

## Exploring innovative strategies for livelihoods in a slash-and-burn context in Madagascar

Experiencing the role of human geography in sustainability-oriented research

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### 1 Introduction

Madagascar, located 375 km off the coast of Mozambique, is considered to be the 4<sup>th</sup> biggest island in the world. Due to its particular evolutionary history, the island boasts a rich biodiversity characterised by a high degree of endemism. MITTERMEIER et al. (1999) declared Madagascar to be a hotspot of biodiversity that should be protected at any cost. He thereby draws attention to the manifold environmental problems the island faces, of which deforestation on the eastern escarpment is the most prominent. Deforestation is largely attributed to slash-and-burn agriculture – locally known as *tavy*. Farmers practice *tavy* mainly for upland rice, transforming primary forest into secondary forest and fallow vegetation. Increasing population densities combined with unfavourable social and political parameters have caused fallow periods to be shortened to 3–5 years, leading to a reduction in soil fertility and fallow vegetation, both critical for production. With the rapid decrease in productivity, the financial situation of peasant households is at risk. This situation is further aggravated by the resulting necessity of households to concentrate on short-term food and livelihood needs. As a consequence, their capacity to intensify land use and cultivate new land is undermined.

The ongoing degradation of Madagascar's forests is attracting the interest and concern of more and more external actors. The government has drawn attention to the precarious situation of the nation regarding own food production, emphasising the expected impact on foreign exchange when food imports become necessary. International voices link deforestation with global warming and declining biodiversity. This has often resulted in development proposals with a conservation-bias that inadequately acknowledge the situation and needs of farmers. Slash-and-burn farmers continue to be held responsible for deforestation, degradation, low productivity and slow technology adaptation. Accordingly, external recommendations aim at sensitising farmers to the long-term benefits of conservation and setting up rules and repressive measures. Despite increasing investments by development and conservation agencies in Madagascar, the efficiency of currently applied strategies remains questionable. Not only is deforestation increasing at a

rate of 150'000 ha per year (FOOD AND AGRICULTURE ORGANIZATION (FAO) 1997), but a steady growth of poverty and vulnerability of peasant livelihoods may also be observed

It is mainly in the last 20 years that research has turned to the investigation of alternatives to slash-and-burn. In Madagascar, as well as at an international level, two major approaches to the above can be identified. The first focuses on stabilising agriculture and securing livelihoods by mitigating the negative effects of slash-and-burn. Considerable research has been dedicated in this area to technical alternatives to fire (e.g. ALEGRE et al. 1989; WILSON & LAL 1986), the use of agroforestry components for soil conservation (HURNI & NUNTAPONG 1983; RODER 1997), the use of fertilizer (NICHOLAIDES et al. 1985; SANCHEZ 1985) or the transfer of nutrients through green manure (e.g. FAGERSTRÖM et al. 2001; RAO et al. 1998). In Madagascar, such experiments were partly tested through research institutes (CENTRE DE COOPÉRATION INTERNATIONALE EN RECHERCHE AGRONOMIQUE POUR LE DÉVELOPPEMENT (CIRAD) 1996; RAKOTOMANANA et al. 1989), but important experiences were also gained through integrated conservation and development projects (e.g. PETERS 1998). As part of the second approach, research endeavours also focused on the replacement of slash-and-burn cultivation by more intensive land use systems, such as e.g. livestock breeding, complex and diversified agroforestry systems (GARRITY 1995), intensified irrigated rice production. On the eastern escarpment of Madagascar, this approach has a long-standing history, having been introduced during colonial times (DE COIGNAC et al. 1973). The results have been critically reviewed in OXBY & BOERBOOM (1985). In recent years, research and development work has focused increasingly on particular components of such alternative production systems, such as intensified irrigated rice (RABEARIMANANA 1988; VALLOIS 1996), improved marketing networks (PARTAGE 1997), as well as non-agricultural activities including, amongst others, ecotourism and handicraft production (KREMEN et al. 1999; SWANSON 1996). The main criticism brought against both approaches concerns the need for external inputs (BERTRAND et al. 1997; WEISCHET 1987), the neglect of the general socio-economic parameters (NOORDWIJK et al. 1997; RODER et al. 1995), and the lack of attention given to specific livelihood strategies and their inherent rationality (GARREAU et al. 2001; WERNER 1993).

