.

4 IMPLEMENTATION AND TRANSFER

4.1 POINT OF ENTRANCE

The work of the project concentrated on a few options for the extension of storage technology and methods. These options were presented to the farmers by means of an entrance test- "Prueba de Concepto"- (s. box). This procedure came into effect every time a new geographical area was included. The individual steps are described in Table 1.

Prueba de Concepto - The Entrance Test

This method was developed, applied and adapted in Guatemala. Later it was systematically applied in all countries: In twelve randomly selected villages, open discussions were held with twelve individual farmers following set guideline. Production-, harvest and post-harvest systems were discussed. Various improved alternatives were presented by means of large photographs and their advantages and disadvantages discussed. The farmers could ask questions. In each community there was a group discussion with twelve other farmers following the same procedure and with the same contents. At each discussion there were two people present, a discussion leader and an observer. Minutes of the meetings were produced for each individual and group discussion on the same day. At the end, the results were analysed and a regional report was composed. The report had to be drawn up within a month. About ten people were involved in the field work. The work in one community could be completed within a day. Advisors of regional institutions also took part in the field work. Various results could be obtained through this method:
a) inclusion of regional advisors
b) involvement of locally available institutions
c) sensitising farmers through the arousal of interest
d) entry into the region
e) gaining knowledge for further procedures
f) localising the position of the target group towards the new technologies

This entrance test was a very successful instrument for confronting all parties concerned with the subject and suggesting alternatives by means of a participatory process, while at the same time getting to know the position of the farmers and defining further procedures.

After entry, it took about three years until a sustainable extension process supported by supply and demand took hold in a region. Successful implementation of demonstrations at individual farmers in the villages was important to this process. Making a good selection was a deciding factor, because these farmers were to have a strong influence on farmers in the surrounding area. The following criteria were considered when choosing these farmers:

-good communication skills
-respected in the area
-easy access, located preferably near the street
-is prepared to receive other farmers and give explanations
-produces sufficient grain.

The chosen farmers were well looked after in the beginning, and the project organised visits to their farms. The materials for the demonstration technology were provided by the project. If, after a year, the farmer was satisfied with the results, he only had to pay a reduced price for the technology (silo, dry rack, etc.). If he was not satisfied and did not want to collaborate further, the technology was removed with his permission, something which happened very rarely.

4.2 THE PROJECT STAGES

Table 1: Procedure followed for the entrance into a new area

		Trimester
Stages	Activities	Months
	Phases:	
	Beginning	
	Structuring	
	Co-ordination	
	Supervision	perm.
	Withdrawal	perm.
	Individual steps	
1	Selection of region/department	
2	Identification of institution which can conduct advisory work with small producers in the region	
3	Negotiating collaboration	
4	Training advisors in 3-day courses	
5	Introduction of technology in 12, randomly selected villages in the region by means of	
	the "Prueba de Concepto"	
	(Entrance test, see box)	
6	Evaluation of results	
7	Presentation of results to the institutions	
8	Selection of farmers for demonstrations	
9	Set up of demonstration technology in each of the 12 selected villages. The technology most requested in the entrance test is shown.	
10	Accompanying the demonstration with presentations on the farms of the region. Registering interest.	
11	Contracts of collaboration worked out between the project and the institutions.	
12	Together with the institutions, craftsmen (metal smiths etc.) are sought and trained by the project	
13	Tradesmen build silos on demand from institutions and/or farmers, or give instructions to farmers on how to build other storage structures.	
14	The institutions propagate active post-harvest protection activities, clarify credit demands of farmers or metal smiths and create contacts with the credit providers	
15	The project supports the institutions with promotion campaigns and materials. It checks the project's progress through permanent monitoring.	
16	The project periodically co-ordinates with the local institutions about further procedure and the need for support	

4.3 ROLE OF THE PROJECT DURING STRUCTURING AND WITHDRAWAL

The project played a very active role in the first 36 months, i.e. until step 13. The institutions had to be convinced to collaborate with the project, to present the technology, and to test it in the field together with the farmers.

