pear to confirm the historical continuity of the temple's role with respect to irrigation.

If we turn to Balinese manuscripts dating from the colonial era, a more detailed picture of the water temple system becomes available. Interpreting the meaning of these texts, however, depends upon a prior understanding of the belief systems that are the foundation of the temple rituals. A single brief example should make this point clear. Consider the following passage from the *Dewa Tattwa* (History of the gods), a well-known religious text.[21] The passage begins with a list of calendrical offerings that should be made at any Ulun Swi (Head of the Ricefields) temple. After the list comes the following warning:

> If these ceremonies are not performed at the Ulun Swi temple, and the Masceti temple, and to Rambut Sedana, the rice terraces will not be productive, nothing will be sufficient, there will be short measures, not enough to eat or drink, because the essences will be taken back by the deities of Gunung Agung and Batur, so the realm will be consumed by drought, there will be plagues and epidemics, humans will be distressed, by the god who reigns in the Ulun Swi temple.

If a colonial officer happened to read this passage, he would surely have interpreted it as nothing more than an injunction to make a series of religious offerings. But from another perspective, the entire water temple system is implicit in these few lines. Rambut Sedana is a deity of prosperity associated with the Rice Goddess. Thus the text says that if offerings are not made to her and to the local water temples, there will be plagues, droughts, and epidemics, resulting in the failure of the rice crop. To neglect the offerings at these local water temples—the Ulun Swi and Masceti—is to risk offending the Goddess of Batur and the God of Mount Agung, which would precipitate a general social catastrophe.

This passage echoes the warning from the "Rajapurana Ulun Danu Batur," that neglect of the water temples will lead to the spread of pests and diseases and the loss of the water needed to make the crops grow. With the advent of the Green Revolution in Bali, these words became prophetic.

CHAPTER SIX

Massive Guidance

THE COLONIAL ERA ended in Bali in 1947 with the birth of the nation of Indonesia. But the end of colonialism did not mean a return to traditional society, to the world as it had been before the arrival of the Dutch. The instruments of government created by the Dutch were not dismantled but carried over into the postcolonial era. In Bali, as elsewhere in Indonesia, the period from independence to the fall of Sukarno in 1965 was an era in which local government bureaucracies, lacking funding, were largely inactive. But this was soon to change. During the 1950s, Indonesia was forced to import nearly one million tons of rice each year. After the fall of Sukarno in 1965, the new government made self-sufficiency in rice a major goal for national development. Coincidentally, the late 1960s also marked the beginnings of the "Green Revolution" in Asia, the spread of new rice-growing technologies that promised to dramatically increase rice production. The Indonesian government became an early and enthusiastic supporter of the Green Revolution, which it adopted as the cornerstone of a policy of agricultural modernization to be spearheaded by regional and local bureaucracies. With its financial position greatly strengthened by revenues from offshore oil, in the late 1960s the Jakarta government began to invest billions of rupiah in the rehabilitation of bureaucracies, at the provincial, regency, and district levels.[1]

As one of the major rice-producing regions of Indonesia, Bali was one of the first targets of the Green Revolution. In its fundamental aims, the new campaign to modernize agriculture resembled the programs launched by the Dutch after the conquest of South Bali in 1908. In both cases, the major purpose was to boost total rice production, converting rice from a subsistence to a cash crop. But there were important differences between the policies of the Dutch early in the century and those of the Green Revolution. The engineers of the colonial age had little to offer in new technology and were, in any case, poorly funded. In contrast, the Green Revolution offered a comprehensive and highly successful new agricultural technology, backed by new bureaucracies flush with cash and in search of a mission.

If the powers of the water temples were rather hazy for the Dutch, they were entirely invisible to the planners involved in promoting the Green only question about the traditional social system was how much resistance it might offer to the spread of the new technologies. In the early 1970s, a series of new agricultural policies encouraged continuous cropping of Green Revolution rice and a shift to bureaucratic management of irrigation and cropping patterns. As a result, the water temples lost control of cropping patterns over most of Bali.

There have been many studies of the effects of the Green Revolution in different parts of Asia.[2] Most have focused on socioeconomic issues, such as changes in the distribution of farm incomes. In Bali, however, the changes introduced by the Green Revolution went beyond the distribution of income to affect the basic structure of the productive system. As we have seen in earlier chapters, before the Green Revolution, irrigation management was largely controlled by the water temples. By removing them from power, the Green Revolution set in motion a social experiment, a practical test of the importance of water temples in rice production. The experiment is not yet finished, but there is enough evidence to permit a preliminary evaluation of the results.

This chapter begins with a historical overview of the Green Revolution in Bali and then proceeds to an analysis of its effects on the productive system.