Taking the current state of research and the particular context of Madagascar as a starting point, the Swiss National Science Foundation Project BEMA (Bilan Écologique à Madagascar) studied the problems linked to slash-and-burn cultivation on the eastern escarpment of Madagascar between 1994 and 2002. A multi-disciplinary team of Swiss and Malagasy students selected a case study approach for investigation of the region of Beforona, which is situated along the highway RN2 connecting Antananarivo and Taomasina and covers a transect from primary forest to highly degraded zones (cf. Figure 1). The research results presented in this article reflect the findings of the study group that pursued the overall goal of identifying alternative and more sustainable land use strategies in a slash-and-burn context (MESSERLI 2004). The group aimed at understanding current peasants' strategies and exploring processes of adopting and adapting innovative components supporting sustainable development.

## 2 Approach and methodology

The approach selected to support the overall research goal involved three steps, each step aiming at illuminating a different aspect relevant to sustainable development (BREU 2006):

- (i) The multidisciplinary studies carried out during the early phases of the BEMA project yielded interesting insights into ecological, socio-economic and cultural processes and dynamics. This descriptive knowledge, which can best be described as systems knowledge, was brought into an interdisciplinary synthesis;
- (ii) As sustainable development is a normative concept, research alone cannot reflect on alternative land use practises. In order to capture the different opinions related to development direction, a multi-level stakeholder analysis was carried out. This resulted in so-called target knowledge, which guided subsequent studies;
- (iii) The identification of «most promising» development paths resulted in new questions regarding practical realization. This need for transformation or operational knowledge led to experimental on-farm research exploring, on the one hand, specific agricultural, organisational and economic innovations, and on the other, their integration into existing livelihood strategies.

The third step of this approach – to which the results presented in this article mainly refer – was built on the theoretical basis of an actor-oriented perspective of peasant strategies (WIESMANN 1998). This theoretical orientation emphasises the term «strategy» and draws attention to the central implication this emphasis has for both research and practise: a certain activity

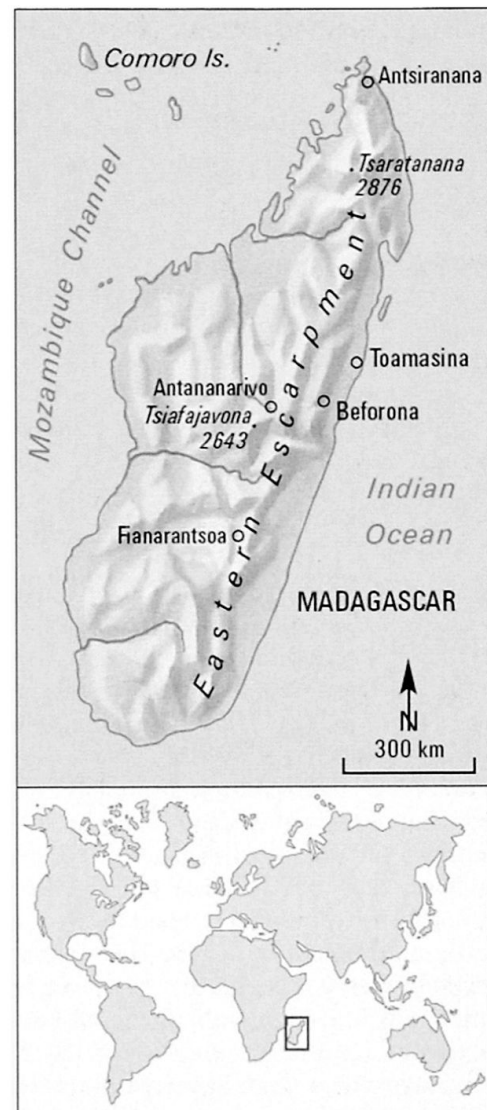


Fig. 1: Madagascar and the research site in Beforona on the eastern escarpment

*Madagaskar und das Untersuchungsgebiet von Beforona am Ostabhing*

*Madagascar et la région d'étude de Beforona sur le versant est*

Source: Relief based on Schweizerischer Mittelschulatlas 1972, © Schweizerische Konferenz der kantonalen Erziehungsdirektoren (EDK); cartography: A. BRODBECK

or change in activity can not be understood without taking into account the manner in which it is an integral part of the process of optimisation within the network of activities, and without relating the network of activities to the structure of meanings, as well as to the perception of dynamic parameters.

