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**CONSERVATION, IDENTITY
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Applied archaeology: revitalizing indigenous agricultural technology within an Andean community

Ann Kendall

ABSTRACT

In many parts of the world European colonization, and more recent social and economic change, has radically altered and, in some cases, decimated both the social structure and the subsistence base of indigenous communities. Archaeologists have often demonstrated the sophistication and practicality of prehistoric technologies, but only rarely have they developed long-term projects to evaluate the continuing relevance of these technologies to present-day communities. In this article the first experience of applied archaeology by The Cusichaca Trust is described, showing how a rural development project was developed within specific environmental and social contexts. The Trust's main research focus was the study of the agricultural infrastructure of the Incas and their predecessors in the Cusichaca and Huallancay side-valleys of the Urubamba Valley, Cuzco, Peru. This was paralleled by a rural development project to restore to full productivity some of the abandoned terraces and canals to the benefit of the local community. Attention is drawn to the relationship between conserving and using ancient agricultural infrastructures and the degree to which community organization is central to the maintenance and use of such technologies.

INTRODUCTION

It is not common to use archaeology to find solutions to contemporary problems, but the experience of the Cusichaca Trust's work demonstrates that a combination of field archaeology and multi-disciplinary research can lead to creative new approaches for rural development, giving archaeology a truly social function.

The concept of applied archaeology was recognized in the 1980s as one of the more socially orientated developments of New Archaeology, with the study of past agricultural systems being one of the most fertile grounds for active involvement (Renfrew and Bahn, 1991). Reassessing the applicability of indigenous technologies within the context of present-day economic situations may highlight their continuing relevance as well as bringing an understanding of

them into a new dimension. Through research and experimental work this can lead to renewed practical applications for these ancient technologies. However, in most cases, the difficulties and long-term social and political commitments required in the application process mean that the results are rarely implemented.

The success of the civilizations of the Central Andes was founded on innovative developments introduced to alleviate environmental risks, thus securing the sustainability of their agriculture base. Among the notable achievements of the pre-Hispanic civilizations of Peru is the creation of agricultural systems able to mitigate the inherent risks of dry land environments in varied ecological niches, from the coastal deserts to the semi-arid high altitude (altiplano). In the altiplano, a range of different solutions were arrived at, including man-made reservoirs or wet cultivation areas

called *cochas* (Flores Ochoa and Paz Flores, 1986) and raised fields called *camellones* or *waru waru* at the edge of Lake Titicaca (Erickson, 1987). The Cusichaca Trust's research and rehabilitation work focused on the terraced agriculture with accompanying irrigation systems that were well developed on the sides of highland valleys.

The Incas and their immediate predecessors in the Cuzco area were skilled farmers who invested a great amount of labour in long-term agricultural developments. In their private estates and homeland the Inca rulers c. AD 1400–1532 perfected many indigenous Andean techniques for maintaining 'sustainable environments', through ambitious construction projects that belied the apparent limitations of their 'bronze-age' technology. Their main practical concern was with the production of maize, a storable crop for food security, and with tackling soil erosion and reducing the risks of climatic change, which they did by building sophisticated irrigated terrace systems (Fig. 1), moving good quality soils to create depth and drainage on high-quality valley side terraces. Irrigation on terraces secured the annual priority crop, of maize as the prime crop, also cultivated in outlying terraced areas associated

with *quinoa* or *kiwicha* (both nutritious grains). In planning their irrigation the Inca are thought to have used a water-level in a container, and to have measured low gradients with poles. They used local materials – carefully selected stone (by quality and texture), clay (for sealing in water) and sand and gravel (for good drainage) – all widely available in the Andes (Kendall, 1997). They 'built to last' by choosing the right terrain, controlling the speed of water flow in the channels and adapting stonework to cope with slow and fast gradients. Their structures also endured because of a well-organized, cohesive system of maintenance responsibilities within the social and religious context of the community.

In Cuzco, along the Sacred Valley and at some other locations such as the Colca Canyon in Arequipa and Andamarca in Ayacucho, the irrigated terraces continue to be an important live agricultural heritage that sustains both indigenous and 'immigrant' populations. The potential for restoration of pre-Hispanic irrigation systems to rehabilitate agricultural terracing can be demonstrated in the Ollantaytambo District where the Cusichaca Trust worked with two communities on separate projects; the first, to be discussed here,

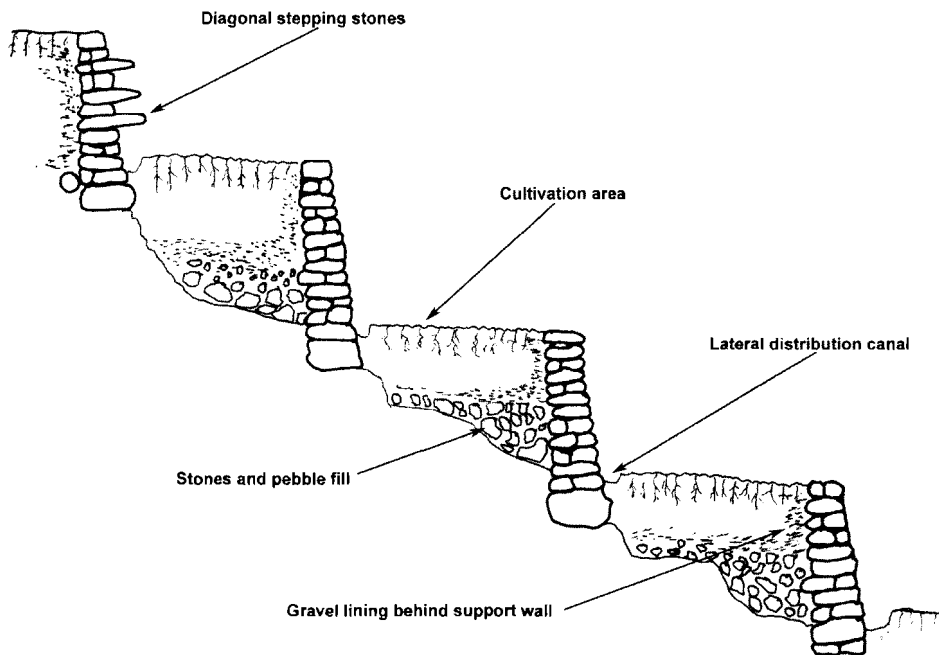


Figure 1. A schematic transverse-section of prime Inca platform terracing. Drawing by A. Kendall.

was at Cusichaca with the farming community of San Jose de Chamana.

