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In situ agrobiodiversity conservation in the Swiss inner Alpine zone

Douglas Bardsley* and Ian Thomas
School of Anthropology, Geography and Environmental Studies, University of Melbourne, Victoria, 3010 Australia (E-mail: dbard@unimelb.edu.au)

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Abstract

This paper considers Swiss experiences of *in situ* agrobiodiversity conservation. The Swiss recognise the multifunctionality of agriculture, particularly within the marginal, mountainous areas of the country and are spending public and private funds to maintain crop landraces, agroecosystems, landscapes, agricultural practices, and rural communities. State programs in marginal agricultural regions tie economic assistance to biodiversity conservation practices, through the use of direct payment systems. With the removal of many import restrictions and state-led marketing, alternative innovative programs linked to local values of diversity provide opportunities for conservation. *In situ* agrobiodiversity conservation ideas being pursued include awareness-raising schemes, scientific initiatives, the establishment of diversity gardens and community-based programs. Any extension of the *in situ* conservation programs could have substantial implications for regional development.

Introduction

This paper examines the opinions of Swiss respondents to *in situ* agrobiodiversity conservation practices and policies. *In situ* conservation is defined by the Convention on Biological Diversity as 'The conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties' (UNEP, 1992). An abundance of opportunity exists within Switzerland to apply innovative ideas for *in situ* agrobiodiversity conservation through state, market and community channels. State programs in marginal agricultural regions are vital for Swiss mountain farming and link assistance to conservation practices, particularly via the directives of the ecological direct payment system and the actions of the Swiss Commission for the Conservation of Cultivated Plants. Initiatives include direct assistance to farmers to conserve biodiversity, the establishment of diversity gardens, community-based initiatives and marketing techniques, such as those developed by the farmers' non-government organisation (NGO[1]), Genossenschaft Gran Alpin, and the supermarket chain, COOP. The importance of *in situ* agrobiodiversity conservation for the consolidation of mountain agricultural communities and agroecosystems are explored.

*Corresponding author
[1]All acronyms are listed in Table 5

Agricultural history

The European Alps are a secondary centre for agrobiodiversity (Moser, 1988; Schachl, 1988; Kleijer et al., 1990; Mattmüller and Kühn, 1994; BLW, 1997). While few agricultural species were domesticated locally in Switzerland, substantial levels of varietal diversity evolved within the country. Agricultural systems are anthropogenic environments where plants and animals are dependent, not merely on the natural laws of evolution, but also on the choices of humans. Traditionally, farmers could observe variations in crops resulting from mutations, genetic exchange and other evolutionary processes, and choose grains from plants that they valued within their own fields to use as seed for following crops. Over periods of time the combined forces of natural and artificial selection would result in distinct local varieties called landraces (Ceccarelli, 1994; Tripp, 1996; FAO, 1996). Thrupp (2000:267) quotes A.H.D. Brown as defining landraces as 'geographically or ecologically distinctive populations (of plants and animals) which are conspicuously diverse in their genetic composition.' Crops of landraces are in general, more genetically diverse than conventionally bred varieties. The number of homozygotic genetic variants within any single landrace crop is large because the amount of genetic difference has not been limited through formal breeding approaches (Ceccarelli, 1994; Frankel et al., 1995).

Switzerland became an area of landrace diversification because of its diverse climates, landscapes and agroecosystems, the variety of cultures that have influenced agricultural development and the nation's geographic position in the

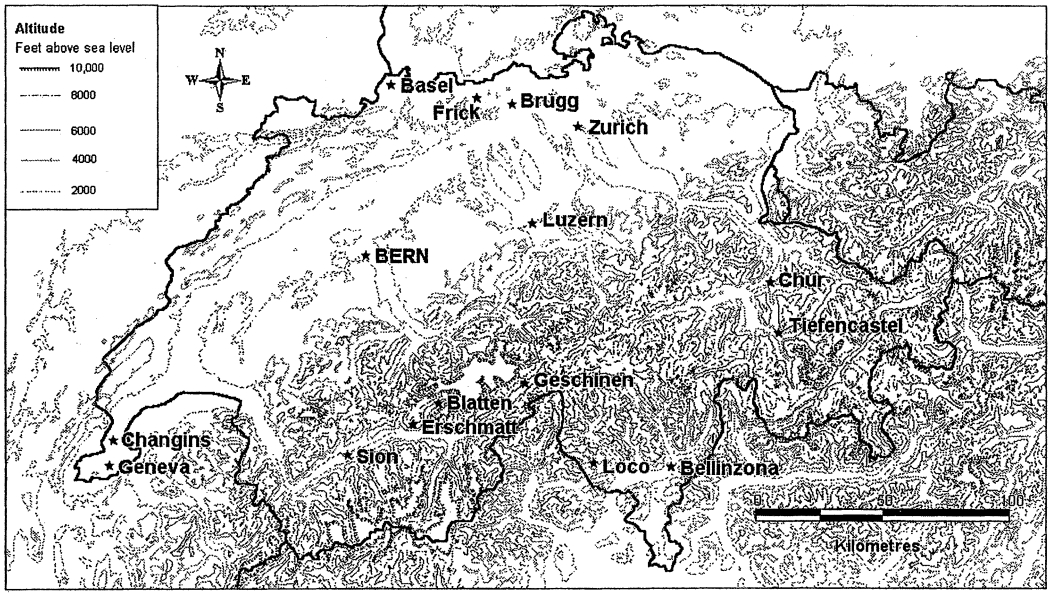

Figure 1. Map of Switzerland indicating major sites of interest to the research.