After the advisors and metal smiths had been trained and the project was well-known, it had to take on another role:

Table 2: The role of the project during structuring and withdrawal

stages	role	length of time	main activities
beginning	active, executive	½ year	make contacts, look for institutions,
			train advisors
structuring	active, co-ordinating	2 ½ years	test technology in the field,
	executive		co-ordinately demonstrate, close

			contracts with executive institutions,
			train advisors and craftsmen, ensure
			logistics, promotion and publicity
consolidation	active-passive	2 years	set quality standards
	mediating,		maintain institutional contacts
	intervening		correct mistakes
monitoring	active-passive	2 years	organise workshops
	catalytic		compare progress
	mediating		discuss common problems
withdrawal	passive	2 years	show ways of problem solving
	observant		
	mediating		
contact point	passive	-	place to go with problems
	consulting		manage address file

This process of build up and withdrawal reoccurred in every new region included in the project. Depending on the political, topographical, administrative and/or geographical situation, a country was divided into operational regions. In an area of 10,000 km2, a region could include up to 10,000 households. A country was divided into 5 to 15 regions. The project contacted and integrated up to three new regions a year until each country had been completely geographically covered.

4.4 THE INDIVIDUAL AREAS OF ACTIVITY

As mentioned in Chapter (3.3: The concept of the transfer of post harvest technology) the project covered a certain number of activity areas. These were adapted to the needs and progress of individual regions.

In the beginning and structuring phases, all of the activity areas were carried out by the project, while towards the withdrawal phase it only performed the supervisory, monitoring and administrative tasks. In each country research work was carried out in the first phase, collecting and registering the post-harvest losses in the traditional system and comparing this data with that of the improved methods which were introduced by the project. This area of activity was then transferred to the agricultural faculties, where students continued the research and wrote dissertations on the subject.

4.4.1 TECHNOLOGY DEVELOPMENT

(Woman taking corn from a silo. Women are directly concerned with the metal silos for they use them most frequently)

The development of technologies in the first few year of the project led to a refined and adapted technological know-how. The following criteria were evaluated when testing the technologies:

1. technical functionality
2. availability of the necessary materials
3. feasibility - profitability
4. acceptance in the target population.

In the beginning, the project observed and studied with precision the post-harvest activities of small farmers to understand them as part of a farm production system. At the same time, it examined other areas related to agricultural production (lie pre- and post-production activities) as well as other farming activities such as, for example, who accomplishes the different tasks on the farm, where is the woman included in the process, etc. Every alternative was compared to the traditional system. A comprehensive study registering losses and their causes proved important points of reference for the comparison. The

deciding step, however, was taken by the farmer, in that he weighed the advantages and disadvantages and finally decided whether he saw the change as an improvement and therefore adopted it.

The project produced a detailed manual for manufacturing sheet metal silos. If the metal silo was already known to be a hermetic storage container, but still had not achieved a breakthrough, it was due to the underestimation of its production. Other projects assumed that a local, traditional metal smith could easily produce a silo. This was clearly a severe incorrect assumption.
Over a period of two years the project studied and tried out the production of metal silos in a step by step process together with a local metal smith who already had experience in working with sheet metal. The following aspects were very important and were therefore included:

-Tools and aids
-Workshop
-Material use- wear and tear
-Fabrication sequence
-Expenditure (costs, time and labour)
-Clarity (didactic, imitability)

The resulting manual is a condensed aid, which in combination with a training course serves as a good basis for the production of a metal silo for grain storage, under the direction of an instructor.

The project produced a somewhat less detailed manual as a guide for the production of metal product to be sold at local village markets.

4.4.2. CO-ORDINATION OF THE PARTIES INVOLVED

The establishment of relationships between and the co-ordination of all parties involved - NGOs, metal smiths, advisors and promoters, credit institutions, material suppliers and where available, agricultural schools and research projects - was one of the project's most important activities. If this functioned well, a large part of the work was already done as synergies could be achieved and encouraged. With this in mind, the project conducted a lot of workshops at both regional and national levels where the various institutions could present their problems, compare them and discuss solutions. Twice a year a national meeting was held with all the transfer channels. Once a year a meeting was held for metal smiths at a regional as well as national level. These meetings contributed greatly to the development of mutual understanding and facilitated experience sharing.

Contracts of collaboration, stipulating which targets were to be reached in the contract period, as well as responsibility and activities, were negotiated with the transfer organisations. The results which were to be achieved by the transferred technology were quantified. In addition, the project also committed itself with regard to promotional and course materials which it would make available. A contract was normally written up for a year with the possibility of renewal. Participatory conditions were specified for the training courses of future advisors and metal smiths. In Honduras alone, the project signed over 50 contracts a year, and in the four other Central American countries it was about 100.