THE LOCAL COMMUNITY: LOCAL ORGANIZATION AND PERCEPTIONS OF BENEFICIARIES

The main purpose and justification for the Cusichaca Trust's agricultural rehabilitation project was to alleviate the poverty being experienced by a present-day Andean community in an area known to have had adequate infrastructure capable of producing a large agricultural surplus in pre-Hispanic times (Fig. 2) (Kendall, 1991a). Much of the lower Cusichaca Valley (Fig. 3), which had been so intensively farmed in the Inca period, was abandoned shortly after the Spanish conquest. It was subsequently sporadically farmed by religious organizations of

the Catholic church, which acquired the lands and incorporated them into their large estates, in this case the *hacienda* of Sillque, located up-valley in the Urubamba Valley. In the mid-18th century the saturation and collapse of the maize market and its transference from Cuzco to Cochabamba in Bolivia (and the rise of the Mexican and North American markets) brought in a history of poor investment. From the early 19th century the area was taken over by individual landowners who brought in Quechua-speaking settlers from further up and down the main valley to re-occupy the lower part of the Cusichaca Valley. When the project members arrived in 1977 the 8–16 families living in San José de Chamana were part of a private hacienda and owned little or no land of their own. The latest arrivals to Chamana had come from Maras with the new *haciendado* (landowner) of Chamana in 1956. These two men

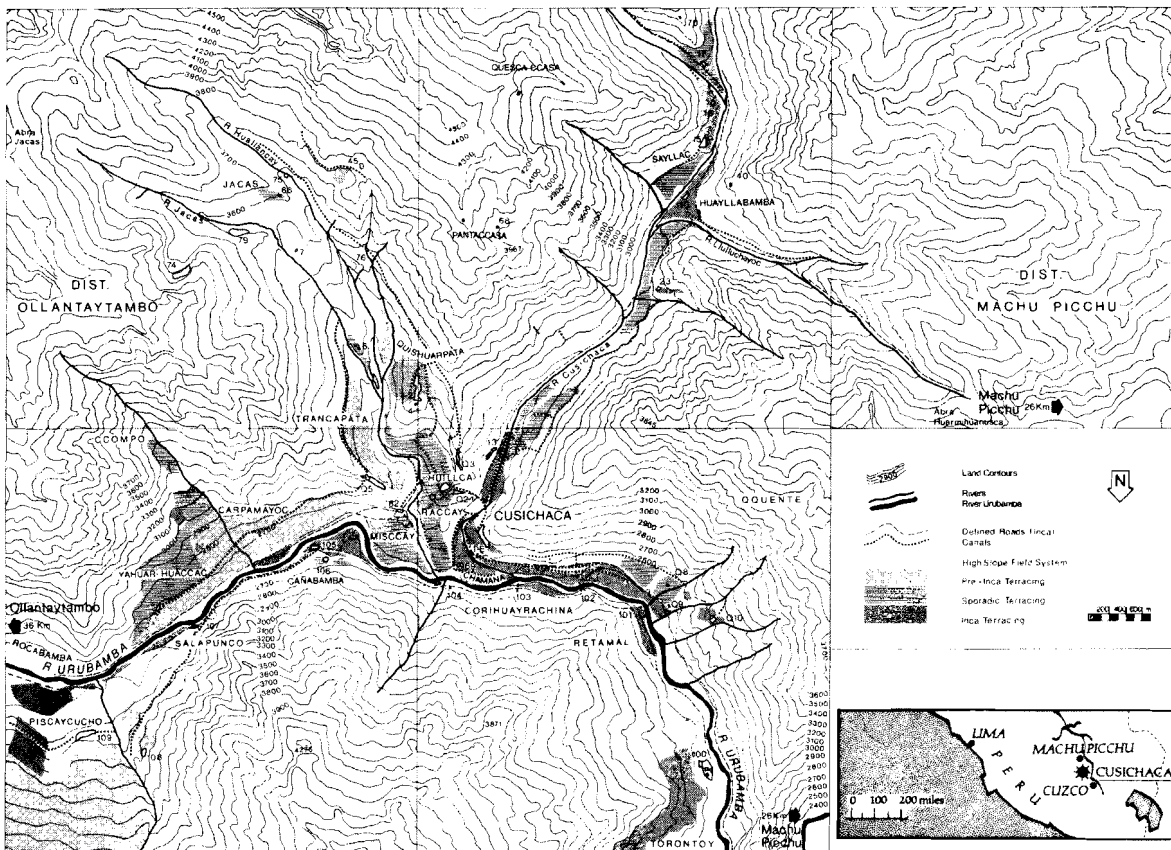


Figure 2. Map showing the present-day communities and late pre-Hispanic sites and land systems in the Cusichaca and Huallancay drainages. Source: Kendall (1984: 259, fig. 3).