THE GREEN REVOLUTION

The Green Revolution in Asia began at the International Rice Research Institute (IRRI) in the Philippines. In 1962, IRRI agronomists developed a new high-yielding variety of rice called IR-8, which matured in 125 days and produced 5,800 pounds of grain per acre on test plots. In the late 1960s, IR-8 and its successors reached Indonesia. Because the IRRI rice was designed to be responsive to chemical fertilizers, it was necessary to provide farmers with access to fertilizers and pesticides as well as the new seed stocks. In 1967, the Indonesian government invited a Swiss company, CIBA, to develop a system for furnishing these necessities to farmers. The new program was called BIMAS (*Bimbingan Massal*), or Massive Guidance. Despite initial failures of the BIMAS program to increase rice production, the government decided to invest heavily in a national program to achieve self-sufficiency in rice. This program was based on two components: government subsidies to reduce the cost of fertilizers and pesticides to the farmers and extension of BIMAS (which the government took over in 1971) to all major rice-growing regions of Indonesia. To ensure that farmers would have access to the fertilizers and pesticides required to grow the new "miracle rice," a government banking system (the People's Bank) was empowered to provide credit to small farmers for the

sive Guidance brought rapid results: by 1974, 48 percent of the terraces of south-central Bali were planted with the new rice; three years later, the proportion had climbed to 70 percent.[3]

Within a few years of the beginning of the Green Revolution, the government took two further steps that had a profound impact on the water temple system in Bali. The first was a shift in cropping patterns. IR-8 proved to be highly susceptible to an insect called the brown planthopper, which is estimated to have destroyed two million tons of rice in Indonesia in 1977. Rice scientists at IRRI came up with a new variety of rice, IR-36, which was resistant to the planthoppers and had the further advantage of maturing very quickly.[4] In Bali, the use of IR-36 was strongly encouraged. Balinese farmers were forbidden to plant native varieties, which take much longer to mature, are less responsive to fertilizers, and produce less grain. Instead, double-cropping or triple-cropping of IR-36 (or other high-yielding rice varieties) was legally mandated. Farmers were instructed to abandon the traditional cropping patterns and to plant high-yielding varieties as often as possible.[5]

The second step was taken as a result of a series of studies by foreign consultants on ways to improve the performance of Balinese irrigation systems. These studies culminated in the Bali Irrigation Project (BIP), a major engineering project launched in 1979 by the Asian Development Bank. The aims of the project were succinctly defined in their feasibility study:[6]

> The Bali Irrigation Project (B.I.P.) is the first large scale attempt in Bali island to improve the irrigation systems. Past interventions by the Department of Public Works have been limited to isolated improvements, with negligible external consequences. In contrast, the B.I.P. will intervene in 130 subaks (about 10 percent of the total Bali subaks), many sharing the water from the same river. The impact of the main improvements will concern:
>
> –River water sharing and subak coordination
> –New Operating & Maintenance rules
> –Programmed cropping patterns
> –Use of measurement systems
> –Changes in cropping techniques
> –Yield monitoring systems
> –Taxes and water charges
>
> In consequence the Subak may lose some of its traditional facets, especially part of its autonomy.

The principal emphasis of the project was the reconstruction of thirty-six weirs and associated irrigation works at an estimated cost of about forty million dollars.[7] Because in most cases these "*subak* improvement justification for the project was largely based on a mandated change to continuous rice cropping for as many *subaks* as possible. In the long run, according to project officials, this would generate a minimum of 80,000 tons of additional rice production each year, which could be sold for export and thus provide the $1,300,000 per annum needed to repay the project loan to the Asian Development Bank.[8] All of these estimates were later revised upward as the project added sixteen *subak* improvement schemes to the original plan.

As a later evaluation report on the project noted, "The introduction of the Project coincided with the government's push for self-sufficiency in rice and the encouragement given to farmers to extend the substitution of short rotation varieties [of rice] for the traditional long duration varieties. . . . These factors temporarily led to the abandonment of the Balinese cropping calendar, traditionally the key to overall watershed and irrigation scheme management."[9] By the late 1970s, the mandated change to continuous rice cropping began to remove the temples from control of irrigation and cropping patterns. In the upper reaches of the rivers, where coordination of irrigation was essential during the dry season, farmers often refused to abandon the temple schedules. But further downstream, the threat of legal penalties against anyone failing to grow the new rice led to continuous cropping of Green Revolution rice. Religious rituals continued in the temples, but field rituals no longer matched the actual stages of rice growth. As soon as one crop was harvested, another was planted, and cropping cycles began to drift apart. During the rainy season, no one was likely to run out of water. But during the dry season, the supply of irrigation water became unpredictable. Soon, district agricultural offices began to report "chaos in the water scheduling" and "explosions of pest populations," as in this 1985 report by the Department of Public Works of the regency of Tabanan.