Methodologically, this research orientation implied collaboration with local land users in an on-farm set-

ting. An intensive culture of dialogue and exchange of knowledge was established, allowing explicit expression of meanings and strategies that shape the different activities of the land users. At the same time, it allowed reflection on and complementation of scientific knowledge.

In a first phase, experimentation was carried out with single innovative activities. They involved technical, organisational, and institutional aspects, which generally referred to production and marketing activities. Farmers and researchers jointly defined the objectives, implemented the necessary tasks, and assessed the outcomes with regard to ecological, economic and socio-cultural indicators. Each experimental activity was repeated by five to ten peasant households.

In a second phase, the focus shifted from single innovative activities to their integration within a set of multiple activities corresponding to the respective livelihood strategies. The research questions guiding these trials were as follows: (a) Can the simultaneous adoption of innovative activities bring about a significant and viable change in livelihood strategies? (b) What is the appraisal of these modified strategies in ecological, economic, and socio-cultural terms? Three pilot households entered into a close collaboration with the research team combining at least three of the earlier tested experimental activities. This collaboration lasted for over two years and involved frequent and regular meetings to design, implement, and adapt the chosen activities. The monitoring was carried out using quantitative as well as qualitative methods (OKALI et al. 1994; WERNER 1993), of which the households' diaries proved to be a valuable source of information. Most important findings were shared among different pilot households and with a wider community through field days, panel group discussions and broadcasts on the local radio.

### 3 Results

Before presenting the results of the third research step dealing with the exploration of innovative livelihood strategies, it is important to understand the main conclusions drawn from the preceding two steps of the research approach:

(i) **Conclusions from the interdisciplinary synthesis of systems knowledge:** By studying the key factors of the land use system in a dynamic way (BRAND 1998; BRAND & PFUND 1998; PFUND 2000; TERRETANY/BEMA 1997, 1998a, 1998b), it was concluded that even though measures to mitigate the most imminent problems linked to decreasing productivity in upland rice represent a necessity for local farmers, these would not allow the vicious circle

of degradation, decreasing yields and over-exploitation to be broken in the long term. More promising paths for sustainable development appeared rather to lie in the promotion of a diversified production system that aims at a better balance between food security and income generation (MESSERLI 2000).

(ii) **Conclusions from the multi-level stakeholder analysis producing target knowledge:** The comparative assessment of different stakeholders' visions revealed that the often praised win-win situations between local and external actors, and between conservation and development interests, represent utopian desires rather than reality. However, promising areas in the land use system could be identified, where trade-offs between subsistence needs, market development and more sustainable natural resource management seem feasible (MESSERLI 2004, 2005).

#### 3.1 Promising innovative land use practises

Based on the insights mentioned above, four major innovative activities were tested to assess their potential to support peasant's livelihoods and contribute towards a more sustainable natural resource management:

(a) **Intensification and extension of irrigated rice cultivation.** The tests on intensification and extension of irrigated rice cultivation brought to light that from a technical point of view, the potential of the region is not yet fully exploited. If the currently irrigable surfaces were to be developed further, the share of total rice demand covered by irrigated rice could be increased from 16% to 46%. Furthermore, if the available and known cultivation methods for increasing yields were applied, irrigated rice production could even cover 92% of total demand. This economically and ecologically desirable scenario is, however, hampered by conflicts over land access and organisational problems related to transhumance for upland rice cultivation. Furthermore, the risk imposed by destructive cyclones also hinders peasant households from making the considerable investments necessary for enhancing this activity. The risk for a household to experience major damage on one of their fields was estimated at about 10% per season.