Figure 3. Inca settlement and terracing at Patallacta, Cusichaca (background), with a Chamana household in the foreground, 1978. Photo: A. Kendall.

had intermarried with local women and, in the 1980s, became the dominant representatives of the growing Chamana community.

In 1980 the entire Cusichaca valley was occupied by only 145 families, with Huayllabamba in the mid-valley being the oldest and largest community of the area, where some 50 families continued to live on top of a small Inca site that their ancestors had reoccupied in colonial times. The history of poor investment and severe post-conquest depopulation brought about a major decline in the traditional agricultural systems as landowners increasingly leased out parts of their properties and were no longer concerned with maintaining irrigation to terraces or retaining a strong labour force. The majority of the indigenous population had neither the time nor the inclination to maintain the agricultural infrastructure on land they no longer owned and, as a result, the community organization necessary to sustain repairs had

broken down. It was partly for such reasons that the Peruvian government implemented the Agrarian Reform, starting in 1964 under President Belaunde and greatly extended under the military government headed by General Velasco Alvarado (1968–1975). These reforms promised to return large tracts of land from hacienda estates to the ownership of indigenous communities and co-operatives. They were partly motivated by social concerns, to alleviate the exploitation of the campesinos, but it was also hoped this would lead to increased agricultural production, which was much needed by the growing urban population. It was to have the opposite effect and subsistence agriculture became even more predominant in the highlands. Although these reforms began in the 1960s, they took many years to implement in places such as Chamana at some remove from the regional political authorities. For instance, Huayllabamba became legally recognized as an indigenous

community, independent of the largest local hacienda at Quente, only in 1980 (Villafuerte, 1981).

At the start of the project Chamana householders continued to work as retainers on the lands of the *haciendado*, while other households at Quishuarpata and Chakimayo were somewhat more independent. After the *haciendado* moved out, the small-scale agricultural households with very little or no irrigated land, were busy during the rainy season but had two months with little agricultural work during the long dry season.

The Cusichaca Trust recognized that the process of explaining and implementing a redevelopment project was complex and could unwittingly aggravate multiple tensions rooted in territorial concerns and distrust between local interest groups. Andean peoples have suffered a long history of reorganization and manipulation by colonial authorities, national governments, landowners and the Church. These feelings of uncertainty and mistrust had been exacerbated by raised expectations, but slow implementation, of the recent Agrarian Reform. In the case of Chamana there had been recent deception and broken promises during the negotiation of land deals with the last hacienda owner. The presence of the Cusichaca Project itself was probably a major concern for many community members. This consisted of a large multinational team of up to 80 people camping on community fields for two to three months each year, which in the early years included members of the British and or Peruvian Army. To the new owners of the Huillca Raccay and Quishuarpata tableland terraces, the Cusichaca Project was offering residents the chance to improve their quality of life through increasing the productivity of their lands and access to increased income through the selling of the expected surplus at accessible markets down valley (Villafuerte and Saico, 1980). However, at times there were differences in understanding between the type of practical and theoretical points prioritized by the project and social concerns and the more immediate practical priorities of local community members.

While the group of farmers never lost sight of the opportunity being offered to them, their caution was understandable. In a culture where constructing terraces, canals and field boundaries can be used as justification for land ownership, the farming

community of Chamana was understandably wary about the intentions of a development project wanting to improve their land. Concerns included who was going to do the work? Would the project contract workers? If some workers should have to be brought in would they try to claim land rights? Basically the project had to earn their trust and clarify that the work would be carried out together with the community group, taking on board their concerns since they were the owners and would remain the owners. No-one could take away their lands if they formalized their status as a legally recognized 'Grupo Campesino'. Although their procedures to become a legally recognized community were initiated in 1979, Chamana did not fully achieve this status until 1987.

THE RESTORATION PROJECT

In the pre-Hispanic period there were some 6000ha of land under cultivation in the wider area of the Cusichaca Valley to the confluence of the Urubamba valley with the Anta valley (today the District of Ollantaytambo, which has the remains of the infrastructure of some 2500ha of Inca and pre-Inca irrigated terraces and 3200ha of high slope field systems), and were capable of feeding some 106,000 people (Fig. 2). The population in the Inca period was much the same as in 1989, about 8500 – discerned from archaeological reconnaissance of the area and aerial photographs. This suggests that about 95% of the produce could have been exported (Kendall, 1991a). However, in the 1970s very little was being exported because of the poor state of the infrastructure, transportation problems and low incentives because of the low price achieved by agricultural produce in the market place. Since the Agrarian Reform, sporadic attempts had been made to restore some old irrigation systems or build new ones. Such works usually used modern materials, for example cement, which often proved unsuitable because of inherent earth movements, a lack of flexibility and the costs and maintenance requirements placed on the community.

Terrace systems are a valuable resource against soil erosion on steep slopes. These systems had been developed, over thousands of years, as a strategy against the risks of variable precipitation, frosts and hail storms that damage agricultural production and food security (Kendall, 1997).

Four main types of terracing were documented in the Cusichaca area:

- The 79ha of high quality Inca agricultural terraces (AD 1440–1532) with integrated irrigation systems were constructed like level platforms, with inclined double-faced stone walls and some stone fill for drainage (see Fig. 1). A special feature is the retention of water/humidity, which encourages the transformation of the soil through microbiological activity and the increase of nutrients, encouraging heightened temperature (a great way to diminish climatic risks) and recycling of nutrients, which can enable continuous cultivation (Kendall, 1997; Kendall and Rodríguez, 2001).
- Inca-period rehabilitation of the late pre-Inca irrigated terracing at Huilca Raccay has some similar features to the Inca terraces but a single stone-faced support wall and less attention to drainage needs.
- Pre-Inca (c. AD 1000–1440) irrigated agricultural terracing is most visible today where 195ha survive on steep slopes up to 3700m a.s.l. Many of these terraces were constructed following the slope contours and built up at the lower end where the support wall is of the single stone-faced type.
- Although difficult to date, there is also a large amount of low-investment unirrigated terracing located on high gradients above settlements formed by stabilizing natural soil erosion through the compacting of the top soil at the lower end and placing occasional fieldstones and vegetation to encourage the formation of natural banks.

