

Review

Pastoralism and development in high Andean arid lands

David L. Browman*

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Andean arid land pastoralism fared poorly under the Bolivian (1953) and Peruvian (1969) agrarian reforms. The two countries employed different approaches in development strategy, but both focussed on 'tech-fix' solutions and ignored the small and medium size producers. Analysis focusses upon reasons for the lack of success for arid land livestock development programs. Evaluation of the socio-cultural obstacles to Andean pastoral development suggest that a new approach integrating the indigenous focus upon flexibility and labor-intensive production with Western capital intensive technology, particularly designed for the bulk of the rural agricultural labor force, the small and medium size producers, may be the solution for improved productivity in the pastoral sector. Appropriate sociology is as necessary as appropriate technology.

High altitude Andean grasslands

The high altitude grasslands utilized for pastoralism in southern Peru and western Bolivia cover nearly 10 million ha and range from roughly 3000-4800 m (10-15,000 ft). Lack of adequate rainfall is a contributing factor to Andean pastoralism. While precipitation is as high as 600 mm/year in the northern portions of the Peruvian puna, it decreases rapidly to less than 100 mm/year in the southern Bolivian altiplano. But as in Himalayan and Siberian pastoralism, Andean pastoralism is also an altitude and temperature response. Grasslands which otherwise receive adequate moisture for plant agriculture are simply too high and too cold to be suitable for cultivation.

The Andean grasslands today have been modified from their original state; that abstract state in which there would have been no grazing selection on the plant communities. The wild guanaco and vicuña herds and other wild browsing animals such as deer, and the subsequent domestic alpaca and llama herds, created and maintained one climax type of grassland, a climax community which today is partly modified by the introduction of new grazing animals with different species preferences. While Crawford, Wishart *et al.* (1970, p. 190) argue that modern grazing pressures have reduced the treeline in elevation by 850 m or 3000 ft, and Ellenberg (1979, p. 407) argues that without the current grazing pressures, much of the highlands would have been forested, archaeological research has indicated substantial grasslands in the altiplano and puna areas since the last glacial advance 12,000 years ago, long before camelids were domesticated.

Grazing strategies

Andean pastoralism may have begun as early as 9000 years ago, with clear evidence for herding of both domestic llama and alpaca around 6000 years ago. With the Spanish

*Department of Anthropology, Washington University, St Louis, Missouri 63130 U.S.A.

conquest. new species were introduced, most important of which, in the Andes, are the sheep.

Pastoralism as a mode of production is used here to indicate that the control of production and the disposition of products from the animal property is the dominant structural framework (cf. Ingold, 1982, p. 62). Thus, there is no incompatibility between shifts to different sectors of activity. Some pastoral activities, such as herding, may require mobility, while other pastoral activities, such as supplementary grain and tuber cultivation, may require fixity. These are merely shifts of activity, not shifts in the structure of social relations of production.

High altitude pastoralists follow a 'resiliency strategy' (Thomas, 1979, p. 160) in seeking to limit risk. Andean (and Himalayan) altitude responses are based on flexible, co-operative strategies which allow environmental problems and opportunities, both to be redistributed among group members, a pattern emphasizing flexibility and resilience. Altitude responses employed to limit risk are labor-expensive, such as moving herds seasonally to take advantage of locally occurring conditions, herd dispersion over wide areas to take advantage of local patch types, multi-species diversification, or herd size increase as insurance against unpredictable ecological conditions.

Most development schemes for pastoralism have been capital-intensive and have sought to limit mobility, if for no other reason than to more efficiently provide extension services to the herders. Though there is no *a priori* reason why a labor-intensive, mobile mode of production cannot be restructured into a capital-intensive, stable variant, such major shifts of pastoral mode can be affected only when specifically addressed. Capital cannot simply replace labor without the necessary institutional framework, a fact ignored by development planners.

Agronomists and development planners frequently assume indigenous irrationality and prescientific grazing strategies. This is most prevalent in the discussion of overgrazing, particularly in the uncritical acceptance of Hardin's 'Tragedy of the Commons' argument. In the altiplano, 'common' pasture is found to be rationally controlled in areas where modern market incentives have not disrupted indigenous practices. Herders are aware of the fact that overgrazing causes loss of wool quality, meat quality, and disease resistance in their stock. For example, in Chichillapi (Puno department) and Sibayo (Arequipa department), Peruvian pastoralists monitor the wool clips and adjust the stock rates when declines in productivity are observed (Brougere, 1980; Caro & Palacios Rios, 1980; Palacios Rios, 1977). LeBaron, Bond *et al.* (1979) found comparable Bolivian mechanisms ranging from limitations on absolute animal numbers to pre-season range inspections to set the number of weeks/months of allowable grazing; in some instances grazing was allowed only certain hours of the day. Herders define by common accord the maximum number of animals each family can have. Surplus animals are usually dealt with in the manner reported for Salca Santa Ana (Huancavelica department) where either grazing rights are purchased from neighbors with less than their quotas, or the surplus stock is sold off (CENCIRA, 1980, p. 252).

The agrarian reforms in Bolivia and Peru have led to increasing integration of the pure and agro-pastoralists with the national economies. Land development has led to restricted mobility, and there is increasing incentive for maximizing, rather than optimizing, herd numbers, which both lead to increased overgrazing.

