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Sustainable Agricultural Development in Bali: Is the Subak an Obstacle, an Agent or Subject?

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Abstract Detailed ethnographic studies of individual subaks indicate that subaks are neither as homogeneous nor as harmonious as some other studies have suggested. Their internal workings are complex and often contradictory and contested. Processes of continuity and change co-exist in delicate dynamic equilibrium. These studies signal a need for wariness about generalization and a need for close study of specific cases. This paper is just such a study, not of a subak as such, but of an innovative and (to date) extraordinarily successful localized project to develop rice-cultivation in a more sustainable direction through a shift away from petrochemical-based agriculture toward a more organic approach based on locally produced compost. We use this case also to address questions about the relevance and role of the subak in such developments.

Keywords Rice · Agriculture · Irrigation · Indonesia · Bali · Organic · Compost

Rice-Farming, Sustainable Development and the Subak

Wet-rice cultivation, traditionally the mainstay of Balinese economy and culture, is undergoing something of a crisis. The problems are multiple: shortages of land and water, environmental problems resulting from decades of petrochemical fertilizer and pesticide use, and a growing imbalance between rising costs of inputs and low prices for produce, exacerbated by a rapidly rising cost of living. The net effect has been, since around 1990, a steady shift of land and labor from agriculture to other sectors and a growing reluctance of young people to take up farming.

While much of this pattern is common elsewhere in Indonesia, throughout tropical Asia and indeed in traditional agricultures all over the world, certain unique economic and cultural conditions make Bali a special case worthy of careful study. Firstly the problems identified above are in some respects exacerbated by the prosperity resulting from the growth of tourism: the general increase in prosperity and cost of living make farmers seem and feel comparatively poorer and more culturally marginalized than they do elsewhere, while simultaneously providing more lucrative opportunities elsewhere in the economy. The accompanying increase in land-values has also provided more lucrative alternative uses for land, resulting in a high rate of conversion of irrigated land to non-agricultural purposes.

On the other hand, the culinary landscape of hotels, restaurants and increasingly food-supply shops serving tourists, but also a population of hundreds of foreign expatriates as well as a growing local middle-class, provides a ready-made market for premium and chemical-free food products. For some years a small but growing network of cultivators and researchers have been working to develop more sustainable and healthier alternative forms of production with this market in mind.[1] While this has been relatively successful in the vegetable and meat sectors, it has been strikingly less so in the rice sector. The reasons for this are not entirely clear and have indeed been a source of some perplexity to all concerned (MacRae 2005b), but

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[1] The picture sketched briefly here is drawn in more detail in an earlier paper by MacRae (2005a).

among them are uncertainty as to the role of subak in this kind of development.

The subak is much celebrated as a model of local, community-based, democratic, resource management (Birkelbach 1973; Lansing 1991:37; Lorenzen 2006:4; Pretty 2002:36; Spiertz 1991:190,191). While some have seen in this its potential as a vehicle for change and development, others however, have identified an inherent conservatism in the workings of subaks (Birkelbach 1973; Hobart 1980:9). Our experience on the ground in Bali is similarly ambiguous. Farmers to whom we, and others, have presented arguments in favor of organic methods are very adept at agreeing in principle, but finding a range of technical reasons why such change is not practicable. Among these reasons is the frequent claim that a need for uniformity and solidarity within the subak does not allow individuals to plant different varieties or use different methods of production. This was the case for example in a subak in west Tabanan where we were involved in an earlier unsuccessful attempt to initiate change to organic production (MacRae 2005b).

On closer examination, however, the rules (*awig-awig*) of subaks in fact concern mostly matters of irrigation, ritual and administration. They rarely specify anything about crop varieties or production methods. In practice, the only area where real uniformity is required is usually in co-ordination of planting and sometimes harvest periods, for reasons of common demand for water. Even in cases where there is a subak-level decision or instruction to plant in a particular way, it is generally not binding on individuals (Jha 2002:96). So when farmers cite subak uniformity and solidarity as a reason for not changing, what they seem really to be referring to are unwritten traditions of planting the same crops the same way, and an inherent disinclination to try something different, perhaps for fear of drawing attention to themselves, the more so should they fail.[2] While subaks may appear as obstacles to change, in reality there seems no real structural reason why they need be so.

