



PONTIFICIA UNIVERSIDAD CATOLICA DEL PERU
DEPARTAMENTO DE INGENIERIA

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Project Financed by the
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by J. Vargas and D. Torrealva*

SUMMARY

This paper describes a housing reconstruction program in northern Peru after the 1983 floods due to "El Niño" phenomenon. The objective of this program was to implement and disseminate improved adobe construction technologies through instruction, training and technical assistance in rural communities that were relocated after the floods.

This project was carried out as the field dissemination part of the Research Project "Preservation of Adobe Constructions in Seismic and Rainy Areas", developed by the Catholic University of Peru (PUCP) from June 1984 to May 1985.

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1. INTRODUCTION

The problem of rural housing has not been seriously studied nor discussed at government level in Peru, thus existing a lack of experience in this field. Although population and housing censuses give us some data on the conditions of housing in rural areas and some information is available regarding the housing typology, this information is usually not enough to determine the real needs, nor the possibilities to improve the housing quality in such areas.

The rural housing is usually the most vulnerable against natural hazards and interesting and helpful mitigation actions have emerged in housing reconstruction when rural communities have been affected by natural disasters (earthquakes, floods, etc.). The experience obtained in these isolated actions have to be rescued in order to make possible an effective and permanent action.

2. BACKGROUND

In order to understand the characteristics of the program, it is necessary to make a description of the most relevant previous facts which had some influence in its definition. It could be said that this program is a pilot effort in the application of an improved technology, as a rehabilitation action in an area affected by a natural disaster.

2.1 Description of the Natural Disaster

Between November 1982 and June 1983, six months of heavy rainfall caused the most dramatic series of flooding of this century over the coastland of northern Peru. The rain was caused by the "El Niño" phenomenon, one of the most spectacular events of the ocean and the atmosphere which produces a great impact in the climate and marine ecosystem.

In the north of Peru from Tumbes to Lambayeque, rainfall was the most heavy registered to that date, approximately 30 times greater than the average.

The damage caused by "El Niño" was very extensive, affecting approximately 1,200 km of the coastal area, from Tumbes to Lima, and specially the Departments of Tumbes, Piura and Lambayeque. The total losses were estimated in US\$ 1,250 million, mainly in agriculture, highways, bridges and industrial installations. At least 100 persons died and thousands lost their houses.

Most of the damage in housing occurred in rural adobe houses whose roofs were unprepared for heavy rains and because of flash floods in towns near the river banks.

2.2 The Reconstruction Process

The interest of the Government after the disaster centered in the reconstruction of highways, the rehabilitation of the agriculture, and the rehabilitation of the basic water and sewage services in the cities. No specific program was established on housing reconstruction.

In order to apply the different reconstruction programs in the areas affected by the natural disaster, Reconstruction and Rehabilitation Offices were created by the Development Corporations of Piura (CORDE-PIURA) and Lambayeque (CORDELAM). The task of promoting housing reconstruction was commissioned to credit institutions, such as the Housing Bank and the Bank of Materials. But in this case, the majority of the persons who lost their houses belong to the low income strata and do not have access to formal credit. However, international institutions such as the Agency for International Development (AID), supported programs destined to the relocation of towns and reconstruction of houses, which in part filled the lack of help to the low-income strata. In exchange, certain State participation was required, thus involving Rehabilitation and Reconstruction Offices in housing programs.

Additionally, labor hand was required from the people participating in those programs.

The general criteria for housing rehabilitation was to relocate the towns on land safe from river floods.

AID supported financially the primary habilitations of lots in several affected towns in the Department of Piura and Lambayeque. It consisted on the levelling of the land the designing of blocks and lots, basic street paving and basic supply of water, after which the relocated people would be able to start the construction of their houses.

In the Department of Lambayeque, CORDELAM made the technical study to relocate three affected towns: Lagunas, Tupac Amaru and Chochope. The first one because was left isolated by the Zaña river and the last two because were flooded.