There are three significant factors to over-grazing: erosion, compaction of soil, and increase of undesirable species. While USAID (1980, p. ix) claimed that 80 per cent of the Bolivian altiplano was eroded and overgrazed, erosion is not as obvious on the altiplano as in high valleys. High cellulose grasses (*Stipa* and *Calamagrostis* spp.) and sagebrush-like *tola* (*Lepidophyllum* and *Baccharis* spp.) have invaded many rangeland areas of the altiplano, replacing grasses with higher palatability and nutritive value. In addition, toxic species of plants increase in overgrazed areas.

Trampling and compaction damage to altiplano rangelands is much greater than suspected. Overgrazing compaction of the soil leads to diminished capacity for water

absorption and increased susceptibility to erosion and lateralization, as well as increased erosion due to the mechanical effects of trampling the soil and to the destruction of protective vegetation. For example, Parker & Alzerruca (1978) found that due to such soil compaction, the principal limiting factor for rangeland production in the northern Bolivian altiplano was lack of water, despite apparent adequate rainfall. The compacted soil prevented appropriate absorption of available rainfall.

Principal herd animals

Both the pure pastoralists and the agro-pastoralists in the southern Peruvian puna and Bolivian altiplano, principally herd auchenids (llama and alpaca) and sheep. Cattle are susceptible to pulmonary edema (Brisket disease) above 3500 m, and for the most part are fed year round at permanent resident sites. Sheep have become the most numerous herd animal (20 million sheep vs. 7 million auchenids) because the Andean area has become increasingly integrated with the world market system where mutton and wool are readily marketable items, but where llama wool and alpaca and llama meat do not have an acceptable market. The sheep, however, have poor adaptation to the available forage, and suffer cold and altitude (hypoxia) stress. Productivity is low for sheep living at high altitude as contrasted to lowland sheep. Average wool yield for altiplano and puna sheep is only c. 1 kg annually, vs. 4 kg for lowland sheep in developed countries. Live weight and carcass weight, at 20 kg and 10 kg, respectively, are only half that of lowland varieties. Poor nutrition and altitude stress has also led to delayed maturity, lowered fertility rates, frequent abortions, and high neonate mortality rates. West (1981*b*) and McCorkle (1983) report that highland criollo breed sheep do not reach adult weight until 3–4 years, and are not bred until 2–3 years of age, in contrast with ages for lowland sheep of 1 year and 6–10 months, respectively. High mortality rates help lead to overstocking. Herders figure that it is better to lose, for example, 30 per cent of 160 animals than 30 per cent of 50 animals.

There have been two approaches utilized for improving Andean stock: one an attempt to upgrade extant native breeds, and the other an attempt to import and replace native with foreign breeds. Under the Peruvian Agrarian Reform, more than 100,000 Corriedale breed sheep were imported from New Zealand to replace the highland criollo breed. This project failed: many of the animals succumbed to the climatic stresses. Those that survived lost weight, had trouble reproducing, and had marked loss of wool quality (Flores Ochoa, 1979; West, 1981*a*). The surviving Corriedale sheep were no more productive than the native criollo breed. An additional sociological problem remains to be solved here, as many of the local communities have strong proscriptions against bringing in outside stock. Outside stock are seen as possible disease vectors, and are viewed as liabilities as they require extra labor and fodder because they are not acclimatized to local conditions.

A more successful attempt to improve stock was the long term program of selective breeding by the Cerro de Pasco Corporation. The resulting Junin breed has improved the productivity of sheep in the Central Sierra (Orlove, 1982, p. 115). Analysis of the failure of the Corriedale sheep by agronomists indicated that the level of nutrition was the major limiting factor. The suggested solution was capital injection in terms of improved pasturage and a new winter fodder storage technology. In the highlands, the principal fields available for growing improved wet season forage and dry season hay are those currently utilized for growing grains, tubers and other foods. A direct loss in carrying capacity results in shifting from secondary to tertiary trophic levels. Moreover this solution was not politically feasible. A major goal for the Agrarian reform was the mobilization of the productivity of the agricultural sector to support development of the industrial sector. Thus heavy capital investment in agricultural projects was not a viable political strategy.

The development programs discussed up to this point have all been predicated upon the unquestioned assumption that the appropriate pastoral solution is to improve the productivity in terms of sheep. Planners have ignored the indigenous herd animals, which have superior physiological adaptations to the environment acquired over 10,000 years or more. Rather than applying technology to bring sheep up to the level of the native herd animals, development efforts would be better directed at improving the already superior adaptations of the auchenids—the alpaca and llama.

The family Camelidae have a smaller size red blood cell, which presents an increased surface area for oxygen diffusion, a critical factor with the lowered oxygen pressure found at high altitudes (Bullard, 1972). The auchenids have greater tolerance to endemic diseases: sheep neonates are much more susceptible to the bacterial diarrheas than are the auchenid neonates. Auchenids tolerate the climatic stresses more successfully as well. For example, one Puno hacienda reported a loss of 40 per cent of its sheep but only 20 per cent of its alpaca during the severe 1956–7 drought (Thomas, 1972, p. 228).