heart of Europe (BUWAL, 1998). The exchange of plant germplasm during prehistory substantially increased levels of agrobiodiversity (Mathieu, 1992; FAO, 1996). Historical cultural influences converged within the inner Alpine region, including cantons Wallis, Tessin and Graubünden, after 9000BP (Figure 1) (Zoller et al., 1996; Schlumbaum et al., 1998). However, isolated valleys limited the exchange of genetic material and encouraged the evolution of local varieties, or landraces, through mutations and re-combinations.

Figure 1[2]

Agriculture in the inner Alpine zone was based largely on a mixed grain-grazing farming system called the 'Bündner-Walliserbetrieb', from Celtic through the Middle Ages to recent times (Netting, 1981; Mathieu, 1992). Farmers buffered themselves from extremes in agro-ecological conditions by diversifying their systems, especially by using numerous small fields, special cultivation and animal husbandry techniques, and different crop species and varieties. It could be argued that traditional agriculture played an important role in enhancing biodiversity and limiting the domination of tree species across the Swiss landscape (Bätzing, 1988; Hampicke, 1999). Numerous endemic herbaceous and grass weed species exist in Switzerland in association with crops and pasture species within extensive agricultural systems (Baur et al., 1997; BUWAL, 1999). At the varietal taxonomic level, a significant number of agricultural cultivars and populations originate from Switzerland. Swiss accessions of the wheat species, *Triticum aestivum* var. aestivum alone number over 1000 in the National genebank and 296 in the US National Plant Germplasm System (Kleijer, 1983; NPGS, 1999). By far the majority of Swiss wheat accessions were derived from Wallis and Graubünden, because the landraces were lost from the plains as agriculture modernised prior to the systematic collection since the 1930s.

A wave of agricultural reform occurred across Switzerland from the 1900s to the 1950s, as agricultural technical improvements became commonly available. Levels of infrastructural development improved rapidly to the stage where even marginal regions were better able to access markets, education and technical assistance (Netting, 1981; Schachl, 1988). At the beginning of the Twentieth century, modern wheat varieties became commonly available and were utilised, particularly on the plains. Prior to this time, wheat landraces fulfilled the requirements of the local agroecosystems and cultural attributes of the people (Schachl, 1988; Kleijer et al., 1990).

Over time, traditional crop landraces were no longer effective in increasingly intensive agricultural systems. Changes in crop varieties led to substantial increases in cereal production in the Twentieth century (SBS, 1960, 1980; SBV, 1999). Cereal varieties were developed to tolerate diseases and insect pests and demanded increased nutrient inputs resulting in high average grain yields. In contrast, landraces respond primarily to higher soil nutrition with high levels of vegetative growth, and reduced quality and quantity of grain. The modern varieties also had marketing advantages, which were recognised by farmers, millers and bakers, whereas landraces often produced relatively low quality flour.

With the uptake of modern agricultural techniques, the total area allocated to landraces and the number of landraces extant in the field rapidly declined. Initially, modern wheat varieties were developed for those systems that could make best use of traits that would lead to higher yields in high-input conditions. These varieties were primarily sourced internationally, with some selections made in Switzerland in Lausanne (Fossati et al., 1988; Ingold, 1998). The moun-

[2]Figure 1 was created using Mapinfo Australia (1994)

tain agricultural systems remained marginalised from the changes to high-input agricultural systems. Lack of capital to purchase inputs, smaller farms, the diversity of agro-ecological conditions including low fertility soils, short growing seasons, long winters and difficulties in transportation ensured that mountain farmers did not rapidly adopt modern varieties.

Communities that were unable to access or make effective use of the emerging agricultural technologies, continued to rely on diversification to reduce the risk involved in their production systems. The subsistence mountain agricultural systems of Switzerland in the early Twentieth century differed little from the production systems of the Middle Ages (Mathieu, 1992; Zoller et al., 1996). Thus, while the landrace diversity eroded rapidly in the plains, the mountain areas, particularly the inner Alpine zone, acted as a refuge for local agrobiodiversity (Schmid et al., 1985).