During the emergency stage and while the primary lot habilitation work was performed, the affected people built temporary shelter using canes, plastic sheets and cardboards, some of them in higher areas and others close to farming areas, also some people abandoned the area and moved to other towns or cities. This situation lasted one year until the beginning of 1984 when people started to move to the new location.

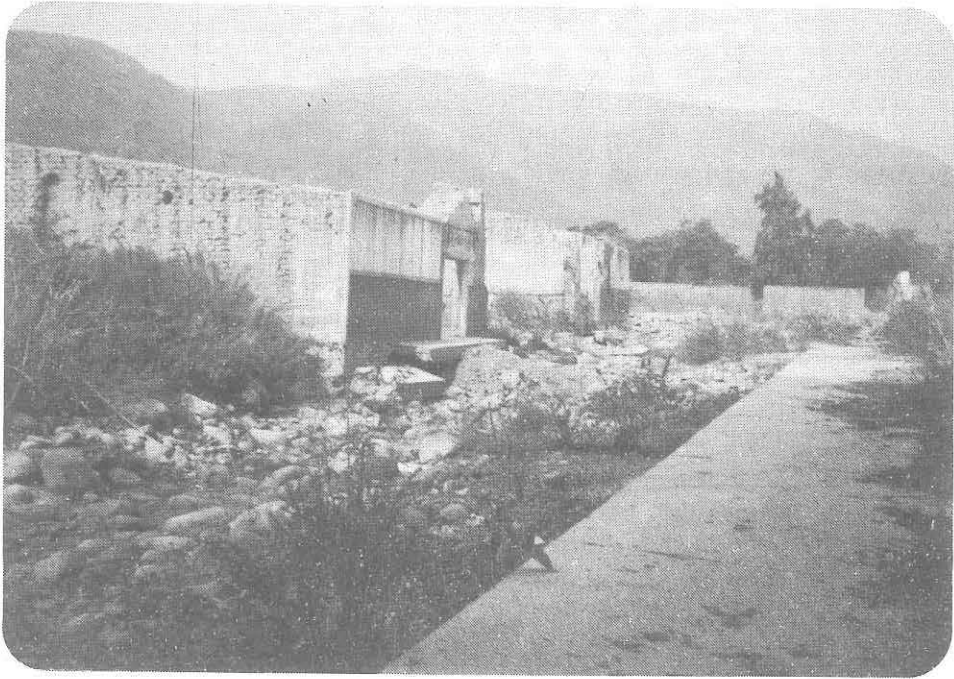


Fig. 1 Damage caused by the floods in the town of Chochope.



Fig. 2 The town of Lagunas abandoned after being isolated by the Zaña river.

The Lagunas case was unique as the people remained in the isolated town until they were massively relocated at Canasloche, some 7 Km from Lagunas.

At the end of the relocation process, CORDELAM channeled new funds from AID for the purchase of construction materials. This aid was given to the three towns mentioned, demanding in exchange that the beneficiaries participate with their work in the construction, and that they follow the recommendations on improved adobe constructions.

2.3 The Technological Innovations in Adobe Construction

The Catholic University of Peru has studied, through several research projects in the last twelve years the way to improve the seismic resistance of the adobe houses, from which practical recommendations have been obtained for their application in the field. The most important recommendations are referred to the inclusion of a mesh of cane inside the adobe walls and the addition of straw and coarse sand to the mud used as a mortar.

Other recommendations refer to the use of a concrete foundation and a wood collar beam attached to the vertical canes and the roof wood beams. The objective is to provide additional strength and to avoid the sudden collapse which is the main cause of human losses during earthquakes in this type of constructions.

Additionally, an improved method of manual fabrication of adobes was recommended which gives a more resistant adobe unit. It mainly consists on the use of a mold with botton part instead of the bottomless mold traditionally used.

3. PROGRAM OBJECTIVES

The program had as its basic objective the study of the application in the field of the model with improved adobe construction. There was a need for knowing if the model developed in the laboratory which had been successful to endure seismic actions, could be reproduced in the field this time constructed by the users and workers, following traditional building systems.