The native auchenids are less destructive of the grazing lands and can more efficiently utilize the available high cellulose grasses. They are plantigrades, and thus do not harm the grass even during overgrazing (Millones, 1982, p. 49). Auchenids have softer hoofs than Western domesticates, and thus do not subject the grasslands to as severe trampling damage (Ellenberg, 1979, p. 411). Alpaca and llama metabolize the existing high cellulose grasses with as much as 25 per cent greater efficiency than the introduced species (Fernandez Baca, 1966; Vallenat, 1970). Thus, on the same pasture, alpacas and llamas will gain weight faster and more efficiently, while having less negative impact on the range than either sheep or cattle. Meat and wool yields for the alpaca and llama are comparable, or superior to, the introduced Western stock. Auchenid meat is superior in raw protein to mutton, and about the same as beef, with low fat and cholesterol levels (Fernandez Benel, 1970, p. 187; West, 1981a, p. 105). While wool yield for alpaca is about 3 kg annually, that of the llama is only half of this. If alpaca are grazed on optimum pasture, wool yields can be increased to as much as 8 kg (Brougere, 1980, p. 93).

Fertility of the herd animals is impacted by the harsh conditions. The llama has a fertility rate of 85 per cent, while that for alpaca is less, at 50–60 per cent. The introduced sheep fertility is no more than 40 per cent, however. For the alpaca, this can be improved by animal management techniques. Many of the pure pastoralists believe that alpaca and maize are alike, in that neither can successfully propagate without the intercession of humans. In the Andes, prior to the arrival of the Spanish, native herders regularly interceded in breeding. During the colonial periods, the Western concept of using only a few males as studs to impregnate many females replaced the pre-Incaic practices of physically helping the alpaca to mate. Thus today fertility for alpaca females due to colonial influences is only 50–60 per cent, but returning to managed breeding, two Peruvian agricultural experiment stations have been successful in raising fertility or birth-rates back up to 70–85 per cent (Novoa, Sumar *et al.*, 1970, p. 145; Fernandez Baca, 1970, p. 143).

Re-instatement of the auchenids as the prime herd animals will require other improvements. Current neonate mortality on the large scale enterprises is still 20–25 per cent, but this can be reduced to 5 per cent using techniques developed at experimental stations (CENCIRA, 1980, p. 190). Parasite load reduction and control is also needed; the abattoir of Cabanillas reported 17 per cent of the animals infected with parasites (Fernandez Benel, 1970, p. 187).

Pastoralism and the Peruvian agrarian reform

The Peruvian Agrarian Reform explicitly attempted to incorporate features from Marxist models by establishing Government agri-business collectives. Because the indigenous

population had certain co-operative labor strategies, the Agrarian Reform model proposed might have been expected to have been very successful. But it was not. The imposition of agri-business high technology, whether 'capitalistic' or 'Marxist' models, is not an appropriate solution for capital-poor, labor-intensive economies.

The problems of the attempted Peruvian collectivization of Andean herders mirrors the problems of the first collectivization attempt (1925–32) of Mongolian herders (Rosenberg, 1981). To avoid collectivization, Mongolian herders slaughtered nearly one-third of their livestock. Herders on the collectives were allowed to maintain their own private flocks, which led to a labor-scheduling conflict between the collective and private herds. Mongolian bureaucrats on the collectives were often incompetent or corrupt, and many abused power to acquire personal wealth. The workers on the collectives found no incentives to produce for the collectives, and thus herders often failed to take proper care of the collective herds. The resultant drop in productivity, coupled with resistance, in the form of livestock slaughter and private herd ownership, ultimately led to the abandonment of the first collectivization attempt. All these problems were repeated by the Peruvian Agrarian Reform 50 years later.

The development strategy of the Peruvian reform was aimed at large estates and largely ignored the small rural producers. Thus only 14–17 per cent of the total rural agricultural work force was incorporated into the reform enterprises—the SAIS (Sociedades Agrícolas de Interés Social), the CAP (Co-operativas Agrarias de Producción), and the Grupos Campesinos; and only 23.4 per cent of pasture lands were included (Matos Mar & Mejia, 1989, p. 68; McClintock, 1981, p. 94).

Two of these enterprises, the CAPs and the SAISs, are of importance with respect to the development of pastoralism. The CAPs were essentially production co-operatives, where members owned the land and livestock communally. These large enterprises involved substantial reductions in the number of individuals employed as herders. Both the CAPs and SAISs were eligible for government technical aid; both were set up as agri-businesses, with the goal to maximize production and profits.

The SAISs were a form of compromise between a full-fledged co-operative like the CAP and the previous land-holding system. Highland livestock haciendas had been surrounded by semi-autonomous herding communities. The hacendados relied upon these communities for their seasonal labor needs, and in return allowed these communities to graze private livestock on part of the hacienda lands. The SAIS was a special kind of co-operative to join these two disparate groups, with a governing council formed by representatives from the surrounding communities, the full-time herding employees (the former hacienda employees) or socios, and the government technicians and managerial personnel at the SAIS.

The Agrarian Reform in the pastoral sector suffered from problems with capital and credit, the imposition of external control on management decisions, conflicts of communal vs. private enterprise, lack of involvement of the rural labor force in the enterprises, and urban price fixing. These led to the collapse of the agrarian reform and a new round of land invasions.

Capital and credit problems

The lands that were expropriated in the formation of the CAPs and SAISs were in most cases decapitalized by the hacendados prior to Government take-over. The enterprises had high initial debt obligations, the re-payment to the government of the indemnification paid the former hacendados. Members of the enterprise and the Government did not re-invest in the enterprise, but extracted the profits for other purposes.