(b) **Intensification of home gardens and marketing networks.** Labour or time invested into home gardens directly competes with time invested into subsistence production. Even though home gardens provide 50-80% of household income, they only receive 8% of total labour input and occupy 7% of total land surface. As food security demands growing labour input, home gardens are neglected and long-term investments necessary for maintaining coffee, spices, and precious fruit cultivation can no longer be ensured. The intensifica-



tion trials of home gardens therefore aimed at producing regular income in the short-term (integration of ginger, vegetables) and at ensuring the production of staple crops usually associated with upland rice (beans, corn, vegetables). It was shown on the one hand, that these agroforests are ecologically highly sustainable, and on the other hand, that revenues are significant, ensuring a return of investment in the long-term. Ginger thereby proved to play a crucial role, allowing for a tripling of productivity compared to traditional cultivation methods. The revenues could further be increased by support given for marketing of produce under an organic label.

(c) **Integration of pig-breeding.** Different households tested the suitability of pig-breeding both for income generation and as a supplement of their nutritional diet. It was shown that the technical feasibility and the economic success depended closely on the linking of pig-breeding with other activities. Only households that already pursued permanent agriculture (home gardens, irrigated rice) were able to ensure the necessary care of animals kept in stables. At the same time, fodder could be supplied by waste products from home gardens and paddy production. Conversely, pig dung proved to be a highly valuable input for compost production, which led to the high productivity of ginger in home gardens. In sum, pig breeding as a stand-alone activity did not meet expectations whereas in association with other production components, it had an important multiplier effect on economic profitability and ecological viability.

(d) **Intensified upland rice production with improved fallow.** To counteract the enormous loss of nutrients during fire cycles, the attempt was made to replace traditional burning with natural decomposition of biomass over an extended period of six months. In a next step, rice was planted by direct seeding or following a reduced burning of remaining biomass. Beans or corn were then planted, to be followed by an improved fallow consisting of leguminous and spontaneous species. The results of the new crop rotation indicate that nutrient management could insofar be improved as nutrient availability in top soils was increased by 60% on average and rice yields could be doubled. However, an important asset of traditional burning techniques came to light: the efficiency of the technique with regard to weed control. Without application of traditional burning techniques, time invested for weeding increased significantly. Even if the experiment demonstrated that a more viable production of upland rice is feasible and that it can even be economically more profitable, certain important limitations persisted. Firstly, farmers often try to maximise the fallow land they are putting under cultivation as proof of need, an important factor in upholding their traditional

access rights to land. Secondly, the tested methods are technically restricted to foot slopes, as erosion of unburnt biomass would cover the young rice sprouts and prevent their full development. In sum, intensified upland rice production does not appear to be a viable alternative to large-scale slash-and-burn cultivation. It might, however, complement the production activities of households already focusing on permanent and sedentary land use.

The participatory evaluation of the above-mentioned investigation can be summarised as follows: even if the outcomes were generally highly appreciated in ecological, economic, as well as socio-cultural terms, farmers often remained reluctant to continue these activities, as they came into conflict with the overall set of activities of the household. The intensification of home gardens, for example, was highly rated, but seemed only justifiable if transhumance related to *tavy* would be abandoned at the benefit of irrigated rice production. In other words, only an adaptation of the entire strategy would allow integrating new activities and exploiting the necessary synergies of the proposed innovations.

### 3.2 Integrating innovations: towards sustainable land use and livelihood strategies

Based on these insights, subsequent trials were started with three so-called pilot households that showed an interest in experimenting simultaneously with a set of innovative activities. From a palette of possible innovations, these households selected components that corresponded best to their household composition and their environmental context, as well as reflecting their preferences. Over a period of two years, a very close collaboration developed between these households and the involved researchers, leading not only to an enriching and constructive exchange of knowledge, but also enabling a close monitoring of the outcomes.