Initial modern varieties were neither specifically adapted to mountain conditions nor were they accessible by the majority of farmers in the margins. In 1948, the winter-wheat variety *Probus* was released with a broad environmental adaptation and was widely adopted by the majority of Swiss farmers, including those in the mountains (Kleijer, 1983; Fossati et al., 1988). The first semi-dwarf variety *Zenith* was released in 1969. By then, rail and road transport allowed all rural communities in the mountains to be made relatively accessible. Whereas isolated communities had previously relied upon bread made from local cereal products, grain, flour and bread could now be imported from the plain. Many mountain communities could no longer sustain traditional agricultural activities, because they could not compete with the cheaper production methods of other regions. Those farmers who cultivated traditional landraces, tolerant of the marginal conditions but giving low yields, could no longer profit from their cultivation. Only in a few specific cases, predominantly in the inner Alpine zone, were cereal landraces still grown in Switzerland after the 1950s. Arable land in the mountains was converted to pasture for the grazing of cattle, sheep or goats, which had become more rewarding than arable production. Because Swiss cereal farmers had to compete with international imports from the 1860s, this pattern was also apparent on a national scale (Mattmüller and Kühn, 1994). Thus, cereal landraces were not only eroded through the replacement by modern varieties, but were lost as cereal production, and agricultural activities in general, were no longer pursued. Unique agrarian cultures disappeared, initially from the plains, and latterly from mountain valleys and high hills.

Local agrobiodiversity was also lost as crops of wheat, barley and oats were cultivated instead of crops such as rye, spelt, emmer and einkorn. Although spelt was once widely grown in Switzerland, plant breeding programs did not concentrate on spelt, so when modern varieties became available it almost disappeared, replaced largely by bread wheat varieties (Harlan, 1995; Nesbitt and Samuel, 1996). Local genetic material was further eroded because local landraces were not extensively utilised for the breeding of the modern varieties that were in demand across the country. As a result, the diversity of agricultural systems, crops, landraces and genetic material was eroded during the modernisation of Swiss agriculture (Simmons, 1997).

Environmental management within agricultural systems had been primarily concerned with maintaining levels of production, protecting natural biodiversity and retaining agricultural landscapes. However, the status of agrobiodiversity has increased in Switzerland since the Convention on Biological Diversity raised awareness of the need to draw together agriculture and ecological concerns (BLW, 1997; UNEP, 1992). As much of the biodiversity that exists in the country is managed within human production systems, it is increasingly recognised that conservation must work with farming communities to maintain that diversity. A number of methods have been formulated to achieve on-farm, *in situ* agrobiodiversity conservation (Jarvis and Hodgkin, 1998; Smale et al., 1998; Brush, 2000).

At the Federal level, the government established the Swiss Commission for the Conservation of Cultivated Plants or Schweizerische Kommisionserhaltung Kulturpflanzen (SKEK) in 1991 to act as an umbrella body to coordinate conservation of agrobiodiversity. The SKEK was established within the Federal Office of Agriculture or Bundesamt für Landwirtschaft (BLW) in response to a rise in interest in the conservation and sustainable use of phytogenetic resources for food and agriculture. Interest grew during the 1990s, especially since the Global Plan of Action was signed at the International Technical Conference on Plant Genetic Resources in Leipzig, Germany in June 1996 (BUWAL, 1998; Schierscher and Kleijer, 1999). Article 140 of the Federal Law on Agriculture, which covers the conservation of agrobiodiversity, and the National Action Plan, developed after the Leipzig Conference, commit the Swiss government to work towards *in situ* agrobiodiversity conservation initiatives (BLW, 1997; BUWAL, 1998).

Research methods

Our research examined programs in Switzerland focussing on the on-farm, *in situ* conservation of wheat (*Triticum aestivum* L.) landraces in the inner Alpine region of Switzerland. As formal approaches to *in situ* conservation are still in their infancy, it was considered appropriate to focus on the perceptions of current stakeholders in the programs. Respondents were targeted who were involved in formal conservation processes including farmers, scientists, public servants, NGO representatives and representatives from food retailers. The aim of the interview process was to gather from key informants, opinions and perceptions of current conservation and development practices and of needs and plans for the future (Chambers, 1994; Lindsay, 1997; Valentine, 1997; Robinson, 1998). Thirty-five respondents were interviewed from August to November 1999 (Table 1). A series of questions was used to guide the interviews, but stakeholders were invited to discuss in-depth those issues believed to be most important in relation to *in situ* agrobiodiversity conservation. The primary qualitative data is presented in Bardsley (2001). In the following discussion,

the respondents are cited according to the number assigned to them in Table 1.

The importance of *in situ* agrobiodiversity conservation

The perceived values of *in situ* agrobiodiversity conservation differ substantially between respondents (Table 2). The values of *in situ* agrobiodiversity conservation for the conservation of genetic resources (63%), for socio-economic applications such as assisting farmers (60%) or for producing specialty products (67%) are relatively equally represented. The social values of retaining diversity for cultural and aesthetic reasons are also broadly recognised. Tourism is a vital aspect of the local regional economies, and the retention of agrobiodiversity is seen by 23 percent of respondents as playing a role in promoting this industry. An equal number recognise that *in situ* agrobiodiversity conservation could support attempts at nature conservation. The retention of diversity on-farm also has a role to play in ensuring agronomic productivity is maintained.

The values of *in situ* for conservation and opportunities for socio-economic development are recognised relatively equally. While no respondents state that *in situ* conservation could not be applied in the Swiss situation, many do acknowledge that the practicalities of agriculture in modern Switzerland, particularly the high costs of production, would limit the application of initiatives. The methods that are being utilised to overcome the limitations are examined in the following discussion.

