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FARMER STRATEGIES IN REGIONAL AGRICULTURAL CHANGE. THE CASE OF COMMERCIAL POTATO PRODUCTION IN OXAPAMPA

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Abstract

Regional agricultural systems are continually constituted and reconstituted by the strategies of individual farmers as they draw upon, and iteratively change, the resources to which they have access, and the constraints to which they are subject because of their personal experience and their membership of a particular social group. One important factor in regional agricultural change is the propensity of farmers to experiment with and change their agricultural strategies. The range of potential experiments is, however, limited by what the farmer conceives as possible. Moreover, the potential long term success of such innovation depends upon the acquisition of accurate knowledge of the new crop and the environmental factors to which it is subject.

Examining the case of recent changes in potato farming in Oxapampa on the east slopes of the Andes, this paper demonstrates how this interplay between perceived possibilities, farmer experimentation and knowledge of the economic and ecological environment contributed to the rapid rise, and then fall, of potato cultivation. Implications both for the concept of adaptation and for the introduction of new crop technologies are discussed.

Compendio

Los sistemas regionales de agricultura son continuamente constituídos y reconstituídos por las estrategias individuales de los agricultores, conforme utilizan y cambian los recursos a los cuales tienen acceso, y a los factores limitantes de las que son objeto debido a sus experiencias personales y su participación en un determinado grupo social. Un factor importante en el cambio de la agricultura regional es la tendencia de los agricultores de experimentar y cambiar sus propias estrategias agrícolas. Sin embargo, el rango de experimentos potenciales es limitado por lo que los agricultores consideran posible. Más aún, el potencial del éxito a largo plazo de tales innovaciones depende del conocimiento preciso y cuidadoso del nuevo cultivo y los factores ambientales que lo afectan.

Examinando el caso de los cambios recientes en el cultivo de la papa en Oxapampa, en la ladera este de los Andes, este informe muestra cómo este juego interviene entre las posibilidades percibidas, la experimentación de los agricultores y el conocimiento económico y del ambiente ecológico, contribuyendo a una alza rápida y luego caída del cultivo de papa. Se discuten tanto las implicancias para el concepto de adaptación como para la introducción de nuevas tecnologías de cultivo.

Glossary of Abbreviations

BAP	Banco Agrario del Perú
CIP	Centro Internacional de la Papa
CIPA	Centro de Investigación y Promoción Agropecuaria
INIAA	Instituto Nacional de Investigación Agraria y Agroindustrial
INIPA	Instituto Nacional de Investigación y Promoción Agropecuaria
ONERN	Oficina Nacional de Evaluación de Recursos Naturales
UNA-La Molina	Universidad Nacional Agraria - La Molina

I. Introduction

That agricultural systems are also cultural systems, and that the agrarian environment is not only farmed, but also perceived (Brookfield, 1969), interpreted (Bennett, 1976) and made meaningful is an important if underemphasized recognition. It suggests that the way in which a farmer and farming group use an environment depends upon how they "see" it --what potentials they see, and what constraints they do not see having never before encountered them. This has implications for how we understand agricultural change-- both the change that occurs when the physical and economic environment change, and that which occurs when a particular group moves into a new environment.

Culture and environment are thus the context of human actions --but they are also constituted by those actions (Gregory, 1982; Giddens, 1979, 1984), and through this recursivity actions promote variation and change in culture and environment (Denevan, 1983). These changes then go on to form new contexts for subsequent actions, both by removing constraints, allowing what before seemed impossible now appear feasible, and by building new constraints. Adaptation to the environment is thus an on-going process with no given end-point (Ellen, 1982).