A first important indicator used to appraise the modified strategies of the households was the time invested in different activities (cf. Figure 2). Compared to the average labour investment of households in the same area, the changes experienced by the pilot households was significant. Whereas households (A) and (B) reduced their investments into *tavy* significantly, household (C) resigned entirely from slash-and-burn cultivation. This allowed for a considerable redistribution of working days into other land use activities such as rice irrigation, livestock breeding, home garden production and marketing. Activities related to subsistence production could thereby be decreased from 55% to 28% on average, whereas cash production saw an increase from 29% to 44%. Moreover, the pilot households were able to invest more time



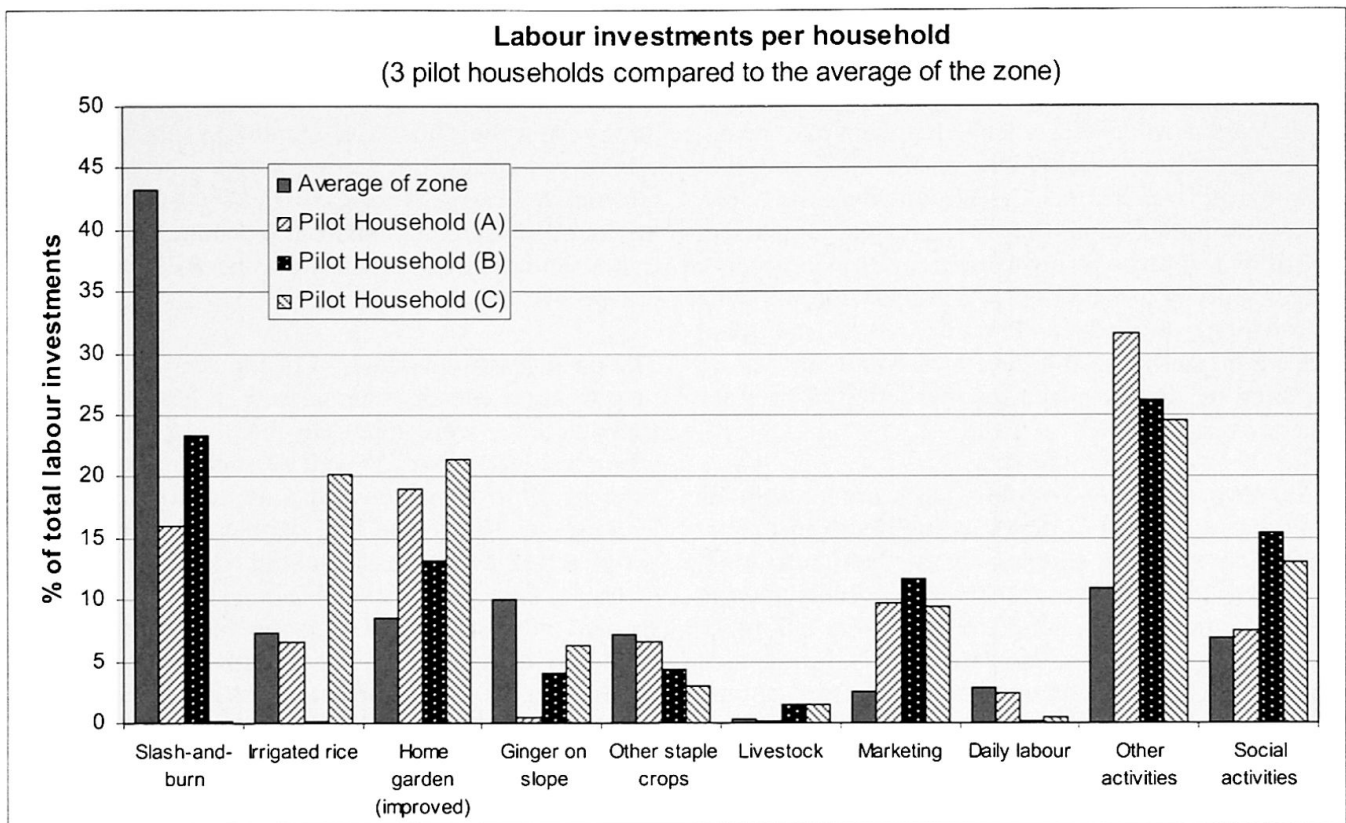


Fig. 2: Time invested by pilot households as compared to household averages from the same area  
*Arbeitsinvestitionen von Pilot Haushalten in Prozent ihrer gesamten Arbeitsleistung, im Vergleich zum Durchschnitt derselben Region*

*Investissements en travail des ménages pilotes en pourcentage de la capacité totale de travail, comparée à la moyenne de la même région*

Source: MESSERLI 2004; TERRE-TANY/BEMA 1998a

into social and other activities such as visits, travelling to town, participating in farmers' associations, and leisure.

