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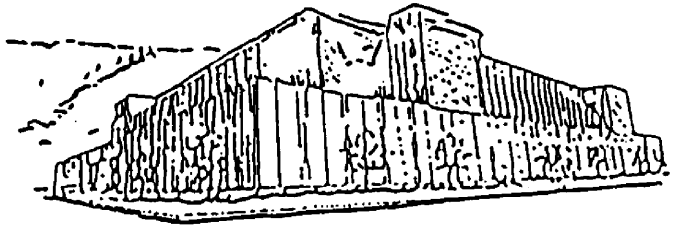
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SWIDDEN AGRICULTURE AND AN INTENSIFIED RICE CULTIVATION

PROGRAM AT RANOMAFANA NATIONAL PARK, MADAGASCAR

by

Laura Michelle Brown

submitted in partial fulfillment
of the requirements for the degree of
Master of Sciences in the Department of Forestry
The University of Montana

May 1998

Approved by:



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Dean, Graduate School

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Swidden Agriculture and an Intensified Rice Production Program at Ranomafana National Park, Madagascar (78 pp.)

Chairperson: Stephen Siebert SFS

Abstract This paper, drawn from one year and eight months of Peace Corps service in south-eastern Madagascar, examines an intensified rice production program in the peripheral zone of Ranomafana National Park (RNP). The program is reviewed and critiqued as an integrated conservation and development project (ICDP). Many rural inhabitants around RNP and in Madagascar in general, are agriculturists living at a subsistence level. As pressures from a growing population increase, farmers tend to move further and further up slope burning patches of forest to grow new crops. Swidden agriculture or "tavy" is a primary threat to Ranomafana's steep mountainous rainforests. Rice is the staple crop of the Ranomafana region and with paddy production low, many farmers depend on dryland tavy rice to meet their household food needs. In an attempt to reduce this threat, the ICDP for RNP seeks to identify and introduce sustainable agricultural systems and promote sound community management of natural resources. To meet this objective, an intensive rice cultivation system was introduced with the help of a Malagasy non-governmental organization (NGO). The program has now been in place for three years. I compare its acceptance among two distinct ethnic groups living adjacent to RNP. The Betsileo of the Western highlands have eagerly accepted the new technique while the Tanala, who live in the more remote central and eastern regions of park, have been unwilling to adopt the method. Tanala resistance can be attributed to numerous factors, including: religious beliefs, cultural identity, taboos, land ownership issues, and house-hold food security. Change in Tanala land use practices is crucial to their improved social and economic well-being. It is also crucial to the biodiversity conservation objectives of RNP.

PREFACE

Development projects in Madagascar, like those in many developing nations, face numerous challenges. Poor management, corruption, political instability, lack of cultural understanding, lack of cooperation between government ministries, poor communication, suspicion and lack of infrastructure can all impede project implementation and success. Numerous managerial and supervisory positions are filled as a result of personal or political favoritism. Others are filled by well-intentioned but poorly qualified individuals. Additionally, many highly motivated and reasonably qualified individuals are never given sufficient support to carry out their work. As a result, protected areas and associated resident peoples are often subject to and affected by poor management decisions and policies. None-the-less some development projects succeed.

My Peace Corps experience exemplified the above. Within four months of arrival at my first site, I was moved to a new location for security reasons. Two months later I was relocated to Ranomafana National Park where I was assigned to assist the park's ecological monitoring team in floral and faunal surveys and illegal activity patrols. Eventually, I became involved with an integrated

conservation and development project focused on the reduction of slash and burn agriculture through the introduction of an improved rice cultivation technique. This technique, Systeme de Riziculture Intensive (SRI), is being promoted by a Malagasy NGO - the Tefy Saina Association.

Through my work, I visited seven villages and conducted informal interviews with male and female farmers and local extension workers. From this experience I gained insight into social and economic reasons for acceptance or rejection of SRI farming. I was also able to gather information on farmers opinions regarding the productivity of the new method versus traditional cultivation techniques and visited numerous paddies at various stages of production. I was unable to gather quantitative yield data, thus I could not draw solid conclusions supporting or rejecting these observations. The greatest impediment to my work was the logistical nightmare of reaching sites. An additional obstacle to work was the suspicion of local villagers. Many were understandably reticent to supply personal information to a complete stranger. As I visited villages more frequently this became less of an obstacle.

Although my project ended abruptly and was not as comprehensive as I had hoped, it was encouraging to see the positive attitude of the Tefy Saina staff and the dedication of extension workers in the field.

ACKNOWLEDGMENTS

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CHAPTER I

BACKGROUND

Madagascar - Global Context

Madagascar, located in the Indian ocean east of the African continent, is the fourth largest island in the world. The island has a terrestrial area of 226,657 square miles, making it approximately the size of Texas.

Madagascar is separated from mainland Africa by the Mozambique channel. It is believed to have broken away from the mainland at least 160 million years ago (Mittermeier et. al., 1994).

Complex topographical, geological and climatological systems, coupled with the island's isolated evolutionary development, have resulted in one of the most biologically diverse ecosystems in the world (Grenfell, 1995).

Approximately 75% of all Malagasy flora and fauna are endemic to the island (Grenfell, 1995). Eighty percent of the approximately 10,000 - 12,000 plant species are endemic, including 200 - 400 flowering plants and 135 species of palm trees (Grenfell, 1995). Madagascar is also home to some 150 species of amphibians and 235 species of reptiles (Jolly, 1989) 95% and 99% of which, respectively, are endemic (Mittermeier et. al., 1994).

One hundred and eight species of mammals reside in Madagascar, including the renowned lemurs. Of the 32 existing lemur species 100% are endemic (Mittermeier et. al., 1994). Tragically, many species have become extinct due to over-hunting and habitat destruction. Among the extinct are fifteen lemur species, a dwarf hippopotamus and the ten foot tall Aepyornis or "elephant bird" (Grenfell, 1995).

Madagascar's first human inhabitants are believed to have arrived between 1500 and 2000 years ago (Mittermeier et. al., 1994). Today, Madagascar's human population is desperately poor and rapidly increasing. The estimated average annual per capita income is approximately \$200 (Sussman et. al., 1994). The country's 12 million inhabitants are increasing at a rate of nearly 3.1% each year (Mittermeier et. al., 1994). This results in a population doubling time of 25 years. To add to the severity of the situation, only 5% of Madagascar's total area is arable land (Laulanie, 1993; Mittermeier et. al., 1994).

Human activity has resulted in major alterations to the landscape of Madagascar. Primary anthropogenic activities include: slash and burn agriculture (tavy), non-commercial timber exploitation, uncontrolled livestock grazing, charcoal production and ornamental plant collection (Grenfell, 1994).

In the eastern rainforests, swidden agriculture (tavy) is the major cause of deforestation, not large commercial timber operations (Sussman et. al., 1994). In this shifting cultivation system, nutrients leech rapidly from the soil and fallow periods are now too short to allow forest or nutrient regeneration (Sussman et. al., 1994). According to Smith (1997), Madagascars forests have poor regenerative powers due to the scarcity or absence of secondary colonizing species. Thus large scale deforestation may be an irreversible process in many areas (Smith, 1997). In addition, deforestation has led to extreme erosion with estimated erosion rates as high as 250 tons per hectare in some watersheds (Sussman et. al., 1994).

Madagascar's remaining rain and cloud forests are of particular environmental and economic significance. These areas are located primarily on the mountainous eastern coast of the island. Madagascar's forests protect crucial watersheds which provide water for irrigated agriculture, as well as for drinking and fish production. Additionally, they provide habitat for much of the island's unique flora and fauna (Grenfell, 1995). These forests are remnants of what is believed to have been a much larger primary forest system. It is unclear how much forest has been cleared, but some estimates indicate that rainforests have diminished by 50% over the last 30 years (Jolly, 1989). An estimated 77,000 - 101,000 square kilometers of natural forest remain

in Madagascar, but 1,500 - 3,000 square kilometers of forest are cleared each year (Jolly, 1989). Currently only 1,122,296 hectares, less than 2% of the island's total area, are officially protected (Grenfell, 1995) (Appendix A). The existing protected areas include national reserves, special reserves, biosphere reserves, national parks, and classified forests. It is highly doubtful that additional land will come under protection. Therefore, Malagasy conservation efforts have begun to take an integrated approach - focusing on conservation of resources through promotion of sustainable practices on the agricultural lands surrounding these important but forest reserves.

Colonial Rule, Agriculture and Tavy

Madagascar's annexation as a French colony began in 1896. Staunch resistance, bloody fighting and famine accompanied this action. Paddy fields were abandoned or destroyed and chronic rice shortages ensued (Jarosz, 1993). Many people escaped to the forests and survived for years practicing traditional tavy agriculture (Jarosz, 1993).

The French colonial powers developed the economy toward export commodities. In the eastern forests, coffee became the primary crop. Large areas of soil were exposed under the French coffee cultivation. As a result, Madagascar's erosion prone soils were severely degraded. In some areas of East Africa, soil erosion rates of coffee fields were

found to be nearly twice that of subsistence plots (Temple, 1971).

Due to low labor demands and attractive producer prices, coffee cultivation increased in popularity among European settlers and some Malagasy farmers (Jarosz, 1993). Fertile lowland areas were devoted to coffee and other export crops. Most Malagasy farmers were forced to move up slope to clear forest for subsistence agriculture (Jarosz, 1993). These practices adversely affected domestic food crop production.

The first major shortfalls in rice production began in 1911 due to state requisitioned exports, falling producer prices, increased local demand, drought and cyclones (Jarosz, 1993). In the tropical eastern forests, shortfalls were credited to the state ban on tavy (Razoharinoro-Randriamboavonjy, 1971 cited in Jarosz, 1993). From 1881 through 1902, laws were enacted throughout the island prohibiting the burning of forests and other lands. By 1913, tavy was universally prohibited (Jarosz, 1993).

In 1913, Governor General Piquie wrote, "Tavy is condemned because of the enormous damage it does to the forests and will, before long, lead to the disappearance of the beautiful forests of the colony." (Piquie, 1913 cited in Jarosz, 1993). The colonial government, envisioning agricultural transformation, imported paddy farmers from the irrigated highlands to instruct the eastern tavy farmers.