In order to accomplish the objectives, it was necessary to identify institutions to work with on specific reconstruction programs, and the following work plan was elaborated to be implemented in such program.

1. Preliminary visit.
2. Survey-study of the housing conditions of a specific location
3. Study of the possibility of constructing new houses in that location.
4. Formulating a specific work plan.

5. Preparation of the teaching and dissemination material.
6. Training instructors and users.
7. Technical assistance in the execution step.

Contacts were made with CORDEPIURA, CORDELAM and CARE which had several reconstruction programs to be implemented in the disaster area. Finally, an agreement was signed between CORDELAM and the PUCP for the reconstruction of the three relocated towns in the Department of Lambayeque.

The agreement centered the technical assistance in Nuevo Tupac Amaru, where CORDELAM had already programmed the construction of 140 houses and the people was apparently ready to build. Technical assistance to Canasloche and Chochope was not specifically mentioned in the agreement due to limitations of time and human resources, but it was intended to give them the technical assistance according to the availability of resources.

In this way, the initial work plan was modified, since CORDELAM had already defined the first three steps.

4. PROGRAM DEVELOPMENT

The dissemination activities were centered in three rural towns: Nuevo Tupac Amaru, Chochope and Canasloche; and one main city of northern Peru (Chiclayo). The program lasted one year, from June 1984 to May 1985, period during which the following activities were performed:

- Preparation of dissemination material (brochures, and audio-visual programs).
- Dissemination lectures at several levels: engineers and architects, local builders and users.
- Elaboration of the technical file (construction plans, list of materials, budget estimates, etc.)
- Training local builders through SENCICO (National Training Institute for Construction Workers).
- Socio-economical study of two rural communities
- Technical assistance during the construction stage.
- Dissemination of the new technology in the city of Chiclayo (newspapers, radio programs, etc.)

The technical team in the field consisted of three engineers and one technician specialized in adobe construction, later on, an anthropologist joined the team to conduct the socio-economical study of the communities involved.