In terms of the other side of the question: can subaks be initiators of change, there is less evidence. During the New Order/Green Revolution period, subaks were appropriated by government as channels for implementation of top-down changes, but in the process their autonomy and democratic decision-making processes were severely compromised (Lansing 1991:113; Arthawiguna *et al.* 2005:3; Poffenberger and Zurbuchen 1980:105; Spiertz 1991:192). They were not agents of change but simply channels for change and were themselves changed in the process. Although even in this case it has been suggested that the general "structure" of subaks tended to slow rather than facilitate change, but that this varied with the qualities of specific subak leadership (Birkelbach 1973:160–1).

Detailed ethnographic studies of individual subaks (Hobart 1980; Jha 2002; Lorenzen 2006), indicate that subaks are neither as homogeneous nor as harmonious as some other studies have suggested. Their internal workings are complex and often contradictory and contested. Processes of continuity and change co-exist in delicate dynamic equilibrium. These studies signal a need for wariness about generalization and a need for close study of specific cases. This paper is just such a study, not of a subak as such, but of an innovative and, to date extraordinarily successful project to develop rice-cultivation in a more sustainable direction. We use it also to address some of these questions about the relevance and role of the subak in such developments.

The Project: Kelompok Somya Pertiwi

In early 2005, Alit Arthawiguna was approached by a group of farmers in Subak Wangaya Betan, in a village of the same name, at the upper end of the Yeh Ho watershed in Tabanan District of western-south Bali.[3] Their initial concern was the management of a growing waste problem caused by their various productive activities, which included rice-milling, chicken raising, and production of cocoa and coffee. Arthawiguna had for some time been searching for a site in which to initiate a shift away from petrochemical-based agriculture toward a more organic approach, based on locally produced compost.[4] At Wangaya Betan he saw the farmers' "wastes" as raw materials for compost and in mid-2005, he initiated, through BPTB, a project of collaborative action research with local farmers.[5]

The aims of the project were to develop a strategy for increased production which was sustainable in economic and social terms as well as environmental ones. The main technological innovations proposed were the "SRI" system of rice intensification, which is based on improved seed selection and seedling raising, along with wider spaced planting patterns; "integrated planting management" and

[2] This preference to avoid drawing attention to oneself has been much remarked upon as a characteristic of Balinese "personality" (Geertz 1979:232; Wikan 1990:65).

[3] This project is reasonably well-known and has already been the subject of publication, so it and key people involved are identified by name.

[4] We use the term "organic", perhaps more loosely that some readers would prefer, to refer generically to production based on naturally occurring fertilizers and pesticides of animal or vegetable origin, rather than ones synthesized from petrochemical products. Certification of "organic" production and products presents special difficulties in Indonesia but there are several groups currently working towards it.

[5] The technical details of this research and its outcomes are documented in Arthawiguna's report (2006).

progressive replacement of synthetic fertilizers, pesticides and growth regulators with compost made from local raw materials.[6]

Arthawiguna's initial reasons for choosing this particular group were, apart from their request for help with their "waste problem", primarily ecological: the upstream location with plentiful unpolluted water and the availability of raw vegetable materials for cattle feed and compost. The fact that they were still using largely traditional rice varieties which are less dependent on synthetic fertilizers and pesticides, was an added bonus.

In June 2005, a group led by Arthawiguna (and including MacRae) met with a group of 10 or so interested farmers at the premises of a local farmer and entrepreneur, Pak Nengah Arisa, who already had successful businesses raising chickens and milling rice. It was convened not by the subak but by Nengah himself. At this meeting Arthawiguna outlined the benefits of organic production and his ideas for the project. As a result of this meeting, a group of four farmers, with a total land area of two hectares, began to change their method of production. Through Arthawiguna, they purchased a proprietary microbial product called *Starbio*[7] to assist in composting existing organic materials including rice-stalks (*jeramih*), chicken manure, rice-mill waste (*sekam*), cocoa and coffee wastes. They also collected cattle manure which neighboring farmers were glad to be rid of. While building up their supply and application of organic fertilizer, they began progressively reducing their already low rates of application of synthetic fertilizer.[8] Their first crops were successful and in fact productivity increased slightly. Other farmers observing this began following their example. Manure soon became a scarce resource and they realized that they needed their own cattle.