During the 1960s there were a number of small land invasions in Peru. 'Agrarian reform' was a plank of all national political parties. Thus, hacendados had been profit-taking, not re-investing in their haciendas, not making improvements or even necessary

repairs of equipment, and in some cases even borrowing heavily against their lands. This profit-taking mode resulted in unrealistic expectations of the profitability of the pastoral enterprises under the reform. For example, the hacendados in pastoral areas of Junin had realized one-third of their gross income as profit (McClintock, 1981, p. 222), leading the new reform co-operatives to expect that they could garner the same rate of profit.

Before herds could be expropriated, many hacendados sold off their animals. Estimates are that as many as 40 per cent of the animals were slaughtered in the first years of the reform (Appleby, 1980; Flores Ochoa, 1979). This decapitalization continued after the initial formation of the enterprises. For example, in the 1970-4 period, while the government sanctioned a slaughter of 180,000 alpaca and llamas, more than 750,000 were butchered (Flores Ochoa, 1979, p. 14). In Peru, as a whole, 1978 livestock holdings (sheep and auchenids only) were still only about two-thirds of the pre-reform holdings; in the single largest herding area, Puno department, livestock numbers were only about 50-55 per cent of the pre-reform holdings (*see* Table 1).

Table 1. *Livestock holdings (Pre-reform vs. end of reform)*

Year	Peru		Puno department	
	Alpaca	Sheep	Alpaca	Sheep
1969	3,300,000	17,000,000	2,100,000	7,100,000
1978	2,400,000	12,500,000	1,100,000	3,900,000

Figures from: Alpaca Peru, 1981; Flores Ochoa, 1982; Primov & Jimenez-Zamalloa, 1981 and West, 1981a.

The Agrarian Reform was part of a larger political plan to improve Peru's position in the world market. The agricultural sector was to produce a surplus to fund other development sectors. Thus, there was little provision for re-investment or extension of credit to the livestock enterprises. The private sector was not permitted to make loans to the enterprise producers. Private funds were invested instead in processing and distribution. Thus, even though private enterprise was no longer important in the large scale production of agricultural goods, control of processing and distribution resulted in the private sector securing the bulk of the profits from agricultural production.

The Government development strategy was aimed at the large enterprises and ignored the small rural producers. In the case of alpaca, for example, the large enterprises held 9 per cent of the animals. Owners of the remaining 91 per cent of the alpaca, the small and medium herders, were never reached by technical assistance programs. Even if only increased a small increment per herder, small-holder campesino production can be very significant in the aggregate. It is thus a major mistake for development planners to ignore the small producer.

The CAPs and SAISs assumed responsibilities for pre-existing debts of the expropriated haciendas, as well as reimbursing the Government for the costs of expropriation. Even though the enterprises were excused from debt repayment for the first few years, they had to start reimbursing the Government for the costs of the expropriated haciendas by the mid-70s. During this period it was not uncommon for the enterprises to pay more than 75 per cent of profits in debt retirement alone, and in some instances there were reports that the entire profits for a year went to debt retirement (Estrada Mestanza, 1978, p. 39; McClintock, 1981, p. 224; Roberts & Samaniego, 1978, p. 256). By the end of the decade, because the debt was a fixed dollar figure, high inflation rates reduced significantly the proportion of the co-operative income required for debt repayment, but that came too late, as the agrarian reform had been terminated.

After debt payment, the Government required that 20 per cent of the remaining profits be paid for social security contributions, 5 per cent for education, 5 per cent for political development of the co-operative, 15 per cent for capital investment, and at least

25 per cent of the remaining amount was earmarked for additional 'social services' (McClintock, 1981, p. 224). Thus after payment of required Government services, contributions and debt payment, there was little profit left for the enterprises to distribute, and even this little was frequently diverted. The peculiar political relationship of the SAISs, with the surrounding *comunidades campesinas* participating in the division of profits, but not being required to make labor inputs, often led to an alliance of the Government technicians and these *comunidades* at the expense of the actual SAIS herders. Together the technocrats and *comunidades* had the votes to distribute the profits among themselves, in terms of salaries for the technocrats and cash grants for the *comunidades*. On SAIS Huanca in Junin, the actual herders and livestock personnel received less than 3 per cent of SAIS profits, but they did all the work on the SAIS (McClintock, 1981, p. 141). The administrators of adjacent SAIS (McClintock, 1981, p. 141). The administrators of adjacent SAIS Cahuide received monthly salaries ranging from 4000 to 30,000 soles (in 1974), while the herders received only 55 soles per month. SAIS Cahuide administrative personnel made up only 9 per cent of the labor force but they consumed 75 per cent of the milk and meat production (Estrada Mestanza, 1978, p. 32,37).

External control

The organization of the enterprises for production reduced their effectiveness as organizations for workers and as a vehicle for the Government to communicate with and influence the *campesino* population, because few permanent laborers were required on these enterprises. The lack of ability to have a meaningful say in their own destiny and the lack of financial rewards for improved productivity meant that the workers saw little personal point in hard work, in suggesting means of improvement, or in contributing to the success of the enterprise. Productivity on the enterprises dropped. Herders worked only part days, there were high absenteeism rates, and there were many complaints of slacking off or inattention to the job (Caballero, 1980a, 1980b). There was increasing conflict between time devoted to the enterprise herds and the privately owned animals (*waqcha*). Enterprise workers in a few cases became so unhappy with the disproportionate rewards that they attacked both the technocrats and the neighbouring communities, with conflict reaching the point of destruction of livestock or capital improvements in some instances (McClintock, 1981, p. 143).