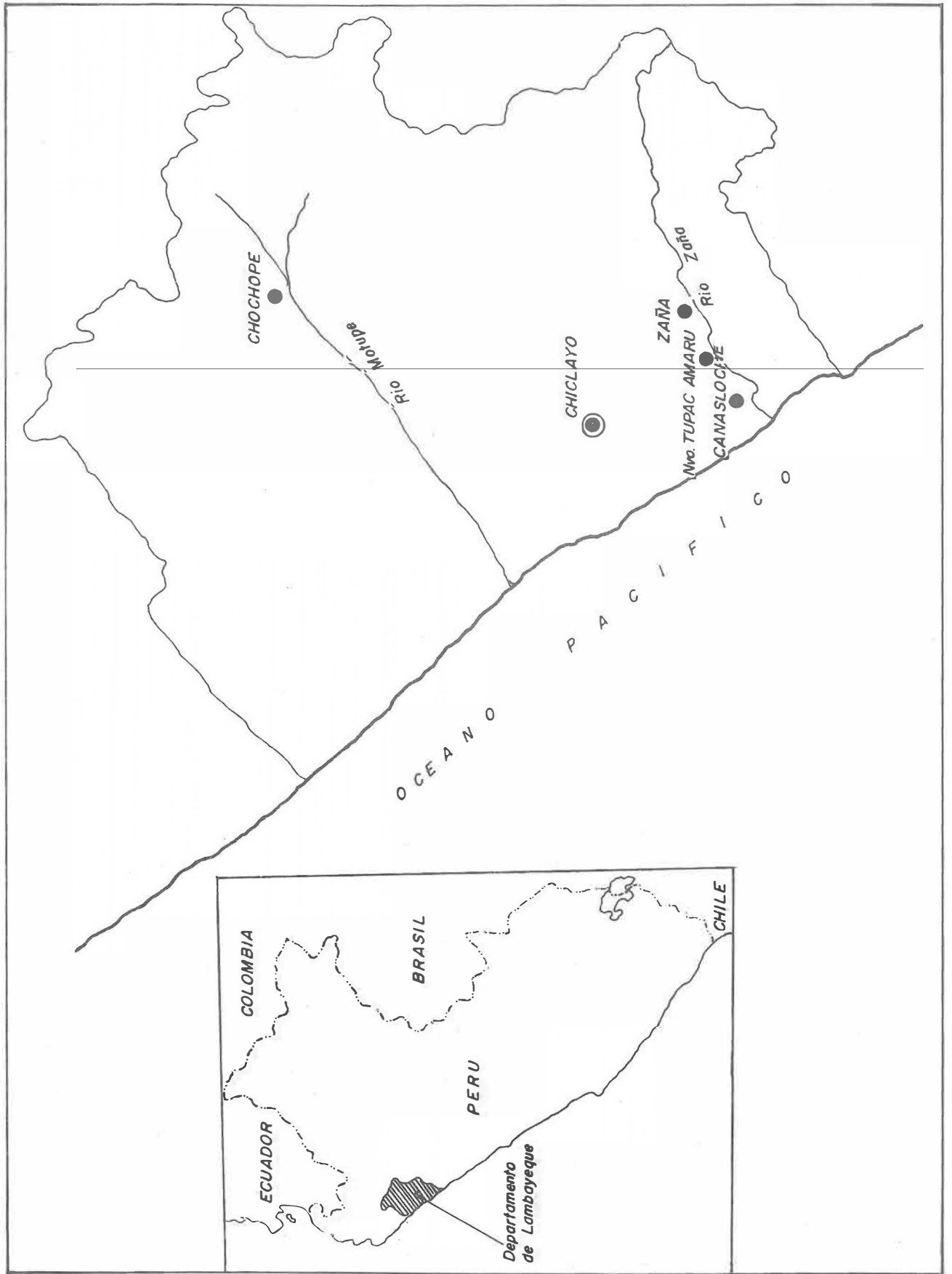


Fig. 3 Area of influence of the dissemination project.

4.1 Acquisition of Construction Materials

Between June and July 1984, the technical file was elaborated by the team in the city of Chiclayo. This was an indispensable requirement for the allocation of funds in the acquisition of materials. The condition to elaborate the technical file was to develop a basic house module, which could be expanded later on by the people. The module had 25 square meters, which fit the budget limitation proposed by AID which amount US\$ 300 per house unit. The design considered a concrete foundation, adobe walls and a roof of wood beams, cane and mud.

Once the technical file was approved by AID and the funds were transferred to CORDELAM, i.e. September 1984, public auctions had to be held for the purchase of the materials. In spite of the efforts of CORDELAM, the first materials arrived in the towns in November, due to a serie of bureaucratic requisites in the process of acquiring the materials.

4.2 Dissemination Activities in the Rural Towns

The first contact with the communities was in July 1984, in the town of Nuevo Tupac Amaru. It was determined that the people did not know the amount and extent of the aid and the requisites demanded in exchange, i.e. labor hand for the construction.

After several assemblies in which the new technology and the requisites for the aid were explained to the settlers, they signed an act compromising to work in the construction of their houses.

The first action towards dissemination was related to the fabrication of adobes. The proposed technology meant more work and thus less production, originating a first rejection towards the new technology on behalf of the adobe makers hired by the beneficiaries. A similiar attitude was adopted by the masons at the time of erecting the adobe walls, due to the cane mesh inside them. This fact, together with the little importance given to the seismic resistance of their houses made little attractive the acceptance of the new design by the settlers.

In Canasloche, 5 Km away from Tupac Amaru, there was a total rejection from the beginning of the program and not a single adobe was fabricated with the new technology.

The results in Chochope were different, the first contacts with the community were made in September and until November there was no great activity because the population was not totally convinced to participate in the project. The initial differences of opinion towards the project were smooth down by allowing the people to fabricate adobes in their traditional way but with the dimensions required by the project and to make changes in the module architectural distribution.