We should understand agricultural practices in this context --as growing out of the interplay between individual innovation and experimentation (Johnson, 1972; Richards, 1985; Franquemont, 1987), the agricultural orthodoxy of the social group of which the individual is a part, and the orthodoxies of the farming systems of other groups in the region. It is the intent of this paper to take this approach, using the example of recent changes in the agricultural system of Oxapampa, located on the east slopes of the Peruvian Andes. It aims to show (1) how different social and ethnic groups perceived the agrarian environment in differing ways based on their previous histories; (2) how the experimentation of farmers in one social group engendered change in another; and (3) how this change promoted practices that were in some sense out of equilibrium with the physical and economic environment. The resulting crop failures have fed back into the perceptual categories of the latter group and have undermined greatly the belief that the crop has any viable role to play in future agricutural strategies in the region. The emphasis in the discussion is upon the recursive relations between the actions of individual farmers and group level changes, and upon the interplay between "cultural" and ecological influences on the choice of agricultural strategy. The implications of this illustration are both theoretical and practical, for they exemplify the

dangers of promoting agrarian change too rapidly and with insufficient preceding empirical research.

Research for the study was carried out in the summer of 1986 with the assistance of the International Potato Center, Peru. It involved extensive interviews with local farmers covering a range in sizes of holding, and with agronomists, extension agents and officials of the National Research and Extension Institute (INIPA)[1], the Agrarian Bank (BAP), the Ministry of Agriculture and the local branch of the Proyecto Especial Pichis-Palcazu, a regional development project.

II. The Study Area

Research was conducted in the Province of Oxapampa in the districts of Oxapampa and Chorobamba, also using data concerning the district of Huancabamba. The most recent estimate available in 1981 put the combined population of these three districts at 19,606 (Rivera and Lopez, 1982). The town of Oxapampa is situated on the eastern slopes of the Andes, approximately 400 km north-east of Lima (see Figure 1).

Lying in the valleys of the Rivers Chorobamba and Chontabamba, the two major physiographic forms of the zone are the steep slopes of the valley sides and the valley bottom. The latter is relatively flat, particularly in the area of lacustrine soils around the town of Oxapampa. This causes waterlogging problems from December to April, and there is as yet relatively little drainage infrastructure. The valley floor is potentially very fertile being periodically refertilized by flooding in the area nearest the river. The soil analyses obtained by a few of the interviewed farmers suggest that the soils are rich in organic matter, lack only a little phosphorus and (down the valley in Llamaquizu) a little potassium, and that they are slightly acidic (see also UNA-La Molina, 1982:22). They are easily mechanizable in the valley floor.

The valley floors and lower slopes are the main area of potato cultivation. There is some cultivation on the higher slopes also, but ideally most of such areas should be forested or used for livestock according to the definition