A year later, in mid-2006, they had grown two crops and productivity had increased from around 4–5 tones per hectare to 5–8 ton/ha.[9] The group had grown to 30 and another 20 were planning to join. They had formed an organization, *Kelompok Somya Pertiwi* (KSP), for marketing their crop. KSP had also begun developing a more systematic collective compost production system, based on cattle manure. Some farmers had also bought their own cattle or obtained them on a calf-sharing basis sponsored by the government.[10] So central had cattle become in their understanding of their farming practice that they had begun referring to their cattle as "fertilizer factories" (*pabrik pupuk*).

The idea spread quickly to neighboring subaks and there has also been growing interest from other farmers from all over Bali and beyond. Arthawiguna obtained a grant of Rp 200 m (US$22,000) from central government (Department of Agriculture) to develop an on-site training centre (*Pusat Pelatihan Pertanian Pedesaan Swadaya, [P4S]*) complete with computer, library, facilities for teaching workshops, new cattle stalls and a biogas system for cooking. At this stage however, despite the success and rapid growth of the project, it still involved only a minority of the subak membership of around 100.

Another year on (mid-2007) productivity had increased by a minimum of 4% up to a maximum of nearly 14% (Arthawiguna 2006: 2). They had also increased their population of cattle to a total of 300. Some of these were owned collectively and kept in a central stall combined with a shed for processing and packaging compost. Nengah also kept his own cattle in a central stall. Most other farmers kept their cattle in small stalls adjacent their fields where the compost would be used. By this stage they had also begun to notice side-benefits such as a return of biodiversity to the ricefield ecosystem, in the form of birds, frogs, eels, fish and insects. The shift from purchase of capital-intensive fertilizer to labor-intensive compost as well as the work involved in processing and packing of compost for sale had also begun to provide new employment opportunities for local people. Thirty farmers were well established in organic production and most of the remaining 70 had begun converting. The P4S was built and functioning as planned. At this stage there was still no formal relationship with the subak, but there was talk of making the relationship more formal, perhaps even making organic production a requirement under the rules of the subak (*awig-awig*) (Fig. 1).

[6] For an explanation of SRI see http://cifad.cornell.edu/SRI/methods.html. For Arthawiguna's own description of its application in this project, see Arthawiguna 2007.

[7] *Starbio* is one of a number of propriety products increasingly used in Indonesian agriculture (see also MacRae 2005a) for activating compost and rendering coarse vegetable materials more digestible for livestock. They are based on ferments of sugar products and work as starters for fermentation of larger bodies of organic material. (See, for example, FAO n.d.)

[8] Farmers throughout Indonesia often use less than the recommended amounts of fertilizer, primarily as a cost-saving measure, a practice that began with the reduction of government subsidies in 1987 and increased with their total withdrawal in 1998 (Arifin 2003:8). In areas such as Wangaya Betan, where traditional rice varieties are still grown, the need for artificial fertilizers is less in the first place. Of the group of 30 surveyed by Arthawiguna in 2006, their average use of urea was 177.79 kg/ha, of KCl was 8.11 kg/ha, and of Sp36, 1.25 kg/ha, all levels well below government recommendations. In addition several farmers were already using significant amounts of organic fertilizer.

[9] These figures refer to the *gabah kering panen,* grain harvested and dried but not milled.

[10] Such schemes are based on traditional methods of livestock resource sharing, known in at least some parts of Bali as *ngadai karang*, in which the person caring for a cow has first right to its offspring.

Fig. 1 Cattle stall in the rice-fields, with farmers, Arthawiguna and Nengah Arisa

What Was Achieved and Why Did It Work?

What has been achieved at this stage, in terms of transition to sustainable or organic production of rice, is truly extraordinary in relation to our previous experience (MacRae 2005a, b) and is, to our knowledge, almost unprecedented in Bali.[11] The reasons for this success are various, ranging from obvious technical ones to less obvious ones embedded in social and even personal processes. Most obvious perhaps is the montane location, at the head of a watershed providing a good supply of unpolluted water and abundant raw materials for composting, although not especially good soil conditions (Arthawiguna 2006: 6). The existing pattern of production, using traditional varieties, low levels of synthetic fertilizer and the retention of some cattle in the ricefield ecology added to this base. Arthawiguna's assessment of local farmers as full-time, committed farmers unafraid of hard work, was a further factor. These factors are however present in many subaks, including some where previous attempts to initiate change have failed, so they are at best enabling rather than determining factors. The factors that seem to have made the critical difference in this case are embedded in social relations, perhaps even in the qualities of individuals.