Fig. 4 Dissemination lecture to the settlers in Nuevo Tupac Amaru.



Fig. 5 Presentation of project to the assembled settlers in Chochope.

In January, 28 houses were about to be finished and with this progress, CORDELAM distributed corrugated plates of tarred pasteboard for the roofs, since there was seasonal rain in that area. The construction stopped in February and March because of the rainy season. In April with a new incentive of a food distribution program, the number of participants in the project increased to 69 families.

The food program was also implemented in Tupac Amaru but it did not incentivate the people to participate in the project, resulting in only 14 families which built with the new technology.



Fig. 6 Food distribution to beneficiaries in Chochope.

4.3 Dissemination Activities in the City of Chiclayo

In order to find out the acceptability of the new technology in a different environment as it is a main city, a dissemination campaign was implemented in Chiclayo. It consisted on radio programs, newspaper ads, and some television interviews. This campaign was coordinated with SENCICO, institution which showed great interest on adopting the new technology for adobe constructions, and which joint training courses had been carried out.

The campaign motivated several individuals and institutions to ask for more information, but the variety of cases made it necessary to study each one individually, taking into account both the needs and the economic resources. This task required personnel with enough time to analyze and solve each of them and only one project was concreted, the construction of a medical post in a rural village.

It was also of interest, the contacts made with the local authorities which organized several dissemination lectures in the slum areas of the city which build mainly with adobe.

4.4 Epilogue

As the time went on, CORDELAM was worried about the low participation of the people of Nuevo Tupac Amaru and Canasloche, and the consequent unused materials already bought and stored, which were not delivered to the beneficiaries

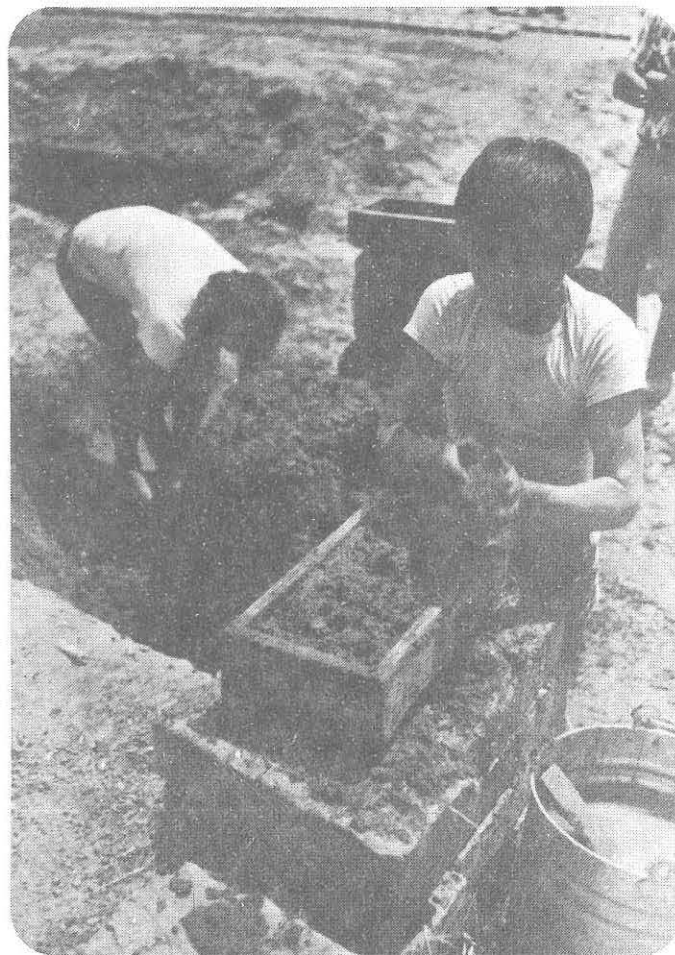


Fig. 7 Children from Nuevo Tupac Amaru making adobes with the new technology.

because did not accept the new technology. In view of this fact, CORDELAM took the decision of giving the materials to be used in the construction of their houses with the traditional technology.