An economic balance of these sets of activities shows that in general terms, the monetary turnover increased by a factor of 2 to 4. Figure 3 shows clearly that this not only enabled increased investment of capital into agricultural production but a range of other benefits as well. Furthermore, households were able to increase their expenditure on health, clothing and other consumables.

From an ecological perspective, the improvements brought about by the introduction of these innovative activities reflected the positive experiences already made in the earlier research phases. Slash-and-burn cultivation was reduced in all households, ranging from complete abandonment to a decrease of cultivated surface by about 50%. The success of the risky transfer of ginger production from steep slopes to the

home gardens also contributed significantly towards environmental improvement. Finally, the integration of pig-breeding and the related use of compost in home garden production further enhanced ecological sustainability.

The acceptance of these innovative activities by the involved households in socio-cultural terms proved to be ambiguous. On the one hand, the effects on the individual households were considered to be on the whole very positive. Aspects mentioned included the improved distribution of labour between household members (women and children were relieved from weeding on *tavy* fields), the increased availability of time allowing investment into social capital, as well as the improved availability of funding for health, clothing, schooling and other consumables. On the other hand, negative experiences were reported regarding changed relations to the larger social community. The conversion to permanent agriculture, the neglect of traditional *tavy* farming,

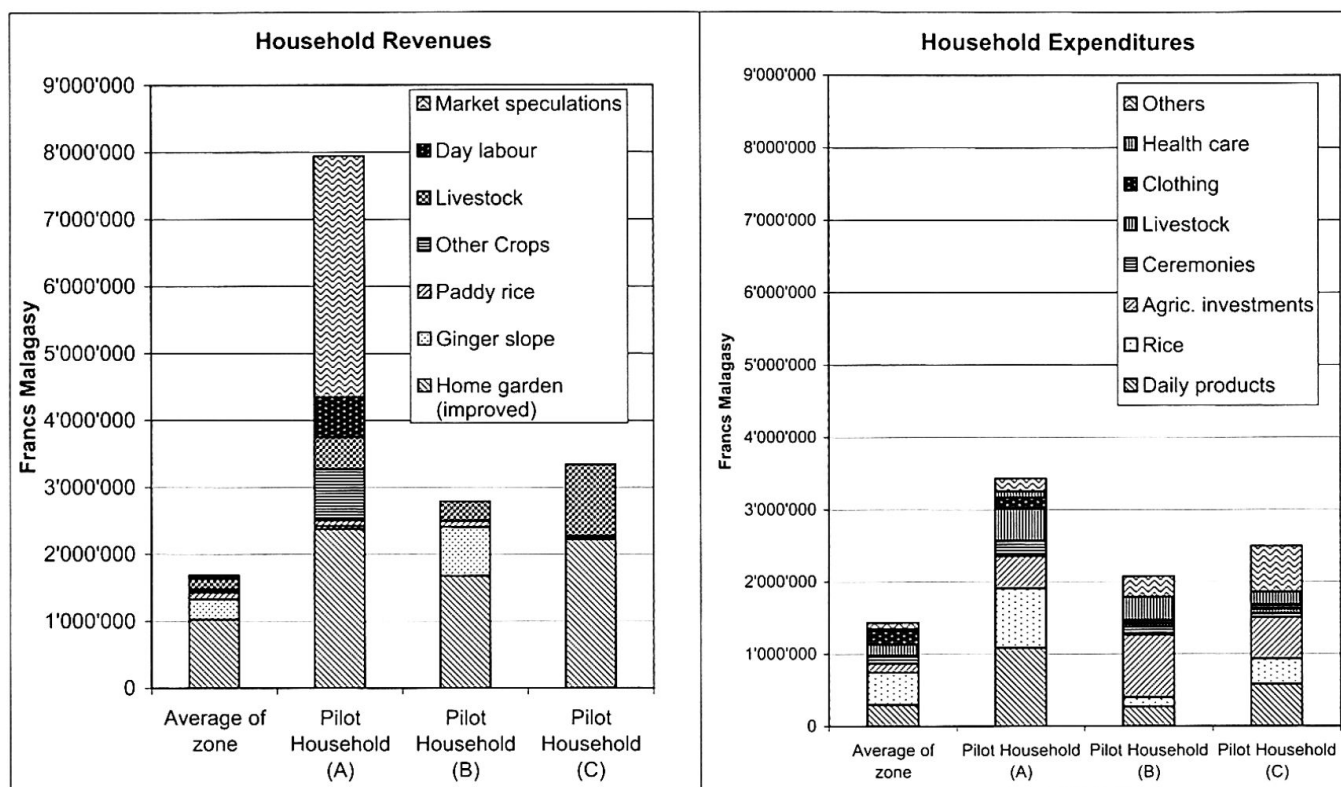


Fig. 3: Comparison of household revenues and expenditures of three pilot households with household averages of the same area (4'000 FMg ~ 1 CHF)

*Haushaltseinkommen und -ausgaben der drei Pilot Haushalte im Vergleich zum Durchschnitt derselben Region (4'000 FMg ~ 1 CHF)*

*Revenus et dépenses des trois ménages pilotes comparés à la moyenne de la même région (4'000 FMg ~ 1 CHF)*

Source: MESSERLI 2004; TERRE-TANY/BEMA 1998a

as well as the improved economic situation led to a social marginalisation of these households, which in one case even culminated in sanctions (land access, social exclusion). This development illustrates that the introduction and management of innovative activities must always be endorsed and supported by a larger community. It also contradicts a commonly received wisdom that innovations are best propagated by individual farmers in view of triggering a snowball effect.