I. Background

Concerning the explosion of pests and diseases which recently attacked the rice crops, such as brown planthoppers, rodents, tungro virus, and other insects, in the Tabanan regency; and also with regard to the frequent problems which began to arise at about the same time concerning water sharing during the dry season, various groups are now urgently working to get on top of the problem. The result has been acknowledgment of the following factors which caused the explosion of pests and diseases:

1. In areas with sufficient irrigation water, farmers are now planting continuously throughout the year.

2. In areas with insufficient water, farmers are planting without a coordinated schedule.

In other words, the farmers/subaks have ceased to follow the centuries-old cyclical cropping patterns.[10]

A similar report for the neighboring regency of Gianyar tells the same tale, beginning with the massive damage to crops caused by the brown planthopper in the late 1970s. As elsewhere in Bali, farmers in Gianyar were encouraged to plant the planthopper-resistant rice IR-36. But IR-36, although unpopular with planthoppers, fell an easy victim to a viral disease called tungro. As a result, the planthopper plague was quickly followed by an "explosion of the tungro virus."

The Explosion of the Tungro Virus

Tungro began to be a problem in Gianyar in 1980, and steadily increased until the explosion in 1983/84, destroying 421.15 hectares of rice completely, predominantly the variety IR 36. . . . A temporary remedy was found in the new rice variety PB 50. In one cropping season, tungro was reduced, but immediately afterward the new rice was afflicted by *Helminthosporium oryzae*.[11]

Following a by now familiar pattern, the new PB 50 rice proved vulnerable to two new diseases, as described in the Gianyar report:

The Explosion of Helminthosporium and Rice Blast

Problems with *Helminthosporium oryzae* actually began in 1977/78 when five hectares were reported to be damaged. The explosion began in 1982/83 when 6007.95 hectares of paddy were afflicted.[12]

Thus by the mid-1980s, Balinese farmers had become locked into a struggle to stay one step ahead of the next rice pest by planting the latest resistant variety of Green Revolution rice. Despite the cash profits from the new rice, many farmers were pressing for a return to irrigation scheduling by the water temples to bring down the pest populations. But to foreign consultants at the Bali Irrigation Project, the proposal to return control of irrigation to water temples was interpreted as religious conservatism and resistance to change. The answer to pests was pesticide, not the prayers of priests. Or as one frustrated American irrigation engineer said to me, "These people don't need a high priest, they need a hydrologist!"

THE CRISIS

Doubtless because the idea of religion playing an important role in agriculture was inconceivable to development planners, it was not until well into the 1980s that development agencies like the Asian Development Bank began to become aware of the practical role of water temples in irrigation management. The first internal evaluations of the Bali Irrigation Project simply reported that various problems had arisen with pest infestations and water shortages that kept rice production from meeting the project's goals. Unsurprisingly, these reports made no mention of water temples, except to note the existence of a Balinese "rice cult."[13] But as reports from field-level officials about the water temples accumulated, eventually the temples came to the attention of senior bank officials. At first, there was little reaction. In the words of a bank evaluation report, the replacement of the water temples by bureaucratic systems of control was seen "as an almost inevitable result of technical progress."[14] Citing Clifford Geertz's analysis of agricultural rituals as a template for cultivation cycles, planners argued that the need to increase rice production made the old schedule of agricultural rituals obsolete. To sustain high levels of rice production, farmers would have to maintain continuous cultivation of high-yielding, short-duration Green Revolution rice. The old ritual calendar, based on the growing cycle of native Balinese rice, might have played a useful role in the past before the advent of chemical fertilizers and pesticides. But the Green Revolution had made the old agrarian calendar irrelevant. The water temples might continue to exist as religious institutions but their practical role in water management would inevitably disappear.[15]

However, by the mid-1980s pressure was mounting on local officials in Bali to return control of irrigation systems to the water temples. A team of agronomists from the agricultural faculty of Bali's Udayana University was commissioned by the Department of Public Works to investigate and reported that "the farmers were pushed to plant rice at the highest possible frequency each year, which gave rise to disorganization in water use."[16] The report urged the government to take note of "the negative effects experienced as a result of the policy of continuous uncoordinated rice planting" and emphasized "the connections between the hierarchy of subak temples and cropping patterns."[17]

At about this time, I also began to try to communicate the role of the water temples to the officials at the Asian Development Bank who controlled the Bali Irrigation Project. In several written reports, I tried to show that the rituals of the water temples were not a template for an outmoded cultivation system but a system of ecological management with deep historical roots in Balinese culture. Agriculture was a social as well as a technical process, dependent on the "hydraulic solidarity" achieved by the temple system. Continuous rice cropping threatened both the ecology of the terraces and the social infrastructure of production. But these arguments failed to make much impression on the bank officials.