In Nuevo Tupac Amaru, the people started to use the foundation materials (stone, concrete and cement) massively but after that, the construction of walls decreased again.

In Canasloche, the people was not able to use the materials for the foundation because of a lack of water in the town. The pipe line system that should provide water to the town was not ready yet.

In Chochope, until the end of the project, the construction continued massively with SENCICO taking the task of giving technical advise in the construction of houses with the new technology, and some months after the end of the project, there were more than one hundred families involved in the project.

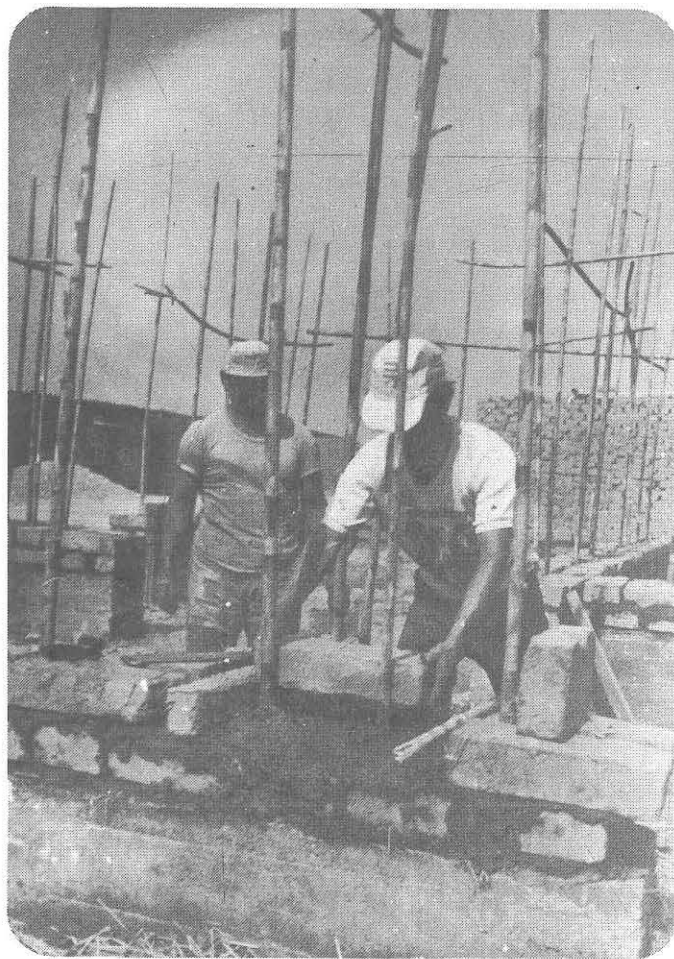


Fig. 8 Building a house with the new technology in Nuevo Tupac Amaru.

5. PROGRAM EVALUATION

Eventhough the objective of the program was disseminate a new technology through its application in the field, it is natural that its success depends not only on the tecnicities of the new constructive system, but on the conditions that said technological change impose to the reconstruction program and viceversa.

5.1 The Administrative System

The community selection, number of beneficiaries, management of funds and acquisition and distribution of material were responsability of CORDELAM. This government institution was not prepared to manage a reconstruction program with communal participation and did not take in consideration the socio-economic conditions in planning the program.

The number of beneficiaries was overestimated in Nuevo Tupac Amaru, many of them belonged to one family (father and sons) and others had left the area moving to other towns. Approximately only 50 percent of the 140 houses were needed in the town. This could have been avoided with a preliminar socio-economic study.

The bureaucratic requirements that had to be fulfilled for the acquisition of materials delayed its delivery to the beneficiaries in approximately three months, in spite of the emergency situation.