Enterprise bureaucracy was often a problem. The workers perceived the technocrats as a new upper class, replacing the hacendados. The size of the enterprises made it difficult to distribute highly technical aid equitably. This led to larger central administrations consuming additional increments of capital, in an attempt to reach all areas of the estate. Distance from Lima (the source of ultimate power) and unfamiliarity with specific local conditions contributed to the inability of the administrators to make appropriate commercial decisions rapidly and effectively. There was opportunity for corruption and abuse of power and position, such as theft of supplies, appropriation of community lands for personal use, and exploitation of authority posts for private wealth.

The herders eliminated by formation of CAPs and SAISs joined a larger number of other unskilled rural laborers in migration to Lima and other coastal urban centers. These underemployed laborers became part of a large urban pressure group advocating low prices for food products. To maintain urban stability, the government established fixed prices for agricultural products, prices which failed to reward the remaining agricultural workers with higher prices for improved productivity, and in some cases failed to even cover the real costs of production (CENCIRA, 1980, p. 272; Martinez, 1980, p. 150). The Government diverted scarce capital to purchase additional foreign foodstuffs to keep urban food prices low, and thus the agricultural sector, rather than producing additional funds for industrial development instead managed to drain off scarce capital and increased the foreign debt.

Government controlled prices on manufactured goods and food provided an opportunity for increased smuggling. Bolivian food prices were higher than in Peru, while manufactured goods were 5–20 per cent cheaper. Peruvian foodstuffs were traded for tape recorders, cassettes, radios, television sets, typewriters and other small appliances, and a wide variety of plastic goods. Black market operations occurred on both sides of the border, as well as at isolated locations elsewhere in the Peruvian highlands (Brougere, 1980, p. 311; Painter, 1981, pp. 4.51). Late in 1980, President Belaunde's administration partially removed food price controls, and smuggling is no longer as rewarding.

Enterprise vs. private animal ownership

The privately owned animals found previously on haciendas, and subsequently on the SAISs and CAPs are known as *waqcha*, *waqcho*, or *huaccha*. In the central sierra, *waqcha* holdings were about 20 per cent of animals on pre-reform haciendas (Martinez Alier, 1973, p. 14), but in the southern Peruvian sierra *waqcha* holdings were much larger. *Waqcha* animal holdings ranged between 35 and 60 per cent on the Puno department haciendas of Panascachi, Chujuni, and Picotani (Maltby 1980, p. 106; Martinez, 1967, pp. 106, 136), and 75 per cent of the holdings of Cuzco department hacienda Ccapana (van den Berghe, 1980, p. 170). This pattern of private holdings continued when the reform enterprises were formed. On SAISs Pusa-Pusa Ccosana and Kuska Sayrisun in Arequipa department (with their inclusion of adjacent comunidades), between 70–80 per cent of the holdings were *waqcha* animals; the neighboring CAP Qolqa Wallata managed to reduce holdings to c. 20 per cent (Brougere, 1980, p. 79; Gomez Rodriguez, 1976, p. 57).

Government attempts to control the number of *waqcha* animals met with limited success. In Junin, herders on SAIS Cahuide successfully increased the initial enterprise limit of 40–60 animals (Martinez Alier, 1973, p. 38). In Puno, the limits of *waqcha* herds were set at 40 sheep equivalents on the SAIS San Juan, but the herders regularly exceeded this limit as the deductions made from salaries for excess livestock were less than the gain to be secured from the sale of excess animals. On the SAISs of the Cailloma area of Arequipa, herders were limited to a maximum of 150 *waqcha* animals; additional animals required additional labor donated to the enterprise and a grazing fee per excess animal. Nevertheless private ownership rewards were such that three-quarters of the herders had more than the 150 animal limit, with private herd sizes up to 625 animals (Gomez Rodriguez, 1976, p. 101).

This pattern of ownership caused management problems between the herders and the enterprises. There was continued conflict over the scheduling of labor requirements for the enterprises and the private flocks. Herders devoted considerably more energy to their *waqcha* holdings. Attempts by agronomists to improve the quality of the enterprise animals were frustrated by the fact that the bulk of the poor quality animals were the property of the huacchilleros (*waqcha* herders).

Waqcha herders generally received more income from their animals than they did from the enterprise. Rich herders sold their surplus pastoral products to itinerant comerciantes, obtaining access to commercial capital denied to poor herders. Rich herders were able to secure disproportionate amounts of available technical assistance from their collectives. Thus Gomez Rodriguez (1976, p. 19) argues that the SAISs and CAPs tended to reaffirm the social distinctions between rich and poor, and polarized the rich and poor herders even more than during pre-collective periods.