Every step in the process has been discussed and decided upon by consensus in meetings open to the entire subak and often attended by interested outsiders as well. These meetings have been organized by Nengah at his own premises, and have been led by Arthawiguna, who has also often brought along outsiders including foreign researchers. In other words, while it has been a collective democratic process, the two key figures initiating, motivating and organizing it have been Nengah and Arthawiguna. Nengah is not an official of the subak, but he is a successful entrepreneur farmer and probably the wealthiest man in the village. He is also a person of intelligence and integrity who has chosen to use his position and resources for the benefit of the whole subak. He appears to have the trust and respect of other farmers. Arthawiguna on the other hand is an outsider, with specialist agricultural knowledge—an agricultural scientist employed by *Balai Pengkajian Teknologi Pertanian* (BPTP), a state agricultural research centre.

It may be tempting to view this as a partnership between state and subak, but in reality it is better understood as a loose network of individuals clustered around the two key figures: Nengah within the farmers group, and Arthawiguna outside it. While Arthawiguna's role is funded by his salary as a civil servant and includes access to a range of government resources, his work goes far beyond the call of duty and most importantly he is seen by KSP members as an individual rather than a representative of the state.

Both men are critical to the project in complementary ways. Nengah is the insider with status, without whom Arthawiguna would have only limited access to and credibility with the farmers. Arthawiguna on the other hand has knowledge and access to resources from outside, which are essential to the project. He and Nengah have known

[11] The one exception of which we are aware is just one valley away in Wangaya Gede, where a local (Gede Hanjaya) married to an expatriate has converted his own fields to organic production, largely to supply an international yoga centre located on his property (MacRae 2005a; Maya 2007).

each other for some time and have a relationship of mutual understanding, trust and indeed friendship in the sense of having the interests of the entire subak at heart. It is the personal qualities of these two men, the relationship between them and the resultant web of trust in the subak which lie at the heart of the project and which make it work. After two years of working together successfully, the trust which the farmers have in Nengah, seems to have extended to Arthawiguna, so he too has a direct store of credibility in their eyes. A further extension of this trust is essential to the next stage of the project to be discussed below.

These then are the key factors which have enabled this project to work so successfully. Less obvious however are more generic qualities, even the invisible absences, the things that have not prevented it from working. Firstly the scale of the project is small: it started very small, grew incrementally in response to individual decisions, and even now involves a group of people living within a known local ecosystem and community. This grounding in local landscape and face-to-face community provides an intelligibility and a sense of ownership which are less easy to achieve in larger-scale projects. Secondly, it is not mediated by a complex system of intermediary outsiders and anonymous bureaucracy: it is simply the farmers linked to the outside world of knowledge, resources and markets by the visible, known and trusted persons of Nengah and Arthawiguna. This paper is not the place to explore these factors in detail, but this scale and the absence of intermediate bureaucracy are the essential flipside to the face-to-face relationships which make this project work.

The Subak?

What then of the role of the subak in all this? The subak is much celebrated in the literature as a model of community-based and sustainable resource management. However in this case it seems at best peripheral to the project, let alone to its success. While the subak, both as an ecological unit and a social one, was the overall site for the project, it was in fact initiated and developed by a small group of individuals within the subak, none of whom were subak officials. No subak official was part of this initial group, although they did join later. As it expanded a formal organization was formed, but this too was independent of the subak. Eventually, but only when the membership of the group expanded to include virtually the whole subak, there was talk of the subak taking on the organic agenda of KSP, and of the project and the subak effectively merging. In other words, rather than the subak acting as an agent of change, it seems to have been a subject of change, transformed by a process which originates both within it and from outside. The reasons for this seem to lie in certain inherent qualities of the subak as an institution. The subak itself had neither supported nor hindered the development. Like most of its individual members it simply sat back and watched and waited. It is tempting to read too much into this observation in terms of structural determination, and worse still to generalize from it. We suspect however, that the reality is somewhat simpler, the product of two factors.