The program was planned as an aid to reconstruction, giving the beneficiaries a minimun housing module to start the construction of their house. But due to the delay in its execution (one year after the emergency), some people had already built basic houses in the traditional way and other had adobes to initiate the construction. For these individuals the program was not convenient because it did not take in consideration the previous work they had done in making their adobes or partially building their houses.

5.2 The Social and Economic Influence

The results obtained in the three rural towns in terms of house units built with the new technology were very different. In Canasloche, not a single house was built with the new technology, in Tupac Amaru only 14 houses (10⁰/o) were built and in Chochope, 69 houses (69⁰/o) were in construction at the end of the project.

The amount and the condition of the aid were the same for the three communities, but the socio-economic reality was different in all of them. In all the

communities the main economic activity is the agriculture. In Canasloche and Nuevo Tupac Amaru which are located 4 Km apart in the same area near the coast, the agriculture activity had not been yet restored to normality after the floods. Also because of the type of farming, their activity is continuous all the year. In Chochope, located in a different site at higher altitude, the agriculture activity is seasonal, demanding only seven months a year. This activity was almost normal and the people had a more stable economic situation.

Canasloche and Nuevo Tupac Amaru are closer to the main city of Chiclayo (40 Km) and therefore have a permanent contact with regional authorities which had promised repeatedly the aid from the government in the reconstruction of their houses. When the conditions of the project were known by the people, many of them felt defrauded with the amount and conditions of the aid.

In Nuevo Tupac Amaru and Canasloche, the settlers did not have much confidence in the technicians and engineers due to a recent bad experience in the construction of a water system for the farms, which resulted in a unused construction because the opinion of the farmers was not taken in account. In Chochope, the presence of the engineers was more appreciated.

The case of Lagunas was unique, in the aspect that the people remained in the isolated town until they were massively relocated at Canasloche. They were able to take all building materials from their previous house specially the roof, doors, windows, etc., this aspect had to be considered when planning the reconstruction of houses in this town. The people also had a very acute problem of water supply which made impossible any attempt of construction. This situation remained during all the year of project execution.

One of the main objections to the project was the reduced size of the module which was against their traditions, and one of the reasons for the greater acceptability of the project in Chochope was to allow the participants to increase the size of the module provided that they assume the increase in the cost.

5.3 The Perception of the Natural Hazards

The perception of the earthquake hazard was very low in the area since they have not experimented a strong earthquake in more than 50 years. This was the reason for which the settlers in Nuevo Tupac Amaru objected the use of the mesh of cane inside the walls, the lectures given to the community explaining the need of the reinforcement against earthquakes did not convince them to assume the increase in the labor cost. It was noticed that in spite of the heavy rains experimented, which collapsed many unprepared roofs, the people who had build their adobe houses used

the same type of roof. These attitudes demonstrate that the rural people in this area do not easily invest in long term mitigation measures as earthquakes.

5.4 Community Participation

It was determined that communal participation is possible only in cases of constructions which benefit to the community and when exist a primary need for it, this was the case of the construction of a water system for the farms in Nuevo Tupac Amaru. Housing construction is an individual task where the participants are members of the same family. Being basically farmers, they buy the adobes and then hire a mason to build the house with the aid of the family members available.

5.5 The Influence of the Technological Innovations

The technological innovations refer to the fabrication of adobes and the construction process, and are oriented to improve the seismic resistance of adobe houses.

The innovations in the fabrication of adobe demanded the use of a mold different from the traditionally used and the inclusion of a considerable amount of straw in it, this meant more work and thus less production resulting in an increase in the unit cost. For this reason it was decided that the beneficiaries fabricate the adobe in the traditional way since it was not of a primary importance in the house quality.

The concrete foundation specified in the project was highly appreciated by the beneficiaries and being the most expensive part of the construction many times is out of their economic possibilities.

The mesh of cane used as reinforcement demanded more work in the construction of the walls. It was determined that in spite of the lectures given to the settlers, they did not fully understand the necessity of the reinforcement against the seismic actions.