In summary, these integrative trials with pilot households – despite their limited number – support the argument that the simultaneous introduction of a combination of different innovative activities may lead to a significant modification of land use and livelihood strategies in the direction of sustainable development. The complementarities and the synergies of these innovative activities in economic, ecological and socio-cultural terms thereby represented the most crucial factor for success.

#### 4 Conclusions

Based on interdisciplinary studies of the land use system (knowledge of systems) and a multi-stakeholder analysis of future development visions (target knowledge), this research was initiated under the premise that the most promising development alternatives to slash-and-burn consist of a gradual conversion into a more intensive and permanent agriculture. The focus was thereby laid on the exploration of transformation knowledge, i.e. the definition of suitable innovative activities and the testing thereof with regard to extent and manner in which they affect current land use and livelihood strategies. It was shown that even if activities result in ecological, economic and social improvements, their adoption and adaptation by peasant households remains the most critical issue. A set-up of on-farm trials enabled three pilot households to combine different innovative components according to their current strategy and their particular context. The results revealed that a significant change of strategy

is possible leading to improved economic, ecological and socio-cultural sustainability. The viability of such innovations within a larger social community, as well as issues related to scaling-up and -out remain future research challenges.

In view of current applied conservation and development strategies, it is important to draw upon the lessons learnt by asking which were the most important factors enabling households to adopt and adapt such innovations. The results presented here indicate that the following factors played an important role: the availability of a palette of innovative activities, which were jointly developed and tested by researchers and farmers in the local context; the empowerment of households to choose and implement innovations, which best corresponded to their specific livelihood strategy; the availability and the improvement of marketing networks for cash crops and agricultural inputs; and finally the endorsement of innovative activities pursued by single households by the larger community. For many of these factors, the good accessibility of the study site along the main road can be considered a bonus, but not as a guarantee for success. Further, it was of outmost importance that improvements were not sought through silver-bullet solutions based on one innovation, but rather through a set of innovative components, carefully chosen and combined by the households themselves. Finally, a continuous process of negotiation between research and concerned actors was very important, linking problem-identification, search for solutions, and implementation, thereby replacing the traditional sequence of «understanding» and «acting» (WIESMANN 2006).