4.4.3. PROMOTION AND PUBLIC-RELATIONS WORK

The project developed a large number of promotional products and activities aimed at reaching different sectors of the public. The four target groups were:

1. farming families
2. advisors
3. institutions - transfer channels

4. craftsmen

(Advisory discussion on the use of the grain silo)

The project developed products which it mostly made available to various institutions. For each course, appropriately structured didactic course material was produced. Materials were developed for advisors active in field work. Flip charts made of material were in high demand as they are very practical to use in the field. Below is an excerpt from the list of different materials which were given free of charge:

-Radio spots and programs
-Comics
-Field plays (theatre)
-Brochures on the technology
-Boards along streets

(Advisory discussions on the use of grain silos)

-Project brochures
-Video cassettes
-Posters with photos
-Lectures and demonstrations
-Films and slide shows
-Caps, pens, writing pads, T-shirts, key chains etc.
-Table and wall calendars
-Diaries
-Sheet metal silo models
-Diplomas

The diversity of the various resources developed step by step. The primary goal was to make the project known and to spread the tested technology. The project aimed to reach the farmers through the radio programs and plays while the posters, diaries, wall calendars etc. were to appeal to the advisors. Street boards and lectures targeted the middle cadre, leading persons and political decision-makers. Additionally, specifically aimed campaigns such as the participation in agricultural exhibitions, were to make the project well known. Newspaper articles were published and personalities in the political scene and development collaboration were sensitised to the problems and invited to field days.

As many graduates of agricultural school are later active in advising, the subject of post-harvest protection was taught in a study module of 30 hours theory and 30 hours of practical training. The project supported the schools by financing a scholarship of six to eight weeks duration for a teacher for special training in the area of post-harvest protection. The project also contributed in the development of a number of practical exercises.

For general schools, the project distributed school supplies (flip charts, slides, etc.) to introduce the subject of post-harvest problems. Through this approach, it hoped to make children in rural areas aware of post-harvest losses and to sensitise them to the subject. Pupils then discussed possible solutions with their teachers.

It is difficult to judge which medium was the most effective. The selection was made taking into consideration costs, target group, how broad and deep the effects would be, the comprehensibility for illiterates and handling factors. Surveys showed that the project had especially become very well known among the advising institutions.

4.4.4. TRAINING OF ADVISORS, PROMOTERS AND METAL SMITHS

The **training of advisors** was one of the constant, main activities of the project. In a three-day course with 4/5 classroom instruction and 1/5 practical exercises, the advisors gained a basic knowledge of the most important causes of harvest losses and looked at various approaches to improving grain storage. They were introduced to the project, its goals and methods. The future advisors served as important connections between the project and the institution they worked for and had therefore to be won over. The project usually accompanied and supported the advisors on their first mission in the field which proved to be a helpful start.

(Lessons for silo builders which include knowledge on the subject of grain storage)

During their training, producers were taught the difference between wood constructions and metal silos. The project trained manually skilled farmers or advisors in wood construction during practical field courses.

The **training of metal smiths** was yet another of the project's key activities. In modules of 5 times 1 week , manually skilled village residents, mostly farmers, were trained to become small entrepreneurs and were permanently accompanied in the the initial phases of their development. Later they produced metal silos independently. The selection process was an important first step in the success of their training. The following selection criteria were taken into consideration:

-takes initiative
-has permanent residence in the village (house and family)
-manually skilled (can handle simple tools)
-can read and write to some extent
-possesses a good reputation (village reference)
-can handle a measuring stick
-is interested
-does not have large bank debts

During the selection, the potential for personal development was also taken into account so paving the way for career promotion of a sort, which was envisaged in the module like structure of the course programme. A module could only be completed if certain conditions and requirements were fulfilled (see box). If a metal smith successfully completed the first four courses, he received the title "Qualified Silo Builder" which gave him the right to stick a quality label on each silo he fabricated. This helped the metal smith to gain respect which in turn increased the saleability of his products. The quality labels were provided free of charge by the project.

If a metal smith fulfilled the above mentioned selection criteria, he was invited to attend the first course or module:

Table 3: Course module for the training of metal smiths: Career Promotion.