Some herders still embark on trade caravans. In Arequipa, Huancavelica, Junin and Puno, herders with adequate numbers of animals take trading caravans to lower elevations (Browman, 1982, p. 146). Individual members of the enterprises thus may become involved in private commercial ventures. Herders with too few animals to form caravans follow the pre-reform patterns of seasonal migration for wage labor. SAIS

members travel to the coastal areas for seasonal agricultural work, to work in the mines of the sierra and on the coast, or to work on coastal construction projects such as the Majes dam.

Government attempts to improve meat quality by restricting meat sales to animals slaughtered in approved abattoirs had led to an increase in black market meat sales and animals rustling. Animal owners slaughter animals themselves, or take them to illegal slaughter houses, in part to avoid state taxes and inspection of meat, and in part because the state was not able to establish official abattoirs convenient to all producers. In Cuzco the illegal sector handles more mutton than the official sector (Primov & Jimenez-Zamalloa, 1981, p. 9); similarly the alpaca and sheep black market in Arequipa is larger than the legal sector (Casaverder Rojas, 1970, p. 210; Brougere, 1980, p. 223). Rustling has increased, due in part to the black market opportunity for quick and easy disposal of animals. While rustlers prey mainly upon the animals of state enterprises, small holders are increasingly being attacked. Animals are being kept closer to the villages—thus aggravating problems of overgrazing—and because of the dangers of herding, rangeland grazing labor is often now restricted to adult males (McCorkle, 1982, p. 30; Orlove, 1980, p. 192).

Enterprise collapse

Managers of the enterprises opted for high technology solutions for problems, cutting labour investment and increasing capitalization. In an area where market uncertainties have traditionally led to an avoidance of heavy capitalization, and labor input is seen as a mechanism of risk reduction, the managers dramatically increased risk and risk management problems.

The agrarian reform did not change the fundamental forces of the agricultural structure. The mechanisms for appropriating the surpluses from the herding sector include: (a) rent paid in labor service for the use of land; (b) rent paid in kind (part of the harvest or herd); (c) maintenance of cheap peasant labor as a means of surplus capture; (d) extraction of surplus via the market (e.g. by keeping agricultural prices artificially low); (e) high interest rates on loans and credit; and (f) various rents and charges paid in cash, 'head taxes' such as grazing fees (Guille, 1980, p. 15). The persistence of the social relations of production in the precapitalist form constitute a fundamental obstacle for development of agriculture in Peru.

The herders became rapidly disillusioned with the agrarian reform because it in effect only exchanged the state for the hacendado as the owner of the lands; less than 15 per cent of the total rural agricultural work force was involved and less than a quarter of all pasture lands were included; the reform was 'rationalized' in 1976 (e.g. rural labor forces were dramatically cut back in an attempt to reduce labor costs and improve profitability); and technical assistance to small herd holdings was basically not included in the thrust of the reform.

A new round of land seizures (also known as 'toros' or 'invasiones') began in 1977, and still continue, with major invasions of the government enterprises in Cerro de Pasco, Cuzco, Huancavelica, Junin and Puno. Two of the major livestock SAISs in Junin (SAIS Tupac Amura and SAIS Huancavelica) had completely disintegrated from campesino invasions by the end of 1980. There were major invasions of two other Junin regional SAISs, with only one major Junin livestock SAIS not yet invaded as of February 1981 (McClintock, 1982, p. 147). In Huancavelica there were 14 major land invasions between May 1978 and November 1979 (CENCIRA, 1980, pp. 67,110); campesino invasions reduced the land holdings of the major livestock SAIS to less than 15 per cent of its reform size. There have been other similar peasant seizures in Ayacucho, Cajamarca, Ica, Lima and Piura. The Agricultural Promotion Law of November 1980 paved the way for an accelerated dissolution of the collective enterprises.

Pastoralism and the Bolivian agrarian reform

The Bolivian reform divided up the large landed estates and redistributed the land to local groups, while the Peruvian reform led to the Government retaining control of large estates by formation of various enterprises. In both Bolivia and Peru, the reform led to a shift of capital from production to the market place, with capital investment in the distribution and processing arenas rather than the production area. As a result of this, the basic pastoral mode of production has been little impacted by agrarian reforms in terms of overt management plans, although it has been much changed by other market place factors.

The 1953 Agrarian Reform in Bolivia was in part a post-facto attempt to legalize land seizures that had already taken place in the altiplano after the 1952 M.N.R. (Movimiento Nacionalista Revolucionario). Two major reform goals impacted the viability of pastoralism: the promotion of migration to the eastern jungle areas to open up new agricultural lands; and the explicit incorporation of the rural peasantry into the national economy.

Changes brought about by the agrarian reform have nearly eliminated caravan trade. Prior to the reform, llama herders formed seasonal caravans, trading locally produced pastoral products as well as handicraft and agricultural products that they acquired along the journey. Drovers used their animals to bring in the harvest in lower elevation agricultural areas in exchange for a portion of that harvest (Browman, in press.). The shift of land title under the reform to campesino syndicates resulted in the expansion of highland fields and thus a reduced need to trade for subsistence foodstuffs. Competition from trucks purchased under new credit available through the agrarian reform eliminated many caravans. Caravan labor was lost: mandatory schooling removed boys from the apprentice pool for caravaners. Increased control by Argentina, Chile and Peru of their borders restricted access of herders to agricultural lowland communities. As a result, herders embark upon trading caravans today only if no other options are available. Drovers feel that to go upon long-distance caravans is 'to suffer' (West, 1981b), that the social costs involved no longer justify the marginal economic returns. Caravan trade has not been eliminated, but it is severely attenuated.