Methods of agrobiodiversity conservation

Primarily because modern forms of agricultural development have substantially altered the agricultural landscapes and ecosystems, there is virtually no ongoing *de facto* conservation of crop landraces on Swiss farms. However, many individuals are concerned about the depletion of agrobiodiversity because of their personal beliefs. From small individual gardens and agricultural properties to entire rural communities, people are proactively working to conserve agrobiodiversity largely through a sense of idealism or to satisfy specific cultural requirements. Several farmers were willing to sacrifice short-term material gains to maintain what they perceive as important activities, systems and genetic resources. Apart from those farmers who are willing to undertake this role for idealistic reasons, the on-farm conservation of landraces will require compensatory measures, because yields are generally reduced when farmers use local varieties instead of high-yielding varieties (Table 3).

Direct state assistance

Switzerland provides one of the highest levels of support for farmers through price supports, tariffs and quotas, state marketing, research and development, and direct assistance. As crop productivity is no longer regarded as an issue that directly threatens the well-being of Swiss society, subsidies for intensification can no longer be justified (Respondents no.: 2, 25, 33). In contrast, the Swiss are increasingly willing to support multifunctional aspects of agriculture (OECD, 1999). There appeared to be some long-term dissatisfaction with the dominant modern agricultural practices (Respondents no.: 1, 12, 20, 22, 34, 35). Doubts raised by affluent individuals concerning the perceived, actual and potential failures of modern agricultural technologies are increasing the demand for alternative products. This rise in concern was concurrent both with international pressure to liberalise their agricultural industry and with commitments to establish more sustainable production methods, including management methods that protect or enhance biodiversity. The combined pressures to change have provided a window of opportunity for unique policy initiatives to assist farmers. Several cantons have developed specific local initiatives to assist farmers to maintain sustainable practices, and in certain cases conserve biodiversity on their farms, often with assistance from the state (Roux and Blum, 1998). At the Federal level, agricultural law Articles 31a and 31b were introduced for direct payments for social and ecological outcomes respectively (Hofer and Freyer, 1995; Curry and Stucki, 1997; OECD, 1998; BFS, 1999; BLW, 1999).

The state is able to support agricultural producers with direct payments because they are not restricted by World Trade Organisation regulations (Ehrler and Bravo-Baumann, 1996). Furthermore, the maturity and decentralisation of the Swiss political structure enhances opportunities to provide effective governance that meets the needs of local people and local environments (Respondents no.: 5, 11, 15, 16). The ecological direct compensation program was introduced in 1993 and environmental reforms became obligatory for state assistance in 1998. The OECD (2000, p88) states that 'expenditures for price support will decline from SF1.3 billion in 1999 to SF0.8 billion in 2003, but outlays for direct income payments to farmers will also increase by SF0.5 billion to SF2.5 billion.'

To obtain payments for environmental activities on the farm, it is compulsory that several hurdles be successfully negotiated throughout the year (Roux and Blum, 1998; BLW, 1999; OECD, 1999). Farming systems must change from conventional production systems to integrated production techniques, including reductions in fertiliser and herbicide use, extensification of crop rotations and reductions in the number of pasture cuts each year (OECD, 1998; BUWAL, 1998). Methods utilised to obtain compensatory payments include the retention of valuable habitat and habitats close to their natural state in set-aside areas, and the sowing of areas with endemic species or the extensive planting of fruit trees (Lambelet-Haueter et al., 1998). Farmers are also able to receive a bonus for organic or biodynamic production (Lampkin et al., 1999). Federal support for agriculture is transforming from a process of supporting production, to a process of supporting farmers' rights, regional development and ecologically sustainable agricultural activities, including conservation of unique agroecosystems and