Firstly, the "core business" of subaks in general is water—the management of irrigation, both its material (*sekala*) and spiritual (*niskala*) dimensions. Specific *awig-awig* specify further rules, to do with obligations of membership, adherence to planting schedules and so on, but usually do not specify such matters as what crops can be planted, methods of cultivation, fertilizer and so on. In fact most *awig-awig* are powerless to prevent even the conversion of irrigated farmland (*sawah, carik*) to non-agricultural uses, as is happening all over Bali at an alarming rate. So, provided farmers adhere to the requirements of *awig-awig*, conversion to new crops or methods is in a sense no business of the subak. However there is equally nothing to prevent the subak from making such developments its business. As it happens, the *awig-awig* of Subak Wangaya Betan is unusually prescriptive in specifying the planting of traditional local varieties, but this does not extend to fertilizers or planting methods.[12]

It is tempting to see this as evidence of the irrelevance of the subak to matters of development, sustainable or otherwise. But it is worth remembering that subaks were appropriated wholesale by the state during the New Order period, initially as subjects of the technological transformations of the Green Revolution and then as agents of it on behalf of the state. While this is evidence of their capacity to act as agents of a sort, it also helps explain why they seem to have lost some of their capacity for independent agency. Most farmers today, including subak officials, have spent most of their working lives within this system of top-down control. As a result, collective memory of earlier practice more based on local knowledge, has largely been lost. On the other hand, members of this generation of farmers are unlikely, at this stage of their careers, to become a vanguard of change, least of all toward more bottom-up developments.

Despite this inherent weakness in the human resources of subaks, it is worth remembering that, as participants in the panel at which this paper was first presented pointed out, the existence of the subak as a social and productive unit provided a point of entry and departure without which

[12] Awig-awig were, until relatively recently, largely matters of collective memory embodied in practice and oral tradition, but have in recent years undergone a government-initiated process of systematization and inscription in written form. It seems likely that this development has rendered subak less flexible in terms of ongoing adaptation to changing circumstances.

the whole project may not have been possible and would certainly have more difficult to initiate. And now, as project and subak merge, its distinctive features will become an increasingly important determinant. Finally, the latest developments, discussed below, also take the existing structure of the subak as their organizational basis. So the subak is clearly not irrelevant to development, but its role needs to seen firstly in terms of its traditionally limited mandate, secondly its inherently conservative orientation, but thirdly also its ability to adapt to changed conditions.

What Has Not Been Achieved?

While the aims of this project are partly environmental, for farmers themselves the primary day-to-day concern is balancing the unequal equation between production costs and return of their harvest. The project to date has been aimed largely at the production side of this equation, and in the process, apart from its environmental side-benefits, it has been successful in lowering production costs, by substituting local labor (in the form of compost production) for cash inputs for fertilizer. It has not yet, however addressed systematically the other side of the equation—the returns for produce. The potential for exploiting the unique Balinese market for boutique and organic produce has not to date been realized. While some of the rice produced by KSP farmers is sold to this market at premium prices via the Bali Organic Association (BOA) and through an expatriate in Ubud, the majority is sold on the local market at little above local prices for ordinary rice. Consequently while the economic situation of KSP farmers has improved, they are not yet particularly affluent and there is still room for more improvement. This, and other unrealized potentials are the focus of the most recent stage of the project.

From Local Subsistence to Global Market: Irrigation Cooperative to Limited Liability Company

In July 2007, a meeting was called in the P4S meeting room, to introduce a new step in the process, also initiated by Arthawiguna. Harry Simorangkir, a representative of an organization called PT Desa Bali (PTDB, "Balinese Village Ltd") presented a slick PowerPoint presentation outlining the aims of PTDB and what it had to offer KSP. Despite its form as a limited liability company, the avowed aims of PTDB are those more commonly found in the development NGO sector—to assist in improving village livelihoods and standards of living, especially through agricultural development. Its means however are not those of charity or aid, but of a business partnership in which PTDB provides capital and expertise to assist the local economic unit, be it subak and/or village, to improve its productivity and profitability and eventually to become an independent business, over a contract period of 10 years.

Their analysis of the problems facing farmers was insightful and comprehensive. Their proposed solution likewise addressed every aspect of the situation in an integrated way. The core of their proposal was for farmers to hand over most of their crop for marketing by PTDB in exchange for a guaranteed monthly income and other benefits. PTDB would provide the initial capital for seed and any other production costs. They would also invest in developments to boost productivity. The fixed income was to be calculated according to the area of land owned or worked by the farmer involved. Farmers would retain one sixth of their crop for their own household use and the rest would be marketed by PTDB. Returns would be used initially to pay off initial investment, with subsequent profits reinvested firstly in developments to boost productivity, insurances against crop failures and health problems, retirement benefits and eventually in savings to build up a stock of capital for the transition to the independent business, to be known as PT Subak Wangaya Betan (Subak Wangaya Betan Ltd).