The roof specified in the project was similar to the commonly used in the area, but some objections were made to the quality of the wood. Due to budget restrictions, the wood used was not the most appropriate for that area, needing a treatment for preservation and eventually the replacement of the roof after 8 to 10 years.

In general, it was noticed that the settlers relate the quality of a house to the type of materials used and not to the construction process. The general idea is that adobe constructions cannot be improved, and as result of a wrong interpreted economy has a characteristic of degradating quality.



Fig. 9 New location of Chochope in September 1984.

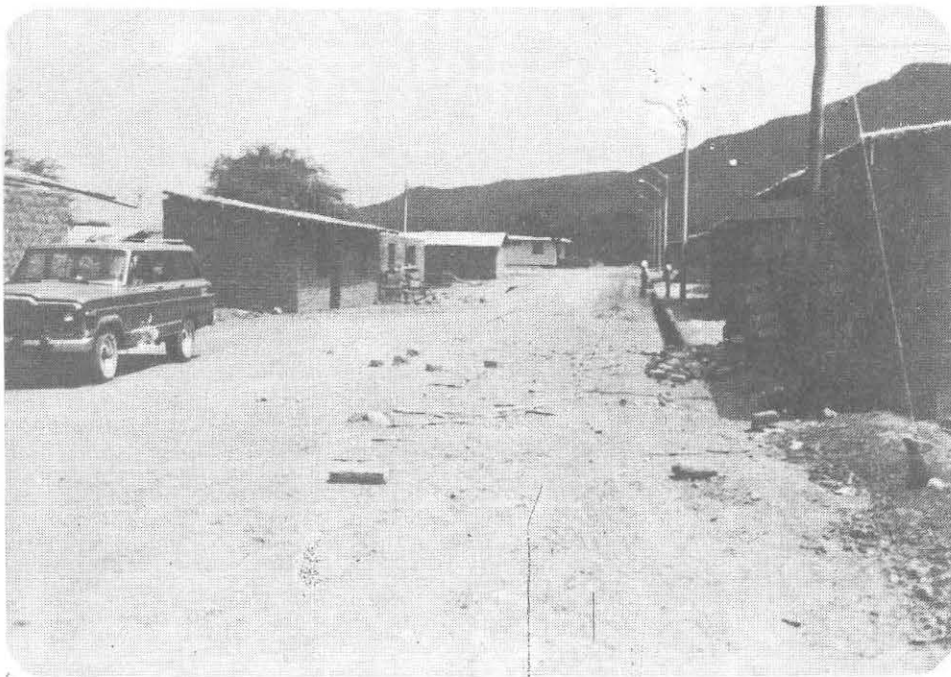


Fig. 10 New houses built in Chochope at the end of the project, May 1985.

6. CONCLUSIONS AND RECOMMENDATIONS

In spite that this dissemination experience has its own characteristic, many of the conclusions can be applied to general housing programs with communal participation. The main conclusions and recommendations are the following:

- Adobe constructions are a real possibility in rural areas, in spite of the damage suffered by this type of housing due to natural hazards. It must be shown not as a forced solution for the poor, but as an authentic alternative if it is technologically well used.
- Including mitigation measures represent an increase in the cost of the house that many times cannot be afforded by low income people. Any project implementing mitigation measures, must be linked to other development programs from which such cost can be covered.
- A socio-economic study and a housing survey is necessary for an adequate planning of the program. The real housing demand and the possibilities of the families to participate in the program must be known in advance.
- The technological solution and the administrative system should be sufficiently flexible in order to make possible a wide participation of the community and the families in the program. This have to be done from the stage when decisions are taken, which will determine not only the possibilities of their participation in the program but the conditions in which their lives will develop in the future.
- Permanent and massive actions toward mitigation in rural housing, necessarily includes the support and participation of the State. This make necessary to disseminate improved technologies between the governmental housing institutions and official regulations for this type of constructions.
- Finally, field experiences must feedback the laboratory reserarch work in order to diminish the existing gap between this two disciplines.

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