Table 1. Swiss respondents

No.	Profession and sex of respondent
1	Director, Forschungsinstitut für biologischen Landbau, Frick, Aargau, male.
2	Project manager, Primalp, Eidgenössische Technische Hochschüle Zentrum, Zürich, male.
3	Plant scientist, Eidgenössische Technische Hochschüle Zentrum, Eschikon, Zürich, male.
4	PhD. Student, Integrated Project Biodiversity, University of Zürich, Zürich, female.
5	Plant scientist, Eidgenössische Technische Hochschüle Zentrum, Zürich, male.
6	Secretary, SKEK, Swiss national genebank, Eidgenössiche Forschungstation für Landbau, Changins, Vaud, female.
7	Wheat breeder, Eidgenössiche Forschungstation für Landbau, Changins, Vaud, male.
8	Plant breeder, Eidgenössiche Forschungstation für Landbau, Changins, Vaud, male.
9	Manager, Swiss national genebank, Eidgenössiche Forschungstation für Landbau, Changins, Vaud, male.
10	Manager, Sortengarten Erschmatt, Erschmatt, Wallis, male.
11	Manager, garden and field plants, Pro Specie Rara, Sortenzentrale, Kölliken, Aargau, male.
12	Biodynamic agriculture researcher, Forschungsinstitut für biologischen Landbau, Frick, Aargau, female.
13	Agricultural economist/farmer, Forschungsinstitut für biologischen Landbau, Frick, Aargau, male.
14	Plant breeder, Getreidezüchtung, Wetzikon-Robenhausen, Zürich, male
15	Manager, Agricultural Genetic Resource Conservation, BLW, Bern, male.
16	Secretary, Crop Genetic Resource Conservation, BLW, Bern, male.
17	Marketing manager, COOP Naturaplan, Basel, male.
18	Plant breeder/manager, Genossenschaft Gran Alpin, Tiefencastel, Graubünden, male.
19	Organic farmer, Filisur, Graubünden, male.
20	Organic farmer, Oviga (Loco), Tessin, male.
21	Archaeobotanist, Botanical Institute, University of Basel, Basel, female.
22	Wheat breeder, Federal Research Station for Agro-ecology and Farming, Reckenholz, Zürich, male.
23	Pasture agronomist, Federal Research Station for Agro-ecology and Farming, Reckenholz, Zürich, male.
24	Regional extension officer, Agricultural training and advisory centre, Frick, male.
25	Farmer, Lötschental Berggemeinde landrace conservation program, Blatten, Wallis, male.
26	Organic farmers, Geschinen, Wallis, male and female.
27	Organic farmer, Urmein, Graubünden, male.
28	Organic farmer, Summaprada/Thusis, Graubünden, male.
29	Organic farmer, Ardez, Graubünden, male.
30	Organic farmer, Scuol, Graubünden, male.
31	Organic farmer, Ftan, Graubünden, male.
32	Organic farmer/vice-president Genossenschaft Gran Alpin, Andeer, Graubünden, male.
33	Manager, Biosphere Reserve Entlebuch, Entlebuch, Bern, male.
34	Marketing manager, Schweizerische Arbeitsgemeinschaft für die Berggebeite, Brugg, Aargau, male.
35	Agronomist/advocate, Schweizerischer Bauernverband, Brugg, Aargau, male.

Table 2. Reasons for *in situ* agrobiodiversity conservation in Switzerland

Reasons for *in situ* conservation	Respondents (N=30)	%
Conserve genetic resources	1, 3, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 18, 19, 22, 23, 26, 27, 28	63
Stabilise/enhance production	1, 8, 14, 25, 27, 32	20
To target farmer assistance	1, 2, 3, 5, 9, 11, 12, 13, 15, 16, 17, 18, 22, 24, 25, 32, 34, 35	60
Specialty products	1, 3, 6, 7, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24, 26, 27, 33	67
Promote tourism	2, 3, 7, 9, 10, 16, 20	23
Promote cultural traditions	3, 7, 10, 13, 15, 16	20
Aesthetics/landscapes	3, 9, 10, 11, 15, 16, 18, 22, 26	30
Conserve natural biodiversity	1, 3, 10, 11, 13, 14, 15	23
Science/education	3, 7, 24	10

Table 3. Summary of methods for *in situ* conservation

Method	Dominant Example:	Respondents for because:	Respondents against because:	*
De facto	Individual farmers idealism	Hobby – enjoyment and interest	Few landraces remain. High opportunity costs	*
State assistance	Direct ecological and social payment	Public funds for social and ecological outcomes	Expensive and uncertain to rely upon state support	***
Marketing	Local, regional and international programs	Highly developed marketing structures. Tourism links	Limited in scope	***
Scientific	Research & Development	Widespread effects. Link *ex* and *in situ*	Complex science. Productivity focus	***
Reserves	Biosphere reserve	Targets ecologically & culturally valuable regions	Limits local development	*
Community	Numerous programs	Provide targeted niche support	Lack capacity & *in situ* focus	***
Awareness raising	Urban-rural links	Essential for all *in situ* programs	Awareness already at a high level	**

(*** = more appropriate method, ** = appropriate method, * = less appropriate method, - = inapplicable method)

landscapes, species, varieties and genetic material (BUWAL, 1998; OECD, 1999).

The Swiss public has been able to recognise numerous alternative values in a robust and sustainable agricultural industry. The lasting benefits of maintaining a rural social structure, particularly in the mountain regions, and an environmental quality, linked to biodiversity conservation, low-pollution levels and the retention of cultural landscapes, are accepted and supported by the direct payments. The outcome is a change in agricultural politics to reduce the protection of the industry, limit surpluses in production, and maintain the trend in time of slowly increasing average farm sizes, while maintaining socio-economic support of rural communities by focusing on environmental outcomes. The result has been the rapid adoption of integrated and organic production systems, particularly in the mountain regions (Wilson et al., 1996; OECD, 1998; Roux and Blum, 1998).

Respondents articulated numerous reasons for the adoption of the direct payment system (Table 4). Rapid changes in international conservation and agricultural trade policy and internal concerns about support programs for agriculture were important in the evolution of the direct payments. Many respondents criticised the new policy as a form of social engineering, which will reduce surplus agricultural output and substantially increase farm sizes in the longer term. However, the recognition of the need for direct assistance for social and ecological outcomes is very high. The Swiss have developed a pioneering policy to assist farmers, which combines responses to international, state and local needs regarding productivity, sustainability, socio-economic development and cultural concerns (Respondents no.: 2, 5, 11, 15, 16, 18, 28, 35).