1. Module	Basic course, silo building course: learns to manufacture a sheet metal silo
2. Module	Refresher course and tinsmith course: Common mistakes are dealt with, and small items
	are produced from extra cuttings; resulting in stove pipes, roof gutters, pie tins etc.
	Participation requirements: has already produced 25 good quality silos
	Number of participants: 50 % of the first course
3. Module ordering	Administrative course I: Basic course: small price calculations are made, calculations for
	materials, storage stock etc.
	Participation requirements: has already produced 50 good quality silos
	Number of participants: 25% of the first course

4. Module calculation,	Administrative course II: Small business development course: Investment analysis, credit
	promotion
	Participation requirements: has produced 100 good quality silos
	Number of participants: 10-15% of the first course
	>Qualified Silo Builder
	>Quality Seal
5. Module	Advanced tinsmith course: Serial production with the help of a metal press
	Participation requirements: must have a metal press at home, costs about Sfr. 1000
	Number of participants: 5% of the first course

The principle of "learning by doing" was applied in these courses where practical work followed short theoretical explanations. The courses took place in a room provided by the project. At the end of the first course, the participants were able to produce a metal silo. After the fabrication of their first silos, the project visited them at home to correct any mistakes.

The silo builder was required to place a user guides on every silo and had to explain the most important steps for proper handling to the prospective owner before handing it over.

The project kept track of each metal smith and as a rule visited them twice a year. As already mentioned, regional and national meetings were organised once or twice a year.

4.4.5 ASSISTANCE AND PROVISION OF PRODUCTION MATERIALS

It was necessary to ensure the local availability of materials, especially galvanised sheet metal, soldering tin, resin, hydrochloric acid and the necessary tools for the production of the metal silos. Additionally, the metal smith had to set up a small workshop at home under a canopy. The workshop was made of horizontal, well-levelled ground under a canopy of 4x5 meters and a table with angle-irons on its long sides. A complete tool set cost ca. Sfr. 150.00; a tool table made with his own materials ca. Sfr. 50.00; without a own materials a table cost ca. Sfr. 200.00 - Sfr. 250.00. The material for a silo with a one-ton capacity cost between Sfr. 40.00 - Sfr. 50.00.

The local availability of materials, especially galvanised sheet metal and soldering tin did not always go without saying. In Honduras there was simply no galvanised sheet metal which met the quality requirements. The project imported this material for several years until two factories in Central America- in Guatemala and Costa Rica- equipped with modern technology and quality material, were able to deliver at a reasonable price. The project ensured the supply and quality of materials through local retailers marketing the material with a POSTCOSECHA quality seal. Procurement and distribution were turned over to the market from the project in stages. With the growing demand, the supply developed to the advantage of both sides.

Through the inclusion of trading, a market slowly developed. From the beginning there were as few artificial conditions created as possible. The goods sold were never subsidised. In addition, the project did not calculate a profit margin, as is done by middlemen, which meant that it was somewhat cheaper in the beginning. The price advantage was justified in the beginning. Later, as demand increased, it was absorbed and taken over by the buyers. The project set quality norms for the rest of the materials and tools available on the local market while supporting local distributors in marketing by making the selling posts known. The goal was to make the goods available as near to the customers i.e. the metal smiths as possible.

The development of the system of marketing galvanised sheet metal and other work supplies progressed through the different stages described below:

Table 4: Stages of the development and privatisation of the marketing system of production materials (sheet metal)

Stages	Stages	activities of the- project	activities of the commerce
stage 1	entrance	-project imports metal -project sells metal and other materials centrally	-none
stage 2	build up	project imports metal -project sells metal and other materials centrally -project orients regional distribution centres	-none -commerce is informed about activities
stage 3	decentral-isation	-project imports metal -metal and materials are sold via local retailers -project controls sales and margins	-local businesses sell metal and materials locally
stage 4	privatisation	-project records demand -co-ordinates buying with wholesaler* -controls sales and price margins	-wholesaler imports/buys metal -local dealers sell metal and materials
stage 5	withdrawal	controls availability and quality of metal and materials	-wholesalers and local dealers sell metal and materials independently

*) Wholesaler: central buying and selling post.

In the end, the project only concentrated on controlling the availability and the quality of the materials as the high demand motivated businesses to ensure the supply.

4.4.6 CREDIT

After the technology had become relatively well-known in a region and was in larger demand, it was the difficulty in obtaining financial support for the purchase of production supplies and metal silos which formed bottlenecks for the metal smiths and farmers respectively.