ECOLOGICAL MODELING

In the spring of 1987, I began a new phase of research on the ecological role of the water temples in collaboration with a systems ecologist, Dr. James Kremer. My investigations had convinced me that the primary role of water temples was in the maintenance of social relationships between productive units. The question that Kremer and I wished to address was, Did these systems of social coordination have measurable effects on rice production? The Green Revolution approach assumed that agriculture was a purely technical process and that production would be optimized if everyone planted high-yielding varieties of rice as often as they could. In contrast, Balinese temple priests and farmers argued that the water temples were necessary to coordinate cropping patterns so that there would be enough irrigation water for everyone and to reduce pests by coordinating fallow periods. Kremer suggested that these alternatives could be formally evaluated in an ecological simulation analysis. Furthermore, such an analysis might yield deeper insights into the reasons for regional differences in the organization of water temple networks.

Our first idea was to investigate cases in which water temples had been removed from irrigation management. But we quickly concluded that it would be impossible to learn very much from such a study because it would be difficult to directly associate events such as pest infestations with the absence of temple control. Moreover, a temple-by-temple comparison would not reveal the effects of higher-level systems of coordination between temples. The water resources available to any single temple are affected to some degree by the irrigation schedules of their neighbors upstream, and we hoped to be able to evaluate the importance of such cooperative arrangements in water management. One of the key features of the temple system, from an ecological point of view, is the difference in the scale of social coordination from one region to another. The pattern of temple organization differs substantially in the mountains, where streams and irrigated areas are small, as compared to the seacoast, where the rivers are much larger. To evaluate the importance of these differences in the productive system, we decided to model all of the irrigation systems that lie between two rivers in south-central Bali, the Oos and the Petanu.

Based on my earlier fieldwork, we knew that water temples make decisions about cropping patterns by taking into consideration the trade-off between two constraints: water sharing and pest control. As previously noted, if everyone plants at the same time, all will also harvest at the same time, and a widespread fallow period can reduce pest populations by depriving them of food and/or habitat. On the other hand, if everyone plants the same rice variety at the same time to coordinate their harvests and fallow periods, then irrigation demand cannot be staggered. Striking an optimal balance between these two constraints is not a simple matter because the choices made by upstream farmers have implications for their downstream neighbors, and constraints such as the amount of water available for irrigation vary by location and by season.

The simulation model we constructed was specifically designed to evaluate the effects of different levels of social coordination on irrigation demand and pest control. A technical report on the model is included as an appendix to this book; here we will consider only the logic of the model and its most significant results. We began by dividing the watershed of the two rivers into 12 subsections, specifying the catchment basins for each of the weirs for which hydrological data were available. For each of the 172 *subaks* located in these basins, we specify the name, area, the basin in which they reside, the weir from which they receive irrigation water, and the weir to which any excess is returned. We also specify the real spatial mosaic connecting these *subaks*. Thus, for each one we note the neighboring *subak* on all four sides or another kind of boundary, like a river, road, or village.

With this geographical setting, the simulation model computes the growth and ultimate harvest of rice for all 172 *subaks* based on the assumptions contained in three submodels. These submodels define the physical hydrology of the rivers and irrigation systems, the growth of rice and other crops, and the population dynamics of pests. Based on historical data on rainfall by season and elevation, runoff to the rivers is calculated. Irrigation demand for each of the *subaks* is computed from the cropping pattern specified in the model. Growth of rice depends upon the variety being grown and the available water supply, and the harvest is reduced if the supply from the rivers is insufficient to meet the demand. The level of pests in each *subak* depends on immigration from adjacent cropland plus growth in place if rice is being grown.

Seven choices of management scenarios are supplied that span the range of coordination among the 172 *subaks*, from all following the same cropping pattern to 172 different schedules. These choices assume that the *subaks* plant and harvest together in groups that parallel to various degrees the subdivisions of the temple hierarchy. Of these choices, only two have actually occurred (as far as we know): the first, in which each