PTDB's approach is two-pronged, addressing both the production and income sides of the equation. They aim to increase production to nine or ten tons per hectare or even more by use of improved seed-raising and planting methods and organic production. The latter will simultaneously reduce production costs. Most of Subak Wangaya Betan are already in the process of making these changes but PTDB see room for more improvement even here, as well as in new subaks joining the scheme. But their main innovation is at the marketing end, where they envisage increasing income considerably by bypassing middlemen to sell high-quality organic rice in premium markets, initially local ones, but ultimately into export markets as well. Their financial projections show potential increases in profitability sufficient to pay for all the proposed benefits on top of the obvious running costs and overheads involved.

PTDB is a registered company with three directors, Harry Simorangkir, Jro Gede Karang Tangkid Suarshana, and Karijo Partosoebroto. Simorangkir is an Indonesian who has spent most of his working life in the IT industry, much of it at a management level, in the Netherlands and has returned to Bali to live and work. He has concerned himself for several years with sustainable agriculture developments and in the process has developed a good working knowledge of the issues facing farmers. He is the working partner, the front-man and to some extent the driving force of PTDB. Jro Gede Karang is a Balinese businessman—one of the most successful of the first generation of tourism entrepreneurs in Bali. He has now stepped back somewhat from his business interests and has

also taken an interest in agricultural development. At the time of the first visit of PTDB to KSP he had just announced his entry into politics, as a potential candidate for the governorship of Bali.[13] Partosoebroto is a Javanese businessman also with connections to the Netherlands, who has had IT interests in Bali at least as far back as the mid-1990s. Through the networks of these directors they claim to have access to the capital needed to finance the proposed developments. Arthawiguna has been appointed as Operations Manager and Gusti Ngurah Alit Sumantri, a lecturer in economics at Universitas Pendidikan Nasional in Denpasar, is the director of finances for the parent company and will be main director of the local company.

Karang and Partosoebroto would appear to have little need of further income, least of all from a project oriented more to long-term local development than short-term capital accumulation. According to Karang, the aim of the project is to provide farmers with access to "the benefits of the global market, but with protection from the risks". Simorangkir appears likely to become a salaried employee of PTDB. In the proposed contracts with the local companies they spawn, PTDB propose to take what appear to be reasonable fees to cover their costs as well as a 20% share in the local companies. The remaining 80% will be divided among the local members as shares, based in this case on their landholdings.

There seems little reason for concern over the motivation of PTDB and the transparency and fairness of their proposals. However, the idea is new and, although they are negotiating with farmers groups elsewhere in Bali, this project is the most advanced, so it is still in a somewhat experimental stage and there will obviously be challenges to confront. PTDB and the farmers come from different worlds in terms of knowledge and experience and real differences in outlook and priorities soon became apparent in their early meetings. While there was considerable enthusiasm in principle, there were also many questions about matters of pragmatic detail. Many of these reflected the real concerns of ordinary farmers: crop failures, differentials of land ownership, utilization and productivity, and especially the inequality between owners and sharecroppers.[14] These issues and the differences of outlook underlying them became increasingly significant in subsequent meetings with Subak Wangaya Betan and then with neighboring subaks who were also interested in joining the scheme. A week later another meeting was called, at which representatives of a neighboring subaks also attended. This subak was even larger (over 300 ha. and over 600 members) than Wangaya Betan and was one of several in the process of conversion to organic production as a result of observing the success at Wangaya Betan.

PTDB were initially keen to enter into contracts before the new planting season in August-September, but as the complexity of the emergent issues became increasingly apparent, PTDB realized that this timetable was not going to be feasible. As they analyzed data collected from farmers, it also became clear that the smaller holdings, especially those worked by share-croppers, would not produce sufficient income to be economically viable. Their proposed solution was to consolidate holdings, partly by retiring older farmers or relocating them to lighter duties in compost production. Changes of this order obviously needed time for negotiation and implementation. To deal with this they developed a 3-step process toward the final 10-year contracts. By the end of August, Subak Wangaya Betan and a group of farmers from neighboring subaks had taken the first step, an agreement for PTDB to meet their production costs and for them to sell their crop to PTDB at slightly above normal market price, with mild sanctions for under-production and bonuses for excess production. This provided an attractive low-risk option for farmers prior to the deeper commitment involved in subsequent steps.