About half of the metal smiths had financed their workshops and tools themselves, and the others received credits, mostly from an NGO. In the beginning the metal smiths required credits of up to 75% to buy production supplies, most important being sheet metal and soldering tin. They bought materials in the value of Sfr. 400.00 - Sfr. 500.00. However, once the business of silo production became lucrative, most metal smiths bought the material out of their own means.

In many cases the transfer channels made their own credit lines available to the farmers. This step was especially important during the initial phases and proved to be indicative for the transfer process. The lines of credit were necessary in the beginning, as the farmers were not ready to place themselves at such a high risk for a new technology. Research in Honduras showed that in the beginning 90% of the farmers bought silos on credit. However, after the silos had been known for three or four years, 60% of the farmers financed them themselves paying cash on receipt. One silo cost between Sfr. 75.00 - Sfr. 100.00 for a storage capacity of 1000 kg. On average a farmer earns Sfr. 25.00 for 100 kilos of corn. Calculating a loss of 10%, being the equivalent of 100 kilos, a farmer could finance a silo in a period of three years if losses can be avoided. By selling the corn shortly before a new harvest, he could double the price he receives and finance his silo in two years.

In the beginning the project also gave credits but withdrew successively as the NGOs made enough credits available.

4.4.7 QUALITY CONTROL AND MONITORING

The larger the project was and the more institutions that took part in the dissemination of post-harvest protection technology, the more important it was to establish quality norms. These norms were strictly supervised by the project's monitoring system because the success of the project depended on the level of quality. An incorrectly used metal silo could destroy a family's entire nourishment supply and discredit an otherwise functioning technology. These quality requirements were purposefully set very high with the monitoring

system intervening if 10% of the criteria were not fulfilled. Such strict quality norms made sure that the security margin was large enough to be able to intervene before it was too late.

The work of the metal smiths, the advisors and the farmers was continually monitored so ensuring the work quality of everyone involved on the one hand while on the other hand supporting the advisors in their day to day jobs and their use of support material provided by the project. This also gave the project team the feedback necessary for its work and the improvement of the support materials.

Certain data was collected according to given indicators (e.g. number of farmers who had never heard of POSTCOSECHA, the number of demonstrations given, farmers with insect infestation in silos, number of poorly soldered silos etc.) in order to make evident the quantitative and qualitative progress of the project.

The participating transfer channels were included during the collection of certain quantitative and qualitative indicators. Although this work was often not exact and therefore unsatisfactory, it was useful, because this process constantly sensitised the institutions, reminding them to the take their work seriously.

4.4.8. ADMINISTRATION OF THE PROJECT AND FUNDING

In addition to all the operative activities, the project had to be lead and administered. National (i.e. country own) contributions were managed by the counterpart institutions. The external (Swiss) funding was managed by the international project leader (advisor) in agreement with the national director and in accordance with the rules of the budget approved by the board of directors. National funding mainly covered salaries, infrastructure and travelling expenses while external funding paid for new provisions, training for courses, scholarships, school and promotional materials and various running costs. With projects without international administrators, funding was managed by the national director.

4.5 INSTITUTIONAL EMBEDDING: COLLABORATION WITH AGRICULTURAL MINISTRIES

In all countries the project was allocated to the advising service under the ministries of agriculture. The project leadership was subordinate to the Directorate of Agriculture. This gave the project an important position within the hierarchy which had its advantages when it came to integrating post-harvest protection activities in workplans of the advising services of the various regional offices.

The success of the project was largely due to private organisations, NGOs, associations and metal smiths. One can ask the valid question of why the agricultural ministries were chosen as direct counterparts if they contributed so little to the effective extension of the post-harvest protection technology. Although collaboration with these partners was difficult, it had its advantages, some considerations being:

- The agricultural ministry was represented nation-wide through its regional offices. This made entry into the individual regions easier, which was especially important in the initial phases of the project.
- Food security is one of the key tasks of agricultural ministries. This fact gave the project the right to request and negotiate counterpart duties, that is tax money, to fulfil this task in the interest of the nation.
- The agricultural advising services of the countries did not have an image of high competence, therefore different partners, especially NGOs, did not feel threatened when collaborating with them.
- The agricultural ministry had the institutional authority to summon conferences and to invite various interest groups, NGOs, banks, educational institutions, marketing boards, planning committees, farmer organisations, international donors etc. to discussions and

consultations. The project was able to benefit from these discussions and consultations and form the bases for further collaboration.
- The post-harvest protection problem is a national problem as it affects a large part of the population. It was in the interests of the agricultural ministries to cover this subject and offer professional advice.