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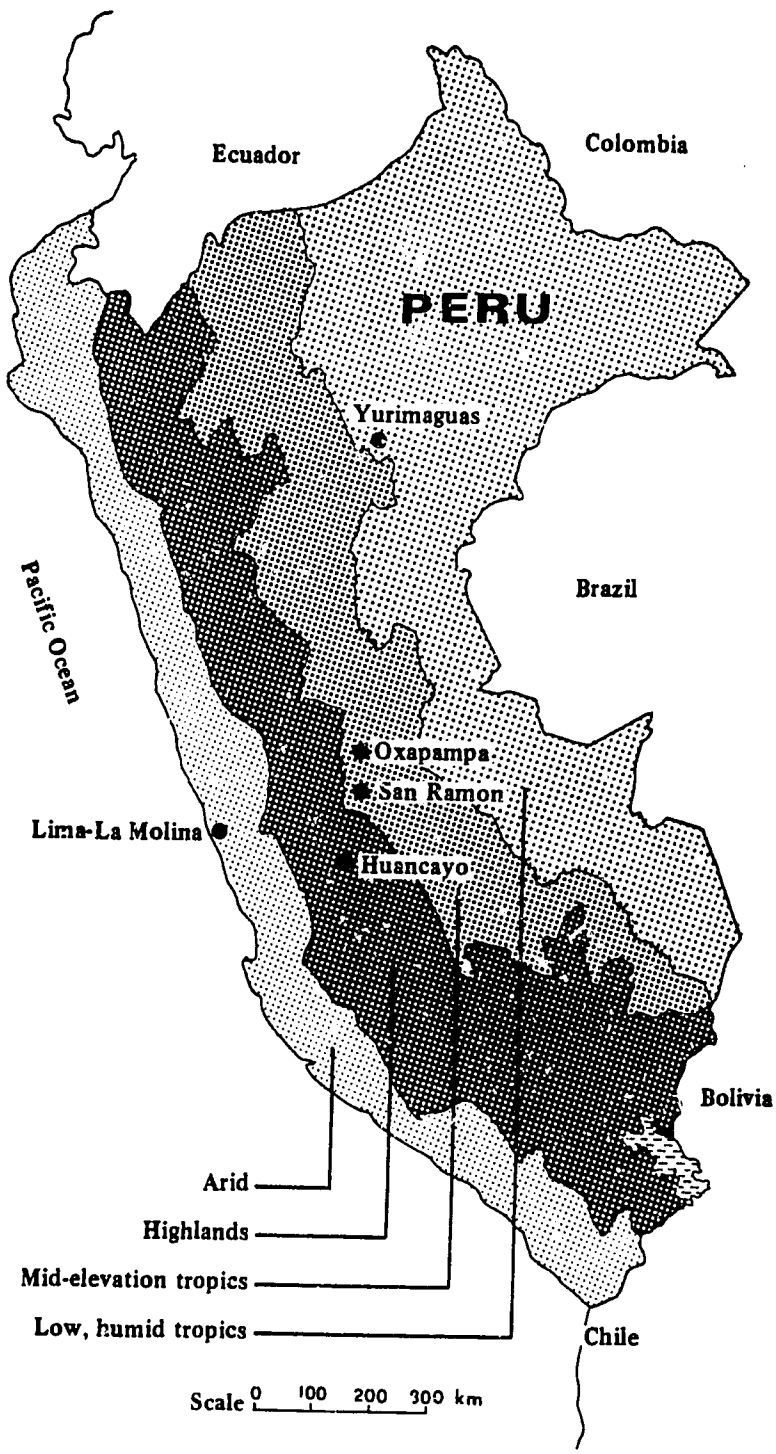
1. INIPA was recently dissolved in a reorganization of research and extension which gives the Ministry of Agriculture responsibility for extension and the National Institute for Agricultural and Agroindustrial Research (INIAA) responsibility for research.

Figure 1.



Source: Adapted from CIP Annual Report, 1986-87

of ONERN, the National Office for the Evaluation of Natural Resources. Erosion is a growing problem (Brack Egg et al., 1986).

a. Climate, Ecology and Basic Potato Production Economics

Located at an altitude of 1,800-1,850 m in the valley floor, Oxapampa has a climatic regime typical of the ceja de selva. Rainfall levels are highly variable from year to year (1,250 to 3,000 mm) and from month to month (Table 1). The intensely rainy season from December to late March can begin as early as October, and can end as late as April. Summer months, particularly June and July, are dry and can be very dry. After July, the norm is frequent rain with very warm sun immediately afterwards. The average annual relative humidity is high (Bockor, 1986). Annual temperatures range from 10 to 28 degrees centigrade, but mornings are often misty with heavy dews and occasional frosts (climatic data from KFW, n.d.).

Table 1. Climatic data from various sources for the Oxapampa region

	CIPA	KFW	Bockor
Annual temperature:			
minimum	12	10	11.2
average	19	14-24	15.5
maximum	23	28	20.9
Rainfall range	500-2,000	1,250-3,000	1,461
Relative humidity	-	-	97

Source: CIPA (1986), KFW (n.d.), Bockor (1986).
Notes: Rainfall data are in mm/annum. Temperature data are in degree centigrade. Bockor does not give a range of rainfall, just a figure for one particular year's measurements. Bockor's maximum and minimum temperatures are not directly comparable with the other two as they represent an average of all daily maximums and daily minimums recorded throughout the year. Dashes mean that there was no data from that source for that parameter.