Motorized transport has replaced llama caravans in large part. A typical Bolivian example is the village of Carangas, which had only three trucks in 1955, but which had more than 180 vehicles engaged in long distance trade by 1976 (Riviere, 1979, p. 101). In 1970 dollars, the average trucker was earning \$600 to \$900 a year, while the mean annual income for the agricultural sector of the country was only \$300 (Slater, Henley *et al.*, 1970). This is a false prosperity, for the truckers' income does not take into account depreciation costs and replacement costs for their vehicles, which are being consigned to the scrap heap long before the 20- or 30-year loan is paid off.

The agrarian reform has increased economic risks and reduced labor availability for both pure pastoralists and agro-pastoralists. New fields being opened up are located in the prime wet season grazing areas; forage availability is being restricted at the critical time of year when young are born. Cultivated fields are not fenced. It is the herders responsibility to keep grazing animals out. To avoid crop damage, the herder must increase his labor input. Some villages have hired guards (*pachaca*) to prevent animals from straying into agricultural fields (Godoy, 1983, p. 23). Expansion of cultivation contributes to elimination of herd holdings in other ways as well: higher losses due to restricted grazing; sale of animals to reimburse a farmer for crop losses suffered by marauding animals; or sale of herds to prevent social friction between the herder and his cultivating neighbors.

Pastoral access to labor has been reduced. Mandatory schooling removed children from the labor pool. New market opportunities also removed children, who find economic and social rewards greater in town than isolated herding in the field. When animal ownership was necessary for social obligations, a large herder could secure labor by payment only in one or two animals. But with the opening up of large agricultural

enterprises in eastern Bolivia, the poor herder can satisfy his social obligations by funds secured from migrant agricultural labor. Nearly one-quarter of the families from the southern Bolivian altiplano now migrate seasonally to acquire funds necessary for subsistence and social needs.

Herding remains an important occupation, however, as much of the southern altiplano is too high and too dry (less than 100 mm in some areas) to support meaningful cultivation. Shifts in patterns of labor availability and capital produced a number of solutions to the labor requirements of herding. Individuals may exchange or rotate herding with a neighbor, where there are multi-species ownership one individual may herd the neighbor's alpaca while the neighbor takes the sheep; if an individual has small numbers of animals, they may be boarded out with larger herders; or the animals may be 'share-herded' in one of the partnership arrangements known as 'wak'i', 'guaqui', 'al partir', 'en partir', 'compania', 'chikata' or other locally applied terms.

Shareherding or *wak'i* refers to what is perceived as an equal sharing of investments and yields. For herding, as well as farming, this involves one individual putting up the perceived capital while the second individual contributes the labor, with the harvest or herd increase being split equally. Shareherding or sharecropping is utilized as a mechanism of risk management, with the risk being spread between two individuals. It is also a mechanism to reduce pheric costs, allowing a campesino to exploit lands or have herds in different ecozones without having to personally travel to each area.

Before integration into the Western cash economy, shareherding was a relatively rare animal management technique. But with migrant wage opportunities on one hand, and the ownership of herd animals no longer necessary for social prestige on the other, shareherding as well as other shared labor arrangements are increasingly popular. For the herders who undertake shareherding, there are increased rewards in yield, now a 50 : 50 split of offspring, rather than the previous one or two animals per year (Browman, 1979). It takes just as much manpower to herd 10 animals as it does 300-500 (the maximum size ranges an experienced herder can handle). Thus it makes more sense for one individual to handle a single large herd than it does for several individuals to handle several small herds. This allows the small holders to retain part of the benefits and security that accrue from animal ownership, and to spread the risk, while freeing them to pursue small craft production or other cash occupations.

In the northern altiplano, the proximity of urban centers and higher rainfall have provided other options for the herders integrated with the national economy. Contraband trade was once the purvey of caravaneers. In the Titicaca area, truckers and fisherfolk have replaced caravan drovers as the principal contrabandistas. In the central and southern altiplano regions, some herders still bring up manufactured goods from Chile and Argentina, regularly provisioning weekly markets as far away as Cochabamba, but this trade has become increasingly risky, and most herders have turned to other options, such as seasonal migrant labor (Browman, 1979, p. 24). Former herd areas around Lake Titicaca now are principally dedicated to fattening livestock or truck garden operations for the urban markets in La Paz, Puno and Juliaca.

The different patterns of the involvement of herders in seasonal migrant wage labor between the northern and southern altiplano had led to some shifts in lowland agriculture as well. In the south (Chuquisaca, Cochabamba, Santa Cruz, etc.), plantations and large land holders count on seasonal migrant labour from the highlands. In the north in the yungas regions of Beni and La Paz, seasonal caravan laborers no longer show up, and there has been a shift from labor-intensive to capital-intensive agriculture since the agrarian reform because of labor shortages (Leons, 1979, p. 99). Herders who formerly came from the Bolivian altiplano have become involved in provisioning the growing urban markets, or in seasonal labor in the urban centers, while the migrant herders who formerly descended seasonally into the yungas from the Peruvian side of the border no longer do so because the agrarian reform in Bolivia excluded non-Bolivians. Thus Puno department Peruvian migrants now have changed

their seasonal migration patterns to large Peruvian urban centers of coastal areas (Collins, 1981, p. 37; Metraux, 1956, p. 398).