Collaboration with the agricultural ministries proved to be difficult in all phases of the project and the project had to expend a lot of time, energy and patience to master these problems, especially the turnover of personnel, and the non-observance of the budget - subjects which constantly led to arguments and tension.

At the same time, the international presence gave the agricultural ministries more weight and credibility. The agricultural ministry alone would not have found approval with the NGOs had it not been for this international presence.

5 KEY ELEMENTS

The following chapter contains a description of the most important elements which contributed to the success of POSTCOSECHA and which could be applicable to other projects. There is no doubt, however, that the combination of various elements led to pleasing results and the impressive region-wide impact. The individual elements are to be weighted according to the type of project and project progress. During the expansion of activities in different countries further experience was gained thereby leading to a condensation of knowledge.

5.1 SIMPLE, ADAPTED TECHNOLOGY

The project developed, adapted and tested, together with the farmers, different alternatives to improve post-harvest protection. The technology most widely accepted was the metal silo, although farmers always had the possibility of deciding on other storage technologies.

The huge success of the metal silos is due to the following factors:

* technically simple to handle and with proper use, success is certain
* a reasonable price for farmers
* shape and volume adapted to the structure of small farm houses
* high quality product, appropriate to the needs of the farmers
* benefits are immediately visible for the whole farming family and other consumers

Handling
Handling must be so simple that all farmers understand it as even good technology can be quickly discredited if it does not function properly due to mishandling. A critical margin of failure, 10% of the target population, cannot be surpassed if the technology is to be distributed further.

Price and Cost Effectiveness
The price of the technology has to be adapted to the buying power of the farmer. The costs arising from a purchase should be able to be paid back in two years at the most with the profits reaped. Additionally, the returns should be higher than the bank's interest rates.

Quality
The product must be technically well tested and able to withstand extreme conditions while even careless handling should not reduce the products life expectancy. Quality control through permanent monitoring is of utmost importance.

Therefore, the project conducted finely balanced, systematic quality monitoring from the beginning, in the sense of an early warning system used to steer processes. The participation of a variety of institutions and people increases the risk of committing, taking on and spreading technical and methodological mistakes.

It is possible to define quality criteria using simple indicators, however, quality requirements should be set high enough to allow leeway for timely corrections.

It is interesting to note that the metal silo had previously been introduced by other local and international institutions, but had never made a breakthrough. What was the reason for this? In these earlier attempts no one had monitored production, and little attention was paid to the everyday handling by the farmer. A metal silo only functions if it is hermetically sealed, i.e. meets the minimal technical quality criteria. Additionally, it functions only well when handled absolutely correctly which means:

a) the grain must be dry when put in and remain dry so that it is not exposed to extreme temperature
variations in the silo;
b) the grain must be preventatively freed of all pests.

Immediate and Obvious Benefits for the Farming Family
Adaptation should not only be of a technical-economic nature, but should also relate to production and work systems. If the solution necessitates more work in times when a lot of work is already required, then resistance to it will be great. The technological jump cannot be to large and must be understandable to the target group. The farmer (user) must see clear advantages in using the new technology. Besides the "hard facts", social aspects are also important to the successful extension of the new technology. Aspects such as prestige, tradition and affect on the family can expedite, slow down or in the worst case prevent adoption of the technology.

5.2 SUPPLY AND DEMAND: THE MARKET

Experience shows that extension of post-harvest technology is only successful if the participants join in business. The project's role as co-ordinator in the beginning was a deciding factor. From the beginning, clear market regulations were applied.

The following four groups were involved in the supply and demand process:

* Commerce as supplier of the raw materials and tools
* Financial institutions as creditors for buyers (farmers) and producers (metal smiths)
* Producers of the silos: metal smiths
* Buyers: the farmers

The co-operation of these parties guaranteed the sustainability of the transfer process.

The creation of artificial conditions which lead to long term dependencies on the part of the participants (advising bodies, banks, commerce etc.) and the target group should be avoided in order to achieve a successful, lasting transfer process with a region-wide impact. From the beginning the market economy approach, which is guided by supply and demand, should be encouraged.