The colonial state's official objective was to save primary forest for rational management and encourage sustainable, intensive rice cultivation (Jarosz, 1993). The program failed due to several reasons. The eastern forests were wetter than the central highlands and insufficient lowland marsh areas existed for irrigated rice production (Jarosz, 1993).

There may have been other motivations behind the governmental ban on tavy. Tavy agriculturists traditionally lived and worked in remote areas. The easiest way to ensure timely and efficient tax collection was to group inhabitants into roadside villages (Jarosz, 1993). For the colonial government, tavy promoted tax evasion and made tax collection more laborious. Additionally, it made the procurement of workers for forced labor parties difficult (Jarosz, 1993).

The Malagasy interpreted the tavy ban as an administrative attempt to force them into wage work by depriving them of an independent means of subsistence (Jarosz, 1993). They equated wage work to enslavement. Additionally, the ban was seen as a threat to religious practices. The tavy field was a place where families prayed to ancestors and made sacrifices to their God. This affirmed the existence of the past in the present through ritual practice (Kottak, 1980). The ban was a major contributing factor in the revolt of 1904 and massacres in

1947 (Jarosz, 1993).

The ban changed tavy from an agricultural practice to a symbol of freedom from French rule. In the early 1900's the Betsileo, an eastern ethnic group, preferred to burn their woodlands and convert them to usable pasture rather than leave them as a form of wealth which belonged exclusively to the state (Olsen, 1993). This touches deeply on land tenure and inheritance issues. The current attitude is expressed in the following quote, "Who can inherit from the state? The government is not my father or my mother" (Olsen, 1993). Illegal burning of primary and secondary forest and prairie became a symbol of protest against state authority (Olson, 1984; Jarosz, 1993). This form of political protest continues today. During my Peace corps service, I witnessed several protest burnings.

History of Malagasy Environmental Law

The history of Malagasy environmental law extends back into the pre-colonial era. The first recorded mention of environmental legislation appears in 1881. At that time, Rainilaiarivony, Prime minister of the Merina Kingdom, issued the "Code of 305 Articles". This code specifically forbade the felling of virgin forest for charcoal or agriculture (Jolly et. al., 1984).

In the late 1890's, the French colonized Madagascar and remained in power until 1960. The colonial government

opened Madagascar's forests to concessionary exploitation in 1921 (Jarosz, 1993). In 1927, legislation was passed creating natural reserves (Jarosz, 1993). By 1930, forest reserves had been created, however, these actions came too late to preserve more than forest fragments (Jarosz, 1993). Between 1895 and 1925, approximately 70% of the primary forest had been destroyed (Jarosz, 1993). Export crop production greatly contributed to this destruction (Jarosz, 1993). This environmental destruction occurred long before overpopulation was an issue. In fact, between 1900 and 1941, the national population growth rate was at or below replacement levels due to famine, disease and alcoholism (Jarosz, 1993). Linkages between population growth, swidden agriculture and forest clearing were not recognized as environmental concerns until the post-colonial period (Jarosz, 1993).

In 1984, in response to the degraded state of the country's natural resources, the Government of Madagascar adopted the Malagasy Strategy for Conservation and Sustainable Development. This strategy called specific attention to the role played by Malagasy people in the environment. Madagascar was one of the first African nations to develop such a strategy. One year after its passage into law, the government organized an international conference on Malagasy environmental problems. At the end of the conference, the government promised to develop an

institutional framework to provide better tools for the management of its environment and to set up operations that would stop resource degradation. At this time it took the first steps toward making the 1984 strategy operational with the preparation of an "Malagasy Environmental Action Plan" (MEAP). The MEAP was formalized in December of 1990 with the adoption of the Malagasy Environmental Charter (Law 90-033).

The objective of the MEAP was to assist the Malagasy people in protecting and improving their environment and pursue sustainable development. The MEAP included three five year segments. The first five year segment was begun in 1990 and the second in 1996.

A rough estimate places the MEAP's 15 year cost at (US) \$300 - 400 million (Swanson, 1996a). Although this may seem high, the government felt that this amount was equivalent to that paid annually by Madagascar due to environmental degradation (Swanson, 1996a).

The Environmental program I (EP-I), designed by a multi-donor and a Malagasy team of environmental specialists led by the World Bank, was the first five year segment of the MEAP. EP-I began the implementation of six priority programs. As this was the first phase of a complex, long-term process, the program was implemented incrementally to allow for the development of local experience and capacity.

Role of ANGAP and NGO's

The National Association for the Management of Protected Areas (ANGAP French acronym) was created in June 1990 in accordance with reforms initiated by the MEAP. The original role of ANGAP was to coordinate implementation of government policy for the management of protected areas and community based development. ANGAP development activities are usually carried out with local residents residing in peripheral zones surrounding protected areas (Grenfell, 1995). ANGAP includes representatives of several Government ministries including the National Office for the Environment, international and national non-governmental organizations (NGO) and a representative from the private tourism industry. It is a non-government, semi-private association (Swanson, 1996a). At present, ANGAP is re-defining its role as the Malagasy National Parks Department and has defined its mission as follows:

To establish, conserve and manage in a sustainable manner a network of National Parks and Reserves representative of the biological diversity and the natural environment unique to Madagascar. These protected areas, source of national pride for both present and future generations, should be places of preservation, education, recreation and national economies.

(Grenfell, 1994 p.6)

History of ICDPs

During the early 1980's, the IUCN World Conservation Strategy promoted the concept of integrated conservation and development programs (ICDPs). Conservation was viewed as a narrow field concerned mainly with wildlife and soil, often creating impediments to development (IUCN-UNEP-WWF, 1980). Agencies responsible for conservation and resource management needed to be concerned not only with production but with maintenance. In the scramble for often scarce government funds, natural resource agencies felt compelled to focus on production as a sign of results which can be directly related to economic performance (IUCN-UNEP-WWF, 1980). These attitudes have resulted in serious environmental repercussions. Focusing on the short-term exploitation of natural resources encouraged over exploitation and environmental degradation (IUCN-UNEP-WWF, 1980). Ignoring the environmental impacts of development projects also lead to costly mistakes. Ecologically damaging development projects also had adverse economic and social damage (IUCN-UNEP-WWF, 1980).

It seemed necessary to include ecological concerns at the policy making stage of development work, rather than the less flexible project stage. This required a clear statement of conservation and development goals as well as responsibilities of participating agencies. The International Union for Conservation of Nature and Natural

Resources (IUCN) felt that conservation and development could be integrated through the instruments used to implement anticipatory environmental policies, through the establishment of coordinating mechanisms to ensure that a cross-sectoral conservation policy is applied, and by adoption of national accounting systems to include measures of conservation performance (IUCN-UNEP-WWF, 1980). Environmental planning and rational use allocation with respect to natural resources were considered crucial to the integration process.

The development of national accounting systems including measures of conservation performance is difficult. Most national accounting systems are strictly based in monetary terms (IUCN-UNEP-WWF, 1980). The costs of conservation measures may often appear to outweigh the benefits as costs are calculable in money, while many environmental benefits are often not (IUCN-UNEP-WWF, 1980).

ICDPs strive to operate by linking conservation and development in three ways: geographically, administratively and functionally. Geographically, ICDPs focus on protected areas or groups of nearby areas and base development projects in the surrounding communities (Alpert, 1996). Projects vary administratively, but most involve a non-governmental organization, a foreign donor agency and a national agency in charge of forestry, wildlife, or parks (Alpert, 1996). Functionally, ICDPs link conservation and

development through four techniques. Whenever possible, they promote inherent local self-interest in biological conservation (e.g., regulating the harvest of wild plants used for fiber or food) by spreading public awareness, removing disincentives, and galvanizing community action (Alpert, 1996). In high tourist areas, ICDPs promote local enterprises (e.g., craft sales) and funnel park entrance fees into local communities. In non-tourist areas, or for resources irreplaceable by money, natural resources are replaced by alternate local sources such as fuelwood plantations (Alpert, 1996; Swanson, 1996a; Grenfell, 1995). Finally benefits, such as schools or clinics, are provided in return for resource use foregone (Alpert, 1996; Swanson, 1996a).

ICDP's often pursue a combination of three main goals. First, the development of better living conditions for local peoples is directly tied to the conservation of relatively intact natural habitats (Alpert, 1996). This distinguishes ICDPs from other approaches by setting a dual and complimentary focus on biological conservation and human development (Alpert, 1996).

The second goal of ICDPs is to design projects which address unique problems at specific sites. In Kenya, for example, the fanya juu terrace, a modified form of contour terracing, has been developed to suit local conditions (Sanders, 1988). The program was based on traditional

practices and was well accepted (Wenner, 1988). In contrast, many soil conservation techniques have been transferred directly from flat lands to slopes, techniques that in the humid tropical uplands are inadequate and impractical to address erosion (Harper and El-Swaify, 1988). In Jamaica, grass barriers, contour furrows, and strip-cropping failed to control erosion as they were designed for gentle slopes in areas of low rainfall (Sheng, 1988).

Finally, ICDPs are designed for conditions in developing countries where populations are high, rural people rely heavily upon local natural resources and protected areas impose opportunity costs on local communities (Alpert, 1996). Governmental attempts to resolve conflicts are often thwarted by limited budgets, poor communication, lack of infrastructure and corruption. ICDPs attempt to fill the need for externally funded, locally based projects by linking conservation and development at individual sites (Alpert, 1996). However, experience indicates that conservation can only be achieved if governments are committed to long-term programs (Sanders, 1988). Short-sighted planning and short-term projects are rarely successful. Worthwhile achievements in conservation have generally been made through long-term programs supported by the necessary legislation, staff, finances, and facilities (Sanders, 1988).

Today, the dominant ICDP model seeks to unite the subsistence needs of resident peoples with conservation goals through the establishment of parks and reserves enclosed by protective peripheral or buffer zones (Shyamsundar, 1996). A peripheral or buffer zone theoretically refers to an economic activity zone of varying land-use intensity that surrounds a protected area (Brechin et. al., 1991). This design is employed in Madagascar at Ranomafana National Park.