Changes in the size of the indigenous population and their social organization have had a radical effect on the construction and demise of these agricultural systems (Kendall and Rodríguez, 2001). In Inca times the *mit'a* public workforce undertook much of this construction work and local overseers were in charge of canal maintenance and use. Following the Spanish Conquest of 1532, disease contributed to the decimation of the population, administrative breakdown resulted in a lack of investment in land improvement and maintenance, and changes in land use led to the deterioration of the canals and terraces. The

introduction of large-hoofed animals from Europe, such as cattle, horses and goats, replaced the delicate-footed camelids. These newly introduced animals grazed near water sources such as canals, resulting in significant damage to both the terraces and canals. In the 1980s studies by the Oficina Nacional de Evaluación de Recursos Naturales (ONERN) estimated that between 50% and 75% of terraces had been abandoned. In some areas the work of looking after community resources, such as irrigation systems, was incorporated within the political and ritual organization of native communities, where all households are obliged to work on canal maintenance at least once a year (Isbell, 1985). For instance, in Andamarca, Carmen Salcedo, Department of Ayacucho, strong commitment and enduring forms of social organization have enabled communities to continue effective maintenance programmes to keep their pre-Hispanic agricultural infrastructure in working order. However, in many other areas, the discouragement of native social and ritual practices and the imposition of external landlords meant there were no longer any social structures in place for the up-keep of the canals.

It is not surprising or untypical, therefore, that the households dispersed around Chamana had no political organization or religious institutions. The 'economic standing' of Andean peasant households is based on the extent and quality of their land holdings, their livestock, the size of their family, their ability to call on external labour and their social obligations. In order to improve the economy of the households in Chamana and the rest of the valley, the Cusichaca Project hoped to bring the community together in a cooperative labour project that would both improve the annual yield from the land and help to develop the social organization and the skills needed to maintain the canal system in the future.

In the Cusichaca area, most of the terrace systems, including some pre-Inca ones, were found to be in a remarkably good state of preservation, but some of the major irrigation canals had irretrievably broken down, causing their abandonment. The most important irrigation system to have broken down was that of the Quishuarpata canal that had irrigated the pre-Inca and Inca terraced lands of Quishuarpata and Huilca Raccay, totaling 45ha. All these lands

could come under permanent agriculture again if the canal were to be restored.

At the time this was the only substantial area of land available to local people since other lands were farmed by the two privately owned haciendas. However, local people lacked the community organization and cohesion required to restore and manage the canal facilities. It was therefore decided that while on-going research would focus on the wider area, feasibility studies for the agricultural restoration project would focus on the Quishuarpata canal.

It was in this context, initially as part of its archaeological research, that the Trust investigated the Quishuarpata irrigation system and its development over a period of 1000 years (Kendall, 1991b). The investigation led to an experimental programme for its restoration. The aim of reactivating productive terrace agriculture was a strategy to alleviate poverty and improve the availability of good agricultural land in the area. The Peruvian archaeologist Julio C. Tello said in the 1960s: 'Estudiar el pasado para comprender el presente y planificar el futuro' ('Study the past in order to understand the present and plan for the future'). We found this to be a two-way benefit – that in gaining an understanding of the present to help plan for the future, this statement could be reversed: the information gained in the present, in the agricultural restoration projects, also became a feedback to help in the interpretation of the archaeological data.

BACKGROUND TO THE RESTORATION PROJECT

Study of the terrace systems

From 1977 the archaeological reconnaissance work was combined with agro-ecological studies, vegetation and soil studies, as well as small remedial support projects to assist local families in the maintenance of a few broken-down canals. Some aspects of the archaeological research were specifically designed to investigate the ancient agricultural technology, including studies of the main canal route, the complex engineering to control water velocity and its distribution (Farrington, 1984) and terrace construction in relation to present-day soil fertility (Keeley, 1980,

1982, 1984). Sociological and anthropological studies provided socio-economic evaluations of local commerce and the potential of wider markets (Michel, 1981; Villafuerte, 1981). These studies were necessary to evaluate whether or not the reconstruction of the ancient systems would provide sustainable agricultural land, whether the local residents would use these fields and whether there was a viable market for the increased production.

In the restoration of the Quishuarpata canal, traditional technology was studied and used as far as possible, using the main known and verifiable locally available materials of stone, sand and clay. These materials are freely available, thus ensuring that the community will be able to maintain the technology whatever their economic status. Canals built using traditional Inca techniques have also proven to be very effective in accommodating the extreme changes in temperature and humidity that occur in the Andean highlands (Kendall, 1997). However, it was not possible to be certain what other special materials or ingredients had been included in pre-Hispanic mortar mixes. It was later learnt that the juice of the cactus *gigantón*, could be mixed into mortar for maintaining dampness (Ignacio Aragon, mastermason, personal communication, 1983) and llama grease has been found plugging gaps between stones of an Inca canal in the Calle Loreto, Cuzco (Hernan Aráoz, personal communication, 1995).