Herders have not completely abandoned caravan trade, but those that still traverse the Bolivian altiplano trade mainly in locally available commodities of general high demand (such as salt blocks from the *salares* in the southern herding areas) or in products unique to the altiplano zone (such as medicinal preparations and pastoral products). The caravans south of Lake Titicaca that were investigated had changed their marketing strategy, now seeking out isolated rural settlements far from available motorized transport routes instead of large villages, in hopes of being able to exchange salt and pastoral products for potatoes and other tubers with farmers too far from easy market access to readily sell them for cash. The drovers are finding it increasingly difficult to barter directly. The isolated communities often want to pay cash, cash which the herders must then take to weekly markets where they are only able to obtain much smaller quantities of agricultural goods than they could through straight barter. The traders that I worked with now only resort to such trading trips under severe economic stress.

Although some caravans still function, basically Andean llamas have disappeared in much the same way that the Bedouin camels did. The drastic reduction of 90 per cent of Syrian camels in two decades (Bahhady, 1981, p. 261) is the same pattern reported for the Andes when train and truck transport replaced llamas as the prime transport facilities. And some of the same responses by the caravan drovers are seen among both Bedouin (Stein, 1982, p. 42) and Andean (Browman, 1979, in press) herders, where disenfranchised drovers have turned to smuggling contraband and seasonal migrant wage labor as replacement strategies.

In Bolivia, the Agrarian Reform did not specifically address pastoral concerns. Rather it focussed upon land redistribution, returning the ownership of the land from large estate owners to communities. With no specific programs geared to pastoral development in the arid and semi-arid lands of the altiplano, it is not surprising that many of the former herders are now truckers, migrant agricultural laborers, or urban migrants. Many herders have sold their animals in order to send children to school, to buy subsistence foodstuffs, or to buy a bicycle, radio or other luxury good (West, 1981*b*, p. 78).

The Bolivian campesino changed from exploitation by large land owners to exploitation by national or regional authorities through market manipulations. Commodity production for the market resulted in increased dependence on rural elites and brokers, and agricultural strategies that led to decapitalization of the household. Government control of food prices made it difficult for rural producers to make a profit. Thus one of the major uncontrollable risks for the campesino is 'societal risk' (cf. Jones, 1980, p. 258), that risk due to the attempts of political authorities to control the market, to keep food prices down in urban areas, or to manipulate agricultural loans and agricultural policy for personal rather than national goals.

Summary

In the arid lands of the Peruvian puna and Bolivian altiplano, four different approaches have been attempted to improve productivity by national development planners: (a) improvement of arid land carrying capacity (by improving water supplies and improving pasturage); (b) improvement of herd animals (by disease control, selective breeding and introduction of new stock types); (c) improvement of services to pastoralists (agricultural extension services and marketing schemes); and (d) attempts to 'improve' the functioning of the pastoralists themselves (by setting up Government collectives). In all these cases, there has been little success, in large part because of the unquestioned acceptance by development planners of mechanization and high technology as the only methods of improvement. No consideration has been made of alternative strategies.

Development literature often can be characterized as being one of two types: the romanticism of the social scientist, which calls for a return to traditional ways of using arid and semi-arid zones, as contrasted to the 'tech-fix' model which pretends that all problems can be solved by technology (Browman, 1980, p. 173). While the technological point of view has been the basic development schema in pastoral areas, it is clear that neither of these two extremes is productive. Our analysis of the failure of the Agrarian Reforms in the Andes in this paper is in fact nearly an exegesis of the failure of the technological approach. It is increasingly clear that the social and institutional constraints to proper range use are greater than purely technical ones; that the major obstacles to improved dryland management are to be found not in the technical sphere but in the socio-cultural sphere.

Development strategies need to take into account the sociological limits as well as ecological limits. To reduce the number of animals in an attempt to increase the quality of meat and wool will require long term benefits greater than at present. There is no cheap substitute for the fertilizer produced by the current herds, fertilizer which is essential for the success of the potato crop. Fewer animals would mean lower standards of living for the herders, resulting in a major political problem. Better animals will require better fodder. Any development strategy that would substitute fewer but 'better' animals would be viewed as 'irrational' by the agro-pastoralists and pure pastoralists, until a mechanism is found to replace the current insurance and other economic factors of large herds.

Hopes that improving productivity will directly funnel additional resources into the national market might well be frustrated. Results at the local level indicate that families with larger flocks enjoy higher standards of living (more meat in the diet, more animals for social and ritual purposes, greater purchasing power). Thus increases in production might in large part simply be siphoned off as improved standards of living at the local level, rather than benefiting the national market.

Technological problems pale beside the socio-cultural obstacles to development. Lack of attention to local social and political factors, along with the external imposition of capital-intensive economy of scale approaches without adequate mechanisms for involving medium and small scale producers contributed to the failure of both Bolivian and Peruvian reforms to achieve their desired goals. The contributions of the arid-land pastoral sector to each of the national economies is becoming increasingly small. One reform was more capitalistic in nature, the other more Marxist, but both sought to employ agri-business economy of scale models. The deficiencies of both systems suggest that it may be the agri-business approach which is at fault, that alternative strategies need to be developed to involve the medium and small producers.

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