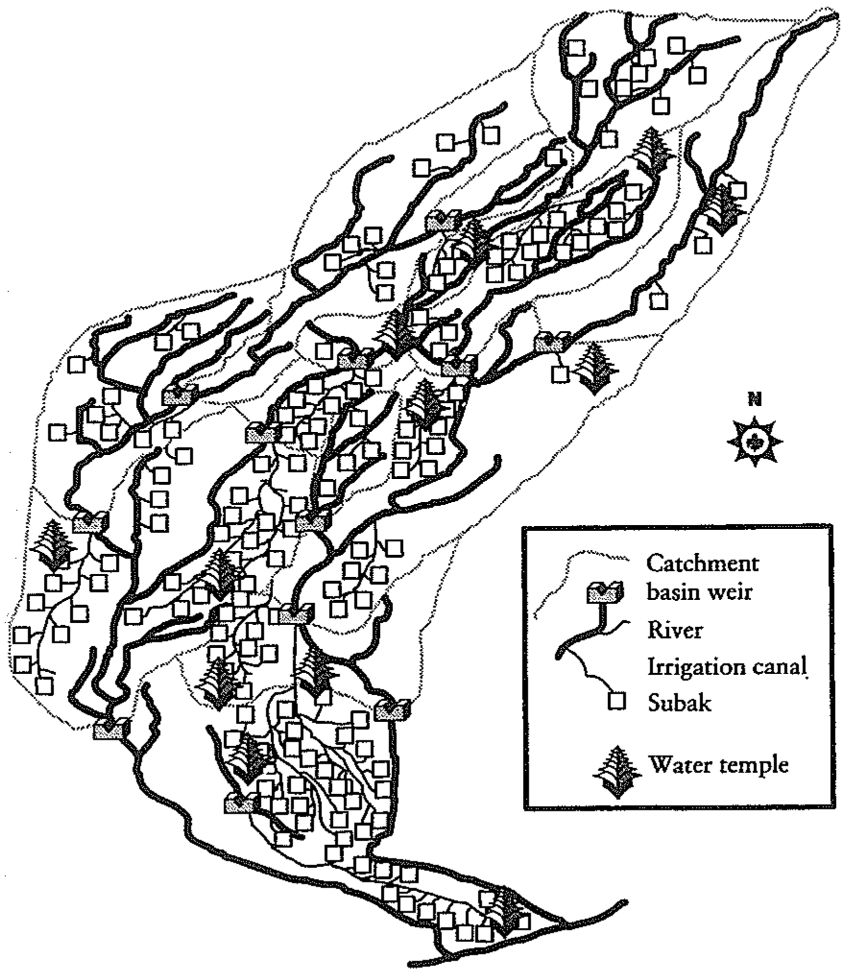

Figure 6.1. Map of the Oos and the Petanu Rivers in the Region of Gianyar. The catchment basins, irrigation system, and *subaks* are shown in relation to major water temples. Map is not to scale.

subak acts as an independent unit setting its own cropping pattern; and the fourth, in which each water temple sets a cropping pattern for its *subak* congregations. But by including a range of five other hypothetical options, it is possible to evaluate a range of possibilities in the social coordination of production while holding the biological and physical factors constant. The model is used to compare the results of many simulation runs, so as to reveal the effects of changing specific assumptions, such as daily rainfall, river flow, irrigation demand, or the rate of pest diffusion.

Because one goal of the modeling is to compare irrigation systems and water temples at different points along the rivers, the computer keeps track of results for each of the twelve catchment basins. In the upper reaches of the rivers, irrigation systems originating at several weirs are generally organized into a single Masceti temple unit with carefully staggered planting intervals designed to maximize water sharing. At these high elevations, the amount of water in the rivers is comparatively small. In contrast, at lower elevations there is much more water in the rivers, so the cropping patterns of upstream irrigation systems have little effect on the amount of water available for downstream neighbors. On the other hand, at lower elevations, the potential damage from rice pests is greater because the rice terraces extend over large areas, and it is possible for pest populations to build up more quickly than in the narrow upstream valleys. The results of a series of simulations that show these results are displayed in time series plots for four catchment basins. In this simulation, all farmers are assumed to be planting three crops of Green Revolution rice. Rainfall, river flow, and pest damage rates are all normal (based on historical data for 1985–1986). Notice that pest levels are higher when each *subak* sets its own cropping patterns, because pests immigrate from adjacent *subaks*. In contrast, when cropping patterns are set by water temples, pest levels are reduced by coordinated fallow periods. Pest damage is also higher in the lowlands for the reasons described.

Along with pest damage, the model also permits a detailed analysis of the likelihood of water stress at various levels of social coordination. The model calculates water stress whenever a *subak* does not have enough water to meet the requirements of the cropping pattern that has been selected. These numbers are based on monthly flow rates for each catchment basin and irrigation demand for each cropping pattern (see the Appendix for details). The model expresses water stress as the percentage of *subaks* that experience a reduced rice harvest owing to water shortages. The graph below shows the results of running identical simulations at each of the seven possible levels of irrigation management. At one extreme, each individual *subak* sets its own cropping pattern, resulting in 172 uncoordinated cropping patterns for the whole watershed. At the other extreme, the entire watershed follows a single cropping pattern, which results in major water shortages. As the graph indicates, the least amount of water stress occurs when water temples set the cropping patterns.