By 1980 the technical feasibility studies for the rehabilitation project were in place. This included the hydraulic engineering studies undertaken by Binnie and Partners (Green, 1978; Becerra, 1982), and topographic studies by the British Army logistical support team. Studies of the main Huilca Raccay terrace system involved excavations, which showed that although the soils were deep and had a good structure, in order to reach appropriate fertility with irrigation they would need manure to increase the nitrogen content and provide organic material. Further test pits to study the water distribution systems and the stability of the terraces revealed that some banks contained several support walls and rubble. This interpretation was confirmed by discussing current practice when working with the community in the preparation of the land for agricultural use: local farmers removed stones from the land and threw them in front of the terrace walls. In past maintenance, these stones would, at intervals,

have been reincorporated in an eroding wall or been reabsorbed by the bank. Additionally working with local people on three canals that had been kept in operation demonstrated continuities in indigenous knowledge and technological ingenuity in handling local materials (stone, sod and wood) for undertaking temporary maintenance works.

Community response

In 1980, after the basic research and feasibility studies had been completed, the project awaited the decision, or initiative, of the community group to start work. For some time there had been no sign from them and the impression was that there must be some continuing mistrust in relation to the motives of the heavily foreign interests of the project. Project personnel became increasingly despondent towards the end of the 1980 season when there was still no sign of a positive move by the community. But then Pancho Candia, the owner of terraces at the top of the agricultural system at Quishuarpata, who had consistently shown interest in the project, complained that much talk and study had taken place in offering to restore the agricultural system but there was no sign of the work starting. He, personally, was waiting for the project to begin, time was passing. This was what was needed to justify making a real move to implement the project. In a position at the top of the system his lands were in the right place to start the canal restoration – where the project must begin. No guarantees were in place for the rest of the community following suit, but if this first stage was carried out successfully with local participation, there could be no better argument for attracting the rest of the community in further stages of the project. It had already been realized that the work would take place during the dry seasons in stages over several years (during the wet season the demands of agricultural work meant that the farmers would not have time to give to the restoration project).

1981–1993. EXECUTION OF THE PROJECT

In 1981 the canal was restored from the third of the four original secondary intakes. The digging out and consolidation of 3km of canal, including the restoration of four fallen sections and of the drop

structure, brought water directly to Quishuarpata. In 1982 the 2km to Huillca Raccay was completed. In 1983, following confirmation that the canal was functioning, work continued to extend the reconstruction back to the canal's original intake off the Huallancay river, at 3700 m.

In 1981 when a contract was signed with Sr. Candia, in which he became responsible for the cleaning of the canal and taking on his team of workers, the project lent him S/150,000, equivalent to US\$300.00, to be reimbursed from his first harvest. This he honoured. The clearing and cleaning work was carried out by his workers who were given food during the *faenas* (community workdays) (Fig. 4). At the start of the work Candia advised that it was necessary to carry out the appropriate rituals and he undertook to provide the necessary prepared offerings for the local



Figure 4. Community farmers participating in the clearing of the canal at Quishuarpata, 1981. Photo: D. Parker.

deities to ask for their blessing through a shaman or curer. After these offerings were made the work proceeded as planned.

As expected, in September the agriculturalists were obliged to return to preparations for their main sowing season. However, given that the project had a permit and joint agreement with the National Institute of Culture (INC) and had the organization, materials and operational funding for transport and to pay for workers, the INC agreed that their mastermason and his local team of restorers could work for a week on each of the fallen sections to Quishuarpata. Ignacio Aragón, a very experienced mastermason on restoration projects, with an excellent knowledge of Inca and traditional building methods and materials, had offered to work with the local community on restoring and conserving the canal, building on local knowledge and ingenuity. This allowed the project to work with and train local people in the necessary skills, rather than buying in outside labourers. He helped them to identify appropriate raw materials of clay, sand, sod and stone, all of which were locally available. Generally the principles of traditional technology were observed closely but his knowledge of modern mixes also led to some incorporation of a cement mortar in two sections subject to soil erosion, identified by the irrigation consultants from Binnie and Partners. A graduate student of hydraulic engineering from Wageningen University and a local student agronomist were taken on to help co-ordinate and to complement the work at Quishuarpata. All this resulted in the achievement of this first phase of restoration work by November 1981.

In 1982, from January to April, further cleaning of the canal was carried out. At Quishuarpata, Candia's son-in-law moved to establish his family there to take full advantage of the newly irrigated terraces and support. The successful re-establishment of irrigation to this point attracted the full interest and participation of the rest of the community. The dry season saw the continuation of restoration works down the second drop structure to Huilca Raccay. For its inauguration in September, the canal carried water for irrigation to prepare the terraces for plowing and sowing of a potato crop (Fig. 5). Inaugurations in Peru are seen as important occasions for asking favours of institutions and prominent regional administrators. This



Figure 5. The arrival of irrigation water at the Huilca Raccay tableland and terraces, showing the restored second drop structure in the background. Photo: A. Kendall.

inauguration achieved the distinction of attracting acceptances from sufficiently empowered dignitaries who were able to further ensure the future socio-economic success of the now irrigated terrace systems; these included the Prefect of the Region, the government head of the Ministry of Industry and Tourism, the local Mayor and agronomists from the Faculty of Agronomy for Agricultural Research (KAYRA) at the National University San Antonio Abad of Cuzco (UNSAAC). This led to two important commitments: the action group Cooperación Popular was sent to build a new bridge over the Urubamba River at Km 88 (distance on the railway from Cuzco), to enable the valley inhabitants to export their produce as well as to provide access for tourists to the famous Inca Trail to Machu Picchu; and KAYRA was to play a vital role in providing agricultural extension support, especially for the

community in a pilot scheme for the rehabilitation of the terraces of Huillca Raccay.

In 1983, during the final year of the canal restoration work in which the Quishuarpata canal was extended back to the upper reaches of its original intake off the River Huallancay, it was the local people who took over and ran the implementation of the project with their own foreman supervising the 20–25 local workers. Work was coordinated with the INC for the clearance of vegetation, digging out, consolidation and restoration work, tasks which were accomplished without difficulty. In October the canal became operative in its entirety and has remained so to date.