Although sustainable development and ICDP concepts are not identical there is a relationship. While not all sustainable development projects are part of an ICDP, ICDPs strive to promote sustainable development. As a result, certain principles of sustainable development are applicable to ICDPs.

Development cannot be sustained without the proper management of natural resources and the environment for future as well as present generations (Brechin and West, 1990). Well managed natural resources provide economic security while their wanton destruction eventually leads to dependence upon outside support. Theoretically and under optimal conditions, ecologically sound development satisfies essential local needs. In particular, this form of development would focus upon the needs of the poorest members of society (Brechin and West, 1990).

Few people would challenge these concepts. However, impoverished people are often more concerned with immediate survival and short-term benefits derived from resources than the benefits of long-term conservation practices (Belsky, 1993). Without the possibility of immediate economic benefit, it may be difficult for them to identify with the need for resource conservation (Brechin and West, 1990). According to Douglas (1988), techniques recommended to farmers should lead to significant increases in yields or income within the first year of practice.

It is important to consider who actually benefits from conservation and development policies and programs. Brechin and West (1990) point out that few eco-development strategies have adequately addressed this question. A major industry has developed around advising African countries on how to develop their resources (Redclift, 1987). North American and European firms have charged as much as \$180,000 for one year of a professional consultants time (Redclift, 1987). In the late 1980's, more than half of the \$7-8 billion spent yearly by development donors in Africa went to finance 80,000 expatriates working for public agencies under official aid programs (Timberlake, 1985 cited in Redclift, 1987). In many cases a minority of the population benefits while rural poor living in or near protected areas continue to suffer (Ghimire, 1994). Frequently, resident peoples have been left out of decision making processes (Ghimire,

1994).

In developing nations, most parks arose when organizations and agencies from more developed nations thrust conservation strategies upon them (Brechin and West, 1990). According to Alpert (1996), ICDPs initiated in this manner often begin without active community participation. Projects that continue in this manner often fail. No program can ultimately succeed without the involvement and consent of those most affected. As long as many rural people live in poverty, support for conservation will be contingent on how well it is linked to their own self-interest and their desire for a better life (Brechin and West, 1990).

A bottom-up approach to conservation and development focuses on active community involvement as well as non-governmental agencies for project ideas. By themselves, bottom-up strategies are often insufficient for most conservation efforts because communities and grassroots organizations typically lack money, technical expertise and global perspective (Uphoff, 1986). Therefore, Uphoff (1986) suggests a package approach connecting supportive and coordinated linkages between top-down activities and those which are bottom-up.

ICDPs in Madagascar

Rural poverty is often a major cause of tropical forest destruction in general and in Madagascar in particular (Browder, 1989). Lack of feasible sustainable livelihood alternatives often contributes to illegal forest clearing (Ghimire, 1994). ICDP's have been advocated as alternative means to address rural poverty. As international funding for the integration of park management and peripheral zone development projects became available, Madagascar quickly adopted the strategy.

During the early 1980's, Madagascar was selected by the World Bank and other international donors for the implementation of an Environmental Action Plan (Jolly, 1989). According to Jolly (1989), this effort was to be an example for other countries to follow. Madagascar was selected for three reasons. First, Madagascar demonstrated its commitment by adopting a national Strategy for Conservation and Sustainable Development in 1984 (Jolly, 1989). The following year, the island hosted an international conference announcing its new plan and inviting the aid of donors. Secondly, Madagascar is regarded as one of the worlds seven mega-diversity countries as well as an international conservation priority (Jolly, 1989). Finally, Madagascar has adhered to the structural adjustment directives of the International Monetary Fund (IMF) (Jolly, 1989).

The Malagasy government adopted the ICDP concept as a primary methodological approach during the first phase of Madagascar's Environmental Action plan from 1991 through 1996 (Swanson, 1996b). The United States Agency for International Development (USAID) was one of the principle donors during this phase through their Sustainable Approaches to Viable Environmental Management project (SAVEM). The main goal of SAVEM was to establish a sustainable relationship between humans and Madagascar's threatened ecosystems (Swanson, 1996b). SAVEM attempted to identify and establish sustainable institutions, methods, and behaviors which promoted sound management of protected areas and peripheral zones (Swanson, 1996b). With the hope of establishing sustainable institutions USAID gave considerable support to ANGAP - the Malagasy equivalent of a park service. Eventually grants to manage six ICDP's were awarded: four to American based NGO's (CARE, CI, WWF, VITA), one to Stony Brook University, and one awarded directly to ANGAP (Swanson, 1996b).

Ranomafana National Park

Ranomafana National Park (RNP) was inaugurated on May 31st, 1991 becoming the fourth of Madagascars six national parks. It is located in the southeastern region of the country between 47°18' - 47°37'E and 21°02' - 21°25'S. The region lies approximately 90 kilometers (56 miles) west of

the Indian Ocean, 60 km (37mi) northeast of the provincial capital of Fianarantsoa and 400km southeast of the national capital, Antananarivo. The park area totals 40,613 hectares (156.83 sq.mi.) and is divided into three distinct parcels (Grenfell, 1995). A three kilometer peripheral zone surrounds the entire park (Appendix B). This 53,100 hectare (205 sq.mi.) zone contains 96 villages and approximately 20,800 people.

The park is located in a steep mountainous region containing lowland rain forests, submontane cloud forests and high plateau forests. Areas of sedge and pandanus swamp also exist. Elevation ranges from 400 to 1417 meters (1313 - 4658 ft) (Grenfell, 1995).

Ranomafana includes and is bisected by the headwaters of the Namorona River, which rise in the forests of the park and descend sharply to the southeast (Grenfell, 1995). Twenty-seven rivers originate in the park. Twenty of these are considered to be of great importance to irrigated agriculture (Swanson, 1996).

Biological Diversity

RNP is a biologically diverse area containing some of the worlds rarest flora and fauna. The forest is home to six species of carnivores, eleven species of insectivores, seven diurnal and five nocturnal species of lemurs, eight species of bats, six endemic rodent species, 111 species of

birds, roughly 117 species of reptiles and amphibians, over 90 species of butterflies, 350 species of spiders and six species of crustaceans (Grenfell, 1995). There is a tremendous diversity of plant species. Among other things, ten species of tree ferns, at least ten species of bamboos and hundreds of orchids thrive in the forest (Grenfell, 1995). Additionally, the park contains numerous endemic palms.

Climate

Temperatures in Ranomafana generally range from 14 - 20C (57 - 68F) with the lowest and highest recorded temperatures being -1C and 37C (30F and 99F) respectively. Yearly rainfall averages 2300-4000mm (100-157.89 in) but varies dependent upon cyclones and tropical depressions (Grenfell, 1995). The region experiences a typical monsoonal climate with rainfall highest from December through March and lowest from May through October. Rainfall is periodic and exceeds potential evapo-transpiration in all months of the year (Grenfell, 1995).

Soil Constraints on Agriculture

Tropical soils have often been considered universally acidic, infertile, and incapable of sustained agricultural production (McNeil, 1964; Friedman, 1977; Sanchez and Logan, 1992). In fact, this is not the case. The tropics contain

a vast diversity of soils (Sanchez and Logan, 1992) and there are numerous examples of successful, sustained soil management in the tropics (Harper and El-Swaify, 1988; Wenner, 1988; Sanchez and Logan, 1992). However, approximately 36% of the tropical land area is dominated by nutrient deficient soils (Sanchez and Logan, 1992). In addition, one-third of the tropics have acid soils with high concentrations of soluble aluminum that presents toxicity problems (Sanchez and Logan, 1992).

Unlike many areas of Africa, Madagascar has been the subject of extensive soil reconnaissance and systematic soil surveys (Eswaran et. Al., 1992, Johnson, 1993). The country is composed primarily of Oxisols in the east and Alfisols in the west (Sanchez, 1976). Typically these are considered highly leached, weathered soils.

The soils of Ranomafana National Park are oxisols and inceptisols. They are acidic and of low natural fertility (Grenfell, 1995). In fact, these soils are considered to be some of the worlds most infertile soils (Johnson, 1993). According to soil surveys conducted by North Carolina State University (Johnson, 1993), the lowland alluvial soils of Ranomafana are as infertile as the upland soils. No significant areas of fertile soils were located within RNP or in areas adjacent to the park boundary (Johnson, 1993; Grenfell, 1995).

Geologic materials are a primary determinant of soil fertility. Medium grade metamorphic rocks such as gneisses and schists form the regional bedrock (Johnson, 1993). Localized granitic intrusions are also found. This type of bedrock contains extremely low levels of nutrients such as phosphorus, potassium, calcium, and magnesium (Johnson, 1993; Nye, 1960). With parent rock of such low nutrient levels it is virtually impossible to form naturally fertile soils (Johnson, 1993).

Upland soils are generally shallow Inceptisols with Saprolite encountered at 50-150 cm. Saprolite is soft weathered rock most often a loam or sandy loam with significant amounts of weathered mica and kaolinite (Johnson, 1993). Saprolite is also found in poorly drained valley soils. The saprolite in those areas has a higher proportion of bases than the upland saprolites but is frequently beyond the reach of rice roots (Johnson, 1993). In some areas gleyed saprolite is present with unusually high levels of exchangeable bases and low aluminum saturation percentages (Johnson, 1993). Unfortunately, gleyed saprolites are not common within one meter of the surface. Therefore, they cannot be reached by the majority of rice roots (Johnson, 1993). Additionally, they are invariably capped with a lag of coarse gravel and stone making any root penetration difficult to impossible (Johnson, 1993).

Poor soils, steep terrain (50-100% slopes) and low seasonal temperatures combine to limit farming around Ranomafana. Farmers throughout the region claim that temperature is the primary limiting factor which prevents a second rice harvest (Johnson, 1993). In some areas, mean monthly temperatures are below 15°C for six months. Temperatures less than 15°C during the rice flowering period result in high rates of grain sterility (Johnson, 1993).

Social and Economic Conditions

Two major ethnic groups live in the park peripheral zone. They are the Betsileo of the Western highland (55%) and the Tanala (42%) who live mainly in the lower elevations in the central and eastern regions of the park (Grenfell, 1995). Households in the peripheral zone average six people (Grenfell, 1995). Husband and wife couples head 88% of the households, 8% are headed by single women and 3% by single men (Grenfell, 1995).