The interaction of these climatic and edaphic conditions make the ecology peculiarly two-faced for potato cultivation. Certain factors would suggest that this should be

a highly marginal zone for the crop. The climate is conducive to late blight (phytophthora infestans; colloquially rancha) (CIP, 1983:18), a fungus that will destroy the crop in a couple of days after summer rains if fungicide is not applied immediately. Conditions also seem particularly favorable for the cut-worm (Agrotis spp.; colloquially, schiuri). The costs of controlling these pests can therefore be especially high. Along with high transport costs to Lima, and the costs of other inputs, this leads to high production and marketing costs (Table 2).

Table 2. Estimated production cost for 1986 from four different sources

Source (Oxapampa)	Total cost of production (Intis/ha)	Percentage costs of production constituted by herbicide and pesticide
BAP	23,000	25.5
Ministerio de Agricultura	23,104	19.3
Comite de productores de papa	27,570	28.7
CIPA	26,310	20.8

Source: BAP, Oxapampa; Ministerio de Agricultura, Oxapampa; CIPA (1986b).

The climatic variability also makes this a marginal zone. The worst scenario is that late rains delay planting, or occur after planting causing the seed to rot; that a dry summer then hinders plant and tuber growth; and that early rains in October then necessitate early harvesting or cause the tubers to rot in the ground.

Conversely, other considerations make this a potentially very lucrative zone for the potato producer. With the high temperatures and the fertile valley soils yields can be very high. While institutions speak of yields around 15 mt/ha, farmers quoted 20-25 mt/ha, and some claimed to obtain over 30 mt/ha. With harvesting concentrated in September and October, the crop reaches Lima towards the end of the coastal harvest and before the onset of the sierran supply -hence prices are generally good. Moreover, the crop cycle is shorter here than in the sierra by about a month meaning returns to investment can be recouped in as little as 3-4 months. Some farmers have made large profits in recent years.

This "two-faced ecology," and the farmers' perceptions of its implications for the cultivation of potatoes, are central in understanding trends in the cultivation of the crop over the last two decades, and especially since 1980.

III. Historical Changes in the Cultivation of the Potato in Oxapampa

Although the influx of European colonists was by then coming to an end, the post war period in Oxapampa has continued to be a time of change. The region has yet to identify a new economic base after the over-extraction of timber led to the decline of this activity, and considerable uncertainty persists over ideal agricultural strategies to pursue (Brack Egg et al., 1986:21). This period has also seen the in-migration from the sierra of peasants displaced by population pressure, poverty and guerrilla-military war. Importantly, this population has brought new ideas and perspectives to bear on the environment. These decades have also seen the region's steady incorporation into the national space economy centered on Lima. The changes in potato cultivation should be seen in the context of, and as part of, these processes of change.

a. Potato Cultivation Prior to 1980

Potato has been cultivated as a kitchen garden (huerto) crop for at least five decades in Oxapampa, but for a long time the strong belief was that it could never be grown on an expanded scale because of ecological and marketing constraints.

However, as sierran migrants arrived in the 1960's and 1970's, many continued to grow the crops that they had grown in their former environment --including potatoes. While many failed and returned, many others succeeded and stayed, adapting production methods to local conditions through a process of incremental experimentation. The results of individual experiments were actively shared and exchanged, and still are. For this ethnic group, with quite different presuppositions, potato cultivation in this zone was deemed difficult but quite feasible. Initially these producers had grown only for consumption, but into the 1970's cash inputs were increasingly used, largely due to the advice of one particular immigrant. This man became, and remains, a key figure in the exchange of information and advice on methods of potato cultivation, and in the adoption and development of new methods. Slowly, through experimentation, larger

areas were grown, and a small surplus was marketed within the region.