Because water sharing and pest control represent opposing constraints

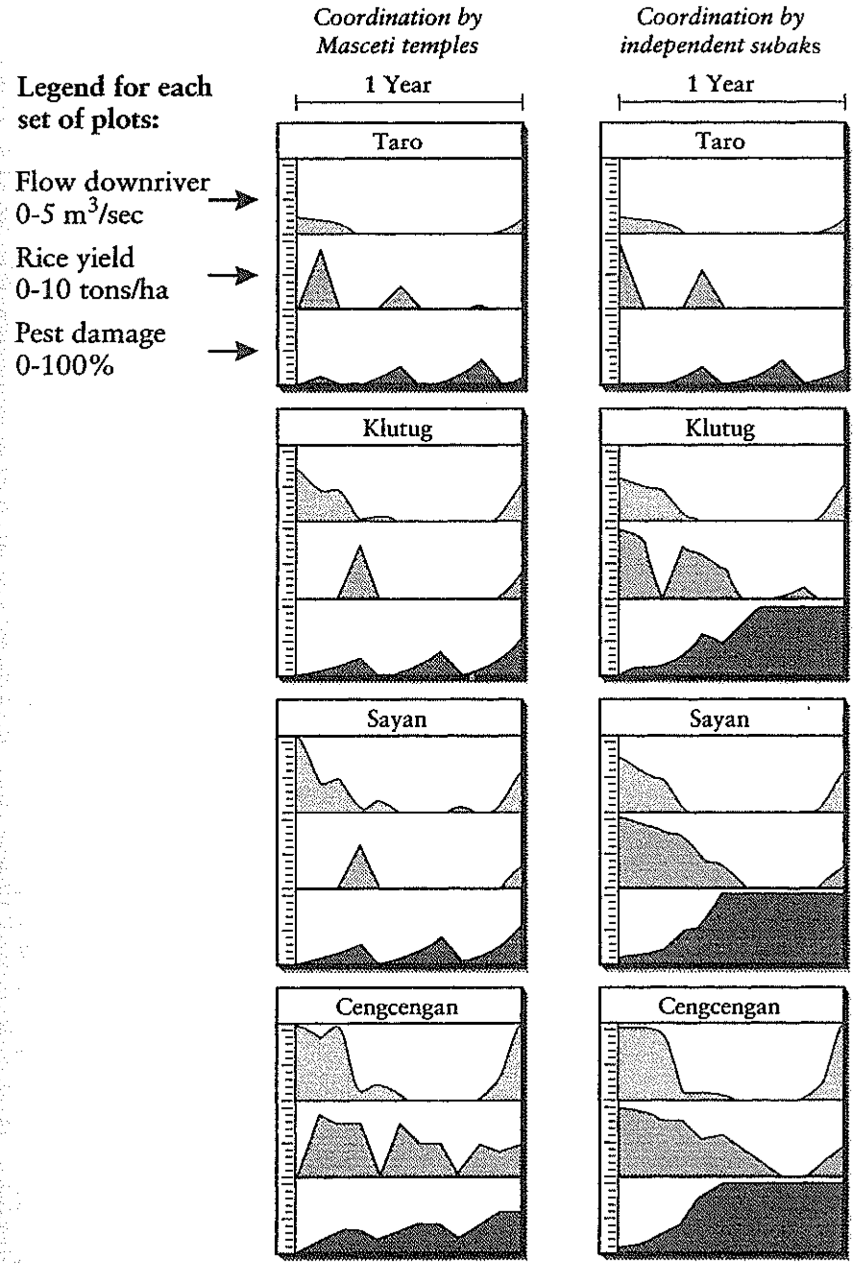

Figure 6.2. Simulated Annual Patterns for River Flow, Rice Yield, and Pest Damage. Compares two runs of the model differing only by the scale of coordination among the *subaks*. Each panel of three plots shows average results for the catchment basins. Note the increased levels of pest damage (up to 100 percent loss of

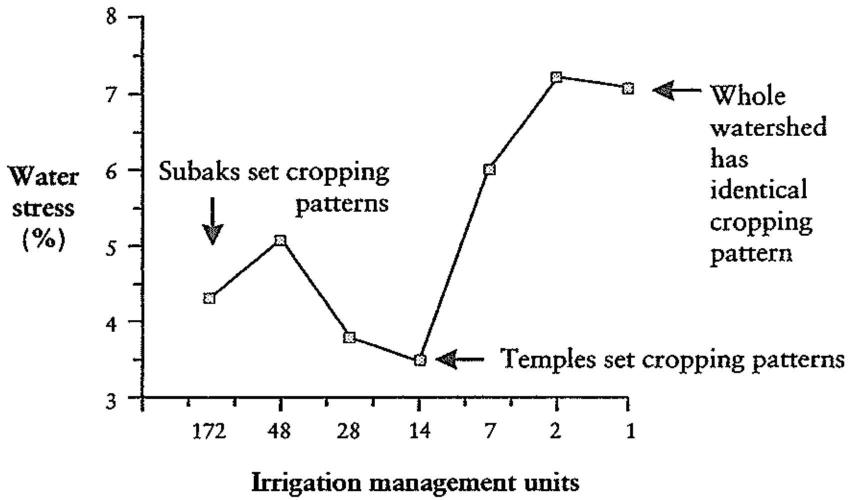

Figure 6.3. Effects of Different Levels of Social Coordination on Water Stress. All farmers are double cropping Green Revolution rice.

on water management, a key question is which level of social coordination strikes the optimal balance between them. For a cropping pattern in which all *subaks* are planting two crops of high-yielding rice, the results are displayed in table 6.4.