The principle economic activity in the region is agriculture with rice as the primary crop. Other crops of local importance include manioc, bananas, corn, coffee, sweet potatoes, taro, pineapple and leafy vegetables (Grenfell, 1995). Some households also raise cattle and poultry.

Individual households or groups of closely associated households hold land ownership for agricultural activities.

This is true for paddies and upland farm plots. The State determines the amount of land given to each village. Technically, only the government can extend the limits of the village land base (Grenfell, 1995). One of the major problems faced by peripheral zone residents of RNP is dividing the limited land base among an increasing population.

In general, forest products existing on communal lands are managed under common property rights regimes. Each community member has the right to consume forest products on land within their group's domain. Customary usage laws limit usage to "moderate" amounts (Grenfell, 1995). Within both ethnic groups, farming rights to a parcel of land are awarded by village authorities. Men and women may own land. Once granted, this "right of use" can be passed from generation to generation. As a result, one may maintain land rights while not residing in the community. In some areas, the first person to clear a piece of land gains "iafampangady" or exclusive usage rights. This often promotes deforestation as people can not be given land use rights until they have first cleared the land.

Immigrants are usually not granted land rights until they have lived in the area for roughly one year and prove that they will obey village laws and customs (Grenfell, 1995). During the trial period, immigrants farm illegally outside of the agricultural perimeter (Grenfell, 1995).

ICDPs and Park Objectives

According to Ghimire (1994), the establishment of parks and reserves for recreation and tourism, or for purposes of exclusive protection of scenic areas of biodiversity is ill-suited to the developing world. Frequently park creation conflicts with existing, often sustainable, resource use and livelihood practices of the local people. Central to the creation and functioning of Ranomafana is the belief that the park does not exist in a vacuum (Grenfell, 1994). People living in the peripheral zone are integral parts of the ecosystem. According to this management approach the park can only be preserved if local residents benefit from and actively participate in the management of the area's resources. Therefore the objective of RNP is to:

Diminish human pressures on the protected area through the introduction of sustainable agricultural systems, alternative income sources, and the sound management of natural resources by local communities (Grenfell, 1994 p.ii).

To achieve this objective, park management seeks to identify and implement an integrated conservation and development project which connects sustainable management and utilization of natural resources with improved socio-economic levels for peripheral zone villagers. In many parks designated after the mid 1980s, this is a common approach to management. Critics of this approach claim that

many conservation and development projects are experimental and were created to reduce conflict over park creation rather than to offer sustainable livelihood alternatives to local residents (Ghimire, 1994).

Park personnel considered the primary threats to conservation in RNP to be: swidden agriculture, non-commercial timber exploitation, and exploitation of non-timber forest products (Grenfell, 1994). In order to tackle these main issues, project activities are focusing on: increasing the productivity of staple food and market crops, sustainable utilization of forest products, initiation of alternative means of income generation, and development of protected area infrastructure (Grenfell, 1994).

Community focused working groups in the fields of health, education, development and conservation strive to function as an interactive team in order to accomplish the park objective. All of this work is monitored by a fifth group which gathers, evaluates and disseminates information in order to provide feedback and evaluate the effectiveness of programs.

The central theme of the RNP is the linkage of forest and natural resources to improved socio-economic conditions. By establishing this linkage through project activities, it is hoped that local residents will have increased awareness of the value of natural resources, that they will be empowered through the management of those resources, that

they will consequently have incentives to conserve resources and thus conservation of biological diversity and ecosystems can be achieved (Grenfell, 1994).

CHAPTER II
OBJECTIVES AND METHODS

Objectives

- * To identify the social and economic reasons for acceptance or rejection of Intensive Rice Cultivation (SRI) techniques

- * To compare and contrast SRI with traditional tavy rice cultivation

Methods

Information for this paper was gathered through informal and formal interviews, personal observation, key informants, oral histories of village elders and review of previous sociological and agricultural research and park management documents. Additional cultural information was gathered from one year of personal experience living and working with Tanala and Betsileo villagers.

In February of 1997, I was assigned to work with Mr. Jules Ramiandrisoa, the local SRI program supervisor. SRI was being practiced in nine villages. We worked in three Betsileo and five Tanala villages where SRI had been introduced. The ninth location, a Betsileo village, was inaccessible due to travel conditions. My work focused on social and economic reasons for acceptance or rejection of

SRI techniques. I also gathered farmers opinions regarding the labor input and productivity of SRI versus traditional cultivation techniques.

During the 1996-1997 season, 68 farmers were practicing SRI in the peripheral zone. I interviewed twenty-four farmers, 16 Betsileo and 8 Tanala. Of this group, 9 were women and 15 were men. Five farmers practiced only SRI, three practiced only traditional rice cultivation and sixteen practiced both methods.

Preliminary visits were made to each village. During those visits I was formally introduced to the villagers and explained that I was studying rice production methods and would like to interview local farmers. Dates were arranged to visit those willing to be interviewed. Consequently, the surveys and interviews were not conducted at random.

Interviews with farmers were informal and focused on agricultural activities specifically: time and labor input, differences between SRI and traditional production methods, sexual division of labor, difficulties encountered with SRI practice, land ownership and cultural aspects of agricultural production. Farmers' families were often present at interviews and frequently contributed information to the discussion. Interviews were conducted during the growing and harvest seasons from January through early May of 1997. In addition to interviews, I visited traditional paddy, tavy and SRI fields with the farmers. During these

visits I was able to observe and occasionally participate in various rice production techniques. As a result of these visits, I observed the stages of rice production from seedling transplant through harvest.

I also conducted informal interviews with the four extension agents responsible for SRI introduction in the seven villages. These interviews focused on the specific techniques which they had taught, and the technical and cultural problems they encountered. A formal interview with the local SRI program supervisor provided additional technical information regarding SRI. This was supplemented with agricultural bulletins published by the Tefy Saina Association. I also traveled to Antananarivo and interviewed the president and vice president of the Tefy Saina Association, Mr. Sebastien Rafaralahy and Justin Rabenandrasana. This interview provided a history of SRI in Madagascar and the goals of the Tefy Saina Association.

CHAPTER III

INTENSIFIED RICE PRODUCTION

Relationship Between Rice Production and Tavy

Rice production by tavy is a time honored traditional practice. In 1661 Monsieur Etienne de Flacourt, the first European to describe tavy, wrote the following,

They (Tanala) plant their rice in the hills and valleys after having cut the woods which are largely of certain coarse canes which are called voulou throughout the island and in the Indies Bambu or Mambu. When dry, they are set afire and burn with a noise to make the earth tremble for a mile around....When the woods have been burned, all ground is covered with ashes, which are moistened by the rain. After some time they plant the rice in a curious manner. It is that all the women and girls of a village help each other in planting, marching side by side as a front, each having a pointed stick in hand with which they punch holes in the ground, dropping into each two grains of rice, covering the whole with the foot, all doing the same thing in unison, dancing and singing(Jarosz, 1993 p.372).

My observations of tavy in 1997 were nearly identical to those of Monsieur de Flacourt.

Today, agriculture is the primary livelihood activity in the Ranomafana region. Rice is the principle crop and both irrigated and non-irrigated varieties are cultivated. Most of the population lives at a subsistence level and household food production is frequently insufficient to meet subsistence needs (Grenfell, 1994). A social impact assessment conducted in five peripheral zone villages indicated that most households did not achieve household food self-sufficiency (Peters, 1994).

Between 1991 and 1993, park personnel conducted a health and socio-economic survey of 516 families in 18 peripheral zone villages. Among other things, the survey collected data on sources of income, hectares cultivated and agricultural production (Grenfell, 1994). The study concluded that increased production of paddy rice was the most pressing community need.

On steep hillsides surrounding the park, swidden cultivation or "tavy" is a common agricultural practice. It is one of the main production methods of local subsistence crops including rice (Grenfell, 1994). It is also considered a serious threaten to the park's flora and fauna, local watersheds, and long-term soil productivity (Grenfell, 1994). The tavy process involves complete forest clearing and subsequent burning of the cut vegetation. The inherently poor soil is temporarily augmented by the ash allowing a brief period of production. The parks steep slopes make soil conservation difficult and prevent the operation of machinery (Grenfell, 1995). According to Johnson (1993), the only viable options, given soil fertility constraints, are to use inorganic fertilizers or to continue tavy.

Where population pressure is low, swidden techniques can be sustainable (Dove, 1983; Jarosz, 1993). Nye (1960) observed that swidden agriculture is a feasible system at population densities of approximately 20 people per square

mile. This figure may vary depending upon climate, soil fertility, crops raised, cropping system and length of fallow.

The population density in the RNP peripheral zone is 102 people per square mile (Grenfell, 1995). Furthermore area soil fertility is low, the cool climate often inhibits production and fallow periods are shortening. In addition, the park itself has removed approximately 40,600 hectares from the agricultural land base. These conditions are not conducive to sustainable tavy.

According to Dove (1983), overcropping and short fallow swidden farming is most often a product of increasing population pressure on a finite or decreasing land base. In Madagascar, demands for agricultural land are so great that farmers must either return to their fields before the forest can regenerate or open new plots (Mittermeier et.al., 1994). On average, tavy fields are cultivated for three years before fallow (Swanson, 1996a). Based on interviews with area farmers, the fallow period in the RNP area has decreased from 25 years to 2 - 5 years in 1991 (Peters, 1992). In Madagascar, 10 - 15 years is considered an ideal fallow period (Mittermeier et. al., 1994). Repetitive burning over short intervals results in increasingly nutrient poor soil capable only of supporting a few grasses (Dove, 1983; Mittermeier et. al., 1994). These areas are then subject to erosion, particularly on steep hillsides

(Mittermeier et. al., 1994).

The majority of the environmental costs enumerated in the MEAP can be attributed to tavy. Of the \$104 million estimated environmental costs, tavy accounts for roughly 80% or \$84 million (Larson, 1994). These figures were based on on-site estimates of soil degradation and off-site damage to roads, harbors, and irrigated systems as well as lost forest revenues from lack of sustainable timber harvest plans on tavy land (Larson, 1994). If further destruction is to be prevented, the basic needs of villagers must be addressed. To do this it is necessary to understand the local customs, agricultural practices, spiritual beliefs and utilitarian reasons for practicing tavy.