No new technology can be promoted if the necessary raw materials are difficult or impossible to obtain. Without getting too involved in the process, the project has to make private employers (commerce, industry) aware of the need for these materials and get them to make the materials available. The goal must be to have this process function independent of the project.

Attempts were made by industrialists to rationalise the production of the metal silo, i.e. to centralise (in the capital) mass production, and then put them on offer at local markets. These attempts failed terribly, because production did not follow demand, and the price of the silos, due to transport and infrastructure costs, was higher than those produced at the local metal smith's.

6.3 THE METAL SMITH (THE SILO BUILDER)

The metal smith ensures a decentralised supply of the technology. He is a member of the village structure and knows the needs of the farmers and is usually a farmer himself. As producer and seller of the silo he becomes a small entrepreneur. Frequently he is in direct competition with other metal smiths in the same community or surrounding villages.

To ensure a large enough demand for the metal smiths, the project calculated the figure of 1000 farmers per smith. If we assume that the life of a silo is 15 years, and a farmer owns on average 1.5 silos, the demand for the metal smith is about 100 silos per year. He must work about 100 to 150 days to produce these silos and can expect a net income of Sfr. 3000 00 to Sfr. 4000 00 a year. Real figures show that in the four countries there were, on average, 37 silos a year per metal smith. Honduras has the most with 53 silos and Nicaragua the least with 26 silos. These numbers will continue to increase, because the demand is steadily growing and in the future not all of the trained metal smiths will produce silos.

The project supported the metal smiths through continual presence and systematic training on module based courses. Accompaniment, training and the simultaneous development of a market for their products gave the metal smiths career prospect.

The metal smiths regionally formed loosely connected groups and discussed their problems together. Central to their discussions was the procurement of raw materials, such as galvanised sheet metal and soldering tin, and the selling price of the silos.

The metal smiths play an important role in the successful dissemination of the grain silos. The deciding factor is that as they earn money with each silo sold and that it is therefore in their own interest to spread this technology.

5.4 ROLE OF THE PROJECT: CONCENTRATION ON KEY FUNCTIONS

The project resolutely limited itself to its key functions, namely:

* technology development
* co-ordination
* training
* production of promotional and course materials
* monitoring

It was only possible to concentrate on these key functions because many different institutions collaborated complementarily.

Key Functions change during the course of a project
The project should clearly define its role in the structuring, consolidation and withdrawal phases.

The project had an active role during the development of technology and promotion. The integration of the metal smiths, farmers, financial institutions and commerce in their traditional roles guaranteed sustainability. The role of the project which continually adapted as it developed, namely active in the beginning and passive-mediating at the end made the transfer process more independent.

External Advisors are often irreplaceable
A project is always a created structure for a limited time and new ideas are often met with resistance. In a relatively short time, difficult organisational and technical tasks have to be overcome. Support from external advisors in the area during critical stages can contribute enormously to success and help free bogged down structures. The experience of POSTCOSECHA clearly confirms this matter.

Planning for a long enough project
The horizon of the project must not be cut short. The development of technology, institutional collaboration and the introduction of new methods demand time. The adoption of new technology takes off exponentially as was clearly evident in the case of the metal silo for post-harvest protection.

6.5 REGION-WIDE IMPACT

The large region-wide impact of the post-harvest protection project in Central America is unarguably an outstanding success.

In order to achieve such region-wide impact the following elements have to work together:

* the simplicity of the technology (see 5.1)
* the free course of market forces (see 5.2)
* the metal smiths' motivation and proximity to customers (see 5.3)
* the concentration of the project on its key functions (see 5.4)
* a solution to problem corresponding to the real needs of the target population
* the continuous training and further education of the parties involved
* collaboration with a variety of institutions

Need Justified Solutions
Looking back it is evident that the post-harvest problem and the metal silo as the most widely distributed solution corresponded to the real needs of the target population. The project took concrete steps to analyse and develop an adapted solution. In this respect , the "Prueba de Concepto" should be emphasised as a means of understanding the daily routine of the farming family and identifying the most suitable post-harvest protection technology. This was followed by the careful development of the metal silo adapted to local conditions and needs. Finally, serious monitoring enabled the project to ensure the quality of the silo and to react to any necessary adaptations of the technology and the extension processes.