Interest in opportunities for *in situ* agrobiodiversity conservation has been enhanced by the success of the direct payment systems, because it is recognised that the retention of landraces on farms would only be successful on a broad scale when it includes some incentives for farmers. In particular, the *in situ* conservation of crop landraces will depend heavily upon the desire to maintain a niche for sustaining mountain agriculture in an era of globalisation. Only about 1.1 million hectares of Switzerland is potentially useful for agricultural production and of this, 300,000 hectares is currently used for arable production (BFS, 1999). To remain viable on the plains, farms should continue to improve production efficiencies. In the marginal mountainous areas that maintain some crop production, opportunities for further development within a productionist paradigm are limited. Mountain farmers are able to exploit the fact that the Swiss public are willing to continue to subsidise the agricultural sector to ensure ecological and social sustainability in mountainous areas (Respondents no.: 1, 2, 5, 8, 10, 15, 22, 23, 28, 31, 34, 35).

Many farmers in the mountain regions now obtain the principle component of their income from direct state assistance rather than from the sale of agricultural products. By responding to the rights of farming communities in the mountains, Switzerland is suggesting that agriculture no longer need rely on the production of foods and fibres to be considered socially valuable. As the multifunctional aspects of agriculture are being recognised by both the state and the Swiss public, conservation of traditional practices in the mountains provides farmers with a direct competitive advantage. Of particular interest in regard to landrace conservation is the inner Alpine region, which is agronomically suited to cereal production at high altitudes and is the region

Table 4. Reasons for the introduction of direct payments in Switzerland

Reasons for direct payments	Respondents (N=29)	%
Internal funding pressure	2, 4, 5, 13, 15, 22, 28, 29, 33, 34, 35	38
Farm income security	2, 4, 5, 8, 15, 19, 25, 27, 35	31
Reduce output	2, 4, 5, 7, 23, 29, 35	24
Increase farm size	2, 18, 19, 20, 27, 29, 33	24
Respond to European Union/ World Trade Organisation	1, 2, 9, 15, 19, 23, 24, 27, 28, 31, 34	38
Ecological outcomes / National Plan of Action	1, 2, 4, 5, 7, 8, 10, 12, 13, 15, 16, 17, 19, 20, 22, 23, 25, 27, 28, 30, 32, 33, 34, 35	83
Maintain landscape	2, 4, 5, 8, 10, 16, 18, 19, 22, 34	34

where cultivation of Swiss crop landraces continues in some isolated high-valleys.

Because the awareness of environmental issues is relatively high in Switzerland, the state has been able to respond rapidly to international and internal concerns associated with agricultural subsidies, the need for regional development and the retention of agrobiodiversity, including ecosystems and landscapes. However, a wider awareness of values and needs for conservation is needed for on-farm *in situ* agrobiodiversity conservation processes to develop (Respondents no.: 1, 3, 6, 9, 10, 11, 12, 15, 17, 18, 19, 24, 26, 32, 35). Forms of special targeted assistance could be provided to farmers in marginal areas who would perform the task of conserving the ancient varieties. These funds would compensate farmers for the provision and maintenance of intellectual property, in the form of the crop varieties that they, or their communities, have developed and maintained. One of the greatest concerns of this form of assistance is that farmers do not wish to be seen as receiving payments for doing nothing. The ecological direct payment scheme primarily aims to conserve natural biodiversity rather than agrobiodiversity. The particular advantage of paying farmers to conserve agrobiodiversity rather than just natural biodiversity could be that they would produce a marketable good as part of the process. As farmers see their role as producer, the best forms of conservation on-farm are those where farmers' production activities are embedded in the role.

Marketing initiatives

While state support will be vital for widespread *in situ* agrobiodiversity conservation and the goodwill of the general public and specific individuals is substantial, the market will play an increasing role in defining its societal value. The development of markets for Swiss landraces and their products is likely to be both a vital reason for *in situ* agrobiodiversity conservation and an important method of compensation for farmers who wish to undertake conservation activities (Respondents no.: 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24, 25, 26, 27, 32, 33, 34, 35). The exotic nature of healthy foods linked to a historical past, the continuing viability of mountain agriculture and the conservation of biodiversity justify an effective market niche for many 'diversity' products, particularly when they are of high quality.

Awareness of the market value of agrobiodiversity is linked to ideas of unique or rare qualities of the product and associated agricultural systems. One of the most important influences upon the marketing of diversity will be the retention of local food cultures. The awareness of the values of agrobiodiversity is eroding in many societies as food and agricultural production cultures follow the dominant modern food culture patterns of the North (Gofton, 1996; Traill, 1997; Friedmann, 1998). Where traditional food cultures can be retained, great opportunities exist to link agrobiodiversity cultivation to the local market. Respondents noted that the philosophical understanding exists amongst consumers that products derived from modern agriculture are often unethical, unhealthy or un-ecological. This illustrates the potential for a new and substantial niche for alternative products. Goods produced with the aim of supporting agrobiodiversity conservation or diversity products from the mountains could become a separate market niche altogether (Respondents no.: 1, 10, 11, 13, 17, 18, 24). Products from local *in situ* programs could be marketed to show that they are linked to biodiversity conservation and with societal and resource management processes perceived as positive by consumers.