Rice Production Strategies - Tanala vs. Betsileo

Two ethnic groups farm the area surrounding the park, the Tanala and the Betsileo. Each group has a different approach to rice production. While they do produce some paddy rice, the Tanala people have traditionally practiced tavy agriculture. Tanala tavy begins when a farmer clears and burns approximately one hectare of land. The seed is sown on dry ground from August through December and harvested four months later. Because of the low soil fertility, low temperatures and poorly adapted upland rice varieties yields average 500 to 2,000 kg/ha (del Castillo, 1993).

Although some Betsileo farmers practice tavy, they have traditionally preferred to cultivate paddy rice. Betsileo villages and paddies are usually located on level ground near streams and rivers. Wet nursery beds are planted from September through December with transplanting to irrigated paddies after one to two months. The main harvest season occurs from March through May. To increase soil nitrogen levels and improve yields, many Betsileo farmers have adopted the practice of crop rotation, alternating between beans and rice (Brown, pers. obs.). Surveys conducted by Peters (1994) indicated that Betsileo farmers in less remote villages were able to exceed household rice self-sufficiency requirements while those in more remote villages failed to reach their basic requirements by as much as 190 kg/ha/household. This may be explained by the fact that villages close to roads are easily accessible to extension workers and have benefitted from development intervention. In addition it is easier for these villagers to travel to markets to buy and sell agricultural goods, purchase fertilizers and rat traps and interact with other farmers.

In general, the Betsileo own more paddy rice than the Tanala (Table 1). Those Tanala who do produce paddy rice, supplement that production with tavy rice (Peters, 1994). Limited attempts were made to increase paddy production. Some Tanala farmers, like the Betsileo, attempted to increase nitrogen levels in their paddies. I observed the

introduction of nitrogen fixing algae into Tanala paddies and, in rare cases, crop rotation.

TABLE 1. *Paddy Holdings and Household Rice Production*

	BETSILEO REMOTE	BETSILEO ACCESSIBLE	TANALA REMOTE	TANALA ACCESSIBLE
Average Holding	.74 ha	.93 ha	.15 ha	.3
Range of Holdings	3 - 0 ha	2 - .09 ha	.4 - .03 ha	.7 - .05 ha
Average Household Size	6.2 persons	5.9 persons	5.3 persons	5.5 persons
Household Rice Needs-150 kg/person	930 kg	885 kg	795 kg	825 kg
Household Production	740 kg	930 kg	150 kg	300 kg

From: Peters, Dai, 1994. SIA of Ranomafana National Park

According to del Castillo (1993), paddy rice production around the park ranges from 400 to 3,000 kg/ha/year. Actual rice consumption rate is 150 kg per person per year, with a preferred consumption rate of 180 kg per person per year (Peters, 1992). A conservative estimate indicates that Tanala households need to supplement paddy production with 525 - 645 kg of tavy rice in order to meet basic consumption requirements (Table 1).

Role of Tefy Saina Association

The Tefy Saina association is a Malagasy NGO whose goal is to develop rural areas by teaching rural men and women improved agricultural practices and soil conservation

techniques (Rafaralahy, pers. comm.). For eight years Tefy Saina has promoted an intensified rice production system (SRI-French acronym). This system was created in Japan by Katayama and introduced in Madagascar by Father Henri de Laulanie. The primary goal of the Tefy Saina Association is to help farmers achieve household rice self-sufficiency (Rafaralahy, pers. comm.). A second distant goal is to develop rice as an export crop (Rafaralahy, pers. comm.). Madagascar is the worlds highest per capita consumer of rice (Mittermeier et. al., 1994). Currently, rice is imported to meet national food needs.

Traditional vs. SRI Techniques

SRI is a relatively new agricultural practice in Madagascar. It was introduced within the past 10 years. In contrast, tavy and traditional paddy rice production have been in practice for centuries. Additionally, marked differences exist between tavy and SRI production techniques (Appendix C).

SRI is based on several key principles, the first of which is water management (Ramiandrisoa, pers. comm.). Through well managed irrigation a minimum of water is utilized. Optimally, water levels are maintained at one to two centimeters in the paddy fields (Laulanie, 1993). Each plot is fed by its own channel so that the water level may be carefully monitored. Traditional paddy to paddy

irrigation (cascade technique) is discouraged. During the vegetative period of rice growth fields are drained to allow for direct oxygenation of the roots (Laulanie, 1993). Unlike SRI, tavy is dryland rice production on rainfed plots. It requires no irrigation or water management.

Tavy fields are directly seeded. They require no nursery plots or seedling transplanting. Traditional paddy cultivation requires transplanting from wet nursery beds. Transplanting occurs at two to three months of age and seedlings are planted randomly in small clumps. SRI seedlings are transplanted from dry bed nurseries at 10 to 15 days of age. Eight days is considered optimal (Ramiandrisona, pers. comm.). The reasoning behind transplanting younger seedlings is that shallow young root systems sustain less damage during transplanting than those of more mature seedlings. Also young seedlings are experiencing rapid cell division. Transplanting at this stage is believed to stimulate greater root production as the seedling adapts to its new environment (Laulanie, 1993). Seedlings are planted individually in 25cm x 25cm or 40cm x 40cm grids (Laulanie, 1993). This may reduce competition between seedlings.

As with traditional paddies and tavy plots, SRI paddies require weeding. However, unlike traditional hand weeding, SRI weeding is accomplished with mechanical weeders. The use of these push-type weeders is possible due to the square

grid pattern in which the seedlings grow. This allows for weeding in two directions. Weeding is required every 15 days. Weeding in traditional paddy and tavy plots is less intensive.

Tavy fields require no leveling. SRI requires careful leveling of paddies. Traditional rice paddies are also leveled however there are many surface irregularities. Fields may vary between 5 and 10cm from one end to the other (Laulanie, 1993). Irregularities are not so serious with traditional methods as paddies are generally covered by 10 - 20cm or more of water. However, with lower water levels unlevelled fields can result in reduced yields.

Unlike traditional means of cultivation, SRI promotes the use of compost to increase soil nutrient levels. Although many farmers do not compost, some utilize compost regularly in their nursery beds and occasionally in paddies.

SRI does not promote the use of genetically altered, non-local or chemically dependant hybrid rice varieties (Rafaralahy, pers. comm.). They do encourage the use of organic (compost) as well as nitrogen, potassium, and phosphorus (Rafanomezantsoa, pers. comm.). The use of inorganic pesticides and herbicides is discouraged.

CHAPTER IV

ACCEPTANCE OF NEW TECHNIQUES

Tanala versus Betsileo

Tefy Saina intensified rice production techniques have not been accepted equally among Betsileo and Tanala villages. Acceptance of the new techniques is more widespread among the Betsileo than the Tanala people. There are a number of possible explanations for this.

Uncertainty versus Security

Using their traditional methods, Tanala farmers often do not produce enough rice to meet household needs. However, even under these desperate conditions, the traditional practices are familiar, understood and culturally acceptable. According to Desjeux (1981), an important cause of the failure of development projects is that they increase the uncertainty of agricultural production. Trying new techniques involves risk. A crop failure on the only harvest could prove disastrous to a family with little other income or means of support. Taking into account the cultural dimension thus involves taking into account uncertainty and trying to transform and reduce it, rather than increase it (Desjeux, 1981).

Agrarian civilizations are marked by certain fundamental characteristics such as the uncertainty of agricultural production due to climatic considerations (Desjeux, 1981). Tavy provides a certain degree of security that is often over-looked by its critics. It is relatively unaffected by flooding which accompanies the east coast's frequent hurricanes and which destroys modern paddy rice. In 1994, a major cyclone destroyed vast stretches of paddy rice leaving the Betsileo in dire straits. The Tanala however were able to salvage rice. Past history has demonstrated to the Tanala the versatility and importance of tavy rice to their survival (Peters, 1994).

Traditional Belief Systems

Tanala villages are generally located in remote areas and have had less outside influence than the Betsileo. They have held fast to traditional beliefs and practices, especially those regarding ancestral spirits. Reverence for ancestors is pervasive among many ethnic groups in Madagascar and is particularly strong among the Tanala (Brown, pers. obs.).

Ancestors are believed to play a very real role in the everyday lives of the Tanala as well as the life of entire villages. Ancestors exist among the living, in the land that sustains them, in trees, in their very bodies. In fact, living, land and ancestry are inseparable.

To live with the ancestors is to be grounded in the land in which they are buried through work ranging from sowing rice to invoking the ancestors and presenting them with gifts (Feeley-harnik, 1991). On Madagascar's high plateau, land is seen as a mother and a divinity surrounding the dead and allowing the living to live. Land also provides a link between the living and the dead who guarantee the survival of those feeding off the land (Desjeux, 1981). Ancestral spirits can be benevolent or vengeful. Honoring and respecting one's ancestors can help to ensure a good life while disrespect can bring on wrath. One way for the Tanala to honor their ancestors is to honor their memory through maintaining their traditions - including agricultural practices. In fact, the term for traditional rice production is "fomba razana" which literally means "the way of the ancestors".

Social Organization and Class Issues

Frequently, development workers think of land in terms of potential productivity, legal rights and ownership patterns (Desjeux, 1981). However, the concept of land usage and ownership among traditional peoples such as the Tanala is often complicated. It is linked in a complex manner to ecosystems and soil management techniques as well as social relations, sacred issues, ancestors, gender and economics (Desjeux, 1981).

Resource utilization by the Tanala people involves more than simple acquisition and consumption. It often involves the passing on of traditional knowledge, techniques and morals as well as socialization and responsibilities. Additionally, it allows individuals to exhibit well-honed talents and abilities. As a result, caveats or limits placed upon resource usage or time-honored practices (e.g., tavy production) may meet with strong opposition.

Social organization can be disrupted by the introduction of new techniques and ideas. For example, tavy plays an important role in the social organization of Tanala villages. Traditionally the *mpanjaka*, the village leader, appropriates and distributes tavy land. He does this with the input of village elders however his specific authority to appropriate and distribute tavy land symbolizes his traditional power as the *mpanjaka* (Peters, 1994). The elimination of tavy removes this authority and threatens to undermine the power of village leaders.