Continuous Education and In-service Training
The extension of technology assumes that a certain amount of knowledge about the problem area and possible solutions are available. Motivation and knowledge from outside! This knowledge must be selectively passed on to the advisors and farmers in courses and advisory meetings. The subject matter of the course has to be appropriate to the situation and practically organised.

By increasing the sensitivity of the target group, the advisors and the institutions, more people can be won over to partake and the effectiveness of the project is increased. The use of a variety of promotional materials and methods help in reaching and appealing to various groups. The more well-known the project is, the more prestigious it is and the greater its identity which in turn can stimulate demand as well as supply. The advisors (the trainers of trainers) in different institutions have to be educated in the subject matter with regard to both didactic-methodology and content on relatively short courses. The practical applicability in daily advising work is of utmost importance and necessitates that advisors have to be given didactically applicable and user-friendly support materials (course materials).

Collaboration with a variety of institutions

A region-wide impact is obtained when a multiplication effect occurs. All the institutions (NGOs, state and private advising organisations) that work with the same target group should be included. The project plays an important role in that it co-ordinates and sets all the parties in motion. Important to this, especially in the beginning, is well-aimed support of the promotion of the idea, the technology and the transfer of know-how. During the selection of institutions to become transfer channels, selection criteria should be more pragmatic than ideological. Collaboration with the same target groups and the adoption of the technical standards are important.

A permanent exchange of information gained by experience gives the institutions, advisors and craftsmen feedback, helps to reduce prevailing paradigms and one is able to learn from the mistakes of others. It is possible to present advising methods and results and individual institutions can put themselves in the limelight. Additionally, geographic coverage can be co-ordinated. Finally, the exchange of experiences is unarguably motivating, encourages synergy and often results in a healthy competitive mindset.

The successful development of a market-conforming, pluralistic strategy requires that enough institutions are active in this sector. If this is not the case, the approach must be more basis oriented, i.e. in collaboration with farming organisations which means that the transfer process takes on a new dimension.

The project learnt something with each expansion into a new country. This new information was intensively exchanged in workshops in individual countries and across boarders. There were actually more regional differences with regard to the speed of adoption rather than in methodology. For example, the Indian population in Guatemala required more work in promotion and awareness raising than was necessary in other countries. The political and cultural context (expulsion and guerrilla warfare etc.) also plays an extremely important role.

The real deciding factor is that the project never created artificial conditions and the transfer process occurred in the target population, i.e. the local metal smiths offer the product and the farmers purchase it if they want it. Everyone earns something and a free market is created eventually making the project redundant. In Honduras the project has reached this stage and for quite some time it has not been possible to inspect all the silos transferred anymore.

SUMMARY

The project started in 1980 in Honduras with the goal of reducing post-harvest losses of grain - most importantly corn, beans, millet and rice - on small farms in Central America through targeted extension of adapted technologies. Resounding results were achieved from the extension of a cylinder-shaped sheet metal container (metal silos) which was manufactured in various sizes by local metal smiths under project guidance.

Today about 100,000 small farms in four countries in Central America - Honduras, Guatemala, Nicaragua, El Salvador - use post-harvest protection measures. By far the most widely distributed is the metal silo. In total, thanks to the metal silo, there is a storage capacity of 100,000 tons of grain available. This amount is sufficient for the nourishment of 600,000 people a year. Additionally, the grain stored under such good conditions is more hygienic and of better quality. The use of metal silos on the farm has a variety of positive side effects to the advantage of the whole family: it improves hygiene in the house; lightens the work load for women and children; improves bargaining position in sales; raises prestige in the village, and increases income, which leads to the overall socio-economic improvement of the family.

The project limited itself to key functions such as the training of advisors and craftsmen, production of school material and publicity work, co-ordination of the collaboration between

transfer channels, logistics, monitoring and evaluation. The actual transfer work at the grass roots level was managed by the transfer channels.

Through a finely formulated transfer strategy, which systematically included various development and advising organisations as channels for extension in the field, a large geographical area could be covered and a large multiplication effect achieved. The unarguable success lead to the project starting the same activities in neighbouring countries, Guatemala (1990), Nicaragua (1992), El Salvador (1994) and with HELVETAS in Paraguay (1995).

The fundamental characteristics that led to the success of the project are: the pluralistic combination of different parties; clear rules of the game; the market economy approach; the role of the project which continually adapted itself as it developed - active in the beginning and passive-mediating in the end and targeted external support.

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