1983–1985. REHABILITATION OF THE TERRACES: 'THE ANDEAN AGRICULTURAL PROJECT'

A pilot area of 7ha of terracing was initially set up as a trial. The general objectives were to be achieved through the support of tools and seed capital supplied by the project and KAYRA, technical assistance through the visits of agronomist, Andrés Peña and, most importantly, the community's own manual work to improve their quality of life by the appropriate

cultivation and care of the newly restored terraces (Figs. 6 and 7). Improved production, agricultural job creation, diversification, improvement of dietary choice and commercialization of surplus production would result from their own endeavours, leading to increased earnings and socio-economic development.

The experiments supervised by Peña took place over three years on terraces that had been abandoned for over 20 years. Prior to this abandonment they had only been cultivated with barley on a fallow system, and prior to that had supported, under irrigation, the more intensive cultivation of crops such as maize from pre-Inca times until the 19th century. Six varieties of *kiwicha*, a highly nutritious native Andean grain under redevelopment at KAYRA, were introduced. This proved to be an ideal habitat for the crop, which came to be more widely re-introduced. Varieties of cleaned Andean cultivars of the tarwi bean, quinoa grain and potatoes were distributed to complement local maize in a carefully monitored crop rotation, also combining with colonial introductions such as barley and broad beans. KAYRA was also concerned to assess the need for fertilizers and pesticides in relation to performance results.



Figure 6. Community agriculture starting up on the Huillca Raccay terraces. Photo: A. Kendall.



Figure 7. Maize planted on a terrace at Huillica Raccay, 2000. Photo: A. Kendall.

Results and recommendations were obtained both for community use and feedback for the university (Peña, 1985, 1986, 1987). In summary, the monetary value of the seed capital and labour input value trebled in the first year, enabling the programme to be widened. In the second year, community conflicts began over sharing out land and keeping animals out. Some hybrids required more fertilizer and were not resistant to pests. There were also problems with transportation for exporting the surplus. The internal conflicts intensified during the year following completion of the restoration work of the project until the farmers realized that the responsibility was entirely theirs and tackled the problems themselves by dividing the land between the different extended family groups, creating boundaries to keep the animals out.

EVALUATION VISITS

In 1992 an evaluation visit, as one of the field trips associated with the Seminar 'Infraestructura agrícola e hidráulica prehispánica. Presente y futuro', was organized by Cusichaca Trust. This visit to Chamana was undertaken to see the state

of the canal and the productivity of the lands on the terraces (Kendall, 1992) (Fig. 8).

It was appreciated that the entire upper tableland was under cultivation and the lands were divided between three extended family groupings. Each had constructed an enclosure to keep out free-roaming animals. The restoration of irrigation had resulted in a significant increase in the percentage of production of maize, potatoes, quinoa and broad beans, products that were being sold in Machu Picchu, Ollantaytambo and Urubamba. An Irrigation Committee, formed in 1983, had successfully maintained the canal, although an overenthusiastic use of cement was noted. The irrigation committee reported that they suffered from a lack of sufficient power to obtain adequate attendance of community members on communal maintenance days to do the work and collect quotas to buy the materials wanted. The Seminar group pointed out it was clear the cement reparations were already cracking and that this problem would be solved with a reduction of dependence on the use of this costly, brittle material and a return to the more appropriately flexible clay with stone, available locally. Further recommendations included reduction of the wear and tear in the main canal by



Figure 8. View of the agricultural rehabilitation of the Huilca Raccay tableland, 1991. Photo: D. Drew.

diminishing the flow of water when irrigation was not needed. The community was farming all the irrigated areas successfully and had plans to further extend them.

The community members' feedback focused particularly on the question of productivity versus costs and the role of fertilizers and pesticides. They said the rehabilitated lands on the tableland were more productive than the lower lands of Chamana (not in the rehabilitation programme). This was because fewer chemical fertilizers and pesticides were needed. Their input of work and investment on the rehabilitated lands was therefore more economic, but it was still relatively low because of low market prices and use of some chemical products. For this reason they wanted to know more about compost and other economic farming methods. The use of seeds appropriate to the area was recommended in preference to hybrids, which required the input of expensive fertilizers and herbicides.

An important measure of the success of the project and strengthening of the community over

the period of the project was that the school expanded from a single-room thatched structure to the construction of substantial buildings comprising four classrooms. The 1992 visit also confirmed the overall stimulus generated by the rehabilitation project: in 1987 a new chapel was built beside the school by the community of Chamana and another canal was restored in a locally organized project activated by the largest single local landowner. Finally, it was reported that no one had migrated out of the area. On the contrary, local sons had brought home brides and daughters husbands, which contributed to an increase in population. The usual lack of resources and microeconomic problems (amongst others), which were combining with the problems of social unrest to provoke urban migrations throughout Peru at this time were not so apparent at Chamana. Unfortunately, though, a storehouse for potatoes provided with windows for diffuse light (based on Inca precedents) went through a major change of function – it was adapted for use as accommodation!

In 1998, a brief evaluation visit by the Agronomist Juan Guillén, found that the canal was still benefiting 13 families in Chamana and three families in Quishuarpata, with sufficient irrigation water and soil fertility to permit up to three crops a year, in some cases incorporating horticulture. These beneficiaries were intensively farming the terrace soils recovered from sporadic pasture. Even two crops a year is exceptional today in the Andes, here two crops a year had become the standard.