Dryland rice plots are often farmed under a system of joint family ownership with the harvest divided among the families (Poostchi, 1986). Previous attempts at paddy rice introduction led to private ownership of single family plots. Private ownership encouraged a system of landlords and landless classes wherein many villagers once accustomed to a share of dryland rice went without (Poostchi, 1986).

Political History and Cultural Identity

To Malagasy people living in the island's eastern rainforests, tavy symbolizes even more than the power of a village leader. It represents independence, freedom to make choices, labor control and their very identity as a people (Peters, 1994). In the face of strict and frequent tavy bans the Tanala have persisted in their practice of tavy agriculture. To understand this more fully, one must look back over the Tanala's turbulent and often tragic history. Tavy became a major point of concern following World War I. The French launched a campaign to end the practice, ostensibly aimed at saving the shrinking forests of the Tanala homeland (Kent, 1962). In reality and under extreme pressure, the Tanala were coerced into raffia palm fiber and coffee production. These were not food crops but export commodities. French administrators believed the only way to improve living standards of the Tanala was to impose "dynamism" from the top, using strong-arm measures, for the "good of the people" (Kent, 1962). During this time, many Tanala were relegated to railroad and port construction. Forced labor continued into the early 1930's (Kent, 1962).

The Tanala never accepted the outside authority and incurred the wrath of successive administrations. In 1947, the Malagasy people launched a bloody but unsuccessful revolt against French rule. The Tanala were among the strongest supporters of this revolt and consequently

suffered the greatest reprisals (Kent, 1962). At the end of the colonial period, the Tanala were left in relative peace and allowed to return to their customs and traditional agricultural practices.

Time, Labor and Other Inputs

A common concern amongst Betsileo and Tanala farmers is the investment of labor. Both Betsileo and Tanala were often resistant to the SRI concept due to the perceived extra time required to meet proper planting and weeding requirements. However, when practitioners were interviewed they unanimously agreed that after one or two seasons of practice the time required for planting was the same and weeding time was often less than that of traditional methods (Brown, pers. obs.). In the Betsileo village of Ambatovaky, I observed that farmers had invented a large wooden rake-like implement which enabled them to grid their fields more quickly and with fewer workers. In the same village, some farmers have willingly accepted certain SRI techniques while rejecting others (Rafanomezantsoa, pers. comm.). For example, they may plant in lines yet ignore spacing rules to short-cut the total work and time required. According to informal interviews, this produced lower yields than with strict adherence to SRI guidelines.

Betsileo farmers completed all their field work by themselves and only occasionally hired fellow villagers to

perform tasks such as churning paddies with oxen or transplanting in large paddies. The Tanala, however hire Betsileo to perform most of the manual labor involved in paddy rice production (Rajaonarivelo, pers. comm.). Many Tanala farmers felt that hiring for the leveling, transplanting and weeding would simply be too expensive using the SRI method.

Tavy production requires fewer inputs than production by either traditional paddy or SRI. As opposed to paddy rice production, tavy production requires no bunds, terracing, fertilizer or compost (Brown, pers. obs.). There is also a widespread belief that tavy fields attract fewer weeds. Farmers practicing SRI often add nitrogen, potassium and phosphorus to their fields (Ramiandrisoa, pers. comm.). For some farmers this is too expensive. Betsileo farmers whom I interviewed complained of insect pest problems. They said that chemical pesticides were too expensive. To address this problem they utilized extracts from an unusual rainforest cactus as an insecticide (Randrianasolo, pers. comm.).

One of the major factors affecting human energy as a means of production is health. As mentioned earlier, many of the households in the Ranomafana area do not achieve household food self-sufficiency. Malnutrition is a problem among both children and adults. Other common debilitating illnesses in the area include schistosomiasis,

malaria, hepatitis and various systemic infections resulting from compromised immune systems. An illness can affect the entire family. Medical care is extremely limited therefore family members are the primary care givers. This takes considerable time away from agricultural activities. In the event of death, the entire village is affected by the imposition of a three day to one week traditional mourning period during which time no work is done. This period may be longer for immediate family members. This is a common practice among many of the islands 18 ethnic groups including the Tanala and Betsileo. Awareness of these conditions may contribute to rejection of a new cultivation technique particularly if it is seen as more time and labor intensive.

CHAPTER V

DISCUSSION

Critique of SRI Project Implementation

The overall park objective centers on diminishing local human pressures on the park through the introduction of sustainable agricultural systems, alternative income sources, and the sound management of natural resources by local communities (Grenfell, 1994). One area of emphasis was increasing the productivity of staple and market crops.

In 1994, the Tefy Saina Association entered into a three year renewable contract with Ranomafana National Park Project. Tefy Saina, with expertise in agriculture and community development, worked as a member of the park development team (Grenfell, 1994). The project began by making a strong geographic link. It focused on peripheral zone villages in three specific areas heavily affected by tavy and associated soil degradation: Sahavondronana, Torotosy and Ambodigoavy (Appendix D).

According to Gale (1991), development projects should promote the restoration, preservation, maintenance, and enhancement of ecosystems. This involves the maintenance of parks and protected areas as well as attention to reforestation. Park maintenance figured prominently in the RNP SRI program. The primary reason behind SRI introduction was to eliminate the need to practice tavy within the park.

The connection between the need to halt destructive tavy agriculture and the introduction of improved rice production techniques linked the park's conservation and development objectives. The project met park objectives in two ways. First, Tefy Saina presented a method of rice production aimed at increasing paddy production and potentially decreasing the need for dryland rice production. Additionally, the association presented options for community resource management in terms of soil conservation and hillside stabilization techniques. The program was to work through local power structures to address the cultural aspect of tavy as well as through educational and technical avenues to improve crop production (Grenfell, 1994).

The SRI project was quick to form grassroots linkages with farmers and village associations. Tefy Saina compiled a list of target groups with whom they would work to accomplish their objectives. This list was composed predominantly of the villagers. Included were members of development support structures in the peripheral zone such as village associations, parent groups linked to village schools, village educational organizations associated with local churches and local conservation and development extension agents (Rapport D'Activites, 1994). They placed their own agents in peripheral zone villages to live and work at the village level identifying local needs and introducing agricultural techniques. Funding for this work

was provided by the park project through USAID. Additional technical assistance came from Cornell and Stony Brook University. This illustrates an initial attempt to create a top-down bottom-up linkage as promoted by Uphoff (1986).

Interestingly, the phrase "Tefy Saina" means "to shape or mold mentalities". Through extension work and outreach, the association hoped to bring about a cultural revolution among rural Malagasy people (Rapport D'Activites, 1994). The association strives to bring about a change in mentality among peasants and to help them evaluate resource management choices in a different manner (Rapport D'Activites, 1994). The Tefy Saina Association believes that the transfer of innovations requires only a change in technical mentality. However, they do not believe that that alone is sufficient for project sustainability. A change in economic and social thought must also occur. These changes tend to take much longer.

This plan of action suggests a modernist theory approach to development. Like modernization theory, it encourages a transition to modernity through complete displacement of traditional values (Rapport D'Activites, 1994). Critics of this approach argue that the advent of modernity does not necessarily require the abandonment of traditional patterns of action, values or beliefs (Webster, 1990). Furthermore, Webster (1990) suggests that people may use traditional roles and expectations as resources that can

be drawn on to serve their social and material needs. According to Harper and El-Swaify (1988), emphasis should be placed upon small incremental improvements in farming systems, which are well-suited to risk adverse peasant cultures. Projects promoting complete removal, rather than improvement of indigenous agricultural systems rarely succeed. The smaller the change required and the more dependable the return from the technology, the more likely the change will be acceptable to farmers (Harper and El-Swaify, 1988).

Tefy Saina recognized that it may be necessary to step back from the immediate emphasis on technical project concepts and instead focus on developing objectives for long term development actions (Rapport D'Activites, 1994). While it is advisable to think of long-term strategies, certain conditions need to be addressed immediately. The destruction caused by the breakdown of the tavy system cannot be ignored. Fallow periods have grown shorter, erosion has become a more serious problem, primary forest within the park is being cleared and household food requirements are not being met. Since the turn of the century, attempts have been made to alter the beliefs and practices of the Tanala. None have succeeded. The best solution may be found in compromise rather than complete change.

Madagascar's political and colonial history plays a major role in how SRI is perceived, especially among the Tanala. The RNP SRI program has failed to recognize this link. According to Baker (1984), the pursuit of non-food cash crops for colonial economies pushed food production and marginalized producers wings only to see them re-emerge in a drastically eroded state. This has certainly been the case in the eastern forests of Madagascar.

According to Tanala oral histories, many people moved deep into the forests to find land and escape French persecution. During the early 1900s, the colonial government launched an unsuccessful campaign to end tavy in the east (Jarosz, 1993). The program was similar to the RNP SRI program. It also attempted to develop lowland marshes into paddies and convert tavy farmers to paddy farmers. Cool wet weather and insufficient lowlands contributed to its failure (Jarosz, 1993). However, an even greater contribution to its failure may have been the governments blind determination to halt tavy. Villagers viewed the ban as an attempt to rob them of an independent means of subsistence and a threat to their religious practices (Jarosz, 1993). This ban incited revolt and bloody massacres. I spoke with village elders who remembered and had participated in these uprisings. The concerns of villagers today echo those of the past.

Ideally, integrated conservation and development projects are guided by goals and principles addressing social, economic, environmental and political issues (Sanders, 1988; Douglas, 1988; Gale, 1991). The Tefy Saina Association strives to assist farmers achieve household food self-sufficiency with a secondary goal of developing an export market (Rafaralahy, pers. comm.). Therefore the majority of their work is accomplished in villages often at the household level. The focus is local. This places emphasis upon quality of life and security of livelihood through improved agricultural techniques which can increase household food production.

Projects should emphasize the interdependence between environment and livelihood (Gale, 1991). In response to this, Tefy Saina agents live and work in villages practicing the conservation techniques that they espouse. They attempt to encourage change through example as well as technical instruction. They promote the development of agricultural demonstration plots managed by local farmers. Additionally, they have taken farmers on small field trips to neighboring villages to view both successful and unsuccessful agricultural techniques. Hopefully, they can take advantage of their village life experiences to help with future project implementation and design.