These developments afforded visible evidence that potato cultivation in the area was quite possible, and showed that the earlier perceptions of the environmental constraints on potato production were exaggerated. It should be stressed that these experiments and adaptations were farmer led: although there had been limited agricultural extension activities there was no local agency of INIPA until 1980 (CIPA, 1986a), and the Agrarian Bank had little interest in potato until 1983. Nor did the agro-chemical stores have much knowledge of the crop.

b. Experiences Since 1980

In the 1970's the experiments with potato cultivation had been mainly conducted by the sierran immigrant population. Channels of information flow between this and the longer established colonists of mainly European descent were not, and still are not, very well defined. However, in the early 1980's farmers with ethnic and social links to this latter group began to grow potato on a larger scale (2-3 ha). Notably, one such farmer was also an immigrant from the sierra who grew potato in the Mantaro Valley. Other immigrants, more wealthy than earlier sierran immigrants, have been similarly important in this process of agricultural change. This propensity to grow the crop, coupled with the mounting visible evidence of the small but healthy potato plots, led the earlier colonists to consider potato production quite feasible.

These early experiments among the "European" and wealthier farmers were also financially successful. Increasingly, potatoes were seen as ecologically viable, and economically attractive. Many were interested in expanding production levels, but could not because of the cost constraint. Appeals were made to the BAP to extend lending for potato cultivation and these petitions, alongside the visible evidence that was also inspiring the appeals, led the BAP to grant such loans in 1983 (Table 3). As a result some producers cultivated over 10 ha, and up to more than 20 ha that year. Favorable climatic conditions led to high yields and reasonable production costs, and price conditions in Lima were good. Some producers made considerable profits.

Table 3. Area cultivated in potato receiving BAP loans

Year	Area lent on (hectares)
1983	92
1984	415
1985	129
1986	115

Source: BAP, Oxapampa.

At the outset of the 1984 campaign, potato was thus seen as a very attractive crop. Farmers and Agrarian Bank alike were highly interested in extending its cultivation. Both capital and psychological constraints to expanded production were now removed. Moreover, by 1983 Lima wholesalers had begun to come to Oxapampa to buy potatoes leading many more producers to realize that the Lima market was open to them. As a result the area cultivated and receiving loans increased enormously (Tables 3 and 4; Figure 2). Many farmers who had no experience of the crop cultivated it that year --lacking experience they were vulnerable. Moreover, because extension services were still weak (the local INIPA agency had only two agronomists and two extension agents in 1984 for the entire agrarian statistical region-- CIPA, 1986, 1986a) and because their experience of potato was limited, there was no institutional source of information to assist such farmers in the development of sound practices. In this sense it can be seen that although psychological and economic constraints had been removed, there was still a severe information constraint.

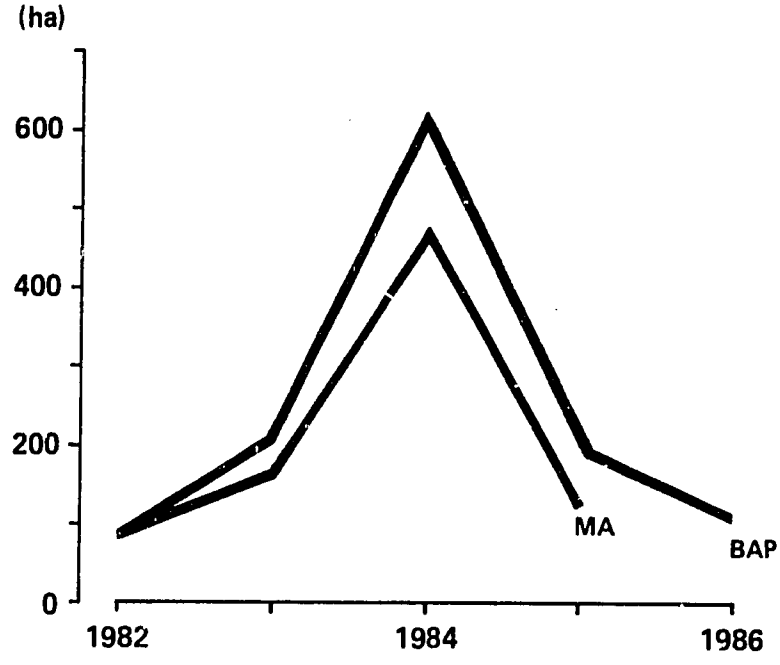
Such differing levels of experience are at least partly reflected in varying production practices. Conditions in 1984 can be inferred from the variation in practices in 1986, which was great (and was probably less than in 1984 as there are now fewer growers). In 1986 there was wide disagreement over ideal amounts of seed, pesticide and fertilizer to use; over which varieties of potato were most resistant to rancha and the growing times of different varieties; over sowing dates (Table 5); over how to handle seed and so on. While these variations in part reflect local differences in on-farm ecology and economy, they also reveal the lack of expertise of many, and the still general immaturity of the region in cultivating potatoes.