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**Summary: Exploring innovative strategies for livelihoods in a slash-and-burn context in Madagascar. Experiencing the role of human geography in sustainability-oriented research**

Slash-and-burn agriculture on the eastern escarpment of Madagascar is held responsible for the ongoing deforestation of the remaining primary forests. Further consequences attributed to the method are the degradation of fallow land, resulting in a loss of productivity, which is considered to be a threat to food security and the livelihoods of the peasants. The research results presented here contribute to current conservation and development efforts regarding alternative land use systems by studying how households can successfully adopt and adapt innovative strategies. Based on an interdisciplinary synthesis of knowledge about the land use system and a transdisciplinary analysis of multi-stakeholder interests, promising development routes were identified and tested. The results of the introduction of single innovative activities indicated overall improvement in ecological, economic and socio-cultural terms. However, the successful adoption by peasant households could only be achieved where households were able to simultaneously combine different innovative activities. This combination maximised synergies and reduced potential conflict between individual innovations and the existing livelihood strategy of a household. Consequently, important basic parameters for such a process could be defined, such as liberty of choice, accessibility and market networks, as well as joint development of innovations between concerned actors and researchers.

**Zusammenfassung: Untersuchungen zu innovativen Lebensunterhaltsstrategien im Brandrodungsfeldbau auf Madagaskar. Erfahrungen einer nachhaltigkeitsorientierten humangeographischen Forschung**

Brandrodung am Ostabhang Madagaskars wird für eine unaufhaltsame Entwaldung der verbleibenden Primärwälder verantwortlich gemacht. Sie bedroht aber gleichzeitig auch die Lebensgrundlagen der lokalen Bevölkerung. Die Ernährungssicherheit wird heute durch den Verlust an nutzbarem Bracheland und der damit verbundenen Abnahme der Produktivität in Frage gestellt. Die vorliegenden Forschungsergebnisse unterstützen gegenwärtige Anstrengungen zur Entwicklung nachhaltiger Landnutzungs-Strategien, indem sie der Frage nachgehen, wie kleinbäuerliche Haushalte Innovationen in ihre bestehenden Strategien integrieren können. Ausgehend von einer interdisziplinären Synthese bestehenden Wissens über das Landnutzungssystem und einer transdisziplinären Analyse von Nutzungsansprüchen unterschiedlicher Interessensgruppen wurden viel versprechende Entwicklungspfade identifiziert und getestet. Es konnte gezeigt werden, dass einzelne innovative Aktivitäten durchaus zu Verbesserungen in ökologischer, ökonomischer oder soziokultureller Hinsicht führen. Die erfolgreiche Integration in bestehende Landnutzungsstrategien ist jedoch nur möglich, wenn ein Haushalt mehrere Innovationen gleichzeitig aufnimmt, dadurch Synergien steigert und Konflikte zwischen einzelnen Innovationen und der vorherrschenden Landnutzungsstrategie vermeiden kann. Als wichtige Rahmenbedingungen für diesen Schritt werden der bestehende Handlungsspielraum der Kleinbauern, die Erschliessung des Raumes, aber auch die gemeinsame Entwicklung von Innovationen zwischen Betroffenen und Forschern genannt.

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**Résumé: Des stratégies innovatrices pour améliorer les conditions de vie des populations vivant de la culture itinérante sur brûlis à Madagascar. Le rôle de la géographie humaine dans la recherche orientée vers la durabilité**

La culture itinérante sur brûlis dans la partie est de Madagascar engendre non seulement une déforestation continue des forêts primaires restantes, mais menace également les moyens d'existence des populations locales. La sécurité alimentaire est mise en question à travers une dégradation des jachères et une perte de productivité croissante. La recherche présentée contribue aux efforts de conservation et de développement visant l'identification des stratégies d'utilisation des terres de manière plus durable, en se penchant sur la question de l'adoption des innovations par les ménages. En partant d'une synthèse environnementale et d'une appréciation transdisciplinaire des parties prenantes à plusieurs échelles, des pistes prometteuses de développement ont été identifiées et testées. Il a été montré que des activités innovatrices particulières pouvaient entraîner des améliorations écologiques, économiques et socio-culturelles considérables. Cependant, l'adoption par les ménages concernés n'est atteinte que si plusieurs activités innovatrices sont adoptées simultanément, afin de maximiser les synergies et d'éviter des conflits entre les innovations particulières et la stratégie d'utilisation des terres existantes. Des conditions cadres pour une telle adoption englobent la liberté de choix des paysans, le désenclavement de la région, ainsi qu'un développement concerté d'innovations entre acteurs concernés et chercheurs.

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