A minimal use of fertilizers was also recorded and local people were found to be following traditional agricultural practices, mixing plantings of maize with beans and quinoa with rotations practiced for nitrogen fertilization of the soil. There was limited use of modern fertilizer for mixing with natural manure for some improved cultigens, which were more demanding. The Irrigation Committee had been strengthened by being taken directly under the wing of the community directorate. They had introduced twice yearly cleaning and maintenance works along the entire canal. An impressive gesture of support had been made by the local office of the National Police at Corihuayrachina, who provided the traditional feast to the voluntary workers. Food security was assured by major crops of maize, followed by horticulture and wheat, and the market at Machu Picchu was a secure one for surplus early maize and potato crops. Local people reported that they could now afford improved medical treatment and education in local towns.

In 2000, a socio-economic study commissioned by Cusichaca Trust found the project to be 80% successful in completing its objectives. It was, however, disturbing to hear that as a result of a major landslide down the railway line there were transport restrictions on taking surplus produce to the preferred market in Machu Picchu. This was because the railway was prioritizing tourism under its new foreign ownership. Produce had to be taken further afield, up the line by pack animals and transport to the more competitive market of Urubamba. This is expected to be a temporary situation until local trains can be reinstated to reach the down-valley markets of Machu Picchu, Santa Teresa and Quillabamba; however, it could be restrictive if not resolved.

IMPLICATIONS OF THE REHABILITATION WORK IN THE CUSICHACA VALLEY

Indigenous pre-Hispanic technology in the Andes developed in economic and social circumstances very different from today. We must take account of these differences. Firstly, the workforce is no longer the same. In Inca times the *mit'a* workforce and water management was in operation, which demanded community participation; this continued to be enforced through laws during the colonial period and water 'judges' continued. However, both these systems of state organization for water management have collapsed, and local community structures for organizing work parties for canal cleaning and maintenance have deteriorated, particularly accelerating since Agrarian Reform when the migration to urban centres resulted in a major loss of infrastructure and community organization. Secondly, the interaction of community *faenas* with religious festivals for the agriculturalists, especially water maintenance with supporting rituals and feasting, has been broken down by the intervention of other interests, including Adventist religions in competition with Catholicism who denounce the consumption of alcohol resulting in reduced community sponsorship (Mitchell, 1991). Today, the organization of communal work parties is severely limited. Migration to urban centres, weakening rural infrastructure and community organization are continual problems. Loss of management is particularly noticeable in the lack of integral planning at the local level, leading to conflicts between animal husbandry and the needs of agriculturalists.

Better transport facilities providing greater access to markets are now becoming available in many, but not all areas, although these can be costly to use, limiting the economic benefits that this greater access to markets should bring. The facilitation of travel can also facilitate technical developments, although these are not always in the best interests of the rural poor. For instance the import of chemical pesticides and fertilizers is harmful to the biomass system inherent in the terraces, and cement is inflexible in seismic areas and not environmentally friendly in maintaining some humidity in the soil to support a diversity of flora generally below irrigation canals.

Two major constraints on highland farmers redeveloping their terraces are: firstly, the distance to markets – particularly for isolated communities with inadequate transport access to their terraces; and secondly, the low sale price for agricultural produce as a result of the government's importation policy of key basic foods, such as rice, pasta and even potatoes, which have sometimes also been subsidised or donated by 'Northern' countries. While these problems can be seen as almost insuperable for surpluses destined for commercialization, there are incentives for well-placed communities with irrigated terraces located between 2100 and 3600m a.s.l. to provide one main harvest a year. This is indispensable to ensure a healthy nutritious diet for family self-sufficiency. In addition, two different harvests a year using the rotation system are also possible in the right locations, but is a more risky strategy in exposed or relatively high locations and where the climate is more variable, being subject to frosts and hailstorms.

In the Cusichaca experiment to apply the lessons learnt about traditional technology from archaeological and anthropological investigations and related disciplines, there has been a considerable level of success. This could encourage further experimentation and development leading to an implementation model for agricultural restoration by rehabilitating the past infrastructure and traditional practices. Successes and demonstrated concepts resulting from this experiment include:

- The practical application of results from archaeological investigation has contributed to providing sustainable social and economic benefits.
- The technical feasibility of re-establishing irrigation in a pre-Hispanic canal using traditional technology was demonstrated.
- 17 poor farmers of Chamana received agricultural extension training, which they applied to achieve two, and sometimes three, crops a year using irrigation and rotation of crops on terracing.
- The sustainability of the project is demonstrated by socio-economic evaluations.
- A spin-off from the organization of community workparties for logistics and restoration was

that local communities, especially Chamana, became more unified and developed stronger political entities.

- The evaluations also list the ways the economic and resulting social benefits have empowered the community and its leadership to take initiatives to improve their organization and quality of life: by improving the school and building a chapel.
- The restoration and rehabilitation experience can be considered a positive preliminary experimental step in addressing the wider redevelopment of abandoned pre-Hispanic agricultural systems in the Andes.

From the achievements of this initial experiment outlined above, the following discussion examines how the Cusichaca Trust has sought to and will continue to take the concept further forward.

FURTHER DEVELOPMENTS

It was hoped that the Cusichaca experiment would be an effective demonstration to encourage further rehabilitation of abandoned canals and terracing using traditional technology. But we soon learnt that this was to be only a first step to achieve this objective. It did, however, result in invitations from other communities to work with them on more ambitious projects involving hundreds of farmers, and a chance to continue learning and developing a model with which to interest government institutions.

In the Cusichaca Valley it was possible to support only one sector of farmers. Thereafter, the Cusichaca Trust developed projects with varied programmes extending more widely to poor farmers throughout valley systems, additionally involving potable water, health and nutrition, and technical workshop and cultural centres. Such a project was carried out between 1987 and 1997 in the Patacancha Valley based on Ollantaytambo, and subsequently from 1998 in the Pampachiri Project in Andahuaylas, Apurimac. In both locations it was learnt that when it comes to the social aspect, the degree of participation by the community in the agricultural restoration work, its management, budgeting for maintenance, foreseeing the potential production and income generation, is essential for efficiency and sustainability.