In this case, damage from pests is highest at the *subak* scale of coordination. Most *subaks* are too small to reduce pest levels by fallow periods because the pests can easily migrate to neighboring ricefields. On the other hand, pest levels are very low if the entire watershed follows a single cropping pattern because the fallow period extends over thousands of hectares. But pest levels are also minimized if cropping patterns are set by water temples. The water temples strike an optimum balance between pest control and water sharing (fig. 6.4).

A similar pattern emerges if the cropping pattern is changed from two to three crops of Green Revolution rice. Pest damage is highest if the *subaks* act as autonomous units.

Water stress is low at the *subak* scale and high at the watershed scale. But the optimum scale of social coordination remains the water temples.

As in the previous case, this result is owing to the effect of the temples in simultaneously minimizing water stress and damage from pests.

Multiple runs of the model with different cropping patterns (including traditional Balinese rice) and different physical and biological constants confirm this basic pattern: regardless of the rice variety and cropping pattern selected, coordination of cropping patterns by Masceti temples produces the highest yields by striking an optimal balance between water

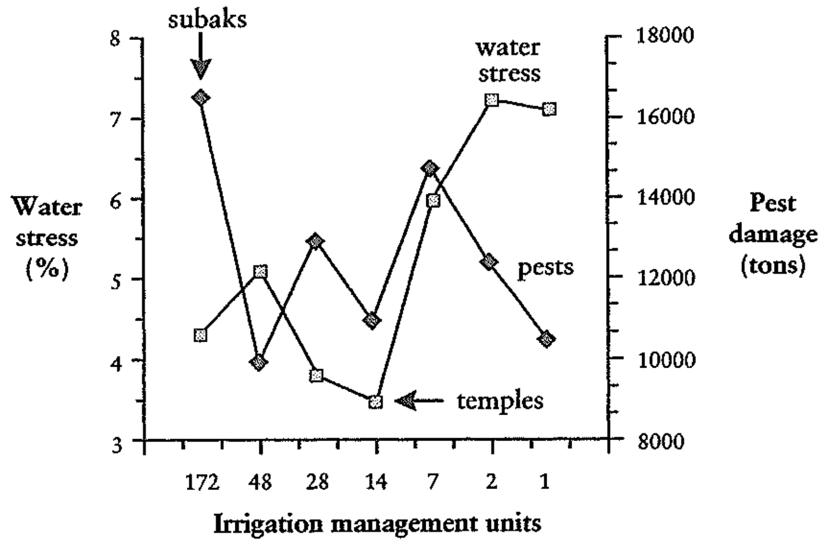

Figure 6.4. Effects of Different Levels of Social Coordination on Pest Damage and Water Stress. All farmers are double cropping Green Revolution rice.

stress and pest damage. This level of coordination in the model corresponds most closely to the actual pattern of water temples along these rivers.

The model shows strong hydrological connectivity between irrigation systems in the upper and middle sections of the rivers. Near the sea, even in the dry season, so much water is in the rivers that cropping decisions by upstream *subaks* appear to have a minimal effect on downstream *subaks*, assuming a normal year for rainfall. However, low rainfall increases the interdependency of *subaks* even in the lower portions of the rivers. With respect to the second constraint, the model predicts that pest damage will occur more rapidly in the lowlands, where there are fewer natural barriers to pest diffusion. Altogether, the water-sharing constraint is most significant for upstream Masceti temples, whereas pest control is more critical downstream. But overall, the model supports the conclusion that the social organization of cropping patterns plays an important role in the management of terrace ecology. The real productive significance of the ritual system is not in the imposition of fixed cropping patterns but in the ability to synchronize the productive activities of large numbers of farmers. The water temples are a social system that manages production, not a ritual clockwork. For these reasons, the ecological model suggests that removing the temples from the control of production ultimately threatens the entire productive system.