The Swiss state is withdrawing from the management of agricultural goods. Simultaneously, evolving marketing structures are enabling private investment into regional, organic and biodynamic production systems associated with agrobiodiversity conservation (BUWAL, 1998; Furgler, 2000). The organic producers' Biosuisse Knospe, Demeter and Migros Bio labels for organic products are certified and widely recognised by consumers (Hofer and Freyer, 1995; Lampkin et al., 1999; COOP, 1999). However, landraces are often not as easily processed or marketed due to high levels of heterogeneity, including variable levels of quality - a factor that is not appreciated within modern marketing systems (Respondents no.: 8, 10, 12, 13, 18, 19, 26, 27, 35). In particular, a lack of interest amongst bakers and millers in the landraces, of varying quality, could hinder the evolution of any *in situ* agrobiodiversity conservation program.

In an increasingly global marketplace, where politics, world views, socio-economic conditions, agro-ecologies and methods of production vary widely, there is a press-

Table 5. List of acronyms used in this article

BFS	Bundesamt für Statistik
BLW	Bundesamt für Landwirtschaft
BP	Before Present
BUWAL	Bundesamt für Umwelt, Wald und Landschaft
FAO	Food and Agriculture Organization
NPGS	National Plant Germplasm System
NGO	Non-Government Organisation
OECD	Organization for Economic Cooperation and Development
SBS	Schweizerischen Bauernsekretariat
SBV	Schweizerischer Bauernverband
SF	Swiss Franc
SKEK	Schweizerische Kommisionserhaltung Kulturpflanzen
UNEP	United Nations Environment Programme

ing need for effective labelling of goods to ensure that people know what exactly is being supported when a product is bought (Paillotin, 1998; Blandford and Fulponi, 1999; OECD, 1999). As globalisation leads to greater homogeneity between and within societies, the 'difference' that remains within the agricultural margins is likely to become a resource in itself. Marketing niches derived from the unique, exotic values associated with the Alps could offer great opportunities for mountain agriculture to diversify and remain viable (Respondents no.: 1, 2, 3, 13, 14, 15, 16, 17, 18, 19, 20, 22, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35). The majority of respondents suggested that the local population would have the greatest links with products originating from the local area, culture and agro-ecological system. Producer-consumer cooperatives, such as the Lötschental farming community, which is being assisted by the NGO Schweizer Bergheimat to produce ryebread from a local rye landraces, provide direct links between farmers and the public.

Regional marketing and direct sales initiatives could be particularly valuable for mountain regions, especially in regions close to tourist centres or cities. As part of the recognition of the need to represent diversity, Swiss agricultural law Articles 2 and 29 for national seed marketing, and Article 140 for plant breeding, allow small numbers of non-listed varieties to be marketed within the local region of production (BLW, 1997). The NGO Schweizerische Arbeitsgemeinschaft für die Berggebiete has worked to develop a common logo for the mountain regions of Switzerland. Genossenschaft Gran Alpin is a marketing cooperative organisation which assists farmers to continue cereal production in the mountain regions of canton Graubünden where wheat was once grown up to an altitude of 1300 metres.

Gran Alpin has worked to produce and market cereal products to obtain premium prices for crops grown in the mountains. The cereals are organically produced and therefore have perceived health and ecological values. They are linked to the cereal mountain farming systems and communities in the mountainous region of Graubünden, so there are also substantial regional development implications. The plant breeder at Gran Alpin is attempting to develop appropriate varieties from local landraces. By utilising local plant germplasm, the agrobiodiversity marketing factor will be added to the concepts of value already attributable to Gran Alpin products.

The high price of boutique diversity products will be prohibitive for some consumers. Products derived from crop landraces may only be purchased by those who could afford them. During periods of economic downturn, the production process may well become unviable. To remain viable, niche producers will have to rely upon a strong economic situation in Switzerland (Respondents no.: 1, 2, 8, 15, 24, 32). There are some concerns that Swiss consumers already make choices between too wide a range of market niches and that to add another, based on agrobiodiversity, would complicate agro-ecological labelling (Respondents no.: 1, 2, 9, 17, 34). If modern food culture erodes the idealism linking forms of food production and presentation, or if consumers are unwilling to investigate the complexity of product labelling, the marketing of diversity products alone may not ensure agrobiodiversity conservation. On the other hand, the diversity products could act as a symbol of the complexity of sustainable agricultural systems. As an organic farmer in Graubünden states, 'If food is cheap, then it is also no longer worth anything. In such a way nobody thinks anymore where the food comes from, how is the bread produced, how much work goes into the bread we buy. It is not worth it. If the bread only costs SF2, then it is not worth thinking of the work that is required to produce it. When bread costs SF10 then the buyer would say, "Hey, what is behind this, why is it so expensive?"'