Since 1992 ten major three-day seminar workshops have been held in highland capitals and towns to disseminate the results, advantages and benefits of traditional agricultural technology. Since 1997 these events have sometimes been in partnership with the Ministry of Agriculture's active arm Programa Nacional de Manejo de Cuencas Hidrograficas y Conservacion de Suelos (PRONAMACHCS), who have extended their work on the prevention of soil erosion to terracing restoration projects working with local conservation committees since 2001 with the Programa de desarrollo rural del valle del Colca (DESCO) who have restored 8000ha of terraces in the Colca Canyon, specializing in working with the communities; and the International Center for Agricultural Research in the Dry Areas (ICARDA) who have contributed to the study of socio-economic aspects with Cusichaca and, since 2002, also with the experienced Andamarca Community. Many smaller one-day events have also been held.

Following the seminar-workshops and practical experience, it is now felt that the way forward is through counteracting the increase in general rural social disorganization by encouraging new initiatives for leadership training and social development. At the same time there needs to be an emphasis on prioritizing the strengthening of agricultural organization. The focus should be on re-introduction of the social 'irrigation culture' to manage and maintain the valuable infrastructure, clarifying and supporting property rights and responsibilities. Community cohesion is required to carry out the routine tasks of maintenance, allocation of pasturing locations and dates, and the repair of the irrigation and terracing works. The Cusichaca Trust will continue its seminar programme and focus on more demonstration projects. The local NGO, Asociación Andina Cusichaca, is being established independently and more energy will need to be directed to advocacy, market research and disseminating results to the government and NGO institutions.

It is intended to continue to work from 2003 in Ayacucho and the Apurimac regions, using the example of the Andamarca community, an indigenous community whose social organization and ritual calendar is geared to, and has successfully maintained, their intensive concentration of pre-Hispanic terracing systems. Interaction between

indigenous communities, who can demonstrate different skills and management strategies to each other, is the best way to stimulate wider appreciation of Andean technologies and ensure their continuing relevance. In many areas of the highlands where farmers currently depend for cash more on herding interests (requiring relatively little input), integrated actions between agriculturalists' interests and herders will add to cohesion within communities.

Finally, from the original project and more recent experiences of Cusichaca Trust, PRONAMACHCS, DESCO and some other NGOs, Andean communities have demonstrated that they can apply their traditional technology with some social and economic innovations to restore the pre-Hispanic agricultural infrastructure of irrigation canals and terraces to significantly increase their economic potential. Questions remain concerning how to bring together the government institutions, NGOs and communities on resolving issues of procedure, technical standards, community participation and marketing. The most important players should be the INC and the Ministry of Agriculture, who need to define the steps and methods to be used for regaining this national agricultural heritage. In some locations there is a groundswell of interest in terracing restoration in Peru. Few NGOs work in this field, but it is expanding so standards and training are much needed.

CONSERVING ARTEFACTS AND MAINTAINING INDIGENOUS COMMUNITIES

In recent years the philosophy of archaeological conservation work has tended to be critical of projects that reconstruct ancient sites, there has instead been a much greater emphasis on preserving and displaying as much as possible of the original structures. The Cusichaca Trust's work to rehabilitate pre-Hispanic terraces and canal systems may be considered as a direct challenge to this conservation philosophy. Although, wherever possible, the stones were replaced in their original position after clearing and cleaning, and some special sections might be dismantled and carefully rebuilt, much of our work required reconstructing terrace walls and canal channels that involved adding new stones, mortar and clay linings.

However, without our interventions these structures would continue to deteriorate and to erode down the steep slopes of the valley. More importantly, our work was designed to rehabilitate these structures as part of a working agricultural infrastructure when functioning irrigated terraces are still the most productive agricultural use of the landscape, and this technology is ideal for the wider conservation of the environment. This draws attention to a potential distinction between conserving the ancient artefact as an original monument as opposed to maintaining the traditional technology within its live social context—it also raises the question of the incorporation of other technologies.

This latter theme was discussed at two seminars organized jointly by the Cusichaca Trust and the National Institute of Culture (INC in Cuzco) in 1992 and 1995. At both of these meetings the point was made that although the continual rebuilding and maintenance of canals and terraces may not be considered as the authentic, original artefact, nonetheless this maintenance work, which must also have taken place during pre-Hispanic periods, is essential to preserving the structures intact and maintaining Andean agricultural practices as a part of the living cultural tradition and constitutes a live patrimony.

The Cusichaca Trust produced a short guide exploring how to organize rehabilitation work using traditional technologies and including some appropriate modern solutions to specific structural problems. This booklet has been distributed for use by other NGOs and communities (Kendall and Green, 1997). The issue of appropriate levels of intervention and the degree to which traditional methods of construction should be used needs to be adequately clarified between all interested parties so that standards of consolidation can be understood and applied by non-archaeologists. Generally the standards of conservation work laid down for the preservation of ancient monuments need to be adjusted in relation to the active use of traditional and appropriate technology for the benefit of living communities in order to achieve the best solution for constructions where only a minimum of maintenance is possible and durability is essential. Non-archaeologists require an official guide for implementation of minimum standards that are acceptable to indigenous cultural heritage

interests, but archaeologists and conservators also require guidance in the function of agricultural infrastructures and how best to work *with* local communities to maintain traditional technologies. The INC recently participated in a further seminar held in Andamarca in 2002, and it is hoped that there will be further progress in developing a more dynamic approach to the conservation of agricultural infrastructures as working examples of traditional technology so that they can maintain their social and economic role into the 21st century.

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