Subsequent discussion with Harry Simorangkir clarified that PTDB saw the subak as the essential natural and social unit on which to base the project. Any unit less than a whole subak would risk inevitable divisions and conflicts of interest. Indeed a point repeated in his presentation was the need for unanimity and solidarity (*bersatuan*). The financial projections also included a percentage return to the subak itself for ritual and development costs. Thus, what was in effect being proposed was a transformation of the irrigation/ritual institution of the subak into the form of a management and marketing company.

What began as a small project within a single subak, expanded to encompass the whole subak and began to transform it from within, perhaps even at the level of its *awig-awig*. Its influence then expanded to affect other subaks, both direct neighbors and further afield. The arrival of another outside party, PTDB, required some kind of corporate structure, initially to negotiate with and perhaps ultimately to enter into a contract with. The subak, while in no way constituted as a business unit, was nevertheless the natural socio-ecological unit for such a relationship and was indeed the preferred option of the external partner for this reason.

[13] Jro Gede Karang's presence, and the content of his speech, was an undoubted boost to the prestige of the project, but may also be read as an early step toward establishing his political legitimacy among farmers. This introduces yet another layer of motivation and interests into the project, but this is perhaps another story.

[14] As Nitish Jha (personal communication) has reminded me, issues of tenure, always important in Balinese agriculture, are one of several missing links in this story. There is a need for more detailed ethnographic research.

Conclusions

What does this story enable us to conclude, in terms of the role of the subak in sustainable development of agriculture? Firstly, in this project, the subak appears at first to have been quite marginal, almost irrelevant, to the development process—sitting back, like most of its members, to wait and watch, before making any changes themselves. The leader of the project was not a subak official, it was not facilitated through subak meetings, and the head of the subak was not involved initially. The reasons for this are not fully understood but they appear to correspond to the resistance to change we have previously found elsewhere.[15] At the same time however, neither did the subak obstruct or restrict the project in any way—it allowed it to proceed among its membership, using its water. This would seem to support our earlier observation that subaks tend to restrict their activities to their traditional mandate over water and ritual. However, as it developed, the project expanded to encompass almost the entire membership of the subak, to the point where there was talk of instituting organic production methods at the level of awig-awig. In other words the subak seems to have become the *subject* of development, transformed from below by the actions of a growing critical mass of its members, rather than as an agent for or against transformation. As in the rather different cases of the traditional role of the subak as described by Lansing, and its co-optation by the government during the Green Revolution, any appearance of agency the subak may have, seems in fact to originate elsewhere, either outside/above or within/below, at the level of its members. Finally, in the latest phase, the transformed subak, (or in this case possibly two subaks) is seen by the outside agent as the natural unit, both ecologically and socially, for a new commercial form. The subak membership and leadership, while not the initiators of this, seem to agree.

So, the provisional answer to our simple question, as always in Bali, is that it depends on the specific case. In terms of the earlier, more general form of our question, about the relationship between subaks and development: it suggests that subaks have the potential to, and probably will be, involved in new kinds of agricultural development, not all of them necessarily sustainable. These are likely to change the form and function of subaks and challenge traditional ideas and practices.

In more general terms these conclusions suggest that the typical subak combination of conservatism within the limited area of irrigation and ritual and *laissez faire* with regard to other changes, has, as Balinese popular ideology constantly reminds us, the potential for both positive and negative results. On the one hand subaks are powerless to prevent wholesale conversion of farmland to other uses; on the other they open the door to forms of development in which environmental, social and economic consequences can be distributed and balanced in many different ways.

It is perhaps worth remembering again that only 40 years ago, when today's senior generation of farmers were beginning their careers, the whole subak system was appropriated by an alliance of government with transnational capital to become the vehicle for the sweeping changes of the Green Revolution. In the process, local knowledge and sustainability were sacrificed on the altar of increased production. We do not recommend a repeat of that command performance, but we do suggest that a similarly wholesale conversion could occur if subaks were to empower themselves to become more active partners in movements for responsible change based on local knowledge and global principles of sustainability.

Speculative Afterword

The detailed micro-studies of Jha (2002) and Lorenzen (2006) lead us toward an appreciation of the complexity and contradiction inherent in the operation of real-life subaks. They also remind us of the dangers of overgeneralization and even more so of romanticization of subaks as mystical manifestations of an "invisible hand" of indigenous ecological wisdom. At the same time, Stephen Lansing (2006) using field research by teams of transnational and interdisciplinary colleagues, has sought to resolve some of these complexities and contradictions by shifting his perspective to a higher level of abstraction—comparing ethnographic evidence with computer simulations of what might be expected in terms of theories of "complex adaptive systems".