Other methods for conserving agrobiodiversity in situ

In situ agrobiodiversity conservation could be supported by raising awareness, particularly amongst the scientific community of the value of retaining varietal diversity in the field. Research and extension within Swiss agriculture is largely limited to the dominant productionist paradigm. While the state and private sectors continue to pressure farmers to modernise their activities without presenting potentially viable alternatives on an equal footing, then opportunities for on-farm conservation will remain limited (Respondents no.: 1, 4, 5, 9, 20, 25, 26, 27). The technical capacity to un-

derstand and apply the science of *in situ* conservation is developing within the Federal research stations. However, from a situation where Switzerland had two public wheat breeding centres at Changins and Zürich-Reckenholz, the national wheat breeding program is being centralised to the Changins station. Respondents suggest that it is likely that there will be little or no national wheat breeding in the future, and Swiss agriculture will rely on varieties developed in other countries and within the private sector, including the partly-government funded Swiss Research Institute for Organic Agriculture or multinational companies, such as the Basel based Syngenta (Respondents no.: 3, 5, 9, 11, 22, 28). Switzerland's ability to accommodate the intricate technical requirements associated with a broadscale *in situ* agrobiodiversity conservation program could be hindered substantially.

Modern varieties and associated agroecosystems are so dominant that there is little local agrobiodiversity to conserve over wide areas. There are few local landraces still grown on farms and where these are grown, they are rarely grown in their site of development (Respondents no.: 3, 5, 10, 15, 18, 19, 26). Fortunately, the seeds of many landraces are still available from the Swiss genebanks and other genebanks throughout the world. Ex and *in situ* conservation could work symbiotically when the landraces are returned to the fields.

Individual breeders are discovering a niche for crop development that incorporates the use of local germplasm, but the applications of research outcomes are limited by the fact that scientific outcomes are often not applicable within the infrastructure of local knowledge and activities. Agricultural schools or variety gardens could play a vital role for *in situ* conservation in Switzerland by providing a link between farmers and the public, and the genebank and breeding community (Respondents no.: 3, 6, 9, 10, 11, 15, 18, 26). The variety garden Sortengarten Erschmatt links the national genebank with people who wish to learn about landraces in Wallis. The Sortengarten is supported by the SKEK, and the NGO Schweizer Bergheimat which has a strong interest in the sustainability of mountain communities. As well as acting as a conduit for germplasm and ideas, the Sortengarten plays a substantial role in raising awareness of the conservation issues.

In the agricultural margins of Switzerland, the retention of agrobiodiversity is connected to the retention of a way of life. Where small areas can be set-aside to concentrate on the channelling of materials between genebanks and farming communities, the activities of local farmers are not substantially hindered. On the other hand, where entire communities are enclosed within reserves, which restrict their activities, unique situations of participation from local people and societal support are required. For example, it has been proposed that the only National Park in Switzerland will be extended to incorporate farming communities within the Engadine in Graubünden. In this case, where community support was not broadly canvassed, the project has faced substantial opposition. In contrast, the Entlebuch Man and Biosphere reserve has attempted to work with local communities from the outset and has developed local cooperation.

There is a role for NGOs to assist the state to facilitate the cooperation of like minded people who assist each other to develop new markets for agrobiodiversity, lobby governments, share materials and to maintain alternative agricultural systems. Community conservation initiatives are guided both by supporters of biodiversity conservation and by those people who recognise that regional development opportunities are available linked to the development of local diversity.

Swiss cooperatives have developed both within village groups and around producers who have like ideas and who are using similar techniques for farm management and marketing. Often such groups form into NGOs whose influence extends beyond the physical limits of a local area. Pro Specie Rara is a NGO that has attempted to coordinate community agrobiodiversity conservation activities throughout Switzerland. They have developed their own genebank by collecting materials from the public. They have a decentralised system for *in situ* conservation, which relies heavily upon the competent actions of the many participants across Switzerland to conserve agrobiodiversity on their properties. COOP, a local supermarket chain, is now marketing some of Pro Specie Rara's diversity products (COOP 1999). The coordination of such diverse individuals and groups could offer the most sustainable opportunities for finding a balance between centralisation and diversity for effective conservation outcomes in the future.

Conclusion

Switzerland has a significant capacity to undertake an *in situ* program because of widespread goodwill towards the farming community and awareness of associated social and environmental issues. It is disadvantaged by high production costs and ongoing perceptions of 'agriculture as production'. Although the state is withdrawing from price support schemes, it is still actively supporting the consolidation of agricultural systems, particularly in mountain regions. To continue to justify state expenditures to a public that is ever more distanced from agricultural activities, and to an international community that is increasing pressure to remove agricultural subsidies, state assistance for agriculture must continue to target support for social and environmental outcomes. The Swiss approach for *in situ* agrobiodiversity conservation indicates that a formal state approach for supporting conservation outcomes can work effectively with community and private interests when an umbrella organisational structure, in this case the SKEK, draws links between the different bodies rather than replicating their activities.

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