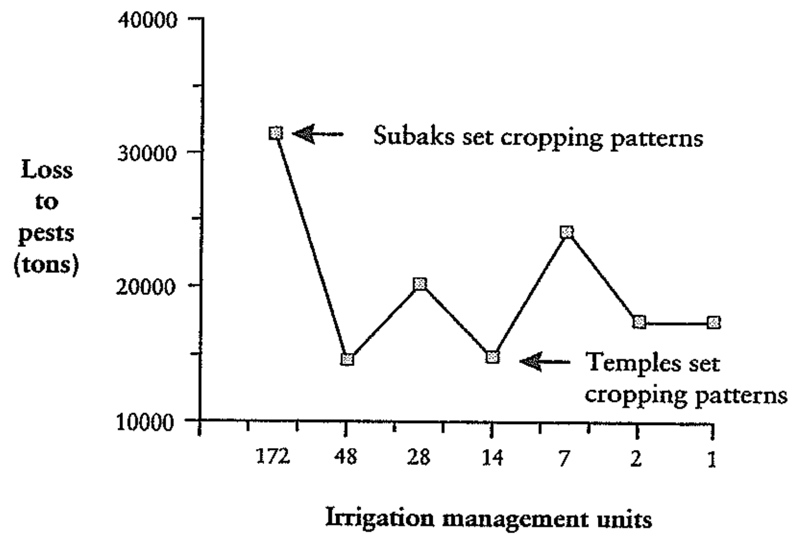

Figure 6.5. Pest Damage at Different Levels of Social Coordination. All farmers are triple cropping Green Revolution rice.

REEVALUATION

We reported these results to the Asian Development Bank in 1988 and received a sympathetic audience. The final evaluation report for the Bali Irrigation Project reversed the bank's earlier skepticism towards water temples, noting that

> The substitution of the "high technology and bureaucratic" solution in the event proved counter-productive, and was the major factor behind the yield and cropped areas declines experienced between 1982 and 1985. . . . The cost of the lack of appreciation of the merits of the traditional regime has been high. Project experience highlights the fact that the irrigated rice terraces of Bali form a complex artificial ecosystem which has been recognized locally over centuries.[18]

The report noted that erosion of the strength of the traditional vertical integration among water temples threatens "the long term sustainability of the irrigation systems."[19] The report concluded with the observation that "no post-evaluated project of the Bank exhibits self-sustained and high performance comparable to Bali."[20]

But perhaps the most satisfying result was the visit of the Project Evaluation Mission to the Temple of the Crater Lake, which was described in this way in the final evaluation report:

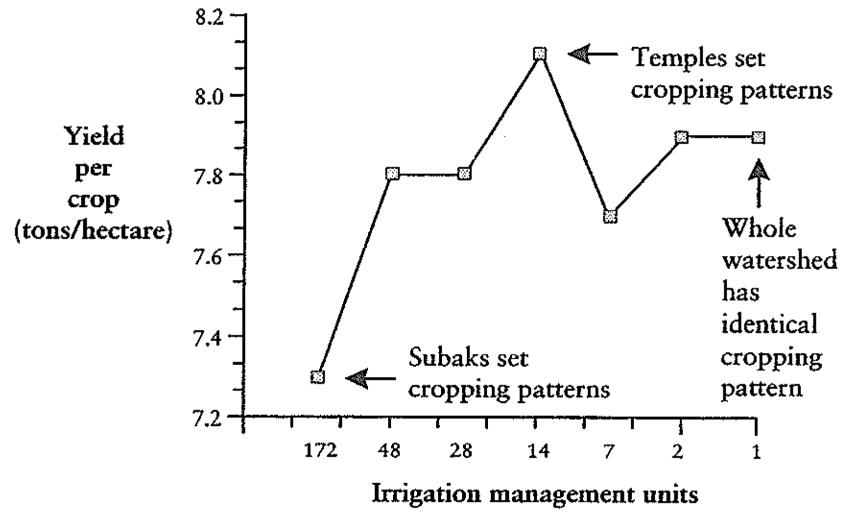

Figure 6.6. Results of Triple Cropping Green Revolution Rice at Different Levels of Social Coordination

> The Project Evaluation Mission interviewed leaders of the high Water User Group at Batur who have been instrumental in the proper establishment of some 45 new subaks during the last ten years. Apart from providing the required spiritual background, they often provided technical advice, for example on spring development, canal and tunnel siting and building, and clarifying water allocation issues. In light of the minimal success of the Project Office to develop new irrigation areas, it is suggested that there would be benefit from seeking advice from them. At the least, it is considered that this exercise would be of assistance in bringing the two parallel water development and management institutions into closer contact and could have more far-reaching impacts.[21]

At the time of this writing, official policy towards irrigation and water temples in Bali is in a state of flux. The need to sustain high levels of rice production and to divert some flows formerly used for irrigation to urban uses continues. Nonetheless, for the first time, the water temples have achieved recognition by state irrigation bureaucracies, and today the temples have regained informal control of cropping patterns in most of Bali.