Table 4. Area sown in potato in Oxapampa

Year	Area sown in potato (ha)		
	BAP	Ministerio Agricultura	KFW
1982			84.2
1983	213	171.5	
1984	600	465.7	
1985	136	128	
1986	130	108	

Source: BAP, Oxapampa (various years); Ministerio de Agricultura, Oxapampa (various years); KFW (n.d.)

Figure 2. Area of potato cultivation in Oxapampa.



Sources: BAP (various years); MA (various years); KFW (n.d.).

Notes (I) 1986 area 10 July only.
(II) 1982 data is from KFW (n.d.)
MA = Ministerio de Agricultura
BAP = Banco Agrario del Peru

Table 5. Distribution of sowing dates in the area

Month	Area of potato actually sown in that month (ha) 1983	1984	1985
January	--	24	--
February	--	--	--
March	--	--	--
April	--	17	--
May	6	167	12
June	82	159	28
July	28	48	77
August	22	50	10
September	20	--	--
October	2	--	--
November	--	--	--
December	11	--	--
Total	171	465	127

Source: Ministerio de Agricultura, Oxapampa

In addition the most recent innovators were probably unaware of the potential severity of labor supply constraints at periods of peak demand; nor did they appreciate how important it would be to obtain labor quickly in order to apply fungicides immediately after spring and summer rains. And finally, perhaps most importantly, neither individuals nor the collective realized how serious the impact of the variable ecological environment could be for potato production; nor how variable the price environment in Lima can be.

The events of 1984 exploded the fragility of this inexperience. Both climate and economy militated against the Oxapampan potato producer. That year, rains lasted longer than usual, causing some seed to rot in the ground. By June fungal problems were becoming very expensive to control, and prices were low (Table 6). Yet still, the Agrarian Bank quarterly report remained optimistic. Conditions continued to deteriorate: a hot summer delayed tuberization so that harvesting was delayed into the rainier season; pest control costs continued to mount, and farmers discovered the labor constraint in the zone which prevented their applying fungicides with sufficient speed. All the while prices stayed low.

Table 6. Farmgate prices for potato in Oxapampa

	Potato prices at farm gate (soles/kg)			
	March	June	September	December
1983	-	700-750	500-600	falling
	-	-	750	500
1984	-	400-500	350-360	350
	500	500 (May)	400	300
1985	-	-	-	1,200
	600 (Feb)	800 (April)	1,600	2,000

Source: BAP, Oxapampa; Ministerio de Agricultura, Oxapampa.
Notes: The figures in the top row for each year are those in the records of the BAP; those in the lower row are from the records of the Ministerio de Agricultura. Dashes refer to the fact that there was no data for the prices for that particular month and year.

In the end the farmers suffered the worst possible combination of high production costs (reflecting the cost of fungicides), low prices and very low yields. Many did not even bother to harvest their potato plots because the low prices did not justify the expense involved. The result was widespread bankruptcy, with many selling off land and capital goods in order to pay their loans: 10 loans from 1984 still remained outstanding in August 1986. For the purpose here, the importance of the above was the lost legitimacy of the potato as a viable crop. The more experienced suffered less and continue to grow the crop profitably; indeed they expect to continue indefinitely. The majority, however, still live under the shadow of 1984 and now feel that the potato is far too risky a crop for the region. While the Agrarian Bank still sees a future for the crop, its staff are guarded in their enthusiasm. So the unintended, but very important effect of the collection of individual decisions to sow potato in 1984 has been the return of a strong psychological constraint to potato cultivation, reflected in the now much reduced area cultivated (Table 4 and Figure 2). It is notable that current trends and opinions suggest a shift back to livestock management, and into safer, lower input crops such as maize and beans.