Ideally, there should be fair, just and equitable access to resources and the distribution of costs and benefits (Gale, 1991). It is imperative to reach poor farmers as well as secure farmers (Harper and El-Swaify, 1988). Excessive focus upon secure farmers is likely to increase income and productivity gaps in poor villages (Harper and El-Swaify, 1988). According to my observations, all members of both ethnic groups had equal access to SRI information. Program participation was open to men and women. While their numbers were small, female farmers did participate in each project village.

Several factors affected female participation. Women are solely responsible for many aspects of rice production. For example, women and girls are responsible for nursery care, transplanting, weeding, drying, pounding and winnowing rice. They also assist in pest control and harvesting. Malagasy women must also divide their time between various other activities including: child care, cooking, water collection, washing, cleaning, maintaining small livestock, and producing household items such as woven floor mats and baskets. I observed that many female participants had older children capable of assisting in farm chores. However, for other women, the special requirements of SRI planting were often viewed as too time consuming.

Women's interest in SRI is also affected by land ownership. If a woman is not the legal owner of the field,

she may not have control over grain distribution or funds from grain sales. As a result, she may be unwilling to invest great time and effort into the project.

Land ownership issues also affect project adoption and equitability in other ways. A prime reason for increasing paddy yields is to eliminate need for tavy rice production. This may be a viable option for those with large paddy areas. However, the benefits of this plan are limited for small land holders. As noted by Peters (1994), the Betsileo, in general, own more paddy fields and will probably benefit more from introduced technologies than the Tanala. Tefy Saina addressed this issue by promoting the creation of rice paddies in marshes throughout the peripheral zone. It was hoped that these fields will augment the areas already under production and assist landless residents acquire their own paddies. This requires intensive management and drainage techniques in order to maintain the water levels critical to SRI production. On large projects this may become complex and require collaboration among many farmers (Rapport D'Activites, 1994). Moreover, this approach failed during the colonial era (Jarosz, 1993). Some small landholders may be unwilling to attempt this work without the certainty of substantial harvests. In addition, mass drainage may prove detrimental to marshland ecosystems.

Traditional belief systems and cultural practices greatly influenced the acceptance of new agricultural techniques among the Tanala. I observed that many extension agents do not hold the same beliefs and view them as an impediment to development. In general, they attribute traditional beliefs to irrational fears stemming from ignorance.

Numerous difficulties were encountered in Tanala villages when SRI and its associated soil conservation techniques were introduced. One of the most significant was the attempt to introduce hillside soil conservation techniques. Local extension agents introduced leguminous hedgerow shrubs such as Tephrosia and Crotalaria as part of a soil improvement plan. Even after attempts at environmental education, many Tanala did not consider the degraded state of local hillsides to be a priority problem. Additionally, they were vehemently opposed to the introduction of the two shrubs. This opposition turned to outright hostility as villagers destroyed sites on which seedlings were planted. Extension agents were told that the Tanala considered these plants "famamo" - soporific or capable of inducing drugged or zombie-like states. Their very presence was considered taboo. This taboo was neither based on ignorance nor irrational fears. Indeed, I discovered that these shrubs contain compounds toxic to fish and livestock (Carrington, 1993). The Tanala own fish ponds

as well as free-ranging cattle. Therefore, these shrubs posed a potential threat to their livelihood and were clearly a poor choice for soil conservation.

Instead of continuing to force the issue with local farmers, extension agents changed tactics and tried a diffusion approach. They opted to work in local primary schools introducing general environmental education courses in SRI, forest and soil conservation, agroforestry and tree nursery management. To reinforce classroom work, they established demonstration plots on school property. This approach resulted in small breakthroughs. Members of some local parents associations became interested in their childrens' projects. Gradually parents began to participate in the program and informally pass information on to other adults. This demonstrates flexibility and creativity on the part of extension agents. However, it does not indicate that they tried to find an acceptable solution to the hedgerow issue.

Investing in primary school programs indicates a long-term conservation strategy. This is proving to be a valuable approach. In the future, it may contribute to increases in the number of SRI paddies and use of soil conservation techniques. However, educational programs should not be used to further inappropriate agendas (e.g. the promotion of Tephrosia and Crotalaria) as is the current situation. To increase adoption rates, educational programs

should stress practices which are both culturally and economically attractive. Programs should also promote projects which are within the technical capabilities of project staff and farmers (Sanders, 1988).

Laulanie (1993) posed the question, how long will it be before residual nutrients of SRI subsoils are depleted? Will mineral fertilizers become necessary to maintain high yields? The answers to these questions could determine whether SRI is ultimately a sustainable project. The answers to these questions are unknown. They require investigation of long-term soil fertility, soil-plant relationships, and fertility improvement (Laulanie, 1993). The Tefy Saina Association believes that soil fertility constraints will become an issue after 10-20 years of SRI practice (Laulanie, 1993). This may give researchers adequate time to investigate potential problems and solutions.

According to SRI records and informal conversations with farmers, SRI yields are greatly exceeding those of traditional methods (Rapport D'Activites, 1996). I visited farmers in each project area who had converted all of their fields to SRI production. Some of them had been practicing SRI for three years. They were particularly impressed by the vigor of the individual rice plants, heavy seed heads and large harvests. In fact, new farmers claimed to have become interested in SRI after observing the success of

others.

The number of participants in all villages increased between 1995 and 1996 (Appendix E). Additionally, a new village was added to the program in 1996. Although increasing, the number of SRI practitioners is still small. At present, it is doubtful that the program has significantly reduced the practice of tavy.

CHAPTER VI
RECOMMENDATIONS

Although the SRI program has striven to follow economic, environmental and social principles, acceptance has differed between ethnic groups. Traditional practices and belief systems have posed unforeseen challenges. Many conflicts have arisen from the unflinching drive to halt all tavy. The project framework is embedded in modernization theory, pursuing cultural change through the halt of traditional practices. However, the best solution may rest in compromise rather than change. According to Peters (1994), the Tanala are frequently interested in improving paddy production when allowed to continue tavy.

I conclude that development workers must accept the concept that tavy represents more to the Tanala than simply a means of rice production. It permeates nearly all aspects of their spiritual and material life. One solution could be to grant the Tanala special permission to continue swidden activities in certain areas. This would aid in reducing the risk and uncertainty associated with the trial of new agricultural techniques. Extension agents could focus on technical education for willing adults and school children.

Amelioration of tavy damage could be pursued through introduction of techniques which increase labor production on tavy plots. For example, the introduction of

acceptable leguminous plants for intercropping and rotation with improved erosion control measures may be appropriate in some situations. While allowing tavy, SRI efforts should also be continued among those interested, as should marshland rice cultivation expansion where feasible.

Tanala villages are typically found at lower elevations. At these altitudes, farmers occasionally can harvest twice a year. The choice of variety is problematic as most local varieties (possibly originating in Indonesia) are photoperiodic, meaning their flowering cycle must occur during the equinox (Laulanie, 1993). Second harvests of paddies could be improved through the use of other varieties without seasonal preferences (Laulanie, 1993).

According to Douglas (1988), conservation measures should be integrated into the local farming systems. Without successful integration conservation efforts may be viewed as excessive labor with little or no benefits. This can lead to project failure. Tefy Saina agents have focused on restoration of degraded agricultural sites through hillside soil conservation techniques. Project planners consider these efforts integral to successful soil conservation. However, conflict has arisen concerning these efforts near Tanala villages. Many Tanala did not consider hillside erosion to be a priority problem. It is also possible that farmers did not receive direct short-term benefits from these erosion control activities.

Additionally, these practices did integrate well into routine farming practices. Perhaps most importantly, some soil conservation techniques violated village taboos.

Certain measures could improve the acceptance of soil conservation techniques. For example, the Tanala own cattle. The introduction of leguminous shrubs which also serve as fodder may be attractive. Additionally, more effort should be placed upon understanding why the Tanala practice certain agricultural techniques. Taboos should be identified, investigated and respected. These beliefs form a framework for village life. There are sound reasons for their existence.

Monitoring and adjustment are crucial to the effectiveness of any project (Swanson, 1996b). According to Harper and El-Swaify (1988), few agricultural assistance projects with conservation components actually quantify the performance of their activities. Commonly, project personnel assume that the conservation methods they implement will reduce erosion and improve yields (Harper and El-Swaify, 1988). This is an inappropriate method of evaluating success. Without careful monitoring and attention it is impossible to correct weaknesses and flaws. At present, Tefy Saina agents routinely collect rice fertility and yield data. They also monitor the number of participants per village and the area under SRI cultivation. This may address technical agricultural development concerns


but it ignores the effect of practices on conservation.

Monitoring project effectiveness will require knowledge of the number of hectares currently under tavy cultivation and the rate of increase or decrease over time. The expense of aerial photography and satellite imagery may prohibit its use. The park does however have a trained GIS worker on staff and access to high quality mapping equipment. Perhaps this resource could be utilized to better monitor tavy activity. Difficulties may arise as workers are not always in the field and may not be willing or able to travel to steep remote tavy sites. Additionally, farmers will naturally be reluctant to provide specific information concerning illegal activities. Finally, observation should focus on changes in soil fertility, runoff and erosion.

Overall, the project should avoid adherence to the concepts of modernization theory. It is imperative to address the lack of household rice self-sufficiency and forest destruction. However, not all traditional knowledge and techniques need to be replaced. In fact, some practices (i.e. use of azola and natural insecticides) should be integrated into the program. The cultural significance of agricultural practices must be understood and respected. Generally, there are sound reasons for taboos and traditions. The program would be enriched by greater cultural understanding and increased villager participation in project development, implementation and management.