His argument, as we understand it, is that "cropping" (essentially planting) patterns of subaks are the result of long processes of incremental adjustments made on the basis of the observations of farmers and ultimately whole subaks, of the relative success and/or failure of the harvests of neighboring subaks. Regardless of the processes involved at the level of individual farmers or subaks, the net effect, over a whole watershed, is not of maximising production of any one subak, but of optimising the balance between water supply and pest control throughout the watershed. The benefits of this process can only be

[15] The role of knowledge or information in this resistance to change is possibly significant. The simple information of the existence of alternatives and reports of their advantages are clearly not in themselves sufficient, as they seem to be in entrepreneurial innovation in the tourism and handicraft sectors. It seems though that one of the differences in this case was a greater and more authoritative depth of knowledge but, as we have seen above, other factors appear to have been more important.

understood at the level of the entire system and in terms not only of productivity, but also of resource management, ecological sustainability, social equity and harmony. In other words, subaks are best understood neither as agents nor as subjects, but as parts of larger systems which in turn can be understood not in terms of any policies of practices of "management", but as "complex adaptive systems", self-correcting systems integrating hydraulic, ecological and socio-cultural elements (2006: 67–87).

What this suggests is not that we should ignore the micro-studies of Jha and Lorenzen *et al*., but that just as they inform Lansing's model, they too can be informed by it. If, as Lorenzen found, the micro-manipulations of water by individual farmers, based on micro-observations of their neighbors, are what enables the system to work at the subak level, is this the lowest level of the system identified in principle by Lansing, but not visible at his level of analysis? If as Jha argues, subak decision-making is characterized, at least in the ethnographic present, by gaps and impediments to flows of relevant knowledge, could it be that such obstacles are ultimately resolved over a longer period by the larger adaptive processes Lansing describes?

While Lansing's argument, and the suggestions above, relate primarily to the subak's traditional mandate of water management, in the case of the evidence presented above, could it be that something similar is going on? Certainly some of the basic processes are not dissimilar. The various expat-led experiments in organic agriculture reported in in MacRae's earlier research (2005a) were all motivated by their belief in a Balinese tendency to copy successful innovations. However, for reasons not entirely clear, this did not happen. While this was not an explicit aim of the Wangaya Betan project, a similar logic was perhaps inherent in it, and has certainly come to pass in practice. The initial innovators were only four farmers. Observation of their success led to the group expanding within 1 year to 30 and within 2 years to almost the entire subak. Meanwhile neighboring subaks were watching and following on the basis of observed success, just as Lansing argues they watch and follow successful cropping patterns (2006:78).

What we might expect, in terms of Lansing's model, is a growing conversion to organic production until such time as one or another variable begins to vary in a way that adversely affects the whole system. For example, the supply of raw materials for composting might run short, climate change might increase or decrease temperature and/or water supply, or the market might become flooded with organic rice, driving the price down. Or new external factors might enter the system, because agricultural systems are never closed ones. Perhaps fluctuations in international rice prices, the impact of international carbon trading economy on the ecological basis of wet-rice production, or perhaps even an offer of a new kind of business partnership with political strings attached.

Trying to imagine, let alone predict such changes is obviously a fruitless task, for which complex adaptive systems theory offers little direct help. But what it does offer, whether we accept the computerized mathematical modelling or not, is a timely reminder that while rice-growing is indeed complex, it is also systematic, and that such changes are to be expected and can be understood by careful analysis at multiple levels. The level we refer to as subak is close to the heart of them all, in terms both of its scale, between the individual farmer/plot and the watershed/temple system, and in its integration of topographical, hydraulic, social and religious aspects. Lansing's research confirms our argument here, that subaks are not inherently either agents of change or obstacles to it. What he adds is the idea that they are parts of systems which manage a dynamic equilibrium between change and continuity. What our evidence from Wangaya Betan shows us may turn out to be an element of this at a micro-scale—how change that appeared to be almost independent of the subak has at first expanded to transform the subak and it now appears likely that the subak will become if not an agent, at least an active partner in a new kind of change outside its traditional mandate of water management.

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