IV. Discussion: Implications for Adaptation Theory

The foregoing has attempted to weave some of the links between regional agricultural change, social groups and the actions of individuals. These actions draw upon resources, and are limited by norms and constraints, that exist both at the level of the individual and the collectivity of which the individual is a part. Thus in the late 1970's sierran immigrants could draw upon a collective stock of knowledge concerning potato cultivation methods in the ceja de selva, and were not severely constrained by social presuppositions that the crop was inappropriate; they were, however, constrained by a lack of credit. The Oxapampinos of far longer residence in the valley could not draw so easily upon such a stock of knowledge, and were constrained by such social norms.

In acting the individual human agent acquires further knowledge, often slowly and iteratively, through a conscious process of experimentation (Johnson, 1972). The benefits of this knowledge pass both directly to the collective through information networks, and indirectly to a wider group, through the visible evidence of the crop growing. This knowledge either endorses or challenges existing norms. As far as it challenges them, new norms are slowly produced, and new agricultural possibilities emerge. Thus, as the individual's actions feed into collective structures, so the conditions of action for other individuals are reproduced, or as in the example discussed, slowly altered (Giddens, 1979). It was through such a process that the potato slowly emerged as a credible commercial crop in Oxapampa.

However, it is important to note that the conditions of action, and the potential to exploit agro-ecological and economic possibilities, do not alter equally for all groups or individuals. Some individuals have more experience and acquired skill than others; some have far greater material resources; and some have privileged access to certain collective resources because of their membership of a particular social group or because of preferential contacts (Blaikie, 1978; Yapa, 1977). Also they will only use sources of information that they consider legitimate and reliable. Access to such resources, and experience of constraints, will vary among individuals in different social groups. The learning process behind ecological resource management thus varies among different social groups and the individuals within them. The discussion of Oxapampa showed this differentiation at the level of very broadly defined groups, but it can easily be seen that it occurs at many levels of collectivity (see Ellen, 1982 for similar points).

As we have said, as learning proceeds, so collective norms and constraints alter --thus the potato became a credible part of the farmer's crop portfolio. Other constraints are more difficult to change --particularly economic ones. However, the case study showed how, through the alteration of perceptions of ecological potentials and constraints, this amalgam of individual actions did contribute importantly to the removal of the credit constraint. And within this it appears that particularly important were the actions of certain key individuals, who had power because of their agronomic knowledge, and a different cultural perspective on the environment that allowed them to see possibilities that longer-standing residents had not seen. This removal greatly accelerated the process of change. The rapidity of this change took individuals, and the region, to a point where production strategies were well out of balance with levels of knowledge; it thus increased the instability of both the regional system and individual farm strategies. It also exemplified the more general fact that adaptation can never be perfect because knowledge in a variable environment can never be perfect (Ellen, 1982).

As a result of the collapse, the environment is now perceived differently from how it was previously. This reflects the new knowledge of the variability in the environment. Although perhaps an overcompensation, it reflects a convergence of rates of change in production strategies and rates of learning. It may thus be a stage toward the adaptation of the agricultural strategies to long term variability in the environment (cf., Gould, 1963). Conversely, it may have led farmers in the region to follow other paths to new agricultural strategies. If these are relatively stable then there may never again be serious cultivation of the potato in the valley; yet, given the continued success of experienced potato growers, the crop could perhaps play an economically and ecologically valid role in a diversified crop portfolio for both the farmer and the region. An implication is that individual and institutional actions combined have unintendedly and indefinitely, altered the conditions of future actions. This is a warning for those professionals involved in the promotion of new crops and cropping systems. It is also an important consideration for adaptation theory --strategies followed are not necessarily rational ecological or economic adaptations. They are also drawn from a limited set of possible "legitimate" strategies. And what is considered legitimate depends upon the historical unfolding of individual actions and their recursive relation with the constraining and enabling structures that condition action: and there are neither ecological nor historical necessities in this unfolding.

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