APPENDIX A

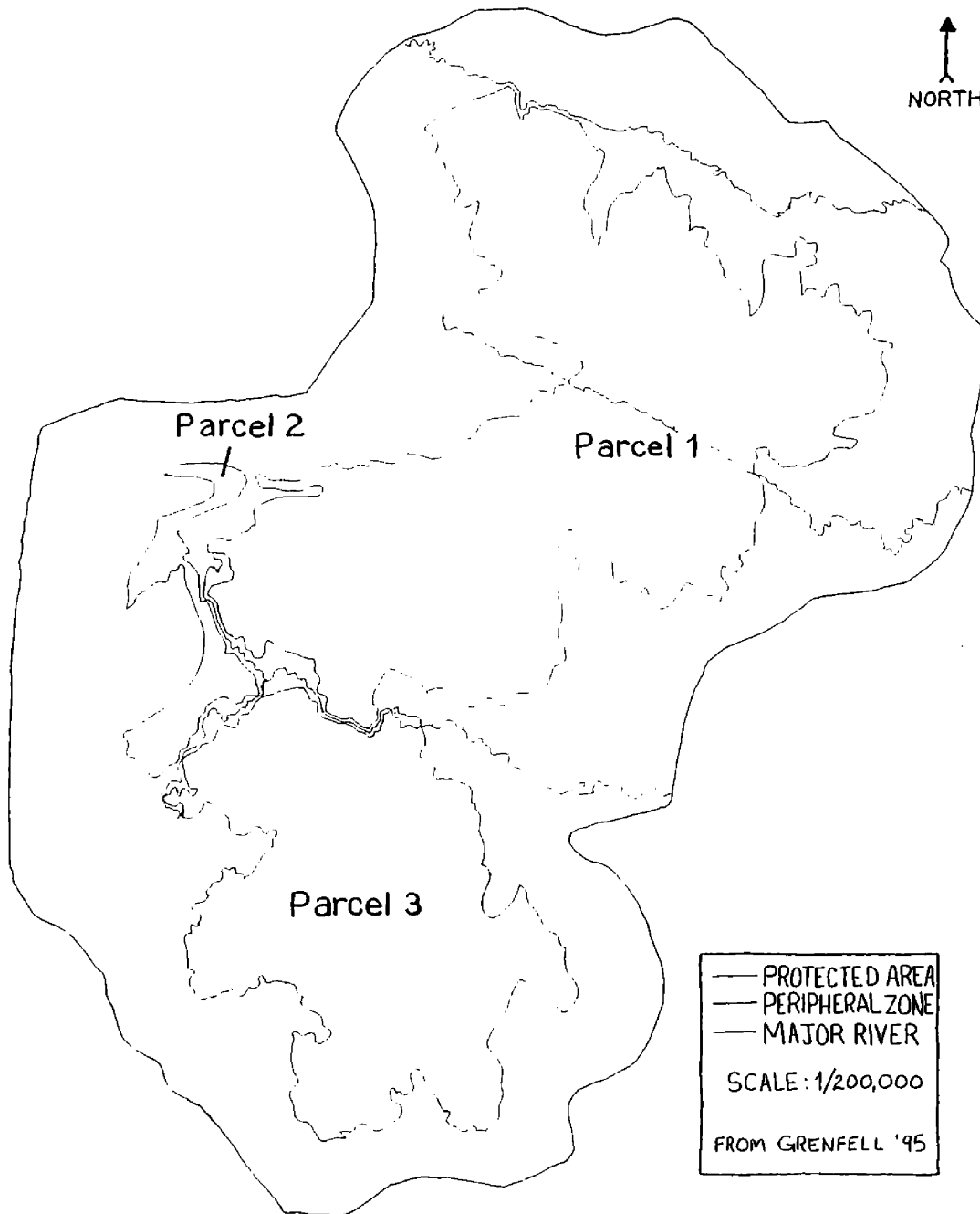
MADAGASCAR PROTECTED AREAS (SELECTED)



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October 1996

APPENDIX B

Ranomafana National Park and Peripheral Zone



APPENDIX C

SRI Techniques Versus Tavy

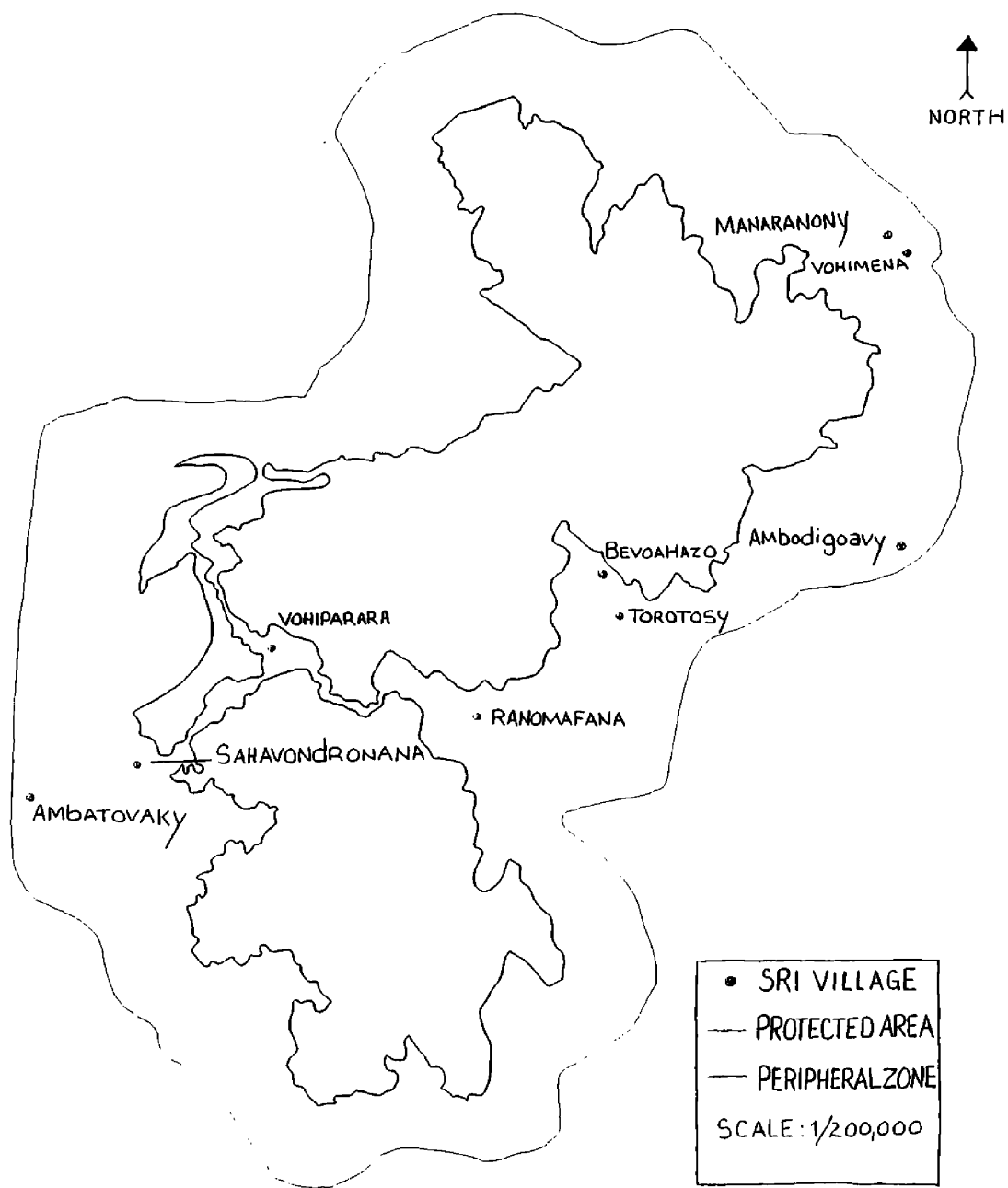
SRI	TAVY
NO INITIAL FOREST CLEARING	FOREST CLEARED TO CREATE FIELDS AND BREAK FALLOW
PLANTED IN PADDY	DRYLAND
DRY BED NURSERY	NO NURSERY
TRANSPLANTING @ 8-10 DAYS	NO TRANSPLANTING
PADDY PLANTED IN GRID PATTERN	DIRECT RANDOM SEEDING
N, P AND K ADDED TO PADDIES	NO ADDITIVES
MECHANICAL WEEDING EVERY 15 DAYS	LIMITED HAND WEEDING
INTENSIVE WATER MGMT	RAINFED
FIELD LEVELING REQUIRED	NO LEVELING
COMPOSTING ENCOURAGED	NO COMPOSTING
LABOR HIGH	LABOR LOW
YIELD 2600-9000 KG/HA *	YIELD 500-2000 KG/HA **

* Rapport D'Activites, 1996.

** del Castillo and Ralijaona, 1993.

APPENDIX D

SRI Program Areas - Ranomafana National Park



APPENDIX E

1995-1996 SRI Program Results

SAHAVONDRONANA	1996	1995
# Of participants	35	28
area cultivated	10 ha 49 ares	4 ha 56 ares
average harvest	8,744 kg/ha	9,184 kg/ha
TOROTOSY	1996	1995
# of participants	15	6
area cultivated	65 ares	1 ha 6 ares
average harvest	8,189 kg/ha	4,604 kg/ha
AMBODIGOAVY	1996	1995
# of participants	5	4
area cultivated	9 ares 88 ca	4 ha 93 ca
average harvest	5,162 kg/ha	2,634 kg/ha
VOHIMENA	1996	no program in 1995
# of participants	13	
area cultivated	19 ares 90 ca	
average harvest	9,165 kg/ha	

Adapted from Rapport D'Activites, 1996.

1 hectare (ha) = 100 ares

1 are = 100 sq meters

1 centiare (ca) = 1 sq meter

APPENDIX F**List of Acronyms**

ANGAP	Association Nationale pour la Gestion des Aires Protegees National Association for the Management of Protected Areas
CARE	Cooperative for American Relief Everywhere Inc.
CI	Conservation International
GIS	Geographic Information System
ICDP	Integrated Conservation and Development Project
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature and Natural Resources
MEAP	Malagasy Environmental Action Plan
NGO	Non Governmental Organization
RNP	Ranomafana National Park
RNPP	Ranomafana National Park Project
SAVEM	Sustainable Approaches to Viable Environmental Management
SRI	Systeme Intensive du Riziculture Intensive Rice Cultivation System
UNEP	United Nations Environmental Programme
USAID	United States Agency for International Development

WWF Worldwide Fund for Wildlife A.K.A. World Wildlife
Fund

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